Aug 2003 (DEIS)
HiluHilu Development
Appendices

DRAFT ENVIRONMENTAL IMPACT STATEMENT
TECHNICAL APPENDICES

HILUHILU DEVELOPMENT

Tax Map Key: 3-7-2-05:01

Applicant:

Hiluhilu Development, LLC

Accepting Authority:

State of Hawaii Land Use Commission

August 2003

H
280

GROUP 70

Group 70 International, Inc.
Architecture ■ Planning ■ Interior Design ■ Environmental Services
Honolulu, HI

Appendix A
Civil Infrastructure

Hiluhilu Development – Civil Infrastructure

1.0 PROJECT DESCRIPTION

The proposed development will be a master planned community with a golf course, residential and commercial properties, and university-related facilities. The master planning process includes integration of the community into the development of the adjacent University of Hawaii West Hawaii Campus.

The various land use elements of the master plan include single and multiple family residential units, an 18-hole golf course, clubhouse, driving range, commercial and university residential facilities, open space and parking areas. Infrastructure facilities to support the development include an internal roadway network that is integrated into the regional roadway plan, a wastewater treatment and disposal system, a potable water supply and fire protection system, a non-potable water irrigation system and other utility systems.

The preliminary development plan is summarized in Table 1-1.

Table 1-1
Preliminary Development Plan

Land Use	Phase 1	Phase 2	Phase 3	Total
Single-family Residential & Townhouses (units)	235	245	110	590
Multi-family Residential (units)	175	80		255
Hotel (units)	120			120
Commercial (acres)	2	22	4	28
Institutional (acres)	32		33	65
Golf Course (acres)	180			180

The single and multi-family residential units and the hotel are planned on approximately 250 acres. The commercial and institutional land uses and the golf course occupy approximately 213 acres. The balance of the 725-acre site will be used for open space, parking, infrastructure facilities, and preservation.

2.0 EXISTING CONDITIONS

2.1 Roadways and Traffic

There are no existing public roadways on the Hiluhilu parcel. However, the parcel is bounded by Queen Kaahumanu Highway on the western end and the Makalei Estates subdivision on the eastern end. The Makalei Estates subdivision has existing roadways, including a collector road that ends just east of the Hiluhilu parcel. A private jeep trail traverses the Hiluhilu parcel in an east-west direction.

The property immediately south of the Hiluhilu parcel is currently undeveloped. Kaimi Nani Drive runs approximately parallel to the southern property line between

Queen Kaahumanu and Mamalahoa Highways about 1¼ miles south of the Hiluhilu parcel. Side streets and parallel streets with residential subdivisions exist along most of Kaimi Nani Drive. Kalaoa 1, 2, and 3 subdivisions exist approximately 3,000 to 4,000 feet south and southeast of the southeast corner of the Hiluhilu parcel, between Makalei Estates and Kaimi Nani Drive. They are each accessed by branch roads from Mamalahoa Highway.

2.2 Drainage Facilities and Utilities

The Hiluhilu parcel has no existing drainage, water, or sewerage facilities on site. The Makalei Estates subdivision, adjacent to the eastern end of the parcel, has existing on-site drainage facilities and an existing County water distribution system. Sewerage at the Makalei Estates subdivision is provided by individual wastewater systems.

The other existing subdivisions in the vicinity of the Hiluhilu parcel also have internal storm drainage systems that use drywells for disposal, are served by the County water system, and use individual wastewater systems for sewage disposal.

2.2.1 Drainage Facilities

The topography of the existing undeveloped site shows no natural drainage channels, suggesting that despite the approximate 5 percent slope from east to west, the ground surface is very permeable and any runoff that occurs during large rainstorms percolates into the ground before it forms permanent channels. The drainage system in the Makalei Estates subdivision, adjacent to the eastern end of the parcel, consists of conveyance structures and drywells.

2.2.2 Water Supply

There is no existing water system on the property. A 12-inch water line in the main road of the Makalei Estates subdivision, which is part of the County water distribution system, ends just west of the western end of the property. The 12-inch main through Makalei Estates connects to the existing 12-inch main in Mamalahoa Highway at the mauka end of Makalei Estates. There are two 0.05 million gallon (MG) reservoirs within Makalei Estates and a 0.30 MG reservoir approximately 1,800 feet mauka of Mamalahoa Highway across from Makalei Estates.

Two potable wells have been developed at the north and south mauka corners of the Makalei Estates subdivision. Each well has a production capacity of 750,000 gallons per day (gpd). Outfitting of the southern well is in the final stages of construction. After completion, the well will provide water to the County Department of Water Supply system. The northern well has been capped and will need to be outfitted to be activated as a source.

2.2.3 Wastewater Collection, Treatment and Disposal

There is no existing sewerage system on the Hiluhilu parcel. The Makalei Estates subdivision, immediately west of the parcel uses individual wastewater systems for treatment and disposal of sewage, as do other subdivisions in the vicinity. The nearest wastewater collection and treatment system is the DOT Airports system serving Kona International Airport, approximately one mile to the west of the western parcel boundary. The nearest public wastewater collection system is the Kailua-Kona municipal system, approximately six miles to the south.

3.0 PROPOSED CIVIL INFRASTRUCTURE

Infrastructure for the proposed development will be built in three phases, as appropriate for the gradual development of the site. Phase 1 will provide the required infrastructure for development of the golf course and hotel, and a portion of the residential, commercial, and institutional properties. Phase 2 will expand the infrastructure systems to accommodate additional residential and commercial development. Phase 3 will provide infrastructure for complete build out of the Hiluhilu parcel.

Each phase of infrastructure development will be designed and constructed to accommodate the proposed U.H. West Hawaii Campus development on the adjacent parcel south of the Hiluhilu parcel.

3.1 Roadway System

3.1.1 Offsite Access

Access to the site will be provided from Queen Kaahumanu Highway at an existing access point designated by DOT Highways Division (Figure 3-1). Connections to existing and proposed offsite roads to the east, north and south of the Hiluhilu parcel will be provided.

3.1.2 Onsite Roads

The project access road from Queen Kaahumanu Highway will continue east past the village center through the golf course and single-family residential areas to the east end of the parcel. At the eastern boundary, this mauka-makai road will connect to the existing mauka-makai road through Makalei Estates that connects to Mamalahoa Highway.

At the village center, the main north-south road will connect to the main road through the U.H. West Hawaii campus center area to provide a continuous north-south road across the southern boundary. The road will be designed for continuation across the northern boundary in the future.

Two additional north-south connector roads east of the village center, as identified in the Keahole to Kailua Development Plan[1] will be accommodated by the Hiluhilu roadway system.

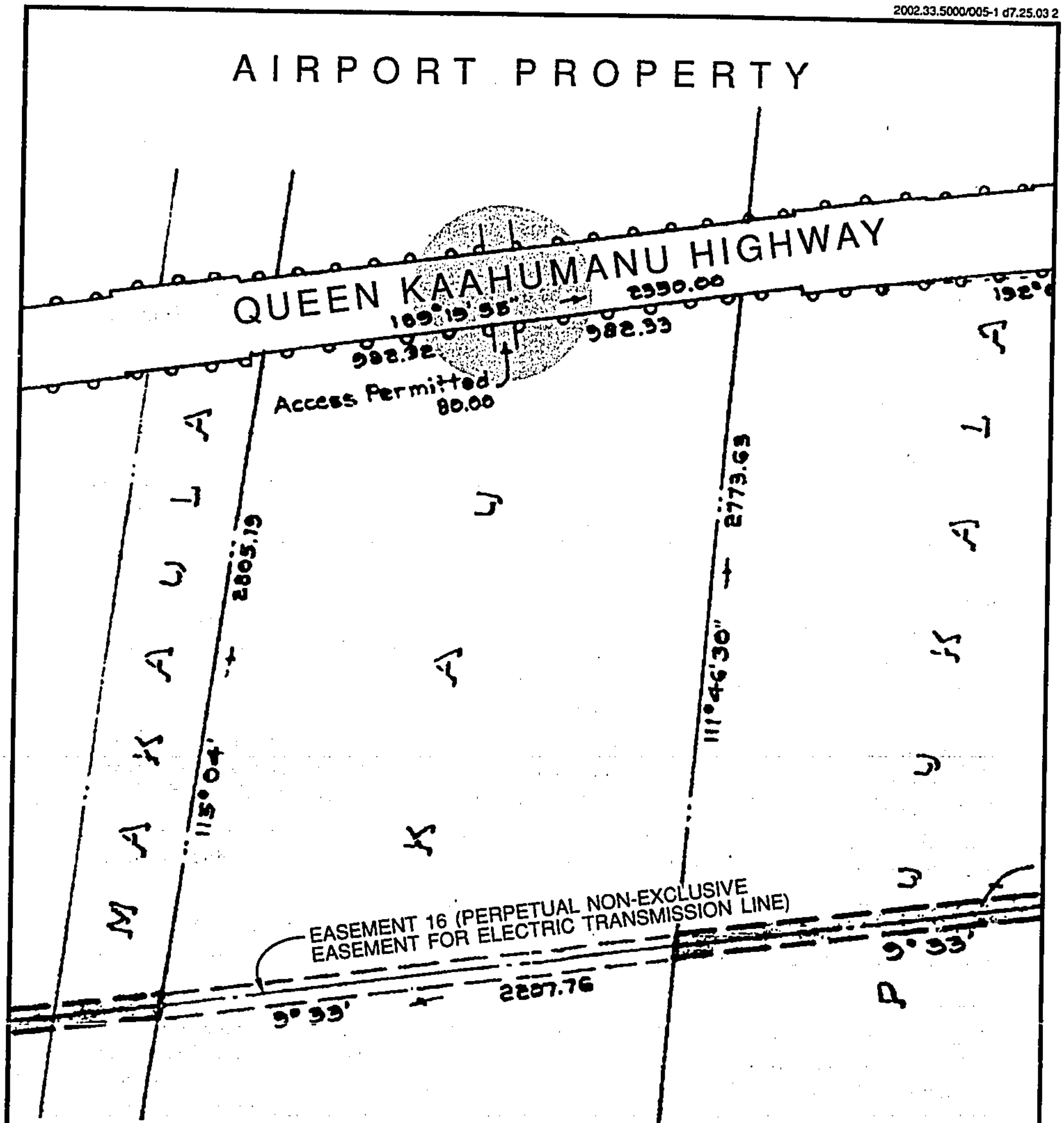
Minor roads within the development will serve the village and surrounding commercial/institutional areas, as well as residential areas within the project. Design of the specific roads will be based on standardized cross sections described in the following sections.

Main Roads

The Hawaii County Public Works Department has two standard road types – streets with sidewalks (Standard Detail R-32) and streets without sidewalks (Standard Detail R-33). These standards will be applied to the main connector roads within the project, which will be dedicated to the County. As a modification to the standard roadway sections, bicycle paths will be provided to support university-related and other bicycle traffic (Figure 3-2).

[1] County of Hawaii Department of Planning and R. M. Towill Corporation, April 1991.

2002.33.5000/005-1 d7.25.03 2



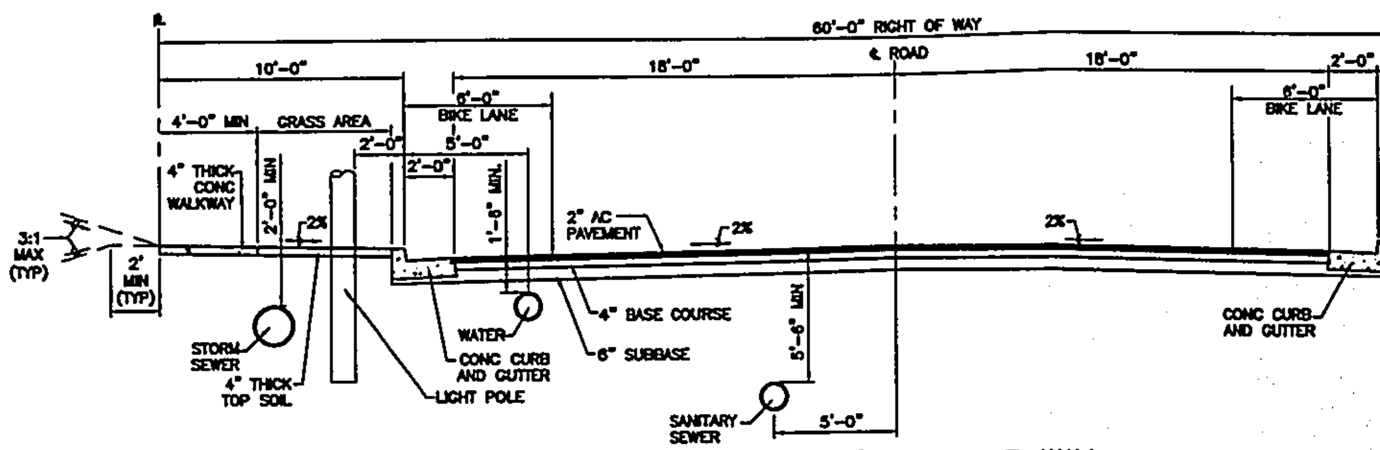
Sources: State of Hawaii, Department of Transportation Highways Division, *Right-of-Way Map, Kailua-Kawaihae Road, Project No. 19 BC-01-71*, Sheet No. 3 of 15 sheets, September 19, 1972; State of Hawaii, Department of Accounting and General Services Survey Division, *Perpetual Non-Exclusive Easement for Electric Transmission Line Easements 10, 13, 15 and 17*, H.S.S. Plat 313, June 1976.

NORTH

0 300 600
SCALE IN FEET

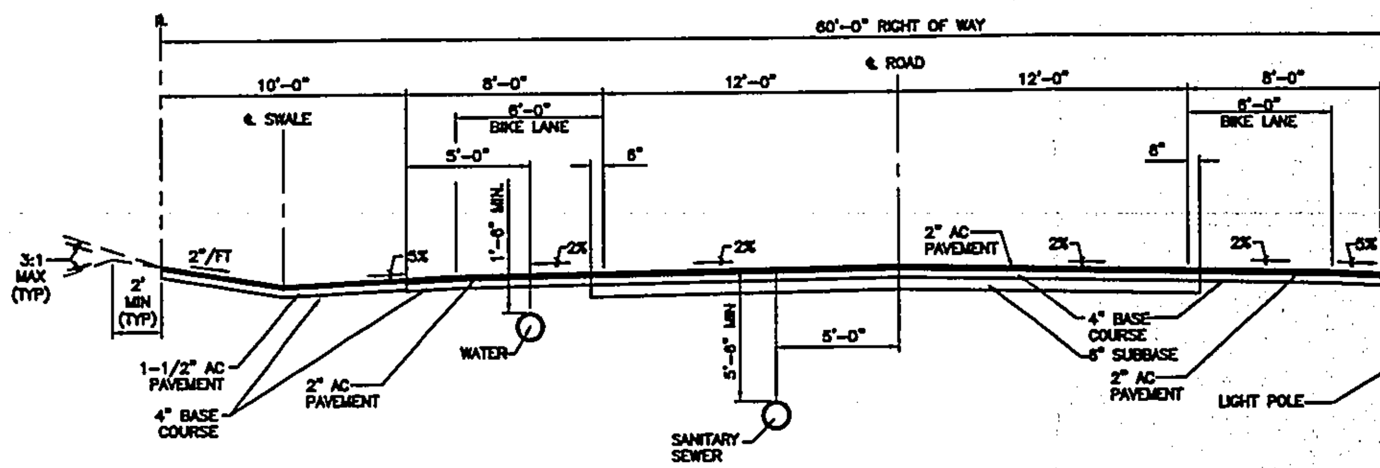
Figure 3-1
LOCATION OF PERMITTED ACCESS AND POWER LINE EASEMENT

Hiluhilu Development—Civil Infrastructure
Belt Collins
July 2003



60' RIGHT-OF-WAY

TYPICAL ROAD SECTION-COLLECTOR STREETS WITH W



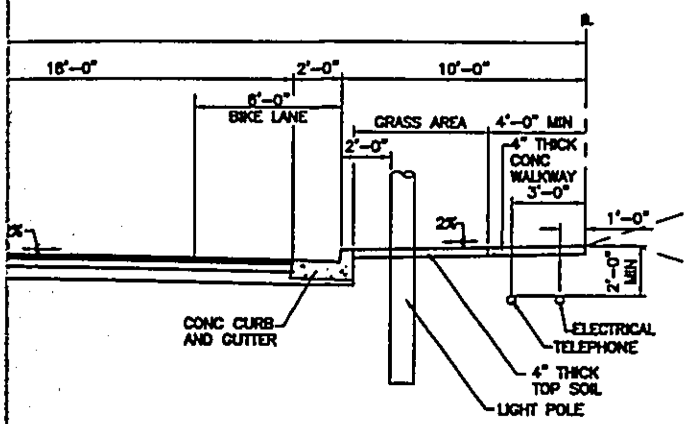
60' RIGHT-OF-WAY

TYPICAL ROAD SECTION-COLLECTOR STREETS W/OUT WAL

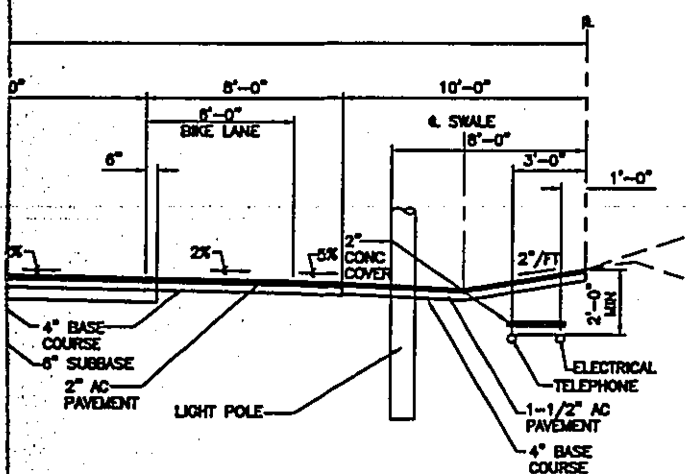
SCALE:

4 0

Fri, 25 Jul 2003 - 2:00pm
M:\Haiuhiu Development\2002335000\CAD\Details\FIG-A.dwg



/AY
STREETS WITH WALKWAY



EETS W/OUT WALKWAY

SCALE:
4 0 2 4 6 8

FIGURE 3-2
HILUHILU DEVELOPMENT-
CIVIL INFRASTRUCTURE
MAIN ROAD SECTIONS

PREPARED BY BELT COLLINS HAWAII LTD.
JULY 2003

Minor Roads

The local roads within the development will remain private and may vary from County standards. 50-foot rights-of-way will be used (Figure 3-3). Minor roads in the village area will include sidewalks, but minor roads in single-family residential areas and low-density commercial/institutional areas will not include sidewalks. Bicycle paths will not be designated on the minor roads due to the lower volume and lower speed of traffic that these roads will carry.

3.2 Site Grading and Erosion Control

3.2.1 Grading

The project does not propose major regrading of the site. The existing topography will be altered only to the extent necessary for construction of the proposed improvements. It is anticipated that grading will occur on a localized scale and that cut and fill quantities will generally balance as construction progresses.

3.2.2 Erosion Control

During all phases of construction on the Hiluhilu parcel, erosion control practices will comply with both State and County regulations. NPDES permits will be obtained from the Hawaii Department of Health for stormwater discharges from construction activities. Best Management Practice plans to control erosion during construction will be a component of the NPDES permits.

3.3 Storm Drainage System

Stormwater runoff from impervious areas will be collected through a system of swales, catch basins, and pipes and transported to stormwater drywells or infiltration areas for disposal. The permeability of the existing soils is evident by the absence of any natural stormwater channels or gullies in the vicinity of the site. Infiltration areas will be located in the golf course and other open spaces, where practical. Drywells will be located within roadway rights-of-way and within individual parcels, as needed.

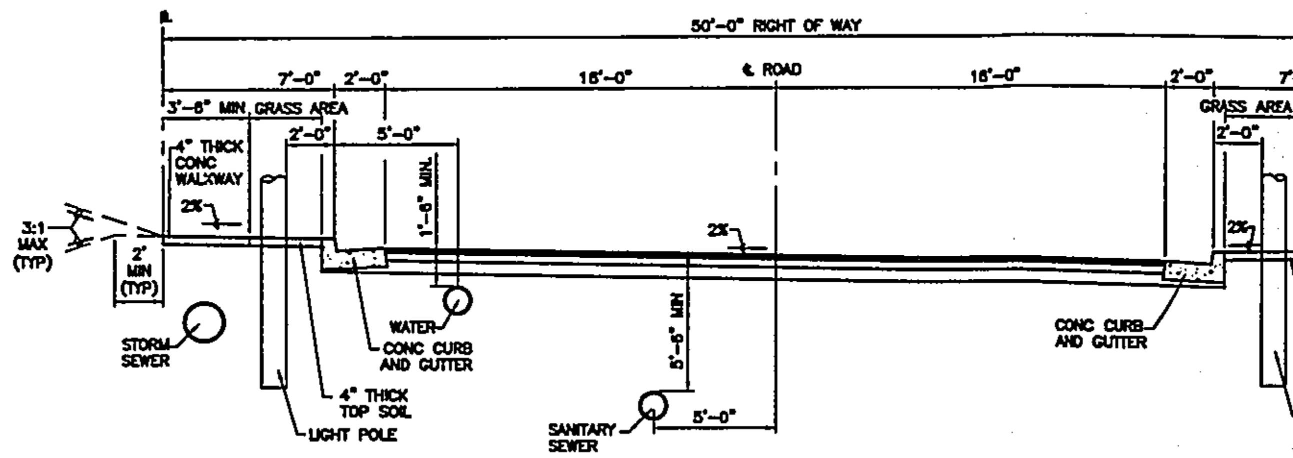
3.4 Water System

The Hiluhilu Development will include expansion of the County's potable water system through the public rights-of-way within the project and construction of a non-potable water system for golf course irrigation.

3.4.1 Potable Water

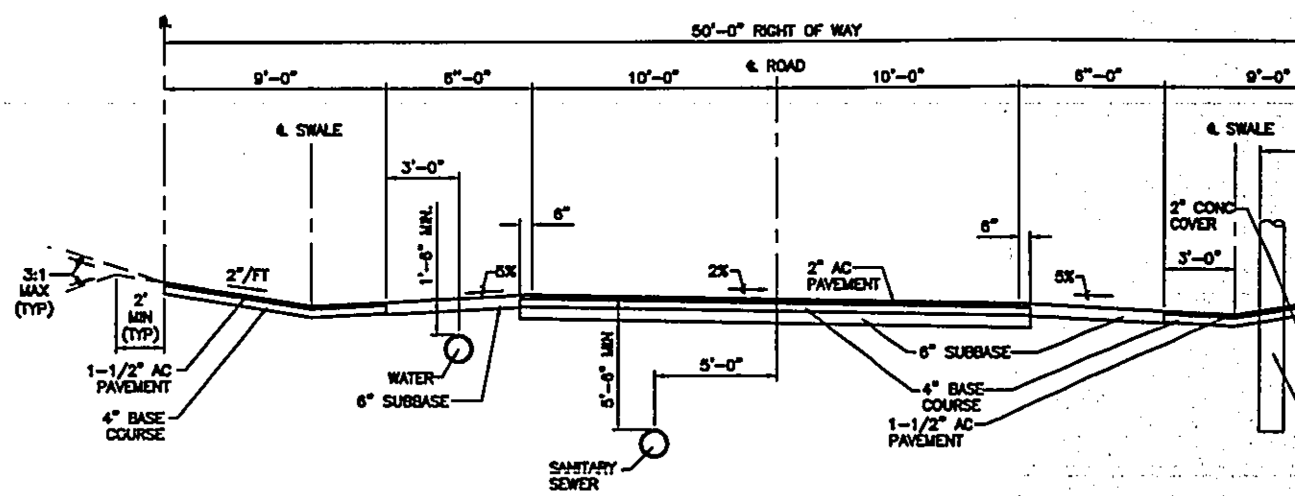
The potable water system will be an extension of the existing County system. Additional supply to the County system will be provided by outfitting an existing well near Mamalahoa Highway at the southeast corner of Makalei Estates. The well is rated for 750,000 gallons per day.

Potable water demand for the Hiluhilu Development is summarized as follows:



50' RIGHT-OF-WAY

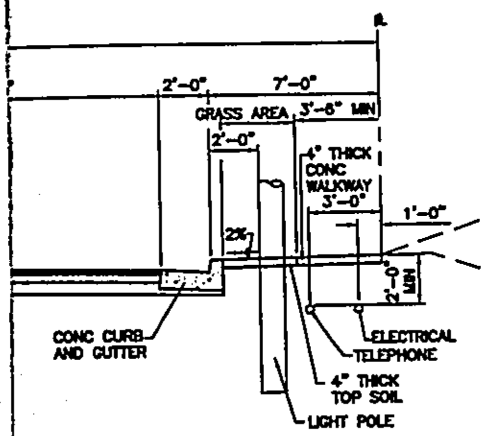
TYPICAL ROAD SECTION-MINOR STREETS WITH WALKW



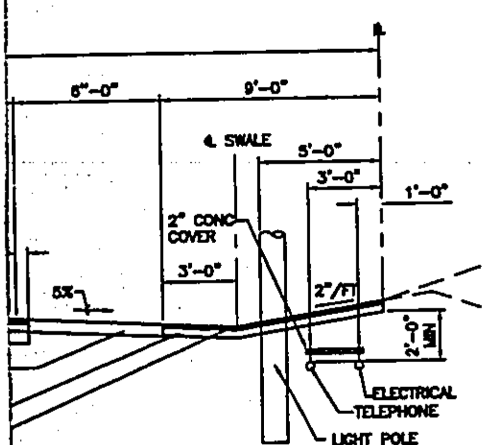
50' RIGHT-OF-WAY

TYPICAL ROAD SECTION-MINOR STREETS W/OUT WALKWAY

Fri, 25 Jul 2003 - 2:03pm
M:\Haihilu Development\2002335000\CAD\Details\FIG-B.dwg



S WITH WALKWAY



OUT WALKWAY

SCALE:
4 0 2 4 6 8

FIGURE 3-3
HILUHILU DEVELOPMENT-
CIVIL INFRASTRUCTURE
MINOR ROAD SECTIONS

PREPARED BY BELT COLLINS HAWAII LTD.
JULY 2003

Table 3-1
Potable Water Demand

Phase	Potable Water Demand (gpd)
1	289,000
2	398,000
3	519,000
Total	1,206,000

The proposed water distribution system will extend the existing 12-inch water main in Makalei Estates down to the village center area and provide a connection to the U.H. West Hawaii Campus parcel at the village center location (Figure 3-4). It will also make possible a connection to the County water main in Queen Kaahumanu highway at Kona International Airport access road via the 0.5-million-gallon reservoir at the 280-foot elevation mauka of the airport access road. This connection is desirable to the Department of Water so that they can move water from supply wells in the mauka areas to satisfy demands along Queen Kaahumanu Highway north of Kailua-Kona.

3.4.2 Golf Course Irrigation

Water for golf course irrigation will be provided by a system with two supply sources. The primary supply will be recycled water from the on-site wastewater treatment plant. The secondary source will be on-site non-potable wells.

Recycled Water

The wastewater treatment plant will produce "R-1" recycled water in accordance with Department of Health requirements for golf course irrigation. As the primary source of golf course irrigation water, the system will be designed to use all recycled water for golf course irrigation to the extent feasible. However, even at full build out, the recycled water will not completely satisfy the irrigation demand of the golf course. For this reason, non-potable wells will be developed to augment the recycled water for golf course irrigation.

Non-potable Well Water

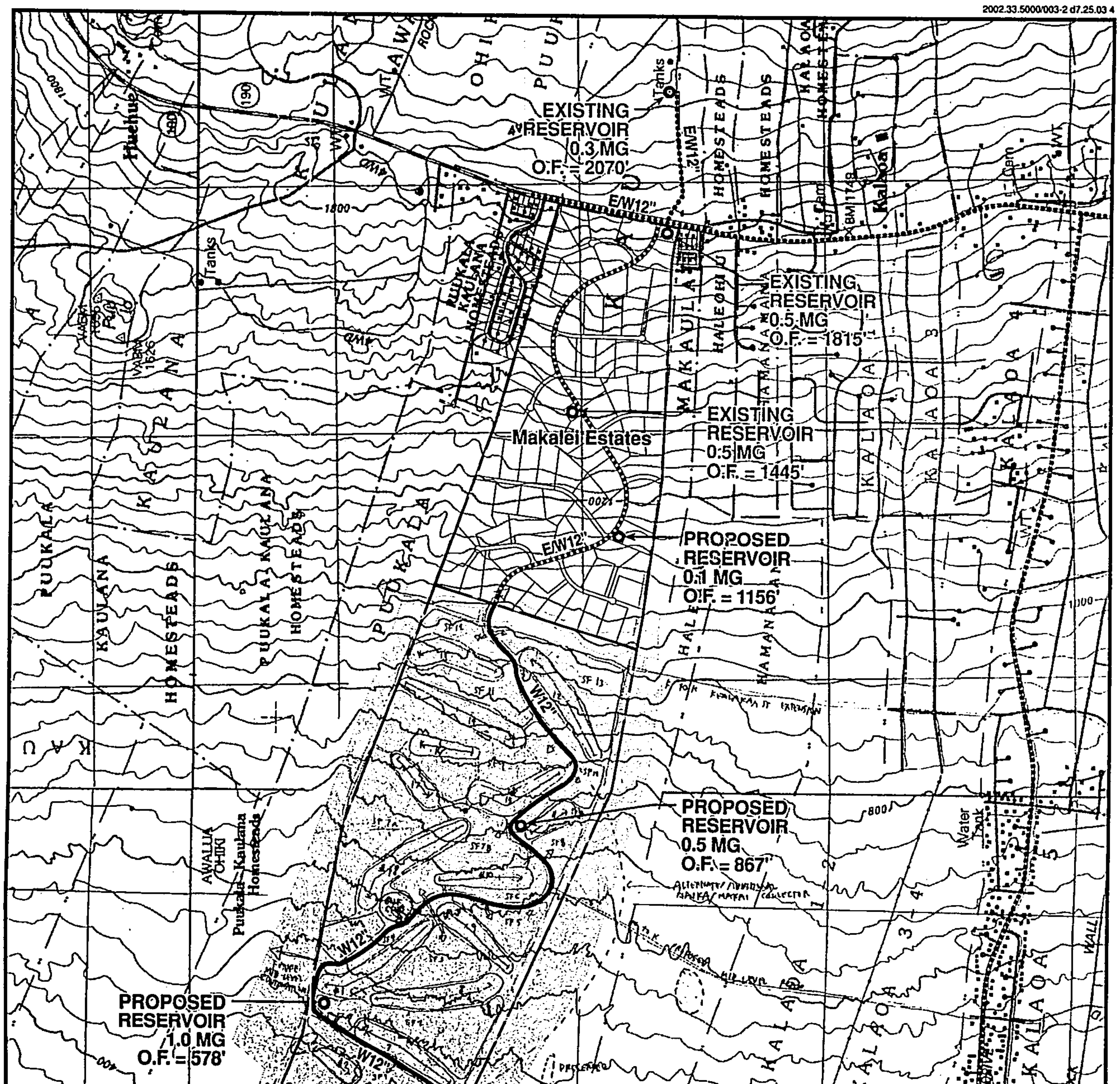
Three private wells will be developed on site to produce nonpotable water for golf course irrigation.

3.5 Wastewater System

A self-contained wastewater collection, treatment and disposal system is proposed for the Hiluhilu Development. A conceptual sketch of the system, which also shows a proposed location for the wastewater treatment plant, is provided in Figure 3-5.

3.5.1 Wastewater Collection

The proposed WWTP location has been selected to maximize the use of gravity flow of raw sewage to the WWTP. The individual wastewater collection system components will also be designed to minimize the need for pumping of raw sewage. Pumping of raw sewage is undesirable due to the high maintenance typically required to provide reliable pumping, the requirement of standby power for sewage pumping stations, the undesirable consequences of a



2002.33.5000/003-2 d7.25.03 4
EXISTING RESERVOIR 0.3 MG O.F. = 2070'
Tanks
E/W12"
EXISTING RESERVOIR 0.5 MG O.F. = 1815'
EXISTING RESERVOIR 0:5 MG O.F. = 1445'
Makalei Estates
PROPOSED RESERVOIR 0.1 MG O.F. = 1156'
E/W12"
W12"
PROPOSED RESERVOIR 0.5 MG O.F. = 867'
PROPOSED RESERVOIR 1.0 MG O.F. = 578'
W12"
Huehue
Kalaoa
BM1748
Water Tank
PUUKALA KAULANA HOMESTEADS
PUUKALA KAULANA HOMESTEADS
HOMESTEADS
KALAOA HOMESTEADS
HALEOHIU
MAKAULA
KALAOA 4
KALAOA 3
PUUKALA
KAULANA
KAU
AWALUA OHIKI
Puukala-Kaulana Homesteads
1800
1000
800
400
WALL
WT

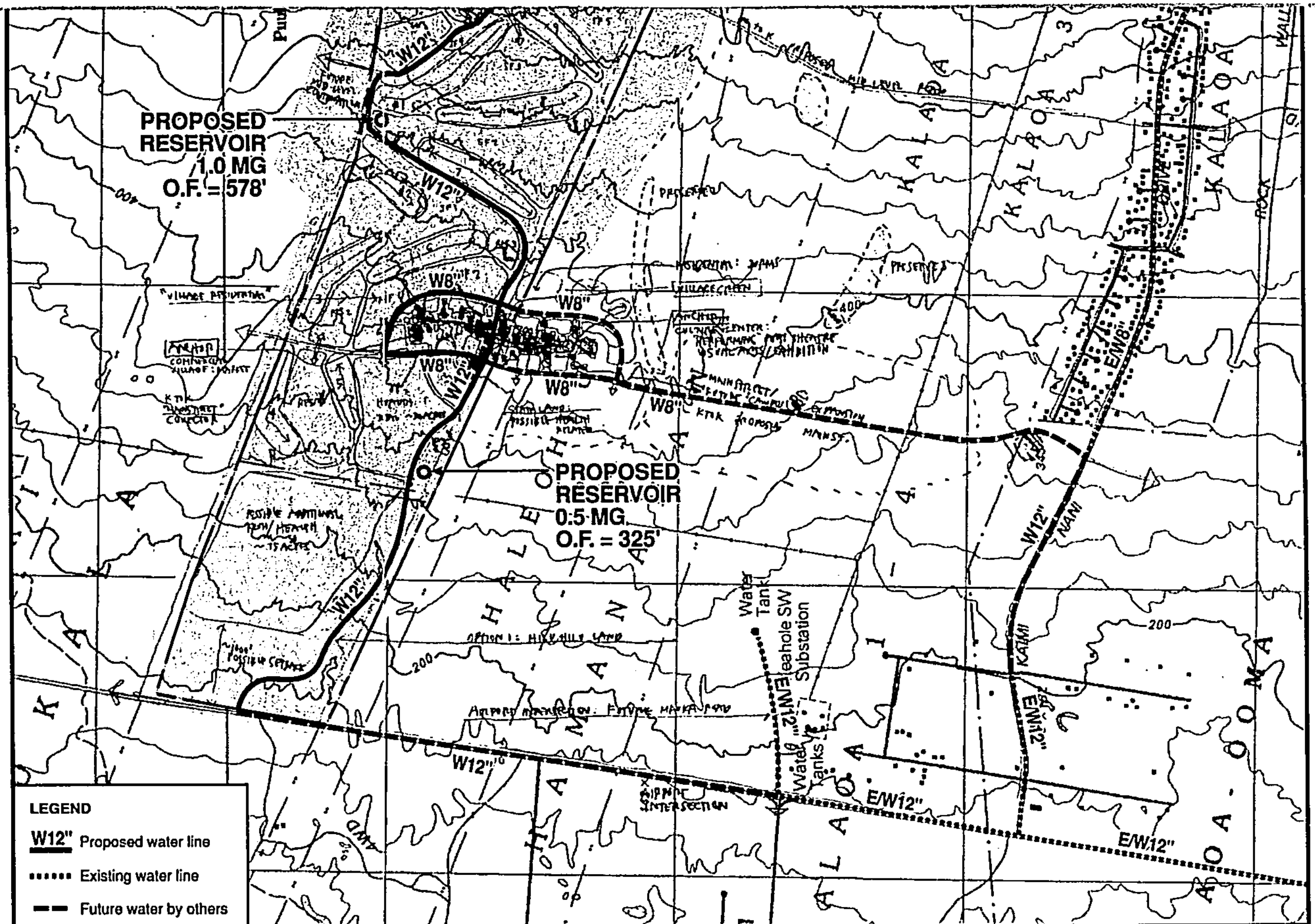
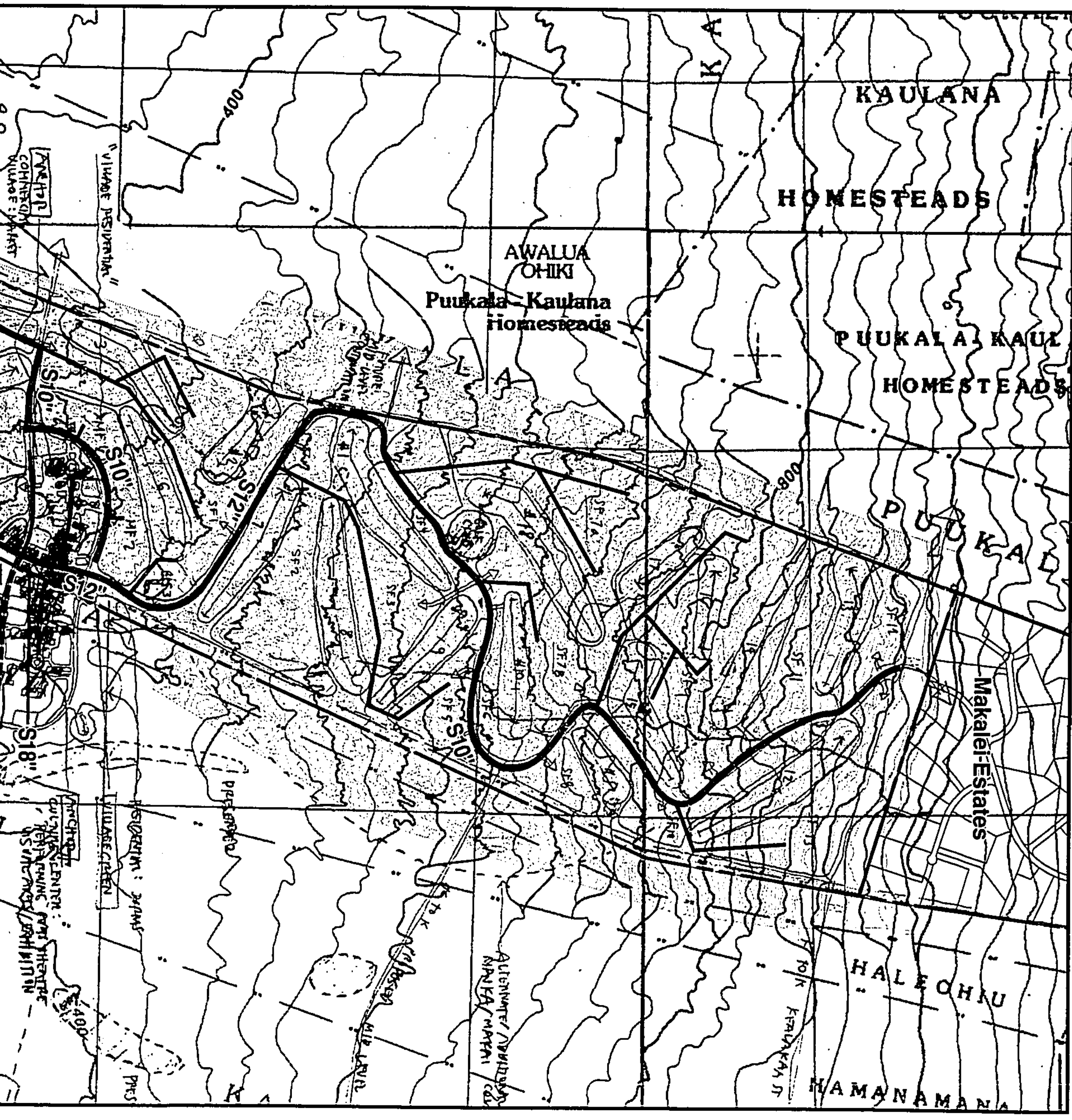


Figure 3-4
HILUHILU DEVELOPMENT
DRAFT WATER MASTER PLAN
Hiluhilu Development—Civil Infrastructure
Prepared by Belt Collins
July 2003



2002.33.5000/004-1 d7.25.03 2

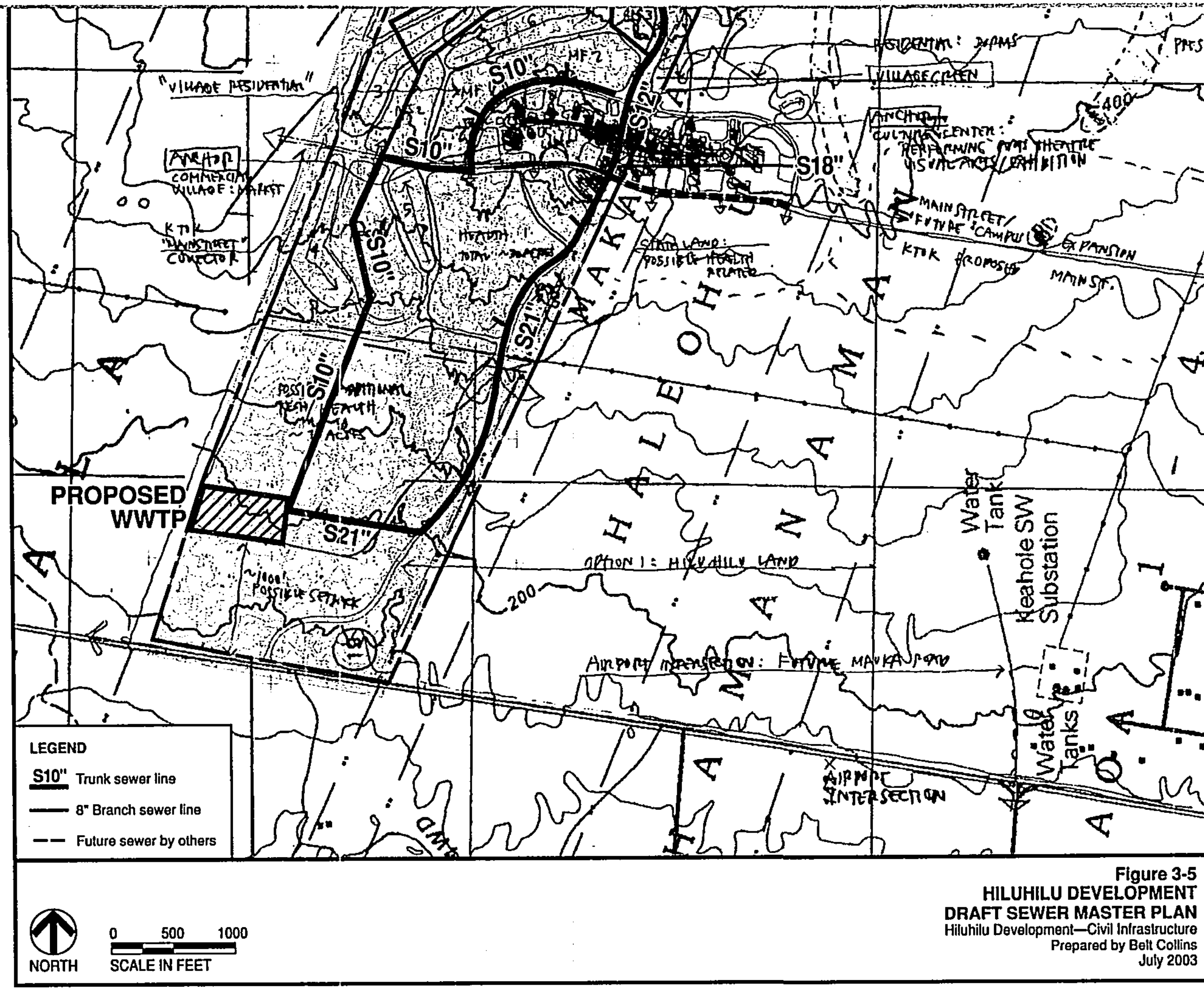


Figure 3-5
HILUHILU DEVELOPMENT
DRAFT SEWER MASTER PLAN
Hiluhilu Development—Civil Infrastructure
Prepared by Belt Collins
July 2003

sewage spill that could result from a pumping system failure, and the energy requirements of pumping.

3.5.2 Wastewater Treatment

The proposed WWTP would provide advanced wastewater treatment to produce recycled water for golf course irrigation meeting the DOH's definition of "R-1 Water." The WWTP would employ a relatively simple "low-tech" process to treat the wastewater to the secondary treatment level. Advanced treatment to produce R-1 water would be accomplished by media or membrane filtration, and ultraviolet light (UV) disinfection.

The WWTP ultimate capacity will be approximately 850,00 gpd. The WWTP will be constructed in three phases to accommodate the development phases of the Hiluhilu project (see Table 1-1).

The WWTP will be designed to minimize energy consumption to the extent practicable. Elevation differences at the proposed site can be exploited to reduce the amount of energy needed to pump the process water within the WWTP. Energy conservation will also be considered in the selection of aeration method and equipment, and in the selection of UV disinfection equipment.

Odor control will also be an important criterion of the WWTP design. Passive odor control design will be employed to the extent practicable, and active odor control systems will be installed only if the passive systems cannot adequately address odors generated at the plant.

3.5.3 Effluent Reuse/Disposal

The R-1 water produced by the WWTP will be pumped to a storage reservoir for use in the golf course irrigation system.

Injection wells are proposed to provide standby disposal, as required by DOH regulations. Effluent that could not be used for golf course irrigation due to rainy weather conditions would be discharged to the injection wells. Also, effluent not meeting the turbidity criteria for R-1 water, due to failure of a treatment component, could be discharged to the injection wells. The latter condition would be infrequent, but must be addressed in system design.

3.5.4 Biosolids Reuse/Disposal

Biosolids produced from the wastewater treatment process would be dewatered at the WWTP and composted with green waste from golf course and other landscaped areas to produce a soil amendment that could be used on site or sold for use off site. The composting process will be designed to meet all USEPA and DOH requirements applicable to the intended uses. The proposed composting facility would be located at the WWTP site and would be equipped with an odor control system to mitigate the potential of nuisance odors typically associated with composting facilities.

3.6 Solid Waste

Solid wastes generated on site will be collected and disposed at approved County solid waste disposal facilities.

4.0 PROBABLE IMAPCTS AND PROPOSED MITIGATION

4.1 Potential Short-Term Impacts

4.1.1 Roads

The major mauka-makai through the site will be constructed in the early stages of development and will provide site access from Queen Kaahumanu Highway to the village center, the golf course, and the residential areas. The road will also provide a through route between Queen Kaahumanu and Mamalahoa Highways by connecting to the main mauka-makai road through the Makalei Estates. This road will provide improved local access and circulation.

The north-south road connecting the village center area with the proposed University of Hawaii at West Hawaii campus will provide transparent access between the village center and the adjacent proposed university campus.

No detrimental short-term environmental impacts are anticipated from the development of the proposed roads within the project site. Regional traffic impacts are assessed in a separate report.

4.1.2 Grading, Drainage, and Erosion Control

During grading activities, portions of the site would be disturbed and the potential for site erosion would increase. The contractor would be required to implement a best management practices (BMP) plan to contain and control site erosion and to prevent the discharge of sediment from the site. The high permeability of the on-site soils provide ample opportunity for on-site sedimentation and infiltration basins. Based on the requirement for construction activities to comply with an approved BMP plan, the short-term environmental impacts from grading activities are anticipated to be insignificant.

The increase of impermeable surfaces that would result from site development will have the effect of increasing stormwater runoff quantities locally. Such runoff will be collected and discharged to on-site drywells for percolation into the ground. Because the site soils are highly permeable, the net effect will not change. Precipitation falling on the site will discharge into the ground as it does now, and off-site runoff will continue to be negligible.

4.1.3 Water and Wastewater

4.1.3.1 Water Environment

Surface Water

There are no surface water bodies on or near the project site. As indicated in Section 4.1.2, the implementation of a BMP plan during construction will prevent the discharge of sediment from the site. As areas of the site are developed, drainage systems will collect runoff and discharge it to the subsurface. The project will be designed such that surface waters will not be discharged off site. The project will have no significant short-term effects on surface waters.

Groundwater

Precipitation on the site currently percolates to the underlying groundwater. This will continue to be the case during and after site development. The construction activities BMP plan will require the contractors to manage materials to prevent the discharge of pollutants to the ground. After development, golf course and landscape management practices will be applied to minimize the use of fertilizers and pesticides that could potentially enter the groundwater. Based on the mitigative measures of conformance to a BMP plan during construction and application of a golf course and landscape management plan after construction, it is anticipated that short-term impacts upon the local groundwater quality will not be significant.

4.1.3.2 Water Supply

Water supply infrastructure, including distribution lines and storage reservoirs will be constructed as approved by the County of Hawaii Department of Water Supply (DWS) and as needed during site development. The proposed water main connection between the Makalei Estates and the existing DWS reservoir mauka of the Kona International Airport access road and Queen Kaahumanu Highway intersection will improve the distribution capabilities of the DWS system. No short-term detrimental impacts on the existing water supply system are anticipated as a result of the proposed project.

The potential short-term impact on water sources is assessed in a separate report.

4.1.3.3 Wastewater

The on-site collection, treatment, and disposal of wastewater will not impact any existing wastewater systems. The proposed treatment level will produce an effluent suitable for golf course and landscape irrigation, thus conserving the available water resources. Effluent that is discharged to the ground through injection wells due to inclement weather or other factors would be of high quality and would not detrimentally affect the aquifer or regional coastal waters.

4.1.4 Solid Waste

No significant short-term impacts on the existing solid waste collection and disposal system or the environment are anticipated as a result of the proposed development.

4.2 Potential Long-Term Impacts

4.2.1 Roads

The long-term impacts of the proposed roads would be similar to the impacts described under Potential Short-Term Impacts and would not be significant. Long-term traffic impacts are assessed in a separate report.

4.2.2 Drainage and Erosion Control

Site drainage in the long term would continue to be discharged to the subsurface and to recharge the underlying groundwater aquifer. After the completion of project construction, ground surfaces would be stable and the potential for erosion would be minimal. Long-term impacts of the project on drainage and erosion control are not anticipated to be significant.

4.2.3 Water and Wastewater

4.2.3.1 Water Environment

Surface Water

The long-term impacts of the project on surface water in the vicinity of the project site would be similar to the impacts described under Potential Short-Term Impacts, and would not be significant.

Groundwater

A long-term golf course and landscape management plan will be implemented to mitigate the potential long-term impacts of fertilizers and pesticides used for turf and landscape maintenance. The long-term impacts of the project on groundwater in the vicinity of the project site would be similar to the impacts described under Potential Short-Term Impacts, and would not be significant.

4.2.3.2 Water Supply

The long-term impacts of the project on the DWS distribution system would be positive, and would be similar to the impacts described under Potential Short-Term Impacts.

The potential long-term impact on water sources is assessed in a separate report.

4.2.3.3 Wastewater

The long-term impact of the proposed on-site wastewater collection, treatment, and disposal systems would be to provide a substantial amount of the irrigation water required for maintenance of the golf course. The occasional disposal of effluent to the subsurface would not result in significant impacts upon the groundwater or nearby coastal waters.

4.2.4 Solid Waste

No significant long-term impacts on the solid waste collection and disposal system or the environment are anticipated as a result of the proposed development.

Appendix B

Botanical Reconnaissance, Lands of
Kau, North Kona, Hawaii

Botanical Reconnaissance
Lands of Kau
North Kona, Hawaii

Patrick Hart, Ph.D

June, 2003

Introduction

This report describes the results of a botanical reconnaissance of an approximately 750 acre portion of the ahupuaa of Ka'u, identified as TMK# 3-7-2-05:1. This land is located between Queen Kaahumanu and Mamalahoa Highways, at elevations ranging from about 150 – 900 feet. The botanical survey was undertaken at the request of Hiluhilu Development LLC to supply information for an Environmental Impact Statement and applications for various land use approvals.

Purpose and Methodology

The objectives of the survey were to 1) identify and take GPS coordinates for all threatened and endangered plant species; 2) list all plant and bird species encountered; and 3) describe the vegetation. The survey paid special attention to identifying and assessing the value of any relict native forest or shrublands.

Fieldwork was conducted in May and June of 2003. Transects were walked from the Jeep road that traverses the property from east to west. In areas where the forest was relatively dense, these transects were separated by 30-50 meters, in more open areas where there was little vegetation, they were separated by up to 200 meters. All parts of the site were visited. Plant species were identified in the field and, as necessary, collected and keyed out in the laboratory. Nomenclature of flowering plants generally follows Wagner et al. (1990), and nomenclature of ferns and fern allies follows Palmer (2003). When federally listed (USFWS 2000) or rare plant taxa were encountered, Universal Transverse Mercator (UTM – Hawaii NAD 83, Zones 4 and 5) coordinates were determined with a Garmin 12 Global Positioning System (GPS) receiver. Bird species were identified by site and sound. On May 3, 2003, Variable Circular Plot (VCP) censuses were conducted at 8 stations in the forested area in the mauka portion of the property (600-800 feet elevation) to estimate the density of Hawaii amakihi (Hemignathus virens virens, a native Hawaiian honeycreeper. No attempt was made to detect night-flying seabirds such as Newell's shearwater (*Puffinus newelli*) or any other animal species such as Hawaiian hoary bats (*Lasiurus cinereus semotus*).

Results

<u>Current Vegetation and Flora of the Area</u>
Twenty-seven native (including 3 federally listed Endangered Species and two Species of Concern) and 35 introduced plant taxa were detected (Table 1). Three general plant communities exist on the project site and are discussed below.

Pennisetum grasslands
Much of the makai portion of the property below about 500 feet elevation consists of nearly barren lava flows, grasslands of introduced fountain grass (*Pennisetum setaceum*), and scattered native and introduced shrubs and trees. The rather sparse herb layer in these grasslands primarily consists of the indigenous uhaloa (*Waltheria indica*), and the introduced partridge pea (*Chamaecrista nictitans*). Other introduced plants include haole

koa (*Leucaena leucocephala*), indigo (*Indigofera suffruticosa*), and *Pluchea symphytifolia*, which are present as low growing shrubs, and silk oak (*Grevillea robusta*), which is present as trees up to 25 feet tall. Native shrubs include the locally common maiapilo (*Capparis sandwichiana*), a federally listed Species of Concern (SOC), and ʻaʻaliʻi (*Dodonea viscosa*). Native trees such as ʻohia (*Metrosideros polymorpha*), lama (*Diospyros sandwicensis*), naio (*Myoporum sandwicense*), alaheʻe (*Psydrax odoratum*), and maua (*Xylosma hawaiiense*) are scattered in very low densities throughout this area. Most significantly, 3 individuals of the state and federally endangered uhi-uhi tree (*Caesalpinia kavaiensis*), and two individuals of the state and federally endangered aiea tree (*Nothocestrum breviflorum*) were encountered. However, one of the ʻaiea trees may be growing just a few feet outside the property boundary. All of the native trees are growing in areas of otherwise barren ʻaʻa lava.

Pennisetum Scrub

From approximately 500-650 feet in elevation, shrubs become co-dominant with fountain grass. The indigenous ʻaʻaliʻi is abundant, forming dense thickets in some areas. Also present are the introduced haole koa and christmasberry (*Schinus terebinthifolius*). Interestingly, the shrubland to the north of the jeep road is dominated by ʻaʻaliʻi, whereas much of the land to the south of the road is dominated by the introduced species. Native trees such as lama, alaheʻe, mamane (*Sophora chrysophylla*), and iliahi (aka. sandalwood, (*Santalum ellipticum*) occasionally emerge above these shrubs. The most remarkable component of this vegetation zone is the numerous stands of giant wiliwili trees that are scattered throughout the area (Fig. 1). These trees are likely the last remnants of the dry forest that once existed there.

Diospyros-Psydrax-Santalum dry forest

A Lowland Dry Forest (Gagne and Cuddihy 1990) that is dominated by lama, alaheʻe, and sandalwood forms a relatively sharp but irregular boundary with the Pennisetum scrub at approximately 650 feet elevation, and continues to the mauka boundary of the property. The forest to the south of the jeep road has numerous large lama and alaheʻe trees, but is relatively disturbed and is dominated by alien trees and shrubs such as silk oak, christmas berry, and haole koa. The dry forest to the north of the jeep road has apparently never experienced a major disturbance, and a 65-75 acre portion of this area may rank among the most intact Lowland Dry Forest fragments remaining on the island. This community consists of a closed canopy of lama and sandalwood trees up to 25 feet tall, with a sub-canopy primarily of alaheʻe, interspersed with wiliwili, kolomona (*Senna gaudichaudii*), ʻakia (*Wikstroemia sandwicensis*), mamane, ʻulei (*Osteomeles anthyllidifolia*), akoko (*Chamaesyce multiformis*), and ʻaʻaliʻi. A few large ohia and silk oak form a scattered emergent layer. At least 13 individuals of the federally endangered halapepe (*Pleomele hawaiiensis*) were encountered within this area, and one ohe makai (*Reynoldsia sandwicensis*), an SOC. With the exception of a few small, disturbed patches (and one old bulldozer cut) that contain fountain grass, christmas berry, and haole koa, much of the understory of this forest is composed of native tree seedlings and saplings, especially lama, alaheʻe, and some sandalwood. Native vines include huehue (*Cocculus triloba*) and koali (*Ipomoea indica*). The abundance of kolomona and sandalwood trees is particularly striking in this forest, as are the numerous large individuals of *Chamaesyce multiformis,* many of which reach diameters larger than have ever been reported for this species.

Birds
Three species of native birds (including one federally listed endangered species and one SOC), and 11 species of introduced birds were detected (Table 2). Hawaii amakihi were abundant in the mauka forested areas of the project site, with a mean density of approximately 4.5 birds per acre.

Rare, Threatened, and Endangered Species
Thirteen individuals of the federally endangered halapepe were encountered. All of these are growing in the Lowland Dry Forest fragment in the upper portion of the property (Fig. 1). Three individuals of the federally listed uhiuhi, and two individuals of aiea were also detected, however, it is likely that one of the 'aiea individuals is located just outside the southern property boundary (Fig.1). In addition, maiapilo, a federally listed (SOC) was common in the makai half of the property. A single individual of ohe makai, another SOC, was located in the dry forest fragment near the mauka boundary of the property (Fig. 1).

The federally endangered Hawaiian Hawk ('Io), *Buteo solitarius,* was regularly seen in the forested sections in the mauka portion of the property. The Hawaiian short-eared owl (Pueo), *Asio flammeus sandwichensis,* is a federally listed SOC, and was seen on one occasion foraging in 'a'ali'i shrubland at approximately 500 feet elevation.

Discussion and Recommendations

Humans have substantially altered the vegetation of much of the property, either directly (eg. clearing for farming and ranching) or indirectly (eg. introduction of cattle and goats, introduction of alien plants, and fire). However, one area still exists where the original Lowland Dry Forest ecosystem is intact (Fig. 1). This Dry Forest remnant is both ecologically and culturally valuable because over 95 % of the state's Dry Forests have been destroyed, and the rest are severely degraded (Wagner et al. 1990). Comprising approximately 65-75 acres, this forest fragment may rank among the most intact of any remaining on the island, and perhaps the state. Scattered throughout this forest are at least 13 individuals of the endangered halapepe tree and at least one ohe makai – an SOC. In addition, the native Hawaii 'amakihi, a honeycreeper that is almost non-existant throughout low elevation areas in Kona, is abundant in this forest. A few hundred meters makai of the Dry Forest are numerous remnant stands of giant wiliwili trees (Fig. 1). The trees are not endangered, but are becoming increasingly rare throughout the state. Even further makai of the wiliwili trees is another band of rare and endangered trees, including 4 maua, 2 'aiea, and 3 uhiuhi trees (Fig. 1). The 'aiea and uhiuhi are federally endangered, the maua probably will be in the next decade or so. One of the 'aiea and 2 of the maua may be just outside the property boundary. The Dry Forest fragment and areas containing the rare and endangered trees above should be considered during the project planning. In order of importance, the following actions are recommended:

- Preserve as much of the Lowland Dry Forest fragment as possible. This forest currently faces 4 major threats- bulldozing, fire, goats, and invasion by exotic plants. If properly protected from these threats, this forest will be an immensely valuable asset to both the university and the surrounding community. In addition, preservation of this forest would protect nesting habitat for the endangered Hawaiian Hawk and continue to provide habitat for the Hawaii amakihi. It is recommended that planners for this project work with an organization such as the North Kona Dry Forest Working Group to come up with a sound management plan for this forest.

- Preserve as many wiliwili stands as possible. Many of the wiliwili on this property are truly exceptional specimens, and all efforts should be made to preserve them. These trees could easily be incorporated into landscaping plans.

- Preserve all maua, ‘aiea, and uhiuhi trees. These trees should be fenced in as large an exclosure as possible (minimum 20 m radius) to protect them from goats. Within these exclosures, seedlings of these and other rare species could be planted. This small scale restoration effort could be coordinated with the North Kona Dry Forest Working Group.

- Select native species that occur naturally on the property as landscaping elements in areas that will be bulldozed. In particular, maiapilo (an SOC), alahe‘e, and ilima should do well as landscaping plants and have the added benefit of needing relatively little water.

Literature Cited

Gagne, W. and L. Cuddihy. 1990. “Vegetation,” pp. 45-114 in W.L. Wagner, D.R. Herbst, and S.H. Sohmer, eds., *Manual of the flowering plants of Hawaii.* 2 vols. Honolulu: University of Hawaii Press.

U.S. Fish and Wildlife Service (USFWS). 2000. *Threatened and endangered plants in Hawaii.* Washington: GPO.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer, eds., *Manual of the flowering plants of Hawaii.* 2 vols. Honolulu: University of Hawaii Press.

Table 1. List of Alien (A), Indigenous (I), and Endemic (E) plant species found during the course of the study. Bold lettering indicates a federally listed endangered species.

Scientific Name	Family	Common Name	Life Form	Status
Abutilon grandifolium	Malvaceae	Hairy abutilon	Shrub	A
Aleurites moluccana	Euphorbiaceae	Kukui	Tree	A
Antigonon leptopus	Polygonaceae	Mexican creeper	Vine	A
Argemone glauca	Papaveraceae	Pua kala	Herb	E
Boerhavia coccinea	Nyctaginaceae	Boerhavia	Herb	A
Caesalpinia kavaiensis	**Fabaceae**	**Uhiuhi**	**Tree**	**E**
Capparis sandwichiana	Capparaceae	Maiapilo	Shrub	E
Carica papaya	Caricaceae	Papaya	Tree	A
Catharanthus roseus	Apocynaceae	Madagascar periwinkle	Shrub	A
Chamaecrista nictitans	Fabaceae	Partridge pea	Herb	A
Chamaesyce multiformis	Euphorbiaceae	'Akoko	Tree	E
Chloris barbata	Poaceae	Swollen finger grass	Grass	A
Cocculus triloba	Menispermaceae	Huehue	Vine	I
Crotalaria incana	Fabaceae	Fuzzy rattlepod	Herb	A
Desmodium incanum	Fabaceae	Spanish Clover	Herb	A
Diospyros sandwicensis	Ebenaceae	Lama	Tree	E
Dodonea viscosa	Sapindaceae	'A'ali'i	Shrub	I
Eleusine indica	Poaceae	Wire grass	Grass	A
Erythrina sandwicensis	Fabaceae	Wiliwili	Tree	E
Grevillea robusta	Proteaceae	Silk oak	Tree	A
Hyptis pectinata	Lamiaceae	Comb hyptis	Shrub	A
Indigofera suffruticosa	Fabaceae	Indigo	Shrub	A
Ipomoea indica	Convolvulaceae	Koali 'awa	Vine	I
Jacaranda mimosifolia	Bignoniaceae	Jacaranda	Tree	A
Kalanchoe pinnata	Crassulaceae	Air plant	Herb	A
Lantana camara	Verbenaceae	Lantana	Shrub	A
Leucaena leucocephala	Fabaceae	Haole koa	Tree	A
Malvastrum coromandelianum	Malvaceae	False mallow	Herb	A
Metrosideros polymorpha	Myrsinaceae	Ohia	Tree	E
Myoporum sandwicense	Myoporaceae	Naio	Tree	I
Nothocestrum breviflorum	**Solanaceae**	**'Aiea**	**Tree**	**E**
Nototrichium sandwicense	Amaranthaceae	Kulu'i	Shrub	E
Opuntia ficus-indica	Cactaceae	Panini	Shrub	A
Osteomeles anthyllidifolia	Rosaceae	'Ulei	Shrub	I
Panicum maximum	Poaceae	Guinea grass	Grass	A
Passiflora foetida	Passifloraceae	Love-in-a-mist	Vine	A
Pennisetum setaceum	Poaceae	Fountain grass	Grass	A
Peperomia leptostachya	Piperaceae	'Ala 'ala wai nui	Herb	I
Phlebodium aureum	Polypodiaceae	Hare's foot fern	Fern	A
Pleomele hawaiiensis	**Agavaceae**	**Halapepe**	**Tree**	**E**
Pluchea symphytifolia	Asteraceae	Sourbush	Shrub	A
Plumbago zeylanica	Plumbaginaceae	'Ilie'e	Herb	I
Portulaca oleracea	Portulacaceae	Pig weed	Herb	A
Portulaca pilosa	Portulacaceae	'Akulikuli	Herb	A
Psidium cattleianum	Myrtaceae	Strawberry guava	Tree	A
Psidium guajava	Myrtaceae	Common guava	Tree	A
Psilotum nudum	Psilotaceae	Moa	Fern	I
Psydrax odoratum	Rubiaceae	Alahe'e	Tree	I

Reynoldsia sandwicensis	Araliaceae	'Ohe makai	Tree	E
Rhynchelytrum repens	Poaceae	Natal redtop	Grass	A
Rivina humilis	Phytolaccaceae	Coral berry	Shrub	A
Santalum paniculatum	Santalaceae	Sandalwood	Tree	E
Schinus terebinthifolius	Anacardiaceae	Christmasberry	Tree	A
Senna gaudichaudii	Fabaceae	Kolomona	Tree	I
Senna occidentalis	Fabaceae	Coffee senna	Shrub	A
Sida fallax	Malvaceae	'Ilima	Shrub	I
Sophora chrysophylla	Fabaceae	Mamane	Tree	E
Stachytarpheta jamaicensis	Verbenaceae	Jamaica vervain	Shrub	A
Verbena littoralis	Verbenaceae	Owi	Herb	A
Waltheria indica	Sterculiaceae	Uhaloa	Herb	I
Wikstroemia sandwicensis	Thymeliaceae	'Akia	Shrub	E
Xylosma hawaiiense	Flacourtiaceae	Maua	Tree	E

Table 2. List of bird species detected on project site. * indicates native endemic species or sub-species. Bold lettering indicates threatened or endangered status.

Scientific Name	*Common Name*
Acridotheres tristis	Common Myna
Asio flammeus sandwichensis	***Hawaiian Short-eared Owl (Pueo)**
Buteo solitarius	***I'o (Hawaiian Hawk)**
Cardinalis cardinalis	Northern Cardinal
Carpodacus mexicanus	House Finch
Francolinus francolinus	Black Francolin
Geopelia striata	Zebra Dove
Hemignathus virens virens	*Hawaii Amakihi
Lonchura malabarica	Warbling silverbill
Nutmeg mannikin	Lonchura punctulata
Serinus mozambicus	Yellow-fronted canary
Streptopelia chinensis	Spotted Dove
Zenaida macroura	Mourning dove
Zosterops japonicus	Japanese White-eye

Table 3. GPS Coordinates (UTM Hawaii NAD 83) for rare and endangered plants and significant stands of trees encountered on the lands of Ka'u, North Kona.

Class	UTM	Easting	Northing
Aiea	5	184432	2185631
Aiea	5	184395	2185448
Maua	5	184397	2185706
Maua	5	184409	2185438
Maua	5	184145	2185479
Maua	5	184277	2185926
Uhiuhi	5	184117	2186026
Uhiuhi	5	184096	2186140
Uhiuhi	5	184370	2185938
Wiliwili stand	5	185490	2186056
Wiliwili stand	5	185565	2185983
Wiliwili stand	5	184822	2185195
Wiliwili stand	5	185062	2185205
Wiliwili stand	5	185462	2185288
Wiliwili stand	5	185293	2185906
Wiliwili stand	5	185021	2186050
Wiliwili stand	5	184925	2186095
Wiliwili stand	5	185260	2185984
Halapepe	5	185905	2185320
Halapepe	5	186139	2185460
Halapepe	5	186098	2185301
Halapepe	5	185880	2185490
Halapepe	5	186289	2185501
Halapepe	5	185942	2185413
Halapepe	5	185965	2185411
Halapepe	5	186003	2185399
Halapepe	5	185906	2185591
Halapepe	5	185676	2185869
Halapepe	5	186136	2185477
Halapepe	5	186021	2185288
Kului	5	185748	2185875
Ohe makai	5	186277	2185448
Aiea	5	184432	2185631
Aiea	5	184395	2185448

Appendix C

ADDENDUM: Archaeological Inventory Survey of the Kaū Development Area

RC-0137

ADDENDUM: Archaeological Inventory Survey of the Kaū Development Area

(TMK: 3-7-2-05:1 por.)

Kaū Ahupua'a
North Kona District
Island of Hawai'i

PREPARED BY:

Matthew R. Clark, B.A.
Dylan S. Amerine, B.A.
J.David Nelson, B.A.
Christopher S. Hand, B.A.
Mark J. Winburn, B.A.
Kasey A. McCune, B.A.
and
Robert B. Rechtman, Ph.D.

PREPARED FOR:

Hiluhilu Development, LLC
P.O. Box 7121
Kamuela, HI 96743

June 2003

RECHTMAN CONSULTING
HC 1 Box 4149 • Kea'au, Hawai'i 96749
phone: (808) 966-7636 • FAX (800)406-2665
e-mail: rechtmanconsult@aol.com

RC-0137

ADDENDUM: Archaeological Inventory Survey of the Kaū Development Area (TMK: 3-7-2-05:1 por.)

Kaū Ahupua'a
North Kona District
Island of Hawai'i

RECHTMAN CONSULTING

Contents

Figures

Tables

INTRODUCTION

At the request of Mr. Guido Giacometti, on behalf of his client Hiluhilu Development, LLC, Rechtman Consulting, LLC conducted archaeological inventory fieldwork on a roughly 725-acre property (TMK: 3-7-2-05:1 por.) in Kaū Ahupua'a, North Kona, Island of Hawai'i (Figure 1). The current study area is a portion of a larger (1000 acre) property that was subject to an archaeological inventory survey in 1990 (Schilz et al. 1990) by Ogden Environmental and Energy Services Company, Inc. (Ogden) [the Bishop Museum (Ching 1970, 1971; Ching and Rosendahl 1968; Rosendahl 1973) and PHRI (Rosendahl 1990) also conducted archaeological fieldwork on portions of this property]. The Ogden report was submitted to DLNR-SHPD and approved. However, based on more recent fieldwork in the upper portion of the original project area, both the current landowner and DLNR-SHPD felt the earlier work was suspect and that additional fieldwork would be warranted for the current study property. Their suspicions were correct; Ogden had recorded only 50 sites (that we collapsed into 34 sites) within the current project area, whereas during the current study we recorded 83 sites, a difference of over 244%.

The current report presents the results of the additional fieldwork, and should be considered an addendum to the original archaeological inventory survey. As such, background information relative to the study area is not repeated here; rather, the reader is referred to the original study (Schilz et al. 1990), and to a recent Cultural Impact Assessment (Orr 2003) prepared for the current project.

This addendum style report was agreed upon in consultation with Patrick McCoy of DLNR-SHPD, and presents the current field findings (correlated where possible with those of the earlier study), and revised significance assessments and treatment recommendations. A brief discussion of the previous archaeology performed on the property is outlined first; followed by a presentation of the field methods and survey results; a synthetic discussion of the findings; and lastly, significance assessments and treatment recommendations for all of the identified sites.

PRIOR ARCHAEOLOGICAL STUDIES WITHIN THE PROJECT AREA

At least five prior studies were conducted within portions of the current project aea. Table 1 lists these studies and their specific locations can be seen on Figure 1.

Table 1. Prior archaeological studies within current project area.

Name and date	*Type of investigation*	*Area covered in investigation*
Ching and Rosendahl (1968)	Surface survey	Western boundary area
Ching (1970, 1971)	Surface survey and subsurface testing	Western boundary area
Rosendahl (1973)	Intensive investigation of a site complex	2 acres in the northwest area
Rosendahl (1990)	Reconnaissance survey	Southern boundary area
Schilz et al. (1990)	Inventory survey	Entire project area

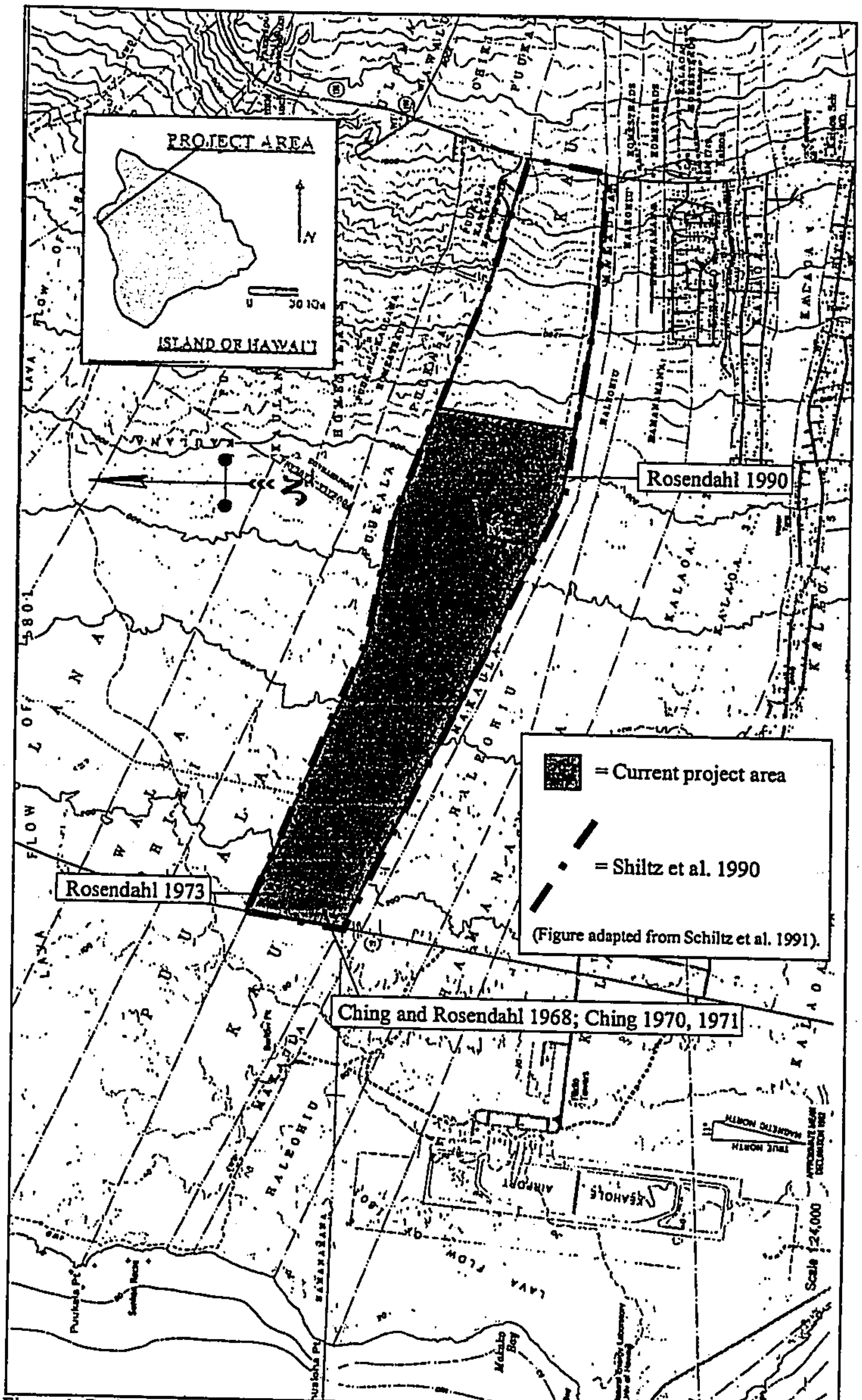


Figure 1. Project area location and previous archaeological studies.

As part of the planning for the Queen Ka'ahumanu Highway, extensive archaeological survey and testing work was conducted in the right-of-way corridor of the then-proposed highway. The two most prominent studies (Ching and Rosendahl 1968; Ching 1971) both covered the *makai*-most portions of the current project area. As a result of these studies, one large site area (covering 2 acres) was identified in the extreme northwestern portion of the current study area (Site H18-24-T1). Following the survey and testing projects, Site Complex D of H18-24-T1 was selected for intensive investigation (Rosendahl 1973). This site, located between 150 and 170 feet above sea level, comprised 62 features (Rosendahl 1973). The primary feature of the site complex was a habitation cave; other features included mounds, platforms, enclosures, rock-filled depressions, and petroglyphs. Rosendahl excavated 5 square meters within the habitation cave and recovered a wide range of artifacts. Ogden did not identify this site during a subsequent inventory survey (Schilz et al. 1990) of the area.

In 1990 PHRI conducted a reconnaissance survey (Rosendahl 1990) of a 100-foot wide corridor along the entire southern boundary of the current project area and extending beyond to the *mauka* highway. Twenty-five sites (nearly 100 features) were identified. More than half of the features were mounds in the upper portion of the current study area and *mauka* in what is now the Makalei Estates Subdivision. All of these sites were relocated and recorded by Ogden during a subsequent inventory survey (Schilz et al. 1990).

In June of 1990, Ogden conducted an archaeological inventory survey of a 1,000-acre property that included the current 725-acre study area (Schilz et al. 1990). The survey strategy included both helicopter survey and pedestrian transects. They spent a total of 720 labor hours on the entire project area. They recorded 132 sites (including the 25 sites PHRI had recorded) within the 1,000 acres, fifty of which were in the current study area. The methods used for determining project area boundaries and for plotting site locations (Schilz et al. 1990:28) were insufficient, leading to several inaccuracies in coverage area and mapped locations. Table 2 shows the range of sites they recorded by functional type.

Table 2. Functional site types recorded by Schilz et al. (1990) within the 1,000 acre project area.

Site Function	*# of Sites*	*% of Total*
Agricultural	44	34
Habitation	33	25
Burial	5	4
Ceremonial	3	2
Transportation	3	2
Ranching	4	3
Marker	16	12
Multifunction	24	18

CURRENT FIELDWORK

Fieldwork for the current project was conducted between August 28 and November 12, 2002. Robert B. Rechtman, Ph.D. served as Field Director and Matthew R. Clark, B.A. as Crew Chief. The field crew was made up of Dylan Amerine, B.A., Gregg Harmon, B.A., Kasey McCune, B.A., Dave Nelson, B.A., Pablo Rivera, B.A., and Mark Winburn, B.A. Approximately 1,300 labor hours were spent in the field. Effectiveness of the field survey was not significantly impacted by vegetation; there were three general vegetation regimes encountered based on elevation (see Hart (2003) for a completed botanical description of the study property). The lower elevation area (140–500 feet above sea level) had only scattered grasses and occasional shrubs (Figure 2), the middle elevation area (500–650) had increased trees (Figure 3), and the upper elevation area (650–950) was dense forest (Figure 4; especially on the north side of the project area where a relatively intact native dryland forest predominates).

Figure 2. View of lower project area showing grasses and bare lava.

Figure 3. View of middle project area showing grasses mixed with shrubs.

Figure 4. View of upper project area showing start of forest line.

Field and Laboratory Procedures

Fieldwork included an on-foot reconnaissance of the entire parcel and test excavations at selected features. Survey transects were oriented north/south and the surveyors maintained a 10-meter spacing interval using Garmin 12 handheld GPS technology. Features identified during the survey were flagged and plotted on a field map. These features were later cleared, recorded in detail, photographed and placed on a large-scale map of the project area (see Figure 5).

Twenty-one 1 x 1 meter test units (TUs) were excavated at fifteen sites. These excavation units were dug following natural strata. Where natural layers could not be determined, excavation followed 10-centimeter arbitrary levels. All excavated material was passed through ¼-inch screening in an attempt to recover cultural material. Excavation units were dug until bedrock was encountered. Excavation record forms were maintained for each test unit and photographs were taken. Upon completion of the units, prior to backfilling, stratigraphic information was recorded and profiles drawn.

Artifacts recovered from the screening process were cleaned, weighed, counted, and described. Faunal remains were tabulated and identified to the lowest taxonomic level possible. Where applicable, the Number of Identified Specimens (NISP) and the Minimum Number of Individuals (MNI) were determined. A total of ten charcoal samples were sent to Beta Analytic, Inc. for age determination (Appendix A).

Analytical Methods

This section describes the methodology and models used in defining sites boundaries, interpreting site function, and assigning temporal affiliations.

Defining Site Boundaries

For the current study, sites can either be individual features, or clusters of features that appear to be spatially or functional related. Unless clear associations exist, platforms, enclosures, trails, walls, and lava tubes are categorized as individual single-feature sites. Where associations are clear, multiple feature sites are defined. Also, the seemingly associated concentration of mounds, modified outcrops, terraces, *kuaiwi*, and enclosures in the southeastern portion of the project area was defined as a single agricultural site complex.

Interpreting Site Function

We have argued elsewhere (Rechtman et al. 2001) that interpretation in archaeology is generally a means to an end no matter what one's theoretical orientation or bias happens to be; it is not an end in itself. Interpreting the function of features and organizing features into sites, whose functions are implicit in the features they contain, is an aspect of what has been labeled Middle-Range Theory (Raab and Goodyear 1984). The results of such endeavors can then be used to address more general theoretical research issues such as the development of complexity or the intensification of agriculture, and so on. However, for the purposes of this archaeological study the goal is to limit the research efforts to the less lofty and more administrative issues of interpreting feature and site function.

Essentially, there are four ways to derive functional interpretations: Direct Informant Information, in this case a particular resource is identified by an individual who knows what it is and how it functioned; Direct Ethnographic Analogy, here a resource is compared to other resources that are known to have been used by members of the identical culture and the function has been documented; General Analogy, in this situation a resource is compared to a similar looking resource that is used by a related culture and the function of the resource has been documented; and Logical Supposition. In this last instance the researcher makes a conclusion about a resource's function based on a logical argument that usually takes into account prior archaeological interpretation, metrically derived information, archaeological associations, and the results of subsurface testing.

Obviously, each of these techniques has a different confidence level associated with its accuracy, Direct Informant Information potentially having the highest confidence level (however, such information always has to be assessed relative to an individuals faulty or selective memory and any political agendas that might interfere) and Logical Supposition potentially the lowest. All four of these techniques have been employed in varying degrees for making functional interpretations of the archaeological sites recorded during the study. Additionally the following models were considered when interpreting potential habitation sites: Cordy (1981, 1995), possible ceremonial sites: Kolb (1991) and Ladefoged et al. (1987), and likely agricultural features and sites: Rechtman et al. (2001).

Assigning Temporal Affiliation

After the individual features identified in the field are assigned formal type designations, they are examined for indicators of temporal affiliation. To begin this process, features are first categorized into three generic time periods; "Precontact times," the years between the arrival of the first Polynesians in Hawai'i and the European discovery of the islands by Captain Cook in 1778; "Historic times," the years after the arrival of Captain Cook, but before "Modern times," which we define as a fifty-year sliding continuum dating back from the present—so beginning roughly in the early 1950's. Modern features are not considered significant by DLNR-SHPD, so are not reported on. All other features were grouped into the two remaining time periods using the recorded archaeological data (e.g. proximity and similarity to other features, surface and subsurface artifacts and architecture, topography, and the accumulated knowledge of Hawaiian archaeological forms), and where possible historical documentary research, and oral historical information (Orr 2003). However, the two main criteria we used in separating Historic features from Precontact features were types of material remains observed in the archaeological deposits and architectural styles.

The presence of historic artifacts at a feature is a common indicator of Historic Period use. As Cordy et al. write:

> Use of historic period artifacts as a relative dating technique is extremely common in Hawaiian archaeology. Certain artifact types were introduced after European Contact—A.D. 1778, the arrival of Captain Cook. These include objects made from materials such as metal, glass, ceramics, and chert. Common artifact types made from these materials include metal nails and spikes, barrel hoops, cans, knives, and bullets; glass bottles and window panes; ceramic pipes, plates, bowls, cups and beads; and chert gun flints. A less frequently considered artifact is concrete used as a construction material. The presence of these objects and materials are indicators of post-A.D. 1778 age. Obviously, historic artifacts were not immediately adopted island-wide by A.D. 1778. Trade objects probably were not numerous until after 1790–1800, so the absence of the items could possibly indicate an early historic period age also. (Cordy et al. 1991: 459)

Of course, a feature containing Historic Period artifacts may not have been used solely during historic times. The feature could have been continually used from Precontact times into Historic times. This would be evidenced by a stratigraphic shift in subsurface artifacts from deeper Precontact items to shallower Historic items. Or, by the presence of artifact types that would have been rapidly replaced early in Historic times by the infusion of European materials (such as bone or shell fishhooks, basalt adzes, and coral or urchin spine abraders) mixed with Historic artifact types. Otherwise, a feature containing predominately historic artifacts, or historic artifacts mixed with less easily replaced Precontact artifacts (such as volcanic glass or cowrie shell octopus lures) probably dates to historic times (Cordy et al. 1991).

Historic walls can distinguished from Precontact walls by varying construction techniques. As Cordy et al. state, "It has long been realized in Hawaiian archaeology that high (1.0+ meter), vertically faced, and core-filled walls are common architectural features of the late 1800s—seen in the form of *kuleana* house lot walls, house walls themselves, and in ranch and *ahupua'a* border walls" (1991: 460). These types of walls are occasionally found in Precontact sites, but were not common and seem to be restricted to certain site types such as *heiau* and canoe houses (Cordy et. al 1991). Often, the materials used to construct the Historic walls were pirated from older Precontact features. Occasionally, the Historic walls even follow the alignments of older walls.

Archaeological sites are groupings of related features that may span more than one time period. Historic Period sites can be further separated into relevant time periods. Precontact sites can also be further segregated into more specific time periods following any of the established regional culture-historical sequences (i.e., Burtchard 1995; Cordy 2000; Haun et al. 1998; Kirch 1985, Schilt 1984) based on radiocarbon assays and potentially other relative and absolute dating techniques. Ten radiocarbon dates were obtained from sites recorded during our investigation and two radiocarbon dates (from SIHP Sites 14346 and 14365) were presented in the Ogden study (Schilz et al. 1990). Rosendahl reported the results of three volcanic glass hydration rind dates from Complex D (now SIHP Site 23862).

Findings

A total of 83 sites were recorded during the current study, including all of the sites recorded earlier by Schilz et al. (1990) and the site recorded by Ching (1971). Site locations are shown on Figure 5. Table 3 presents a listing of the sites, correlated with the earlier studies where possible.

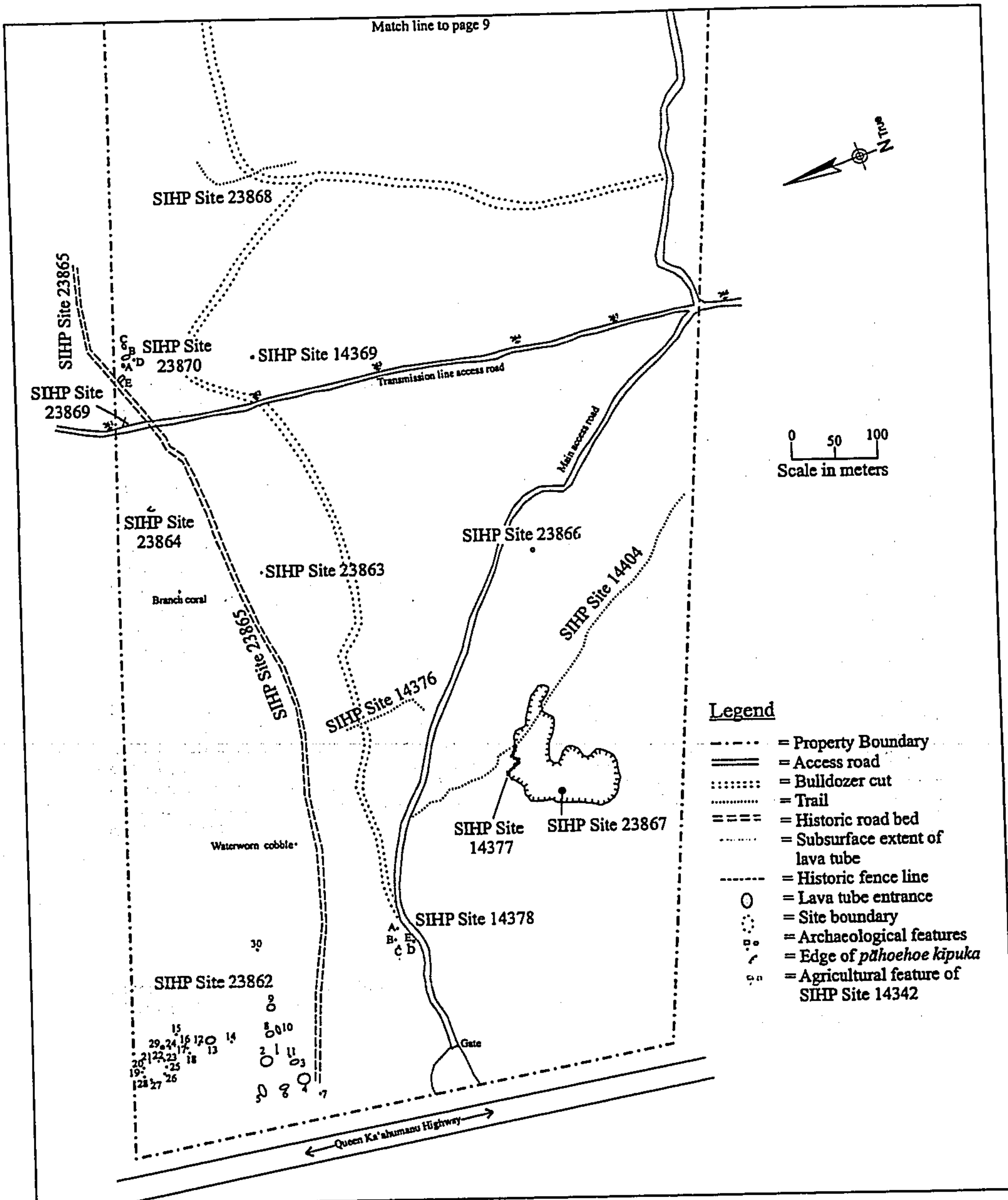


Figure 5. Site location map (continued on pages 9 and 10).

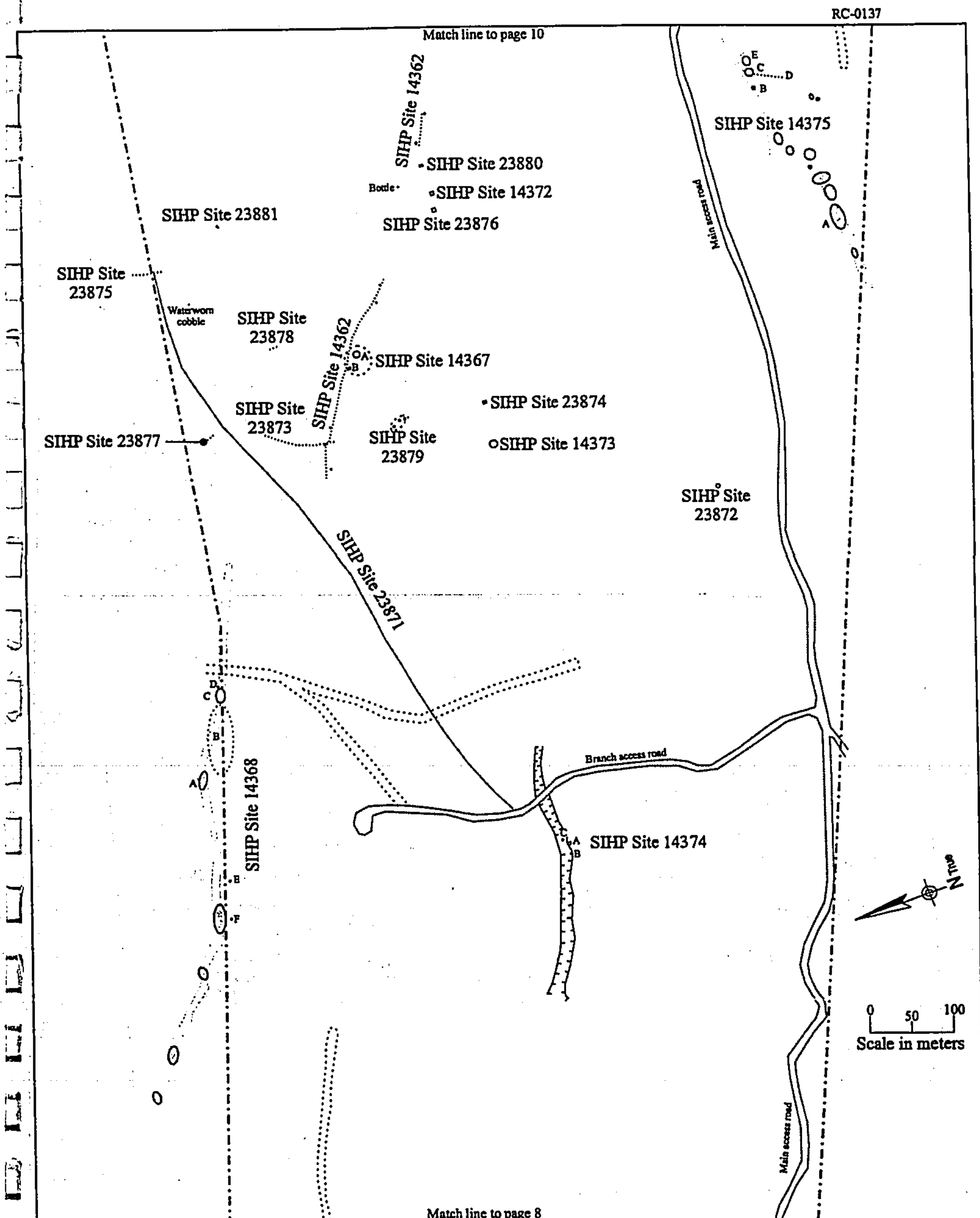


Figure 5. Site location map (continued; see page 8 for map legend).

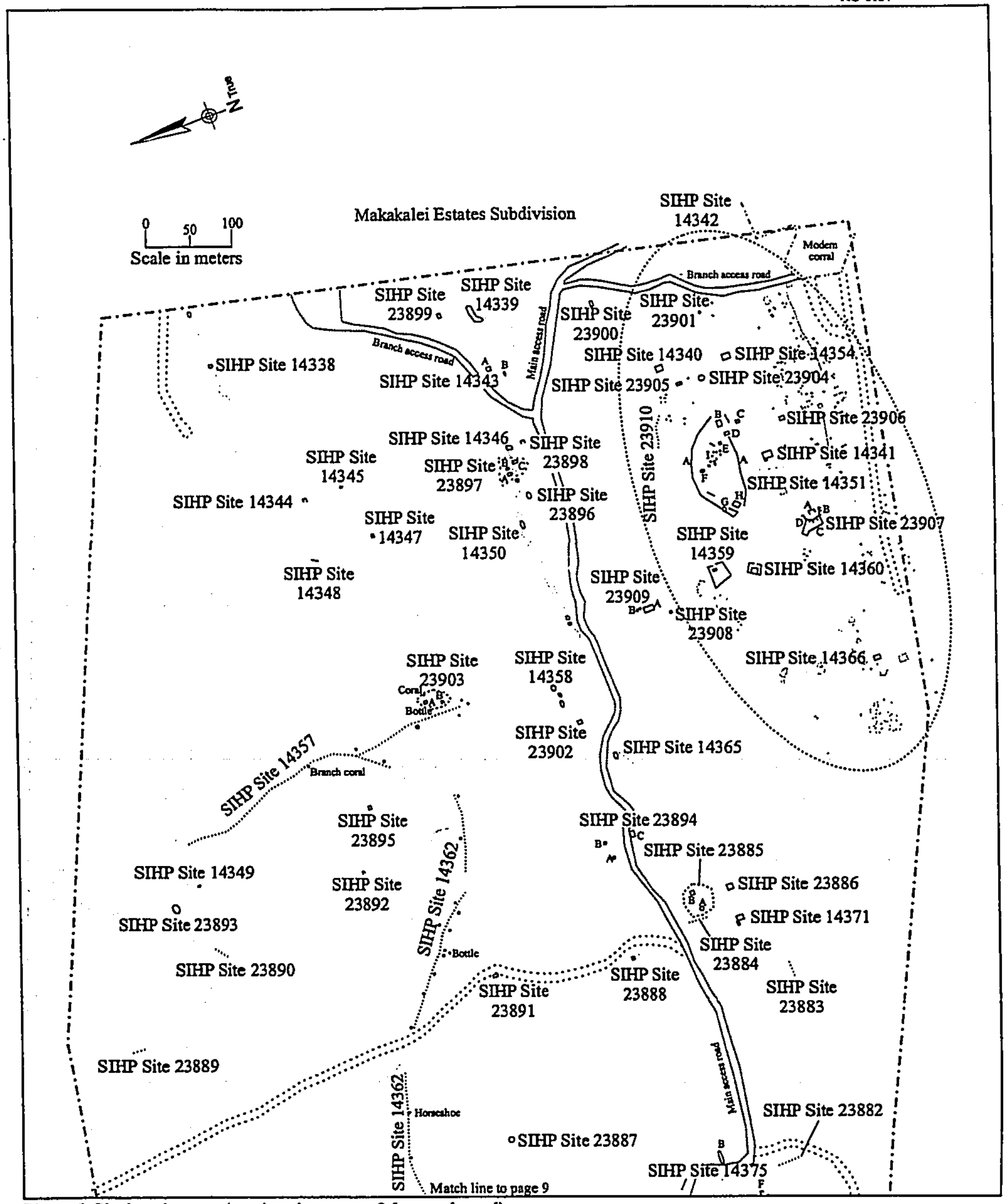


Figure 5. Site location map (continued; see page 8 for map legend).

Table 3. Sites recorded in the current study area.

SIHP Site #	*Prior Designation*	*Site Description*
14338	14338	Isolated find in lava tube
14339	14339	Precontact temporary habitation lava tube
14340	14340	Animal pen
14341	14341	Precontact permanent habitation platform
14342	14342,14356, 14361, 14370, 14396-14403	Precontact agricultural complex
14343	14343	Precontact temporary habitation terrace
14344	14344	Precontact temporary habitation enclosure
14345	14345	Precontact temporary habitation C-shape
14346	14346	Precontact temporary habitation lava tube
14347	14347	Precontact temporary habitation enclosure
14348	14348	Alignment
14349	14349	Mound
14350	14350	Precontact temporary habitation lava tube
14351	14351, 14352, 14353, 14355	Precontact temporary habitation complex
14354	14354	Precontact permanent habitation terrace
14357	14357	Trail
14358	14358	Isolated find in lava tube
14359	14359	Cattle enclosure
14360	14360	*Heiau*
14362	14362, 14363, 14364	Trail
14365	14365	Precontact temporary habitation lava tube
14366	14366	Precontact temporary habitation platform
14367	14367	Precontact temporary habitation lava tube
14368	14368	Precontact permanent habitation complex
14369	14369	"Hunting blind"
14371	14371	Precontact permanent habitation platform
14372	14372	Precontact temporary habitation platform
14373	14373	Precontact temporary habitation lava tube
14374	14374	Precontact temporary habitation complex
14375	14375	Precontact lava tube habitation complex
14376	14376	Trail
14377	14377	Wall
14378	14378	Cairns
14404	14404	Trail
23862	H18-24-T1 Complex D	Precontact permanent habitation complex
23863	–	Cairn
23864	–	Precontact temporary habitation enclosure/shrine
23865	–	Historic road bed
23866	–	Precontact temporary habitation pavement
23867	–	Precontact temporary habitation C-shape
23868	–	Trail
23869	–	Historic boundary marker
23870	–	Precontact temporary habitation complex
23871	–	Historic fence line
23872	–	*Pāhoehoe* evcavation
23873	–	Trail
23874	–	*Pāhoehoe* excavation
23875	–	Trail
23876	–	Precontact temporary habitation modified outcrop
23877	–	Trail
23878	–	Trail

continued on next page

Table 3. Continued.

SIHP Site #	*Prior Designation*	*Site Description*
23879	–	*Pāhoehoe* excavation
23880	–	Precontact temporary habitation platform
23881	–	Precontact temporary habitation C-shape
23882	–	Trail
23883	–	Trail
23884	–	Trail
23885	–	Precontact temporary habitation complex
23886	–	Precontact temporary habitation enclosure
23887	–	Precontact temporary habitation pavement
23888	–	Precontact temporary habitation modified outcrop
23889	–	Trail
23890	–	Trail
23891	–	Precontact temporary habitation terrace
23892	–	Precontact temporary habitation enclosure
23893	–	Precontact temporary habitation lava tube
23894	–	Precontact temporary habitation complex
23895	–	Precontact temporary habitation modified outcrop
23896	–	Precontact temporary habitation enclosure
23897	–	Precontact temporary habitation complex
23898	–	Historic habitation enclosure
23899	–	Precontact temporary habitation enclosure
23900	–	Precontact temporary habitation terrace
23901	–	Cairn
23902	–	Precontact temporary habitation terrace
23903	–	Precontact temporary habitation complex
23904	–	Precontact temporary habitation modified outcrop
23905	–	Precontact temporary habitation enclosure
23906	–	Precontact temporary habitation enclosure
23907	–	Historic habitation complex
23908	–	Precontact temporary habitation lava tube
23909	–	Precontact permanent habitation platform
23910	–	Trail

End of table.

SIHP Site 14338

Site 14338 is a lava tube and associated fractured water-worn cobble located in the northeast corner of the project area along the eastern property boundary (see Figure 5). The tube entrance is accessed through a deep sink area 5 meters in diameter by 2.5 meters deep with vertical edges. A fractured water-worn cobble with use marks (possibly a hammerstone) was found on ground surface within this sink area (Figure 6). The subsurface portion of the tube can be accessed through an entrance along the eastern edge of the sink (Figure 7). Reaching the floor of the tube then requires a harrowing vertical ascent of approximately 4 meters along loose cobble rubble. The subsurface passageway runs approximately 70 meters east to a secondary opening and 55 meters west to a dead end. No additional cultural remains or cultural modifications were encountered within the subsurface extent of the lava tube. The water-worn cobble appears to be an isolated artifact.

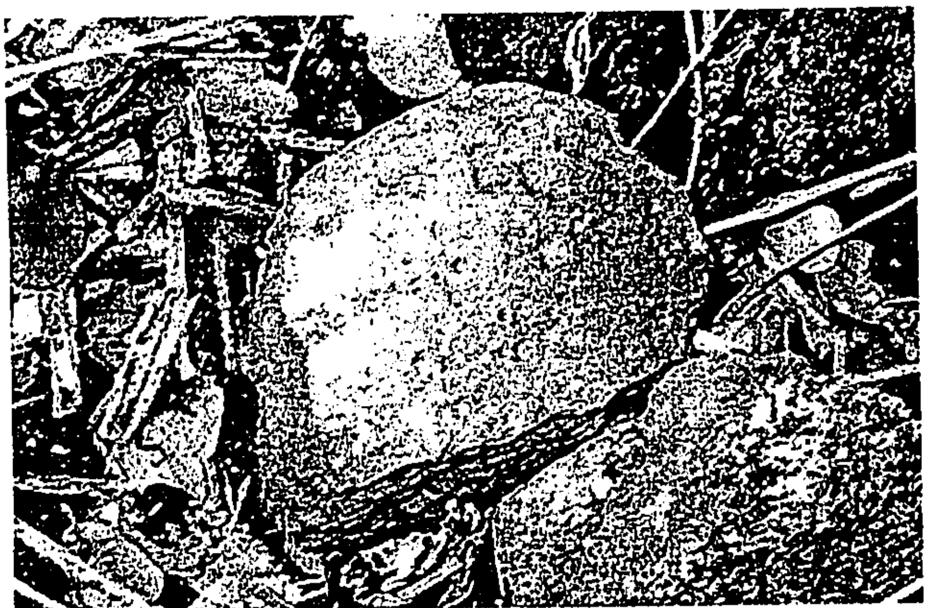


Figure 6. SIHP Site 14338 possible hammerstone, overview.

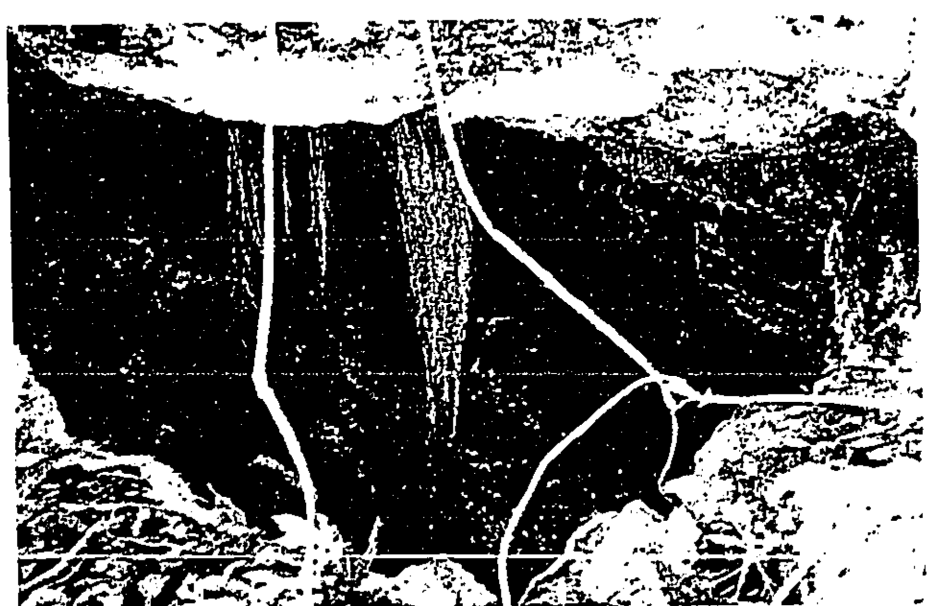


Figure 7. SIHP Site 14338 tube entrance view to east.

SIHP Site 14339

Site 14339 is a habitation tube located in the east central portion of the project area near the eastern property boundary (see Figure 5). The site consists of a modified overhang within a collapsed bedrock sink (Feature A) and a habitation area located at the western end of the sink within a lava tube (Feature B). The sink area measures approximately 25 meters long by 7 meters wide; the subsurface portion of the lava tube measures 8 meters wide and runs west for approximately 45 meters before pinching out. The sink is bordered to the south by a *pāhoehoe* lava flow and to the north by an *'a'ā* lava flow. Habitation debris including marine shell and *kukui* was observed at Feature B. Site 14339 likely served a Precontact temporary habitation site. Individual feature descriptions follow and their locations are shown on Figure 8.

Feature A

Feature A is a modified overhang located along the southern edge of the sink area 15 meters east of Feature B (see Figure 8). The feature measures 8.3 meters long by 3.5 meters deep, but the natural overhang is only 1.6 meters deep with an interior height of 1.1 meters. The interior portion of the feature sits lower than the external ground surface. Modified portions of Feature A consist of a stacked *pāhoehoe* slab and cobble wall at the northeastern end of the overhang (5.0 meters long, 1.3 meters wide, 1.2 meter interior height, and 0.9 meter exterior height; Figure 9) and *pāhoehoe* slabs placed vertically at the western end to create an additional enclosed area. Also at the western end of the feature is a loosely stacked collection of *'a'ā* and *pāhoehoe* cobbles 2.0 meters long by 1.0 meter wide and 82 centimeters high along its interior edge. A possible entryway to the feature exists between the two modifications at the western end of Feature A. Cobble rubble and thin soil are present within the overhang. Feature A likely served a habitation function.

Feature B

Feature B is a habitation area located within a lava tube at the western end of the sink area (see Figure 8). Feature B is accessed through an opening in the *pāhoehoe* bedrock that measures 2.5 meters long by 1.0 meter wide (Figure 10). The subterraneous portion of the lava tube runs approximate 45 meters west, but only the first 12 meters contained cultural debris. The tube floor in this area has been mostly cleared of cobble rubble leaving smooth bedrock floor. Cultural debris found at Feature B included a *Cypraea* fragment, *kukui* fragments, and a stick that was charred at both ends. It appears that Feature B, like Feature A, was used for habitation purposes.

SIHP Site 14340

Site 14340 is a roughly rectangular enclosure located in the southeastern portion of the project area approximately 20 meters northeast of Site 23905 (see Figure 5). Vegetation in the area consists of *koa haole*, Christmas-berry, *kukui*, and silver oak. The enclosure walls are constructed of stacked/collapsed *'a'ā* cobbles with some *pāhoehoe* mixed in (in the southeast corner). The enclosure measures 8.5 meters long by 7.0 meters wide (Figure 11). The northwest corner of the feature is largely intact with stacked walls standing up to 1.1m high (Figure 12). The walls appear to be of core-filled construction, but this is very difficult to tell amongst the collapse. The interior of the enclosure consists of uneven *'a'ā* and *pāhoehoe* bedrock covered by thin soil. Pink and blue flagging tape was found tied to a rock within the enclosure's interior. Site 14340, based on the height of the walls, was most likely used as an animal pen (Rechtman et al. 2001; Rechtman and Clark 2002). It as possible that the enclosure was utilized for habitation, though because of the uneven interior ground surface, it doesn't appear particularly well suited to this function and no cultural debris was observed in the vicinity. Site 23905 (a temporary habitation enclosure 20 meters to the southwest) may have served as the habitation feature for the individual(s) tending livestock at Site 14340.

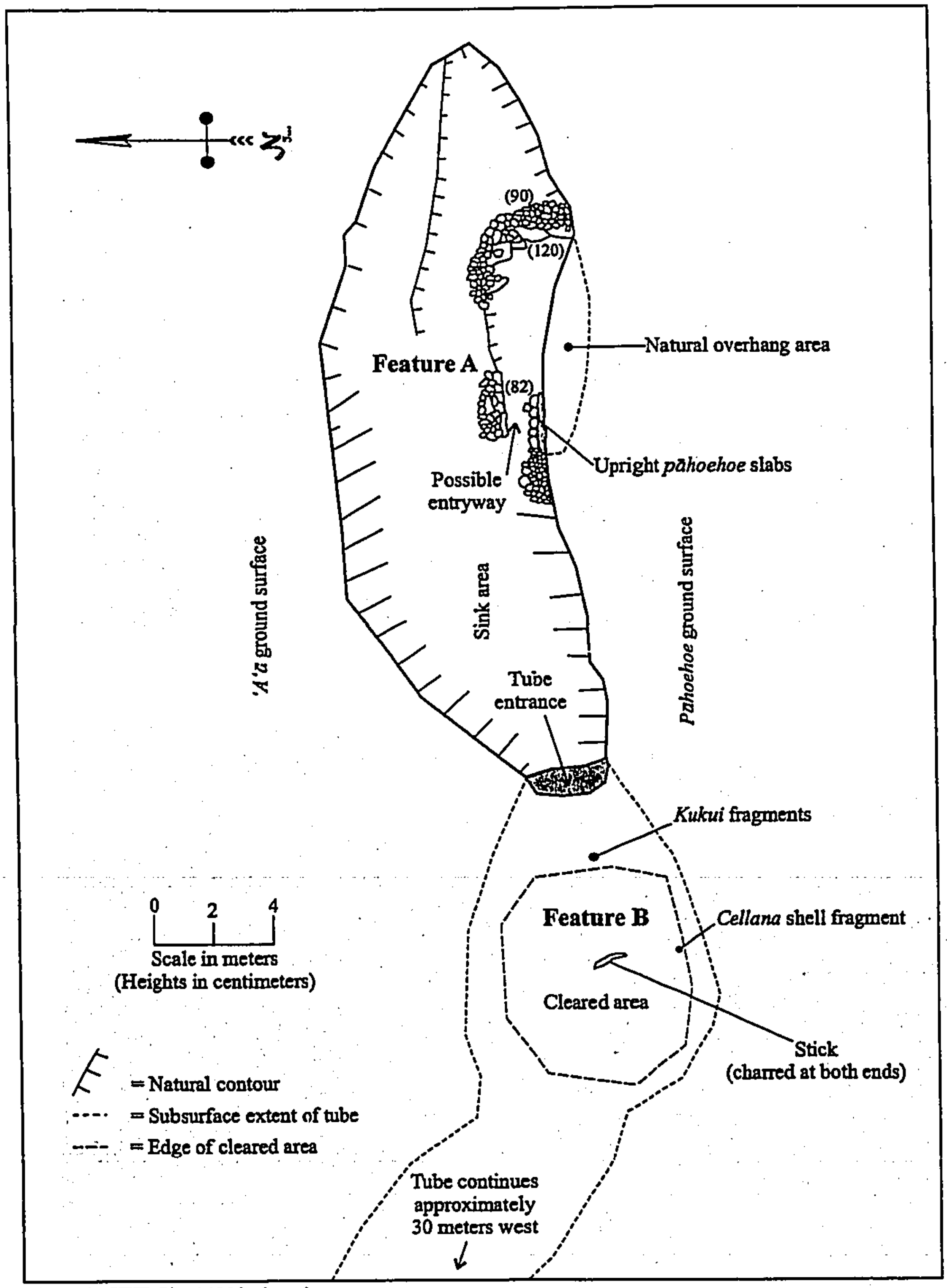


Figure 8. SIHP Site 14339 plan view.


Figure 9. SIHP Site 14339 Feature A, view to east.

Figure 10. SIHP Site 14339 Feature B tube entrance, view to west.

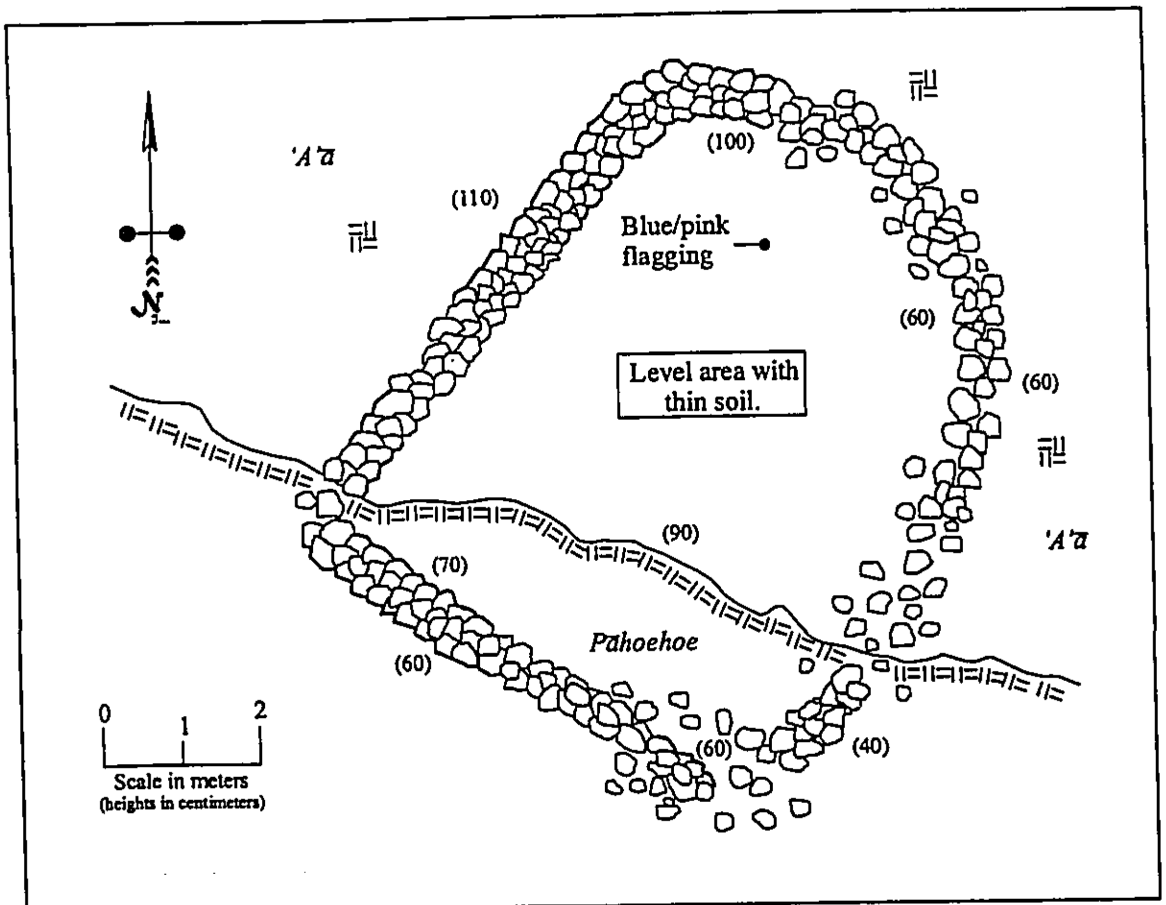


Figure 11. SIHP Site 14340 plan view.

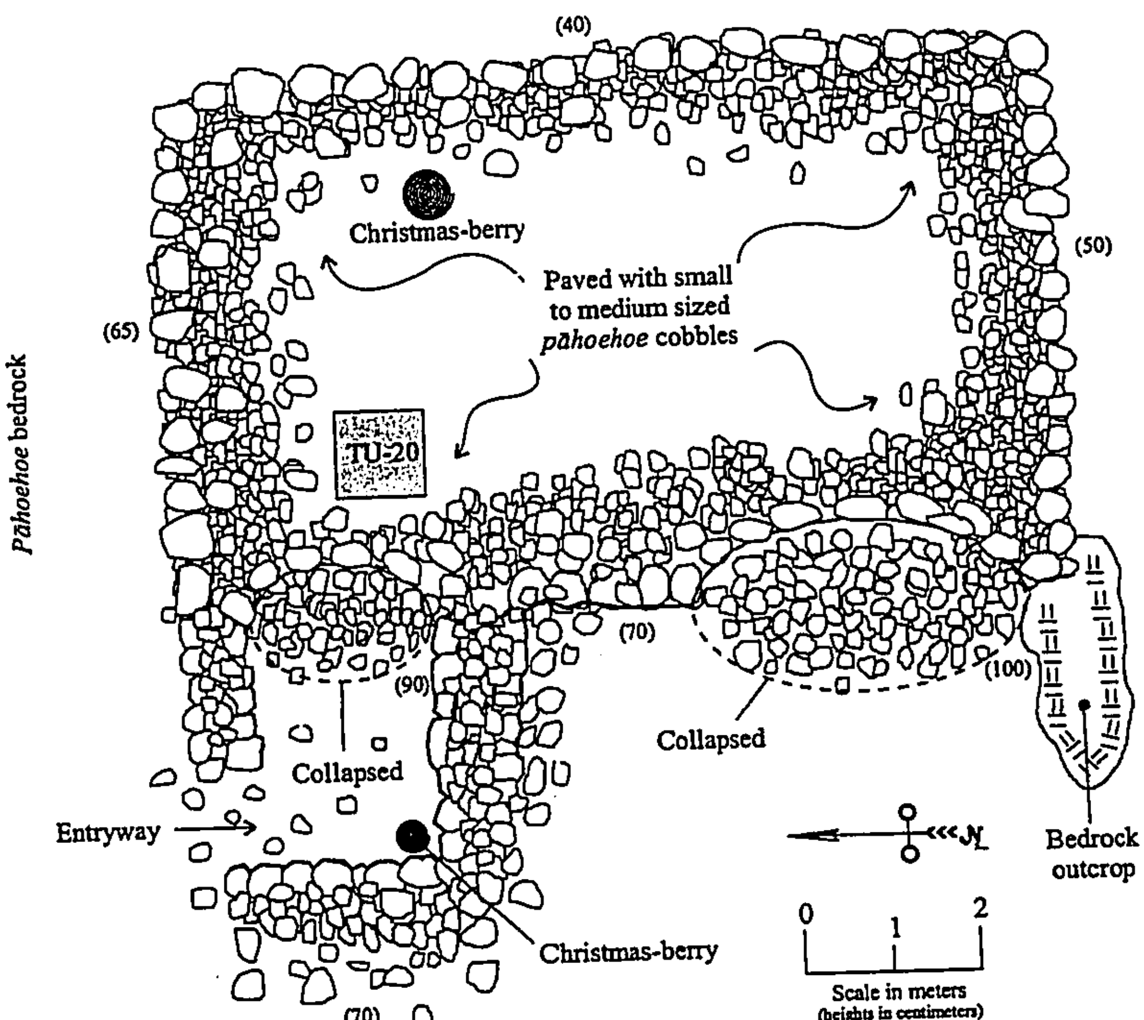
Figure 12. SIHP Site 14340 view to northeast of intact northwest corner.

SIHP Site 14341

Site 14341 is a permanent habitation platform with an attached enclosure located in the southeast portion of the project area, approximately 30 meters south of Site 14351 (see Figure 5). Vegetation in the vicinity of the site consists of air plants, Christmas-berry, silver oak, *koa haole*, *'a'ali'i*, and sparse grasses. The platform is rectangular, measuring 9.3 meters (north/south), by 6.2 meters (east/west), with a small enclosure (4.0 meters by 4.0 meters) attached to the north end of the west side (Figure 13). It is constructed of *pāhoehoe* cobbles on exposed *pāhoehoe* bedrock. The western (*makai*) edge stands up to 1.0 meter high and is constructed of stacked cobbles. The feature is paved with medium to small sized *pāhoehoe* cobbles (Figure 14). The enclosure is mostly collapsed but once had stacked walls up to 90 centimeters high and 1.0 meter wide. A single 1 x 1 meter test unit (TU-20) was excavated in the northwestern portion of the platform.

Excavation of TU-20 revealed a three layer stratigraphic profile resting on uneven bedrock (see Figure 13). Layer I, the architectural layer, consisted of small sized angular *pāhoehoe* cobbles to small sized boulders that created a level surface above an extremely uneven *pāhoehoe* bedrock ground surface; the north half of Layer I extended to a depth of 31 centimeters, and the southern half to 82 centimeters below the unit's surface. Layer II consisted of very dark brown (7.5YR 2.5/2) fine sandy silt with rootlets and pebbly decomposing *pāhoehoe* and *a'ā* gravels intermixed. Layer II extended from 31-88 centimeters below the unit's surface in the north, and from 82-88 centimeters in the south. It appears that this layer was deposited subsequent to the construction of Site 14341 as it coincides with the Layer I but rests on top of Layer III (culturally sterile soil). Layer II was excavated in five arbitrary 10-centimeter levels (Levels 1-5). Layer II contained a waterworn basalt hammerstone (from Level 1), polished coral, urchin (*Echinoidea*), volcanic glass flakes (utilized flakes and debitage), basalt flakes, marine shell, *kukui*, charcoal, fish bone, pig (*Sus*) bone, and rodent bone (Table 4). Within Layer II, Feature A (an ash lens) was encountered in the eastern half of the north wall, 70-88 centimeters below the surface of the unit (occupying Levels 4 and 5) (Figure 15). The ash lens was distinguished from the surrounding dark brown soil by its grayish-brown (10YR 5/2) color; this soil was screened separately. Feature A contained a high volume of burnt urchin (*Echinoidea*) fragments, charcoal, and a large volcanic glass flake. Layer III, located directly beneath Layer II and Feature A, consisted of dark grayish-brown (10YR 4/2) culturally sterile fine silt mixed with decomposing bedrock that extended from 88 to106 centimeters below the surface of the unit and terminated at bedrock. Excavation of TU-20 terminated at bedrock.

A charcoal sample recovered from TU-20, Layer II, Feature A 70-80 centimeters below the unit's surface (ACC # RC-0137-194) was sent to Beta Analytic, Inc for radiocarbon age determination (Beta-173878; see Appendix A). The carbon sample produced a conventional radiocarbon age of 570±110 B.P., or a 2 sigma calibrated result of A.D. 1240-1490, indicating that Site 14341 was constructed during Precontact times, at a relatively early date for this part of North Kona. The ash lens that the sample was extracted from (Feature A) was located at the base of the cultural soil layer (Layer II) resting on a pre-cultural soil layer (Layer III) suggesting that this date may be from the initial occupation of Site 14341. The amount and type of cultural debris collected from TU-20, along with the feature's large size and formal attributes (Cordy 1981, 1995), suggest that Site 14341 was utilized for Precontact permanent habitation purposes.



TU-20 West wall profile.

Layer I- Architectural layer consisting of piled *pāhoehoe* cobbles and boulders on bedrock.

Layer II- Very dark brown (7.5YR 2.5/2) fine sandy silt accumulated subsequent to the construction of the feature within the architectural layer and pockets of bedrock. A small ash lens (Feature A) (10YR 5/2 Greyish brown silt) was deposited in a pocket of bedrock 70-88 cm below the surface of the unit in the northeast corner (not shown in profile). Layer II contained all the cultural material recovered from TU-20.

Layer III- 10YR 4/2 Dark greyish brown fine sand/silt mixed with decomposing bedrock. Sterile soil accumulated prior to construction of Site 14341.

0 10 20
Scale in centimeters

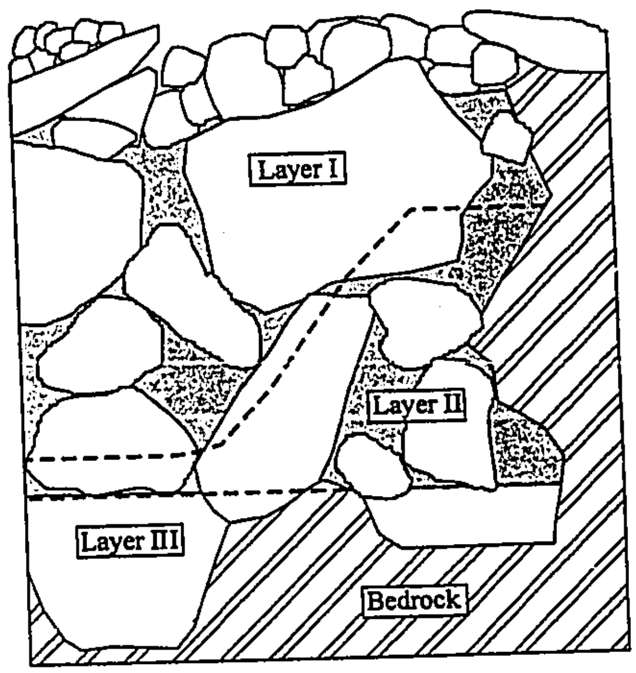


Figure 13. SIHP Site 14341 plan view and TU-20 profile.

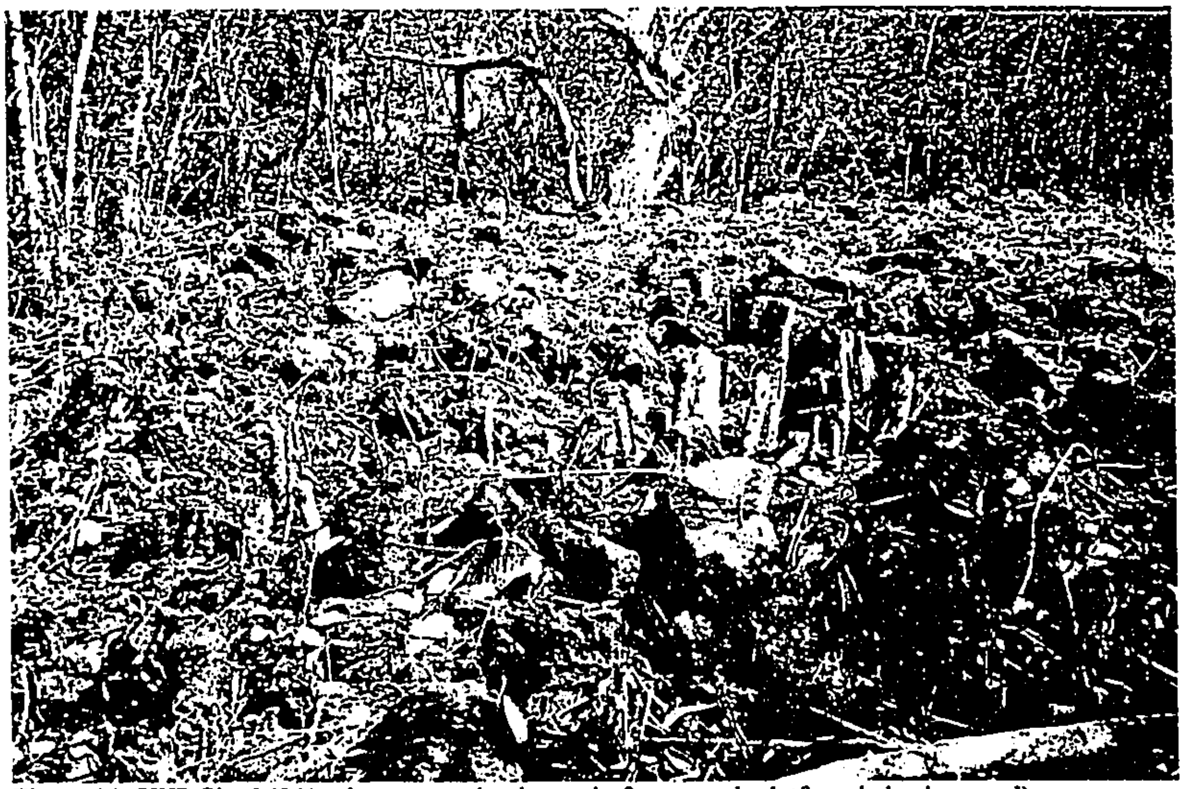


Figure 14. SIHP Site 14341, view to east (enclosure in foreground, platform in background).


Figure 15. SIHP Site 14341 TU-2 overview to north of Feature A (Layer II base of Level 4).

Table 4. Recovered cultural material from SIHP Site 14341 TU-20 Layer II.

ACC#	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
127	1	Basalt	Hammerstone	1	-	138.2
128	1	Volcanic glass	Utilized Flake	1	-	1.2
129	1	Shell	*Cypraea*	9	2	3.9
130	1	Shell	*Echinoidea*	18	1	1.2
131	1	Shell	*Brachidontes*	1	1	<0.1
132	1	Shell	Unidentified	3	1	1.9
133	1	Organic	*kukui*	14	1	5.3
134	2	Volcanic glass	Flake	2	-	0.3
135	2	Shell	*Cypraea*	8	1	2.8
136	2	Shell	*Echinoidea*	6	1	0.4
137	2	Shell	*Drupa*	1	1	0.6
138	2	Shell	*Brachidontes*	2	1	<0.1
139	2	Organic	*kukui*	2	2	1.0
140	3	Volcanic glass	Flake	2	1	0.6
141	3	Bone	Rodent	4	1	0.1
142	3	Shell	*Cypraea*	5	1	3.7
143	3	Shell	*Echinoidea*	19	1	1.4
144	3	Shell	*Drupa*	2	1	0.8
145	3	Shell	*Conus*	1	1	0.7
146	3	Shell	*Brachidontes*	3	1	0.4
147	3	Shell	Unidentified	1	1	0.5
148	3	Organic	*kukui*	9	1	3.0
149	3	Organic	Charcoal	-	-	0.1
150	4	Volcanic glass	Utilized Flake	1	-	1.9
151	4	Volcanic glass	Utilized Flake	1	-	0.5
152	4	Volcanic glass	Flake	5	-	1.8
153	4	Basalt	Flake	2	-	0.7
154	4	Bone	*Sus* Tooth	1	1	0.2
155	4	Bone	Fish	1	1	0.3
156	4	Bone	Bird	1	1	0.2
157	4	Bone	Rodent	4	1	0.3
158	4	Shell	*Cypraea*	8	1	6.2
159	4	Shell	*Echinoidea*	43	1	3.2
160	4	Shell	*Brachidontes*	5	2	0.6
161	4	Shell	*Conus*	1	1	0.3
162	4	Shell	*Nerita*	1	1	0.3
163	4	Shell	Unidentified	2	1	0.1
164	4	Organic	*kukui*	4	1	1.0
165	4	Organic	Charcoal	-	-	0.7
166	4 (Feat. A)	Volcanic glass	Utilized Flake	1	-	2.6
167	4 (Feat. A)	Volcanic glass	Flake	4	-	2.5
168	4 (Feat. A)	Shell	*Echinoidea*	29	1	2.5
169	4 (Feat. A)	Shell	*Cypraea*	2	1	1.6
170	4 (Feat. A)	Shell	*Drupa*	1	1	0.1
171	4 (Feat. A)	Shell	*Brachidontes*	2	1	0.2
172	4 (Feat. A)	Organic	Charcoal	-	-	0.2
173	5	Volcanic glass	Utilized Flake	1	-	2.9
174	5	Volcanic glass	Utilized Flake	1	-	0.9

continued on next page

Table 4. Continued.

ACC#	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
175	5	Volcanic glass	Flake(greenish)	1	-	1.0
176	5	Basalt	Flake	1	-	0.2
177	5	Volcanic glass	Flake	14	-	5.7
178	5	Bone	Fish	1	1	0.2
179	5	Bone	Rodent	2	1	0.3
180	5	Shell	*Cypraea*	28	1	11.3
181	5	Shell	*Echinoidea*	47	1	3.9
182	5	Shell	*Pinctada*	1	1	5.6
183	5	Shell	*Drupa*	2	1	0.4
184	5	Shell	*Conus*	1	1	0.2
185	5	Shell	*Brachidontes*	1	1	0.1
186	5	Organic	Charcoal	-	-	1.2
187	5	Coral	Polished	1	-	7.5
188	5 (Feat. A)	Basalt	Flake	1	-	0.9
189	5 (Feat. A)	Volcanic glass	Flake	2	-	0.9
190	5 (Feat. A)	Shell	*Cypraea*	2	1	1.6
191	5 (Feat. A)	Shell	*Echinoidea*	9	1	0.9
192	5 (Feat. A)	Shell	*Brachidontes*	1	1	0.1
193	5 (Feat. A)	Shell	Unidentified	1	1	0.5
194	5 (Feat. A)	Organic	Charcoal	-	-	1.2
195	6	Volcanic glass	Flake	11	-	3.8
196	6	Bone	Rodent	4	1	0.2
197	6	Shell	*Cypraea*	27	1	9.1
198	6	Shell	*Echinoidea*	71	1	4.8
199	6	Shell	*Brachidontes*	3	1	0.5
200	6	Shell	*Nerita*	1	1	0.2
201	6	Shell	*Conus*	1	1	0.2
202	6	Shell	Unidentified	2	1	0.3
203	6	Organic	*kukui*	8	1	2.0
204	6	Organic	Charcoal	-	-	2.5

End of table

SIHP Site 14342

Site 14342 is a large agricultural complex consisting of 234 features located in the southeastern portion of the project area (see Figure 5). The agricultural features are spread over a wide area (approximately 600 meters long by 400 meters wide) of various terrain (i.e., *'a'ā* and *pāhoehoe* flows; soil and bedrock; steep to moderate slopes) and are interspersed among numerous Precontact and Historic archaeological sites of various forms and functions. During Precontact times, the habitation sites in the area may have housed farmers tending their nearby fields. Historic ranching endeavors, however (as evidenced by Site 14359; see description below), have sufficiently impacted the archaeological landscape so as to make associations between the agricultural features and the habitation features extremely difficult to determine. For this reason the agricultural features have been grouped separately from the habitation sites. The features of Site 14342 may represent the northern most extent of what has been termed the Kona field system (SIHP Site 6601). Of the recorded 234 features, there are 207 mounds (88.4%), 13 modified outcrops (5.5%), 2 *kuaiwi* remnants (0.8%), 8 enclosures (3.4%), 3 terraces (1.2%), and 1 pavement (0.4%). This configuration of features (predominately mounds) is consistent with an interpretation that sweet potato was the dominant agricultural crop grown in this area, an interpretation also consistent with oral historical information (Orr 2003). All of the features of Site 14342 are listed in Table 5 and their locations are shown on Figure 16.

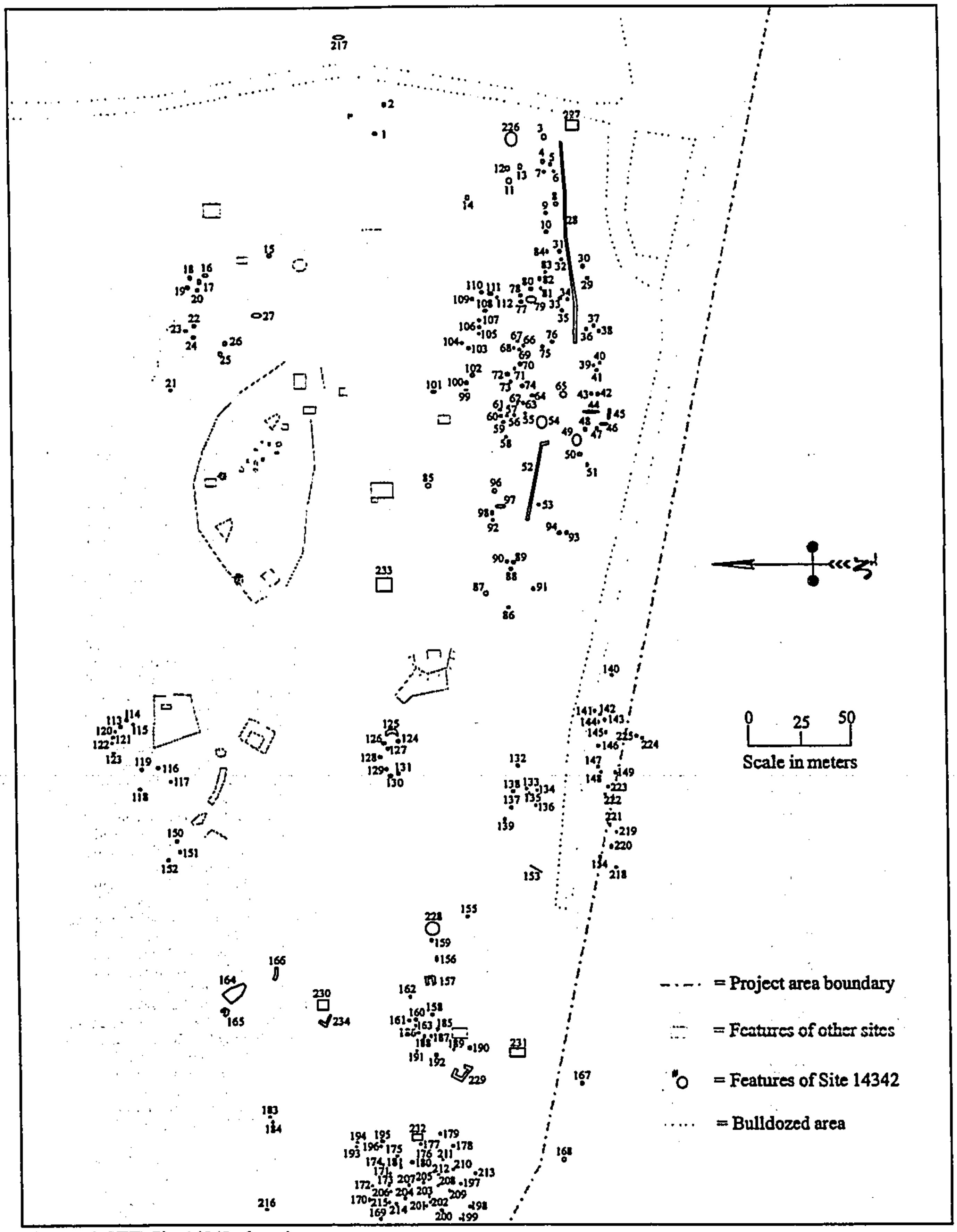


Figure 16. SIHP Site 14342 plan view.

Table 5. SIHP Site 14342 agricultural features.

Feature #	*Feature Type*	*Shape*	*Length (m)*	*Width (m)*	*Height (m)*	*Attributes*
1	Mound	Circular	2.6	2.6	0.8	Piled *pāhoehoe* cobbles on bedrock
2	Mound	Circular	1.9	1.9	0.5	Piled *pāhoehoe* cobbles on bedrock
3	Modified outcrop	Circular	2.0	2.0	1.0	Piled *pāhoehoe* against outcrop
4	Mound	Circular	2.2	2.2	0.6	Piled *pāhoehoe* cobbles on bedrock
5	Mound	Circular	2.0	2.0	0.8	Piled *pāhoehoe* cobbles on bedrock
6	Mound	Circular	2.0	2.0	0.5	Piled *pāhoehoe* cobbles on bedrock
7	Mound	Circular	2.0	2.0	0.6	Piled *pāhoehoe* cobbles on bedrock
8	Mound	Linear	2.7	1.4	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on bedrock
9	Mound	Circular	2.1	2.1	0.5	Piled *pāhoehoe* cobbles on bedrock
10	Mound	Circular	2.1	2.1	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on bedrock
11	Modified outcrop	Irregular	3.7	3.0	1.0	Piled *'a'ā* and *pāhoehoe* against outcrop
12	Mound	Circular	1.7	1.7	0.7	Piled *pāhoehoe* cobbles on soil
13	Mound	Circular	1.8	1.8	0.7	Piled *pāhoehoe* cobbles on soil
14	Modified outcrop	Circular	3.0	3.0	1.0	Piled *pāhoehoe* against outcrop
15	Mound	Circular	2.0	2.0	0.5	Piled *'a'ā* cobbles on bedrock
16	Mound	Oval	2.6	1.6	0.7	Piled *'a'ā* cobbles on soil
17	Mound	Circular	1.7	1.7	0.4	Piled *'a'ā* cobbles on soil
18	Mound	Circular	2.1	2.1	0.4	Piled *'a'ā* cobbles on soil
19	Mound	Circular	1.9	1.9	0.3	Piled *'a'ā* cobbles on soil
20	Modified outcrop	Circular	1.2	1.2	0.5	Piled *'a'ā* cobbles against outcrop
21	Mound	Oval	2.1	1.0	0.5	Piled *'a'ā* cobbles on soil
22	Modified outcrop	Circular	1.8	1.8	0.5	Piled *'a'ā* cobbles against outcrop
23	Mound	Circular	1.4	1.4	0.6	Piled *'a'ā* cobbles on bedrock
24	Mound	Circular	1.5	1.5	0.5	Piled *'a'ā* cobbles on bedrock
25	Mound	Oval	2.3	1.7	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
26	Mound	Oval	1.8	1.5	0.4	Piled *'a'ā* and *pāhoehoe* cobbles on soil
27	Modified outcrop	Linear	3.6	1.9	1.0	Piled *'a'ā* cobbles against outcrop
28	*kuatwi*	Linear	96.0	1.5	0.5	Piled *'a'ā* cobbles
29	Mound	Oval	2.4	1.6	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on bedrock
30	Mound	Circular	1.5	1.5	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on bedrock
31	Mound	Circular	2.4	2.4	0.5	Piled *'a'ā* cobbles on *'a'ā* and soil
32	Mound	Circular	2.2	2.2	0.4	Piled *'a'ā* cobbles on *'a'ā* and soil
33	Mound	Oval	1.6	1.6	0.6	Piled *'a'ā* cobbles on *'a'ā* and soil
34	Mound	Circular	1.9	1.9	0.3	Piled *'a'ā* cobbles on *'a'ā* and soil
35	Mound	Oval	1.3	1.3	0.4	Piled *'a'ā* cobbles on *'a'ā* and soil
36	Mound	Circular	1.6	1.6	0.7	Piled *'a'ā* cobbles on *'a'ā* and soil
37	Mound	Circular	1.2	1.2	0.4	Piled *'a'ā* cobbles on *'a'ā* and soil
38	Mound	Circular	1.5	1.5	0.5	Piled *'a'ā* cobbles on *'a'ā* and soil
39	Mound	Circular	1.8	1.8	0.4	Piled *'a'ā* cobbles on *'a'ā* and soil
40	Mound	Circular	1.5	1.5	0.6	Piled *'a'ā* cobbles on *'a'ā* and soil
41	Mound	Circular	1.8	1.8	0.7	Piled *'a'ā* cobbles on *'a'ā* and soil
42	Mound	Circular	2.0	2.0	0.6	Piled *'a'ā* cobbles on *'a'ā* and soil
43	Mound	Circular	2.7	2.7	0.8	Piled *'a'ā* cobbles on *'a'ā* and soil
44	Mound	Oval	5.9	1.6	0.8	Piled *pāhoehoe* cobbles on soil
45	Terrace	Linear	10.6	2.3	0.8	Piled *pāhoehoe* cobbles on soil
46	Mound	Oval	5.0	1.8	0.6	Piled *pāhoehoe* cobbles on soil
47	Mound	Oval	3.0	2.5	0.9	Piled *pāhoehoe* cobbles on soil
48	Mound	Oval	4.4	3.0	0.9	Piled *pāhoehoe* cobbles on soil
49	Enclosure	Circular	4.8	4.8	0.8	Piled *pāhoehoe* cobbles; walls 1.0m wide
50	Mound	Circular	2.5	2.5	1.0	Piled *pāhoehoe* cobbles on soil
51	Mound	Oval	2.9	1.9	0.9	Piled *pāhoehoe* cobbles on soil
52	*Kuatwi*	Linear		1.0	0.5	Piled *pāhoehoe* cobbles on soil
53	Mound	Circular	2.1	2.1	0.5	Piled *pāhoehoe* cobbles on soil
54	Enclosure	Circular	5.5	5.2	0.4	Piled *pāhoehoe* cobbles; walls 2.0m wide
55	Mound	Oval	2.8	1.8	0.8	Piled *'a'ā* and *pāhoehoe* cobbles on soil
56	Mound	Circular	1.4	1.4	0.4	Piled *'a'ā* and *pāhoehoe* cobbles on soil
57	Mound	Circular	1.6	1.6	0.7	Piled *'a'ā* cobbles on soil
58	Mound	Circular	1.9	1.9	0.6	Piled *'a'ā* cobbles on soil
59	Mound	Circular	2.0	2.0	0.6	Piled *'a'ā* cobbles on soil
60	Mound	Oval	1.9	1.7	0.7	Piled *'a'ā* cobbles on soil
61	Mound	Circular	1.6	1.6	0.5	Piled *'a'ā* cobbles on soil
62	Mound	Circular	1.4	1.4	0.3	Piled *'a'ā* cobbles on soil
63	Mound	Oval	2.4	1.8	0.8	Piled *'a'ā* cobbles on soil and *'a'ā* outcrop
64	Mound	Circular	1.8	1.8	0.4	Piled *'a'ā* cobbles on soil
65	Mound	Oval	3.3	1.8	0.6	Piled *pāhoehoe* cobbles on soil

continued on next page

Table 5. Continued.

Feature #	*Feature Type*	*Shape*	*Length (m)*	*Width (m)*	*Height (m)*	*Attributes*
66	Mound	Circular	1.6	1.6	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
67	Mound	Circular	1.2	1.2	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
68	Mound	Oval	2.1	1.4	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
69	Mound	Crescent	2.2	1.5	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
70	Mound	Oval	2.5	1.5	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
71	Mound	Oval	3.1	1.9	0.8	Piled *'a'ā* and *pāhoehoe* cobbles on soil
72	Mound	Oval	3.6	1.7	0.7	Piled *'a'ā* and *pāhoehoe* cobbles on soil
73	Mound	Oval	3.3	1.9	0.8	Piled *'a'ā* and *pāhoehoe* cobbles on soil
74	Mound	Oval	3.1	2.4	0.9	Piled *'a'ā* and *pāhoehoe* cobbles on soil
75	Mound	Oval	2.5	1.8	0.7	Piled *'a'ā* and *pāhoehoe* cobbles
76	Mound	Oval	2.6	1.8	0.6	Piled *'a'ā* cobbles on soil
77	Mound	Linear	2.9	1.3	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
78	Mound	Oval	2.8	1.4	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
79	Mound	Linear	4.7	1.9	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
80	Mound	Circular	2.1	2.1	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
81	Mound	Oval	2.2	1.6	0.4	Piled *'a'ā* and *pāhoehoe* cobbles on soil
82	Mound	Oval	4.2	1.8	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
83	Mound	Irregular	3.4	1.5	0.7	Piled *'a'ā* and *pāhoehoe* cobbles on soil
84	Modified outcrop	Circular	2.4	2.4	0.8	Piled *'a'ā* and *pāhoehoe* cobbles
85	Modified outcrop	Irregular	5.5	3.2	1.3	Piled/stacked *pāhoehoe* cobbles on outcrop
86	Mound	Circular	2.0	2.0	0.8	Piled *'a'ā* cobbles on *'a'ā* outcrop
87	Enclosure	Circular	3.2	3.2	1.1	Piled *'a'ā* cobbles on steep slope; opens west
88	Mound	Oval	2.6	2.1	0.9	Piled *'a'ā* cobbles on soil
89	Mound	Oval	2.6	1.6	1.0	Piled *'a'ā* cobbles on soil
90	Mound	Linear	3.8	1.7	0.8	Piled *'a'ā* cobbles on soil
91	Mound	Circular	1.4	1.4	0.6	Piled *'a'ā* cobbles on soil
92	Mound	Circular	1.8	1.8	0.8	Piled *'a'ā* cobbles on soil
93	Mound	Circular	1.4	1.4	0.7	Piled *pāhoehoe* cobbles on soil
94	Mound	Circular	1.7	1.7	0.6	Piled *pāhoehoe* cobbles on soil
95	Mound	Linear	2.3	1.3	0.7	Piled *'a'ā* cobbles on soil
96	Mound	Oval	2.5	1.6	0.7	Piled *'a'ā* cobbles on soil
97	Mound	Linear	3.2	1.5	1.0	Piled *'a'ā* cobbles on soil
98	Mound	Oval	2.9	1.0	0.6	Piled *'a'ā* cobbles on soil
99	Mound	Circular	1.5	1.5	0.5	Piled *'a'ā* cobbles on soil
100	Mound	Circular	3.3	3.3	0.7	Piled *'a'ā* cobbles on soil
101	Mound	Crescent	3.1	1.8	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
102	Mound	Oval	3.8	2.9	1.0	Piled *'a'ā* cobbles
103	Mound	Circular	1.8	1.8	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
104	Mound	Circular	2.0	2.0	0.7	Piled *'a'ā* and *pāhoehoe* cobbles on soil
105	Mound	Circular	1.8	1.8	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
106	Mound	Oval	1.8	1.5	0.4	Piled *'a'ā* and *pāhoehoe* cobbles on soil
107	Mound	Oval	2.5	2.5	0.8	Piled *'a'ā* and *pāhoehoe* cobbles on soil
108	Mound	Linear	2.6	1.4	0.5	Piled *'a'ā* and *pāhoehoe* cobbles on soil
109	Mound	Circular	1.6	1.6	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
110	Mound	Circular	1.8	1.8	0.6	Piled *'a'ā* and *pāhoehoe* cobbles on soil
111	Mound	Circular	1.7	1.7	0.4	Piled *'a'ā* and *pāhoehoe* cobbles on soil
112	Mound	Oval	1.8	1.3	0.4	Piled *'a'ā* and *pāhoehoe* cobbles on soil
113	Mound	Oval	2.5	1.5	0.7	Piled *'a'ā* cobbles on soil
114	Mound	Circular	1.8	1.8	0.5	Piled *'a'ā* cobbles on soil
115	Mound	Circular	1.5	1.5	0.5	Piled *'a'ā* cobbles on soil
116	Mound	Circular	2.1	2.1	0.5	Piled *'a'ā* cobbles
117	Mound	Circular	1.8	1.8	0.5	Piled *'a'ā* cobbles on soil
118	Mound	Circular	1.1	1.1	0.4	Piled *'a'ā* cobbles on soil
119	Mound	Circular	1.9	1.9	0.4	Piled *'a'ā* cobbles on soil
120	Mound	Oval	1.8	1.3	0.6	Piled *'a'ā* cobbles on soil
121	Mound	Circular	1.3	1.3	0.6	Piled *'a'ā* cobbles on soil
122	Mound	Circular	2.1	1.5	0.3	Piled *'a'ā* cobbles on soil
123	Mound	Circular	2.1	2.1	0.4	Piled *'a'ā* cobbles on soil
124	Mound	Oval	2.5	1.6	0.6	Piled *'a'ā* cobbles on soil and on *'a'ā* outcrop
125	Mound	Crescent	5.1	2.0	1.2	Stacked *'a'ā* cobbles on bedrock
126	Mound	Linear	4.5	1.9	0.5	Piled *'a'ā* cobbles on soil; L-shaped
127	Mound	Oval	2.1	1.4	0.5	Piled *'a'ā* cobbles on soil
128	Mound	Oval	2.9	1.8	0.6	Piled *'a'ā* cobbles on soil
129	Mound	Linear	3.9	2.1	0.7	Piled *'a'ā* cobbles on soil
130	Mound	Circular	1.6	1.6	0.7	Piled *'a'ā* cobbles on soil
131	Mound	Oval	2.2	1.5	0.5	Piled *'a'ā* cobbles on soil

continued on next page

Table 5. Continued.

Feature #	*Feature Type*	*Shape*	*Length (m)*	*Width (m)*	*Height (m)*	*Attributes*
132	Mound	Circular	2.0	2.0	0.5	Piled *'a'ā* cobbles on soil
133	Mound	Oval	2.2	1.7	0.5	Piled *'a'ā* cobbles on soil
134	Mound	Circular	1.8	1.8	0.7	Piled *'a'ā* cobbles on soil
135	Mound	Circular	1.8	1.8	0.4	Piled *'a'ā* cobbles on soil
136	Mound	Circular	1.8	1.8	0.5	Piled *'a'ā* cobbles on soil
137	Mound	Oval	2.0	1.1	0.5	Piled *'a'ā* cobbles on soil
138	Mound	Linear	2.4	1.2	0.5	Piled *'a'ā* cobbles on soil
139	Mound	Circular	2.0	1.9	0.8	Piled *'a'ā* cobbles on soil
140	Mound	Circular	3.1	1.6	0.9	Piled *'a'ā* cobbles on soil
141	Mound	Circular	1.7	1.7	0.5	Piled *'a'ā* cobbles on soil
142	Mound	Circular	3.2	1.8	0.6	Piled *'a'ā* cobbles on soil
143	Mound	Oval	3.2	1.9	0.8	Piled *'a'ā* cobbles on soil
144	Mound	Circular	1.7	1.4	0.4	Piled *'a'ā* cobbles on soil
145	Mound	Circular	1.7	1.7	0.5	Piled *'a'ā* cobbles on soil
146	Mound	Circular	1.8	1.6	0.4	Piled *'a'ā* cobbles on soil
147	Mound	Circular	3.1	2.0	0.8	Piled *'a'ā* cobbles on soil
148	Mound	Circular	1.6	1.6	0.5	Piled *'a'ā* cobbles on soil
149	Mound	Circular	3.3	3.2	0.8	Piled *'a'ā* cobbles
150	Mound	Oval	1.8	1.7	0.4	Piled *'a'ā* cobbles
151	Mound	Circular	1.4	1.2	0.6	Piled *'a'ā* cobbles
152	Mound	Circular	1.8	1.8	0.5	Piled *'a'ā* cobbles
153	Terrace	Linear	8.0	0.7	1.1	Stacked *'a'ā* cobbles, 3 courses high
154	Mound	Circular	1.3	1.2	0.3	Piled *'a'ā* cobbles
155	Mound	Circular	1.9	1.9	0.7	Piled *'a'ā* cobbles
156	Mound	Circular	1.1	1.1	0.2	Piled *'a'ā* cobbles
157	Enclosure	C-shape	4.8	3.6	0.6	Piled *'a'ā* cobbles; opening to west
158	Mound	Circular	1.9	1.9	0.4	Piled *'a'ā* cobbles
159	Mound	Oval	2.7	1.8	0.9	Piled *'a'ā* cobbles
160	Mound	Oval	3.7	1.8	1.1	Piled *'a'ā* cobbles
161	Mound	Circular	1.2	1.2	0.3	Piled *'a'ā* cobbles
162	Mound	Circular	1.3	1.3	0.4	Piled *'a'ā* cobbles
163	Mound	Circular	1.0	1.0	0.4	Piled *'a'ā* cobbles
164	Enclosure	Irregular	8.0	7.0	0.7	Piled *'a'ā* cobbles
165	Enclosure	Crescent	5.0	4.0	0.5	Stacked *'a'ā* cobbles
166	Mound	Linear	4.5	1.4	1.0	Piled *'a'ā* cobbles on *'a'ā*; opening to NW
167	Mound	Circular	1.6	1.6	0.7	Piled and stacked *pāhoehoe* cobbles
168	Mound	Oval	1.7	1.2	0.3	Piled *pāhoehoe* cobbles
169	Mound	Oval	2.2	1.2	0.4	Piled *pāhoehoe* cobbles on bedrock, near soil
170	Mound	Oval	1.8	1.3	0.4	Piled *'a'ā* cobbles on soil
171	Mound	Circular	1.3	1.3	0.4	Piled *'a'ā* cobbles on soil
172	Mound	Circular	1.6	1.6	0.3	Piled *'a'ā* cobbles on soil
173	Mound	Oval	1.2	1.0	0.3	Piled *'a'ā* cobbles on soil
174	Mound	Oval	1.4	1.2	0.4	Piled *'a'ā* cobbles on soil
175	Mound	Square	2.3	1.6	1.0	Stacked *'a'ā* cobbles on bedrock
176	Mound	Circular	1.2	1.2	0.7	Piled *'a'ā* cobbles on soil
177	Mound	Circular	1.0	1.0	0.4	Piled *'a'ā* cobbles on soil
178	Mound	Circular	1.8	1.8	0.4	Piled *'a'ā* cobbles on soil
179	Mound	Circular	1.7	1.7	0.4	Piled *'a'ā* cobbles on soil
180	Mound	Circular	1.3	1.3	0.4	Piled *'a'ā* cobbles on soil
181	Mound	Circular	1.1	1.1	0.7	Piled *'a'ā* cobbles on soil
182	Mound	Oval	1.1	0.9	0.5	Piled *'a'ā* cobbles on soil
183	Mound	Circular	1.7	1.7	0.6	Piled *pāhoehoe* cobbles on bedrock, near soil
184	Mound	Oval	2.9	1.6	0.6	Piled *pāhoehoe* cobbles on bedrock
185	Mound	Irregular	2.4	1.8	0.3	Piled *'a'ā* cobbles on soil
186	Mound	Crescent	3.3	1.9	0.4	Piled *'a'ā* cobbles on soil
187	Mound	Oval	2.0	1.4	0.4	Piled *'a'ā* cobbles on soil
188	Mound	Circular	1.6	1.2	0.3	Piled *'a'ā* cobbles on soil
189	Mound	Oval	2.4	1.8	0.2	Piled *'a'ā* cobbles on soil
190	Mound	Circular	1.2	1.2	0.3	Piled *'a'ā* cobbles on soil
191	Mound	Circular	1.6	1.6	0.3	Piled *'a'ā* cobbles on soil
192	Mound	Oval	2.0	1.5	0.3	Piled *'a'ā* cobbles on soil
193	Mound	Circular	1.7	1.5	0.4	Piled *'a'ā* cobbles on soil
194	Mound	Circular	1.5	1.5	0.4	Piled *'a'ā* cobbles on soil
195	Mound	Linear	2.4	1.2	0.5	Piled *'a'ā* cobbles on soil
196	Mound	Irregular	2.1	1.4	0.5	Piled *'a'ā* cobbles on soil
197	Mound	Circular	2.2	2.1	0.8	Piled *'a'ā* cobbles on soil

continued on next page

Table 5. Continued.

Feature #	*Feature Type*	*Shape*	*Length (m)*	*Width (m)*	*Height (m)*	*Attributes*
198	Mound	Circular	2.4	2.2	0.6	Piled *'a'ā* cobbles on soil
199	Mound	Oval	2.0	1.2	0.7	Piled *'a'ā* cobbles on soil
200	Mound	Linear	2.9	1.2	0.3	Piled *'a'ā* cobbles on soil
201	Mound	Oval	1.7	1.0	0.4	Piled *'a'ā* cobbles on soil
202	Mound	Oval	1.5	1.3	0.4	Piled *'a'ā* cobbles on soil
203	Mound	Circular	1.4	1.4	0.4	Piled *'a'ā* cobbles on soil
204	Mound	Irregular	1.9	1.6	0.5	Piled *'a'ā* cobbles on soil
205	Mound	Circular	1.1	1.1	0.2	Piled *'a'ā* cobbles on soil
206	Mound	Oval	1.8	1.3	0.4	Piled *'a'ā* cobbles on soil
207	Mound	Circular	1.2	1.2	0.4	Piled *'a'ā* cobbles on soil
208	Mound	Circular	1.0	1.0	0.3	Piled *'a'ā* cobbles on soil
209	Mound	Circular	1.1	1.0	0.4	Piled *'a'ā* cobbles on soil
210	Mound	Circular	1.8	1.8	0.6	Piled *'a'ā* cobbles on soil
211	Mound	Irregular	1.4	1.0	0.3	Piled *'a'ā* cobbles on bedrock, near soil
212	Mound	Circular	1.4	1.2	0.4	Piled *'a'ā* cobbles on bedrock, near soil
213	Mound	Oval	1.6	0.9	0.2	Piled *'a'ā* cobbles on bedrock, near soil
214	Mound	Circular	1.2	1.0	0.4	Piled *'a'ā* cobbles on bedrock, near soil
215	Mound	Oval	1.4	1.0	0.4	Piled, roughly stacked *'a'ā* cobbles
216	Mound	Circular	1.4	1.1	0.7	Piled, roughly stacked *'a'ā* cobbles
217	Mound	Linear	4.4	1.4	0.6	Piled *'a'ā* cobbles on soil
218	Mound	Circular	1.9	1.9	0.7	Piled *'a'ā* cobbles on soil
219	Mound	Circular	1.0	1.0	0.4	Piled *'a'ā* cobbles on soil
220	Mound	Circular	1.2	1.2	0.5	Piled *'a'ā* cobbles on soil
221	Mound	Oval	2.1	1.3	0.4	Piled *'a'ā* cobbles on soil
222	Mound	Oval	2.6	2.2	0.8	Piled *'a'ā* cobbles on soil
223	Mound	Oval	1.7	1.1	0.4	Piled *'a'ā* cobbles on soil
224	Mound	Oval	3.3	1.9	0.6	Piled *'a'ā* cobbles on soil
225	Mound	Circular	1.6	1.6	0.5	Piled *'a'ā* cobbles on soil
226	Modified outcrop	Oval	8.0	6.0	1.2	Piled *pāhoehoe* cobbles on soil
227	Enclosure	Square	4.7	4.3	0.6	Piled, roughly stacked *'a'ā* cobbles
228	Modified outcrop	Circular	4.5	4.2	1.1	Piled, roughly stacked *'a'ā* cobbles on bedrock
229	Enclosure	Rectangular	6.5	3.1	0.6	Piled *'a'ā* cobbles on bedrock
230	Modified outcrop	Square	4.0	4.0	1.0	Piled *'a'ā* cobbles on bedrock
231	Modified outcrop	Irregular	5.0	2.5	1.7	Piled *'a'ā* cobbles on bedrock
232	Modified outcrop	Square	3.9	4.1	0.9	Piled, roughly stacked *'a'ā* cobbles on bedrock
233	Pavement	Rectangular	8.0	6.0	0.2	Piled *pāhoehoe* cobbles on bedrock
234	Terrace	L-shaped	5.0	4.0	0.7	Piled, roughly stacked *'a'ā* cobbles on bedrock

End of table

Within Site 14342, 207 features were designated as mounds (see Table 5). Of these, 204 can be characterized as informal, being constructed of piled *'a'ā* and/or *pāhoehoe* cobbles, with little or no definitive shape. The remaining three mounds show more deliberate piled construction with some stacking. The mounds are constructed on varied terrain. Some are in areas with thin soil deposits and others on bedrock. These stone collections could be interpreted either as clearing or planting features, but the majority recorded within the project area, because of their small size and informal construction, appear to have been used for the cultivation of sweet potato (Orr 2003).

Modified outcrops range from small piles of cobbles and boulders on (or supported by) a naturally occurring bedrock outcrop, to more elaborate additions, which are purposefully stacked. Of the thirteen features designated as modified outcrops at Site 14342, ten are informal piles of stone on bedrock (see Table 5). The remaining three exhibit both piling and stacking. Modified outcrops, like mounds, could be interpreted either as clearing or planting features, but the majority recorded within the project area, because of their small size and informal construction, appear to have been used for the cultivation of sweet potato.

A 1 x 1 meter test unit (TU-19) was excavated within the northeast portion of Feature 85 (Figure 17), a modified outcrop in the north central portion of Site 14342 (see Figure 16). Feature 85 is an irregularly shaped modified outcrop constructed of piled (perhaps formerly stacked) *pāhoehoe* cobbles around two small lava blister openings. It measures 5.5 meters long by 3.2 meters wide and stands up to 1.3 meters high. Excavation of TU-19 revealed an architectural layer (Layer I) of small to large sized *pāhoehoe* and *'a'ā* cobbles resting on bedrock. A small amount of soil had collected in the voids and was screened separately. Only a single *kukui* fragment was recovered from the screen, and appeared to be naturally occurring at the feature. Excavation of TU-19 terminated at bedrock (Figure 18).

TU-21 was excavated at Feature 228, another modified outcrop (Figure 19). Feature 228 is located in the south central portion of Site 14342 (see Figure 16). Feature 228 is circular with an enclosure-like appearance, but is constructed of piled and loosely stacked *'a'ā* cobbles on a natural outcrop (Figure 20). The circular edge is formed by three courses of *'a'ā* cobbles standing 1.1 meters high, with an interior diameter of 4.2-4.5 meters. The central area of Feature 228 consists of small *'a'ā* cobbles with one large *pāhoehoe* slab and exposed bedrock also present. Excavation of TU-21 revealed an architectural layer (Layer I) composed of *'a'ā* pebbles and cobbles on bedrock. A thin soil layer consisting of very dark brown (10YR 2/2) silt (Layer II) had accumulated at the base of Layer I and was screened separately. No cultural material of any kind was recovered from TU21.

Two remnant *kuaiwi* segments were identified within Site 14342 (Features 28 and 52; see Table 5). These segments are linear and run following the slope of the terrain (generally *mauka/makai*). In profile, these *kuaiwi*, although low-lying and cattle trodden, have a rounded or humped appearance. Feature 28 showed piled *'a'ā* construction, while Feature 52 exhibited signs of loosely stacked, but mostly piled,*pāhoehoe* construction.

An agricultural enclosure is a stone construction defining at least 75% of the perimeter of an interior space. Eight enclosures were identified within Site 14342 (see Table 5). These features show various types of construction (i.e. loosely stacked or piled) and differing shapes (i.e. square, rectangular, circular, irregular, etc.). All of the agricultural enclosures recorded as part of the current study are crudely constructed in opportunistic locations taking full advantage of natural landforms (i.e. bedrock outcrops, depressions, etc.). These features are thought to be agricultural planting areas, possibly used to keep pigs out while retaining soil and moisture. None of the eight identified enclosures were excavated, however these features will be tested during subsequent data recovery efforts.

Three terrace walls were identified at Site 14342 (Features 45, 153, and 230; see Table 5). A terrace wall is a linear or curvilinear stone construction built perpendicular to the natural slope of the terrain. Soil is sometimes placed, or more often naturally accumulated, on the upslope side of the terrace to form a level surface area possibly used for planting. Feature 45 is a terrace wall constructed of piled *pahoehoe* cobbles with a linear shape. Feature 153 is a linear terrace wall constructed of stacked *'a'ā* cobbles, and Feature 230 is an L-shaped terrace wall of loosely stacked *'a'ā* construction.

A pavement is a stone-surfaced area level with the surrounding ground surface on at least one side. One pavement was identified at Site 14342 (Feature 233; see Table 5). Feature 233 is a rectangular-shaped pavement 8.0 meters long by 6.0 meters wide with a height of 20 centimeters along its *makai* edge. It is constructed of *pahoehoe* cobbles on bedrock. Similar pavements have been tentatively identified as agricultural processing areas (Rechtman et al. 2001). This feature was not excavated; it will be more fully investigated during subsequent data recovery efforts.

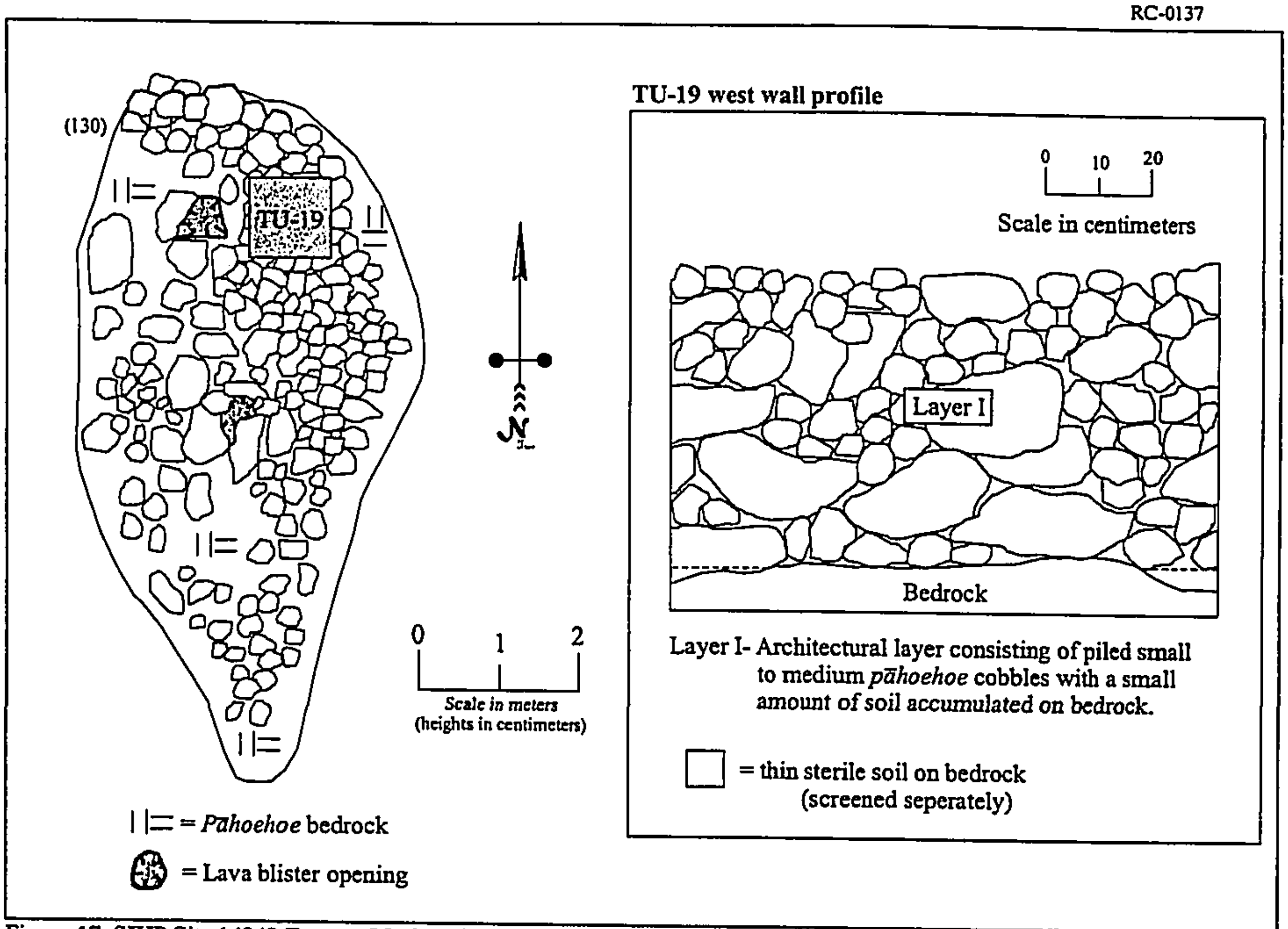


Figure 17. SIHP Site 14342 Feature 85 plan view and TU-19 profile.

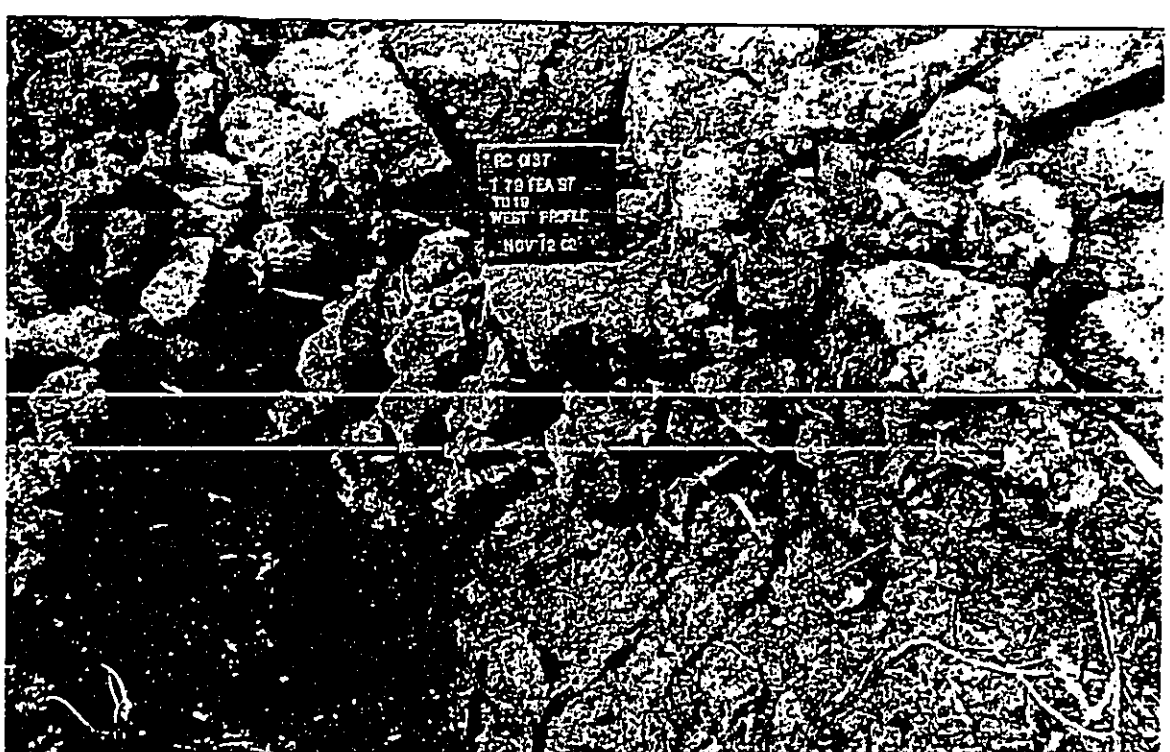


Figure 18. SIHP Site 14342 Feature 85 TU-19 west wall profile and base of excavation view to west.

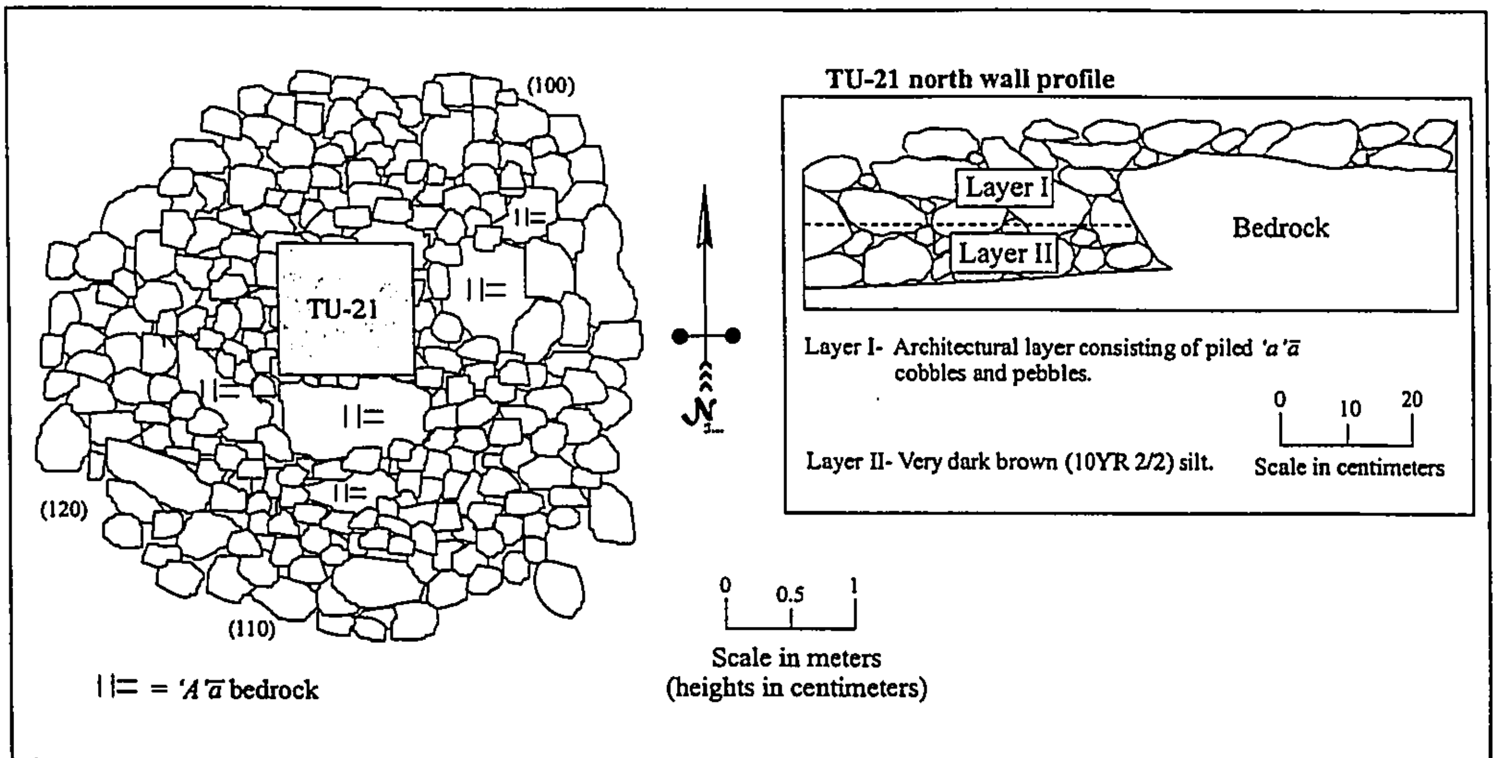


Figure 19. SIHP Site 14342 Feature 228 plan view and TU-21 profile.

Figure 20. Site 14342 Feature 228 view to south.

SIHP Site 14343

Site 14343 consists of a habitation terrace (Feature A) and mound (Feature B) located in the eastern portion of the project area north within the central area of the Y-intersection of the main access road (see Figure 5). Vegetation in the area consists of fountain grass, air plants, Christmas-berry, *koa haole*, and silver oak. Feature A is constructed on a level area at the top of a steep north facing slope with Feature B located 20 meters to its southwest. A 1 x 1 meter test unit (TU-20) excavated at Feature A produced cultural material consistent with a habitation function for the site. Based on the findings at TU-20, along with the formal attributes and minimalistic construction of Feature A (Cordy 1981, 1995), it is suggested the Site 14343 served a Precontact temporary habitation function. The size of Feature A (25 square meters), however, is consistent with a permanent habitation (Cordy 1981, 1995). The specific nature of the habitation at Site 14342 will be a focus of subsequent data recovery efforts.

Feature A

Feature A is a habitation terrace located 20 meters northeast of Feature B at the top of steep north facing slope. The feature, which is roughly square, measures 5.0 meters by 5.0 meters (Figure 21). It is constructed of stacked *pāhoehoe* and *a'ā* small-sized boulders, cobbles, and slabs on an *a'ā* lava flow. The east edge is not easily discernable because it is level with natural bedrock. The southern edge is lined with horizontal *pāhoehoe* slabs that rise 27 centimeters above ground surface. There is a possible entrance located at the very west end of the southern edge that is lined with one course of *a'ā* cobbles. The western and northern edges are stacked up to 1.8 meters high with *a'ā* boulders; the top course of each edge consists of *pāhoehoe* slabs at the terrace's surface. The western wall is relatively intact (Figure 22), but the northern wall is partially collapsed. The level surface of Feature A is paved with *pāhoehoe* and *a'ā* cobbles and *pāhoehoe* slabs (Figure 23). A 1 x 1 meter test unit (TU-10) was excavated in the southeastern portion of Feature A.

Excavation of TU-10 revealed a two-layer stratigraphic profile (see Figure 21). Layer I, the architectural layer, consisted of *a'ā* pebbles and small- to medium-sized cobbles mixed with cultural material including marine shell, volcanic glass, and *kukui* (Table 6). Layer I extended to a depth of 80 centimeters below the unit's surface. Layer II consisted of very dark brown (10 YR 2/2) fine silt with organics and cobble inclusions that started at 80 centimeters and terminated at 110 centimeters below the unit's surface. Excavation of TU-10 terminated at bedrock 110 centimeters below the unit's surface (Figure 24).

Table 6. Recovered cultural material from SIHP Site 14343 TU-10.

ACC#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
84	I	Volcanic glass	Flake	3		2.2
85	I	Shell	*Cypraea*	11	1	8.2
86	I	Shell	*Babylonia*	1	1	0.5
87	I	Shell	*Brachidontes*	1	1	0.1
88	I	Organic	*kukui*	4	1	0.3
89	I	Organic	Charcoal	-	-	0.1
90	II	Volcanic glass	Utilized Flake	1	-	1.2
91	II	Volcanic glass	Flake	2	-	1.7
92	II	Shell	*Cypraea*	3	1	1.4
93	II	Organic	Charcoal	5	-	0.4

Feature B

Feature B is a mound of piled *pāhoehoe* slabs built on top of an elevated, decomposing *pāhoehoe* flow (Figure 25). The mound measures 1.9 meters (east/west) by 1.2 meters (north/south) and is 56 centimeters high. It is located 20 meters to the west of Feature A. Feature B may be the remains of a collapsed cairn (*ahu*) that has the appearance of a mound.

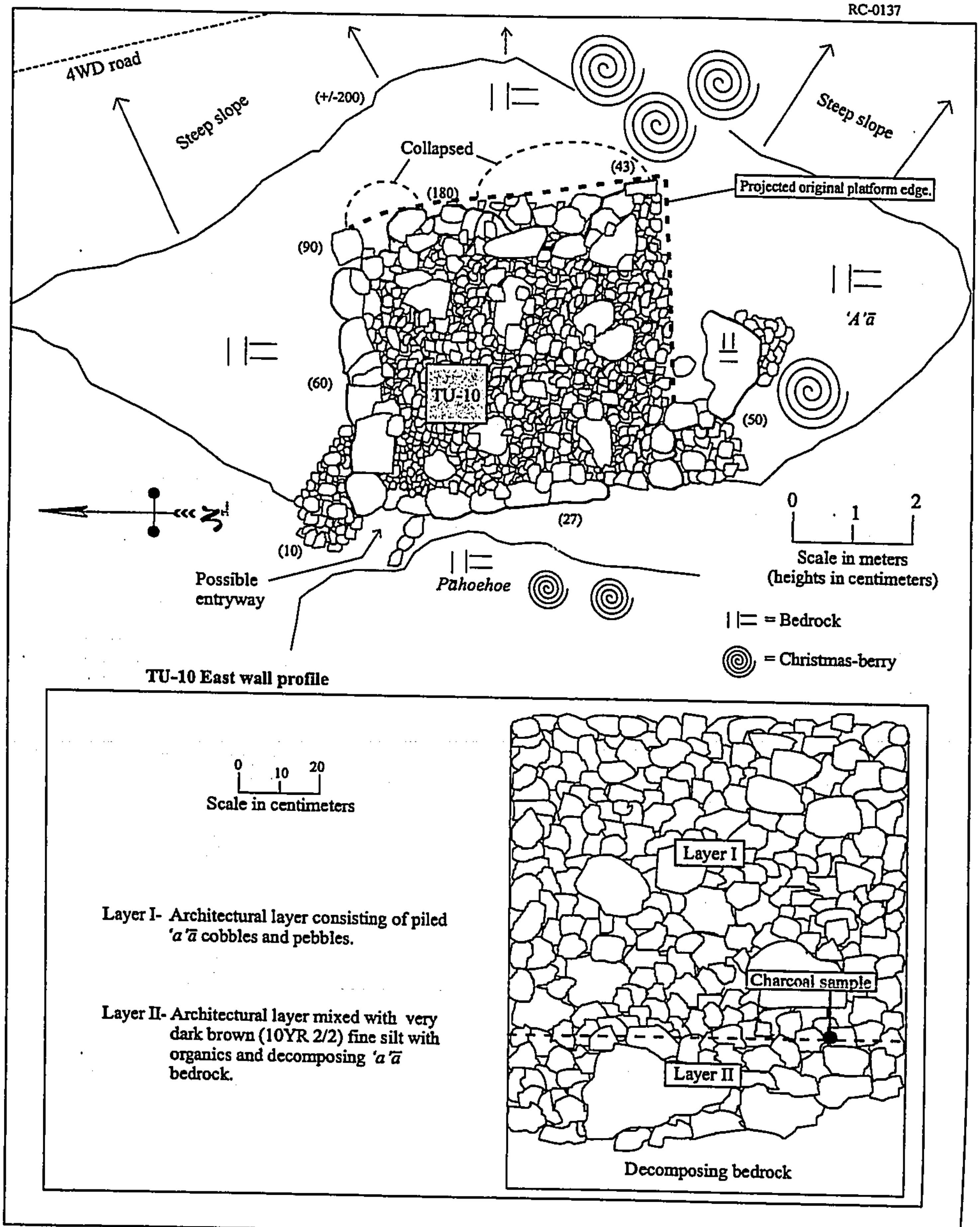


Figure 21. SIHP Site 14343 plan view and TU-10 profile.

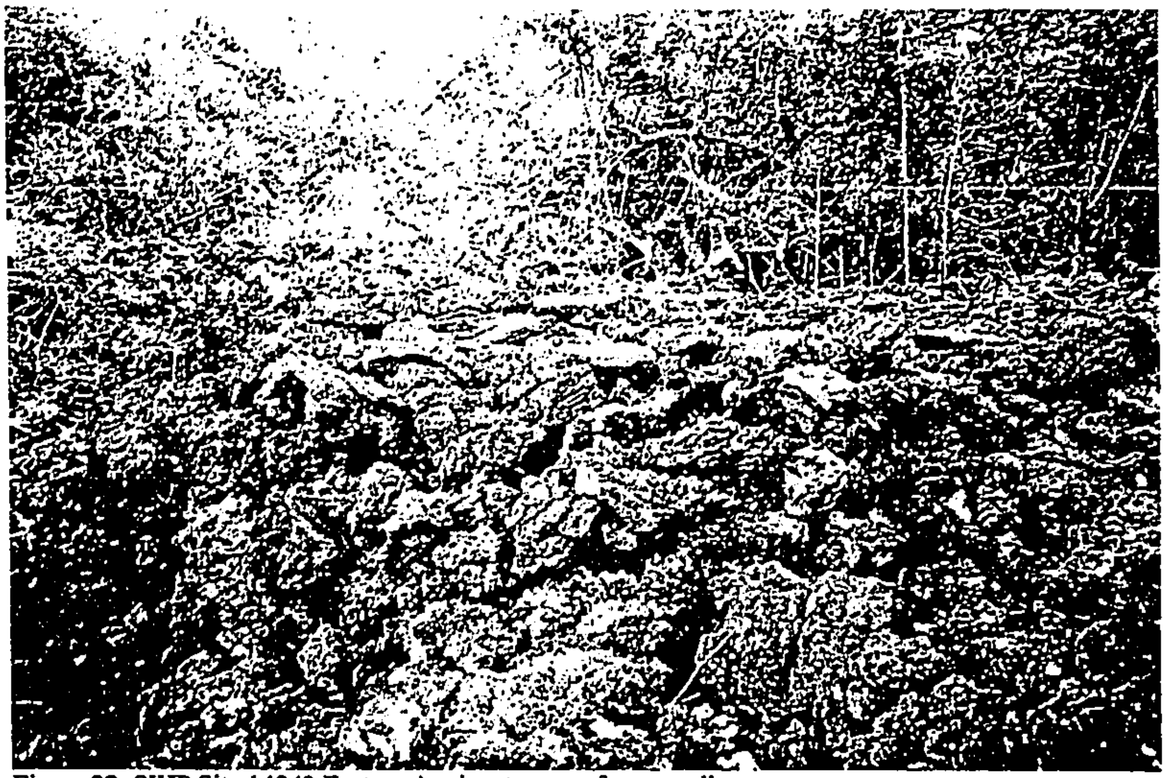


Figure 22. SIHP Site 14343 Feature A, view to east of west wall.

Figure 23. SIHP Site 14343 Feature A surface, view to west.

Figure 24. SIHP Site 14343 Feature A TU-10 base of excavation.

Figure 25. SIHP Site 14343 Feature B, view to east.

SIHP Site 14344

Site 14344 is a very rough 3-sided enclosure located in the east central portion of the project area (see Figure 5). The enclosure is roughly square (3.0 meters by 3.0 meters) and opens to the west. It is constructed on an *'a'ā* flow with its open end abutting a *pāhoehoe* bedrock outcrop (Figure 26). The walls of the enclosure consist of piled *'a'ā* cobbles standing up to 40 centimeters high and 70 centimeters wide. The interior area is roughly paved small *'a'ā* cobbles, *'a'ā* slabs, and *pāhoehoe* slabs. Site 14344, based on its form, small size (Cordy 1981, 1995), and minimal construction, most likely functioned as a Precontact temporary habitation.

Figure 26. SIHP Site 14344, view to southwest.

SIHP Site 14345

Site 14345 is a C-shaped enclosure opening to the southeast located in the east central portion of the project area (see Figure 5). The feature is constructed of *'a'ā* cobbles and slabs on an *'a'ā* flow (the same flow as Site 14344). It measures 1.6 meters long by 1.3 meters wide (Figure 27). The interior edges are lined with upright *'a'ā* slabs with cobbles supporting them along the exterior edges (Figure 28). The interior ground surface is paved with *'a'ā* pebbles. The enclosure's open end (to the south and east) abuts a *pāhoehoe* bedrock outcrop. Site 14345, based on its form, small size, and minimal construction (Cordy 1981, 1995), likely served a Precontact temporary habitation function. Another possible interpretation, since the C-shape opens to the southeast (not to the west as most of the C-shaped enclosures within the study area) is that the feature functioned as a hunting blind. Further data recovery efforts at Site 14345 will help shed light on this subject.

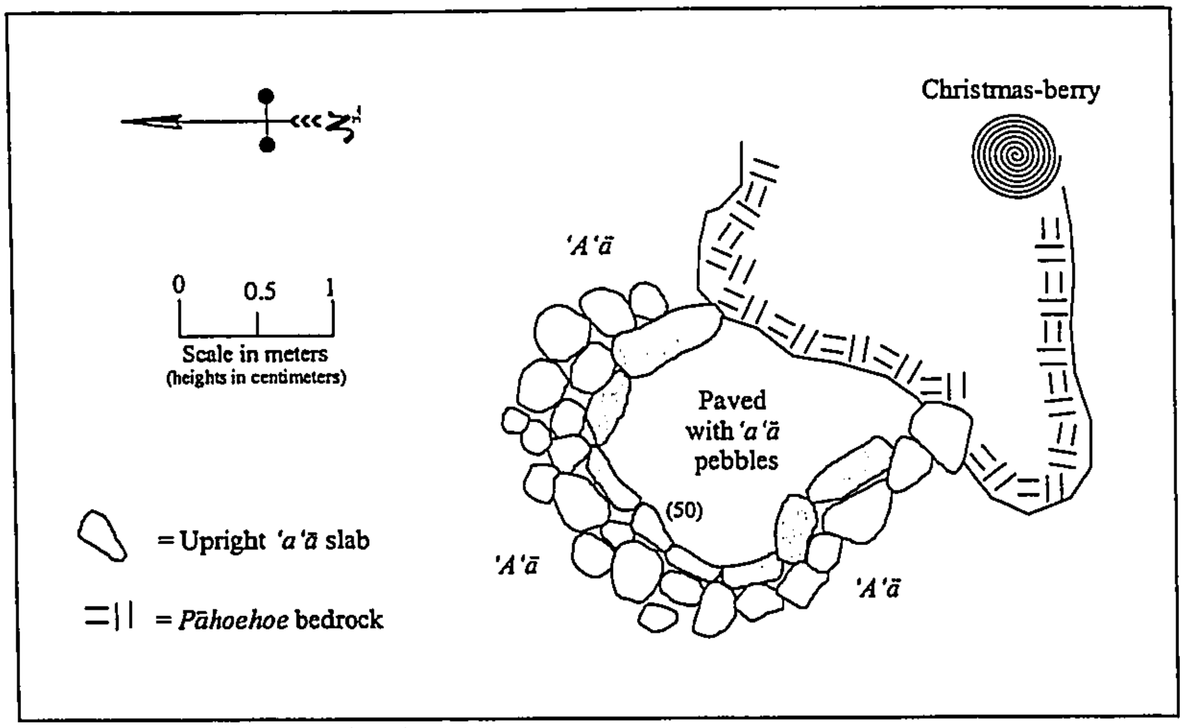


Figure 27. SIHP Site 14345 plan view.

Figure 28. SIHP Site 14345 view to south.

SIHP Site 14346

Site 14346 is a lava tube habitation located north of the main access road in the eastern half of the project area (see Figure 5). It is part of the same tube system that contains Site 14350 approximately 90 meters to the west. Site 14346 is accessed through a *pāhoehoe* bedrock sink (6.5 meters by 5.0 meters by 2.0 meters deep) that is filled with rubble. Two slabs, possibly utilized as a stepped entrance (Figure 29), descend the south edge of the sink from the direction of Site 23898 (Figure 30). The entrance is located at the west end of the sink and has been partially blocked off by a *pāhoehoe* cobble and slab wall (1.5 meters high by 2.5m long) (Figure 31). To the west of the wall is a terraced area (2.0 meters square) with flat slabs stacked along its *makai* edge (65 centimeters high) and paved with small *pāhoehoe* cobbles (Figure 32). A second terraced paved area (2.3 meters long by 1.7 meters wide by 70 centimeters high), similar to the first, is located 2.0 meters *makai* (down slope) of the other (Figure 33). Beyond this, on the tube floor, is a cleared area with a rough bedrock surface that was possibly utilized for daily living purposes. *Kukui* fragments were observed near the second terraced area.

Site 14346 was certainly used for habitation purposes, perhaps beginning in Precontact times, but its use may have continued into Historic times. It is also possible that habitation of Site 14386 began in Historic times. The closest feature to Site 14346 is a three sided core-filled wall enclosure with historic artifacts present (Site 23898); see description below). Site 23898 is located just south of the sink area, the direction from which the stepped entryway leads into the tube. Site 14350, within the same tube system, also contains historic artifacts (see below). The wall at the entrance to the tube is of very fragile construction and does not appear to have stood the test of time (see Figure 31), further suggesting a possible recent (historic) construction. Temporal associations will be a focus of future data recovery efforts at this site.

Figure 29. SIHP Site 14346 tube entrance and stepped entryway (to left of entrance), view to southwest.

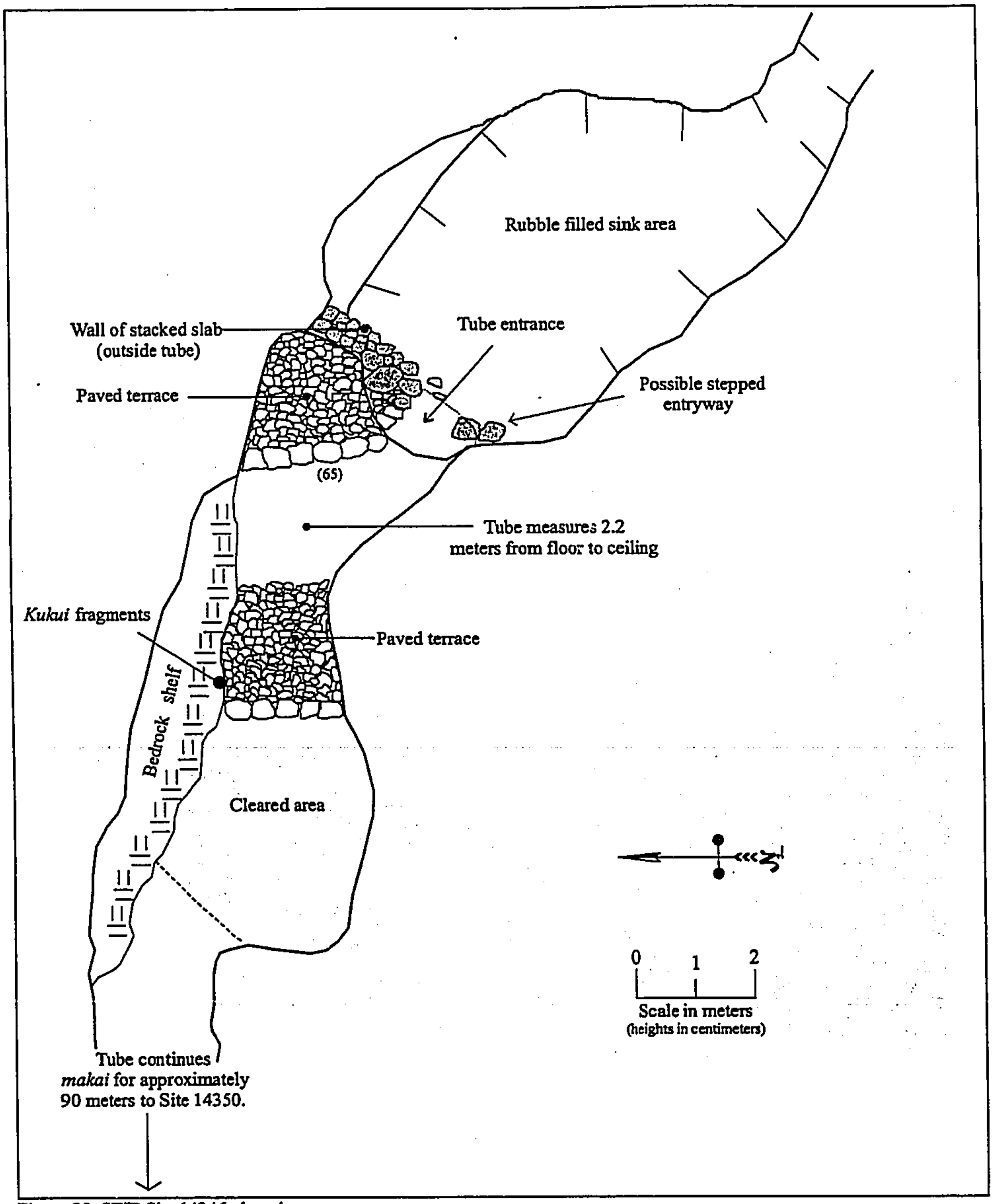


Figure 30. SIHP Site 14346 plan view.

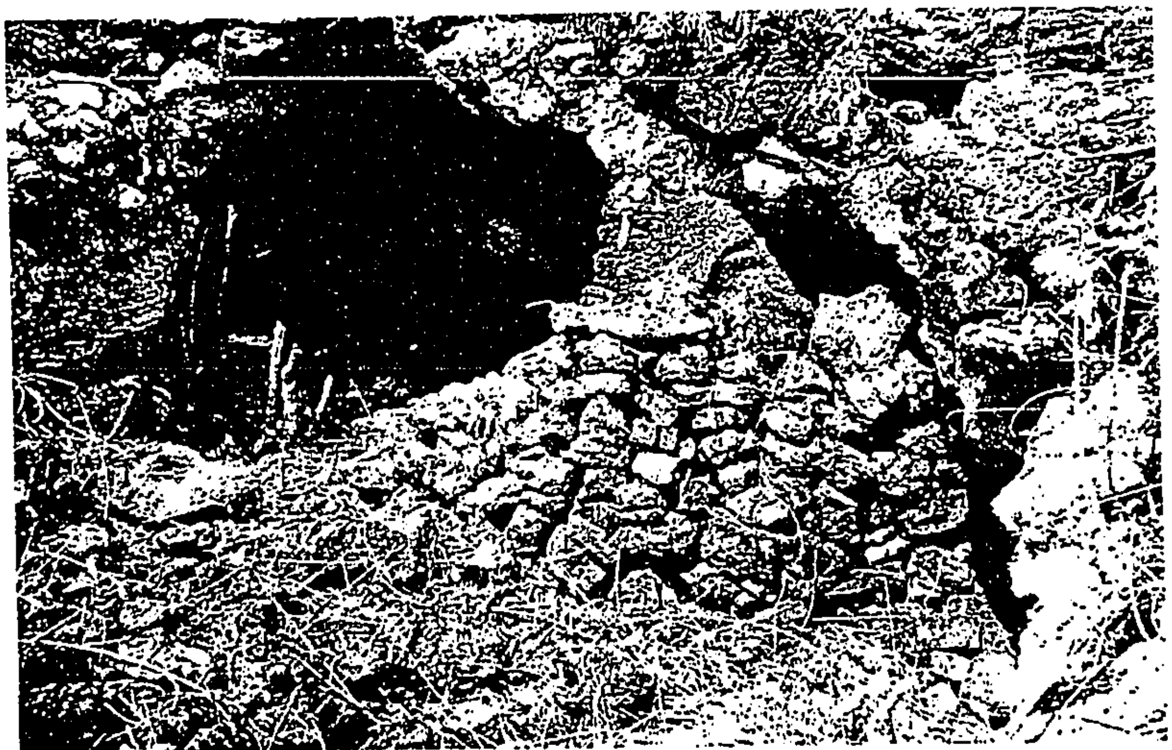


Figure 31. SIHP Site 14346 view to west of wall at the tube entrance.

Figure 32. SIHP Site 14346 interior view to east of upper terrace.


Figure 33. SIHP Site 14346 interior view to east of lower terrace.

SIHP Site 14347

Site 14347 is a small temporary habitation enclosure located in the east central portion of the project area (see Figure 5). The enclosure, which measures 3.8 meters long by 3.3 meters wide, is built on an *'a'ā* flow (Figure 34). The enclosure's walls stand up to 50 centimeters high and 1.0 meter wide. They are constructed, where not collapsed, with vertical *pāhoehoe* slabs placed along the interior edges and *'a'ā* cobbles filling the space behind (Figure 35). A possible entryway is located in the enclosure's northwest corner. The interior floor of the feature is roughly paved with small *'a'ā* cobbles and *pāhoehoe* slabs. Site 14347, based on its form and small size (Cordy 1981, 1995), likely served a Precontact temporary habitation function.

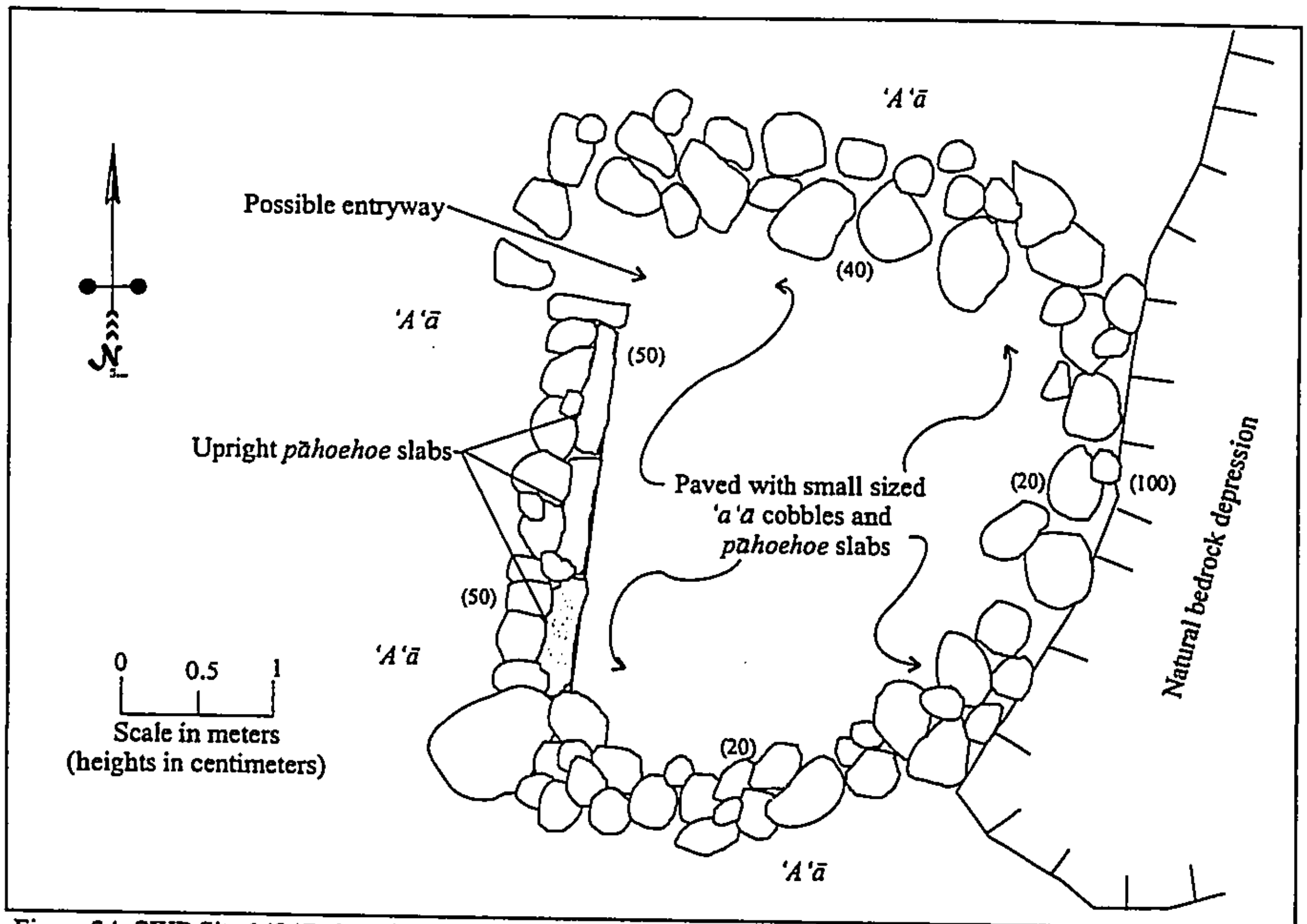


Figure 34. SIHP Site 14347 plan view.

Figure 35. SIHP Site 14347 view to south.

SIHP Site 14348

Site 14348 is an *'a'ā* cobble alignment located in the east central portion of the project area (see Figure 5). The alignment measures 7.5 meters long by 0.6 meters wide by 50 centimeters high (Figure 36). It runs at 20/200° and is constructed of piled *'a'ā* cobbles. This site was originally recorded by Ogden (Schliz 1990) as a linear mound serving an agricultural function that had additional features (mounds) nearby. The additional features, despite intensive survey, could not be relocated during the current study. Since the agricultural function for Site 14348 has already been accepted by DLNR-SHPD, and since no better explanation can be offered for the site, this interpretation is retained for the current study. One possible alternative explanation is that the alignment marks the edge of a trail route, but no such route could be identified in the field.

Figure 36. SIHP Site 14348, view to north.

SIHP Site 14349

Site 14349 is a single mound constructed of piled *pāhoehoe* cobbles located in the eastern portion of the project area near the northern property boundary (see Figure 5). The mound is built on *pāhoehoe* bedrock and no others are located in the vicinity. It measures 1.6 meters in diameter and stands up to 64 centimeters above ground surface (Figure 37). It is located near a small blister opening, but no cultural modifications or remains were found within. Site 14349 may represent a large (collapsed?) cairn (*ahu*) perhaps marking the route of one of the trails located in its vicinity (Site 14357 or Site 23890), but no trail could be traced across the bedrock ground surface.

Figure 37. SIHP Site 14349, view to northwest.

SIHP Site 14350

Site 14350 is a lava tube habitation located in the eastern portion of the project area north of the main access road (see Figure 5). It is part of the same tube system that contains Site 14346 approximately 90 meters to the east. The two sites are connected, although the passage is extremely difficult and narrow in places. Site 14350 is accessed through an opening in the *pāhoehoe* bedrock ground surface that measures 3.0 meters long by 2.0 meters wide by 2.3 meters deep (Figure 38). *Pāhoehoe* cobbles and slabs have been piled up along the north edge of the opening to allow for access (Figure 39). The tube passage goes both *mauka* and *makai* for considerable distances, but cultural debris is confined to a 10.0-meter by 6.0-meter area surrounding the opening. Cultural debris observed at the site includes pig (*Sus*) and cow bones, *Cypraea* shell fragments, coral, metal fragments, and a broken, white improved earthenware shallow bowl with a blue transfer Asian print and no maker's mark (Figure 40).

Both *mauka* and *makai* of the tube entrance, there are areas that were cleared of rubble where food remains and ash have collected, presumably from fires at these locations. The *mauka* area's clearing is 2.5 meters long by 2.0 meters wide, and the tube's ceiling height in this area is 1.5 meters high (Figure 41) The cleared area *makai* of the tube entrance measures 3.5 meters by 3.0 meters, with a ceiling height of 1.7 meters (Figure 42); this area is also covered in ash. The tube continues *makai* approximately 100.0 meters to a small opening, with no cultural debris observed. Site 14350 was certainly used for habitation purposes; the question is when the occupation of this lava tube began. It seems reasonable to suggest that Precontact peoples would have first utilized this easily accessible, even comfortable, tube for temporary habitation, and that the use of the site carried on into Historic times. Further data recovery efforts at Site 14350 will help shed light on this subject.

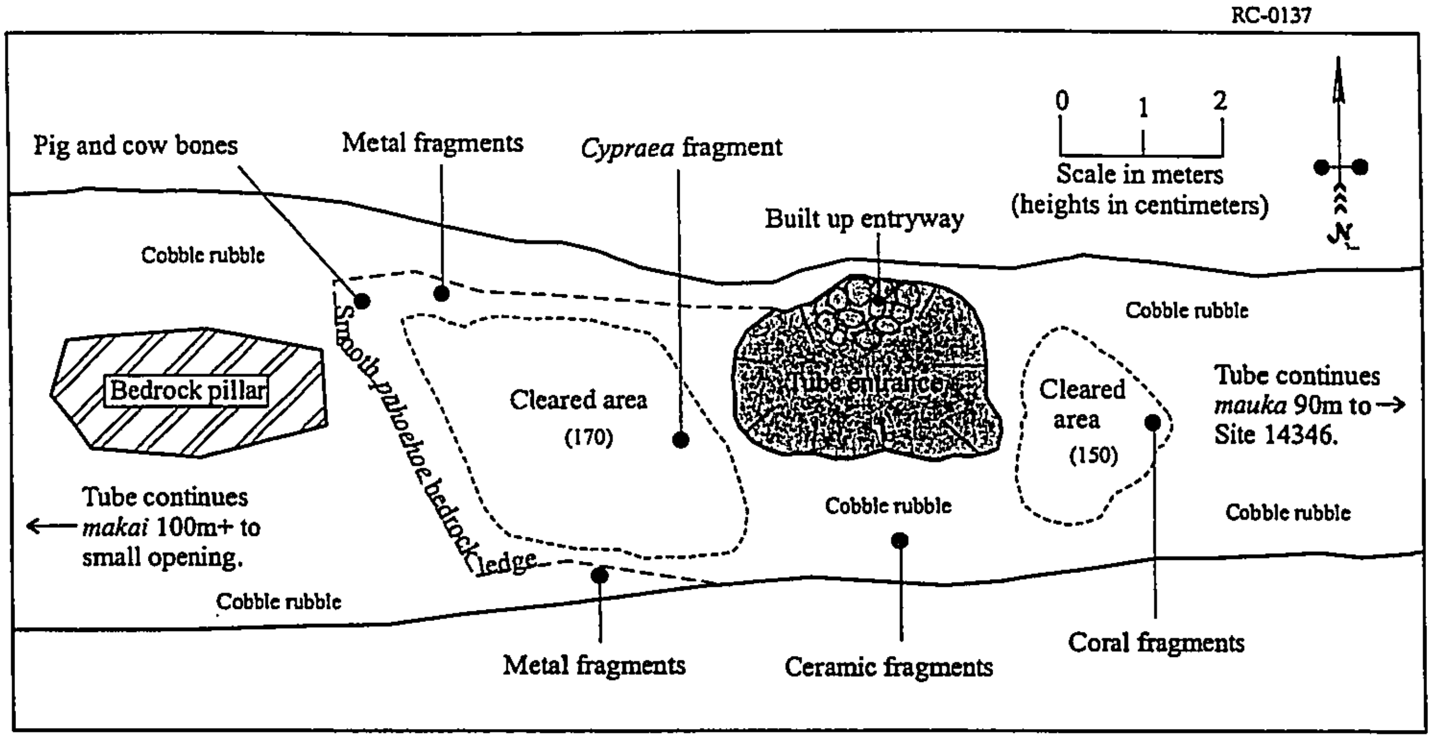


Figure 38. SIHP Site 14350 plan view.

Figure 39. SIHP Site 14350 tube entrance view to east (note piled cobbles and slabs used as entryway).

Figure 40. SIHP Site 14350 partially reconstructed shallow ceramic bowl overview.

Figure 41. SIHP Site 14350 *mauka* cleared area, view to east.

Figure 42. SIHP Site 14350 *makai* cleared area, view to west.

SIHP Site 14351

Site 14351 is a walled habitation/agricultural complex located in the southeastern portion of the project area (see Figure 5). Together these features represent a Precontact permanent habitation area with associated agricultural features. The complex consists of 9 features including an enclosing wall (Feature A), two terraces (Features B and D), two enclosures (Features C and H), a modified outcrop (Feature E), two small habitation tubes (Features F and G), and 12 agricultural features (Feature I). Three 1 x 1 meter test units were excavated at Features C, E, and H. Cultural remains recovered from these (with the exception of a single horseshoe discovered on the surface of Feature E) were consistent with a Precontact habitation function for the site. Two radiocarbon samples collected (Beta-17376, 17377) from this site (Features C and E) produced conventional radiocarbon ages of 210±60 B.P. and 230±70 B.P. respectively, with 2 Sigma calibrated results of A.D. 1460 to 1950 and intercepts of A.D. 1650–1660 (see Appendix A), further reinforcing the Precontact nature of this habitation area. Feature A (the enclosing wall) however, may have been a later addition to the site in early Historic time as grazing animals became more of a nuisance in the area (the presence of a horseshoe also points to later or continued use). Subsequent data recovery efforts will help further refine the temporal associations of the features within Site 14351. Feature B, the likely main habitation at the site is slated for preservation. All of the Features are discussed individually below and their locations are shown on Figure 43.

Feature A

Feature A is a collapsed wall that almost entirely encloses Site 14351 (see Figure 43). The wall is constructed of both *'a'ā* and *pāhoehoe* cobbles. It was formerly stacked (perhaps even core-filled), but is now nearly completely collapsed. The most intact sections of Feature A measure 1.0–1.5 meters wide and stand 0.5–0.8 meters high. The wall may have been constructed to keep pigs and/or cattle out of the habitation/agricultural areas of Site 14351. Feature A is not present in areas where natural barriers exist; such as near Feature B where a steep slope (facing generally to the west) would have proved an ample deterrent to animals, or near Feature D where a naturally occurring bedrock outcrop could accomplish the same purpose as the wall. Also, where Feature A crosses Feature G (a sinkhole), that feature would deter animals from entering the complex. Entry into the complex was most likely accomplished through one of two seemingly purposeful breaks in Feature A; one near Feature H and another near Feature D.

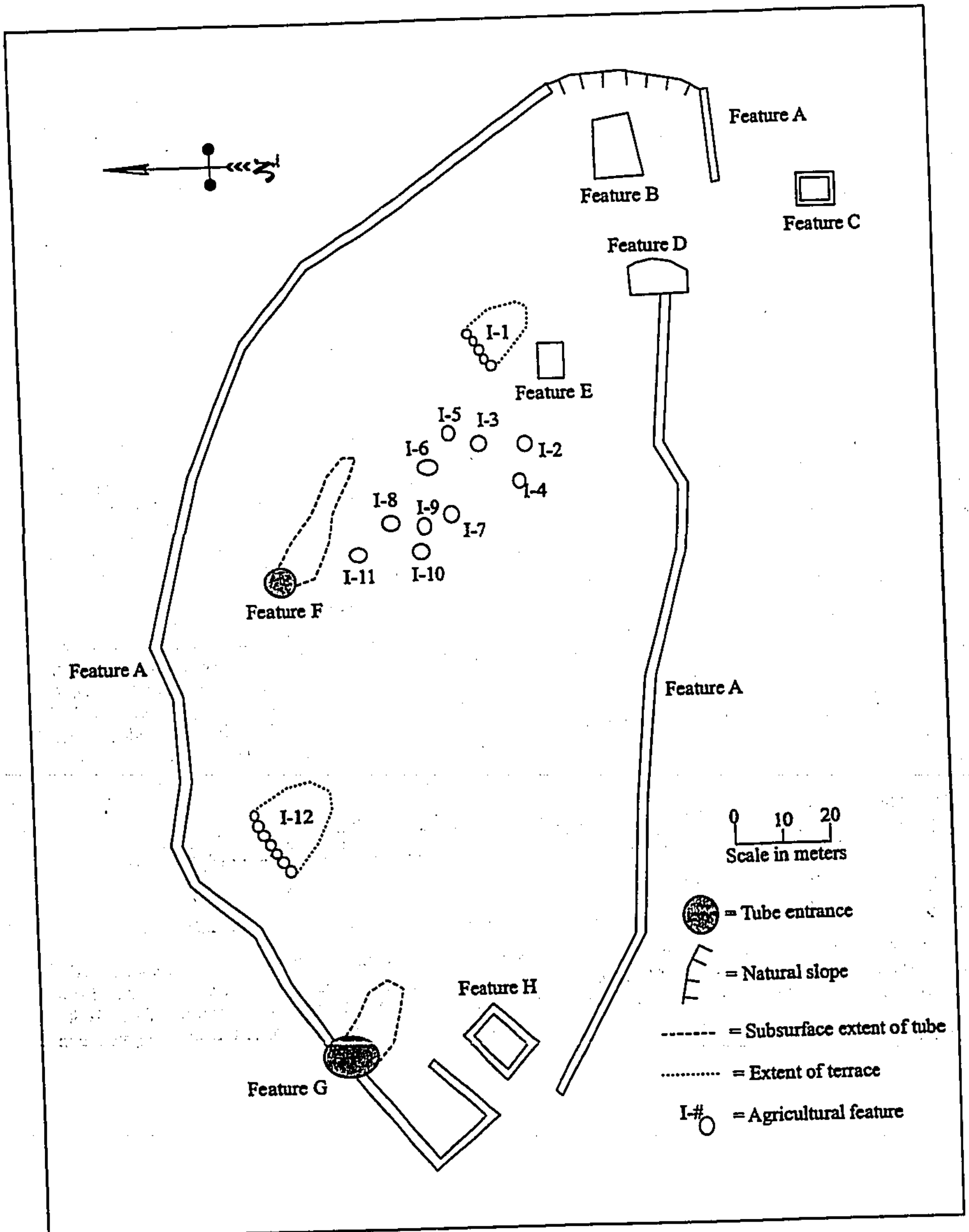


Figure 43. SIHP Site 14351 plan view.

Feature B

Feature B is a large terraced platform located at the extreme eastern end of Site 14351 (see Figure 43). The feature is constructed to the south against a steeply sloping (10 degree) *'a'ā* flow that also rings the feature to the east and north. A Christmas-berry tree is growing out of the center of the feature and a large *kukui* tree and a large *wiliwili* tree are present near its perimeter. Feature B measures 7.0 meters long (east/west) and 6.0 meters wide (north/south) (Figure 44). The exterior edges of the feature are constructed of neatly stacked *'a'ā* cobbles (Figure 45), while the level platform surface is paved with small *'a'ā* cobbles and pebbles. A large section of the north edge has collapsed, along with small sections of the west edge. The east side of the platform measures up to 1.5 meters high, the north up to 1.25 meters high, and the west side stands 1.0 meter high. The south edge has no height as it is level with the sloping bedrock ground surface. A possible internal division was noted in the northwest corner of the feature, as evidenced by an alignment of 3 *'a'ā* cobbles on the platform surface. A large *pāhoehoe* slab was discovered laid flat near the platform's southwest corner. No cultural material was observed on the surface of Feature B and it was not excavated as it is slated for preservation. Nevertheless, as the largest construction at Site 14351 representing the greatest time investment, Feature B likely served as the main habitation area and probably supported a roofed structure.

Feature C

Feature C is a square enclosure located outside of the enclosed area in the eastern portion of Site 14351 approximately 10 meters south of Feature A (see Figure 43). The enclosure has exterior dimensions of 4.7 meters long (east/west) by 4.4 meters (north/south) wide (Figure 46). The walls are constructed of small to medium sized *pāhoehoe* cobbles and have an average width of 80 centimeters (Figure 47). The north and south walls stand up to 60 centimeters high; the east wall, which is partially collapsed into the enclosure, 80 centimeters high; and the west wall 50 centimeters high. A possible entryway, marked by a wall break, was noted in the center of the west (*makai*) wall. One large *pāhoehoe* slab was observed laying flat in the interior near the entrance. A 1 x 1 meter test unit (TU-16) was excavated in the south central portion of Feature C.

Excavation of TU-16 revealed a two-layer stratigraphic profile (see Figure 46). Layer I consisted of an architectural layer of small *'a'ā* cobbles and pebbles. A concentration of *kukui* shell was observed in the southeast corner of TU-16 at a depth of 16 centimeters below surface, but was all naturally occurring (and not collected). A fractured basalt adze fragment was the only cultural material recovered from Layer I (Table 7). Layer II consisted of dark brown (7.5 YR 3/2) fine silt mixed with *'a'ā* gravels. Remains recovered from this layer included rodent bones and charcoal (see Table 7). Excavation of TU-16 terminated at bedrock 70 centimeters below the unit's surface (Figure 48).

Table 7. Recovered cultural material from SIHP Site 14351 Feature C TU-16.

ACC#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
121	I	Basalt	Adze fragment	1	-	94.7
122	II	Bone	Rodent	2	1	0.1
123	II	Organic	Charcoal	-	-	1.9

The charcoal sample recovered in the screen from Layer II (ACC # RC-0137-123) was sent to Beta Analytic, Inc. for radiocarbon analysis (Beta-173877; see Appendix A). The carbon sample produced a conventional radiocarbon age of 230±70 B.P., or a 2 Sigma calibrated result of A.D. 1460 to 1950 with an intercept of A.D. 1650. Feature C may have functioned as a small living area, or perhaps, based on the presence of the adze fragment and the lack of other debris, as a work area.

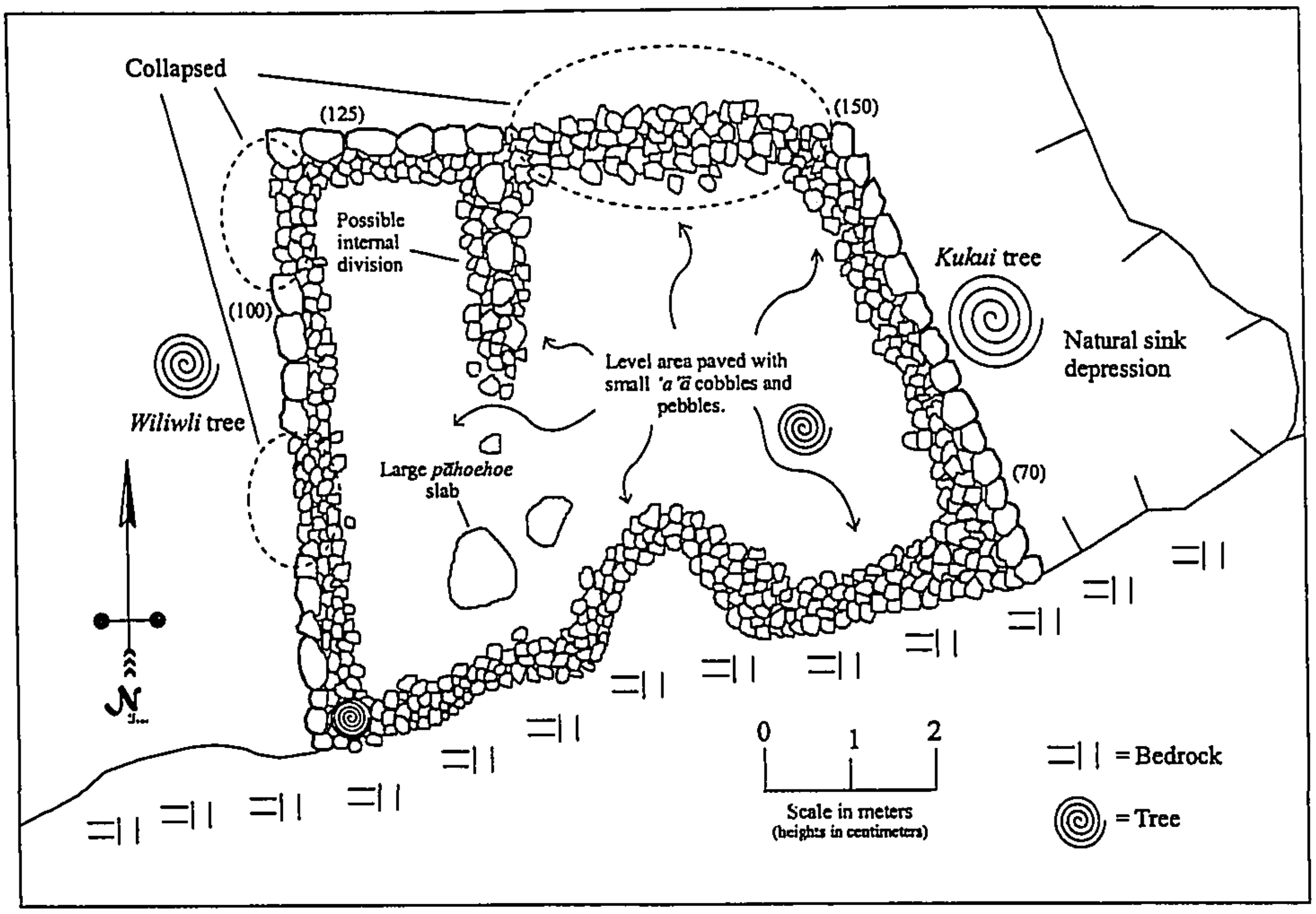


Figure 44. SIHP Site 14351 Feature B plan view.

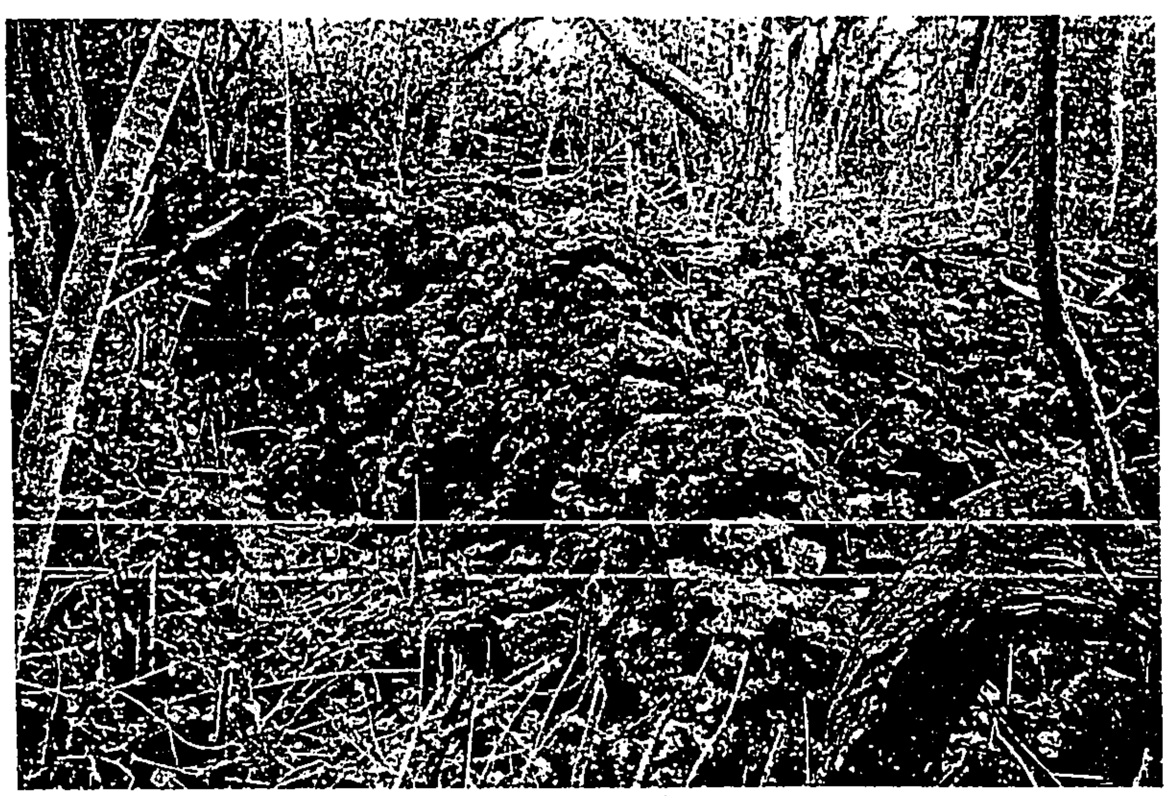


Figure 45. SIHP Site 14351 Feature B view to south of northeast corner.

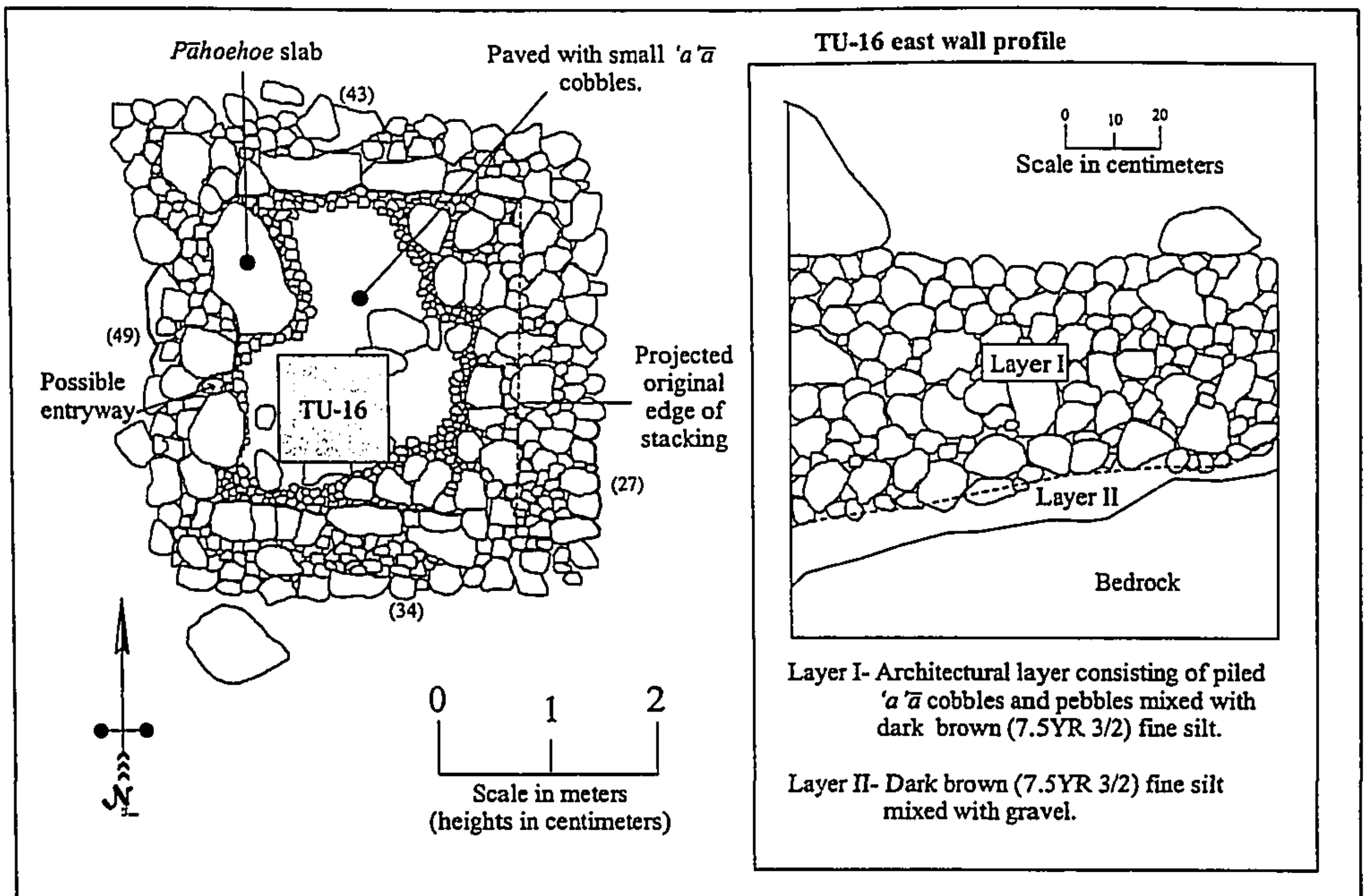


Figure 46. SIHP Site 14351 Feature C plan view and TU 16 profile.

Figure 47. SIHP Site 14351 Feature C view to southeast.

Figure 48. SIHP Site 14351 Feature C TU-16 base of excavation overview.

Feature D

Feature D is a terrace located approximately 17 meters west of Feature B (see Figure 43). The terrace is constructed against a *pāhoehoe* bedrock outcrop that slopes to the southwest. Feature A runs west from the western edge of the feature. The terrace measures 6.0 meters long by 5.0 meters wide with an average height of 1.0 meter along its western (down slope) edge. It is constructed of stacked *pāhoehoe* cobbles and boulders, with the western edge stacked up to eight courses high. The surface of the feature is paved with small *pāhoehoe* cobbles. Some collapse was observed along the south edge of the terrace. Feature D may have functioned as a living area (like Features B and E) or, perhaps, because of its position against a steeply sloped bedrock outcrop adjoined with Feature A and lack of observable habitation debris, as a paved level entryway along the south edge of the enclosed area. Across Feature D from south to north would have (when Feature A was still intact) offered the easiest access into the complex in this portion of Site 14351. Subsequent data recovery efforts at Site 14351 will help refine the function of Feature D.

Feature E

Feature E is a modified outcrop located approximately 18 meters northwest of Feature D (see Figure 43). The bedrock outcrop is modified with stacked *pāhoehoe* cobble alignments along its south and west edges (Figure 49). The feature is roughly square, measuring 2.4 meters (east/west) by 2.3 meters (north/south) by up to 53 centimeters high (Figure 50). Small *pāhoehoe* and *'a'ā* cobbles create a roughly paved level surface against bedrock to the north and east. A horseshoe was found at the east edge of the feature and collected (Figure 51). A 1x1 meter test unit (TU-15) was excavated in the southwestern portion of the site.

Excavation of TU-15 revealed a two-layer stratigraphic profile (see Figure 49). Layer I, the architectural layer, consisted of small to large sized *pāhoehoe* cobbles with a thin paving of small *'a'ā* cobbles and gravels. A *Cypraea* shell fragment and *kukui* (naturally occurring) were recovered from this layer. Layer II consisted of a thin deposit of very dark brown (10YR 2/2) fine silt mixed with *'a'ā* and *pāhoehoe* gravels beneath Layer I on bedrock. Cultural material recovered from Layer II included marine shell fragments, *kukui* (naturally occurring), and charcoal (Table 8). Excavation of TU-15 terminated at bedrock 40 centimeters below the unit's surface(Figure 52).

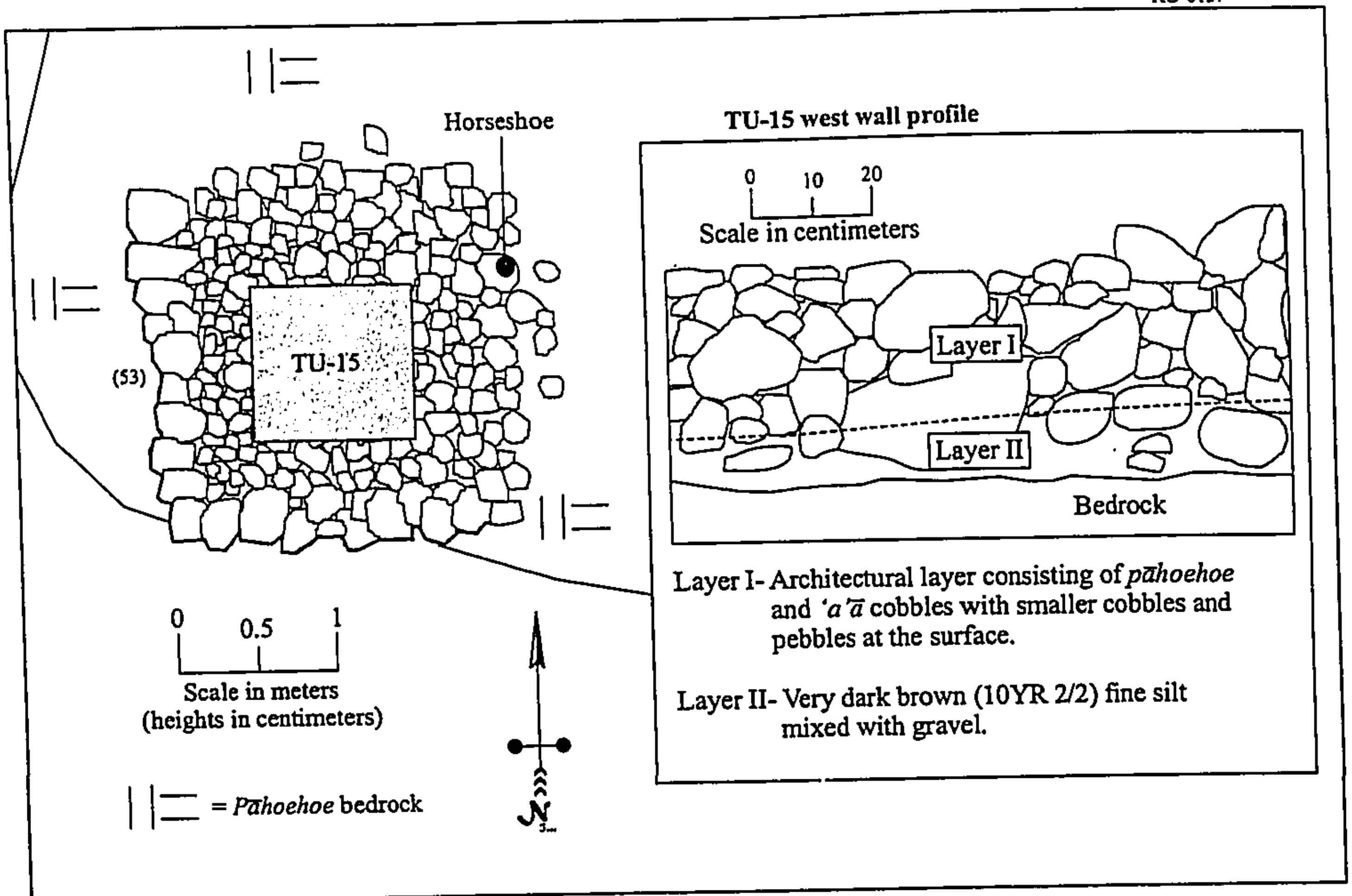


Figure 49. SIHP Site 14351 Feature E plan view and TU-15 profile.

Figure 50. SIHP Site 14351 Feature E view to east.

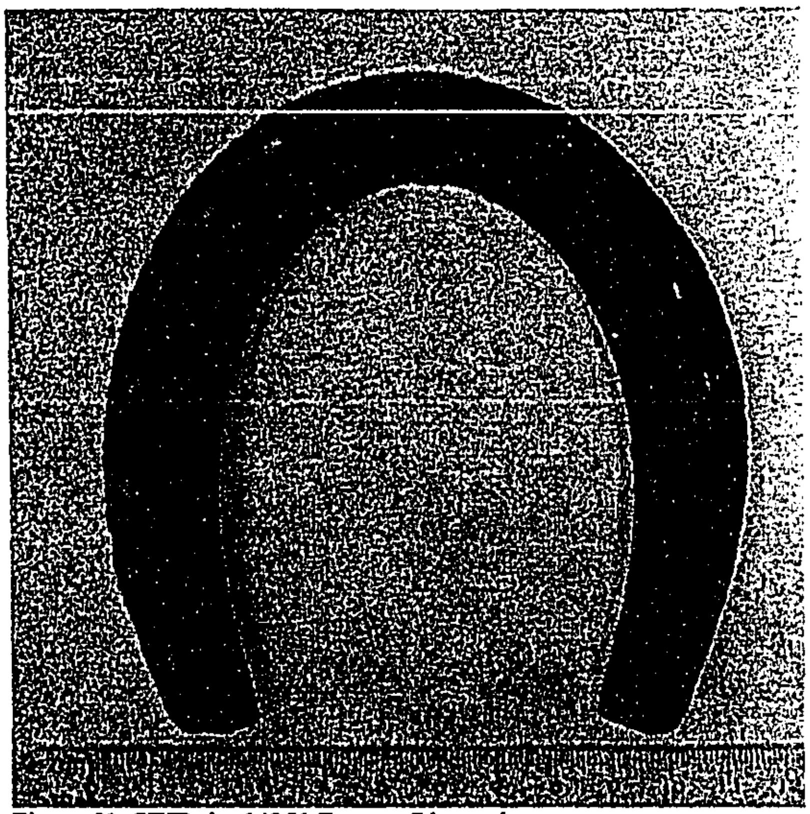


Figure 51. SIHP site 14351 Feature C horseshoe.

Table 8. Recovered cultural material from SIHP Site 14351 Feature E TU-15.

ACC#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
116	I	Shell	*Cypraea*	1	1	26.2
117	I	Organic	*kukui*	43	4	32.5
118	II	Shell	*Cypraea*	6	4	8.8
119	II	Organic	*kukui*	250	4	110.5
120	II	Organic	Charcoal	-	-	3.1

The charcoal sample recovered in the screen from Layer II (ACC # RC-0137-120) was sent to Beta Analytic, Inc. for radiocarbon analysis (Beta-173876; see Appendix A). The carbon sample produced a conventional radiocarbon age of 210±60 B.P., or a 2 Sigma calibrated result of A.D. 1520 to 1950 with an intercept of A.D. 1660. Feature E, like Feature C, may have functioned as a small living area, or perhaps as a work area.

Feature F

Feature F is a habitation tube located in north central portion of Site 14351 (see Figure 43). The tube is accessed through a collapsed section of *'a'ā* bedrock that measures 1.0 meter in diameter (Figure 53). A subsurface passageway (4 meters wide) runs at 160 degrees (*mauka*) for 9 meters to a point where a stacked *pāhoehoe* cobble and slab wall (80 centimeters high) runs across the tube passage (Figure 54). Cultural material observed on the surface in this area of the tube consisted of 1 fire-cracked water-worn cobble possibly used as a hammerstone, 1 sherd of volcanic glass, numerous pig (*Sus*) bones including several mandibles, and *kukui* fragments. Beyond the stacked wall the tube continues for 10 meters before pinching out and becoming impassible. No cultural material was observed beyond the wall.

Figure 52. SIHP Site 14351 Feature E TU-15 base of excavation overview.

Figure 53. SIHP Site 14351 Feature F tube entrance view to southeast.

Figure 54. SIHP Site 14351 Feature F interior wall view to southeast.

Feature G

Feature G consists of a sinkhole 3.2 meters long (east/west) by 2.2 meters wide (north/south) located in the midst of Feature A, 20 meters north of Feature H (see Figure 43). Two large *kukui* trees (1 alive, 1 dead) are present within the sink. A tube entrance (1.0 meter in diameter) runs east from the eastern (*mauka)* side of the sink (Figure 55). The tube opening is largely blocked by cobble rubble, but once accessed the tube runs at 134 degrees (*mauka*) for 6.0 meters and is 3.0 meters wide. Cultural material observed within the tube consisted of pig (*Sus*) bones, *cellana* and *cypradae* shell fragments, and *kukui* fragments. Based on the presence of habitation debris, Feature G, like Feature F, was likely used for Precontact habitation purposes.

Feature H

Feature H is a square enclosure constructed of stacked *pāhoehoe* and *'a'ā* cobbles located at the western end of Site 14351, 20 meters south of Feature G (see Figure 43). The interior of the enclosure measures 3.2 meters long and 3.2 meters wide, with walls up to 66 centimeters high and 75 centimeters wide (Figure 56). The enclosure walls are largely intact except for the south wall, which is collapsed in the southeast corner (Figure 57). A 0.5-meter wide possible entryway is located in the northeast corner. The south wall of the enclosure was built on *'a'ā* bedrock, with the remaining walls constructed on soil. The interior surface of the enclosure consists of a relatively level soil. A 1 x 1 meter test unit (TU-17) was excavated in the central portion of Feature H.


Figure 55. SIHP Site 14351 Feature G tube entrance view to east.

Excavation of TU-17 revealed a single layer stratigraphic profile (see Figure 56). Layer I, the only soil layer, consisted of loose, very dark brown (10YR 2/2) very fine sandy silt mixed with surface floral debris and few small *'a'ā* cobles. Layer I gradually transitioned to a black (10 YR 2/1) loose, very fine sandy silt with a high gravel content. Recovered cultural material consisted of a volcanic glass flake and a small number of *kukui* fragments (likely naturally occurring) (Table 9). Excavation of TU-17 terminated at bedrock 30 centimeters below the unit's surface (Figure 58). Feature H, like Feature C, may have functioned as a small living area, or perhaps as a work area.

Table 9. Recovered cultural material from SIHP Site 14351 Feature H TU-17.

ACC#	*Depth**	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
124	0-10	Volcanic glass	Flake	1	-	0.3
125	0-10	Organic	*kukui*	14	3	3.1
126	10-20	Organic	*kukui*	5	1	1.9

*Depth in centimeters below unit's surface.

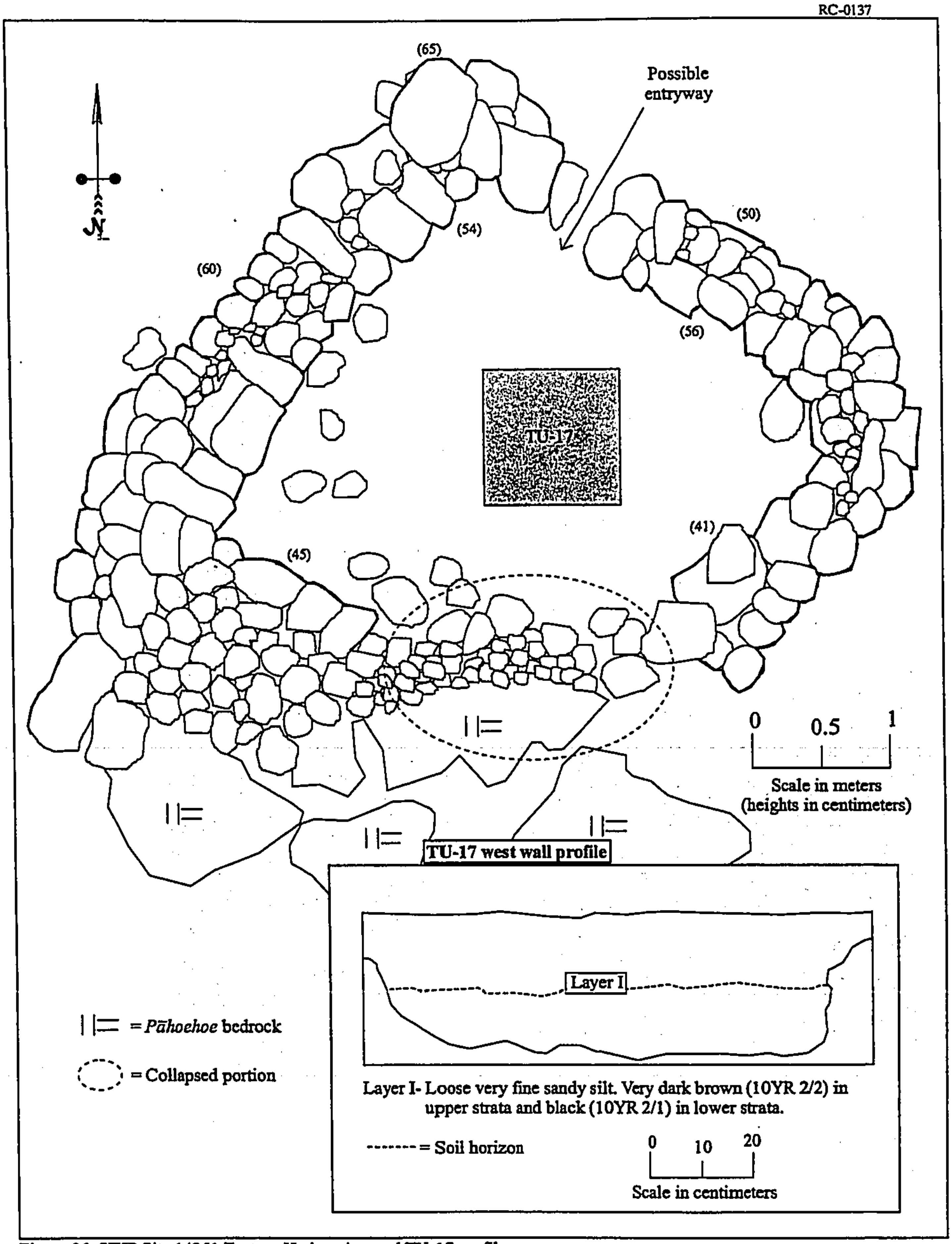


Figure 56. SIHP Site 14351 Feature H plan view and TU-17 profile.

Figure 57. SIHP Site 14351 Feature H view to northwest.

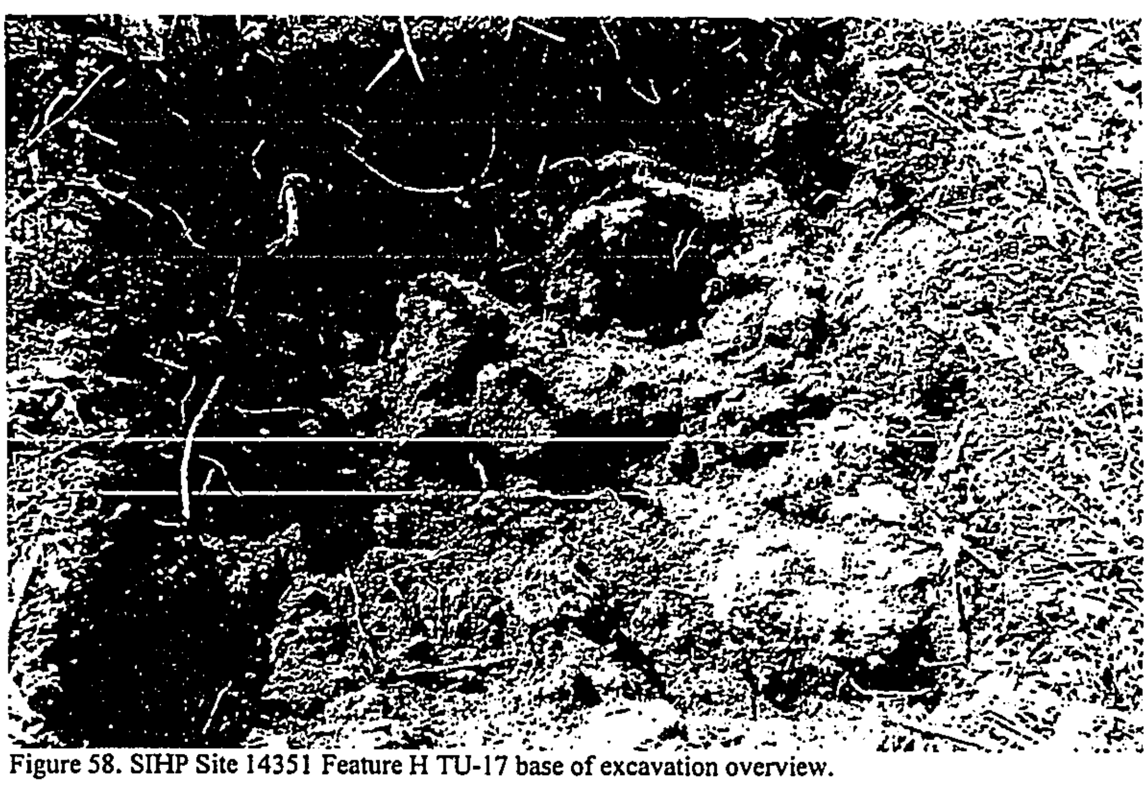


Figure 58. SIHP Site 14351 Feature H TU-17 base of excavation overview.

Feature I

Feature I consists of 12 agricultural features contained within the enclosed area interspersed among the other features. The agricultural features include 9 piled low-lying *'a'ā* cobble mounds constructed on thin soil, 1 modified outcrop, and two terraced areas retaining soil on their *mauka* (upslope) sides (Table 10). These features may have been utilized as planting features, perhaps for sweet potato, but the mounds and the modified outcrop could simply represent clearing piles. The individual agricultural features area listed in Table x and their locations are shown on Figure 59.

Table 10. SIHP Site 14351 Feature I agricultural features.

Feature#	*Feature type*	*Shape*	*Length (m)*	*Width (m)*	*Height (m)*	*Attributes*
I-2	Modified outcrop	Circular	1.9	1.9	0.6	Piled 'a'ā cobbles
I-3	Mound	Oval	2.8	1.3	0.5	Piled *'a'ā* cobbles on soil
I-4	Mound	Oval	2.6	1.4	0.4	Piled *'a'ā* cobbles on soil
I-5	Mound	Circular	2.2	2.2.	0.5	Piled *'a'ā* cobbles on soil
I-6	Mound	Circular	2.3	2.3	0.4	Piled *'a'ā* cobbles on soil
I-7	Mound	Circular	2.7	2.7	0.9	Piled *'a'ā* cobbles on soil
I-8	Mound	Circular	1.8	1.8	0.4	Piled *'a'ā* cobbles on soil
I-9	Mound	Circular	2.1	2.1	0.4	Piled *'a'ā* cobbles on soil
I-10	Mound	Circular	2.1	2.1	0.4	Piled *'a'ā* cobbles on soil
I-11	Mound	Circular	1.8	1.8	0.3	Piled *'a'ā* cobbles on soil
I-12	Terrace	Linear	8.8	8.7	0.9	Piled *'a'ā* cobbles retaining soil to SE

SIHP Site 14354

Site 14354 is a terrace located in the southeast corner of the project area (see Figure 5). The feature is constructed on *pāhoehoe* bedrock that slopes gently to the southwest. It measures 8.5 meters long by 5.5 meters wide (Figure 59). The feature is constructed with *pāhoehoe* cobbles neatly stacked along the south and west edges 2-3 courses (up to 80 centimeters) high (Figure 60); the southwest corner is completely collapsed. The north and east edges are leveled with the *pāhoehoe* bedrock ground surface. The surface of the terrace is paved with small sized pāhoehoe cobbles. A small depression (40 centimeters in diameter and 16 centimeters deep) ringed by *pāhoehoe* slabs is present in the northeast portion of the terrace (Figure 61). A sloped entryway (2.0 meters long by 1.5 meters wide) constructed of *pāhoehoe* slabs leads from ground surface along the western edge of the feature up (north) to the feature's surface 65 centimeters above ground surface. *Kukui* fragments were observed near the base of the entryway, but were most likely naturally deposited. A 1 x 1 meter test unit TU-18 was excavated into the northeast corner of Site 14354.

Excavation of TU-18 revealed a two-layer stratigraphic profile (see Figure 59). Layer I, the 26-centimeter thick architectural layer, consisted of small sized pāhoehoe cobbles at the surface with larger sized cobbles and boulders beneath resting on bedrock. Layer II, a very dark grayish brown (10YR 3/2) fine silt mixed with gravels, had collected beneath Layer I in low spots in the bedrock. Layer II measured up to 14 centimeters thick and terminated at *pāhoehoe* bedrock. No cultural material was recovered from TU-18 and excavation ceased 40 centimeters below the unit's surface at bedrock (Figure 62). The formal attributes and size of Site 14354 are consistent with those of a Precontact permanent habitation (Cordy 1981, 1995), but the lack of habitation debris at the site is surprising. If Precontact individuals were residing there on a permanent basis, one would expect to find at least some evidence of their subsistence. Subsequent data recovery efforts may help refine the function of Site 14354.

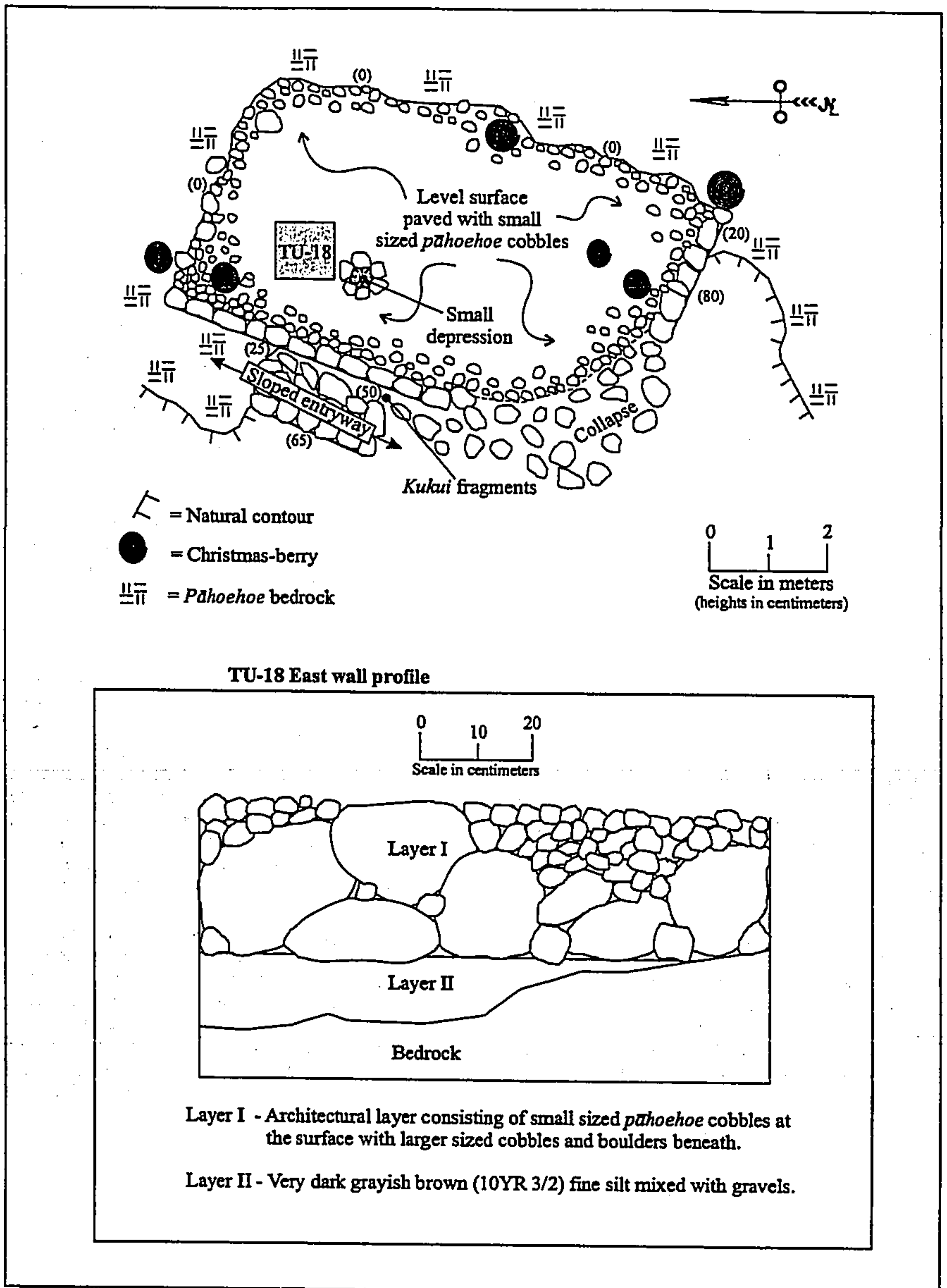


Figure 59. SIHP Site 14354 plan view and TU-18 profile.

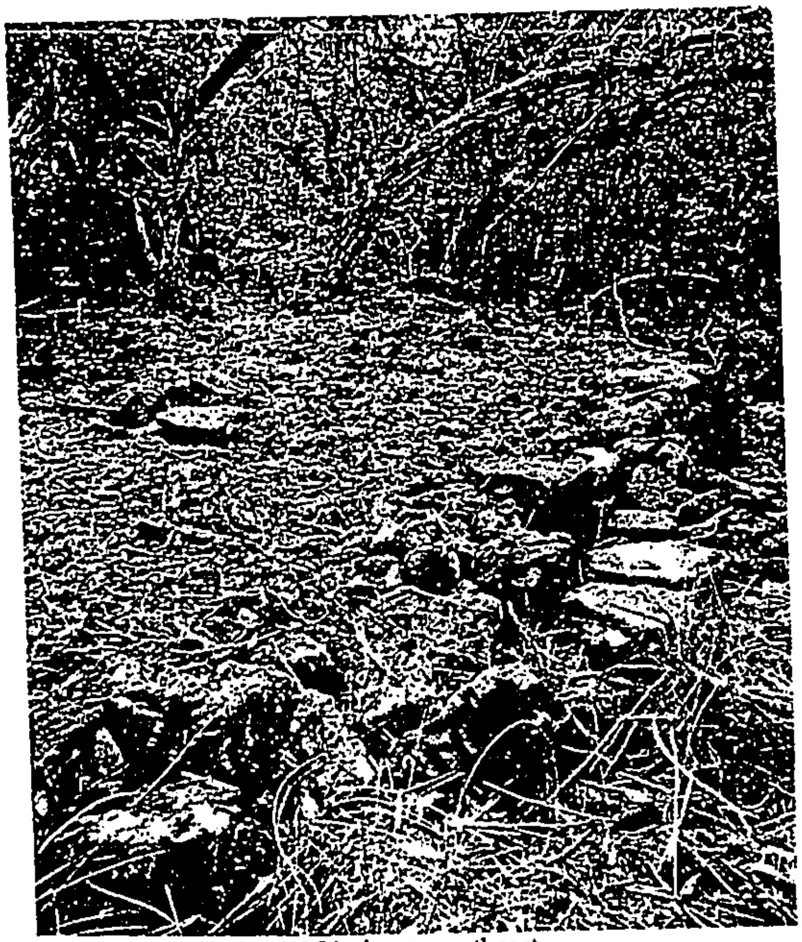


Figure 60. SIHP Site 14354 view to southeast.

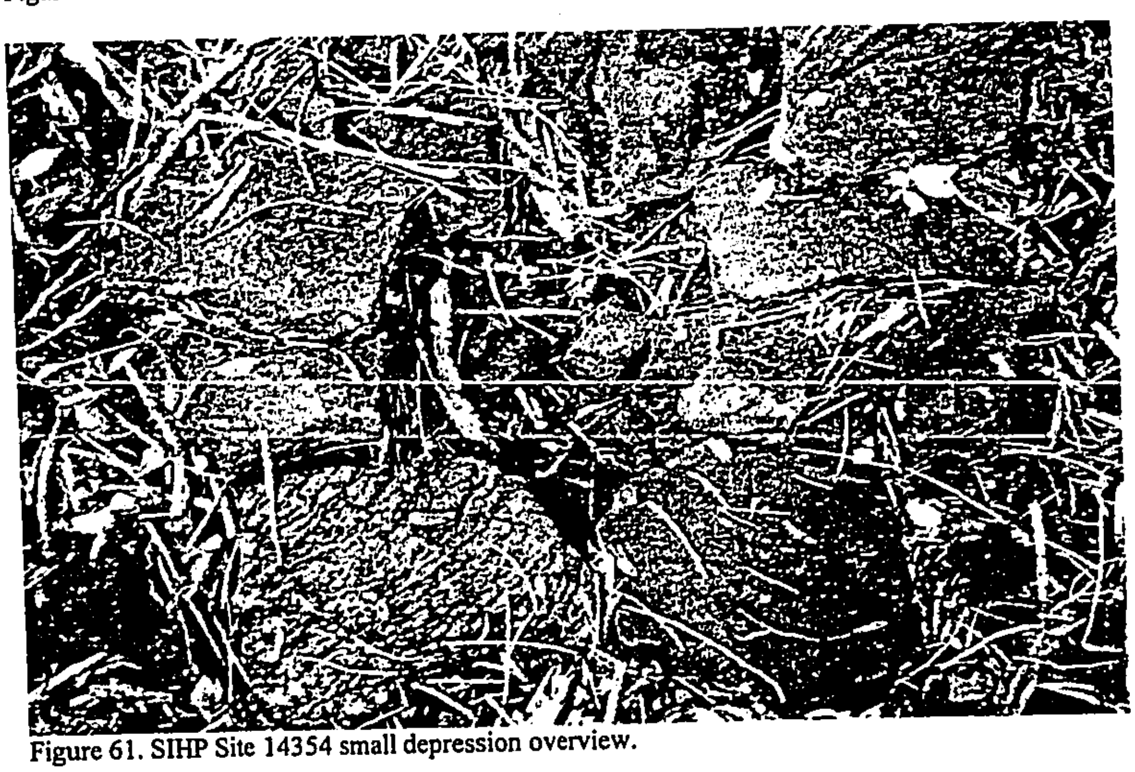


Figure 61. SIHP Site 14354 small depression overview.

Figure 62. SIHP Site 14354 TU-18 base of excavation view to east.

SIHP Site 14357

Site 14357 is a trail route running a meandering course north/south across *pāhoehoe* and *'a'ā* flows in the east central portion of the project area (see Figure 5). The traceable route of the trail runs for approximately 360 meters and is evidenced by a worn path across *pāhoehoe* flows (Figure 63) and cleared cobbles with rough kerbing across *'a'ā* flows. A collection of approximately 10 branch coral fragments on the trail's surface (Feature A) and 6 cairns (*ahu*)(Features B-G) were also found along the route of Site 14357. There is a possible branch segment located between Features B and C running to the west. The trail route becomes untraceable to the north at a large *pāhoehoe* flat covered by fountain grass. It becomes untraceable to the south as it passes Site 23903 (a temporary habitation complex; see description below) at Features F and G, which is where the trail may have joined Site 14362 (a *mauka/makai* trail; see description below). Site 14357 was most likely a Precontact trail, but it probably saw continued use into the Historic ranching times, based on the construction of the cairns (see feature descriptions below) and the presence of a bottle at Site 23903. Individual feature descriptions follow below and the traceable route of the trail and feature locations are shown on Figure 64.

Feature A

Feature A is a cache of approximately 10 branch coral fragments located on ground surface in the midst of the trail route (Figure 65). The fragments are contained within an area 1.5 meters in diameter. The surrounding terrain was thoroughly searched for formal features, but none were located. The significance of the branch coral deposit is unclear at this time, but this location will receive further study during subsequent data recovery.

Feature B

Feature B is a cairn (*ahu*) constructed of 3 stacked *pāhoehoe* cobbles on *pāhoehoe* bedrock (Figure 66). It measures 40 centimeters in diameter and stands 70 centimeters high.

Figure 63. SIHP Site 14357 trail route across *pāhoehoe* bedrock view to north.

Feature C

Feature C is a large cairn (*ahu*) of stacked *pāhoehoe* slabs (6 courses high) on pāhoehoe bedrock (Figure 67). It measures 70 centimeters in diameter and stands 1.0 meter high. The feature may have been larger in the past as evidenced by collapsed slabs along its north edge. There is a possible filled pāhoehoe excavation just to the south of Feature C.

Feature D

Feature D is a cairn (*ahu*) constructed of 3 *pāhoehoe* cobbles propping up a *pāhoehoe* slab (Figure 68). It measures 80 centimeters in diameter and stands 70 centimeters high.

Feature E

Feature E is a cairn (*ahu*) constructed of stacked *'a'ā* and *pāhoehoe* cobbles with one *pāhoehoe* slab (Figure 69). It measures 50 centimeters in diameter and stands 80 centimeters high.

Feature F

Feature F is a cairn (*ahu*) constructed of 5 stacked *pāhoehoe* slabs on an *'a'ā* flow (Figure 70). It measures 40 centimeters in diameter and stands 55 centimeters high.

Feature G

Feature G is a collapsed cairn (*ahu*) formerly constructed of 7 *pāhoehoe* cobbles on *pāhoehoe* bedrock (Figure 71). In its collapsed form the cairn measures 100 centimeters in diameter and stands 30 centimeters high.

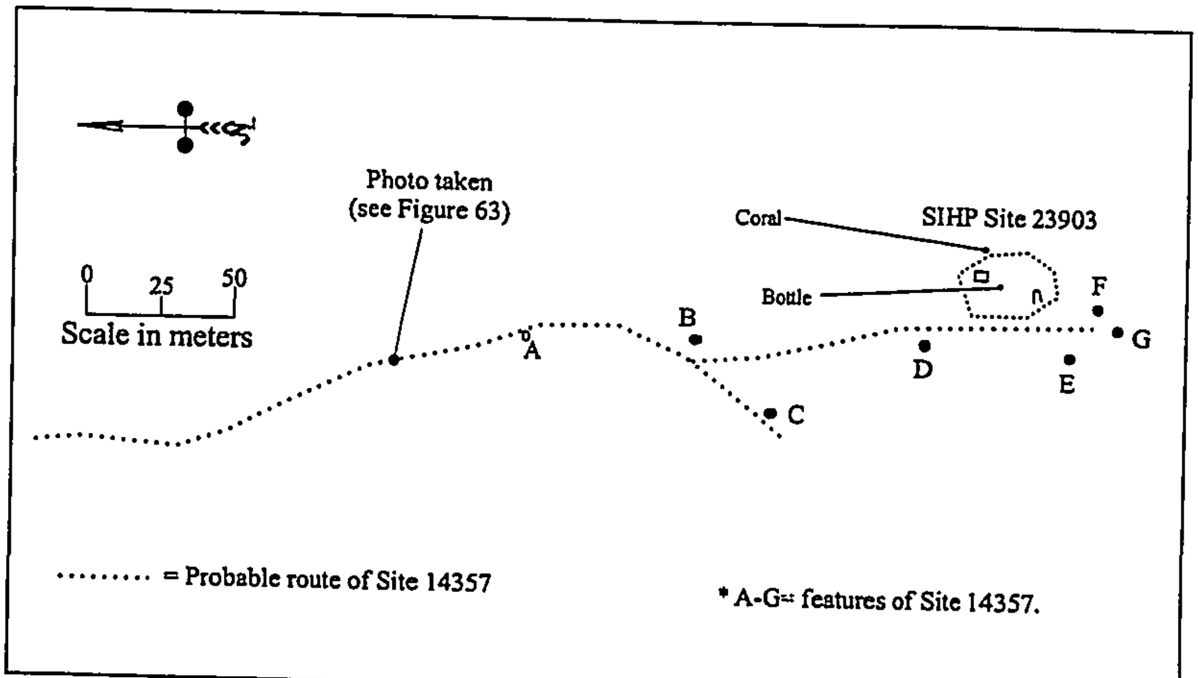


Figure 64. SIHP Site 14357 plan view.

Figure 65. SIHP Site 14357 Feature A overview to west.

Figure 66. SIHP Site 14357 Feature B view to south.

Figure 67. SIHP Site 14357 Feature C view to east.


Figure 68. SIHP Site 14357 Feature D view to south.


Figure 69. SIHP Site 14357 Feature E view to east.

Figure 70. SIHP Site 14357 Feature F view to south.

Figure 71. SIHP Site 14357 Feature G view to south.

SIHP Site 14358

Site 14358 is a lava tube located in the eastern portion of the project area along the northern edge of the main access road (see Figure 5). The tube has a succession of three small entrances in the *pāhoehoe* bedrock running in a line east to west. A subsurface passageway runs both *mauka* and *makai* of the entrances, but no cultural modification or cultural debris was discovered within the tube. Approximately 40 meters east of the eastern most entrance a large tree branch (slightly rotted) was found propped against the north wall of the tube beneath a narrow side passage located 2.5 meters above the floor of the tube (Figure 72). The branch appeared propped there to help gain access to this passageway. However, upon inspection, it was found that the side passage was too narrow to access and only approximately 2 meters deep. No cultural material of any kind was observed within this narrow passageway. The tree branch could have been left there by a Precontact or Historic individual exploring the tube system, but more likely a modern visitor looking for a side passage placed it there. Ogden archaeologists originally recorded Site 14358 (Schilz et al. 1990), and they may have placed the branch there at that time. Whatever the case, the branch is considered an isolated find as no habitation debris or architectural modification was observed within the tube.

Figure 72. SIHP Site 14358 tree branch view to west.

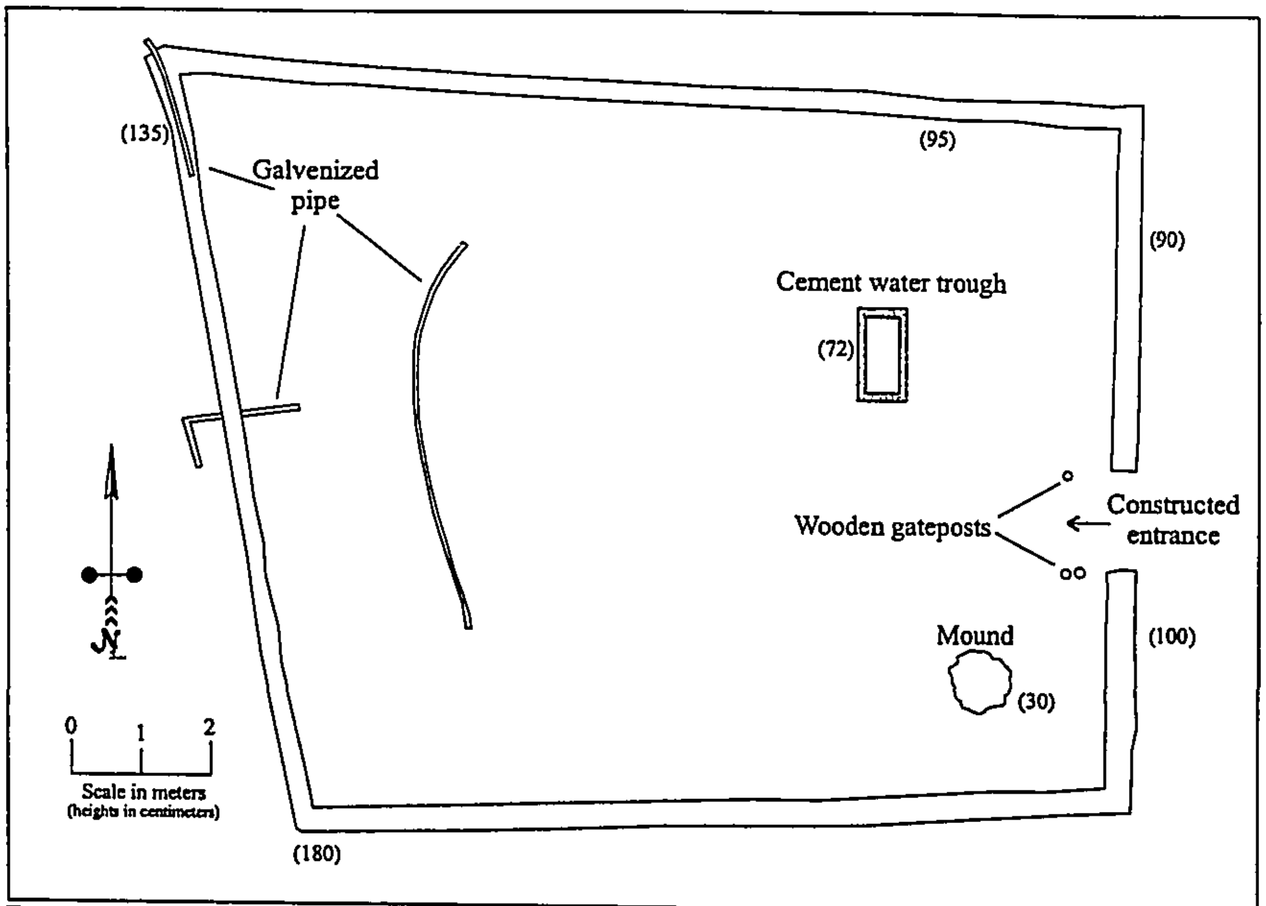
SIHP Site 14359

Site 14359 is a four-sided Historic cattle enclosure located in the southeastern portion of the project area (see Figure 5). The walls, which are constructed of *'a'ā* cobbles, are core-filled and stand 1.1—1.8 meters high by 0.9 meters wide (Figure 73). The south wall measures 22 meters long; the east wall 19 meters long; the west wall 26 meters long; and the north wall 26 meters long (Figure 74). The walls are fairly well preserved, indicating that the enclosure was likely used into relatively recent times. A constructed opening (3.2 meters wide), flanked on either side by wooden gateposts, is located in the center of the eastern wall (Figure 75). The remains of the gate, complete with metal hinges, are decaying on ground surface next to the posts.

Figure 73. SIHP Site 14359 view to south of enclosure's exterior northeast corner.

The interior of the enclosure contains a cement water trough, a piled *'a'ā* cobble mound, and 3 sections of galvanized metal pipe (waterline). The cement trough is located in the enclosure's northeast corner. It measures 2.4 meters long by 1.0 meter wide by 72 centimeters high, has straight sides and 4 metal anchor bolts protruding from its south end (Figure 76). An inscription etched into the rim of the east wall reads: "MADE , IN , THE YEAR 1938 MR. JOSEPH KEPANO HUE HUE. R.". The inscription continues on the rim of the north wall: "Good Bey HUE HUE RANCH So Long Boys" ("Bey" was most likely meant to be written "Bye"). The mound is located in the southeast corner of the enclosure. It measures 2.1 meters in diameter by 30 centimeters high and is most likely a by-product of clearing cobbles from the interior of the enclosure. A long section of galvanized pipe rests on ground surface at the west end of the enclosure, a second section runs under the west wall, and a third is resting on top of the west wall at its northern end.

Outside the enclosure, a round, clear glass bottle, machine made with no markings was found cached in a lava blister 10 meters to the southwest of the enclosure's southwest corner. Also a depressed area 30 meters west of the feature appears to have been quarried, perhaps to collect materials for the construction of the enclosure's walls. George Kinoulu "Kino" Kahananui Sr., who worked for Hu'ehu'e Ranch from 1941—1960, remembered this cattle enclosure and recollected that he had bulldozed a tract to the enclosure in order to lay down a waterline (see Cultural Impact Assessment for the current study; Orr 2003).



Feature 74. SIHP Site 14359 plan view.

Figure 75. SIHP Site 14359 view to south of opening in east wall.

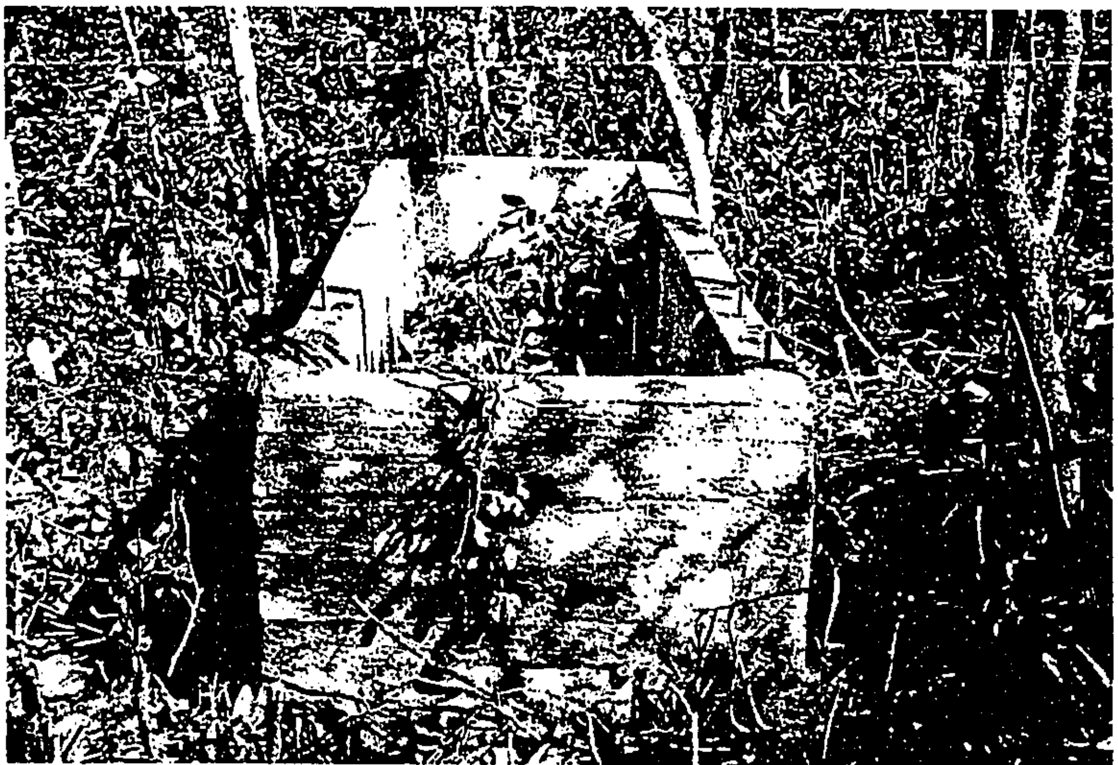


Figure 76. SIHP Site 14359 cement water trough view to north.

SIHP Site 14360

Site 14360 is a *heiau* located at the top of a northwest-facing slope in the southeastern portion of the project area (see Figure 5). The site consists of an enclosed area measuring 14.2 meters (north/south) by 12.6 meters (east/west) with an entrance in the eastern wall and a platform constructed along the interior edge of the western wall (Figure 77). The enclosure walls are constructed of *'a'ā* cobbles, formerly stacked, but now mostly collapsed. They stand up to 1.0 meter wide and 80 centimeters tall. An entrance constructed in the center of the eastern wall measures 1.5 meters wide. The interior of the enclosure is covered by dense vegetation (primarily fountain grass). The natural terrain slopes steeply away from the north and west enclosure walls, affording the feature an excellent coastal vista.

A platform is centrally located along the interior edge of the enclosure's west wall (Figure 78). The platform measures 4.0 meters (east/west) by 7.0 meters (north/south). The edges consist of stacked *'a'ā* cobbles standing up to 80 centimeters high and the platform's surface, although obscured by fountain grass, appears to be paved with *'a'ā* pebbles. A ramp, 1.3 meters wide located along the eastern edge of the platform, leads from ground surface to the platform's surface. A second possible ramp (it could just be wall collapse) is located along the enclosure's western wall in the northwest corner of the platform.

Site 14360, based on its large size (179 square meters) and its formal attributes (i.e. enclosed elevated platform with ramp leading up to it), is considered to be a small *heiau* (Kolb 1991; Ladefoged et al. 1987). The site is located within a large agricultural complex (Site 14342), and accordingly may have functioned as an agricultural *heiau*. No subsurface testing was performed at Site 14360 as it is slated for preservation.

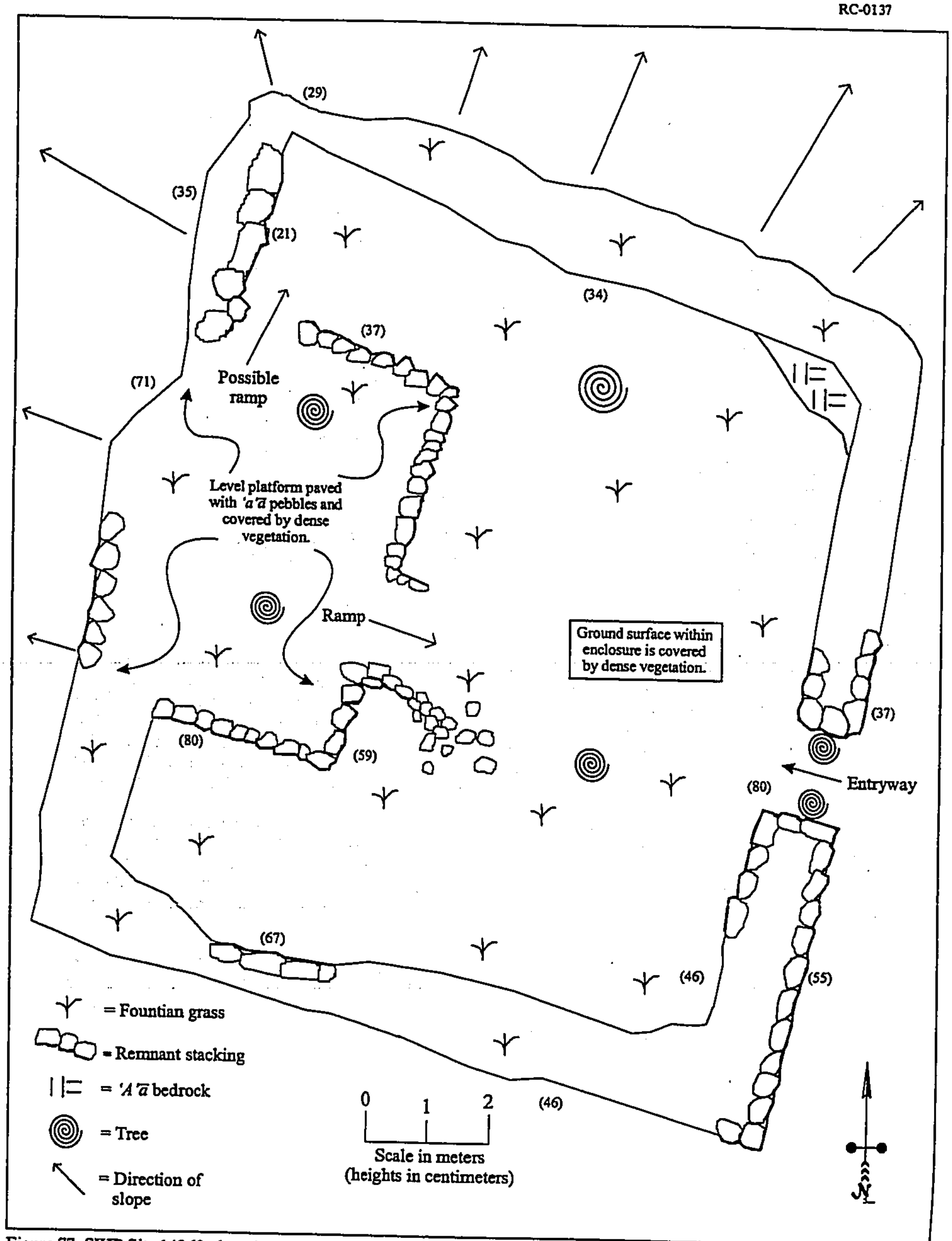


Figure 77. SIHP Site 14360 plan view.

Figure 78. SIHP Site 14360 view to northwest of platform.

SIHP Site 14362

Site 14362 is a *mauka/makai* trail located in the east central portion of the project area (see Figure 5). This trail segment was originally recorded by Ogden (Schilz et al. 1990) as three individual cairns (Sites 14362, 14363, and 14364). However, it was realized during the current inventory survey that those three cairns along with 14 newly recorded ones, mark the route of a *mauka/makai* trail running for approximately 1,025 meters (although traceable only intermittently) across the project area in a southeasterly/northwesterly direction (Figure 79). For this reason the three site designations were combined under a single SIHP number (Site 14362) and the two remaining site numbers (Sites 14363 and 14364) were eliminated.

Vegetation in the vicinity of Site 14362 consists primarily of a fairly uniform ground cover of fountain grass. The trail runs across both *pāhoehoe* and *'a'ā* lava flows that slope gently to the west. It is marked by 17 individual cairns (*ahu*) spaced at irregular intervals. Where the trail crosses *pāhoehoe* its route is extremely difficult to follow and can only be identified by the placement of the cairns. This being said, however, often the easiest route across the bedrock (such as on a raised linear ridge) is the one that leads from one cairn to the next. In at least two separate locations, where the route of the trail carries it across a *pāhoehoe* cobble field, the cobbles have been removed to the trail's edge creating a rough kerbing on one side or the other. These kerbed sections sometimes have the appearance of a rough linear terrace, but it appears as though the trail would have followed bedrock at the base of the terrace and not crossed on the surface of it (Figure 80). Where the trail crosses *'a'ā* lava flows, the large cobbles have been removed and placed along its edges, thus creating a rough kerbing (Figure 81). The path then consists of only small *'a'ā* cobbles sometimes augmented with slabs of *pāhoehoe* used as stepping-stones. Despite these trail improvements, in several sections more than one path (all equally accessible) could be followed between cairns. Although no longer traceable, Site 14362 may have continued west along Site 23871 (an historic fence line) to Site 14374 and then continued to the coast (see Figure 5), and east to a junction with Site 14357 (a north/south trail) at a grouping of three cairns (see Figure 79).

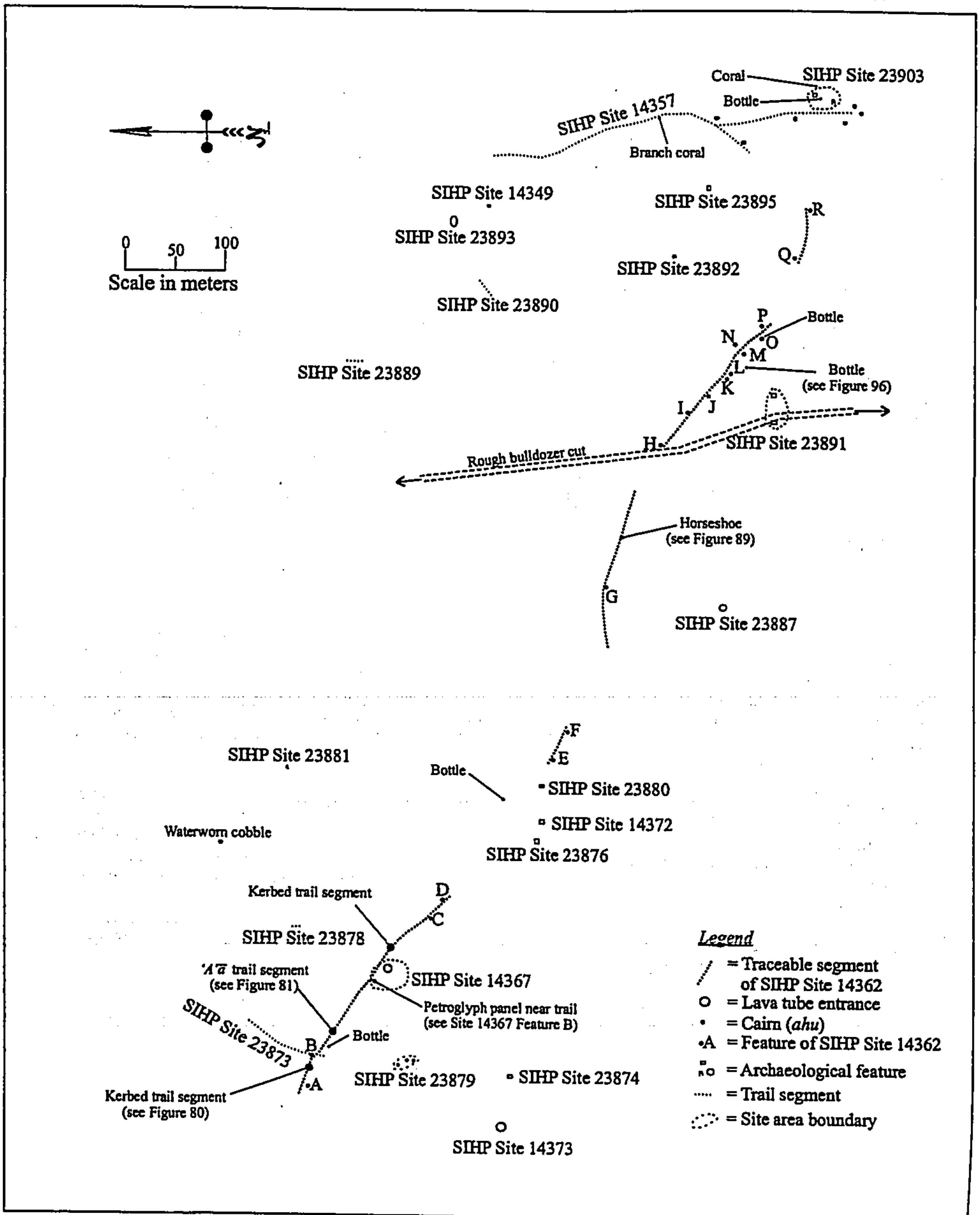


Figure 79. SIHP Site 14362 and vicinity plan view.

Figure 80. SIHP Site 14362, *pāhoehoe* cobble kerbing along south edge of trail, view to east.

Figure 81. SIHP Site 14362, section of trail crossing an *'a'ā* flow view to west.

Several of the recorded archaeological features in this portion of the project area may have been accessed by Site 14362 or by branch trails running north and/or south from its length (see Figure 79). Four habitation sites (Sites 14367, 14372, 23876, and 23880) are located immediately adjacent to the probable route of the trail. One of these, a small habitation tube (Site 14367 Feature A) has a petroglyph panel (Site 14367 Feature B) located adjacent to the trail route that may have had a specific meaning to passing travelers (see Site 14367 description below). Also, four glass bottles (2 broken ones and only one with markings) and a horseshoe were found along the probable trail route. These artifacts are evidence that the trail was utilized at least into Historic times, most likely by ranchers on horse back. In fact, during an oral interview with George Kinoulu "Kino" Kahananui Sr., who worked in the area for Hu'ehu'e ranch from 1941-1960, he identified the trail as Hamanamana Trail, named for an *ahupua'a* located south of Kaū Ahupua'a (see Cultural Impact Assessment for current study; Orr 2003).

Individual descriptions for all 17 cairns recorded at Site 14362 (Features A-R) are presented below. These descriptions follow the trail route from west to east. The locations of all the features are shown on Figure 79.

Feature A

Feature A is a small cairn (*ahu*) constructed of three stacked *pāhoehoe* slabs resting on a raised *pāhoehoe* bedrock outcrop (Figure 82). Feature A, which is located along the southern edge of the trail route, measures 80 centimeters long by 40 centimeters wide by 40 centimeters tall.

Figure 82. SIHP Site 14362 Feature A view to west.

Feature B

Feature B is a cairn (*ahu*) constructed of piled *pāhoehoe* cobbles partially supported by a small bedrock outcrop along its northern edge (Figure 83). The cairn measures 1.8 meters long by 1.4 meters wide and stands up to 65 centimeters above ground surface along its southern edge. Feature B may mark the location where Site 23873 (a north/south trail) intersects Site 14362.


Figure 83. SIHP Site 14362 Feature B view to west.

Feature C

Feature C is a cairn (*ahu*) constructed of 5 stacked *pāhoehoe* cobbles resting on *pāhoehoe* bedrock (Figure 84). It measures 70 centimeters in diameter, stands up to 80 centimeters high, and appears to be located along the southern edge of the intended trail route.


Figure 84. SIHP Site 14362 Feature C view to east.

Feature D

Feature D is a cairn (*ahu*) constructed of 2 stacked *pāhoehoe* slabs resting on *pāhoehoe* bedrock (Figure 85). It measures 80 centimeters in diameter, stands up to 40 centimeters above ground surface, and appears to be located along the northern edge of the intended trail route.

Figure 85. SIHP Site 14362 Feature D view to west.

Feature E

Feature E is a cairn (*ahu*) constructed of 3 *pāhoehoe* cobbles stacked on *pāhoehoe* bedrock (Figure 86). Feature E measures 70 centimeters in diameter and stands 40 centimeters above the surrounding ground surface.

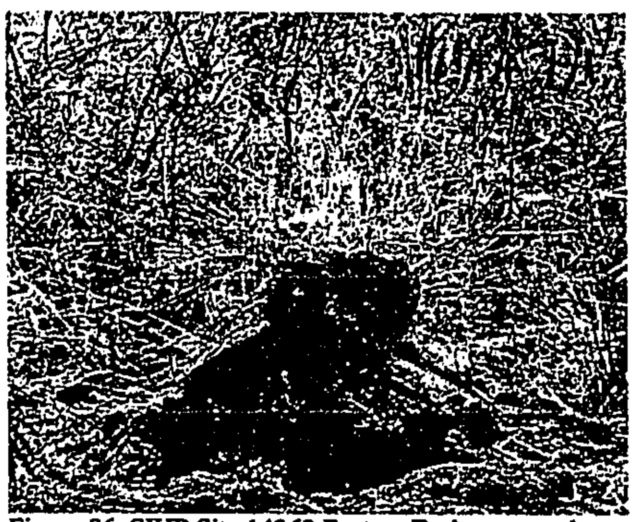


Figure 86. SIHP Site 14362 Feature E view to south.

Feature F

Feature F is a cairn (*ahu*) constructed of 4 *pāhoehoe* cobbles stacked on *pāhoehoe* bedrock (Figure 87). Feature F measures 80 centimeters in diameter and stands 50 centimeters above the surrounding ground surface.


Figure 87. SIHP Site 14362 Feature F view to north.

Feature G

Feature G is a collapsed cairn (*ahu*) constructed of *'a'ā* cobbles on *'a'ā* bedrock (Figure 88). The cairn, in its collapsed state, measures 2.0 meters (north/south) by 1.8 meters (east/west) and stands up to 0.6 meters above ground surface. The trail route can be traced across the *'a'ā* landscape for 60 meters to the west of Feature G and for 100 meters to the east of Feature G. In this area the trail route has been cleared of large cobbles creating a rough kerbing along its edges and leaving only small cobbles as evidence of its route. Furthermore, fountain grass has grown out of the trail along much of its length making the route easily traceable. A few *pāhoehoe* cobble stepping-stones were also noted along this length of trail. A small horseshoe (Figure 89) was found 50 meters east of Feature G, suggesting that the trail was utilized into historic ranching times.


Figure 88. SIHP Site 14362 Feature G view to west.

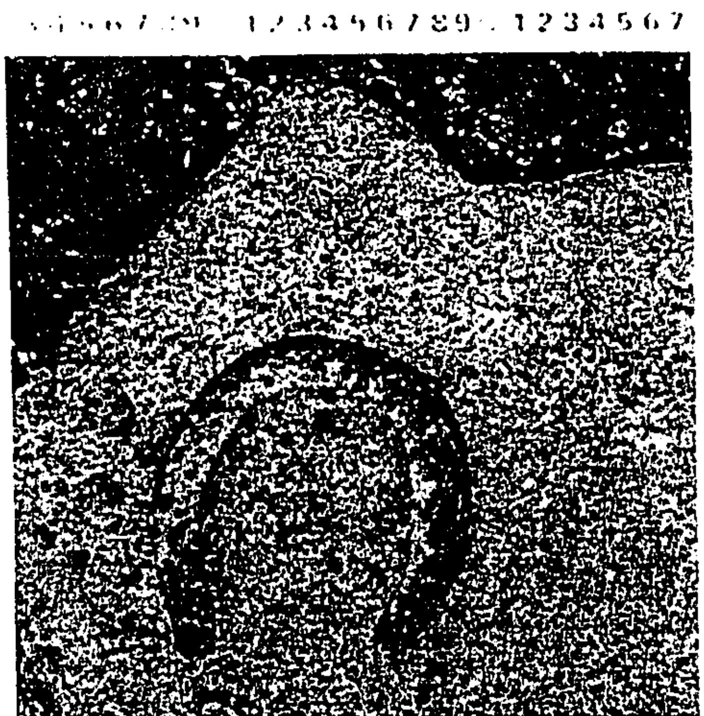


Figure 89. SIHP Site 14362, horseshoe found 50 meters east of Feature G along the trail route (scale in centimeters).

Feature H

Feature H is a cairn (*ahu*) constructed of 2 *pāhoehoe* cobbles stacked on *pāhoehoe* bedrock (Figure 90). The cairn measures 60 centimeters in diameter and stands 70 centimeters above the surrounding ground surface. Feature H is located just east of a rough bulldozer cut running north/south that bisects the trail route (see Figure 5).

Figure 90. SIHP Site 14362 Feature H view to northeast.

Feature I

Feature I is a cairn (*ahu*) constructed of 2 *pāhoehoe* cobbles stacked on *pāhoehoe* bedrock (Figure 91). Feature I measures 50 centimeters in diameter and stands 50 centimeters above the surrounding ground surface. A third cobble may have fallen off the top of the cairn.

Figure 91. SIHP Site 14362 Feature I view to west.

Feature J

Feature J is a cairn (*ahu*) constructed of 2 *pāhoehoe* cobbles stacked on *pāhoehoe* bedrock (Figure 92). Feature J measures 50 centimeters in diameter and stands 80 centimeters above the surrounding ground surface.

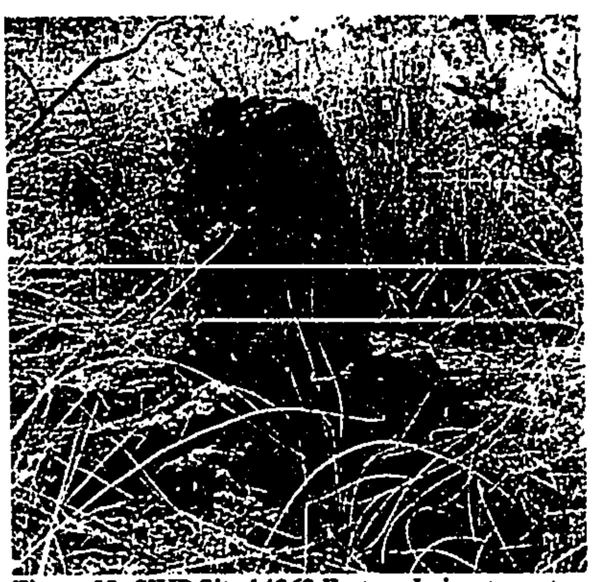


Figure 92. SIHP Site 14362 Feature J view to east.

Feature K

Feature K is a collapsed cairn (*ahu*) constructed of 4 *pāhoehoe* slabs, 2 of which remain stacked resting on *pāhoehoe* bedrock (Figure 93). Feature K measures 60 centimeters in diameter and stands 40 centimeters above the surrounding ground surface.

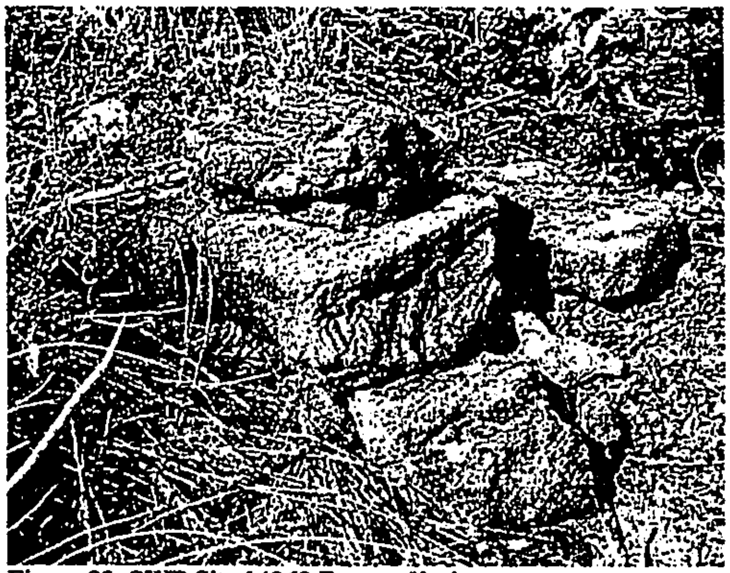


Figure 93. SIHP Site 14362 Feature K view to west.

Feature L

Feature L is a cairn (*ahu*) constructed of 3 *pāhoehoe* slabs stacked on *pāhoehoe* bedrock (Figure 94). Feature L measures 60 centimeters in diameter and stands 70 centimeters above the surrounding ground surface.

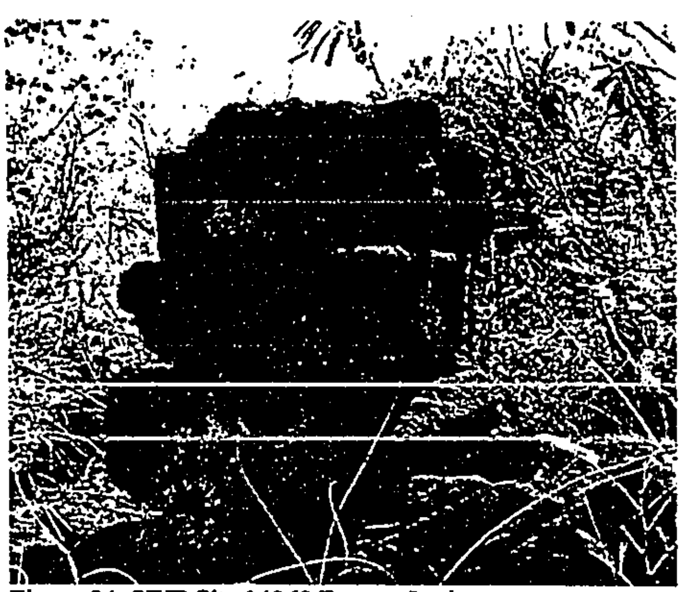


Figure 94. SIHP Site 14362 Feature L view east.

Feature M

Feature M is a collapsed cairn (*ahu*) constructed of *pāhoehoe* cobbles resting on *pāhoehoe* bedrock (Figure 95). Feature M, in its collapsed and scattered state, measures 1.5 meters in diameter and stands 40 centimeters above the surrounding ground surface.


Figure 95. SIHP Site 14362 Feature M view to west.

A machine made, hand finished, aqua colored, glass *sake* bottle (40 centimeters tall and 10 centimeters in diameter) with a rounded base was found cached in a small blister opening between Features L and M (Figure 96). Across one side the bottle reads (from top to bottom): "ONE HALF GALLON/(Japanese character)/TRADE MARK/ FUJI MASUMUNE/F.S.B. CO." Around its base the bottle reads: "BOTTLE/MADE IN JAPAN." The location of this bottle suggests that Site 14362 was utilized into Historic times. The bottle may have been used for storing water after its original contents were consumed.


Figure 96. SIHP Site 14362, *sake* bottle found cached in lava blister.

Feature N

Feature N is a cairn (*ahu*) constructed of 7 *pāhoehoe* cobbles that were formerly stacked, but are now mostly collapsed, resting on *pāhoehoe* bedrock (Figure 97). Feature N (including the collapsed cobbles) measures 1.5 meters in diameter and stands 50 centimeters above the surrounding ground surface.

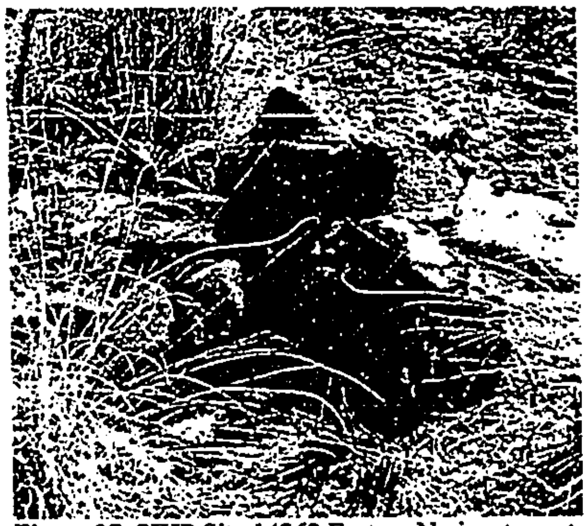


Figure 97. SIHP Site 14362 Feature N view to east.

Feature O

Feature O is a roughly square cairn (*ahu*) constructed of stacked *pāhoehoe* cobbles (Figure 98), partially collapsed (Figure 99), resting on *pāhoehoe* bedrock. Feature O (including the collapsed portions) measures 3.0 meters along a side, but when intact may have measured only 1.3 meters along each side. The intact, stacked south side of Feature O stands 1.2 meters (7 courses) above the surrounding ground surface. A clear glass, machine made bottle with the markings "2183/24-4" on the round base was found on bedrock along the south side of the feature. It is possible that Feature O, since it is so substantially constructed, served as a rest-stop along the trail similar to Site 23880 (see description below).

Figure 98. SIHP Site 14362 Feature O view to north of staked southern side.


Figure 99. SIHP Site 14362 Feature O view to south of collapsed northern side.

Feature P

Feature P is a cairn (*ahu*) constructed of approximately 8 small *pāhoehoe* cobbles stacked on *pāhoehoe* bedrock (Figure 100). Feature P measures 80 centimeters in diameter and stands 50 centimeters above the surrounding ground surface.


Figure 100. SIHP Site 14362 Feature P view to north.

Feature Q

Feature Q is a cairn (*ahu*) consisting of 7 *pāhoehoe* cobbles, formerly stacked but now mostly collapsed, resting on *pāhoehoe* bedrock (Figure 101). The cairn (including the collapse) measures 1.3 meters long by 0.5 meters wide and stands up to 40 centimeters above ground surface. The trail route between Feature Q and Feature P (to the west) and Feature R (to the east) is extremely difficult to follow across the *pāhoehoe* landscape, therefore its identification is tenuous.

Figure 101. SIHP Site 14362 Feature Q view to north.

Feature R

Feature R is a cairn (*ahu*) constructed of 4 *pāhoehoe* slabs stacked on *pāhoehoe* bedrock (Figure 102). The cairn measures 50 centimeters in diameter and stands 70 centimeters above the surrounding ground surface. Feature R marks the traceable western extent of Site 14362.

Figure 102. SIHP Site 14362 Feature R view to northeast.

SIHP Site 14365

Site 14365 is a lava tube habitation located in the eastern portion of the project area along the edge of the main access road (see Figure 5). The tube is accessed through a collapsed section of *pāhoehoe* bedrock that measures 3.5 meters (east/west) by 3.0 meters (north/south) by 1.3 meters deep (Figure 103). A subsurface passage way runs both east (*mauka*) and west (*makai*) from the tube entrance (Figure 104). The *makai* passageway runs at 240° for 18 meters before becoming impassable. At the entrance it opens up into a chamber measuring 8.0 meters long by 3.0 meters wide by 1.2 meters high. The floor of this area consists of bedrock covered by thin soil (< 5 centimeters) and cobble rubble. A possible groundstone slab was found 2.3 meters into the *makai* passageway. *Kukui* fragments and a *Cypraea* shell fragment were also observed near the entrance to the *makai* passageway. Ogden may have collected addition cultural remains from the site during the previous inventory survey, but this is extremely difficult to tell from their site description (Schilz et al. 1990). The *mauka* tube runs for 6.0 meters at 80° then pinches out. Site 14365, based on the presence of habitation debris, was likely used during the Precontact period fortemporary habitation purposes.

Figure 103. SIHP Site 14365 view to south.

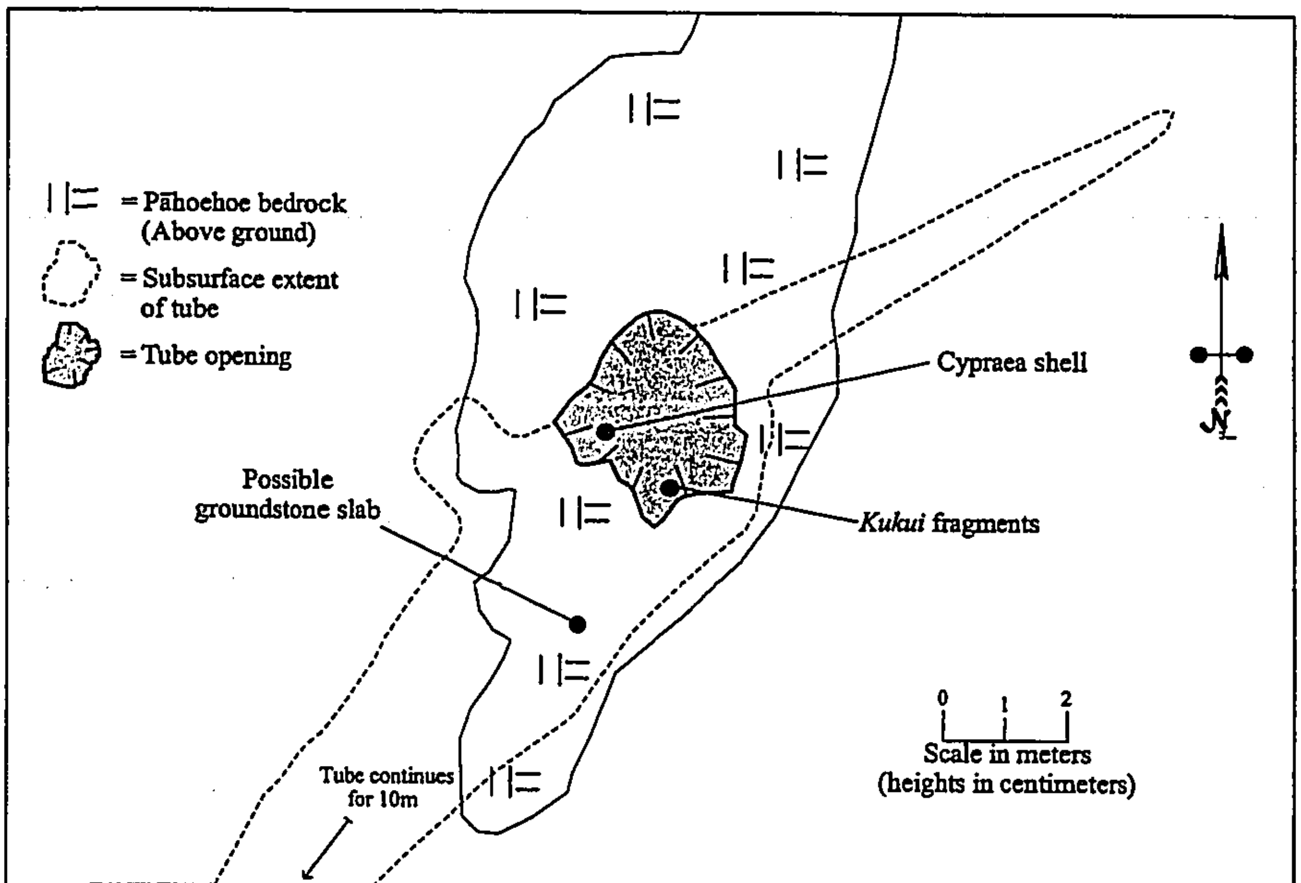


Figure 104. SIHP Site 14365 plan view.

SIHP Site 14366

Site 14366 is a rectangular platform located in the southeast portion of the project area near the southern property boundary (see Figure 5). The site is constructed in a natural depression area with an *'a'ā* outcrop rising up to 1.5 meters above ground surface near the feature's north and west edges. The platform measures 4.8 meters long by 3.9 meters wide (Figure 105). It is constructed with neatly stacked (4-5 courses; up to 1.0 meter high) *'a'ā* cobbles along the exterior edges, and the surface is paved with small sized *'a'ā* cobbles (Figure 106). A small depression (30 centimeters in diameter by 25 centimeters deep) is located in the southeastern portion of the platforms surface. A possible stepped entryway leads from ground surface in the southeast corner of the site up a bedrock outcrop at the platform's surface. Site 14366, based on its formal attributes (i.e. elevated platform with a level surface) and its small size (18.72 square meters), likely functioned as a Precontact temporary habitation, perhaps related to the agricultural features in its vicinity (Site 14342). No subsurface testing was preformed at this site as it is slated for preservation.

SIHP Site 14367

Site 14367 consists of a lava blister habitation area (Feature A) and a petroglyph panel (Feature B) located in the central portion of the project area along the south edge of the probable route of Site 14362 (a *mauka/makai* trail) (see Figure 5). It appears as though Feature A was utilized for temporary habitation purposes and that the petroglyph images (Feature B) were created by the individual(s) residing there. The nature of the habitation may have been directly linked to the nearby trail route (Site 14362). Precontact Hawaiians (and later historic individuals), traveling between the coastal and upland resource areas, may have stayed at this site periodically on an "as neede" basis when rest or shelter was required. Marine shell fragments, bottle glass, metal wire, and modern bullet were all found at the site further pointing to its habitation function and continued use into Historic and Modern times The petroglyphs, although most likely created by people(s) staying at the site, may have served as a Precontact "road sign" along the trail transmitting a mutually intelligible message from the artist to passing travelers (Kwiatkowski 1991). Site 14367 is slated for preservation) Individual feature descriptions follow below andtheir locations are shown on Figure 107.

Feature A

Feature A consists of a *pāhoehoe* bedrock sink with three small lava blisters (large enough for habitation) spaced around its edges (see Figure 107). The central area of the sink measures 7.0 meters in diameter and has been very roughly paved with *pāhoehoe* slabs. The blisters are located one along the *mauka* edge and two at the *makai* edge. The largest of these blisters (along the *mauka* edge) measures 3.0 meters wide by 5.0 meters deep by 1.2 meters high; the two others are slightly smaller (Figure 108). All three have been cleared of cobble rubble leaving smooth bedrock floors. Three *cellana* shell fragments were observed in the southwest corner of the sink. Metal wire, bottle glass, and a bullet casing were also found, but these were most likely later additions to the site, perhaps left by goat hunters.

Feature B

Feature B is a petroglyph panel located 12 meters northwest of Feature A (see Figure 107). The images are pecked into smooth *pāhoehoe* bedrock (Figure 109) and consist 3 definite anthropomorphs and 1 badly eroded image that is most likely an anthropomorph (Figure 110). Other motifs (such as a circle) may be present, but the panel is very weathered making this difficult to discern or record. Feature B is located along the south edge of the probable route of Site 14362 (a *mauka/makai* trail) and may have functioned as a form of Precontact "road sign" (Kwiatkowski 1991).

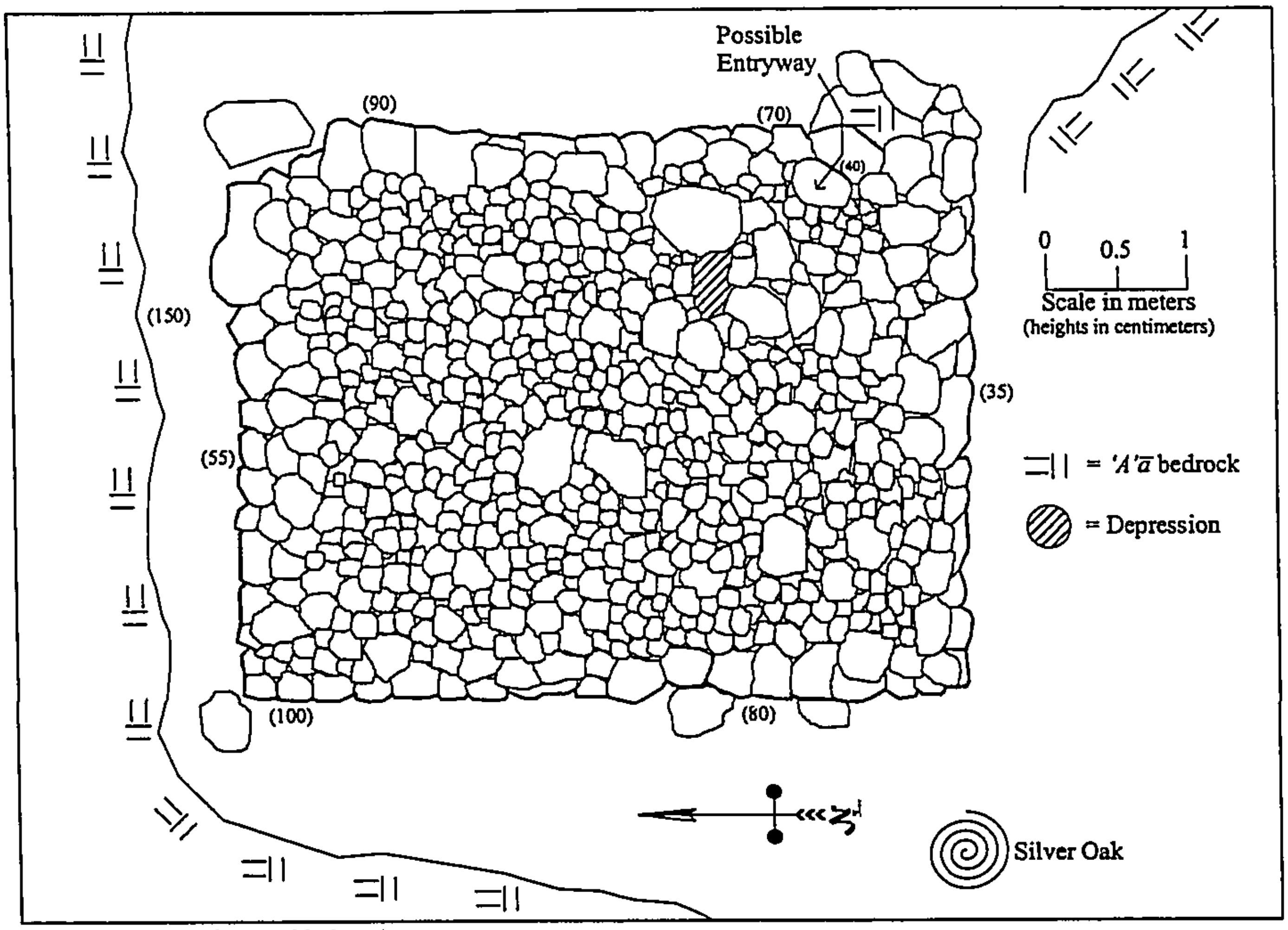


Figure 105. SIHP Site 14366 plan view.

Figure 106. SIHP Site 14366 view to south.

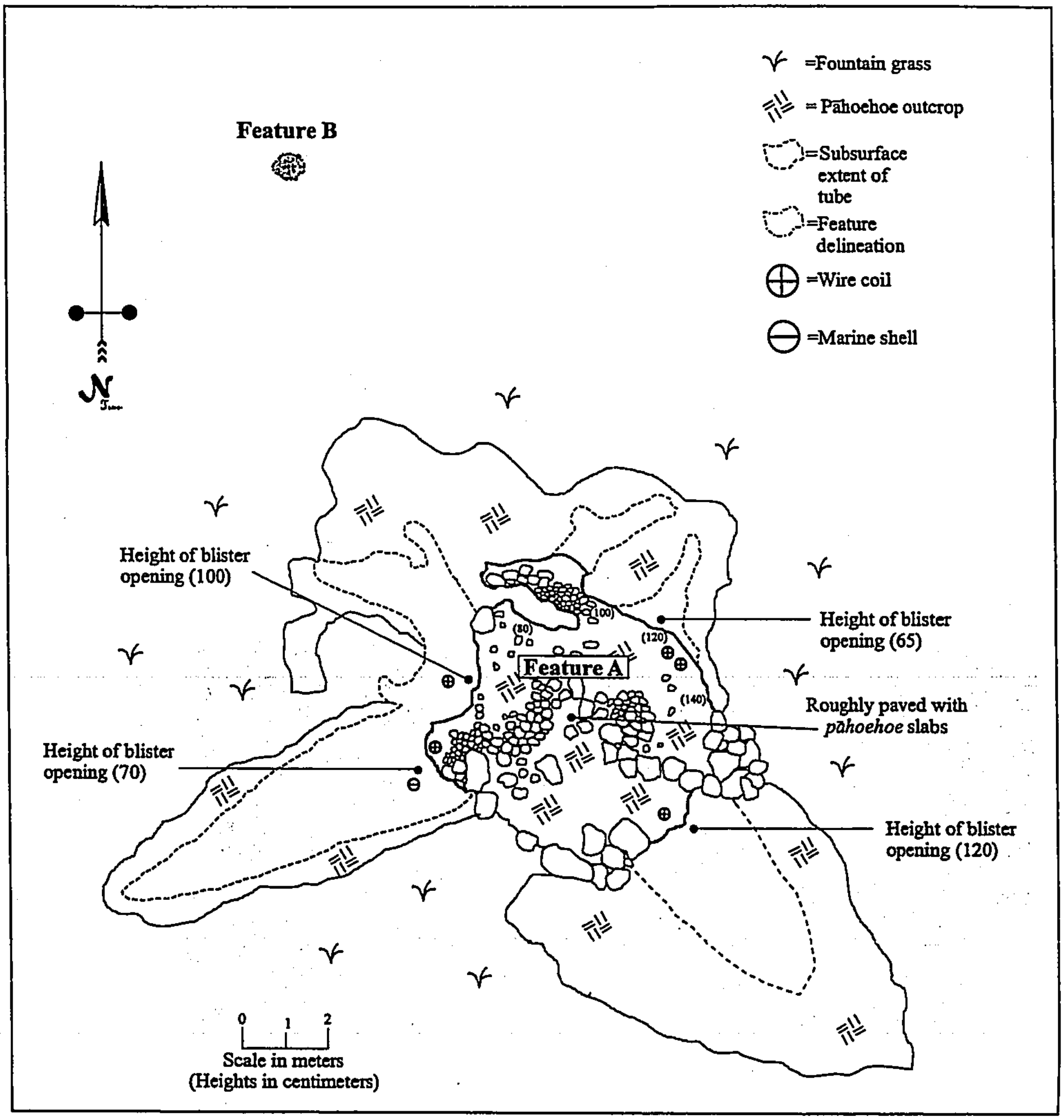


Figure 107. SIHP Site 14367 plan view.

Figure 108. SIHP Site 14367 Feature A paved area and *makai* blister opening view to west.

Figure 109. SIHP Site 14367 Feature B overview to east.

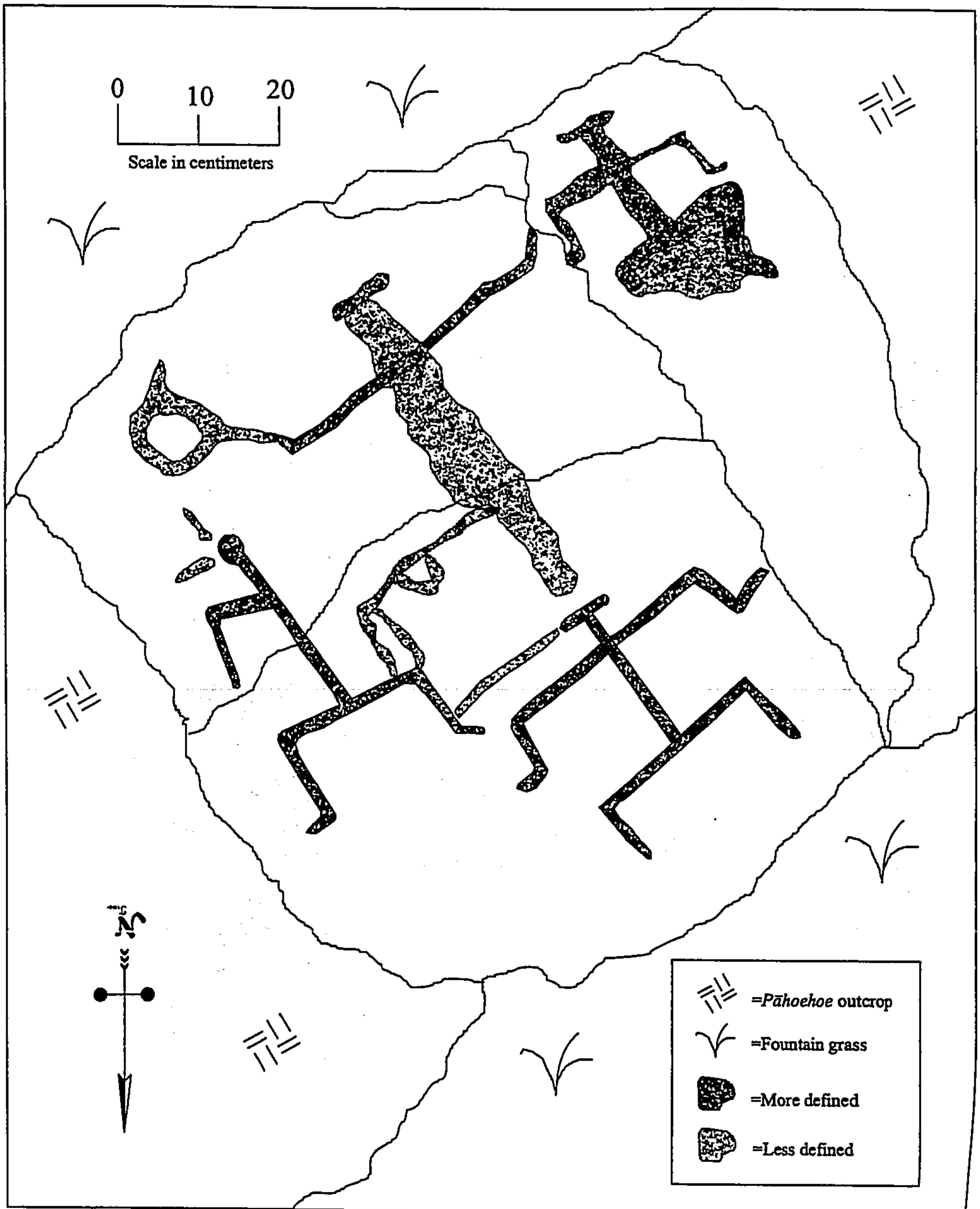


Figure 110. SIHP Site 14367 Feature B plan view.

SIHP Site 14368

Site 14368 is a Precontact habitation/agricultural complex concentrated in and around a series of collapsed lava tube openings stretching *mauka/makai* for approximately 750 meters along the northern boundary of the project area (see Figure 5). The lava tube system contains six collapsed openings in *pāhoehoe* bedrock, connected, for the most part, by a sub-surface passage. Ground surface in the vicinity of Site 14368 slopes gently to the west and consists primarily of *pāhoehoe* bedrock and cobbles covered by sparse soil and fountain grass (Figure 111); *'a'ā* flows are present to the north and south of the site. Only the eastern portion of the tube system is within the Kaū Ahupua'a project area; the western portion trails into Pu'ukala Ahupua'a. The habitation area itself is centered in and around the two eastern-most openings and consists of two lava tube habitation areas (Features A and C), a concentration of 24+ stone mounds (Feature B), a circular cairn (Feature D), and two stone alignments (Features E and F) (Figure 112). In addition to these features, a possible stepping-stone trail segment was noted running northeast (away from the project area) from the eastern most tube opening (Feature C). Also, several more stone mounds were noted to the north of the ones recorded as Feature B, but were located well outside of the current project area so were not recorded themselves. A old wooden pole marking the property boundary is located 1.2 meters south of Feature D, just to the east of Feature C. Extensive bulldozing has occurred to the north and east of Site 14368.

The lava tube openings (Features A and C) at Site 14368 most likely served as the main habitation area. They would have provided the most shelter and shade in the barren landscape and are large enough to be comfortable living areas. Features A and C also contain all the habitation debris noted at the site and the only constructed habitation features (three terraces). Feature B, the collection of mounds, may represent the remains of a small household garden associated with Features A and C. Agriculture would have been difficult in this marginal area of North Kona, but residents of the lava tubes may have attempted to cultivate crops such as sweet potato to make daily subsistence easier. Since there is almost no soil on the *pāhoehoe* bedrock surrounding the lava tube openings, the mounds could have been constructed as planting features. If mulched, the mounds would retain moisture and soil and perhaps create a suitable environment for the cultivation of sweet potato. Based on the paucity of food remains at Site 14368 along with the insubstantial construction of the habitation features, it appears that the nature of the habitation was perhaps semi-permanent or seasonal. The presence of the garden, however, suggests that the site was utilized on more than a temporary basis. Feature D (a circular cairn) is most likely a Historic feature formerly used to mark the boundary of the study parcel. Features E and F (stone alignments) may either be agricultural features related to feature B, but further removed, or boundary markers related to Feature D, as they are located directly on the project area boundary. Individual feature descriptions follow and their locations are shown on Figure 112.

Figure 111. SIHP Site 14368 view to southwest from Feature C towards Feature A.

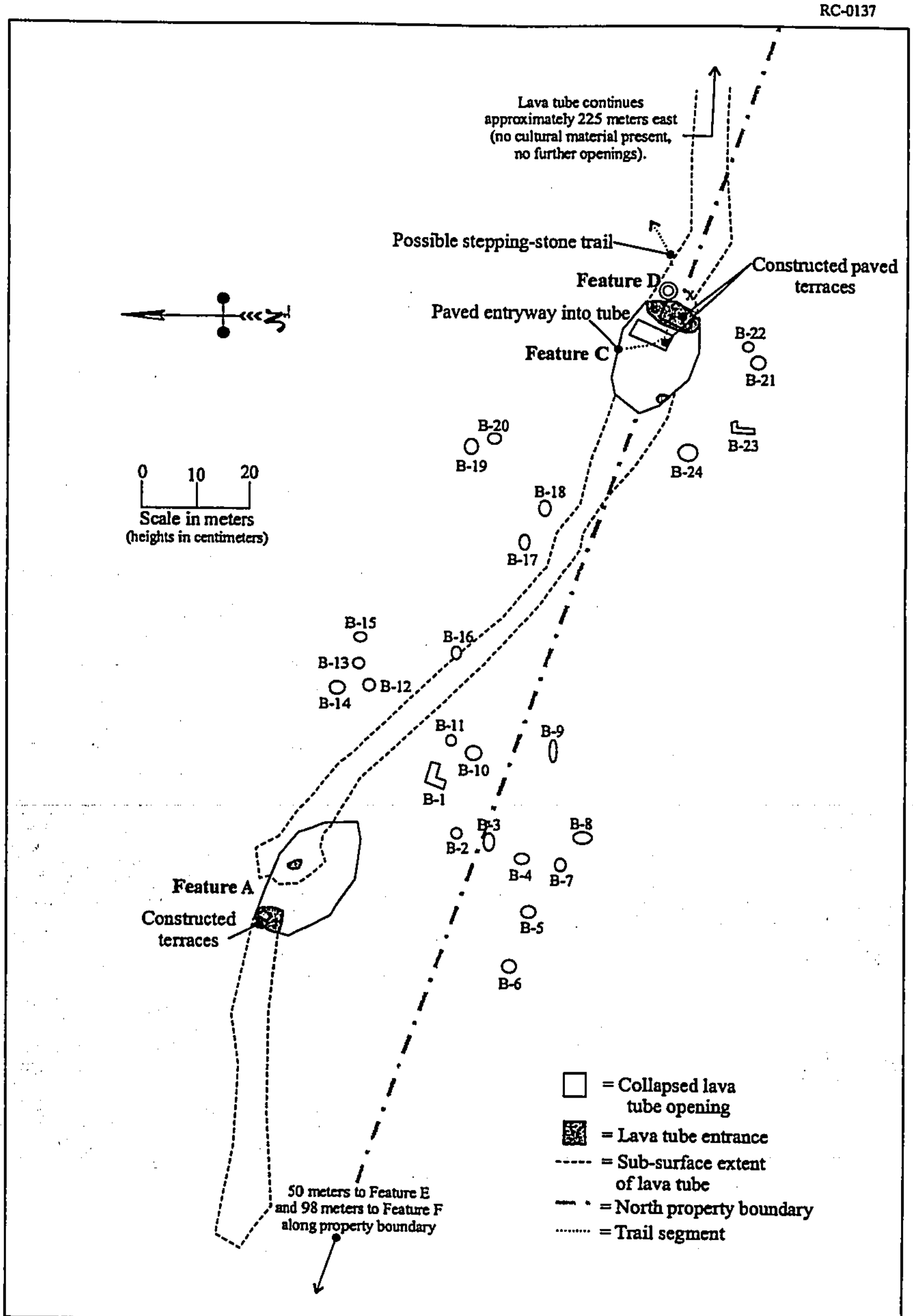


Figure 112. SIHP Site 14368 Features A-D plan view.

Feature A

Feature A is the western-most of the two collapsed lava tube openings used for habitation at Site 14368 (see Figure 112). The opening measures 20 meters long by 10 meters wide by up to 6 meters deep. The interior of the opening consists of piled rubble reaches to ground surface outside the feature in some locations. A large lava tube runs west from an entrance at the western end of the collapsed opening for approximately 70 meters before becoming impassable. Two terraces are constructed, one above the other, at the western end of the opening beneath the overhang at the beginning of the lava tube along its north side. The upper (eastern) terrace measures 2.3 meters (east/west) by 2.7 meters (north/south) and rises 75 centimeters above the lower (western) terrace, which measures 3.2 meters (east/west) by 2.6 meters (north/south) and rises 90 centimeters above the tube floor. Both terraces are constructed of stacked *pāhoehoe* slabs and cobbles and have roughly paved level surfaces. Several urchin fragments were observed on ground surface near these features. A second small lava tube entrance (Figure 113) located along the north edge of Feature A leads to an underground passage connecting it with Feature C approximately 100 meters to the east. Urchin fragments were also observed within this opening, but no architectural modification was discovered.

Figure 113. SIHP Site 14368 Feature A terraces view to east from inside lava tube.

Feature B

Feature B is a collection of 24 stone mounds located in an area 130 meters long by 60 meters wide between Features A and C (see Figure 112). As previously mentioned, additional mounds continue to the north, but were not recorded as they are located well outside of the current project area. The mounds of Feature B are all piled on *pāhoehoe* bedrock (Table 11). They are constructed largely of *pāhoehoe* cobbles, though some *'a'ā* cobbles are also present. The mounds are all of various shapes and sizes (Figures 114 and 115), but probably functioned as agricultural planting features (see above).

Table 11. Agricultural features of SIHP Site 14368 Feature B.

Feature #	*Feature Type*	*Shape*	*Length (m)*	*Width (m)*	*Height (m)*	*Attribute*
B-1	Mound	L-shaped	4.3	3.3	0.7	Piled
B-2	Mound	Circular	2.0	2.0	0.6	Piled
B-3	Mound	Linear	4.0	1.1	0.6	Piled
B-4	Mound	Irregular	3.5	1.9	0.8	Piled
B-5	Mound	Circular	2.0	2.0	0.3	Piled
B-6	Mound	Oval	2.2	1.3	0.3	Piled
B-7	Mound	Oval	2.0	1.3	0.5	Piled
B-8	Mound	Oval	4.7	2.7	0.6	Piled
B-9	Mound	Linear	4.3	1.0	0.5	Piled
B-10*	Mound	Oval	3.1	3.1	0.7	Piled
B-11*	Mound	Circular	1.8	1.8	0.6	Piled
B-12	Mound	Circular	2.7	2.7	0.7	Piled
B-13	Mound	Circular	2.1	2.1	0.6	Piled
B-14	Mound	Circular	2.2	2.2	0.7	Piled
B-15	Mound	Oval	2.7	1.3	0.5	Piled
B-16	Mound	Oval	2.5	1.7	0.5	Piled
B-17	Mound	Oval	2.4	1.6	0.6	Piled
B-18	Mound	Circular	2.1	2.1	0.5	Piled
B-19	Mound	Circular	2.3	2.3	0.3	Piled
B-20	Mound	Circular	2.4	2.4	0.3	Piled
B-21	Mound	Circular	2.0	2.0	0.4	Piled
B-22	Mound	Circular	1.3	1.3	0.4	Piled
B-23	Mound	L-shaped	3.0	2.5	0.5	Piled
B-24	Mound	Circular	2.5	2.5	0.8	Piled

*see photograph below.

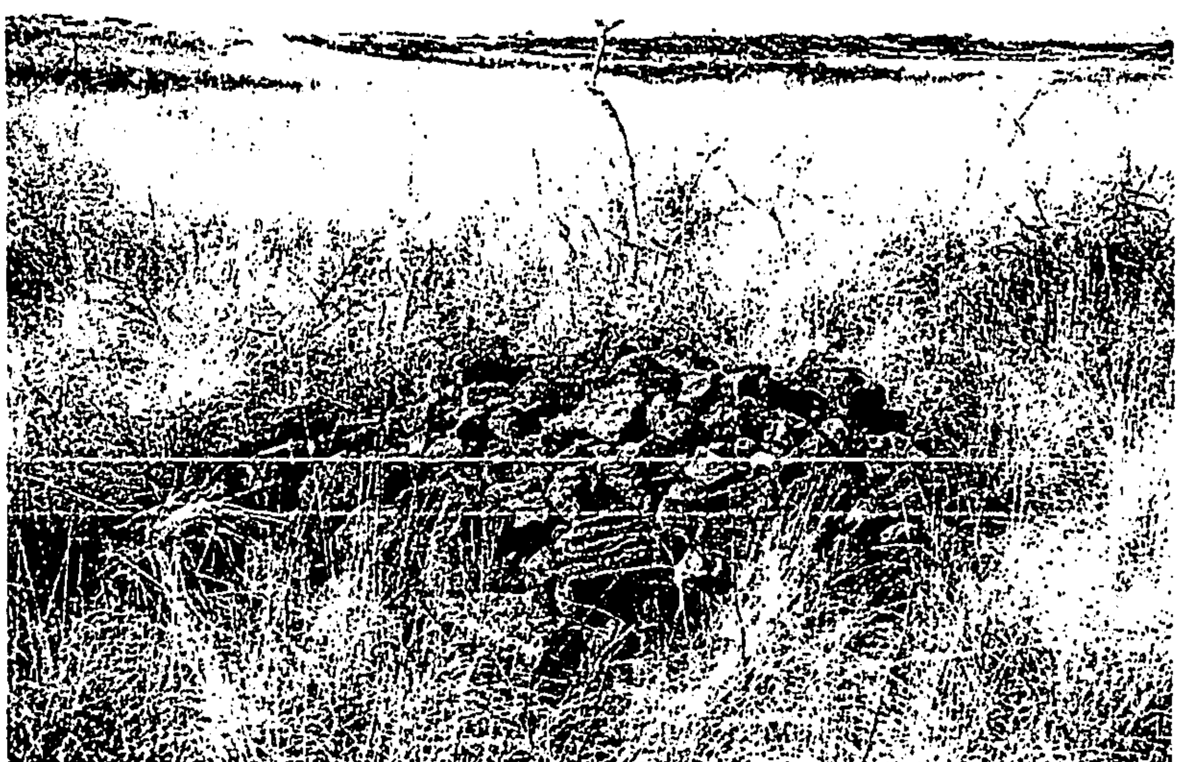


Figure 114. SIHP Site 14368 Feature B-10 view to south.


Figure 115. SIHP Site 14368 Feature B-11 view to west.

Feature C

Feature C is the easternmost of the two collapsed lava tube openings used for habitation at Site 14368 (see Figure 112). The opening measures 15 meters by 12 meters and is connected underground to Feature A through a small tube entrance located in its southwest corner. A large lava tube entrance (12 meters by 7 meters) also leads to the east from the opening. A paved entryway (path) runs into the collapsed opening from the bedrock ground surface on its north side. This 1-meter wide path is roughly paved with *pāhoehoe* slabs that run a meandering course southeast from ground surface for approximately 8 meters to a paved terrace area (Figure 116). The paved terrace is located at the eastern end of the opening exposed to the elements. The terrace measures 8.0 meters long by 3.0 meters wide and is roughly paved with *pāhoehoe* slabs (Figure 117). The path then leads east from this feature to a second paved terrace located below the first (2 meters to the east) just within the overhang of the tube. This terrace measures 6.0 meters by 6.0 meters and is also roughly paved with *pāhoehoe* slabs. Its eastern edge is partially faced with upright *pāhoehoe* slabs with a height 60 centimeters above the tube floor (Figure 118). Some marine shell fragments were found associated with these terraces.

To the east of the lower paved terrace, the tube floor is smooth and level, cleared of cobbles, and covered by a thin layer of silt. This area, too, was most likely used for habitation. The cleared area measures 7.0 meters across (from tube edge to tube edge) by seven meters high (from floor to ceiling) by 15.0 meters deep (to a point where the tube ceiling lowers to 1.6 meters above the floor and the clearing stops). A significant deposit of marine shell and urchin fragments were found within the cleared area. The lava tube continues approximately 225 meters further east before becoming impassable, but no further cultural material was present beyond the clearing.

Figure 116. SIHP Site 14368 Feature C paved path leading into opening view to north.

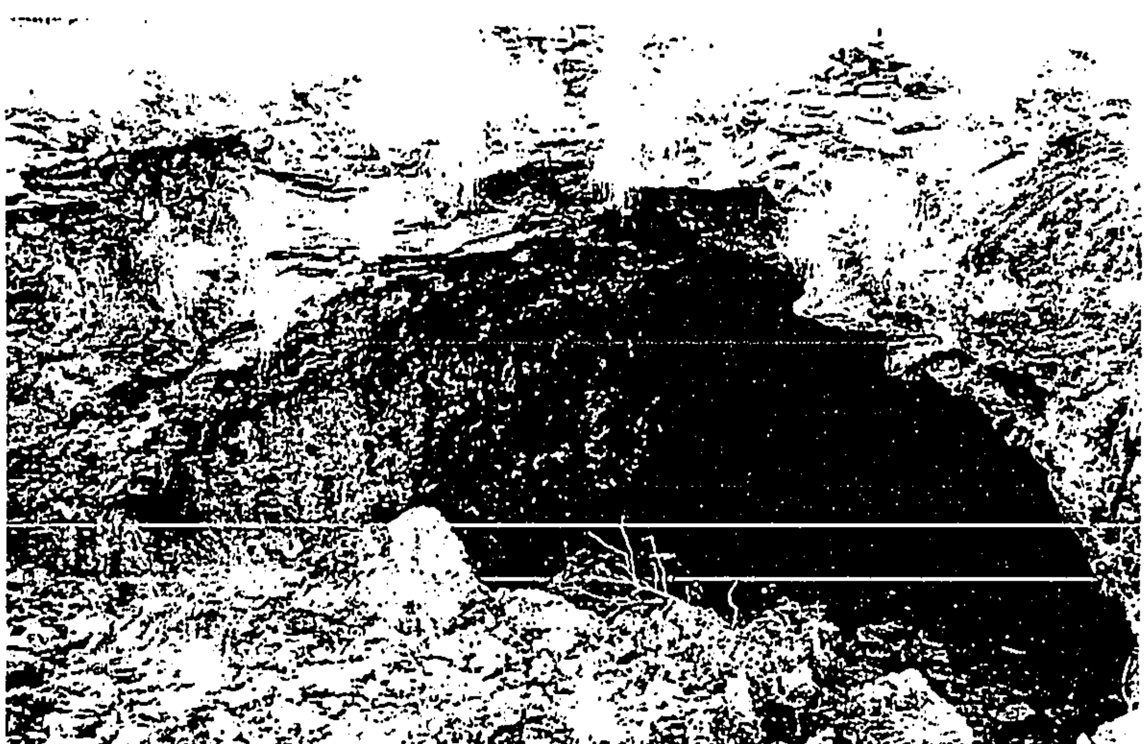


Figure 117. SIHP Site 14368 Feature C upper paved terrace and eastern tube entrance view to east.

Figure 118. SIHP Site 14368 Feature C lower terrace view to southwest.

Feature D

Feature D is a circular cairn located on ground surface at the eastern edge of Feature C above the eastern tube entrance (see Figure 112). The location of the cairn corresponds almost exactly to the northern boundary of the study parcel. Also, an old wooden pole marking the property boundary is standing upright 1.5 meters south of Feature D (Figure 119). Due to its proximity to the property boundary and nearness to the property pole, it is suggested that Feature D functioned as a boundary marker prior to the placement of the more recent pole. Feature D has the appearance of a circular enclosure with no opening. It measures 3.2 meters in diameter (from exterior edge to exterior edge) with an interior diameter of 1.2 meters (Figure 120). The feature is constructed of stacked *pāhoehoe* slabs resting on bedrock and standing up to 80 centimeters above ground surface. The southeast edge of the cairn is largely collapsed. A single fragment of metal wire was found within Feature D's enclosed area.

Figure 119. SIHP Site 14368 Feature D and nearby wooden pole view to west.


Figure 120. SIHP Site 14368 Feature D close-up view to north of collapsed southeast side.

Feature E

Feature E is a stacked *pāhoehoe* cobble alignment 2 courses (45 centimeters) high located along the northern property boundary approximately 50 meters southwest of the main habitation area at Site 14368 (see Figure 5). The alignment runs for 4.9 meters along the property boundary. It is constructed of *pāhoehoe* slabs and cobbles (Figure 121). Feature E may have been leveled along its north side with the surrounding bedrock giving it a width of 1.8 meters. This feature most likely functioned as a boundary marker similar to Feature D, but could also have been used as an agricultural terrace similar to the mounds of Feature B.

Feature F

Feature F is an L-shaped alignment of *pāhoehoe* cobbles stacked against a natural bedrock outcrop located along the northern property boundary 48 meters southwest of Feature E (see Figure 5). Each segment of the L-shaped alignment measures 2.2 meters long and stands up to 60 centimeters above ground surface along its interior north and east edges (Figure 122). The south and west sides of the alignment are level with a bedrock outcrop. The walls of Feature F have a core-filled appearance and may date to the Historic period. A modern (recently placed) survey marker is located four meters west of the L-shaped alignment. Feature F may be a boundary marker similar to Features D and E, or it could have possibly been utilized as a temporary habitation, although no habitation debris was present.

Figure 121. SIHP Site 14368 Feature E view to east.

Figure 122. SIHP Site 14368 Feature F view to south.

SIHP Site 14369

Site 14369 is a small, circular arrangement of stones located in the western portion of the project area, just east of the power-line road (see Figure 5). The site consists of a collection of approximately 30 *pāhoehoe* cobbles and 10 *pāhoehoe* slabs arranged in a half-circle upon the surrounding *pāhoehoe* bedrock surface (Figure 123). Two of the slabs are standing upright, 47 centimeters above ground surface, along the north edge of the feature, while the rest have collapsed. The arrangement of the stones measures 2.15 meters N/S by 2.25 meters E/W and resembles a C-shape enclosure opening to the south. This site was previously identified by Ogden (Schilz et al. 1990) during their inventory survey of the project area as a "hunting blind" — an orange plastic tag was found at the site with the markings ERCE-10-110. This interpretation of the site's function was approved by DLNR-SHPD and is retained for the current study.


Figure 123. SIHP Site 14369 view to northeast.

SIHP Site 14371

Site 14371 is a permanent habitation platform located in the east central portion of the project area along the south edge of the main access road near Sites 23884, 23885, and 23886 (see Figure 5). The site consists of a low-lying rectangular platform (Feature A) with a smaller, higher rectangular platform protruding from its northwest corner (Feature B) (Figure 124). It is situated on level *pāhoehoe* bedrock at the top of a moderate slope with an excellent view to the coast. Vegetation in the area consists of fountain grass, Christmas-berry, *koa haole*, and one large, but dead *wiliwili* tree. A small amount of *kukui* was recovered from a 1 x 1 meter test unit (TU-5) excavated at Feature B. Site 14371, based on its large size and formal attributes, is interpreted as a Precontact permanent habitation (Cordy 1981, 1995).

Feature A

Feature A is a low-lying platform, measuring 4.5 meters (east/west) by 5.5 meters (north/south), built on *pāhoehoe* bedrock (Figure 125). The feature is constructed with a single course of large *pāhoehoe* slabs lining its exterior edges, and smaller cobbles paving the central area (Figure 126). The platform is elevated approximately 50 centimeters above ground surface around its entire perimeter. Feature A was most likely the main habitation area of Site 14371. A cleared area on natural ground surface to the south of Feature A may also have been utilized as a living area.

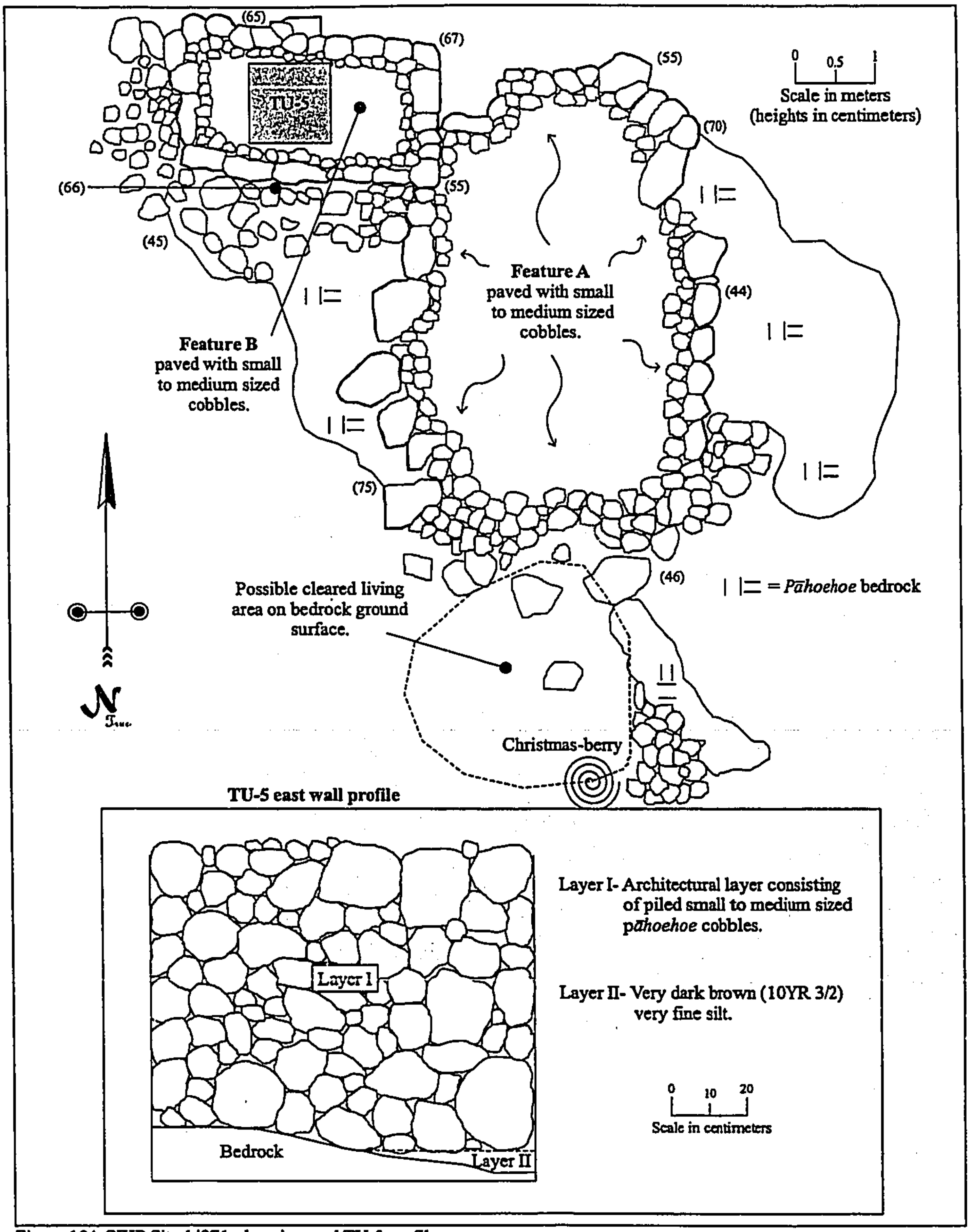


Figure 124. SIHP Site 14371 plan view and TU-5 profile.

Figure 125. SIHP Site 14371 view to north (towards Feature B) of Feature A's west wall.

Figure 126. SIHP Site 14371 Feature A platform surface view to west.

Feature B

Feature B is a second smaller platform built off the northwest corner of Feature A. Feature B measures 3.0 meters (east/west) by 1.7 meters (north/south) and stands up to 65 centimeters above ground surface. It too is lined along its exterior edge with upright *pāhoehoe* slabs and filled with smaller cobbles (Figure 127). The platform's surface is fairly level and only slightly collapsed. Judging by the seemingly more intact nature of Feature B and its taller height, it may have been built more recently than Feature A.

The original thought of fieldworkers was that Feature B might contain a burial. For this reason, a 1 x 1 meter test unit (TU-5) was excavated into the central portion of the feature. Excavation of TU-5 revealed a two-layer stratigraphic profile resting on bedrock (see Figure 124). Layer I, the architectural layer, consisted of piled small to medium sized *pāhoehoe* cobbles and slabs resting on bedrock. A small amount of soil (<0.5 gallons; Layer II) had collected at the base of Layer I at bedrock. This soil, very dark grayish brown (10YR 3/2) very fine silt, was screened through ¼-inch mesh screen. The only cultural material collected was 7.0 grams of *kukui* fragments. Excavation of TU-5 terminated at bedrock 89 centimeters below the unit's surface. The function of Feature B remains uncertain at this time, but it may have also been utilized for habitation. Subsequent data recovery efforts at Site 14371 may help to further refine this interpretation.

Figure 127. SIHP Site 14371 Feature B close-up view to west.

SIHP Site 14372

Site 14372 is a modified outcrop centrally located within the project area along the southern edge of a probable *mauka/makai* trail route (Site 14362) (see Figure 5). The site is situated in a relatively open, moderately sloping *pāhoehoe* lava field; fountain grass and *koa haole* are the main plant species in this zone. The feature is built up against a sloped (to the south) *pāhoehoe* bedrock outcrop, located approximately 20 east of Site 23876.

The platform measures 5.0 meters long (east/west) by 4.5 meters (north/south), and is constructed with angular *pāhoehoe* (80%), and *'a'ā* (20%) cobbles (Figure 128). The surface of the feature slopes south, possibly due to disturbance; the only sign of structural integrity is the western edge where *pāhoehoe* slabs are stacked 70 centimeters high (see Figure 128). The southern edge tapers down abruptly to the ground surface; no trace of a once intact line of original wall was observed. The eastern edge has areas of intact-stacked *pāhoehoe* slabs, and the northern portion of the platform terminates along the raised bedrock outcrop.

A 1.5-meter deep crevasse in the *pāhoehoe* bedrock parallels the north edge of the platform, and a lava tube, accessible through the crevasse near the northeastern corner of the platform, extends west for approximately 10.0 meters. No portable cultural debris was observed in association with Site 14372; neither on the features surface or within the lava tube. Site 14372, based on its formal attributes, opportunistic location against a bedrock outcrop with minimal construction, and location near a known trail route, likely functioned as a Precontact temporary habitation.

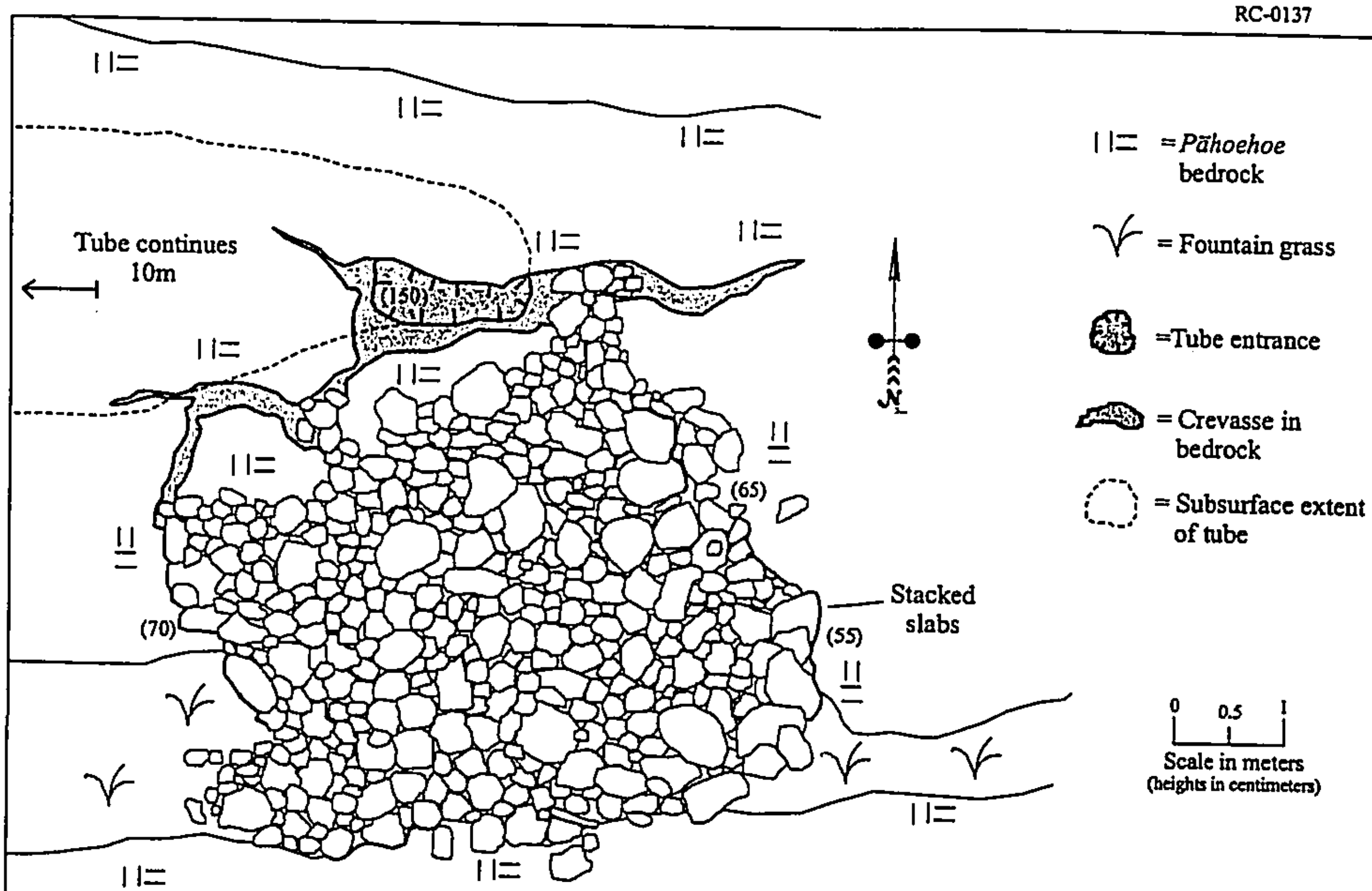


Figure 128. SIHP Site 14372 plan view and photo of stacked western edge view to northeast.

SIHP Site 14373

Site 14373 is a modified lava tube located in the central portion of the project area (see Figure 5). The tube is accessed through a collapsed opening measuring 5.4 meters long by 2.9 meters wide by 1.9 meters deep (Figure 130). Entry to the tube floor is facilitated by large cobbles and boulders piled in the southwest corner of the opening to create a rough ramp. The tube floor within the opening has been largely cleared of cobble rubble leaving bedrock covered by thin soil and vegetation. The cleared cobbles were used to construct the entryway and the two additional features (Features A and B) located at opposite ends of the opening. Two fragments of branch coral were discovered near Feature A at the north end of the opening. A subsurface passage extends east from the south end of the opening for approximately 10 meters before gradually pinching out. When originally recorded by Ogden (Schilz et al. 1990) Site 14373 was thought to have served a ceremonial function (most likely because of the presence of branch coral). However, more detailed recording and testing carried out during the current inventory survey suggests that Site 14373 was most likely utilized for temporary habitation purposes, perhaps with an associated household shrine (Feature A; see below).

Feature A

Feature A is located at the north end of the opening partially under an overhang (see Figure 129). The feature, a roughly rectangular collection of *pāhoehoe* cobbles and slabs, measures roughly 1.3 meters long by 1.1 meters wide, and is located approximately 85 centimeters above the floor of the tube. Feature A is constructed with *pāhoehoe* slabs, standing on edge, placed around its exterior. The central area of Feature A is filled with small to medium sized cobbles (Figure 130). Two branch coral fragments were discovered on bedrock near the feature's northeast corner. A 1 x 1 meter test unit (TU-9) was excavated in the central portion of Feature A. Excavation of TU-9 revealed a single architectural layer (Layer I) of *pāhoehoe* cobbles and slabs up to 50 centimeters thick resting on bedrock (see Figure 129). Cultural material recovered from Layer I included a *kukui* fragment, urchin, and marine shell fragments (Table 12). Excavation of TU-9 terminated at bedrock (Figure 131). The form of Feature A, along with its small size and the presence of branch coral, suggest that it may have functioned as a household shrine. The presence of food remains at Feature A could be coincidental—if they were discarded at the feature and filtered into Layer I—and may not be related to the feature's function, but rather to the function of the site as a whole.

Table 12. Recovered cultural material from SIHP Site 14373 Feature A TU-9.

ACC#	Layer	Material	Species/type	Count	MNI	Weight (g)
81	I	Shell	*Cypraea*	4	2	2.8
82	I	Shell	*Echinoidea*	10	-	1.0
83	I	Organic	*Kukui*	1	1	1.0

Feature B

Feature B is a rough terrace of *pāhoehoe* slabs and cobbles located at the southern end of the tube opening partially within the sub-surface passage (see Figure 129). Feature B measures 2.5 meters long by 2.1 meters wide and stands up to 50 centimeters above the tube floor along its western edge. The surface of Feature B is roughly paved with *pāhoehoe* slabs (Figure 132). The western edge of the feature was formerly stacked, but is now mostly collapsed with the exception of a 0.8 meter segment at its eastern end. The north and south edges of the terrace abut the sides of the lava tube, while the eastern edge is nearly level with the tube floor. Feature B may have been utilized as the main habitation feature at Site 14373, or it may represent a stacked clearing pile of rubble removed from the tube floor. Further data recovery will help answer that question.

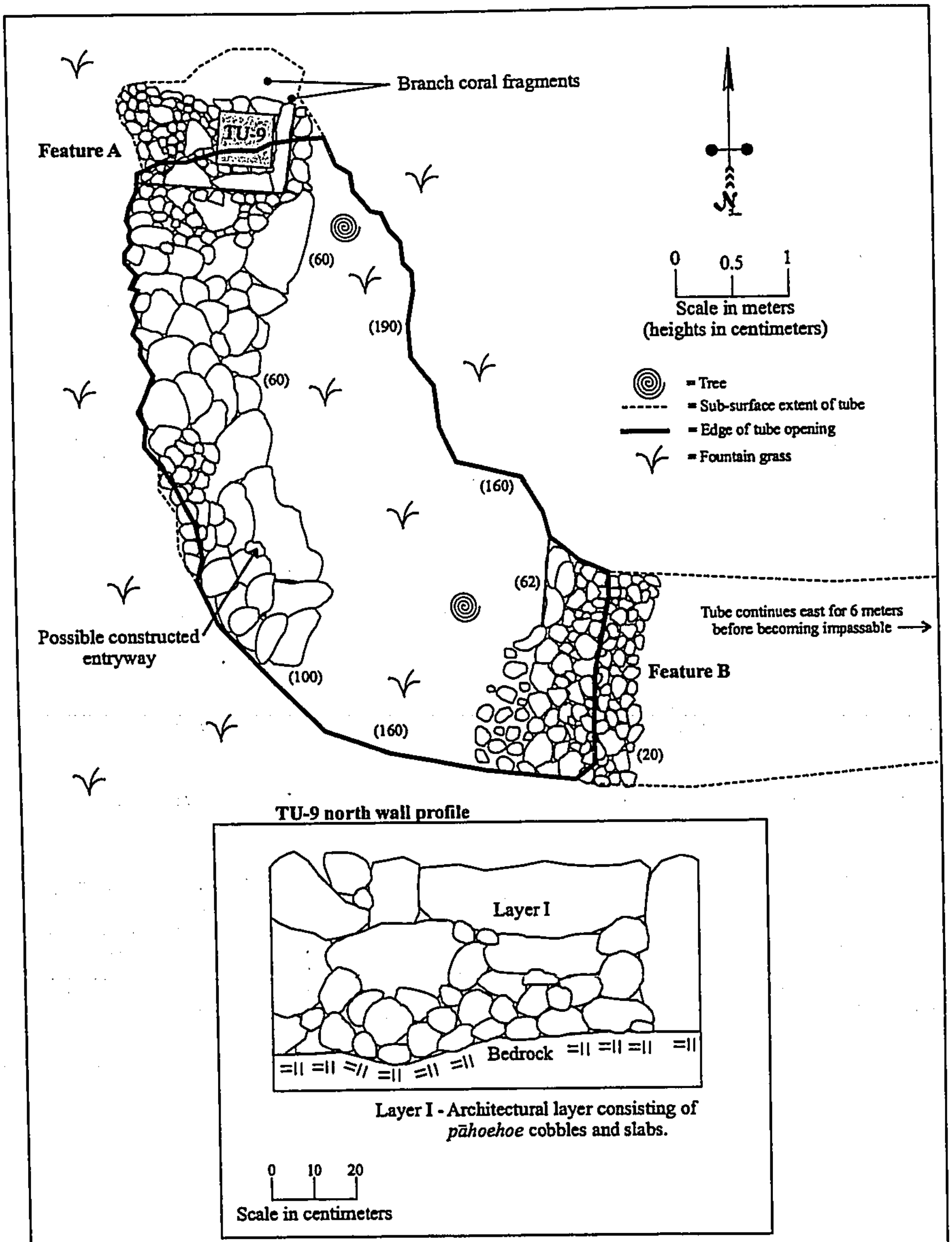


Figure 129. SIHP Site 14373 plan view and TU-9 profile.

Figure 130. SIHP Site 14373 Feature A view to north.

Figure 131. SIHP Site 14373 Feature A TU-9 base of excavation view to north.

Figure 132. SIHP Site 14373 Feature B view to east from tube entrance.

SIHP Site 14374

Site 14374 consists of a C-shaped enclosure (Feature A) and two cairns (*ahu*) (Features B and C) located within a long, narrow *pāhoehoe kipuka* centrally located within the project area (see Figure 5). The site rests along the north edge of an *'a'ā* flow that opens up onto an older, smooth *pāhoehoe* flow, measuring 10 meters across, that runs a meandering course *mauka/makai* for approximately 280 meters. Feature A probably served as temporary habitation along the edge of a *mauka/makai* travel route following the *pahoehoe kipuka* through the surrounding *a'a* fields. The trail itself could not be traced (with the possible exception of a short segment marked by worn *pāhoehoe* just east of the site), but if it did exist it most likely followed the route marked by the two cairns (Figure 133). Vegetation in the area consists of fountain grass and silver oak.

Feature A

Feature A is a C-shaped enclosure located centrally between Features B and C (see Figure 133). Constructed of *'a'ā* cobbles and *pāhoehoe* slabs, the enclosure opens to the north and measures 2.3 meters N/S by 3.0 meters E/W (Figure 134). The interior edge of Feature A reaches a height of 60 centimeters above ground surface, and is roughly paved with smooth *pāhoehoe* slabs.

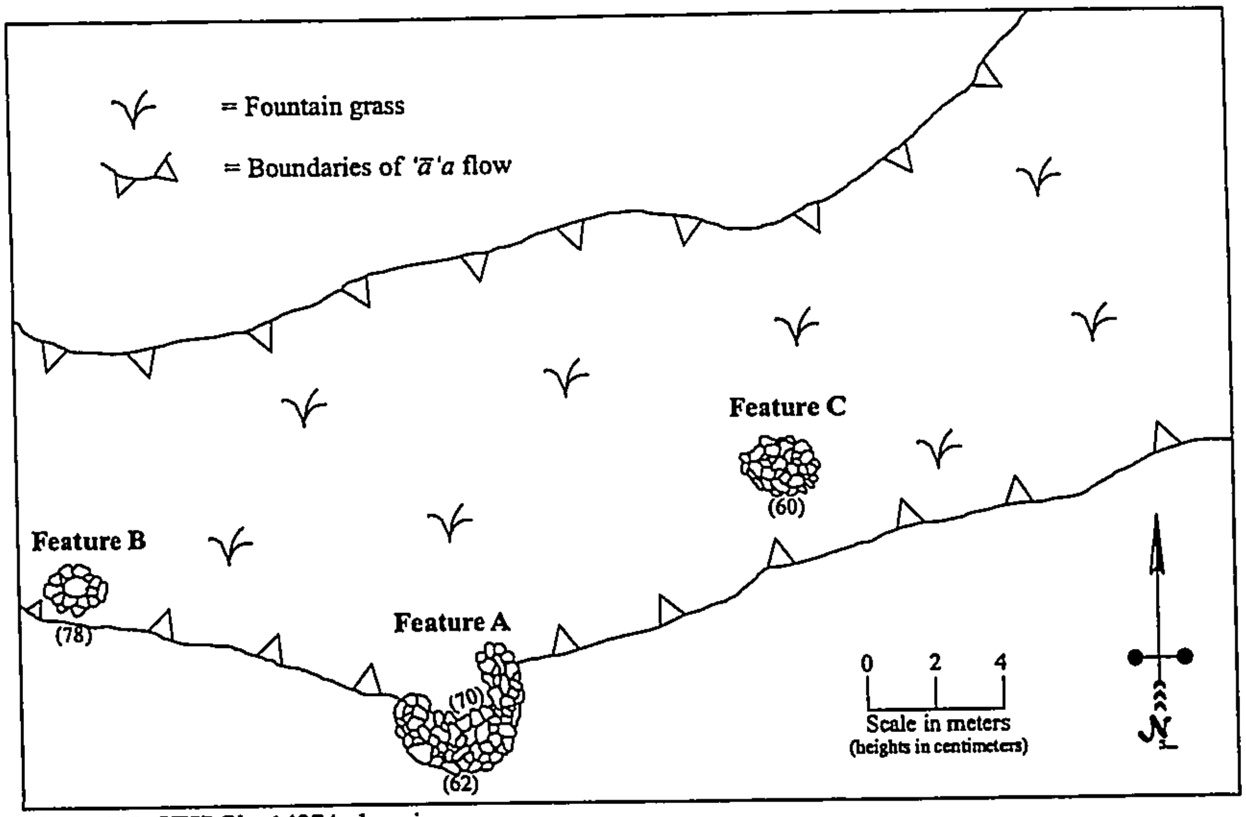


Figure 133. SIHP Site 14374 plan view.

Figure 134. SIHP Site 14374 Feature A view to south.

Feature B

Feature B is a cairn (*ahu*) located at the *makai* edge of Site 14374 (see Figure 133). The cairn is constructed of loosely stacked and piled *'a'ā* cobbles. It measures 1.7 meters in diameter and rises up to 90 centimeters above ground surface (Figure 135). Feature B rests along the south edge of the *kīpuka*, 8 meters west of Feature A and nearly 20 meters west of Feature C.

Figure 135. SIHP Site 14374 Feature B view to north.

Feature C

Feature C is a second cairn (*ahu*) located at the *mauka* edge of Site 14374, along the southern edge of the *kipuka* 10 meters east of Feature A (see Figure 133). The cairn is built mainly with piled *'a'ā* cobbles, but includes a few *pāhoehoe* cobbles. Feature C measures 2.2 meters (east/west) by 1.5 meters (north/south) and reaches a maximum height of 55 centimeters above the surrounding ground surface (Figure 136).

Figure 136. SIHP Site 14374 Feature C view to east.

SIHP Site 14375

Site 14375 is a Precontact habitation complex located in the central portion of the project area along the southern property boundary (see Figure 5). The site consists of 4 lava tube/collapsed blister habitations (Features A, B, C, and E) none of which are connected by subsurface passageways, a stepping-stone trail segment (Feature D), and a temporary habitation enclosure (Feature F). These features are located in an area approximately 200 meters long by 70 meters wide. Several additional non-cultural collapsed lava blisters are also present within the site area. All blisters and subsurface passageways were explored to their fullest possible extent during the course of recording Site 14375. The identified cultural remains found at the features are consistent with a Precontact habitation function for Site 14375. Individual feature descriptions are presented below and the features' locations are shown on Figure 137.

Feature A

Feature A is a habitation tube located at the western end of Site 14375 (see Figure 137). Feature A contains four large openings connected by an underground passage. The main habitation chamber (Features A-1 and A-2) is located 82 meters west of the most accessible entrance, which has a stepping stone entryway (Feature A-3). The subsurface portion of the tube is approximately 120 meters long, averages 8.0 meters wide, and stands 1.5-4.0 meters high. The floor of the tube consists of bedrock covered by cobble rubble. Habitation debris was found scattered throughout the feature.

Feature A-1

Feature A-1 is a cleared habitation area on the tube floor located at the western end of Feature A, just west of an inaccessible tube opening (skylight) (Figure 138). The cleared area measures 5.0 meters by 4.0 meters. A circular fire ring, measuring 2.0 meters in diameter and constructed of *pāhoehoe* slabs and cobbles placed on the natural bedrock floor (one course high), is located in the center of the cleared area. The interior of the ring is filled with fine grayish-white ash (Figure 139). Habitation debris identified at Feature A-1 included *kukui*, marine shell fragments (including *Cypraea* and *Cellana*), urchin (*Echinoidea*), pig (*Sus*) and goat bones. The cobbles that were cleared from the central area of Feature A-1 have been loosely stacked and piled (up to 40 centimeters high) along the exterior north and south edges of the clearing. The cleared cobbles form two terraces (up to 1.5 meters wide), roughly paved with *pāhoehoe* slabs and cobbles, against the tube walls (Figure 140). These terraces were likely used as an additional living area. The clearing's east edge is unmodified roof fall material and the west end is a rubble-filled tube passage. The tube becomes impassable approximately 10 meters west of Feature A-1.

Feature A-2

Feature A-2 is an ash concentration on the tube floor located 16.0 meters east of Feature A-1 on the opposite side of the inaccessible tube opening (skylight) (see Figure 137). The ash concentration lies on bedrock, and unlike the one at Feature A-1, Feature A-2 does not have a rock ring encircling it (Figure 141). Habitation debris observed in the vicinity of the ash concentration included *kukui*, charcoal, *Cypraea* shell, and *Echinoidea* fragments, plus one fish bone located 1.0 meter to the west of the feature.

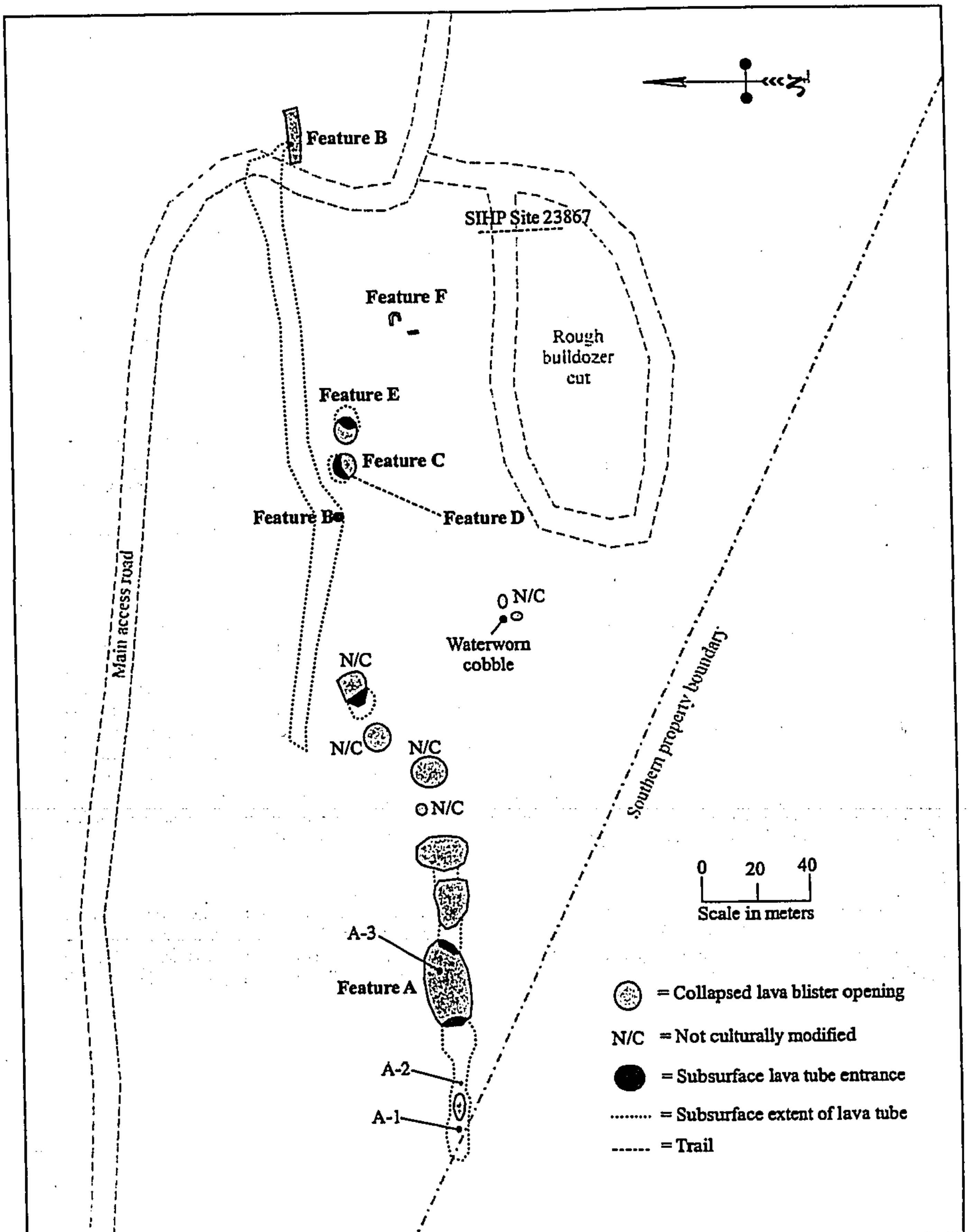


Figure 137. SIHP Site 14375 plan view.

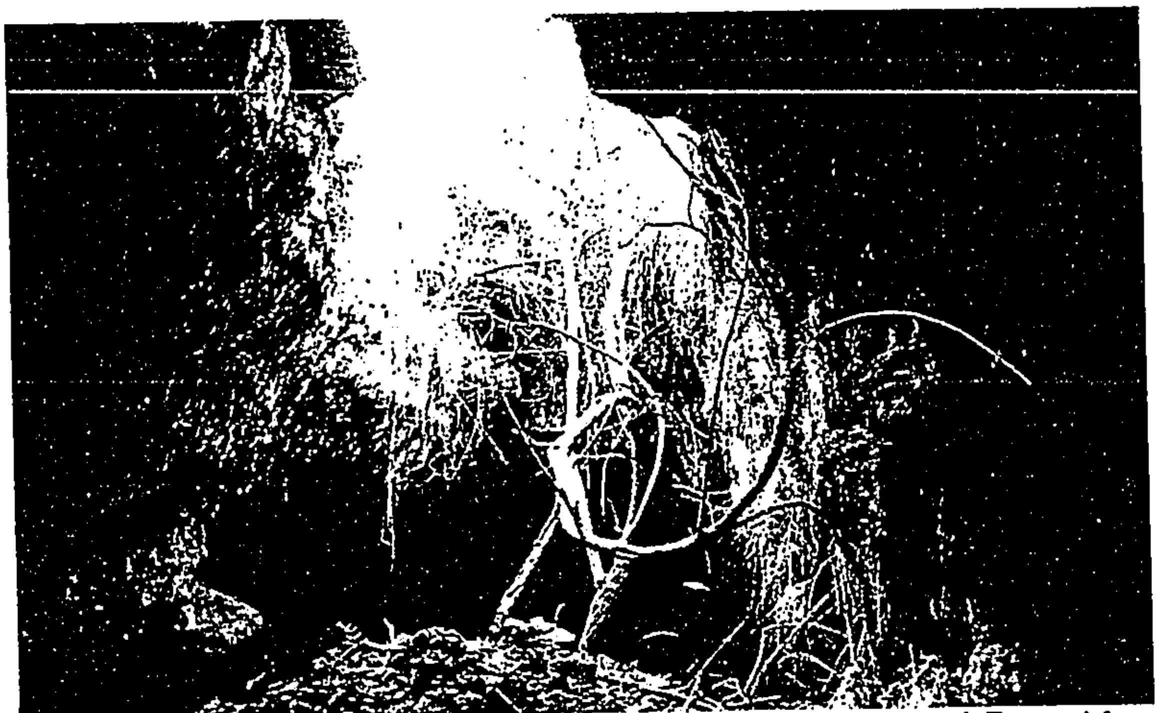


Figure 138. SIHP Site 14375 Feature A inaccessible tube opening view to west towards Feature A-1.

Figure 139. SIHP Site 14375 Feature A-1 fire ring with ash concentration view to west.

Figure 140. SIHP Site 14375 Feature A-1 terrace along north wall of tube view to east.

Figure 141. SIHP Site 14375 Feature A-2 view to west.

Feature A-3

Feature A-3 is a path that descends from ground surface, at the most accessible collapsed blister opening, into the subsurface portions of the tube system (see Figure 137). The pathway begins in the central rubble area of the collapsed blister, and runs southeast descending into the *mauka* segment of the tube system. The walkway consists of *pāhoehoe* slab stepping-stones set into *pāhoehoe* pebble fill (Figure 142). Paralleling the stepping-stones to the north is a 3.3-meter long by 45-centimeter tall alignment of large *pāhoehoe* boulders that terminates at a large natural *pāhoehoe* bedrock outcrop. Paralleling the trail to the south is a naturally occurring wall of boulders 1.5 meters tall by 3.5 meters long. Past the north-facing wall of boulders, the south side of the trail is lined with large *pāhoehoe* slabs that are stacked in a semi-circle against the east-facing segment of the boulder wall. The slabs form a small terrace measuring 3.0 meters (north/south) by 1.5 meters (east/west) that is roughly paved with small *pāhoehoe* cobbles (Figure 143). The stepping-stones form steps descending along the northeast corner of the terrace, and then terminate at its south end. A small (25-centimeter diameter) concentration of white ash (similar to Feature A-2) is located 2.0 meters east of the southeast corner of the terrace on the bedrock floor of the tube. The terrace may have been utilized for habitation purposes. The tube runs approximately 40 meters east of Feature A-3, past two inaccessible tube openings before ending in collapse. No additional architectural modifications were discovered.

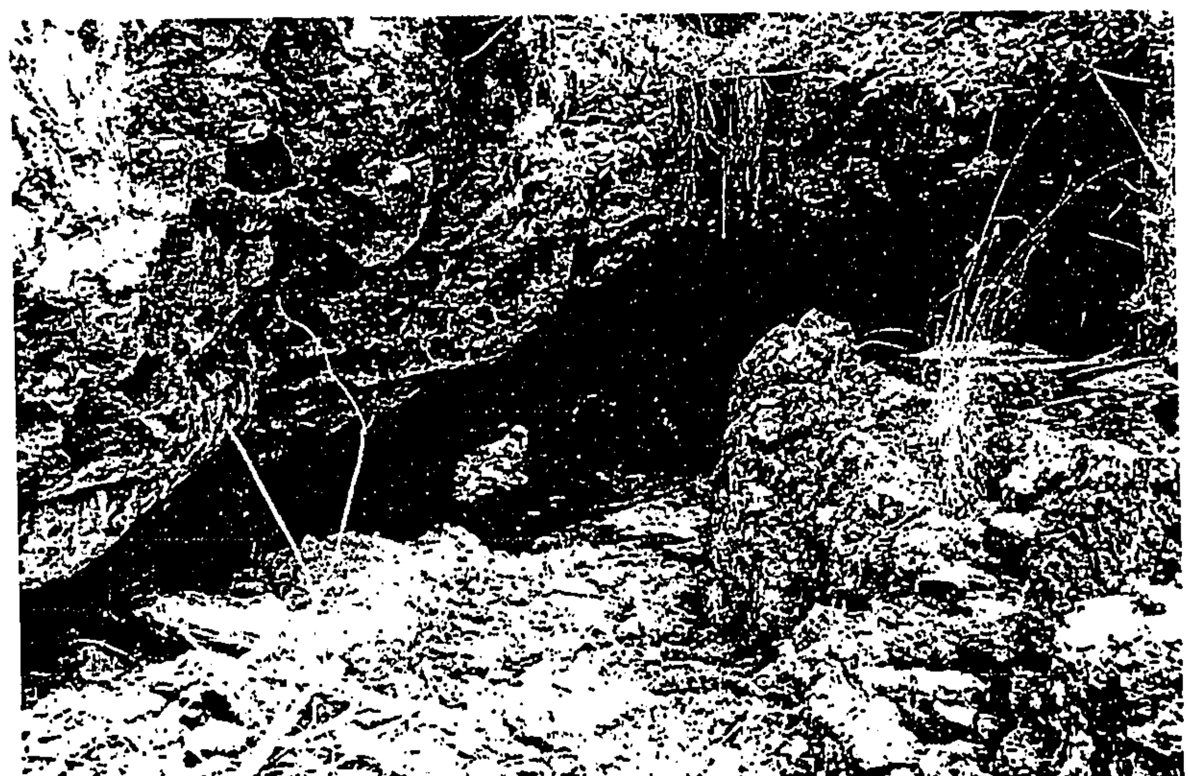


Figure 142. SIHP Site 14375 Feature A-3 view to east.

Figure 143. SIHP Site 14375 Feature A-3 view to east (terrace in foreground).

Feature B

Feature B is a habitation tube with two entrances located along the northern edge of Site 14375 The lava tube runs for approximately 240 meters underground, from the eastern end of the site to its central area (see Figure 137). The tube is accessed through a small entrance at its eastern end within a long, narrow bedrock sink. The entrance is small, just large enough for an adult human to belly-crawl through. After a crawl of approximately 20 meters the tube opens into a large chamber. Within this chamber, a small concentration of Precontact habitation debris was discovered, including marine shell, *Echinoidea* fragments, and pig (*Sus*) bone.

The tube continues west from this chamber and is generally large enough for walking, although crawling is required in sections. Approximately 110 meters from the eastern entrance a black, "No Fear" baseball hat and a pair of sunglasses were discovered on the tube floor. Sixty meters further east, a 1990 U.S. dime and 1983 U.S. quarter were found on the tube floor near a pile of cobbles. This pile of cobbles was intentionally placed to allow access to a ledge located approximately 4 meters above the tube floor. The ledge contained a stacking of *pāhoehoe* slabs (8 courses, 1.1 meters high) beneath a small (1.0 meter in diameter) skylight located 3.6 meters above the ledge (Figure 144). The stacked slabs appear to be an individual(s)'s attempt to exit the tube (by standing on top of the stacking a tall, dexterous individual could conceivably climb out the opening). The tube continues approximately 70 meters beyond this feature before ending in collapse. Based on the small amount of habitation debris found at the eastern end of Feature B, it is likely that the tube was used for Precontact temporary habitation purposes.

Figure 144. SIHP Site 14375 Feature B stacked *pāhoehoe* slabs view to east.

Feature C

Feature C is a collapsed lava blister located just west of a similar blister (Feature E) in the central area of Site 14375 (see Figure 137). The surrounding ground surface consists of a weathered *pāhoehoe* flow that has subsided leaving a depressed area 10 meters in diameter with vertical sides and no lava tubes leading away from it (Figure 145).

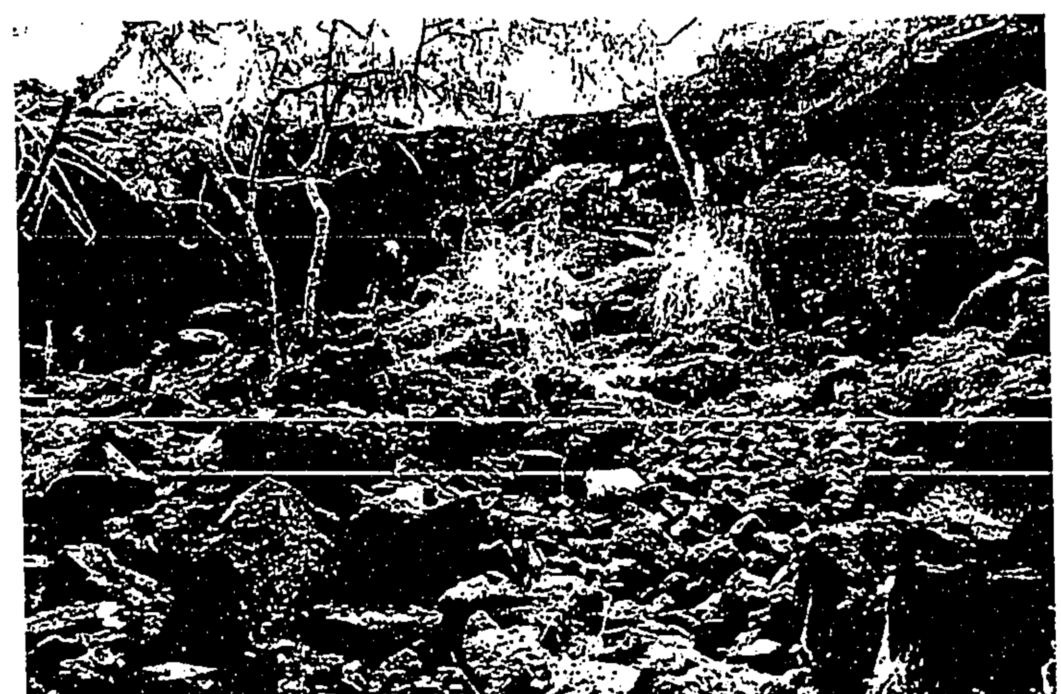


Figure 145. SIHP Site 14375 Feature C view from southwest corner to the southeast.

A sloping entrance of cobble rubble along the south wall of Feature C leads into the collapsed blister to a level terraced area at its center. Large to medium sized *pāhoehoe* cobbles and upright slabs line both sides of a stepping-stone walkway that ends atop this fairly level terrace. The north edge of the terrace stands 2—5 courses (85 centimeters) high, and measures 6.5 meters (east/west) by 7.0 meters (north/south). *Pāhoehoe* slabs are placed on the surface at the eastern end of the terrace making it level with the western end.

Below this (to the north) the cave floor has been somewhat cleared of cobble rubble, beneath a slight overhang, leaving a living area 8.0 meters long (east/west) by 3.0 meters wide (north/south) (Figure 146). Small deposits of soil and ash are present in this area. Habitation debris discovered within the cleared area included *kukui* and *Echinoidea.*

In the southwest corner of Feature C there is a small terrace exposed to the elements. The north-facing front edge of the terrace is constructed of *pāhoehoe* boulders and cobbles loosely stacked 3—4 courses (1.1 meter) high. Behind this the terrace's level surface, which measures 1.5m (east/west) by 1.1m (north/south) is paved with *pāhoehoe* cobbles and pebbles. One small coral fragment was discovered to the east of this feature.

In the southeast corner of Feature C is a paved area that lies beneath a 5.0 meter (northeast/southeast) by 3.0-meter (northwest/southeast) bedrock overhang (Figure 147). This area has a partially exposed natural bedrock floor, and is also partially paved with *pāhoehoe* slabs and pebbles toward the cave opening. Waterworn pebbles, *kukui,* coral, and marine shell fragments were observed in this area.

On the ground surface outside the collapsed blister located 1.4 meters southeast of its eastern edge is a *papamū*. The *papamū* is pecked into the smooth exposed *pāhoehoe* bedrock ground surface (Figure 148). It measures 40 centimeters by 40 centimeters and consists of approximately one hundred 1-2 centimeter circular depressions in the bedrock, placed in 10 by 10 rows.


Figure 146. SIHP Site 14375 Feature C cleared area view north from ground surface along southern edge.

Figure 147. SIHP Site 14375 Feature C paved area under overhang view to southeast.

Figure 148. SIHP Site 14375 Feature C *papamū* overview.

Feature D

Feature D is a stepping-stone trail segment leading southwest from the southern edge of Feature C (see Figure 137). The traceable segment of the trail runs for 22.0 meters across a cobble field and consists of large *pāhoehoe* slabs placed one after another (Figure 149). Feature D disappears once it reaches a smooth *pāhoehoe* bedrock ground surface.

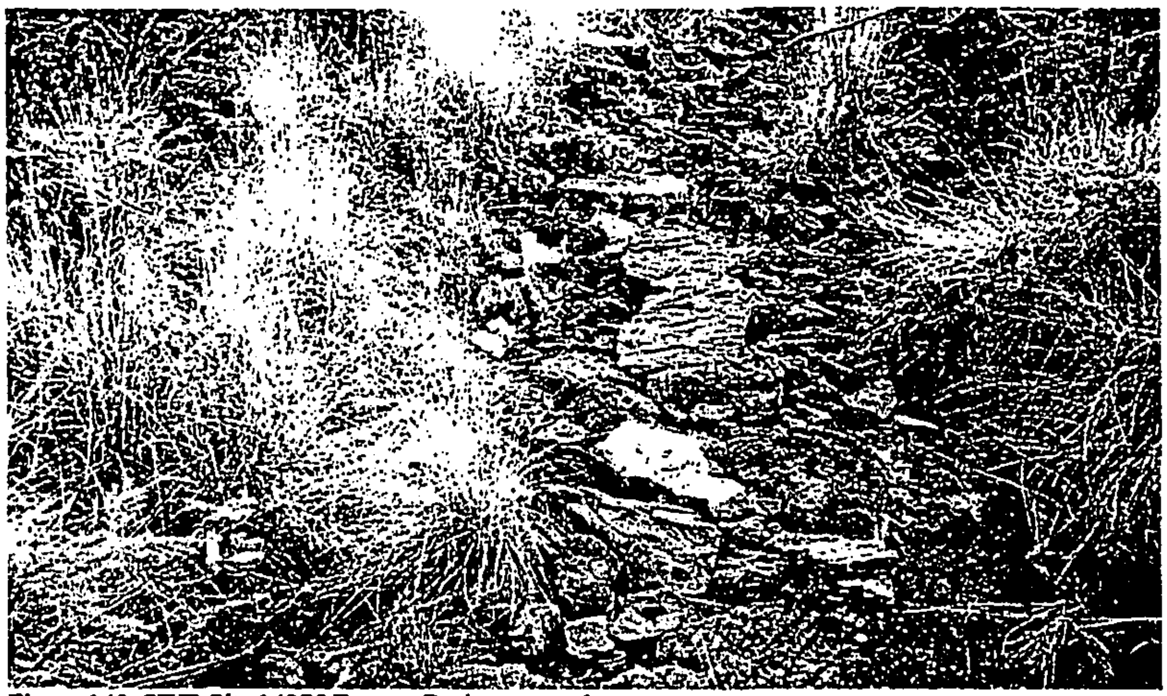


Figure 149. SIHP Site 14375 Feature D view to northeast.

Feature E

Feature E is a collapsed lava blister located just east of a similar blister (Feature C) in the central area of Site 14375 (see Figure 137). The surrounding ground surface consists of weathered *pāhoehoe* flow that has subsided leaving a depressed area approximately 10 meters in diameter with vertical sides and only a short lava tube leading east from it (Figure 150). A *papamū* is pecked into a natural bedrock shelf against the south wall of the collapsed blister near ground surface (Figure 151). Feature E also contains a habitation area beneath a large bedrock overhang at its eastern end. The culturally modified portions of the feature begin where the ground starts to slope down into a subsurface area measuring 8.8 meters (east/west) by 4.3 meters (north/south) (Figure 152). About 1.0 meter east of the drip line the tube floor descends steeply into a 5.0-meter in diameter, circular chamber; from which a narrow tube segment extends 4.0 meters *mauka* before ending at collapse.

Habitation debris observed amid the large-sized rubble that has fallen to the tube floor included marine shell (*Cellana*, *Cypraea*, and other) fragments, *Echinoidea* fragments, *kukui*, pig and goat bone, a dog tooth, water-worn pebbles, coral, and an ash concentration. The ash is contained within a 1.5-meter in diameter fire ring located in the north-central section of the chamber. The ring is a spot in the cave floor where rubble was cleared and ash has accumulated. A collapsed terrace, 4.5 meters (north/south) by 1.5 meters (east/west), is located at the sloping entrance to the subsurface portion of the tube. Built against the north wall of the tube, its eastern edge is constructed of stacked *pāhoehoe* slabs; the western side is built into the slope. To the south, the feature has collapsed and lost integrity, but it may have once spanned the entire width of the tube.

Figure 150. SIHP Site 14375 Feature E collapsed blister and tube entrance view to east.

Figure 151. SIHP Site 14375 Feature E *papamū* view to south.


Figure 152. SIHP Site 14375 Feature E subsurface chamber view to west.

Feature F

Feature F consists of a three-sided enclosure and a piled linear mound located on *pāhoehoe* bedrock ground surface 30.0 meters southeast of Feature E (see Figure 137). The three-sided enclosure is constructed with *pāhoehoe* cobbles and small boulders on level *pāhoehoe* bedrock (Figure 153). It opens to the west and southwest. The 55-centimeter tall north wall measures 1.0 meter wide and trends east/west for 3.6 meters. It is separated from the adjacent eastern wall by a 1.0-meter gap in the enclosure's northeast corner. The collapsed eastern wall measures 3.5 meters long and only about 20 centimeters tall, and contains a rubble scatter to the east. The southern segment of the enclosure measures 3.5 meters long and is also mostly collapsed. A 2.3-meter long by 75-centimeter wide by 40-centimeter high linear pile of small *pāhoehoe* boulders, which does not appear to serve any purpose, is constructed on the surface of a *pāhoehoe* outcrop located 11.5 meters west of the enclosure. Feature F, based on its small size and crude form, likely served a Precontact temporary habitation function (Cordy 1981, 1995).


Figure 153. SIHP Site 14375 Feature F view to north.

SIHP Site 14376

Site 14376 is a trail segment centrally located within the western portion of the project area to the north of the main access road (see Figure 5). Site 14376 runs a meandering course north/south for approximately 50 meters across an exposed *'a'ā* field. The trail route has been cleared of all large stones so that only small *a'a* pebbles remain, which are visible as a slightly lighter color than the surrounding flow. Some portions of the trail contain *'a'ā* and *pāhoehoe* slabs that have been placed on the trail to serve as stepping-stones (Figure 154). Site 14376 may have once been connected to Site 14404, but bulldozer activity in the area has obliterated its route.

Figure 154. SIHP Site 14376 view to the south.

SIHP Site 14377

Site 14377 is a stacked wall located along the edge of a *kīpuka* situated in the southwestern portion of the project area (see Figure 5). The wall, consisting of small to large sized *'a'ā* cobbles that have been roughly stacked 2 to 4 courses high, borders the edge of an *'a'ā* flow that surrounds a small *pāhoehoe kīpuka* (Figure 155). Meandering for a total of 51.7 meters, the wall is in poor condition with some segments completely collapsed. Maximum height attained is 50 centimeters above the *'a'ā* bedrock to its north and 175 centimeters above the *kīpuka* ground surface to the north. The wall has an average width of 50 centimeters. Site 14377 may have served as a partial border for Site 14404 (a trail) as it entered the *kīpuka* from the north.


Figure 155. SIHP Site 14377 view to the southeast.

SIHP Site 14378

Site 14378 is an area of 5 cairns (Features A—E) centrally located in the western portion of the project area along the northern edge of the bulldozed access road (see Figure 5). The mounds are also located at the interface of an older *pāhoehoe* flow (to the northwest) and a younger *'a'ā* flow (to the southeast). One mound is located on the edge of the *a'a* flow, while the other three rest on *pāhoehoe* bedrock. Evidence of heavy bulldozing activity, as well as a bulldozed access road are evident in the vicinity of Site 14378.

Feature A

Feature A is a circular stacked *a'a* cobble cairn (*ahu*) located at the southeastern edge of Site 14378 on the *a'a* flow. The cairn measures 1.2 meters in diameter and has vertical sides that stand 90 centimeters above ground surface (Figure 156).

Feature B

Feature B is a collapsed cairn (*ahu*) with an upright stick stuck into its northern edge. The mound is constructed of piled *pāhoehoe* cobbles on exposed *pāhoehoe* bedrock. It measures 2.3 meters in diameter and stands 50 centimeters above ground surface (Figure 157). The stick is burned, which appears to have occurred while it was standing upright in Feature B.

Feature C

Feature C is a partially stacked, partially piled *pāhoehoe* cobble cairn (*ahu*) resting on exposed *pāhoehoe* bedrock. The cairn, which measures 1.9 by 1.7 meters, shows rough stacking along its northern edge and rises 70 centimeters above ground surface (Figure 158).

Feature D

Feature D is a small cairn (*ahu*) of piled *pāhoehoe* cobbles on exposed *pāhoehoe* bedrock. Possibly stacked at some point, Feature D is now mostly collapsed and scattered over an area 1.3 meters in diameter (Figure 159) It stands up to 75 centimeters above the surrounding ground surface.

Feature E

Feature E is a small cairn (*ahu*) of piled *pāhoehoe* slabs and cobbles resting on exposed *pāhoehoe* bedrock. Some *a'a* cobbles are present at the base of the cairn (Figure 160). Feature E measures 1.2 meters in diameter and has a height of 50 centimeters above ground surface.

Figure 156. SIHP Site 14378 Feature A view to the west towards Feature B.

Figure 157. SIHP Site 14378 Feature B view to the west.

Figure 158. SIHP Site 14378 Feature C view to the south.

Figure 159. SIHP Site 14378 Feature D view to the west.

Figure 160. SIHP Site 14378 Feature E view to the south.

SIHP Site 14404

Site 14404 is a trail segment located in the western portion of the project area (see Figure 5). The trail meanders from the main access road in a southeasterly direction for approximately 500 meters all the way to the southern property boundary where it continues into Maka'ula Ahupua'a (out of the current project area). Although primarily traversing *'a'ā*, approximately a quarter of the way along its length the trail runs across a *pāhoehoe kīpuka* that contains Sites 14377 and 23867. The trail is cleared of large *'a'ā* cobbles, creating a path of slightly lighter small cobbles and pebbles that is visible through the surrounding *'a'ā*. Some segments of Site 14404 also contain flat *pāhoehoe* cobbles spaced along the trail to serve as stepping-stones (Figure 161). A metal site tag marked "PHRI 89-760 SITE 25 9 FEB 90" was discovered on the trail near the southern property boundary indicating that the site was originally recorded by PHRI (Rosendahl 1990). Before the widespread bulldozing occurred on the study parcel, this trail may have continued northwest past Sites 14378 and 23862 to the northern property boundary and out of the current study area.

Figure 161. SIHP Site 14404 view to northwest.

SIHP Site 23862

Site 23862 was originally recorded and tested in 1972 by the Bernice P. Bishop Museum during a survey of the then-proposed Kailua-Kawaihae road corridor (Queen Ka'ahumanu Highway) (Ching 1970, 1971). At that time the site was designated as Complex D, a collection of 62 archaeological features situated in two clusters (a *mauka* cluster and a *makai* cluster) located within Kaū Ahupua'a (only the *mauka* cluster is within the current project area). The site was later remapped and further tested by PHRI. (Rosendahl 1973) as part of archaeological salvage operations for the construction of the Kailua-Kawaihae Road (Figure 162). The salvage work carried out at Complex D—concentrating on the supposed main habitation feature of the site; a lava tube (Feature 701; now Feature 13)—was meant to mitigate any possible impacts to the features resulting from the construction of the highway (Queen Ka'ahumanu Highway is currently located to the west of Site 23862). Ogden did not relocate the site during their archaeological inventory survey of the subject parcel (Schilz et al. 1990) and apparently Complex D was never listed in the State Inventory of Historic Places (SIHP).

All but three of the features previously recorded within the *mauka* cluster of Complex D (Features 701-19, 701-25, and 701-27) were located during the current inventory survey; Features 701-25 and 701-27 were most likely destroyed by road construction activity and Feature 701-19 was "dismantled" by archaeologists during the salvage operation (Rosendahl 1973:29) (see Figure 162). In addition to the previously recorded features, 6 previously unrecorded features (Features 11, 12, 14, 15, 16, and 18) were also added to the site's description (Table 13).

Since this *mauka* cluster of features had already been grouped into a single site, which has already undergone data recovery, it was decided to retain the feature grouping as a single SIHP site number (SIHP Site 23862). That being said however, the features—although certainly related spatially, if not temporally and functionally—could be separated into five smaller groupings (Features 1—11; Features 12—14; Features 15—18; Features 19—29; and Feature 30; see Figure 5 and Table 13). As currently defined, Site 23862 is a grouping of 30 archaeological features (Features 1-30) located in the northwest corner of the project area. The complex consists of 5 modified outcrops, 3 modified depressions, 4 C-shaped enclosures, 14 cairns (*ahu*), a rock alignment, a lava tube, a petroglyph panel, and a bedrock grinding slick.

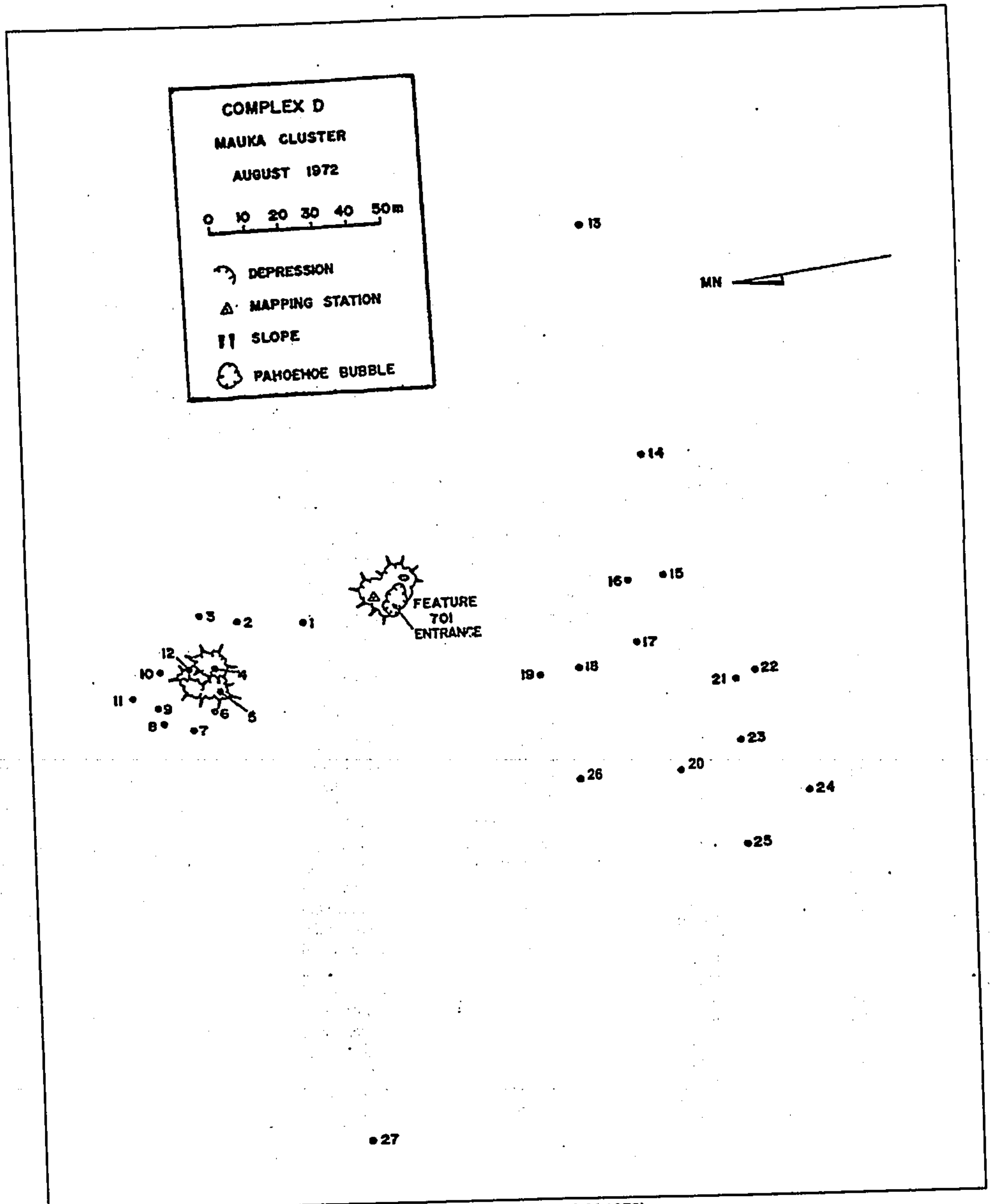


Figure 162. *Mauka* cluster of features in SIHP Site 23862 (From Rosendahl 1973).

Ground surface in the vicinity of the site slopes gently to the west and consists of smooth *pāhoehoe* bedrock covered by fountain grass. The features of Site 23862 are, for the most part, constructed on elevated bedrock outcrops containing less vegetation then the surrounding ground surface. The entire site area is littered with marine shell fragments mixed with some coral fragments and waterworn pebbles. Before the eruption of Hualālai in 1801, Site 23862 would have occupied a prominent location above the great fishpond of Pa'aiea. This site was most likely utilized before, up to, and after the time of that eruption for habitation purposes. Dates collected during the salvage operations at Feature 13 (a lava tube) suggest that the site was occupied from at least the end of the 15th century to the middle of the 17th century (Rosendahl 1973:27). One of the petroglyphs at Feature 29 is a Hawaiian name spelled out in the English alphabet, suggesting that the site was utilized at least into Historic times. The nature of the habitation at 23862 (specifically at Features 2-6, 8-10, 16-18, and 30) was most likely seasonal or recurrent—none of these features contain the substantives of construction to be considered permanent habitations (Cordy 1981, 1995)—and involved a wide range of general living activities. Occupation at Feature 13 (the lava tube) could be interpreted as more extended based on the amount of habitation debris present (Rosendahl 1973:62). Features 1, 6, 14, and 15 (all cairns) may mark the route of one or more trails that are no longer visible across the *pāhoehoe* bedrock landscape. Features 19-29 (10 cairns and a petroglyph panel) are grouped on a bedrock outcrop at the Kaū/Pu'ukala Ahupua'a boundary and may represent a ceremonial site related to the *makahiki* festival (Rechtman 1999) (see below). Individual feature descriptions follow below and their locations are shown on Figure 5.

Table 13. Features recorded at SIHP Site 23862 and their previous designations.

Feature #	PHRI #	Feature type	Feature Function
1	701-17	Cairn	Marker
2	701-18	Modified outcrop	Habitation
3	701-21, 22	Modified outcrop	Habitation
4	701-23	Modified outcrop	Habitation
5	701-26	Modified outcrop	Habitation
6	701-20	Modified depression	Habitation
7	701-24	Cairn	Marker
8	701-16	Modified depression	Habitation
9	701-14	Modified outcrop	Habitation
10	701-15	Modified depression	Habitation
11	-	Grinding slick	Resource processing
12	-	Rock alignment	Habitation
13	701	Lava tube	Habitation
14	-	Cairn	Marker
15	-	Cairn	Marker
16	-	C-shape enclosure	Habitation
17	701-1	C-shape enclosure	Habitation
18	-	C-shape enclosure	Habitation
19	701-9	Cairn	Ceremonial
20	701-11	Cairn	Ceremonial
21	701-10	Cairn	Ceremonial
22	701-12	Cairn	Ceremonial
23	701-4	Cairn	Ceremonial
24	701-2	Cairn	Ceremonial
25	701-5	Cairn	Ceremonial
26	701-6	Cairn	Ceremonial
27	701-7	Cairn	Ceremonial
28	701-8	Cairn	Ceremonial
29	701-3	Petroglyphs	Ceremonial
30	701-13	C-shape enclosure	Habitation

Feature 1

Feature 1 is a small cairn (*ahu*) located in the south-central portion of Site 23862 (see Figure 5). The cairn is situated on the southwest corner of a *pāhoehoe* bedrock outcrop that also contains Feature 2 (10 meters to the northwest) (Figure 163). Feature 1, which consists of approximately 25 piled *pāhoehoe* cobbles (Figure 164), measures 1.6 meters long by 1.1 meters wide and reaches a maximum height of 0.8 meters above ground surface. The bedrock to the northeast of the cairn has been partially filled in with cobbles to create a more leveled surface. It is possible that Feature 1 marks the former route of a trail that is no longer visible across the*pāhoehoe* bedrock landscape.

Feature 2

Feature 2 is a modified outcrop located in the south central portion of Site 23862 (see Figure 163). This feature consists of small to large sized *pāhoehoe* cobbles used to augment a raised *pāhoehoe* bedrock outcrop in order to create a somewhat level paved area on its surface (Figure 165). The feature covers a roughly square area that measures approximately 12.0 meters along each side and rises up to 1.3 meters above the surrounding ground surface. A small concentration ofmarine shell (n=30) was observed on the surface of Feature 2.

Feature 3

Feature 3, located along the southern edge of Site 23862, consists of a slightly raised exposed *pāhoehoe* bedrock outcrop containing two level paved areas (see Figure 163). The northern paved area, constructed along the northern edge of the bedrock outcrop, has a rough surface of small to large sized *pāhoehoe* cobbles. This paved area (Figure 166), which is roughly triangular in shape, measures 6.5 meters long by 4.0 meters wide. Its north side reaches 0.75 meters above ground surface, while the west edge stands 0.3 meters above ground surface, and the remaining edges are level with the bedrock outcrop.

The southern paved area of Feature 3 is located along the southwestern edge of the outcrop, approximately 4 meters south of the northern paved area. This pavement has a relatively uniform, rectangular surface of small to medium sized *pāhoehoe* cobbles. It measures 6.5 meters long by 3.0 meters wide. A slight circular depression (15 centimeters deep), with a large *Cellana* shell adjacent to it, is present in the northwest corner of the paved area. Its north, east, and west sides are level with the bedrock outcrop, while the southern edge rises up to 0.3 meters above ground surface. The entire outcrop is littered with marine shell fragments (n>500) and waterworn pebbles (n>20). The bedrock section between the two paved areas is also level and was probably utilized in its unmodified state.

Feature 4

Feature 4 is a modified outcrop located in the southwest corner of Site 23862 (see Figure 163). The feature consists of a small, relatively level, terraced pavement, constructed of *pāhoehoe* cobbles piled up against the west edge of an exposed *pāhoehoe* bedrock outcrop (Figure 167). Feature 4 measures 6.0 meters long by 2.5 meters wide and stands up to 0.25 meters above ground surface along its western edge. Several marine shell fragments (n>20) and small waterworn pebbles (n>15) were noted on the surface of the feature.

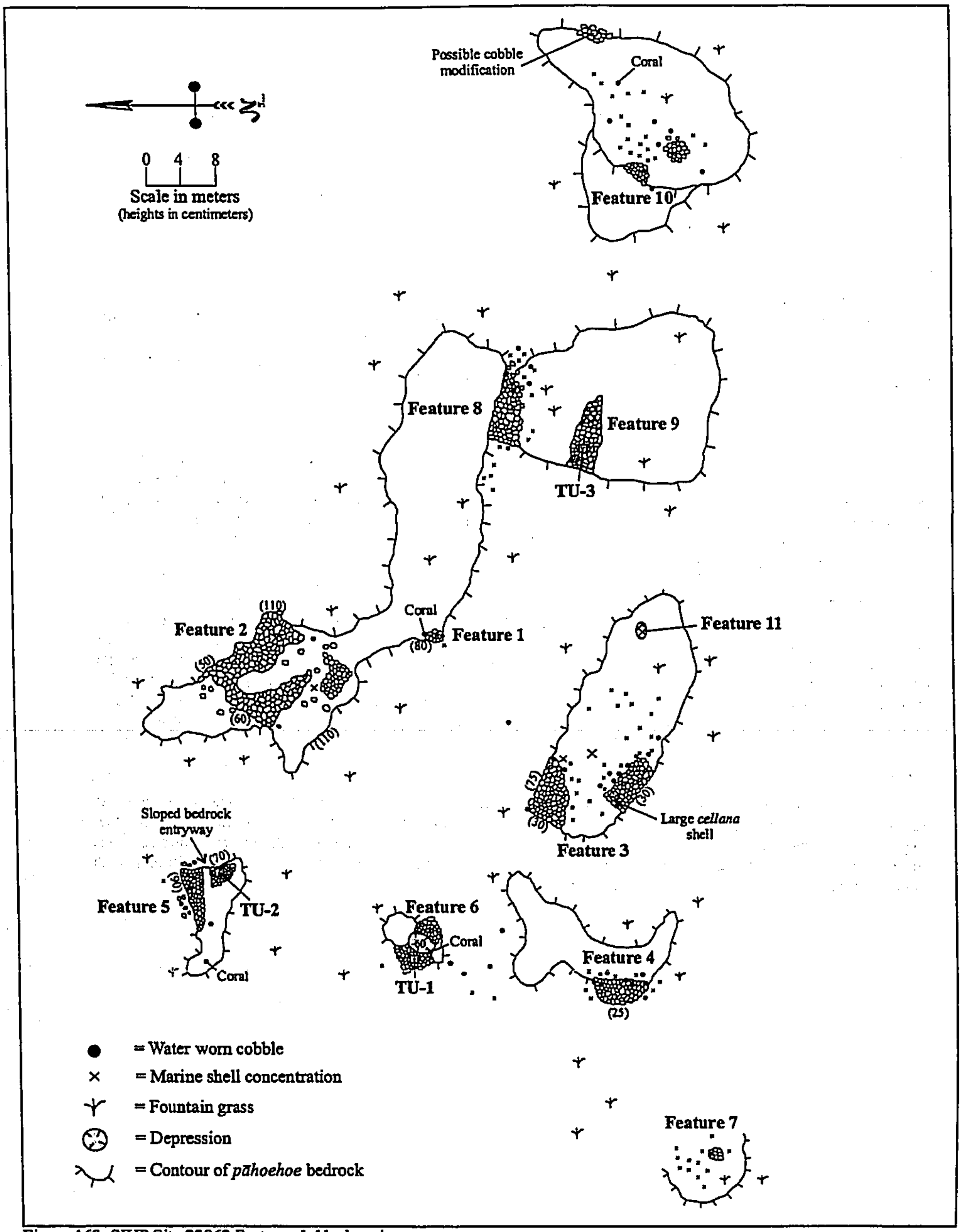


Figure 163. SIHP Site 23862 Features 1-11 plan view.

Figure 164. SIHP Site 23862 Feature 1 view to east.

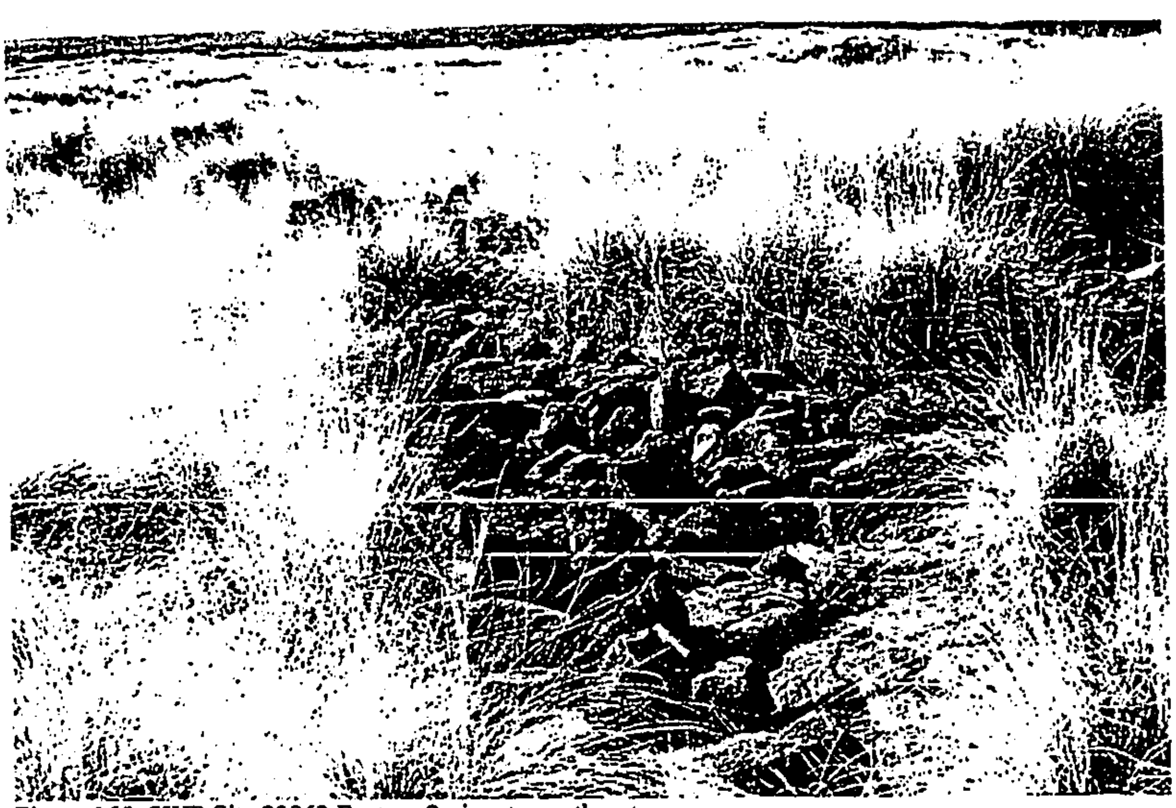


Figure 165. SIHP Site 23862 Feature 2 view to southeast.

Figure 166. SIHP Site 23862Feature 3 northern paved area view to west.

Figure 167. SIHP Site 23862 Feature 4 view to southwest.

Feature 5

Feature 5 is a modified outcrop located in the west central portion of Site 23862 (see Figure 163). The feature is constructed of well-stacked *pāhoehoe* cobbles on an exposed *pāhoehoe* bedrock outcrop. The cobble modification on the outcrop is divided into a northern section and a southern section by a one-meter wide strip of exposed bedrock (Figure 168). This bedrock strip slopes at approximately 15°, following the natural bedrock contours, from ground surface at the eastern edge of the outcrop to level top surface of the feature at the outcrop's western end. It was originally suspected by the field investigators that this strip might have been used as a possible entryway to the feature. However, upon further investigation into the previous archaeology of the area it was found that PHRI had tested the feature as part of an archaeological salvage project for the construction of the Queen Ka'ahumanu Highway (Rosendahl 1973). During that project Feature 5 (formerly feature 701-26; see Figure 162) was called a platform. Rosendahl described the feature thusly:

> This is a rectangular structure, averaging 70 cm in height, with dimensions of 7 by 9.2 meters. A stacked-stone facing is found on two sides; the other two sides are formed by a natural outcropping. The platform is filled and roughly paved flat with small aa cobbles. It was dismantled and found to be built upon a bare *pāhoehoe* base. A single piece of shell and two pieces of coral were recovered from the fill. (1973:29)

Judging from this description, it seems that the bedrock strip bisecting Feature 5 is simply an archaeological excavation unit that was never back filled. Currently the feature appears as two separate, but related, constructions on a bedrock outcrop. The southern, smaller construction measures 3.0 meters long by 2.0 meters wide. Its eastern edge consists of roughly stacked large *pāhoehoe* cobbles, which support a paving of small *pāhoehoe* cobbles to the west. The northern construction measures 7.0 meters long by 2.5 meters wide. It has neatly stacked northern and eastern edges, while the remaining two sides are level with the exposed bedrock. The surfaces of both the northern and southern constructions are leveled and paved with small cobbles and slabs of *pāhoehoe*. One coral fragment, one waterworn pebble, and one *cypraea* shell fragment were noted on the surface of Feature 5.

Figure 168. SIHP Site 23862 Feature 5 view to west.

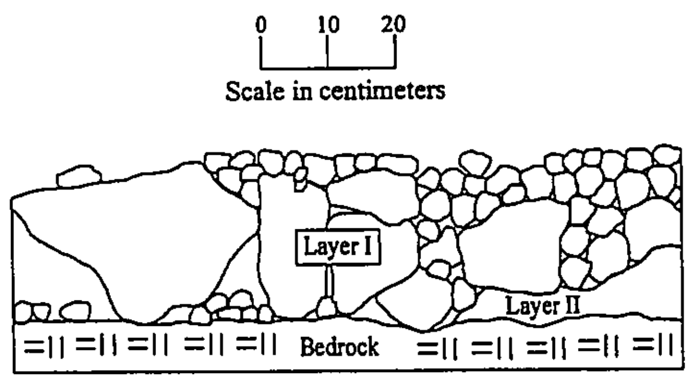
Feature 5 was re-tested as part of the current inventory survey. A single 1 x 1 meter test unit (TU-2) was excavated in the smaller, southern construction of the feature. Excavation of TU-2 revealed a simple two-layer stratigraphic profile terminating at *pāhoehoe* bedrock (Figure 169). Layer I, the architectural layer, consisted of pebbles and small to large sized *pāhoehoe* cobbles extending to bedrock at a depth of 25 centimeters below the unit's surface. Layer II consisted of small pockets of dark yellowish brown (10YR 4/3) very fine silt deposited within the cracks of the bedrock beneath Layer I. Fifty small fragments (9.7g) of unidentifiable mammal bone were collected from the screen. Also, trace amounts of marine shell were noted in the soil, but were too small to be retained by the screen and therefore not collected. No further cultural material was recovered from TU-2, and excavation was terminated at the bedrock surface (Figure 170).

Feature 6

Feature 6 is a modified depression located in the southwestern portion of Site 23862 (see Figure 163). This depression covers a roughly circular (2.3-meter diameter) area 60 centimeters deep (Figure 171). The floor of the depression consists of bedrock covered by a thin layer (5 cm) of soil. Stacked pavements bound the depression to the east and west. The eastern pavement has a somewhat level surface, measuring 2.3 by 2.1 meters, formed by small to medium sized *pāhoehoe* cobbles that stand 60 centimeters above the depression floor. The western pavement measures 3.0 by 2.0 meters and has a very level surface of small *pāhoehoe* cobbles that rises 65 centimeters above the edge of the depression. The central depression is bounded to the north by a raised bedrock outcrop and to the south by an elevated ground surface. Several waterworn pebbles (n>6), marine shell fragments (n>5), and one coral fragment were noted near the feature. A 1 x 1 meter test unit (TU-1) was excavated in the western pavement area.

Excavation of TU-1 revealed a two-layer stratigraphic profile resting on bedrock and containing a small lens of a third identified soil type (Figure 172). Layer I, the architectural layer, consisted of small to medium sized *pāhoehoe* cobbles mixed with cultural material that extended to a depth of 40 centimeters below the unit's surface. Layer II consisted of very dark gray (7.5 YR 3/1) silt with root and gravel inclusions. Layer II extended from 40—70 centimeters below the unit's surface and soil moisture levels increased with depth. Layer II was excavated in three arbitrary 10-centimeter levels (Levels 1—3). Cultural material was recovered from each level (Table 14). A small, dark brown (7.5YR 3/2) lens of organically rich, clayey silt, Layer IIb, was noted within the lower two levels of Layer II (see Figure 172). One basalt hammerstone fragment, six urchin spine abraders, and one coral abrader fragment were recovered during excavation of TU-1 (Figure 173). Excavation was terminated upon encountering bedrock.

Upon reviewing previous archaeological studies in the area, it was discovered that Feature 6 might have been previously tested by PHRI, Inc. as part of an archaeological salvage project for the construction of the Queen Ka'ahumanu Highway (Rosendahl 1973). In that report, Feature 6 (formerly Feature 701-20; see Table 13) is called a rock-filled depression. Rosendahl notes that the feature was dismantled and that it had "a 50-cm-deep stone fill overlying 10-to-15-cm-thick deposit of dark gray soil containing a few pieces of shell, mostly cowry" (1973:29). This is a similar stratigraphy to that discovered within TU-1 as part of the current inventory survey. The central depression within in Feature 6 most likely represents the remains of an archaeological excavation unit that was never back-filled. Before the salvage operation at Site 23862 (Rosendahl 1973), Feature 6 probably had a level, paved surface similar to Features 8 and 10. Feature 6 was most likely utilized forPrecontact habitation purposes.



Layer I- Architectural layer consisting of pebbles and small to large sized *pāhoehoe* cobbles.

Layer II- Dark yellowish brown (10yr 4/3) very fine silt.

Figure 169. SIHP Site 23862 Feature 5 TU-2 south wall profile.

Figure 170. SIHP Site 23862 Feature 5 TU-2 base of excavation view to south.

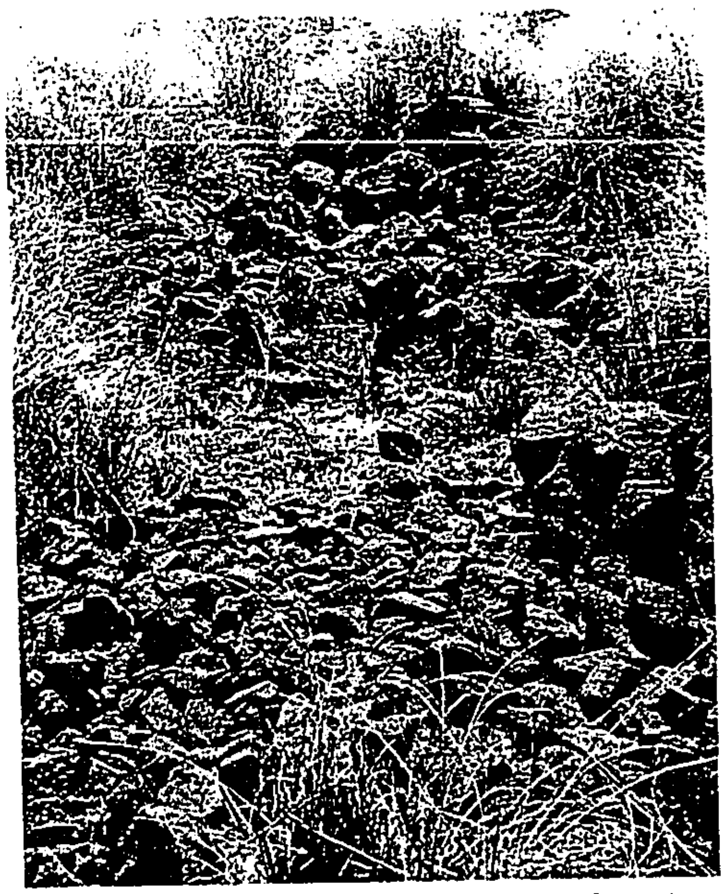
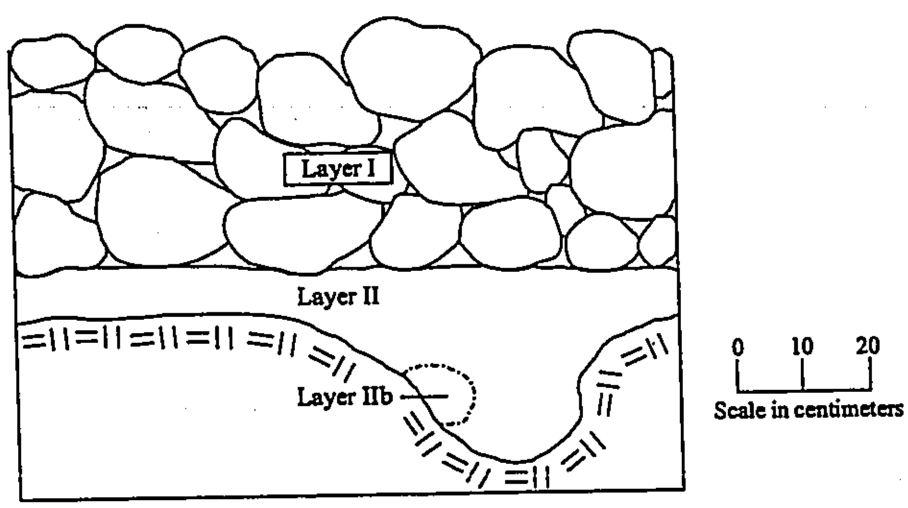


Figure 171. SIHP Site 23862 Feature 6 view to southeast.



Layer I- Architectural layer consisting of small to medium sized *pāhoehoe* cobbles mixed with cultural material.

Layer II- Very dark gray (7.5 YR 3/1) silt with root and gravel inclusions.

Layer IIb- Dark brown (7.5YR 3/2) lens of organically rich, clayey silt.

Figure 172. SIHP Site 23862 Feature 6 TU-1 north wall profile.

Table 14. Recovered cultural material from SIHP Site 23862 Feature 6, TU-1.

ACC#	*Layer*	*Depth**	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
1	I	0-40	Basalt	Hammerstone	1	-	147.0
2	I	0-40	Bone	*Sus*	1	1	0.1
3	I	0-40	Shell	*Cypraea*	78	29	78.2
4	I	0-40	Shell	*Nerita*	9	8	1.7
5	I	0-40	Shell	*Drupa*	1	1	1.2
6	I	0-40	Shell	*Brachydontis*	7	2	0.4
7	II	40-50	*Echinoidea*	Abrader	1	1	2.7
8	II	40-50	*Echinoidea*	Abrader	1	1	2.3
9	II	40-50	*Echinoidea*	Abrader	1	1	1.3
10	II	40-50	Coral	Abrader	1	1	1.2
11	II	40-50	Bone	Fish	15	1	2.0
12	II	40-50	Bone	*Sus*	1	1	0.9
13	II	40-50	Bone	Bird	1	1	0.2
14	II	40-50	Bone	Small fragments	21	-	1.8
15	II	40-50	Volcanic glass	Flakes	2	-	0.8
16	II	40-50	Shell	*Cypridae*	1152	166	824.1
17	II	40-50	Shell	*Nerita*	382	373	81.0
18	II	40-50	Shell	*Brachydontis*	450	167	55.2
19	II	40-50	Shell	*Drupa*	63	17	48.0
20	II	40-50	Shell	*Echinoidea*	119	-	17.1
21	II	40-50	Coral	-	1	1	1.4
22	II	40-50	Shell	*Littorina*	7	7	1.7
23	II	40-50	Shell	*Pyrene*	1	1	1.2
24	II	40-50	Shell	*Conus*	31	11	40.3
25	II	40-50	Shell	*Cellana*	12	4	3.1
26	II	40-50	Shell	*Pinctada*	3	1	2.0
27	II	40-50	Shell	*Fimbria*	4	1	1.4
28	II	40-50	Shell	Crab (claw)	1	1	<0.1
29	II	40-50	Shell	Unidentified	6	3	1.9
30	II	50-60	*Echinoidea*	Abrader	1	1	0.3
31	II	50-60	*Echinoidea*	Abrader	1	1	0.2
32	II	50-60	*Echinoidea*	Abrader	1	1	0.1
33	II	50-60	Bone	Fish	5	1	0.4
34	II	50-60	Bone	*Sus*	1	1	1.1
35	II	50-60	Bone	Small fragment	1	1	0.3
36	II	50-60	Shell	*Cypraea*	103	10	60.2
37	II	50-60	Shell	*Nerita*	83	82	18.1
38	II	50-60	Shell	*Brachydontis*	69	24	8.3
39	II	50-60	Shell	*Drupa*	15	2	5.3
40	II	50-60	Shell	*Echinoidea*	16	-	1.9
41	II	50-60	Shell	*Conus*	3	2	1.6
42	II	50-60	Shell	*Cellana*	1	1	0.2
43	II	60-70	Bone	Fish	1	1	0.3
44	II	60-70	Shell	*Cypraea*	25	4	12.6
45	II	60-70	Shell	*Nerita*	18	16	3.4
46	II	60-70	Shell	*Brachydontis*	14	5	1.7
47	II	60-70	Shell	*Conus*	1	1	0.8
48	II	60-70	Shell	*Drupa*	3	2	2.5
49	II	60-70	Shell	*Echinoidea*	4	-	0.7
50	II	60-70	Shell	*Pinctada*	1	1	0.1
51	II	60-70	Shell	*Trochus*	1	1	0.2

**depth in centimeters below unit's surface.*

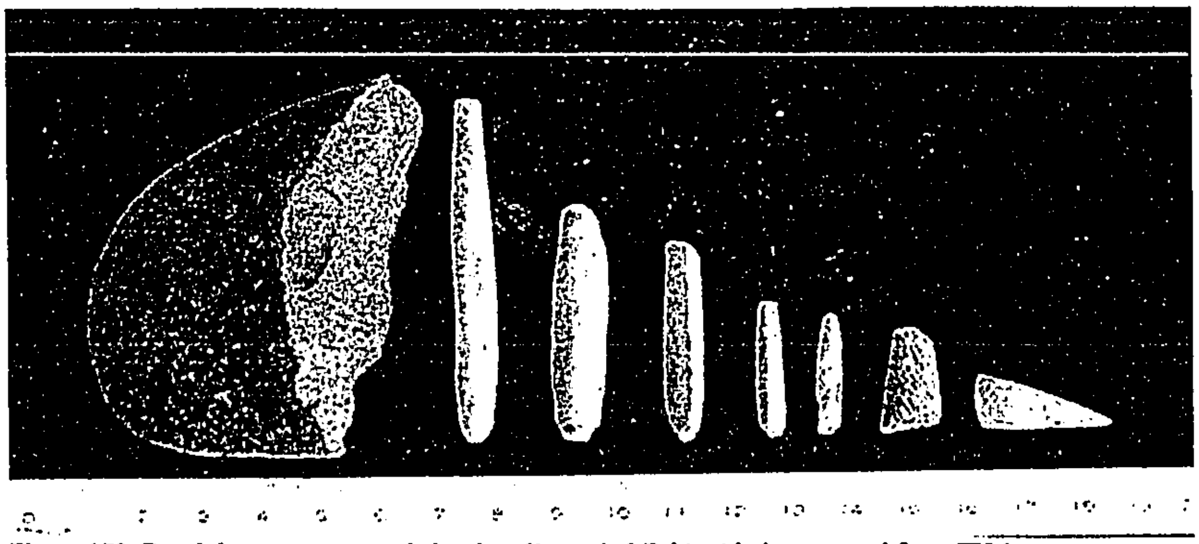


Figure 173. Basalt hammerstone and abraders (1 coral, 6 *Echinoidea*) recovered from TU-1.

Feature 7

Feature 7 is a cairn (*ahu*) situated in the southwestern corner of Site 23862 (see Figure 163). The cairn is located on an exposed bedrock outcrop that is raised up to the south and west of the feature. Feature 7 measures 1.7 meters in diameter and rises 0.7 meters above the surrounding ground surface, but is mostly collapsed (Figure 174). It may have been formerly constructed of stacked large *pāhoehoe* cobbles. A dense scatter of marine shell fragments (n>100) surrounds the feature. Feature 7, like Feature 1, may represent the former route of a trail that is no longer evident across the *pāhoehoe* bedrock landscape.

Figure 174. SIHP Site 23862 Feature 7 view to west.

Feature 8

Feature 8 is a modified depression located in the south-central portion of Site 23862 (see Figure 163). It is constructed with large *pāhoehoe* cobbles filling in a depressed bedrock area (Figure 175). The surface of the feature is paved with small cobbles to create a roughly level pavement. Overall, the surface area of Feature 8 measures 7.5 meters long by 3.1 meters wide, and all of its sides are level with the surrounding ground surface. Along its northern edge, the pavement abuts the same bedrock outcrop that contains Features 1 and 2. The western end of the feature is better paved than the eastern end. Marine shell (n>100) and waterworn cobbles (n>10) were noted scattered in the surrounding area. Feature 8 was most likely utilized for Precontact habitation purposes.

Feature 9

Feature 9 is a modified outcrop containing two small pavement areas located in the southeastern portion of Site 23862 (see Figure 163). The surface of the exposed *pāhoehoe* bedrock outcrop is relatively level, with the small pavement areas located near the center of the outcrop. The western pavement area measures 3.1 meters by 2.4 meters and consists of large sized *pāhoehoe* cobbles that have completely collapsed into an uneven surface (Figure 176). One waterworn pebble was noted on its surface. The second pavement, located approximately 3 meters southeast of the first pavement area, measures 2.0 meters by 2.0 meters and consists of small *pāhoehoe* cobbles that fill in a slight depression on top of the outcrop. Many fragments of marine shell (n>300), some waterworn pebbles (n>5), and one coral fragment were scattered around the outcrop area. A third possible cobble modification exists along the eastern edge of the feature, but may also be interpreted as non-cultural. Feature 9 was most likely utilized for Precontact habitation purposes.

Figure 175. SIHP Site 23862 Feature 8 view to east.

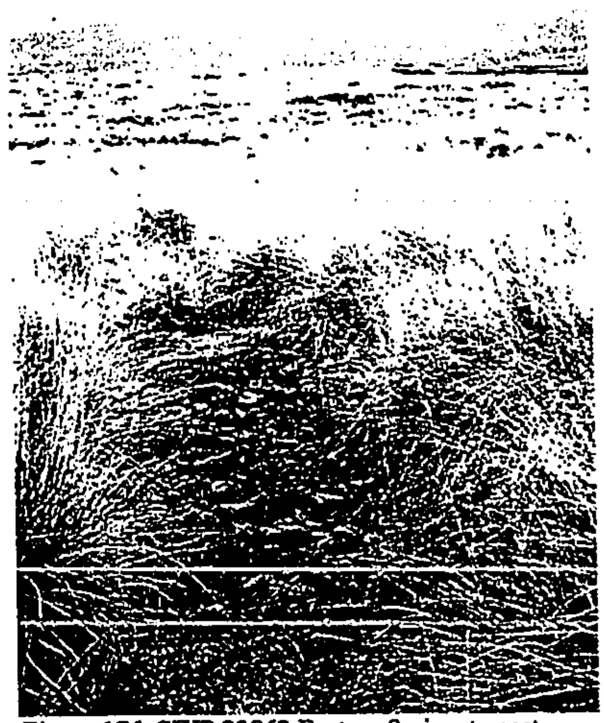


Figure 176. SIHP 23862 Feature 9 view to east.

Feature 10

Feature 10 is a modified depression located in the south central portion of Site 23862 (see Figure 163). The feature consists of large angular *pāhoehoe* cobbles filling in a depressed bedrock area. The feature is paved with small to medium sized *pāhoehoe* cobbles to create a level surface area that measures 8.0 by 2.7 meters. A small depression, measuring 50 centimeters in diameter, is located near the western termination of the platform surface. The west edge of the feature rises 55 centimeters above ground surface, with the remaining sides relatively level with the bedrock ground surface (Figure 177).

Figure 177. SIHP 23862 Feature 10 view to the east.

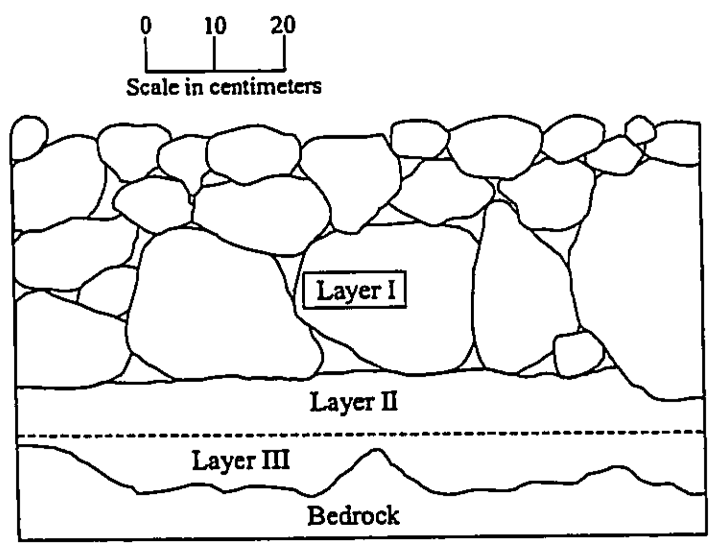
A single 1 x 1 meter test unit (TU-3) was excavated in the approximate center of Feature 10. Excavation of TU-3 revealed a three-layer stratigraphic profile resting upon bedrock (Figure 178). Layer I, representing the architectural layer of Feature 10, consisted of small to large sized *pāhoehoe* cobbles that extended to a depth of 39 centimeters below the unit's surface. Layer II ranged in depth from 39—46 centimeters below the unit's surface and consisted of very dark brown (10YR 2/2) moist clayey silt containing rootlets, basalt fragments, and bedrock cobbles. Marine shell fragments were collected from Layers I and II (Table 15). Layer II gradually transitioned into Layer III, a dark brown (10YR 3/3) moist clayey silt containing cobbles, roots, and decomposing bedrock inclusions. Layer III, and the excavation of TU-3, terminated upon reaching bedrock (Figure 179). Judging by the recovered cultural remains, Feature 10 was most likely utilized for Precontact habitation purposes.

Table 15. Recovered cultural material from SIHP Site 23862 Feature 10, TU-3.

ACC #	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
53	I	Shell	*Cypraea*	2	1	0.8
54	II	Shell	*Pinctada*	1	1	3.0
55	II	Shell	*Cypraea*	1	1	0.1
56	II	Shell	*Echinoidea*	1	1	<0.1

Feature 11

Feature 11 is a grinding slick on a *pāhoehoe* bedrock flat that is located on the same outcrop as Feature 3 (see Figure 163). The slick area—noticeable by its dark color and smoothed surface (Figure 180)—measures 3.5 meters long by 2.5 meters wide. Feature 11 is located approximately 8 meters east of Feature 3 (a habitation feature), and may have been for food processing purposes.



Layer I - Architectural layer consisting of small to large sized piled *pāhoehoe* cobbles.

Layer II - Very dark brown (10YR 2/2) clayey silt.

Layer III - Dark brown (10YR 3/3) clayey silt with decomposing bedrock.

Figure 178. SIHP Site 23862 Feature 10 TU-3 east wall profile.

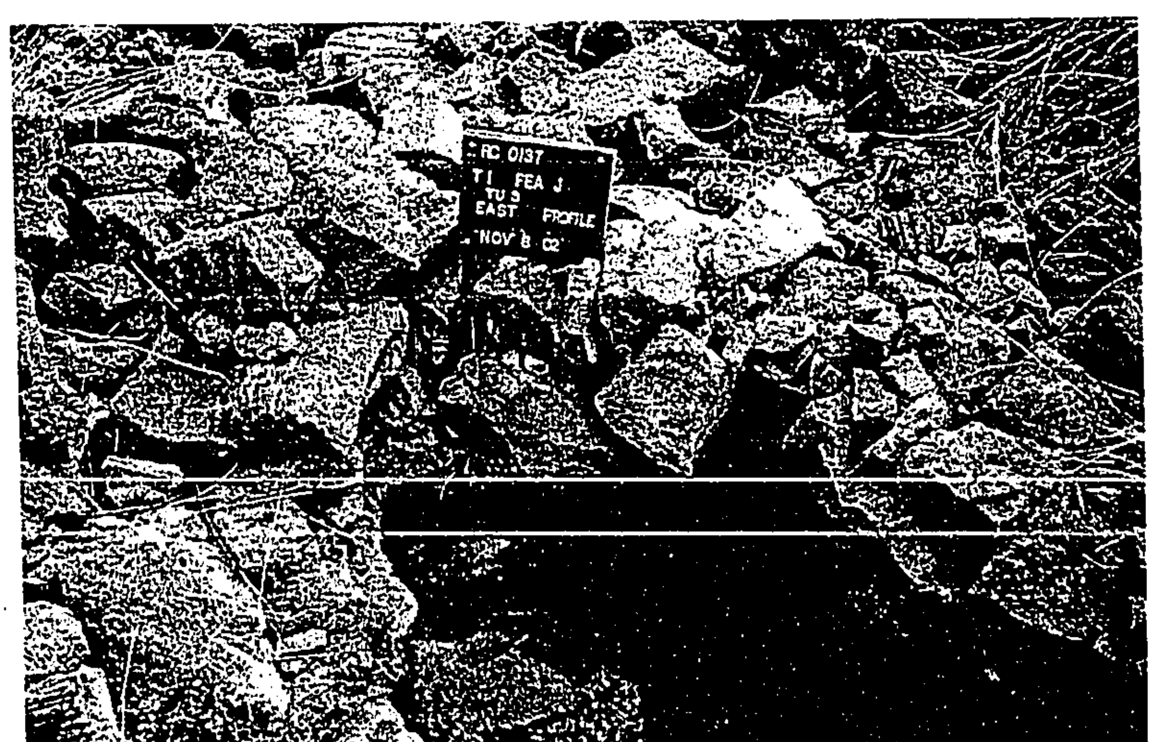


Figure 179. SIHP Site 23862 Feature 11 TU-3 view to east.

Figure 180. SIHP Site 23862 Feature 11 overview.

Feature 12

Feature 12 is a cobble alignment located in the central portion of Site 23862 (see Figure 5). The alignment, which is constructed of piled *pāhoehoe* cobbles standing up to 60 centimeters above ground surface and measuring 1.1 meters wide (Figure 181), runs northwest/southeast fcr 2.6 meters in a natural low spot between two *pāhoehoe* bedrock outcrops, connecting the two (Figure 182). The southern bedrock outcrop contains a large lava tube opening (Feature 13) and dense surface scatter of marine shell. Feature 12 is most likely related in some way to the habitation use of Feature 13 (see below).

Figure 181. SIHP Site 23862 Feature 12 view to the south.

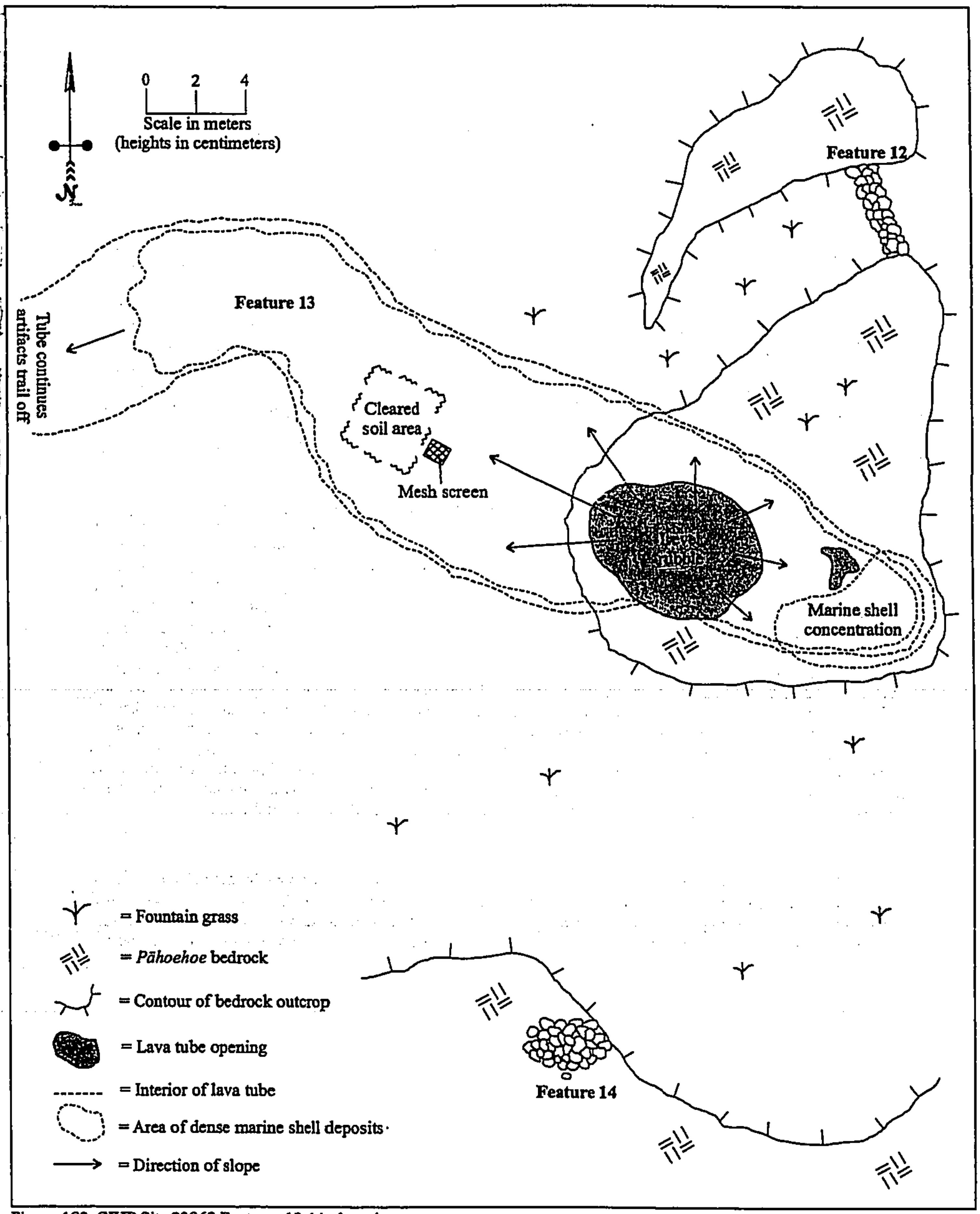


Figure 182. SIHP Site 23862 Features 12-14 plan view.

Feature 13

Feature 13 is a lava tube (dwelling cave) located in the central portion of Site 23862 between Features 12 and 14 (see Figure 182). This lava tube was the focus of intensive subsurface excavations in the early 1970s by PHRI as part of an archaeological salvage project for the construction of the Queen Ka'ahumanu Highway (Rosendahl 1973). Feature 13 (formerly Feature 701; see Table 13) was originally recorded and tested by Ching (1970) and then later reexamined and further tested by PHRI. Rosendahl (1973:23—25) described Feature 13 as consisting of three chambers (a north, east, and west chamber), with the west being the largest and the area where most of the salvage work was accomplished (Figure 183). By the time of the Rosendahl work, virtually the entire cultural deposit within the north chamber had been previously removed by Ching (1970), but 1 x 0.5 meter unit was excavated there. A 2 x 2 meter excavation unit was also completed by PHRI in the east chamber. The only architectural feature found within the dwelling cave was a fire pit located in the west chamber. Combined, the Rosendahl (1973) and Ching (1970) work uncovered a large amount of midden remains (Figure 184) at Feature 13, along with 230 portable artifacts (including 154 abraders, 21 adze fragments, 4 hammerstones, 9 fishing related items, 2 ornaments, and 6 domestic implements, along with several lithic fragments and cut shell and bone pieces). Three volcanic glass flakes where submitted for age determinations, which returned dates ranging from the end of the 15th century to the middle of the 17th century (Rosendahl 1973:27). From this work, Rosendahl suggests that occupation at Feature 13 could have been extended in nature and involved a range of general living activities that were related in some way to the nearby great fishpond named Pa'aiea (1973:62). A description of Feature 13 from the current inventory survey follows below.

The primary opening into Feature 13, located on an exposed bedrock area, measures approximately 7.0 by 5.0 meters, with a smaller, 1.0 meter diameter opening about 3.0 meters to the east (see Figure 182). A somewhat level *pāhoehoe* rubble area lies within the collapsed blister opening, which then slopes down into the cave interior on all sides except the south. Dense concentrations of marine shell *(Cellana, Conus, Cypraea, Drupa, Echinoidea,* and *Nerita)* mixed with coral fragments and waterworn pebbles are located on the bedrock surface, within the interior of the opening (north chamber), and extending into the tube (Figure 185), but no architectural cultural modification was apparent. The primary *makai* tube interior measures 9.0 meters across along the western side of the opening. The central area of the *makai* tube (west chamber) also contains scattered cobbles and boulders and soil deposits of fine grayish silt, with a small soil area (3.5 by 2.7 meters) located approximately 7.0 meters from the opening that has been cleared of midden and artifacts. A mesh screen and dust mask are located near this cleared area, and are most likely left over from the salvage project (Rosendahl 1973) (Figure 186). The lava tube continues more than 90 meters to the west, with the midden and artifacts trailing off within the first 20 meters of the tube's interior. A smaller cave, measuring 7.0 meters across, extends to the east (east chamber) off the *mauka* edge of the main opening. The secondary surface opening forms a skylight over this smaller, *mauka* cave. The interior of the *mauka* cave contains no soil, but has the same dense surface midden continuing throughout. The *mauka* cave has a rough floor surface of collapsed boulders and cobbles, and terminates approximately 8.0 meters to the east.

Feature 14

Feature 14 is a collapsed cairn (*ahu*) resting on a *pāhoehoe* bedrock outcrop located approximately 17 meters to the southwest of Feature 13 (see Figure 182). The cairn was constructed of flat, weathered, angular *pāhoehoe* cobbles that now make up a scattered pile measuring 3.1 meters long by 2.5 meters wide by up to 40 centimeters tall (Figure 187). Feature 14 may mark the former route of a trail that is no longer evident across the *pāhoehoe* bedrock landscape.

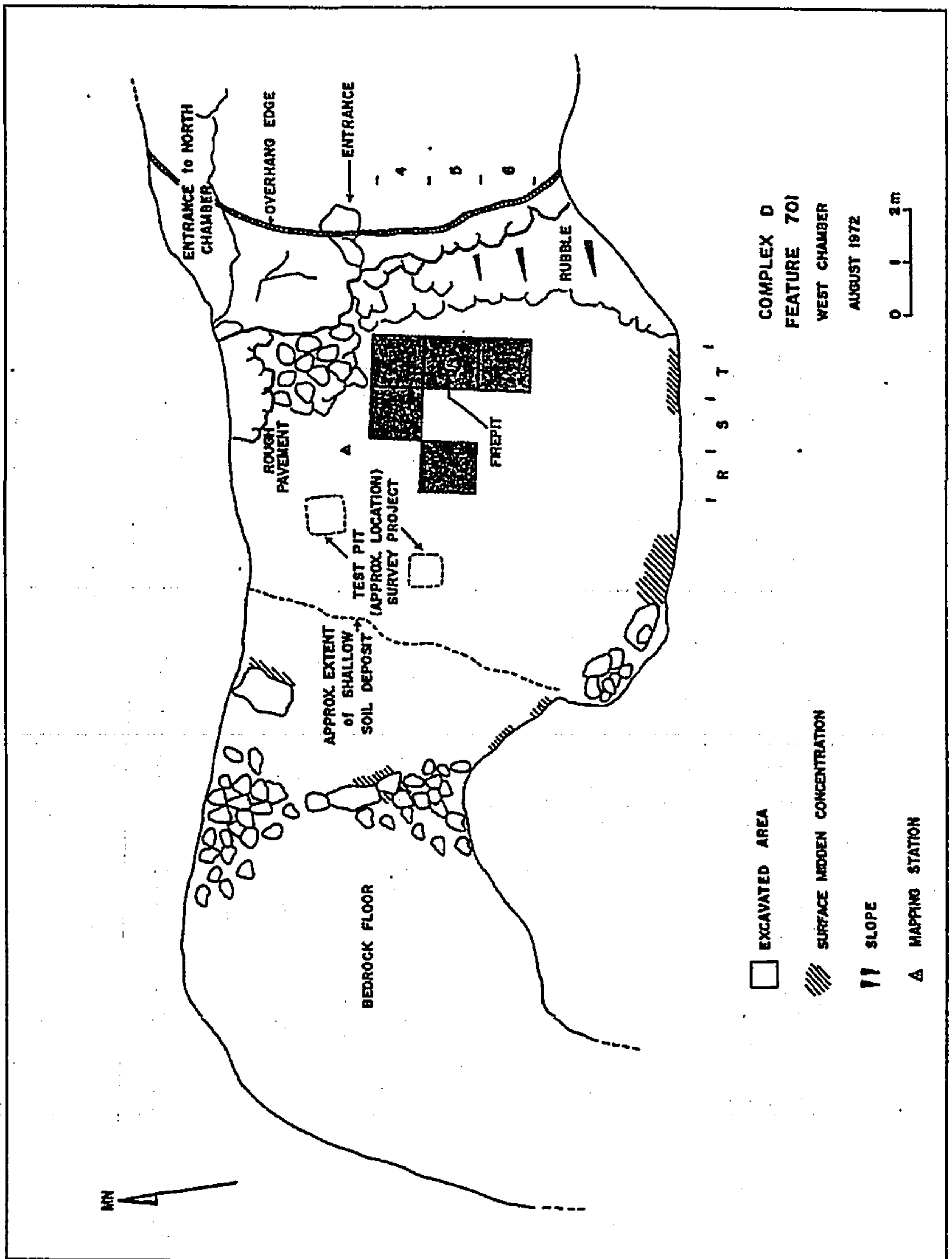


Figure 183. SIHP Site 23862 Feature 13, plan view of west chamber (from Rosendahl 1973:26).

Material	Weight of Remains (gm) for Excavated Areas		
	W Chamber ($5\ m^2$)	E Chamber ($3\ m^2$)	N Chamber ($0.5\ m^2$)
SHELL			
Gastropoda (Univalves)			
Terebra strigillata Linnaeus	3	-	1
Conus catus Hwass	148	4	12
Conus ebraeus Linnaeus	18	2	2
Conus imperialis Linnaeus	150	-	-
Conus literatus millepunctatus Lamarck	27	2	-
Conus textile Linnaeus	5	-	-
Conus spp.	244	69	25
Morula tuberculata Blainville	54	7	1
Drupa horrida Lamarck	64	-	-
Drupa ricinus Linnaeus	173	42	18
Thais aperta Blainville	42	10	-
Thais harpa Conrad	13	2	-
Thais intermedia Kiener	67	22	5
Cymatium pileare Linnaeus	7	-	-
Cypraea caputserpentis Linnaeus	13,156	3130	1266
Cypraea mauritiana Linnaeus	59	-	-
Cypraea reticulata Martyn	1,261	387	118
Strombus maculatus Nuttall	29	2	-
Planaxis labiosus A. Adams	8	-	tr
Littorina pintado Wood	15	7	3
Heloloniscus exaratus Nuttall	100	12	19
Trochus intextus Kiener	3	10	2
Nerita picea Recluz	1,304	309	124
Nerita polita Linnaeus	25	4	4
Neritina cariosa Gray	194	22	22
Melampus castaneus (Muhlfeld)	3	-	-
Pelecypoda (Bivalves)			
Brachidontes cerebristriatus Pilsbry	63	12	13
Isognomon (Melina) californicum Conrad	1,362	143	172
Ostrea sp.	21	-	-
Antigona reticulata Linnaeus	34	-	2
Tellina rugosa Born	4	21	2
Echinodermata (Sea Urchins)			
Echinothrix diadema (Linnaeus)	4	23	12
Echinometra mathaei (Blainville)	555	173	44
Heterocentrotus mammillatus (Linnaeus)	107	38	10
Colobocentrotus atratus (Linnaeus)	10	25	8
FLORA			
Aleurites moluccana Willdenow (Candlenut)	1,267	26	60
Pandanus spp.	(4)*	-	-
Charcoal	17	90	-
CRUSTACEA	2	1	-
BONE			
Mammal	353	8	7
Bird	2	4	2
Fish	295	50	52
Shark Tooth	-	(1)	-
MISCELLANEOUS			
Small pebbles (black)	101(5)	-	-
Basalt cobbles	120(1)	-	-
Lava	185	-	-

*No. of specimens in parenthesis.

Figure 184. SIHP Site 23862 Feature 13, Table 4 from Rosendahl (1973:28) listing recovered remains.

Figure 185. SIHP Site 23862 Feature 13 entrance and surface marine shell scatter, view to the west.

Figure 186. SIHP Site 23862 Feature 13 cave interior with mesh screen, view to the west.


Figure 187. SIHP Site 23862 Feature 14 view to the west.

Feature 15

Feature 15 is a collapsed cairn (*ahu*) located in the northeastern portion of Site 23862 (Figure 188). The feature consists of piled small to medium sized *pāhoehoe* cobbles on exposed *pāhoehoe* bedrock. In its collapsed state the cairn measures 1.5 meters long by 1.0 meter wide and stands up to 20 centimeters above the surrounding bedrock ground surface. Feature 15 may mark the route of a former trail that is no longer evident across the *pāhoehoe* bedrock landscape.

Feature 16

Feature 16 is the easternmost of a series of three C-shaped enclosures (Features 16, 17, and 18) that run east/west along a bedrock ridge in the north central portion of Site 23862 (see Figure 188). This small enclosure remnant opens to the north and is constructed of small to medium sized *pāhoehoe* cobbles piled 1—2 courses high (20 centimeters above ground surface). It measures 3.0 meters long by 2.0 meters wide. Feature 16 may have been utilized recurrently, or during a singular episode, for Precontact habitation purposes.

Feature 17

Feature 17 is the central C-shaped enclosure located between Features 16 and 18 in the north-central portion of Site 23862 (see Figure 188), also opens to the north (Figure 189). The feature is in fairly good condition with the east edge remaining partially stacked and the other walls only partially collapsed. Feature 17 measures 4.5 by 2.5 meters and reaches a maximum height of 37 centimeters above ground surface. It is constructed of medium-sized *pāhoehoe* cobbles. Feature 17 may have been utilized recurrently, or during a singular episode, for Precontact habitation purposes.

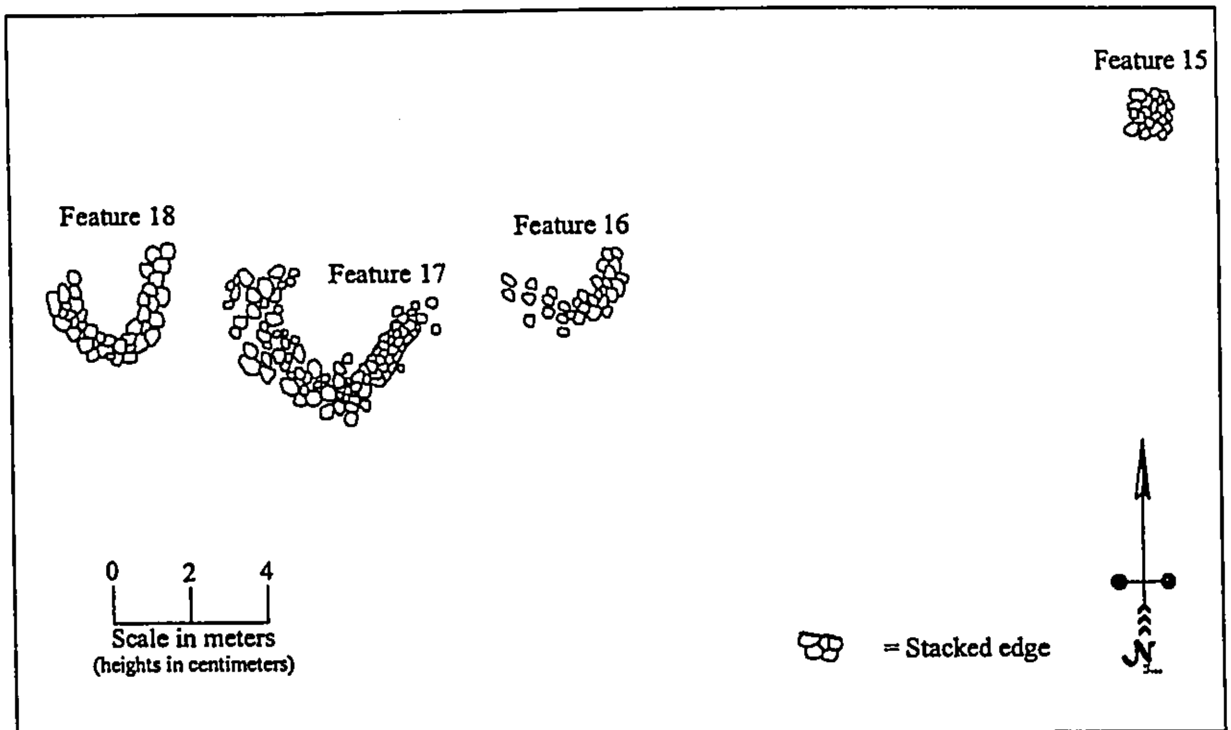


Figure 188. SIHP Site 23862 Features 15-18 plan view.

Figure 189. SIHP Site 23862 Feature 17 view to the west.

Feature 18

Feature 18 is the westernmost of a series of three C-shaped enclosures (Features 16, 17, and 18) that run east/west along a bedrock ridge in the north central portion of Site 23862 (see Figure 188). It also opens to the north and is constructed of piled *pāhoehoe* cobbles heavily overgrown by fountain grass. This feature measures 2.7 meters long by 2.1 meters wide and rises 25 centimeters above the surrounding ground surface. Feature 18 may have been utilized recurrently, or during a singular episode, for Precontact habitation purposes.

Features 19—28

Features 19—28 are a series of 10 cairns (*ahu*) forming a rough circle on an exposed *pāhoehoe* bedrock outcrop at the northern edge of Site 23862 (see Figure 5). These features are located approximately on the northern border of Kaū Ahupua'a where it meets Pu'ukala Ahupua'a. The location of these features at an *ahupua'a* boundary near a habitation area that was formerly near the fishpond of Pa'aiea, an important natural resource, provides information relative to the practices that may have taken place there. A similar series of 10 cairns (SIHP Site 10992) was recorded at the Ka'ūpūlehu/Kukio Ahupua'a border (Komori 1981, Carter 1985, Rechtman 1999) to the north of the current project area. In the preservation plan for that site Rechtman writes:

> It is at locations like this one that yearly tribute in the form of *makahiki* taxation was collectively made by the *ahupua'a* The *ahupua'a* chief (*konohiki* in Hawaiian) amassed material wealth and food and then offered it to representatives of the paramount chief and his god as they made a circuit around the island. If the offering was sufficient and accepted, then members of the *ahupua'a* were content that their yearly cycle was renewed. If the offerings were not accepted, then further economic hardships would be placed on the *ahupua'a*. When it was not *makahiki* season, sites like this were used for religious ceremonies associated with purification of the land. (1999:13)

Features 19—28 appear to serve a similar function as the one purposed for Site 10992. Further testifying to the ceremonial nature of these features is the presence of four petroglyphs (Feature 29) pecked into a bedrock flat just to the north of the outcrop containing Features 19—28. No habitation debris was observed in association with theses features, but a large branch coral fragment was discovered on the outcrop within the central area of the cairns' rough circular alignment. Individual descriptions for each of the cairns follows below and their locations ca be seen on Figure 190.

Feature 19 is a cairn constructed of medium-sized piled *pāhoehoe* cobbles with larger stones toward the center. It is in poor condition with rocks scattered in a circle 3.0 meters in diameter. Feature 19 attains a maximum height at its center of 43 centimeters above ground surface.

Feature 20 is a cairn constructed of medium to large sized *pāhoehoe* cobbles piled up and scattered over an area 1.8 by 1.6 meters. The cairn reaches up to 33 centimeters above ground surface and is situated on a small, fairly level *pāhoehoe* bedrock outcrop that lies northwest of the larger main outcrop. Feature 20 lies approximately 5.5 meters northeast of Feature 19.

Feature 21 is a cairn situated on the north end of the main outcrop adjacent to a large crack in the bedrock. Constructed of medium to large sized piled and scattered *pāhoehoe* cobbles, the cairn covers an oval area measuring 2.2 by 1.8 meters and reaches a height of 43 centimeters above the surface of the outcrop (Figure 191). Feature 21 lies approximately 8.0 meters southeast of Feature 20.

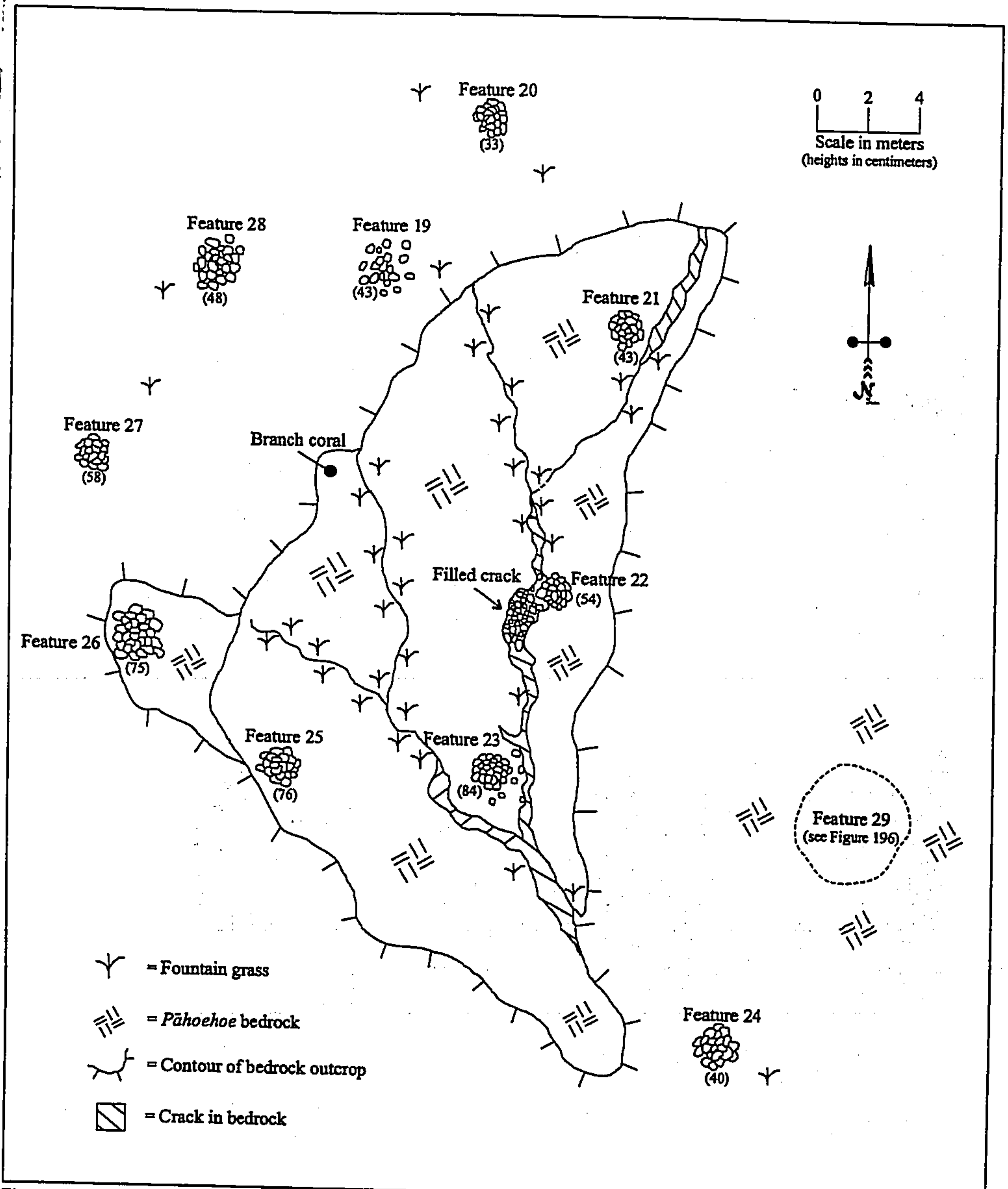


Figure 190. SIHP Site 23862 Features 19-29 plan view.

Figure 191. SIHP Site 23862 Feature 21 view to the southwest.

Feature 22, a fairly well-preserved cairn, is located near the center of the main outcrop just east of a filled crack (see Figure 190). The feature is roughly rectangular in shape and constructed of piled medium to large sized *pāhoehoe* cobbles. It measures 1.4 by 1.1 meters and rise 54 centimeters above the surface of the outcrop (Figure 192). Feature 22 lies roughly 8.5 meters south of Feature 21.

Figure 192. SIHP Site 23862 Feature 22 view to the west.

Feature 23 is a cairn that lies atop the central apex of the main bedrock outcrop 6 meters southwest of Feature 22 (see Figure 190). This circular cairn (2.5 meters in diameter) is in good condition, with a maximum height of 84 centimeters above the bedrock surface (Figure 193). It is constructed of large *pāhoehoe* cobbles at the base with medium to small cobbles piled on top to fill in the spaces.

Figure 193. SIHP Site 23862 Feature 23 view to the southeast.

Feature 24, located slightly to the southeast of the main outcrop, consists of a circular cairn (1.8 meters in diameter) constructed of medium to large sized piled *pāhoehoe* cobbles. The cairn is in stable condition and attains a maximum height of 40 centimeters above ground surface. Feature 24 lies nearly 12 meters southeast of Feature 23.

Feature 25 is a roughly rectangular cairn measuring 2.2 by 1.1 meters (Figure 194). It is situated along the southwest edge of the main outcrop (see Figure 190). The cairn is constructed of medium to large sized *pāhoehoe* cobbles piled up to 76 centimeters above the surface of the outcrop. Feature 25 lies approximately 6.5 meters west of Feature 24.

Feature 26 is a circular cairn (1.8 meters in diameter) that lies on a small peninsula of *pāhoehoe* bedrock extending off the west edge of the main outcrop (see Figure 190). Feature 26 is constructed of small to large sized *pāhoehoe* cobbles piled up to 75 centimeters above the bedrock surface (Figure 195). It is located approximately 5.5 meters from Feature 25.

Feature 27 is a poorly preserved cairn located along the western perimeter of the feature cluster approximately 5.5 meters north and slightly west of Feature 27 (see Figure 190). The cairn, which is constructed of medium sized *pāhoehoe* cobbles piled up to 58 centimeters above ground surface, is scattered over a roughly rectangular area measuring 1.3 by 0.9 meters.

Feature 28, situated in the northwest corner of the feature cluster (see Figure 190), is a cairn constructed of piled small to large *pāhoehoe* cobbles that rises 48 centimeters above ground surface. The cairn is scattered over an area measuring 2.6 by 2.0 meters and lies approximately 7.0 meters northeast of Feature 27.


Figure 194. SIHP Site 23862 Feature 25 view to the northwest.


Figure 195. SIHP Site 23862 Feature 26 view to the northeast.

Feature 29

Feature 29 is a panel of four petroglyphs pecked into a *pāhoehoe* bedrock flat located 8.5 east of the bedrock outcrop housing Features 19—28 (see Figure 190). The petroglyph panel contains three separate groupings of figures (Figure 196). The first area contains two anthropomorphic figures ranging in height from 30 to 40 centimeters. The second area contains a single anthropomorph 35 centimeters long by 30 centimeters wide, with a small, unidentifiable, possibly eroded petroglyph near the left foot. The final figure is a pecked name, obviously created during historic times, which reads, "KEKAULAHAO" (Figure 197). The name is 100 centimeters long with the lettering measuring approximately 12 centimeters in height. As previously mentioned in the description for Features 19—28, Feature 29 may be part of a ceremonial site related to the *makahiki* festival (see above).

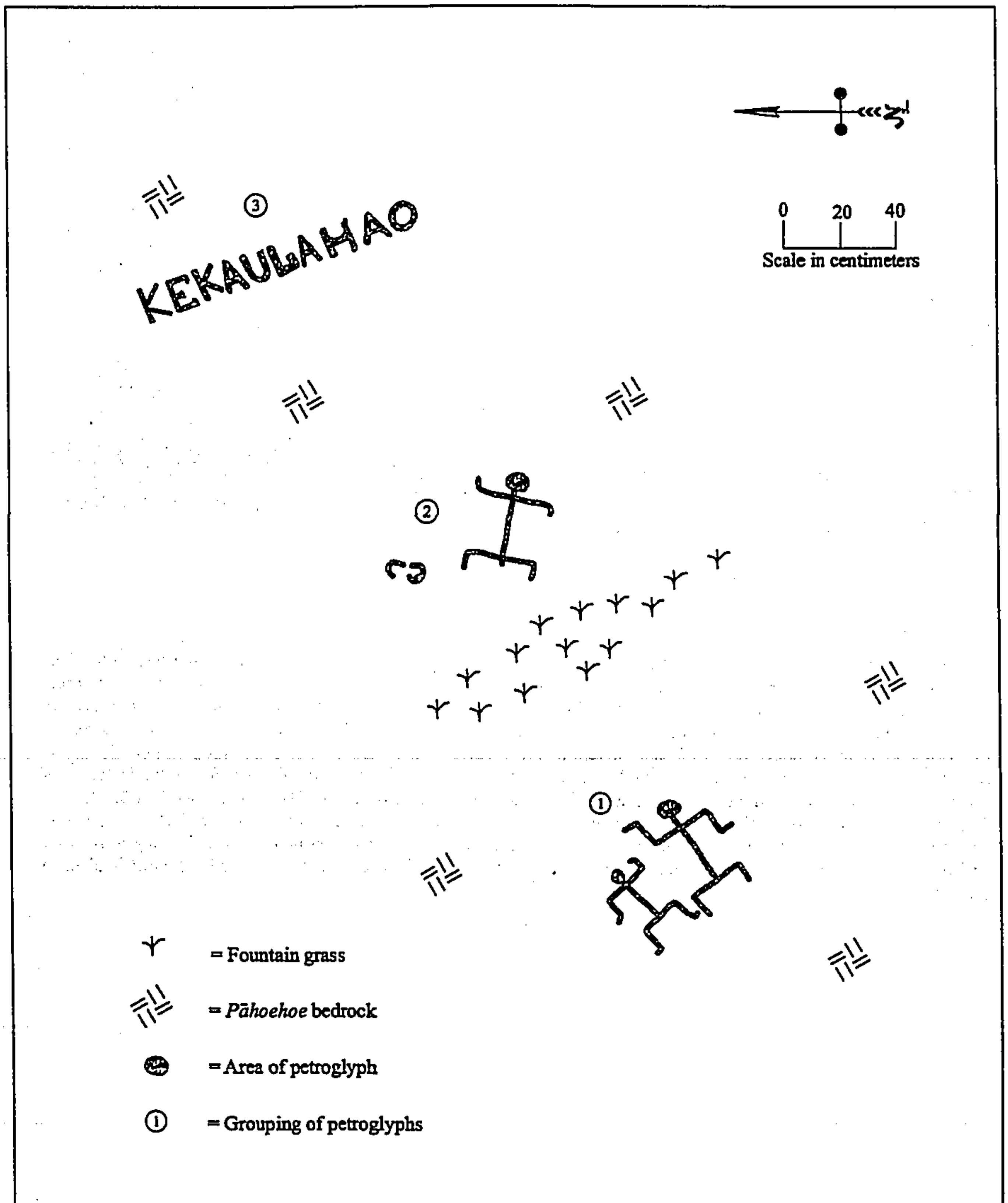


Figure 196. SIHP Site 23862 Feature 29 plan view.

Figure 197. SIHP Site 23862 Feature 29 petroglyph group #3, overview.

Feature 30

Feature 30 is an isolated C-shaped enclosure located in the southeastern corner of Site 23862 (see Figure 5). The enclosure opens to the northwest and is constructed of small to large *pāhoehoe* cobbles arranged on an exposed *pāhoehoe* bedrock surface (Figure 198). Interior dimensions of the feature are 2.0 by 1.65 meters, with the interior edge consisting of a linear alignment of large *pāhoehoe* cobbles one course high (Figure 199). The outside edges are piled or collapsed, standing up to 35 centimeters above ground surface. The wall widths range from 80 to 100 centimeters. Old flagging tape was noted tied around a rock in the central area of the feature. Since this feature was not recorded by Ogden (Schilz et al. 1990), the flagging must be left over from the PHRI salvage work at Site 23862 (Rosendahl 1973). A short, linear alignment of cobbles was noted 12 meters to the north of Feature 30, but is probably not cultural. No habitation debris was observed in the area, suggesting that Feature 30 may have been utilized only sparingly, during a singular episode, or perhaps on a limited recurrent basis, for Precontact habitation purposes.

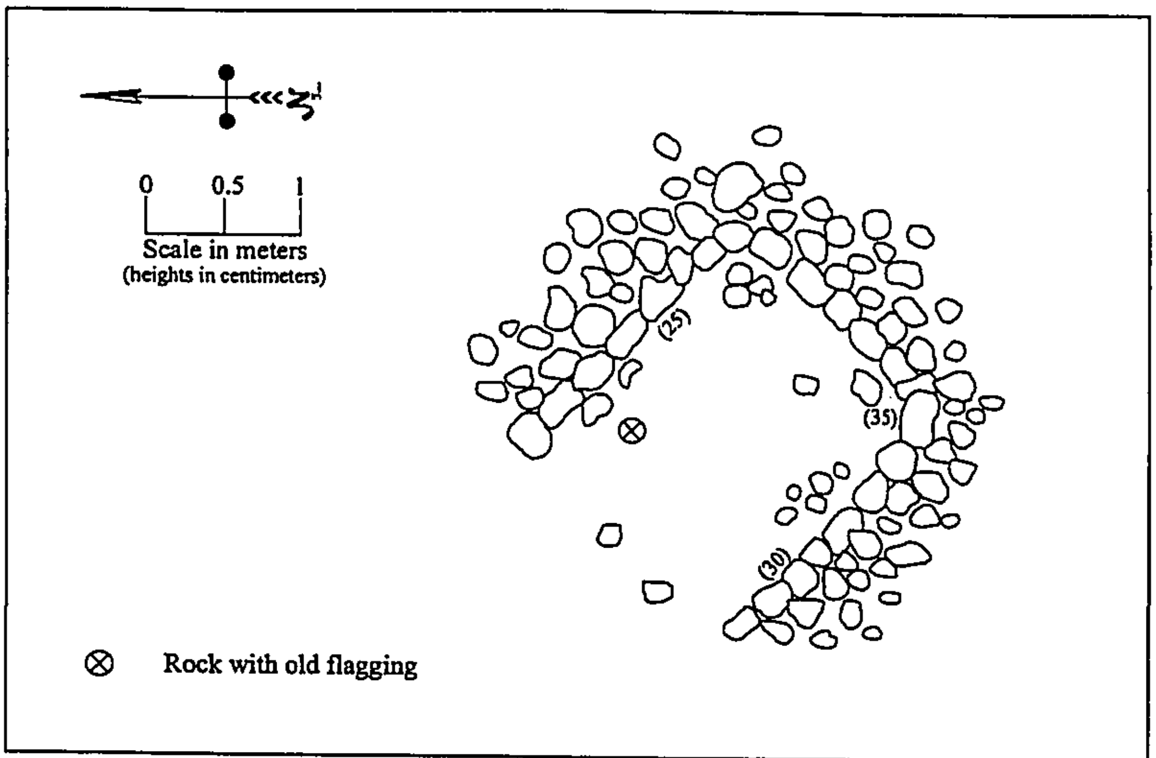


Figure 198. SIHP 23862 Feature 30 plan view.

Figure 199. SIHP 23862 Feature 30 view to the southeast.

SIHP Site 23863

Site 23863 is a single cairn (*ahu*) located in the northwestern portion of the project area along the northern edge of an *a'a* flow where it meets an older *pāhoehoe* flow (see Figure 5). The cairn is roughly circular, measuring 70 centimeters diameter, and is constructed of approximately 20 medium-sized *a'a* cobbles piled up to 60 centimeters above ground surface (Figure 200). Site 23863 may mark the former route of trail that is no longer visible across the landscape. It is also possible that Site 23863 is related to Site 23865 (an old road bed), which runs east/west across the project area to the north of the cairn.

Figure 200. SIHP Site 23863 view to the east.

SIHP Site 23864

Site 23864 is a modified outcrop enclosure located in the western portion of the project area along the northern border of Kaū Ahupua'a (see Figure 5). The site consists of a natural *pāhoehoe* bedrock outcrop that has been modified to create a small three-sided enclosure opening to the south (Figure 201). The north and west walls of the enclosure are formed by the remnants of a small lava tube (6.0 meters long by 4.0 meters wide) that collapsed, leaving nearly vertical thin segments of *pāhoehoe* bedrock rising 120–150 centimeters above the surrounding ground surface (Figure 202). Cobbles were added to the northwest corner of the enclosure to fill in a gap between the north and west bedrock walls (Figure 203). The east wall was formerly constructed of upright *pāhoehoe* slabs, which at one time probably consisted of two rows of slabs with small cobbles used to fill in between and hold the slabs in place, but is now mostly collapsed, leaving only three slabs that remain standing (Figure 204). The interior of the enclosure is filled with fountain grass.

A concentration of coral (including branch coral), along with two oblong waterworn cobbles, was discovered in the northeast corner of the enclosure (Figure 205). The two cobbles were propped up against an upright *pāhoehoe* slab with coral arranged around them and a small rock tied with flagging tape placed beneath them. This arrangement could represent a small shrine, or perhaps a placement of portable artifacts arranged by whoever left the flagging tape, which appears to have been left at the site by archaeologists. Site 23864 was not recorded during the earlier Ogden inventory survey of the study parcel (Schilz et al. 1990), but may have been discovered by PHRI, who began an inventory survey of the parcel that was never completed or reported on. Whatever the case, based on the presence of oblong water worn cobbles and branch coral (along with the lack of habitation debris), Site 23864 was most likely utilized during Precontact times as a shrine. Based on the size and opportunistic construction of the enclosure it could also have served a secondary function as a temporary habitation (Cordy 1981, 1995). Site 23864 may have been constructed and used by residents of Site 23870 (a habitation complex to the east). The location of the shrine, along the *ahupua'a* boundary, suggests that Site 23864 could have had ceremonial significance related to the *makahiki* festival (similar to Site 23682 Features 19—29 located to the west).

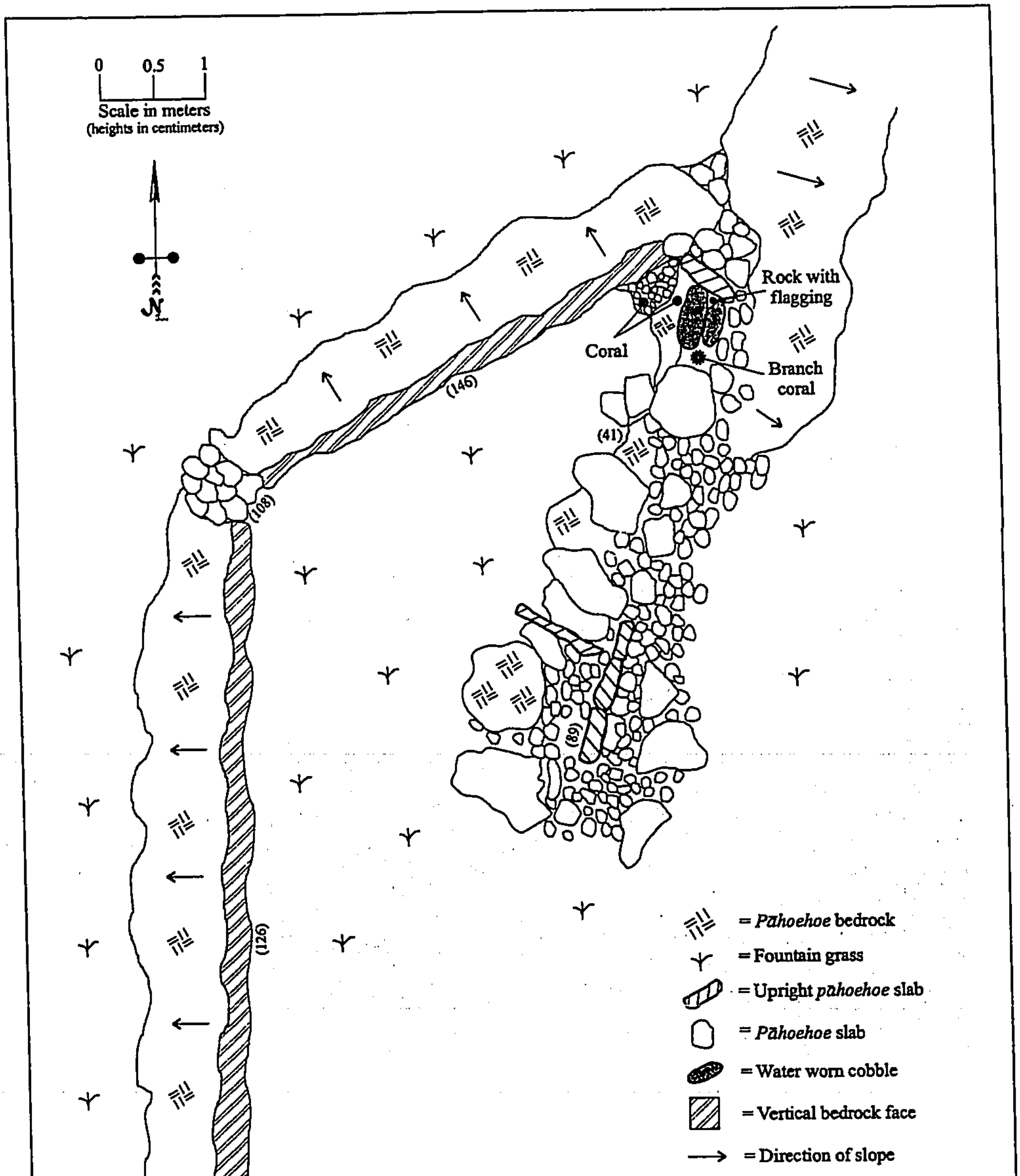


Figure 201. SIHP Site 23864 plan view.

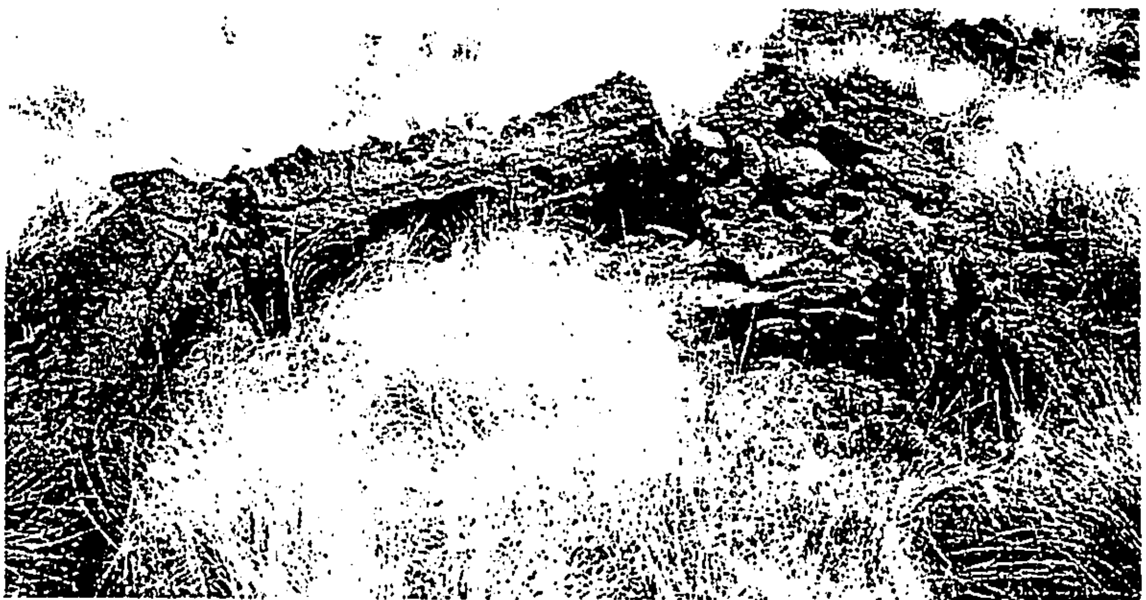


Figure 202. SIHP Site 23864 view to the north.


Figure 203. SIHP Site 23864 close-up of filled gap view to the west.

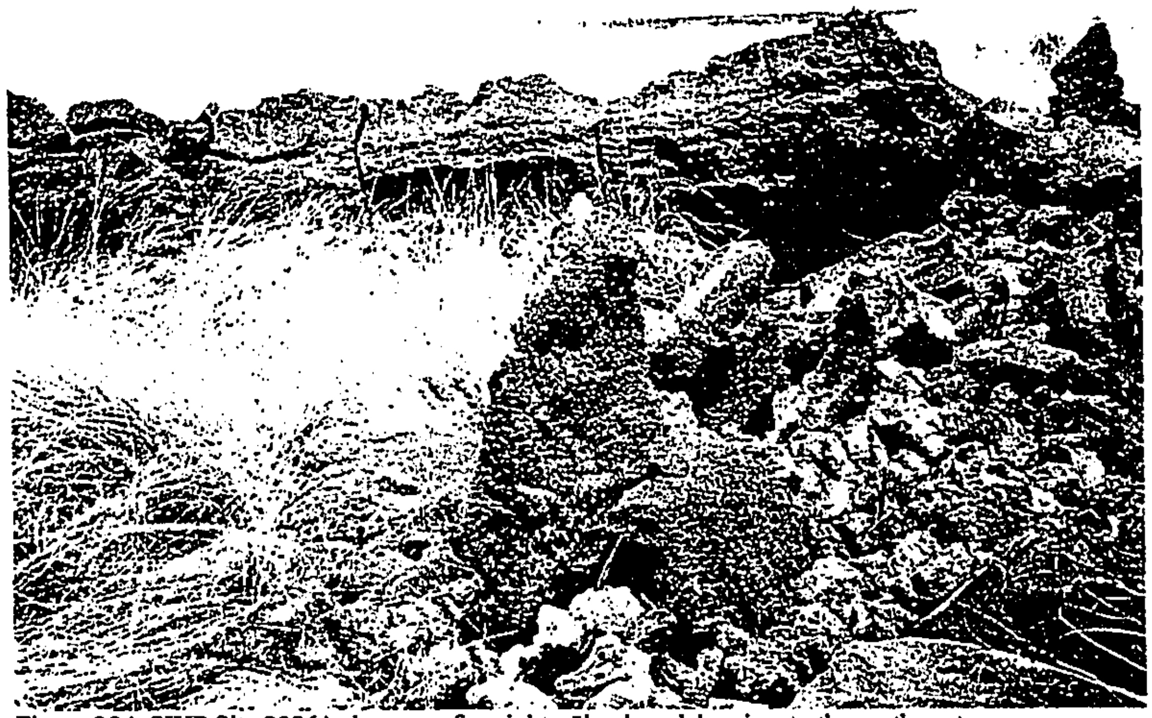


Figure 204. SIHP Site 23864 close-up of upright *pāhoehoe* slabs view to the northwest.

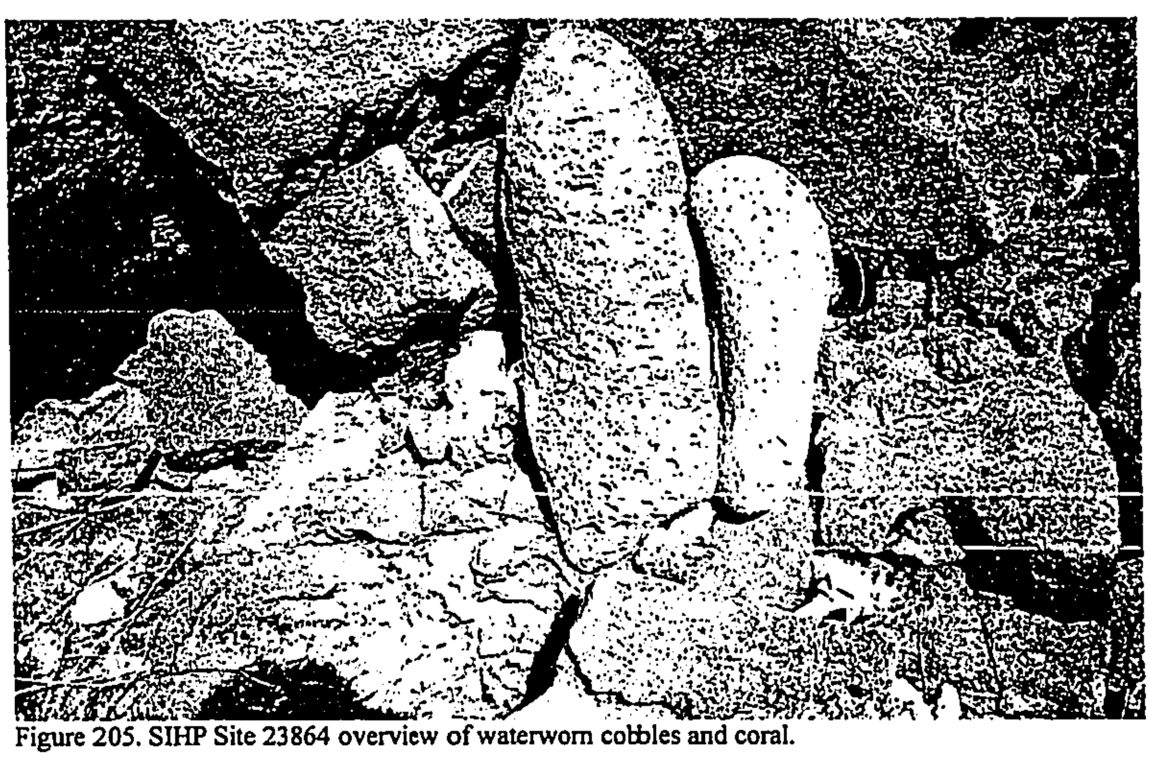


Figure 205. SIHP Site 23864 overview of waterworn cobbles and coral.

SIHP Site 23865

Site 23685 is a historic roadbed that runs *mauka/makai* across the western portion of the project area (see Figure 5). Traceable sections of the roadbed run from the southern edge of Site Complex D east past Site 23870 where it exits the project area to the north and continues to a large platform not recorded as part of the current study. The road appears to have been intended for use by wheeled vehicles, most likely carts and wagons, during the 19th and early 20th century. It may have functioned as a driveway to the aforementioned platform located on the adjacent parcel to the north. The roadbed is constructed (to varying degrees) of *pāhoehoe* cobbles laid out on *pāhoehoe* bedrock. In some areas the road consists of unmodified smooth bedrock. In other areas cracks and depressions in the bedrock have been roughly filled with cobbles to create a somewhat level path. Near the northern boundary of the study parcel the road climbs a seep hill. In this section a ramp — 3.3 meters wide and constructed with large cobbles stacked along its exterior edge and medium sized cobbles paving the interior — was built to allow for easier passage up the hill (Figure 206). Isolated marine shell fragments, waterworn pebbles, and coral were noted along the route of the road. Also, a clear glass bottle with no markings was found cached in a bedrock outcrop near the edge of the roadway. It is possible that Site 23685 follows the alignment of an older foot trail.

Figure 206. SIHP Site 23865 view to the northeast toward Site 23870.

SIHP Site 23866

Site 23866 is a small, leveled pavement area located on an *'a'ā* flow within the southwestern portion of the project area (see Figure 5). The site consists of a rectangular area (4.9 meters by 4.7 meters) that has been mostly cleared of large cobbles to create a fairly level surface of medium to small-sized *'a'ā* cobbles and pebbles (Figure 207). Many of the cleared cobbles appear to have been moved to the eastern edge of the pavement to create a piled linear alignment running north/south (Figure 208). This linear cobble alignment measures 4.5 meters long and 0.9 meters wide with an average height of 0.5 meters above ground surface. The site sits adjacent to a steep, north-facing slope with a prominent view of the coastline and the surrounding area. One small fragment of branch coral was discovered in the southwest corner of the clearing. Two large *'a'ā* boulders and a decayed tree are also present on the surface of the pavement. The presence of branch coral, along with the site's location, suggest that it might have been used for Precontact ceremonial purposes. Alternatively, given its size and crude formal characteristics, Site 23866 could have been used for Precontact temporary habitation purposes (Cordy 1981, 1995).

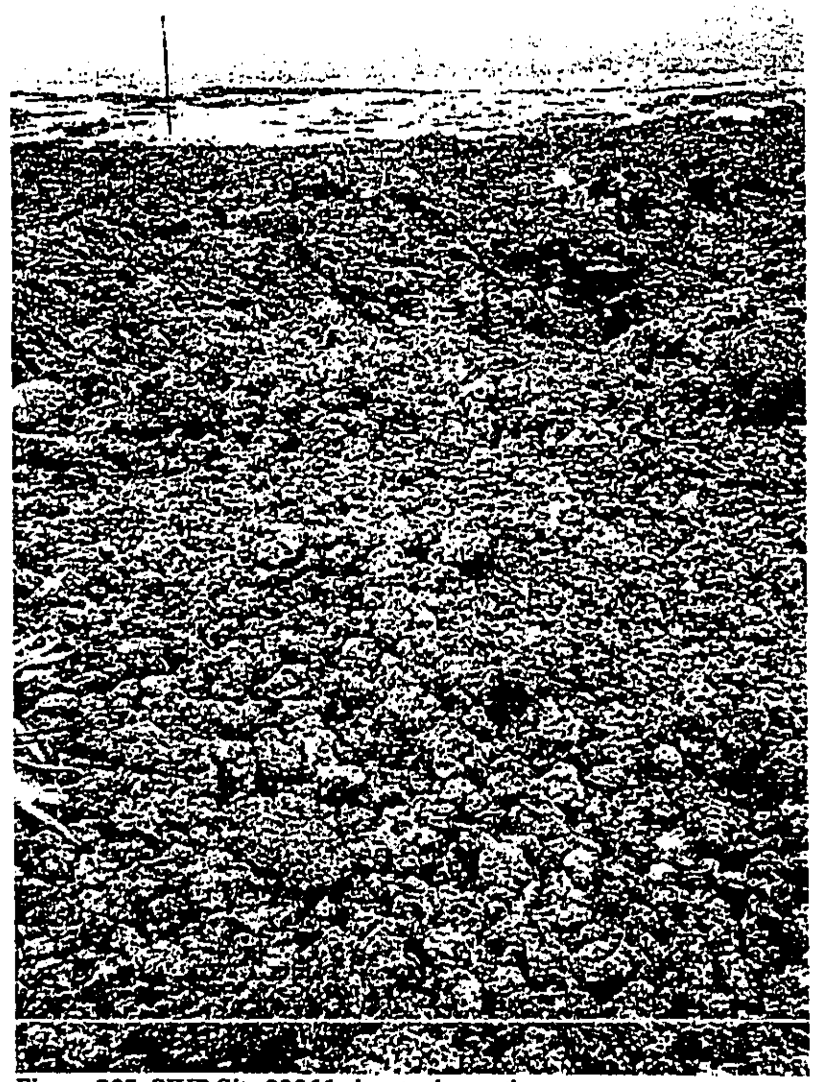


Figure 207. SIHP Site 23866 view to the northeast.

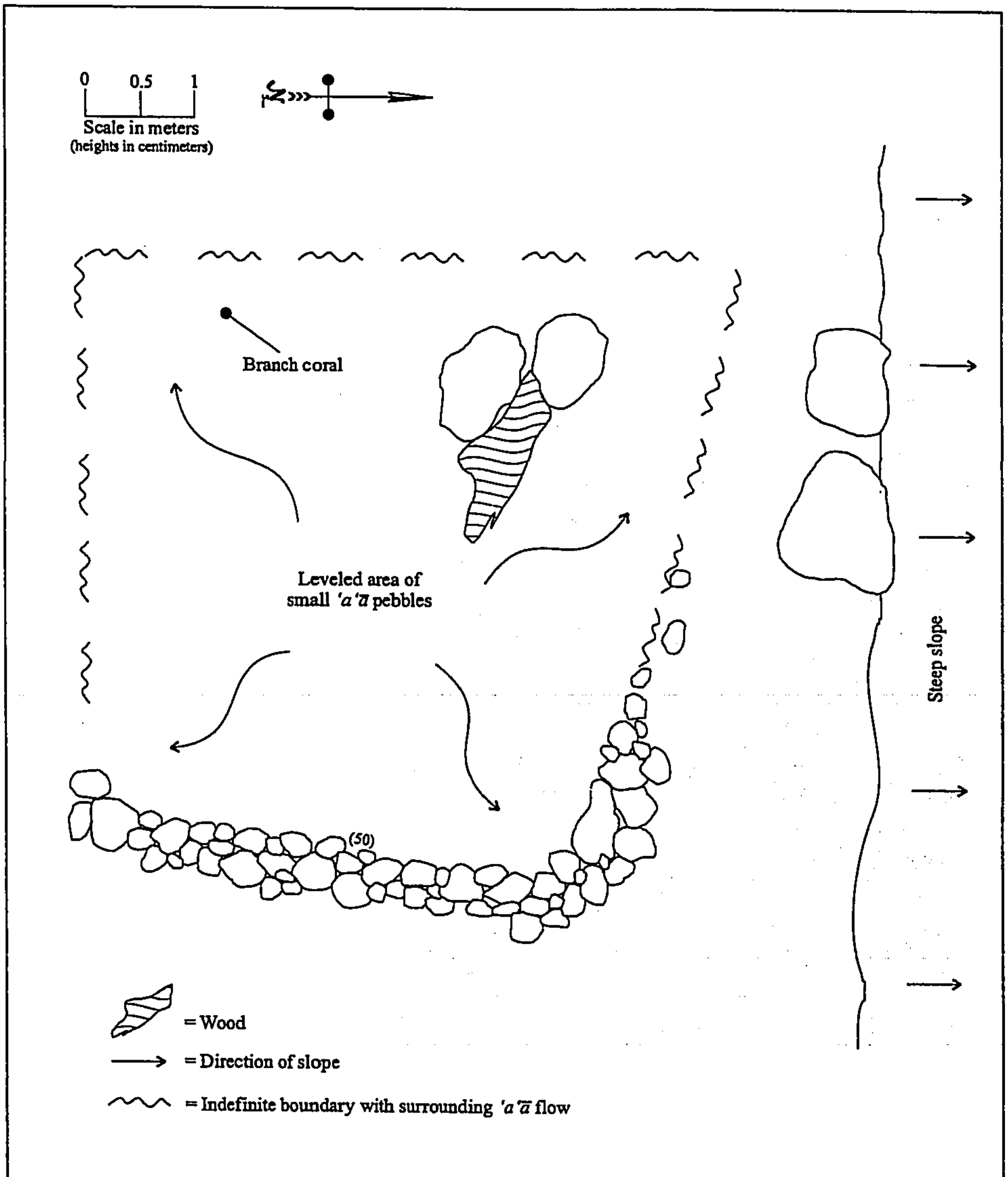


Figure 208. SIHP Site 23866 plan view.

SIHP Site 23867

Site 23867 consists of two C-shaped enclosures located in the western portion of the project area within the same *'a'ā* surrounded *pāhoehoe kīpuka* (Figure 209) that contains Site14377 (see Figure 5). The larger C-shape (Feature A) covers an area 3.0 by 2.5 meters and attains a maximum height of 45 centimeters above ground surface (Figure 210). A second, smaller possible C-shaped remnant (Feature B) lies adjacent to the southeast wall of Feature A and measures approximately 1.0 by 1.0 meter. Both Features A and B open to the northwest and are constructed of piled small to large sized *pāhoehoe* cobbles on exposed *pāhoehoe* bedrock (Figure 211). A scattering of small to medium sized *pāhoehoe* cobbles lies 4.8 meters west of Site 23867 on the same bedrock outcrop, but is most likely not cultural. The features of Site 23867, judging by their formal attributes and size, most likely served Precontact temporary habitation purposes (Cordy 1981, 1995). Site 23867 may have been utilized during a single habitation episode, or recurrently over the years for short durations by people traveling along Site 14404 (a trail).

Figure 209. *Pāhoehoe kīpuka* containing SIHP Site 23867 view to the southwest.

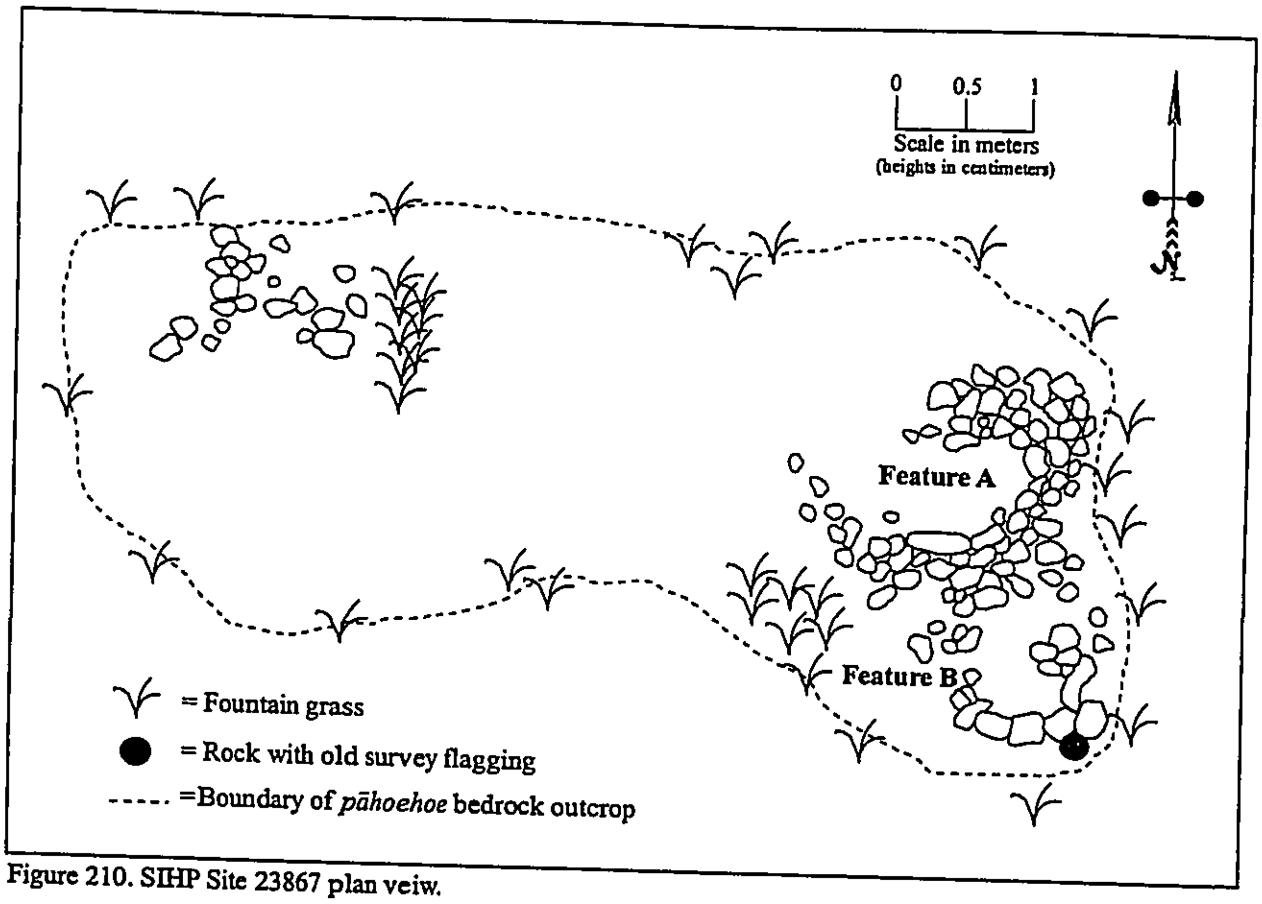


Figure 210. SIHP Site 23867 plan veiw.

Figure 211. SIHP Site 23867 view to the southeast.

SIHP Site 23868

Site 23868 is a stepping-stone trail located in the west-central portion of the project area (see Figure 5). The trail is constructed with flat *pāhoehoe* slabs laid out as stepping-stones across an expansive *'a'ā* field (Figure 212). The identifiable portion of this trail runs a meandering course north/south (but turning slightly east at its northern end) for approximately 120 meters. Site 23868, which is somewhat difficult to follow, was bisected by bulldozer at some point in recent history.

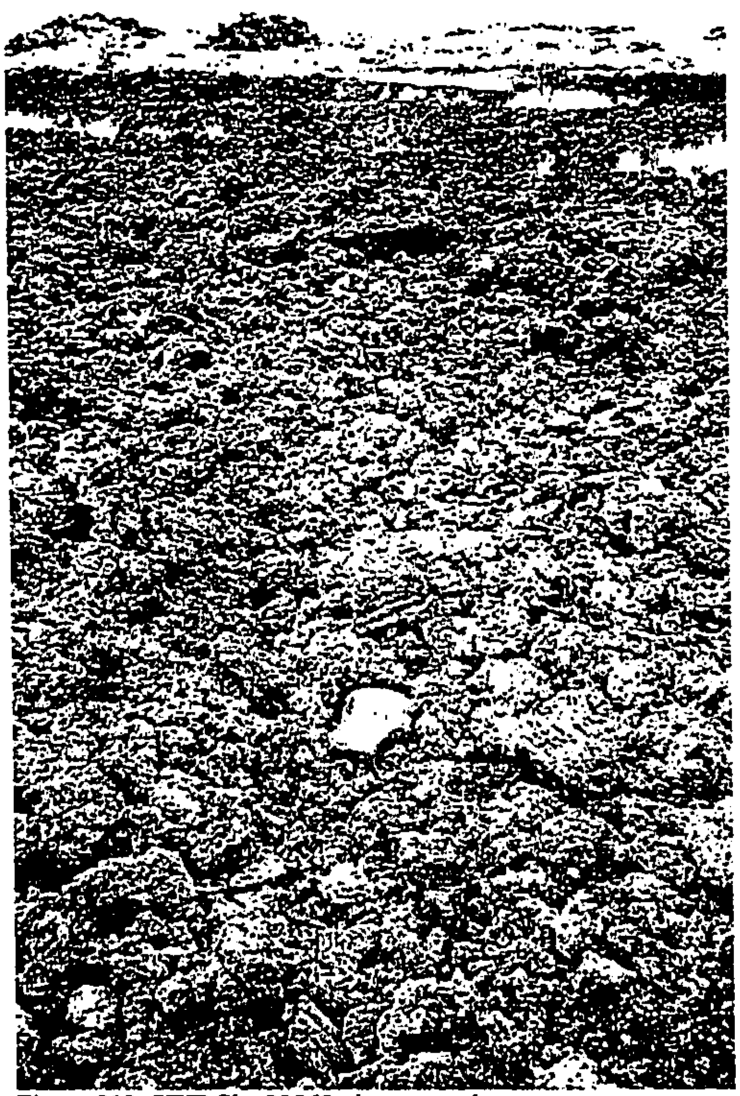


Figure 212. SIHP Site 23868 view to north.

SIHP Site 23869

Site 23869, located at the junction of a bulldozed (power line) road and the northern property boundary in the western portion of the project area (see Figure 5), consists solely of a single incised "X" on a *pāhoehoe* bedrock slab (Figure 213). Each line of the "X" measures 12 centimeters in length. The incised stone lies amidst a scattering of large *pāhoehoe* cobbles surrounded by fountain grass. The location of this feature suggests that it is an old property boundary marker placed slightly south of where the current survey line exists today.

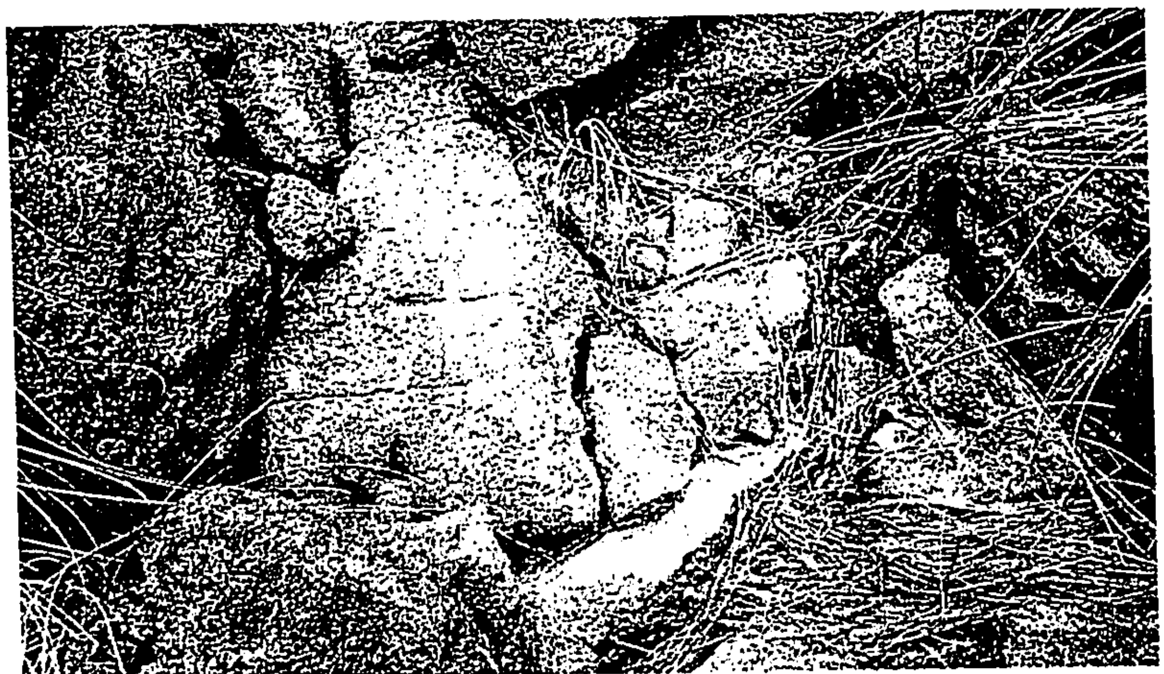


Figure 213. SIHP Site 23869 overview.

SIHP Site 23870

Site 23870 is a habitation complex, situated on the top of a small hill, along the northern property boundary in the western portion of the project area (see Figure 5). The site consists of a habitation area within a lava blister (Feature A), two pavement areas (Features B and C), an oval alignment of stones (Feature D), and a platform remnant (Feature E) (Figure 214). The hill has a commanding 360° view of the surrounding area, which—along with the presence of a natural lava blister—is probably why Precontact Hawaiians decided to live there. Based on small size of the features and their insubstantial construction (Cordy 1981, 1995), the nature of the habitation appears to be semi-permanent or perhaps seasonal and may have been related to the site's proximity to the great fishpond of Pa'aiea, which was destroyed by lava in 1801.

An old property boundary marker "H4" is spray-painted on the bedrock between Features A and B, along with a circular paint mark and a small pile of cobbles (Figure 215). Site 23865 (an old road bed) runs along the northern edge of Site 23870 and Feature E may have been partially dismantled to construct its length. Marine shell fragments along with some old bullet casings and a few AA batteries were noted on ground surface within the site area. Many of the marine shell fragments appear to have been removed from the lava blister (Feature A) indicating that the site was perhaps looted or previously tested by archaeologists, but never reported on. Ground surface on top of the hill consists of sparse soil with large areas of exposed *pāhoehoe* bedrock. Vegetation throughout the area consists almost solely of fountain grass.

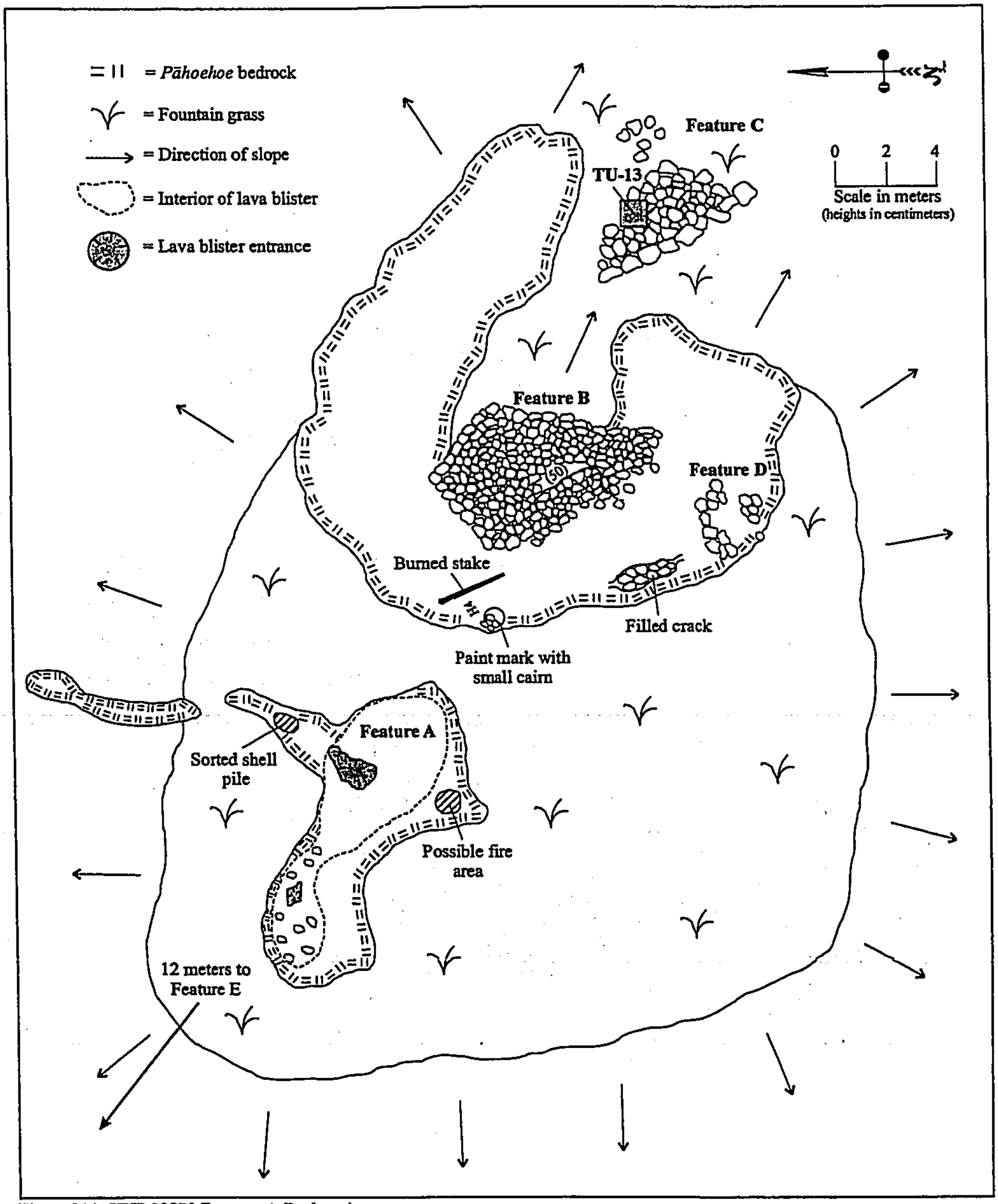


Figure 214. SIHP 23870 Features A-D plan view.


Figure 215. SIHP Site 23870 overview of property marker.

Feature A

Feature A is a small lava blister with two openings centrally located on top of the hill at the *makai* edge of the site (see Figure 214). The western (*makai)* opening measures 0.8 by 0.5 meters (Figure 216), and the eastern (*mauka)* opening measures 1.7 meters by 1.0-meter (Figure 217). Both openings contain marine shell and coral fragments and are connected by a sub-surface passage. The interior of the *makai* opening is narrow, filled with rubble and has a very low ceiling. The *mauka* tube interior is comparably spacious, with a thin layer of soil covering the cleared, level floor (Figure 218). A large stone rests directly inside the opening, and may have served as a step into the interior. This end of the lava blister seems the most likely area for habitation. Modern debris of batteries and bullet casings were also noted within the blister interior. A small pile of size-sorted shell is located 2 meters north of the *mauka* blister entrance, and may have been left by looters (or perhaps archaeologists). Approximately 3 meters south of the *mauka* blister entrance is a small area that may have been used for fires.

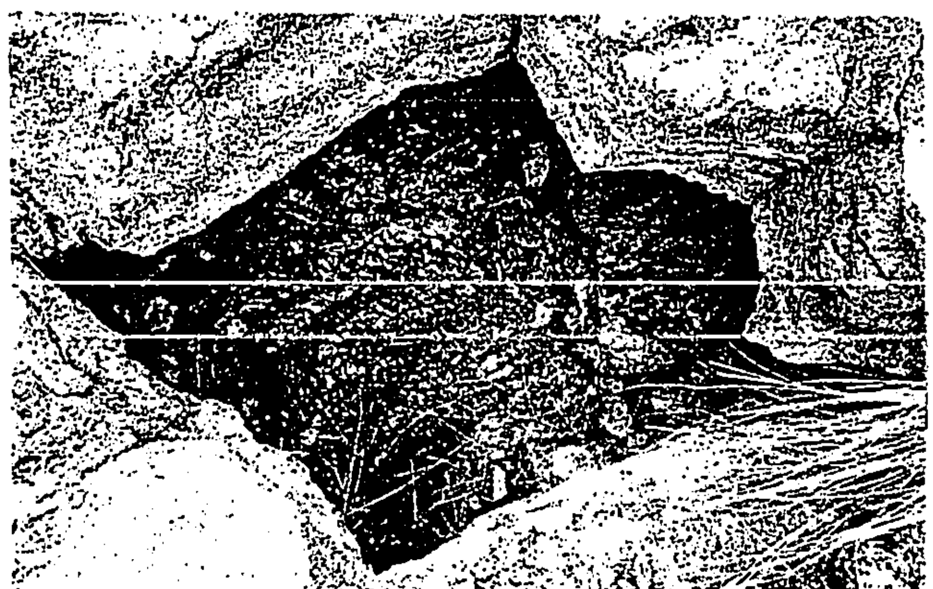


Figure 216. SIHP Site 23870 Feature A overview of *makai* blister opening.

Figure 217. SIHP Site 23870 Feature A *mauka* blister opening view to south.

Figure 218. SIHP Site 23870 Feature A interior view to east.

Feature B

Feature B is a terraced pavement located 7 meters east of Feature A (see Figure 214). The pavement, measuring 8.0 by 5.0 meters, is constructed of piled *pāhoehoe* and *'a'ā* cobbles (Figure 219). Smaller cobbles, pebbles, and flat *pāhoehoe* slabs pave the feature creating a relatively level surface. The north and east edges of Feature B rise 60 centimeters above ground surface, while the other sides are level with the surrounding bedrock. A second elevated level of pavement exists along the southeast side of the feature, but appears to be mostly natural. Marine shell and coral were observed on the surface of Feature B. A small, partially-filled crack lies 3 meters to the southwest of Feature B, but may not be cultural. This feature was most likely used for habitation purposes.

Figure 219. SIHP Site 23870 Feature B view to south.

Feature C

Feature C is a collection of large *pāhoehoe* cobbles and boulders located in the southeastern area of Site 23870, part-way downslope from the hilltop containing Features A, B, and D (see Figure 214). This area may at one time have been a terraced pavement similar to Feature B, but is now completely collapsed and unrecognizable (Figure 220). Feature C measures 6.0 by 3.0 meters and reaches a maximum height of 85 centimeters above ground surface. A single 1 x 1 meter test unit was excavated along the north edge of Feature C (TU-13).

Figure 220. SIHP Site 23870 Feature C view to west.

Excavation of TU-13 revealed a two-layer stratigraphic profile resting on bedrock (Figure 221). Layer I, the architectural layer, consisted of medium to large sized *pāhoehoe* cobbles that continued to 55 centimeters below the unit's surface. Layer II consisted of very dark brown (10YR 3/2) loamy silt mixed with cobbles and gravel 22 centimeters thick. This layer contained small fragments of marine shell (Table 16) and continued to undulating *pāhoehoe* bedrock. Excavation of TU-13 terminated upon encountering bedrock at a depth of 77 centimeters below the unit's surface (Figure 222).

Table 16. Recovered cultural material from SIHP Site 23870, Feature C, TU-13.

ACC#	*Level*	*Material*	*Species/Type*	*Count*	*MNI*	*Weight (g)*
109	II	Shell	*Cypraea*	1	1	1.1
110	II	Shell	*Echinoidea*	1	-	0.2
111	II	Shell	Unidentified	2	1	0.2

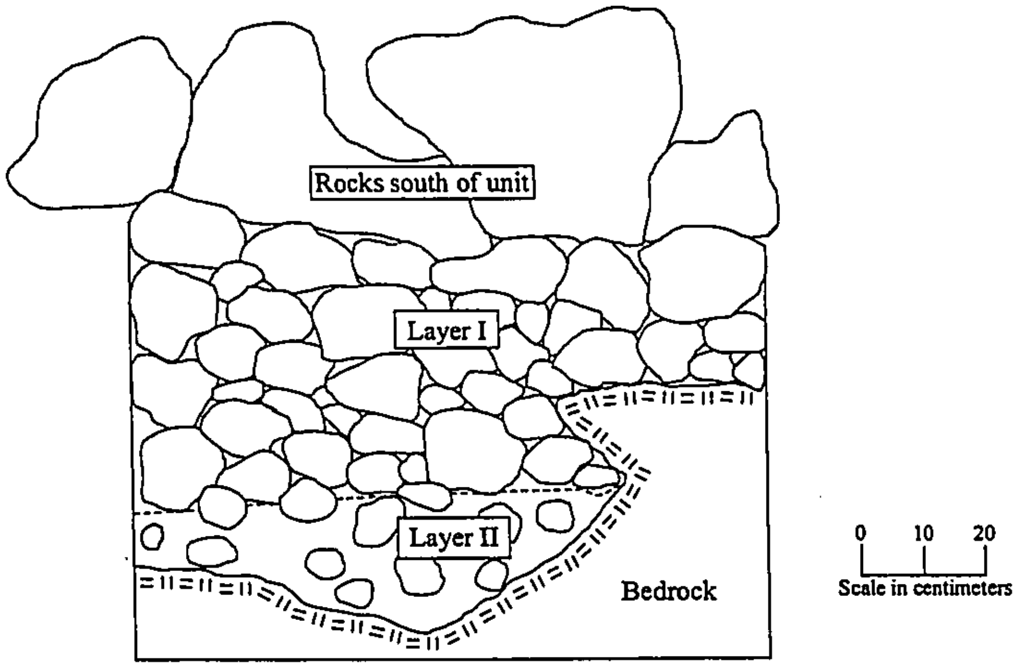
Feature D

Feature D is a small, oval alignment of stones located about 3 meters south of Feature B (see Figure 214). The feature is constructed of approximately 30 large *pāhoehoe* cobbles stacked and piled 1-2 courses high (45 centimeters above ground surface) and arranged in an oval covering an area 2.7 by 1.6 meters (Figure 223). This feature may have served as a fire ring or perhaps a small temporary habitation.

Feature E

Feature E is a platform situated along the *makai* side of the small hill that contains Features A, B, and D approximately 12 meters northwest of Feature A (see Figure 5). The feature is constructed with small to large *pāhoehoe* cobbles stacked 4 to 6 courses high to create a rectangular, fairly level platform measuring approximately 5.5 by 2.0 meters (Figure 224). The western wall of the platform remains neatly stacked, while other areas of the feature are eroded and collapsed (Figure 225). Two small stacks of medium-sized *pāhoehoe* slabs and cobbles lie atop the platform along its western edge. The north stack measures 40 centimeters above the platform's surface, while the south stack, a large slab crossing two cobbles, rises 32 centimeters above the platform's surface (Figure 226). These stacks may be cairns (*ahu*), related to Site 23865, that were built on the feature's surface at a date later than its original construction. Site 23865 (an old road bed) abuts the north edge of the platform. It appears as though Feature E was partially dismantled to aid in, and allow for, the construction of the roadbed. A single 1 x 1 meter test unit (TU-12) was excavated in the north half of the platform.

Excavation of TU-12 revealed a simple two-layer stratigraphic profile consisting of an architectural structure layer and a thin soil deposit (Figure 227). Layer I, the architectural layer, consisted of well-fitted, small to large *pāhoehoe* slabs and cobbles that extended to 106 centimeters below unit surface. Cultural artifacts, including marine shell fragments and *kukui*, were recovered from Layer I. Layer II consisted of a thin, 2—5 centimeter thick soil deposit directly beneath the architectural layer resting on bedrock. This soil layer of very dark brown (10YR 2/2) fine silt contained small roots and cultural artifacts, including marine shell, fish bone, and charcoal (Table 17). Layer II, and excavation of TU-12, terminated upon reaching bedrock (Figure 228).



Layer I - Architectural layer consisting of piled medium to large sized *pāhoehoe* cobbles.

Layer II - Very dark brown (10YR 3/2) silt loam mixed with cobbles and gravel.

Figure 221. SIHP Site 23870 Feature C TU-13 south wall profile.

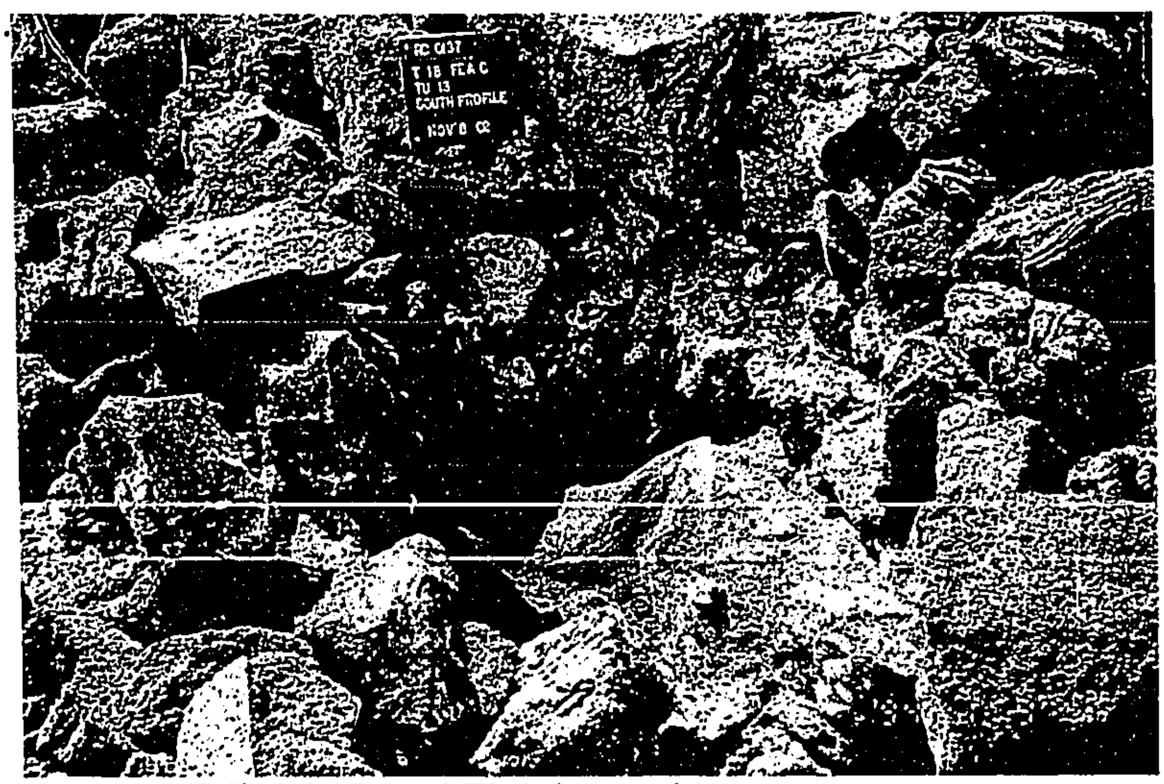


Figure 222. SIHP Site 23870 Feature C TU-13 view to south.

Figure 223. SIHP Site 23870 Feature D view to north toward Feature B.

A carbon sample recovered from TU-12 Layer II (ACC # RC-0137-108; see Table 17) was sent to Beta Analytic for analysis. The sample produced a conventional radiocarbon age of 110±90 years before present (Beta-173874; see Appendix A), indicating that the sample had burned relatively recently (within the last 200 years). With the exception of the carbon sample, artifacts recovered from feature E seem to indicate a Precontact habitation function associated with Features A—D. The recent date for the carbon sample may indicate that the feature was used into historic (and even modern times), serving a function somehow related to Site 23865 (an old road bed), and that charred material from this episode of usage filtered down through the architectural layer (Layer I) into Layer II. Conversely, the carbon sample could also indicate that Feature E was constructed later than Features A-D and is not related to them at all, or that Site 23870, 18 does not date to Precontact times, but to the Historic period. Although all the options are plausible, it seems likely, based on the lack of historic artifacts at Site 23870 that it was utilized for Precontact habitation purposes, but that Feature E (and perhaps the others) saw continuedHistoric use.

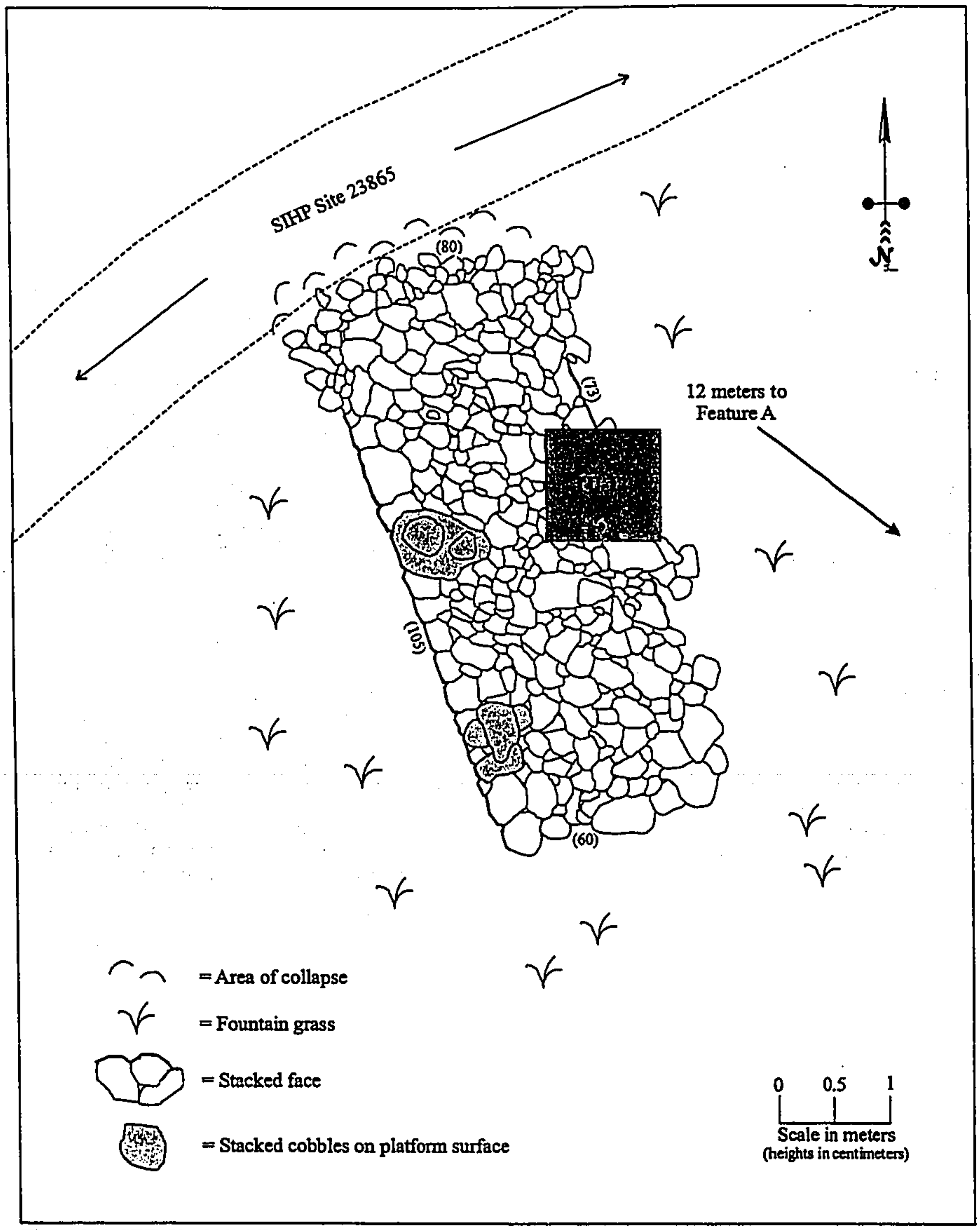


Figure 224. SIHP Site 23870 Feature E plan view.


Figure 225. SIHP Site 23870 Feature E view to west.


Figure 226. SIHP Site 23870 Feature E view to the northeast showing stacks on platform's surface.

Table 17. Recovered cultural material from SIHP Site 23870 Feature E TU-12.

ACC#	*Level*	*Material*	*Species/Type*	*Count*	*MNI*	*Weight (g)*
99	I	Shell	*Echinoidea*	48	-	6.4
100	I	Organic	*Kukui*	2	-	2.5
101	II	Bone	Fish	2	1	0.2
102	II	Shell	*Echinoidea*	50	-	5.1
103	II	Shell	*Cypraea*	1	1	0.6
104	II	Shell	*Nerita*	2	2	0.2
105	II	Shell	Unidentified	1	1	1.6
106	II	Shell	*Brachydontis*	2	1	0.3
107	II	Shell	*Kukui*	33	-	7.1
108	II	Organic	Charcoal	-	-	1.1

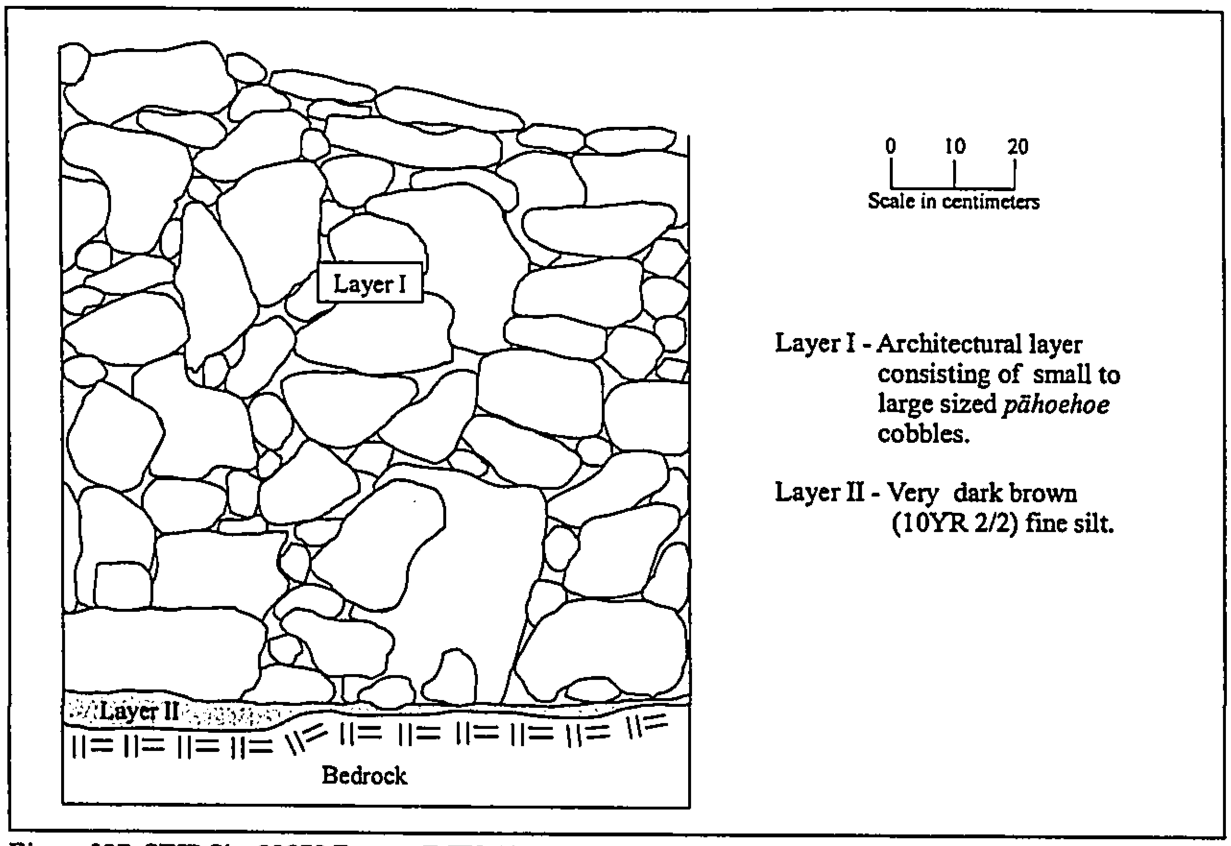


Figure 227. SIHP Site 23870 Feature E TU-12 west wall profile.

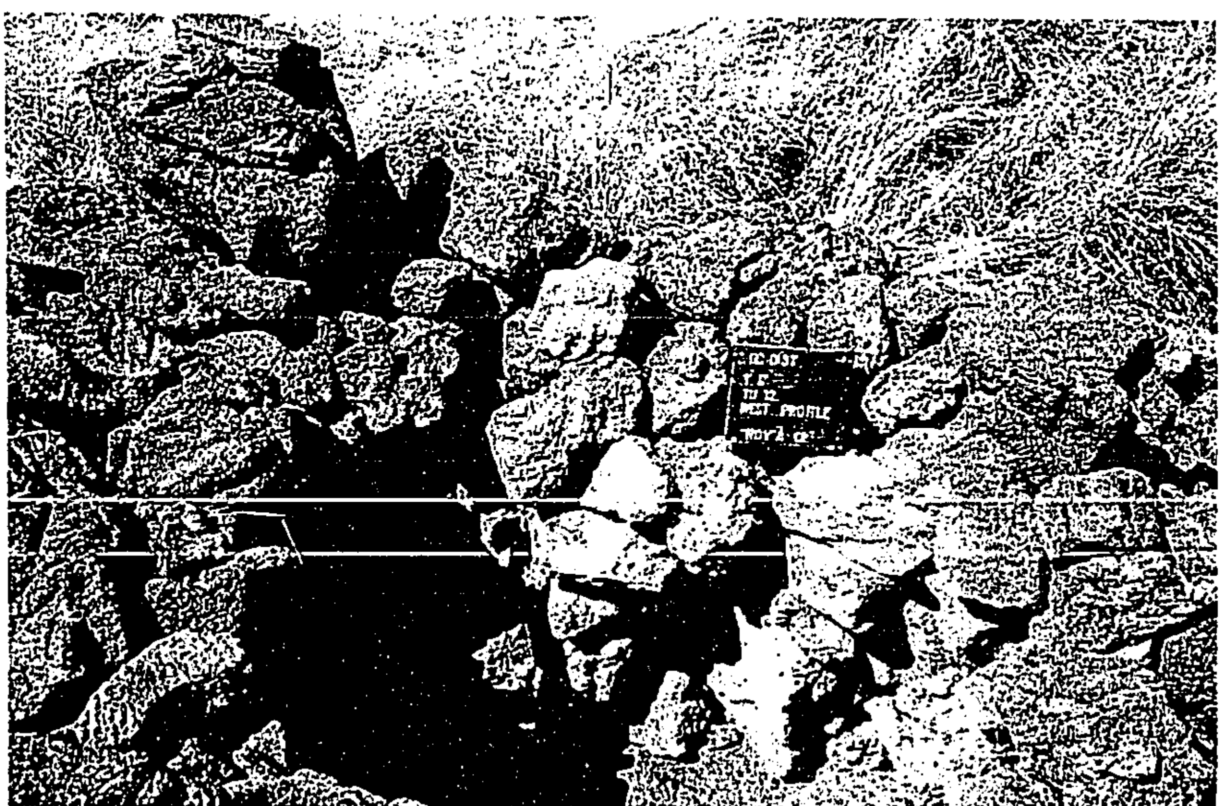


Figure 228. SIHP Site 23870 Feature E TU-12 view to west.

SIHP Site 23871

Site 23871 is a Historic fence line running in a northeasterly/southwesterly direction (250°/70°) across the project area from Site 23871 to Site 23875 (see Figure 5). The fence-line must have burned at some point in the past because currently it is barely traceable across the *'a'ā* landscape. The former alignment of Site 23871 is evidenced by wooden posts (branches and sticks) stuck upright in the *'a'ā* and supported by small collections of cobbles at their bases (Figure 229). Fragments of wire fence and a metal staple were found near one of the posts. In areas where the posts are no longer present the collections of stones that supported them can still be located. Site 23871 stretches for a distance of approximately 750 meters across the study area and then continues to the northeast. This fence was most likely used for ranching purposes during Historic times. George Kinoulu "Kino" Kahananui Sr., who worked for Hu'ehu'e Ranch from 1941—1960, claimed that they did not run cattle in this portion of the project area during his tenure at the ranch (see Cultural Impact Assessment; Orr 2003). This would suggest that either the fence was functioning at some point earlier then 1941, or that the fence was erected by a ranch other than Hu'ehu'e Ranch.

Figure 229. SIHP Site 23871 upright fence post view to north.

SIHP Site23872

Site 23872 is a *pāhoehoe* excavation located in the south central portion of the project area (see Figure 5). The site consists of a shallow lava blister measuring 4.15 meters long by 1.1 meters wide by 0.4 meters deep from which approximately 50 large *pāhoehoe* cobbles have been removed. The removed cobbles are piled along the north side of the excavation (Figure 230). The base of the excavation contains a thin layer of soil (2—3 centimeters) overlying bedrock. A second possible excavation, which measures 1.3 meters long by 0.9 meters wide by 0.4 meters deep, is located 3 meters east of the first. The function of *pāhoehoe* excavations is the subject of an archaeological debate and remains uncertain at this time. It could be that the excavator of the lava blister was collecting cobbles for building material, searching for soil to plant in, or simply excavating to see what there was to see. No further interpretation is possible at this site.

Figure 230. SIHP Site 23872 piled cobbles view to southeast.

SIHP Site 23873

Site 23873 is a stepping-stone trail segment located in the north central portion of the project area (see Figure 5). The trail, where traceable, consists of *pāhoehoe* slabs laid flat at regular intervals across an *'a'ā* field (Figure 231). It runs a meandering broken course in a northeasterly/southwesterly direction for approximately 80 meters. The southern end of the trail may intersect with Site 14362 (a *mauka/makai* trail) near its western end at a cairn (Site 14362 Feature B). Site 23873 becomes untraceable at both ends when it encounters *pāhoehoe* bedrock covered by fountain grass.

Figure 231. SIHP Site 23873 view to southwest.

SIHP Site 23874

Site 23874 is a filled low spot in a section of exposed *pāhoehoe* bedrock centrally located within the project area (see Figure 5). Site 23874 consists of an arranged pile of flat angular *pāhoehoe* cobbles (Figure 232), irregular in shape, measuring 2.2 meters (north/south) by 1.9 meters (east/west). In some places the arrangement reaches 2 courses (50 centimeters) high. A small lava blister entrance, not large enough to enter, is located just to the northeast of the feature (Figure 233). The interior of the blister was examined using flashlights, but no cultural remains or modifications were noted. The cobbles used to construct Site 23874 may have been excavated from this blister.

A 1 x 1 meter test unit (TU-8) was excavated into the central portion of Site 23874 to help determine the site's function (see Figure 233). Excavation of TU-8 revealed a single culturally sterile architectural layer (Layer I) resting on bedrock. A small amount of very dark grayish brown (10YR 3/2) fine silt had collected in the cracks of the bedrock (approximately 1 dustpan full). This soil was screened through ¼" mesh screen, but no cultural material was recovered. Excavation of TU-8 terminated at bedrock (Figure 234). Based on the lack of cultural remains at Site 23874 and its insubstantial construction, it seems that this feature is nothing more than a *pāhoehoe* excavation with an undetermined function.

Figure 232. SIHP Site 23874 view to northwest.

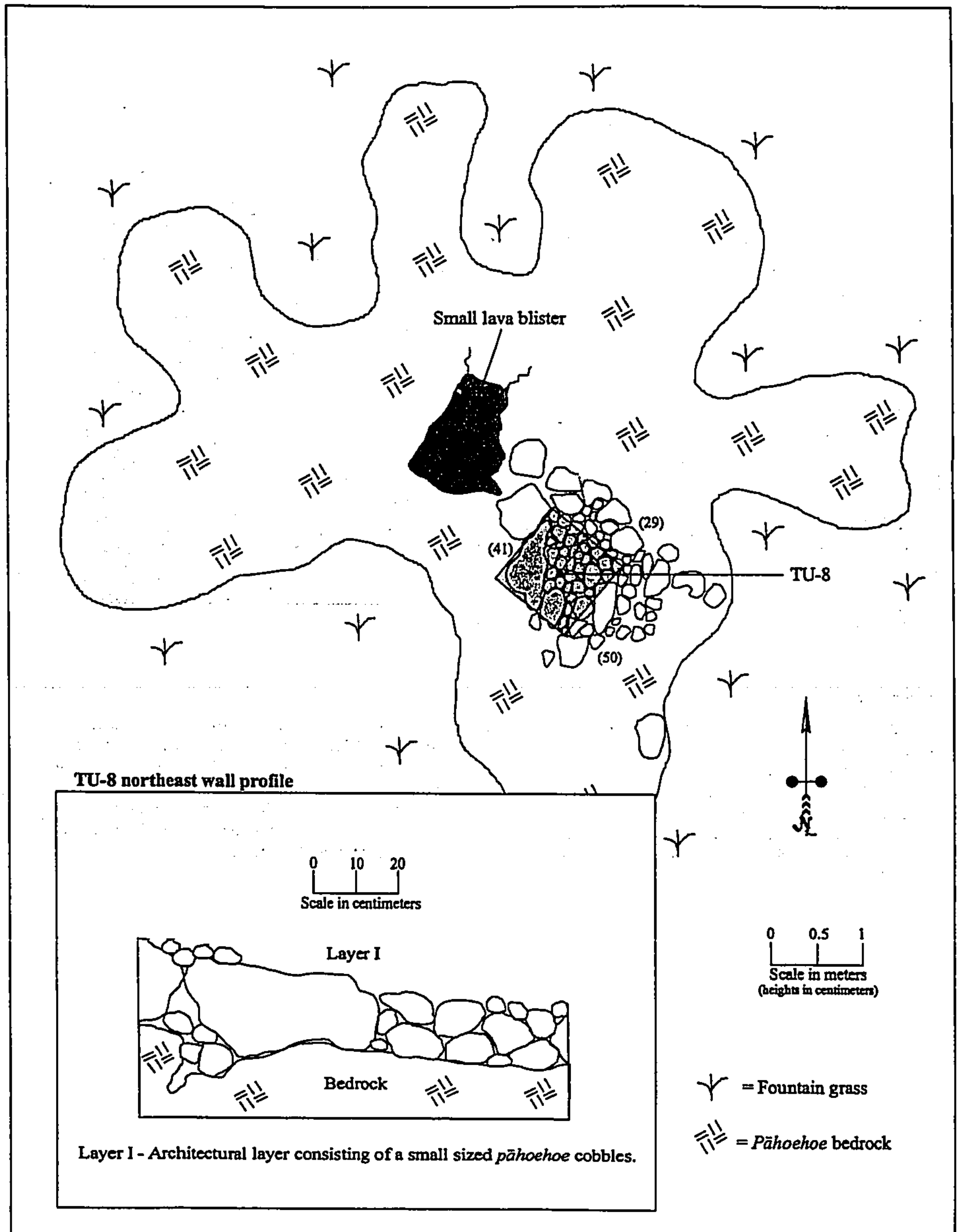


Figure 223. SIHP Site 23874 plan view and TU-8 profile.


Figure 234. SIHP Site 23874 TU-8 base of excavation view to east.

SIHP Site 23875

Site 23875 is a trail segment located near the north property boundary in the central portion of the project area (see Figure 5). The trail runs a meandering course north/south across an *'a'ā* lava field. Site 23875 is recognizable because larger cobbles have been moved to the sides of the trail route so that only smaller, darker pebbles remain (Figure 235). The trail shows evidence of recent use by grazing donkeys (lots of manure present). Beginning just south of the northern property boundary, Site 23875 runs north (crossing Site 23871 at its eastern end) for 40 meters across the *'a'ā* and then continues out of the project area over *pāhoehoe* bedrock for an undetermined distance. The south end of the trail also becomes untraceable at a *pāhoehoe* flow covered by fountain grass.

Figure 235. SIHP Site 23875 view to south.

SIHP Site 23876

Site 23876 is a modified outcrop located in the central portion of the project area (see Figure 5). The feature is situated along the south side of the probable route of a *mauka/makai* trail (Site 14362) on a *pāhoehoe* bedrock outcrop (Figure 236). It is constructed with a row of neatly stacked *pāhoehoe* cobbles along its northeast edge (3.2 meters long and 64 centimeters high) retaining a fill of smaller cobbles to the southwest that are level with the surface of the bedrock outcrop (Figure 237). The surface of the feature is relatively level and measures 2.3 meters at its widest point (Figure 238). The south and west edges of Site 23876 terminate at a partially filled crack in the *pāhoehoe* bedrock. No cultural debris was observed on the surface of the feature.

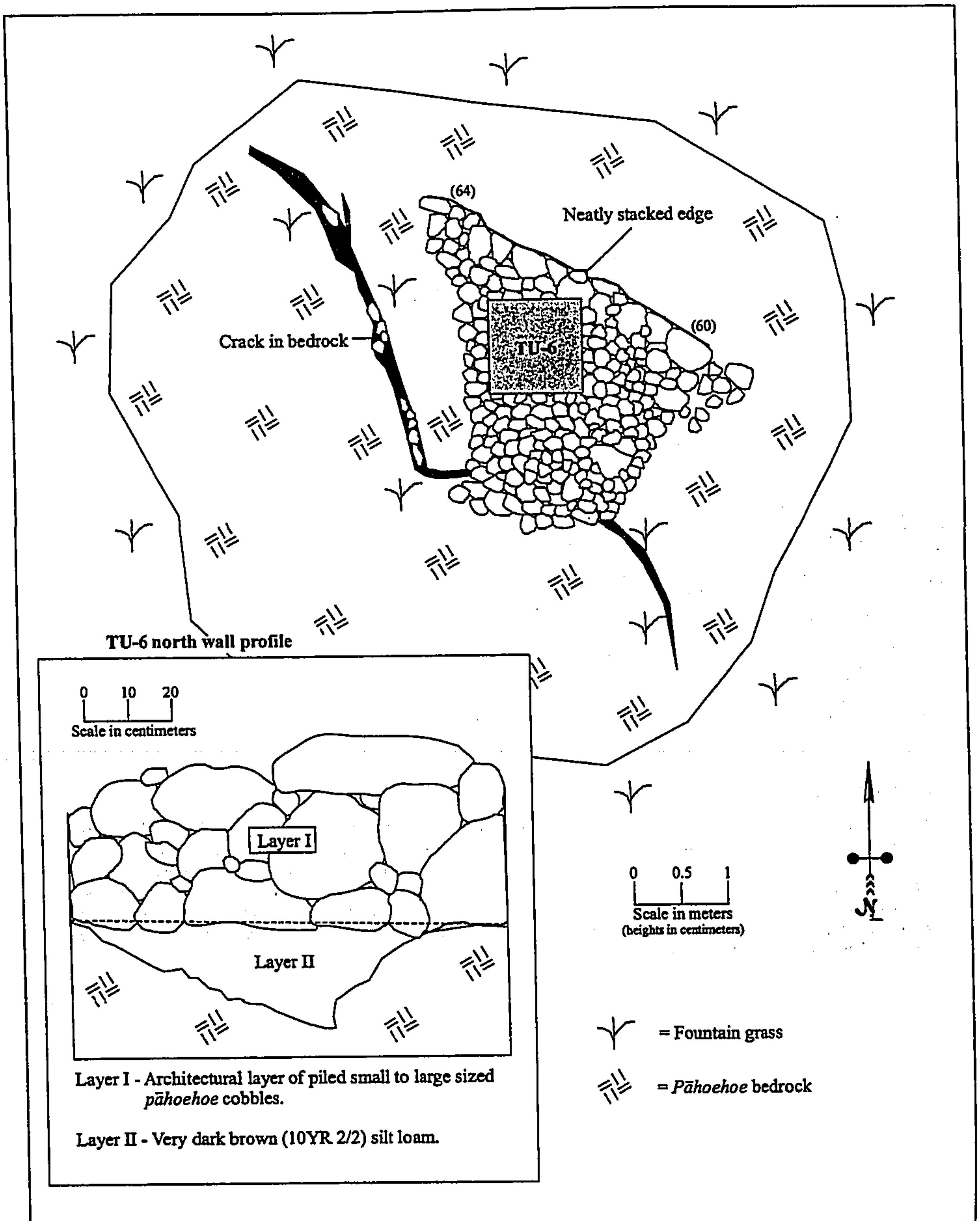


Figure 236. SIHP Site 23876 plan view and TU-6 profile.


Figure 237. SIHP Site 23876 view to south.

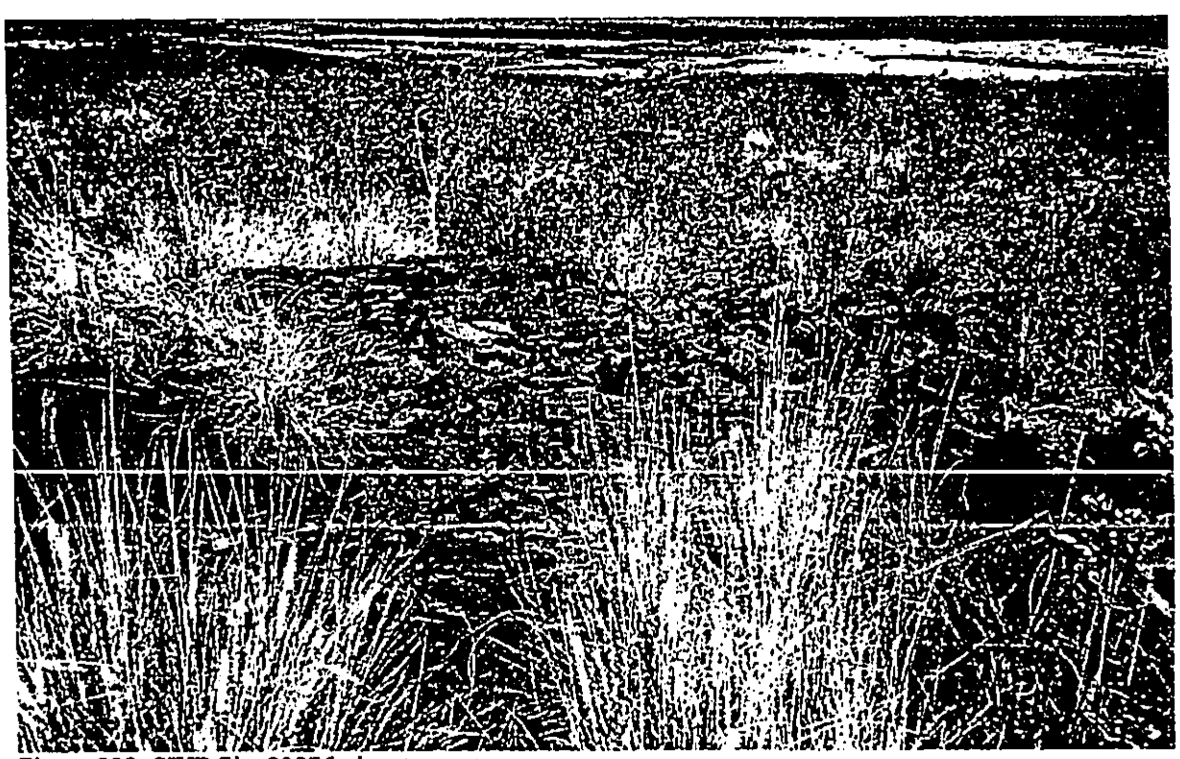


Figure 238. SIHP Site 23876 view to west.

A 1 x 1 meter test unit (TU-6) was excavated in the central portion of Site 23876. Excavation of TU-6 revealed a two-layer stratigraphic profile resting on bedrock (see Figure 236). Layer I, the 42 centimeters thick architectural layer, consisted of jumbled small to large sized *pāhoehoe* cobbles partially resting on bedrock and partially resting on Layer II. Layer II consisted of a pocket of very dark brown (10YR 2/2) loamy silt mixed with rootlets collected in a bedrock depression up to 20 centimeters thick. Excavation of TU-6 terminated at bedrock 62 centimeters below the unit's surface (Figure 239). No cultural material was recovered from either layer. Despite the fact that the feature lacked any habitation debris, it is suggested that Site 23876 most likely served a temporary habitation purpose. This analysis is based on the feature's small size and insubstantial construction (Cordy 1981, 1995), along with the fact that it is located along a prominent trail route (Site 14362) and would have been ideal for a stay of short duration. Site 23876 may have been utilized only once or recurrently as needed by individuals traveling along the trail.

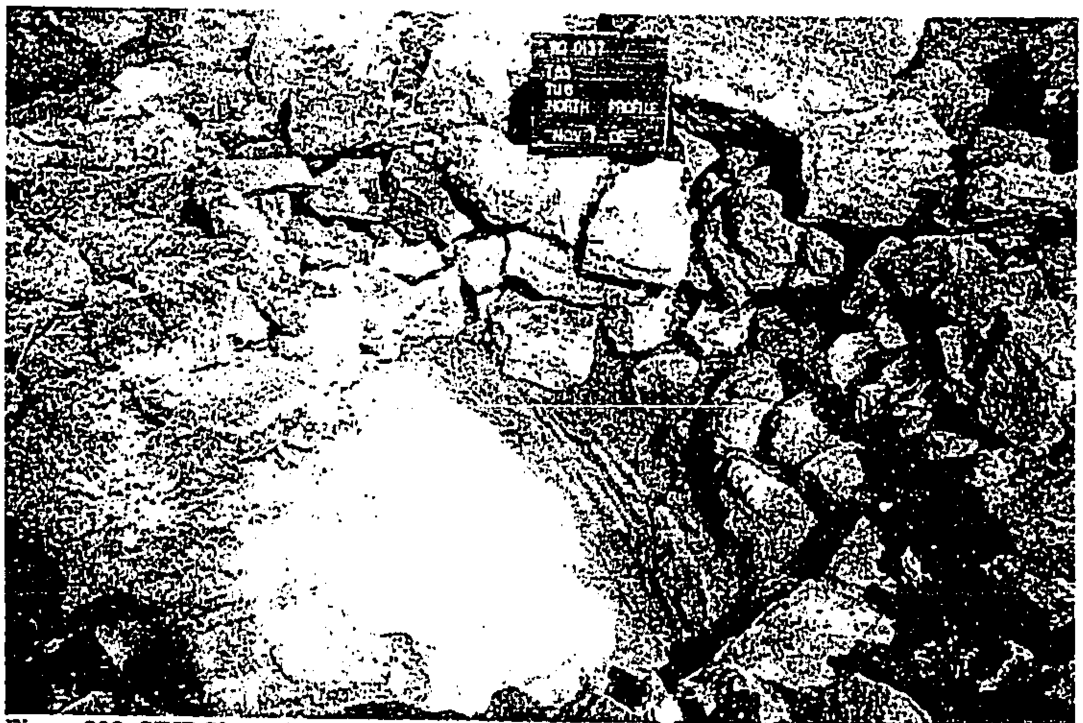


Figure 239. SIHP Site 23876 TU-6 base of excavation view to north.

SIHP Site 23877

Site 23877 is a stepping-stone trail segment located in the north-central portion of the project area (see Figure 5). The trail trends north/south for approximately 10 meters and consists of eleven *pāhoehoe* slabs placed across an *'a'ā* flow (the flow area measures 22 meters east/west by 10 meters north/south). The *pāhoehoe* stepping-stones are all between 0.3 and 0.5 meters in diameter, and are placed at an average of one per meter in a linear fashion (Figure 240). There is no evidence of the trail on either side of the *'a'ā* outcrop across the *pāhoehoe* bedrock. Nevertheless, Site 23877 may have continued south to either Site 23873 or Site 23878.

SIHP Site 23878

Site 23878 is a stepping-stone trail segment located in the north central portion of the project area (see Figure 5). The trail trends north/south for approximately 7.5 meters and consists of seven angular *pāhoehoe* slabs placed in a line across an *'a'ā* lava flow. The *pāhoehoe* stepping-stones are all between 0.3 and 0.5 meters in diameter, and are placed at an average of one per meter in a linear fashion (Figure 241). There is no evidence of the trail on either side of the *'a'ā* flow across the *pāhoehoe* bedrock. However, Site 23878 may have continued south to Site 14362 and/or northwest to Site 23877.

Figure 240. SIHP Site 23877 view to south.

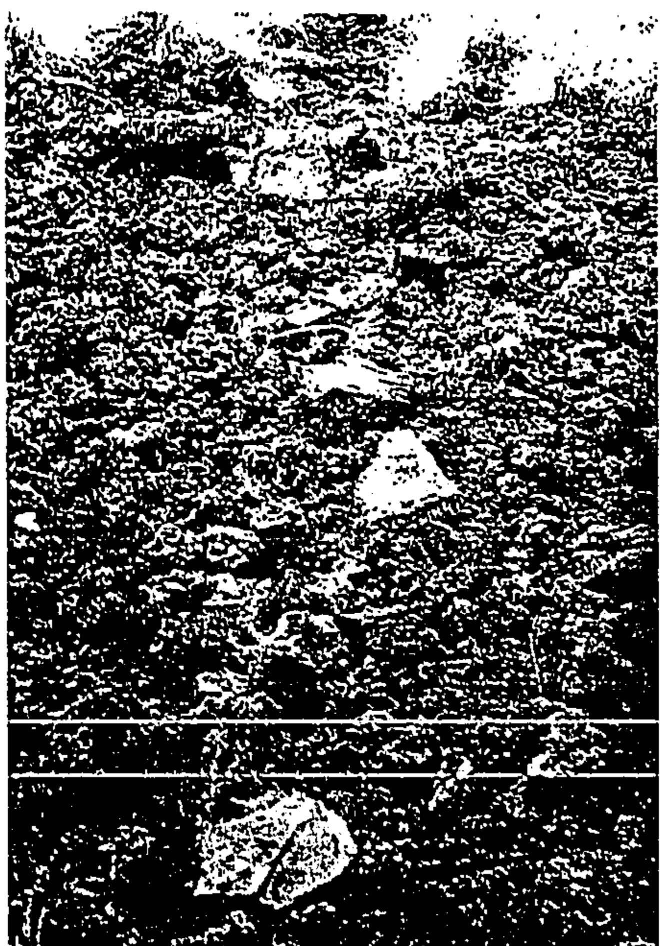


Figure 241. SIHP Site 23878 view to north.

SIHP Site 23879

Site 23879 consists of three *pāhoehoe* excavations in an area measuring 6 meters long by 3 meters wide located in the central portion of the project area (see Figure 5). The excavations are within a *pāhoehoe* bedrock flat that is sparsely covered by fountain grass (Figure 242). The excavated areas measure 1.6 x 1.3 meters, 1.6 x 1.1 meters, and 0.7 x 0.4 meters respectively. They are all approximately 30 centimeters deep (Figure 243). The cobbles removed from the excavations are scattered around the site area. The function of *pāhoehoe* excavations is the subject of an archaeological debate and remains uncertain at this time. It could be that the excavator was collecting cobbles for building material, searching for soil to plant in, or simply excavating to see what there was to see. No further interpretation is possible at this site.

Figure 242. SIHP Site 23879 view to south.

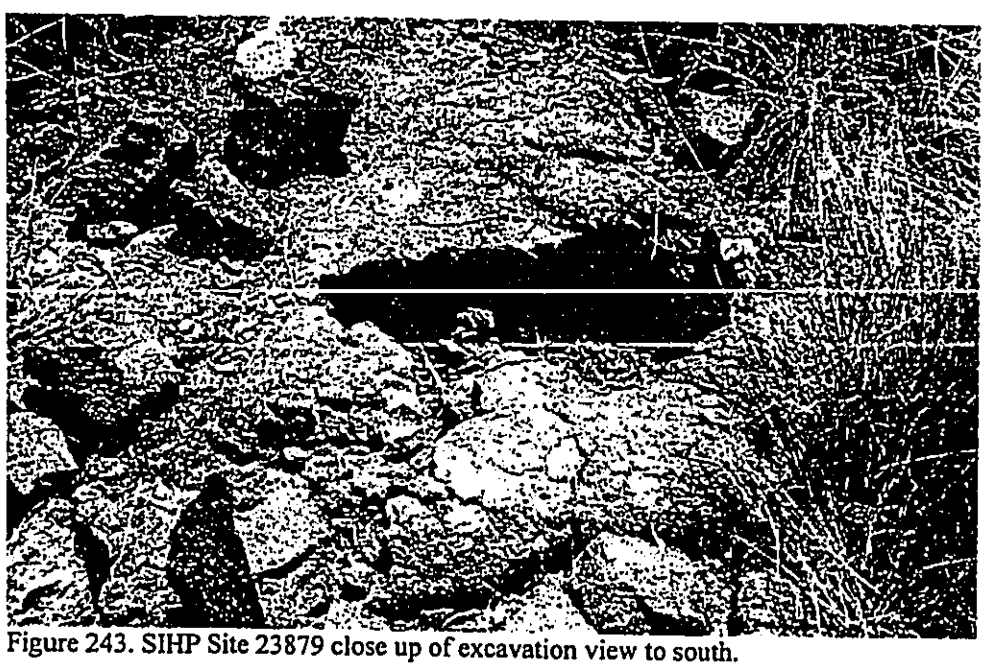


Figure 243. SIHP Site 23879 close up of excavation view to south.

SIHP Site 23880

Site 23880 is a platform remnant centrally located within the project area (see Figure 5). The platform is located along the southern edge of the probable route of a *mauka/makai* trail (Site 14362). It is roughly square and measures 2.8 meters by 2.5 meters (Figure 244) not including a collapsed rubble scatter along the south half of the feature (Figure 245). The north half of the platform is largely intact with neatly stacked edges standing up to 70 centimeters above the surrounding *pāhoehoe* bedrock ground surface (Figure 246). The intact surface of the feature is relatively level and paved with smaller sized *pāhoehoe* cobbles. A rusted tin can was found on the northern corner of Site 23880 and a waterworn cobble was discovered on ground surface three meters to its south.

A 1 x 1 meter test unit (TU-7) was excavated into the intact section of Site 23880 (see Figure 244). Excavation of TU-7 revealed a two-layer stratigraphic profile resting on bedrock. Layer I, the architectural layer, consisted of small to large sized *pāhoehoe* cobbles that continued to bedrock. At the base of Layer I a 15-centimeter thick layer of dark grayish brown (10YR 3/2) very fine silt mixed with gravels and decaying organics (Layer II) had collected on bedrock. This layer appears to have accumulated after the construction of the feature since no soil was present outside of the feature on the surrounding *pāhoehoe* bedrock, and since Layer I appears to have been constructed on bedrock. Layer II was sifted through ¼-inch mesh screen and all cultural material was collected. Cultural material recovered from TU-7 Layer II included the aforementioned rusted tin can, fish bone, marine shell fragments, *kukui* fragments, and charcoal (Table 18). Excavation of TU-7 terminated at bedrock 65 centimeters below the unit's surface (Figure 247).

Table 18. Recovered cultural material from SIHP Site 23880, TU-7.

ACC#	*Layer*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
73	I	Tin	Can	1	-	
74	II	Volcanic Glass	Flake	1	-	0.4
75	II	Bone	Fish	4	1	0.4
76	II	Shell	*Nerita*	11	10	2.3
77	II	Shell	*Echinoidea*	8	1	0.3
78	II	Organic	*Kukui*	13	1	2.9
80	II	Organic	Charcoal	-	-	1.29

A charcoal sample (ACC # RC-0137-80) recovered from the screen at the base of Layer II was sent to Beta Analytic, Inc. for radiocarbon age determination (Beta-173873; see Appendix A). The carbon sample produced a conventional radiocarbon age of 250±80 B.P., or a 2 sigma calibrated result of A.D. 1400 to 1650, indicating that Site 23880 was constructed during Precontact times. This result could also indicate that the *mauka/makai* trail (Site 14362) that runs just to the south of Site 23880 was being used even earlier than this feature was constructed. The presence of the rusted tin can on the surface of the platform shows that the trail (and perhaps the feature itself) saw continued use into historic times. The discovery of food remains within TU-7 indicates that Site 23880 was most likely used for habitation purposes, probably related to use of the *mauka/makai* trail (Site 14362). However, the small amount of recovered cultural material, along with the feature's insubstantial construction (Cordy 1981, 1995), suggests that the nature of the habitation was most likely temporary or recurrent in nature. Perhaps Site 23880 supported a shade structure used as a rest area by individuals passing by the site on their way to the uplands or the coast.

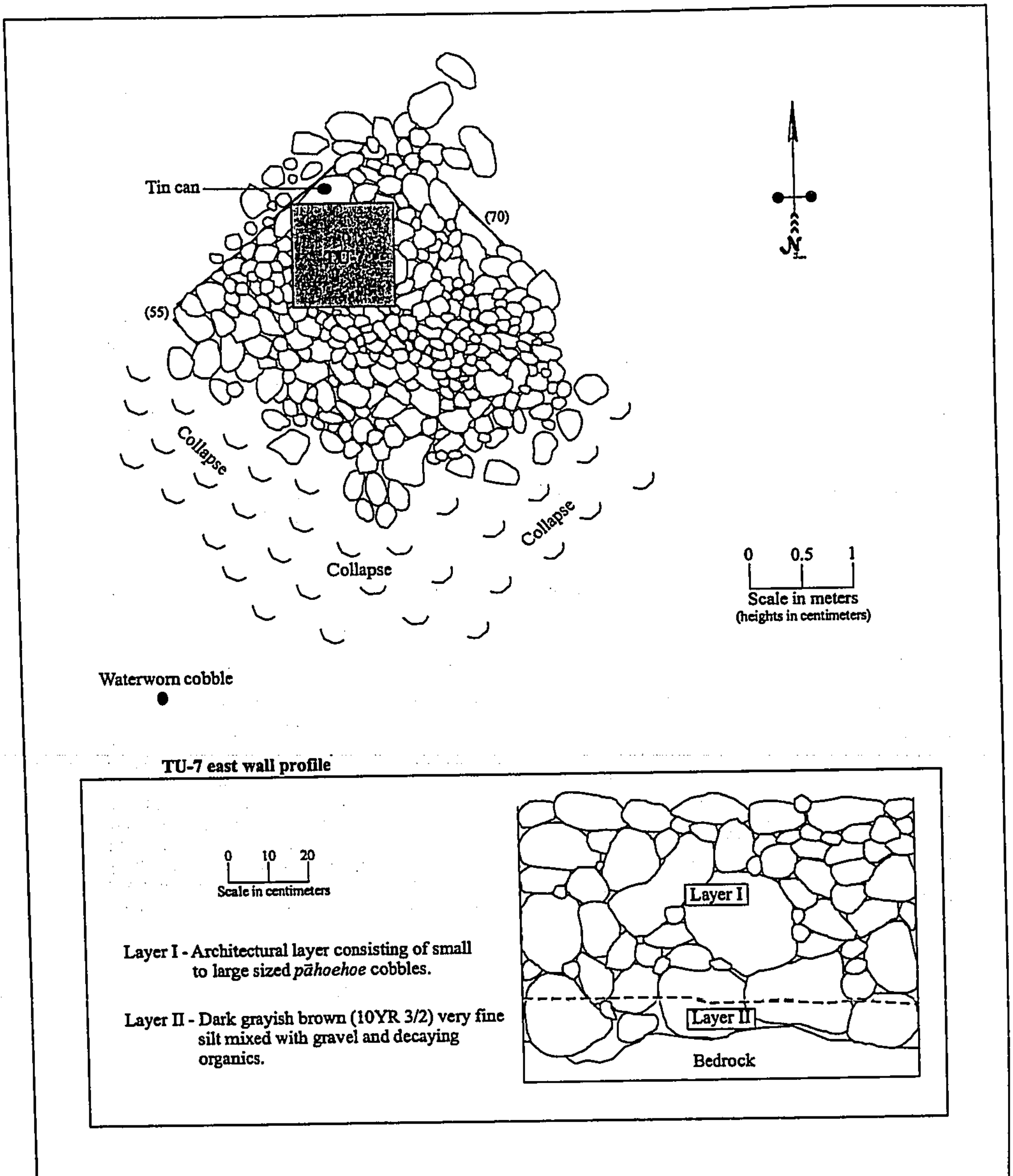


Figure 244. SIHP Site 23880 plan view and TU-7 profile.

Figure 245. SIHP Site 23880 view to northeast.

Figure 246. SIHP Site 23880 view to southwest.

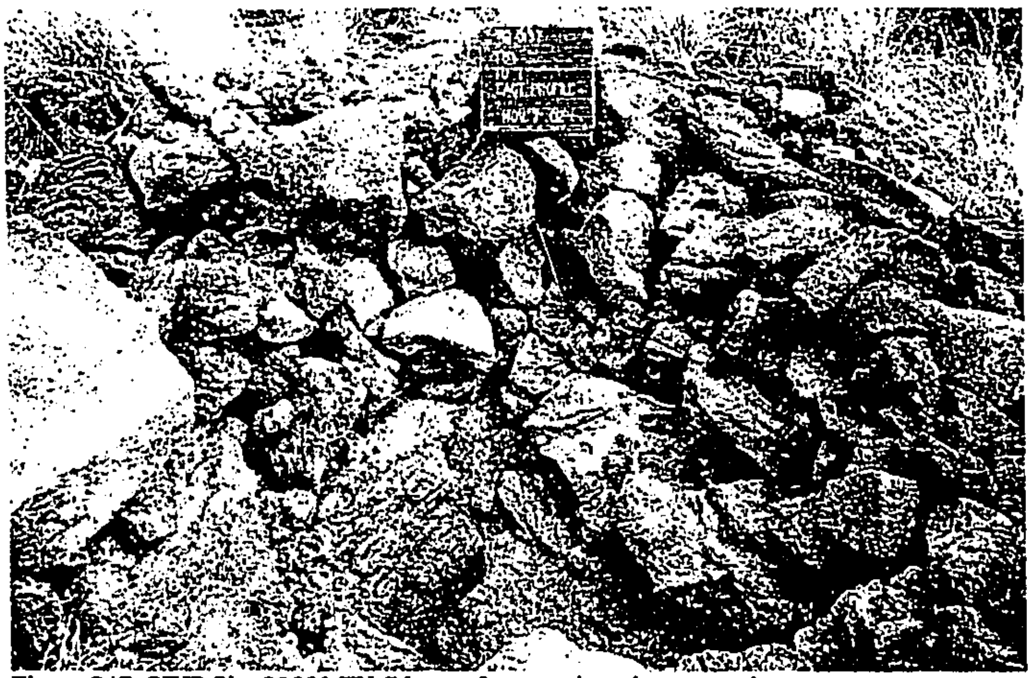


Figure 247. SIHP Site 23880 TU-7 base of excavation view to northeast.

SIHP Site 23881

Site 23881 is a small C-shaped enclosure located in the north-central portion of the project area (see Figure 5). The feature is crudely constructed of approximately 30 *pāhoehoe* cobbles loosely arranged on bedrock next to a small, excavated blister (Figure 248). The C-shape measures 2.0 meters (north/south) by 1.6 meters (east/west) and it opens to the east. It is possible that Site 23881 was never utilized as a C-shape, but simply represents a *pāhoehoe* excavation. If it is a C-shape then the feature was most likely utilized during a single episode for temporary habitation purposes (Cordy 1981, 1995), perhaps related to Site 23875—a trail segment located along the northern property boundary that could have continued past Site 23881, but that is now untraceable.

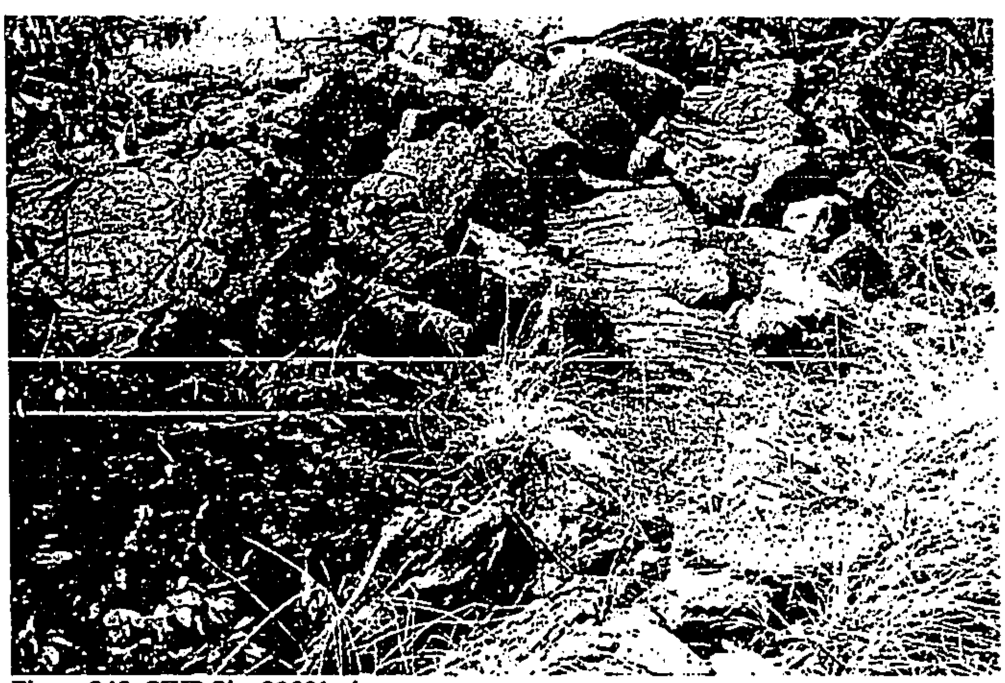


Figure 248. SIHP Site 23881 view to west.

SIHP Site 23882

Site 23882 is a stepping-stone trail segment located in the south-central portion of the project area near the southern property boundary (see Figure 5). The trail consists of *pāhoehoe* slabs laid flat across an *'a'ā* lava flow located between two *pāhoehoe* flows (Figure 249). The trail runs north/south for approximately 30 meters, but has been impacted at both ends by bulldozer activity in the area and cannot be traced onto the *pāhoehoe* flows. Site 23882 may have provided access to Site 14375.

Figure 249. SIHP site 23882 view to north.

SIHP Site 23883

Site 23883 is a stepping-stone trail segment located in the east-central portion of the project area near the southern property boundary (see Figure 5). The trail runs *mauka/makai* for approximately 15 meters through dense brush (Figure 250). It is constructed of eight *pāhoehoe* slabs laid flat across an *'a'ā* flow. Site 23883 becomes untraceable at both its east and west ends when it encounters *pāhoehoe* bedrock.


Figure 250. SIHP Site 23883 view to north.

SIHP Site 23884

Site 23884 is a stepping-stone trail segment located in the east-central portion of the project area near the southern edge of the main access road (see Figure 5). The trail runs south from the main access road for approximately 24 meters nearly to Site 23885. It is constructed with *pāhoehoe* slabs laid flat across an *'a'ā* lava flow at the frequency of two per meter (Figure 251). The entire site area is covered by dense vegetation. Both ends of Site 23884 become untraceable at *pāhoehoe* lava flows.


Figure 251. SIHP site 23884 view to north.

SIHP Site 23885

Site 23885 consists of two temporary habitation features (Features A and B) located along the eastern edge of a stepping-stone trail segment (Site 23884) in the east central portion of the project area near the southern property boundary (see Figure 5). The features are located on a narrow finger of *'a'ā* lava that slopes gently to the west and is surrounded by *pāhoehoe* bedrock (Figure 252). Feature A, the western most of the two features, is a roughly square enclosure located approximately 8 meters from the edge of the north/south stepping-stone trail (Site 23884), and Feature B is a *pāhoehoe* slab pavement located approximately 18 meters east of Feature A. Two water worn pebbles and three coral fragments were observed on ground surface within the site area. Based on the small size and insubstantial construction of these features (Cordy 1981, 1995), it is thought that they functioned as Precontact temporary habitations, perhaps related to the use of the nearby trail (Site 23884). Individual descriptions for each feature are presented below.

Feature A

Feature A is a roughly square enclosure located on the *'a'ā* flow in the western portion of Site 23885 (see Figure 252). The enclosure, which was constructed by removing *'a'ā* cobbles from a central area and piling them around the exterior edges, measures 2.6 meters long by 2.5 meters wide. The interior of the enclosure consists of small sized *'a'ā* cobbles covered by fountain grass, with the interior edges standing up to 85 centimeters high. The exterior edges are level with the surrounding *'a'ā* lava (Figure 253).

Feature B

Feature B is a rough pavement of *pāhoehoe* slabs measuring 9.2 meters long by 6.5 meters wide located 18 meters east of Feature A (see Figure 252). This feature, although large, has very minimal construction. It is located on an area of *'a'ā* cobbles, but is almost completely surrounded by *pāhoehoe* bedrock. Several *pāhoehoe* slabs have been laid flat on the *'a'ā* to create a roughly level pavement (Figure 254) possibly used for temporary habitation purposes (*pili* grass could have been placed on the pavement to create a comfortable sleeping area). A small pile (mound) of *'a'ā* cobbles (1.4 meters in diameter and 0.3 meters tall) sits on the southwest corner of Feature B and two waterworn pebbles were found along its eastern edge. A small lava blister located along the features southern edge could have been used as a cache area, but no cultural material was discovered within.

SIHP Site 23886

Site 23886 is an enclosure located in the east-central portion of the project area near the southern property boundary (see Figure 5). The enclosure measures 2.3 meters (north/south) by 2.1 meters (east/west) along its interior edges (Figure 255). It is constructed of *pāhoehoe* cobbles and slabs on *pāhoehoe* bedrock (Figure 256). The interior edges are lined with slabs and cobbles, formerly stacked, but now largely collapsed, standing up to 50 centimeters (2 courses) high, while the exterior edges are nearly completely collapsed and very indistinct. Although no habitation debris was observed at Site 23886, it appears, based on its small size and formal attributes, that the enclosure was utilized for temporary habitation purposes (Cordy 1981, 1995).

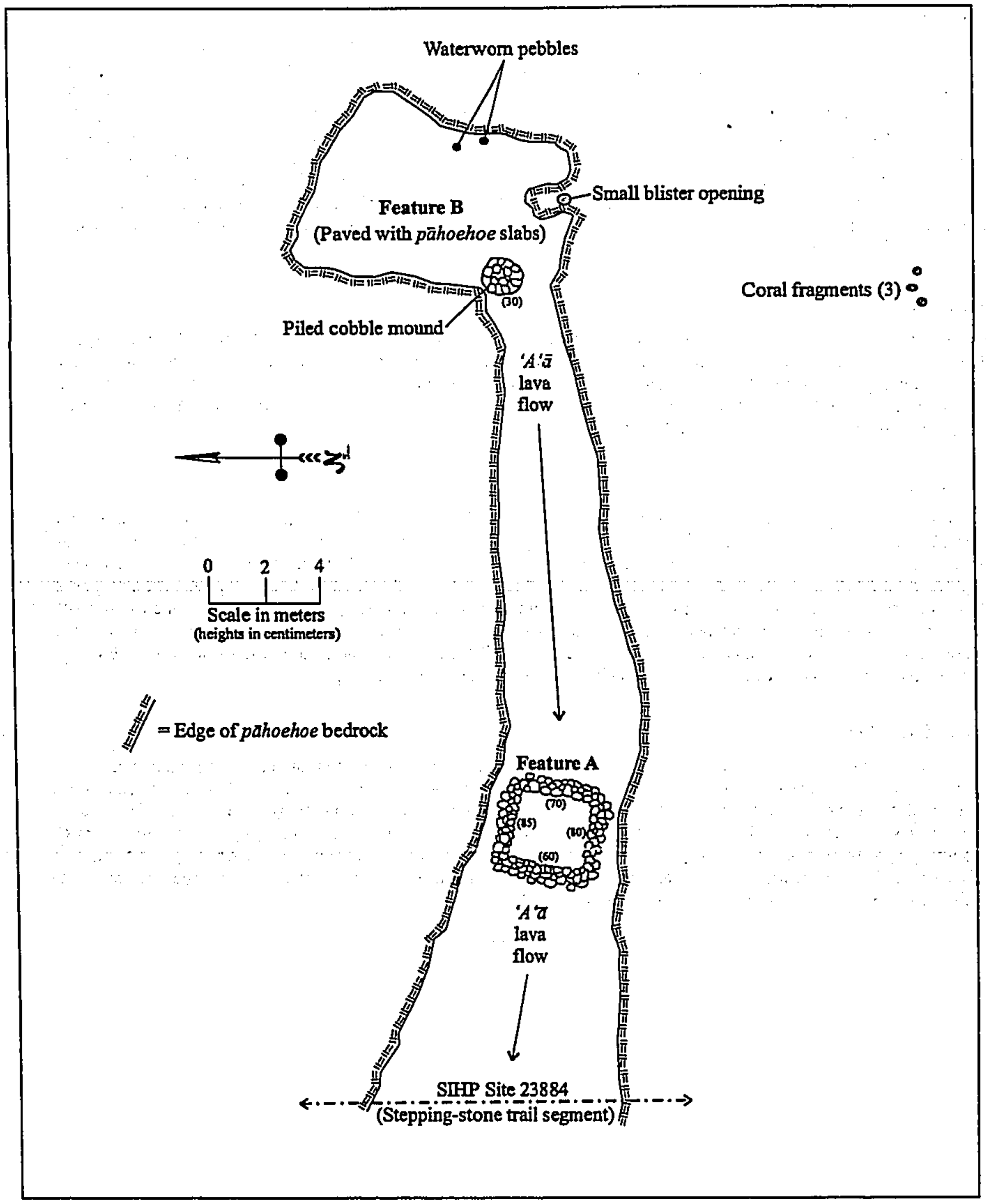


Figure 252. SIHP Site 23885 plan view.

Figure 253. SIHP Site 23885 Feature A view to south east.

Figure 254. SIHP site 23885 Feature B view to northwest.

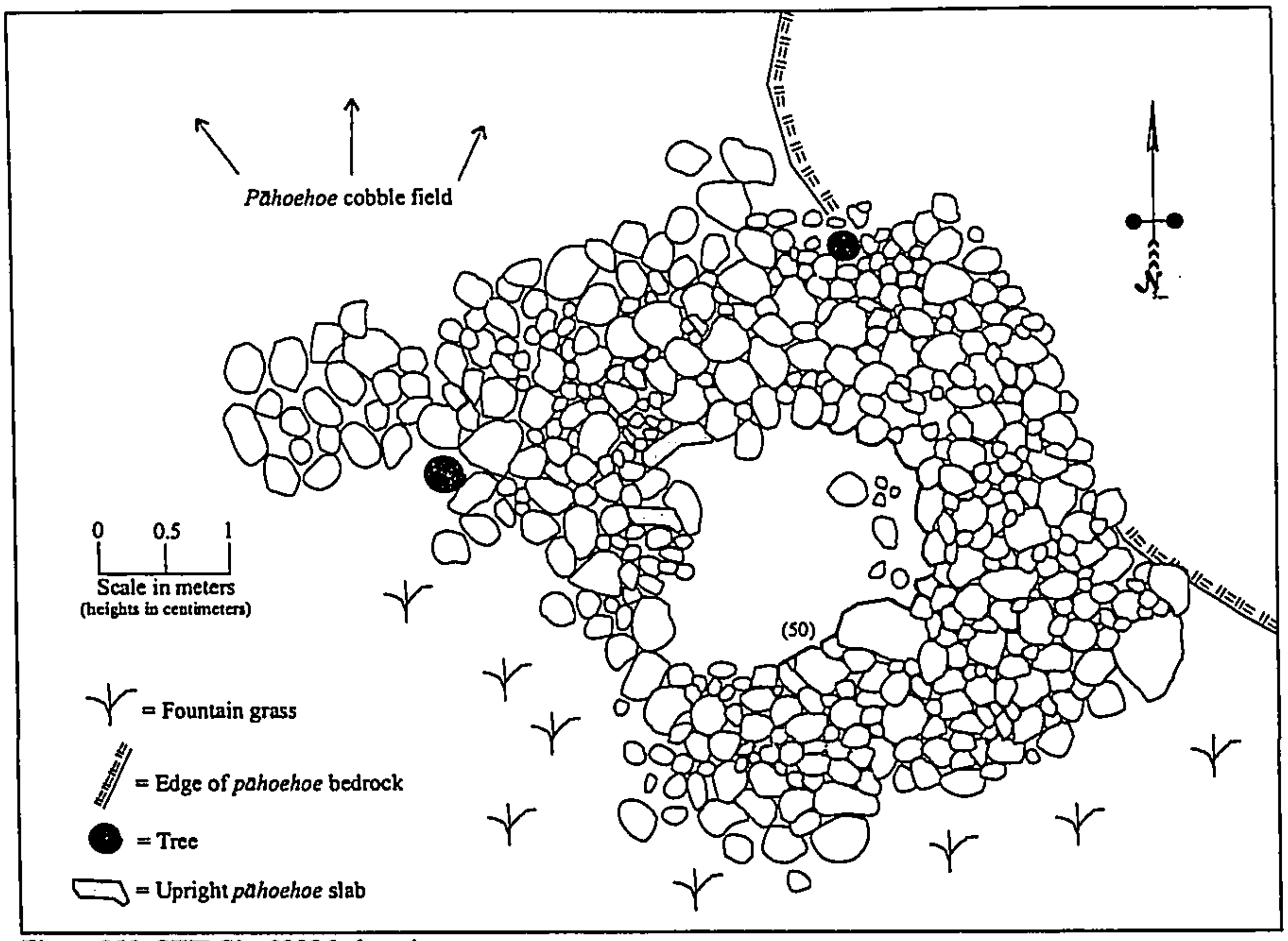


Figure 255. SIHP Site 23886 plan view.

Figure 256. SIHP Site 23886 view to northeast.

SIHP Site 23887

Site 23887 is a small pavement located in the east-central portion of the project area (see Figure 5). The pavement, which measures 5.0 meters (east/west) by 2.3 meters (north/south), is constructed of small to medium sized *pāhoehoe* cobbles that form a rough surface level with the surrounding *pāhoehoe* bedrock on all sides (Figure 257). The feature is located adjacent to a shallow blister opening (not large enough to be accessed by humans). Site 23887, based on its formal attributes and insubstantial construction, may have served a Precontact temporary habitation function (Cordy 1981, 1995).

Figure 257. SIHP Site 23887 view to southeast.

SIHP Site 23888

Site 23888 is a modified outcrop located in the east-central portion of the project area (see Figure 5). The site is constructed on a raised *pāhoehoe* bedrock outcrop that protrudes approximately 2 meters above the surrounding ground surface. A rough bulldozer cut (not drivable), running north from the main access road, skirts the eastern edge of the outcrop, but does not impact the feature. An area 3.4 meters long by 3.1 meters wide on top of the outcrop has been modified with loosely stacked and piled *pāhoehoe* cobbles and slabs to form a rough terrace (Figure 258). A level area in the middle of the terrace measuring 2.3 meters long by 1.6 meters wide has been cleared of cobbles leaving a surface of thin soil covering bedrock. The feature rises up to 55 centimeters above the surface of the outcrop in its southwest corner and up to 60 centimeters above the interior cleared area along its southern edge. Site 23888 was possibly accessed by following gently sloping bedrock from ground surface to the feature's surface along its western edge.

RC-0137

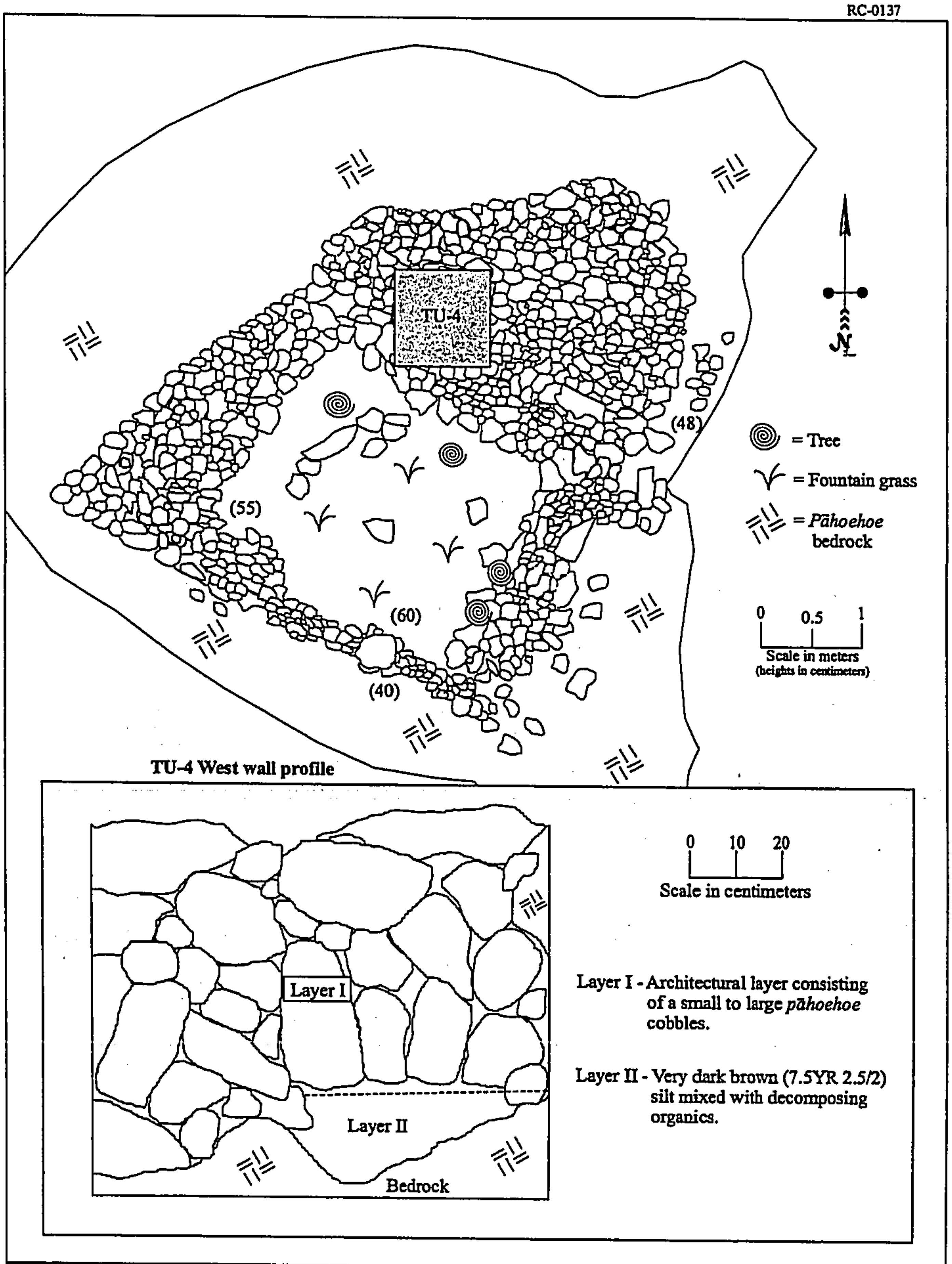


Figure 258. SIHP Site 23888 plan view and TU-4 profile.

Figure 259. SIHP Site 23888 view to south.

A 1 x 1 meter test unit (TU-4) was excavated in the northwest corner of Site 23888 near the edge of the terraced area (see Figure 258). Excavation of TU-4 revealed an architectural layer (Layer I) resting on bedrock with a small amount of soil (Layer II) collected in a bedrock depression beneath Layer I. Layer I, which measured 80 centimeters thick in the southwest corner of TU-4, consisted of piled small to large *pāhoehoe* cobbles resting on bedrock. Layer II, a very dark brown (7.5YR 2.5/2) silt mixed with decomposing organics, had collected at the base of Layer I within a bedrock depression along the western half of TU-4. Layer II measured up to 25 centimeters thick and terminated at bedrock. The soil matrix was passed through ¼-inch mesh screen in arbitrary 10-centimeter levels and all cultural material was collected. Cultural material was recovered from the first two arbitrary levels (20 centimeters) of Layer II included an octopus lure (*luhe'e*) (Figure 260), volcanic glass flakes (including 1 utilized flake), marine shell fragments, urchin fragments, *kukui*, and charcoal (Table 19). Excavation of TU-4 terminated at bedrock 80 centimeters below the unit's surface (Figure 261).

Table 19. Recovered cultural material from SIHP Site 23888 TU-4 Layer II.

ACC#	*Level*	*Material*	*Species/type*	*Count*	*MNI*	*Weight (g)*
57	1	*Cypraea*	*Luhe'e*	1	1	59.2
58	1	Volcanic Glass	Utilized Flake	1	-	1.2
59	1	Volcanic Glass	Flakes	5	-	3.1
60	1	Bone	Small fragment	1	1	<0.1
61	1	Organic	Charcoal	-	-	5.1
62	1	Shell	*Cypraea*	23	6	6.8
63	1	Shell	*Echinoidea*	21	-	1.2
64	1	Shell	*Conus*	2	2	1.9
65	1	Shell	*Nerita*	2	2	0.2
66	1	Shell	*Brachidontes*	3	1	0.5
67	1	Organic	*Kukui*	5	2	4.0
68	2	Volcanic Glass	Flake	1	-	0.2
69	2	Shell	*Cypraea*	6	1	1.6
70	2	Shell	*Drupa*	2	1	0.6
71	2	Shell	*Echinoidea*	10	-	0.1

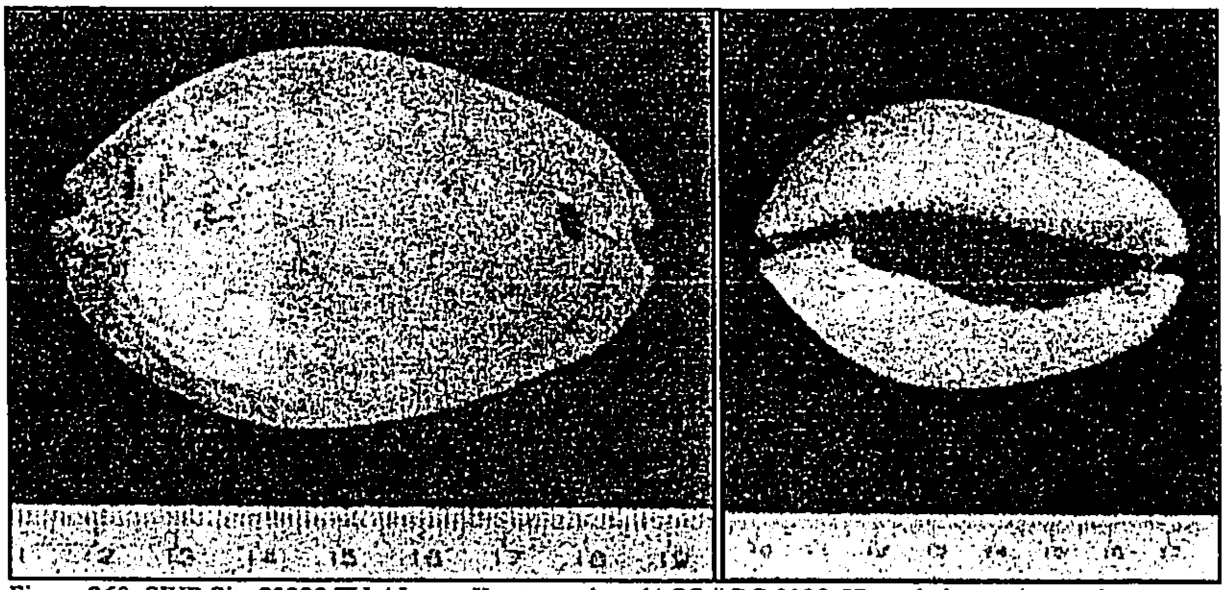


Figure 260. SIHP Site 23888 TU-4 Layer II octopus lure (ACC # RC-0138-57; scale in centimeters).

Figure 261. SIHP Site 23888 TU-4 base of excavation overview to west (note bedrock depression).

A charcoal sample (ACC # RC-0138-61) collected in the screen from Layer II, Level 1 was submitted to Beta Analytic, Inc. for radiocarbon age determination (Beta-173871; see Appendix A). The carbon sample produced a conventional radiocarbon age of 180±60 BP, or a 2 sigma calibrated result of A.D. 1640 to 1950, indicating that Site 23888 was most likely utilized during late Precontact or early historic times. Furthermore, the type and amount of cultural material recovered from TU-4, along with the feature's small size and insubstantial construction (Cordy 1981, 1995), indicates that it was utilized for temporary habitation purposes. The presence of the octopus lure (*luhe'e*) at the site suggests that the nature of the habitation may have been related to *mauka/makai* travel between upland and coastal resources. Site 23888 may have functioned as a Precontact temporary habitation near a trail route.

SIHP Site 23889

Site 23889 is a stepping-stone trail segment located in the east-central portion of the project area near the northern boundary of the property (see Figure 5). The trail, which is constructed of approximately ten *pāhoehoe* slabs laid flat, runs north/south for 15 meters across a narrow *'a'ā* flow. Site 23889 becomes untraceable at both its north and south ends when it encounters *pāhoehoe* bedrock.

SIHP Site 23890

Site 23890 is a stepping-stone trail segment located in the east central-portion of the project area near the northern property boundary (see Figure 5). The trail, which is constructed of approximately 30 *pāhoehoe* slabs laid flat (Figure 262), runs northeast/southwest for 15 meters across a narrow *'a'ā* flow. Site 23890 becomes untraceable in both directions when it encounters *pāhoehoe* bedrock.

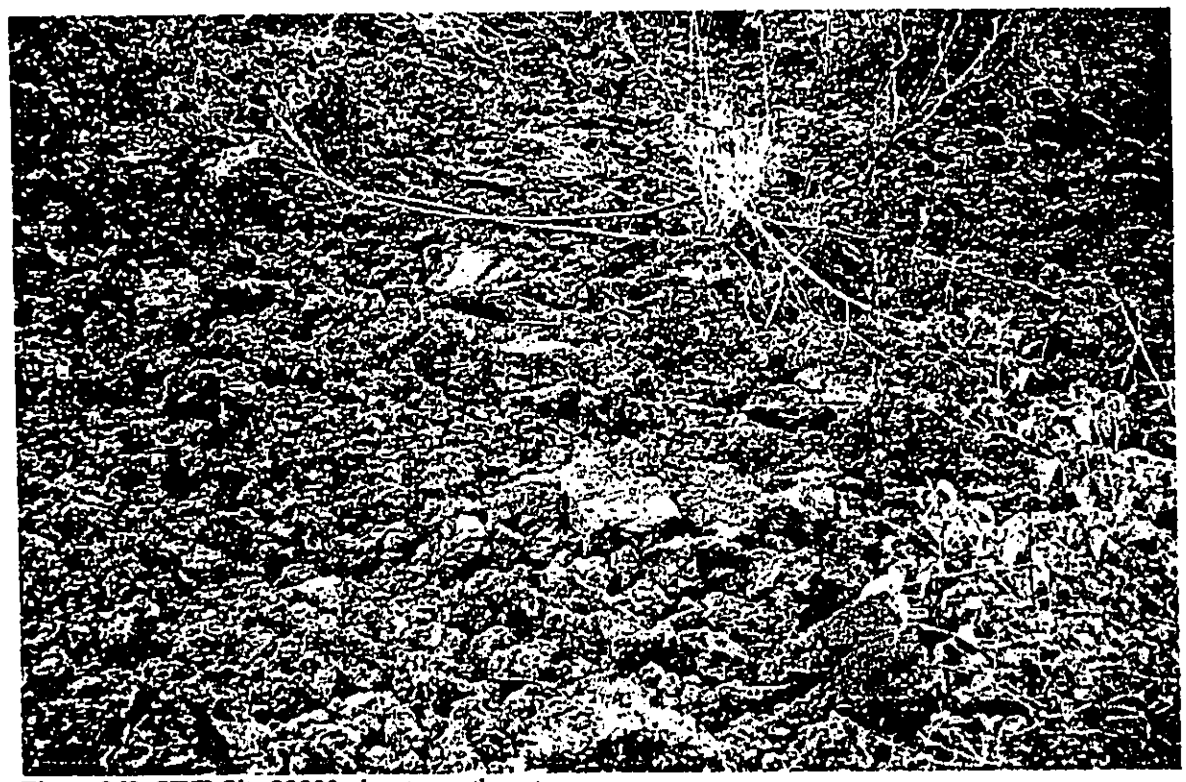


Figure 262. SIHP Site 23890 view to southwest.

SIHP Site23891

Site 23891 is a terrace remnant located in the east central portion of the project area (see Figure 5). A bulldozer cut (not drivable), running south from the main access road, has heavily impacted the eastern half of the feature making site interpretation difficult. What remains of the feature consists of roughly stacked western edge 4.4 meter long and 63 centimeters high that is terraced into the bulldozer cut 1.2 meters to its east (Figure 263). The western edge is constructed of medium to large sized *pāhoehoe* cobbles, while the surface of the feature is roughly paved with small sized cobbles. The intact western portion of the feature rests on *pāhoehoe* bedrock, but the eastern portion is scattered into a cobble field pushed there by the bulldozer. This site, because of its deteriorated condition, is difficult to assign a function to, but based on its intact form and its proximity to Site 14362 (a *mauka/makai* trail), it is suggested that Site 23891 served a habitation function, most likely temporary in nature (Cordy 1981, 1995).

Figure 263. SIHP Site 23891 view to northeast.

SIHP Site 23892

Site 23892 is a roughly square enclosure located in the east-central portion of the project area (see Figure 5). The enclosure measures 2.0 meters along each side and rests on *pāhoehoe* bedrock (Figure 264). It is constructed with *pāhoehoe* cobbles loosely stacked up to 2 courses (50 centimeters) high forming walls 50—75 centimeters thick (Figure 265). The interior of the enclosure consists of bedrock covered by fountain grass with some cobble rubble present. A possible entrance to the enclosure is located in its northwest corner (Figure 266). Site 23892, based on its small size and insubstantial construction (Cordy 1981, 1995), most likely served a temporary habitation function.

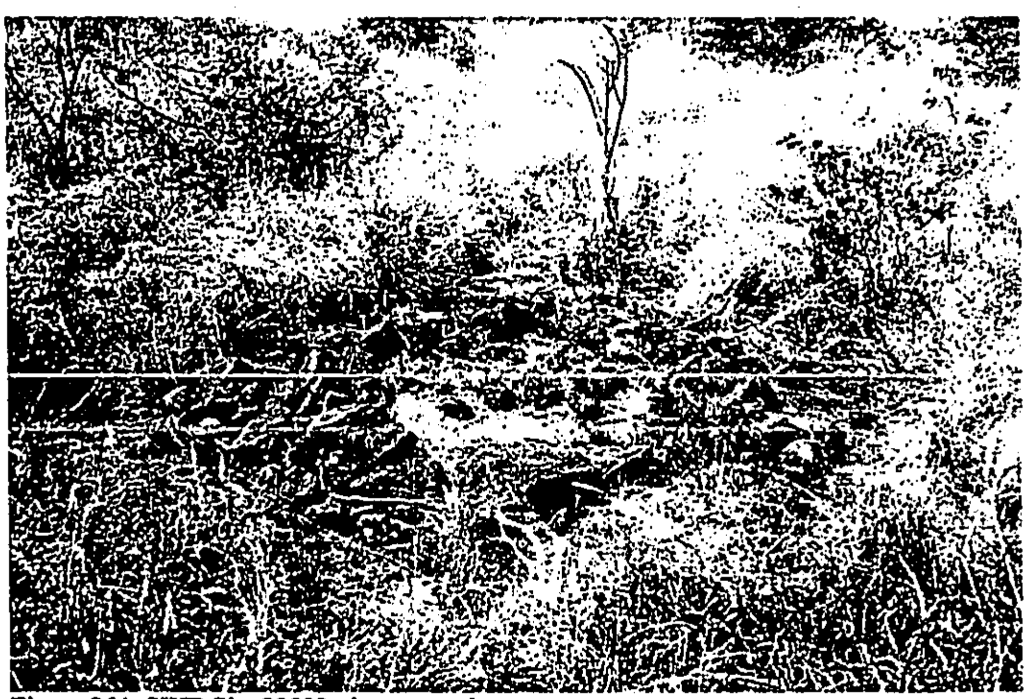


Figure 264. SIHP Site 23892 view to southwest.

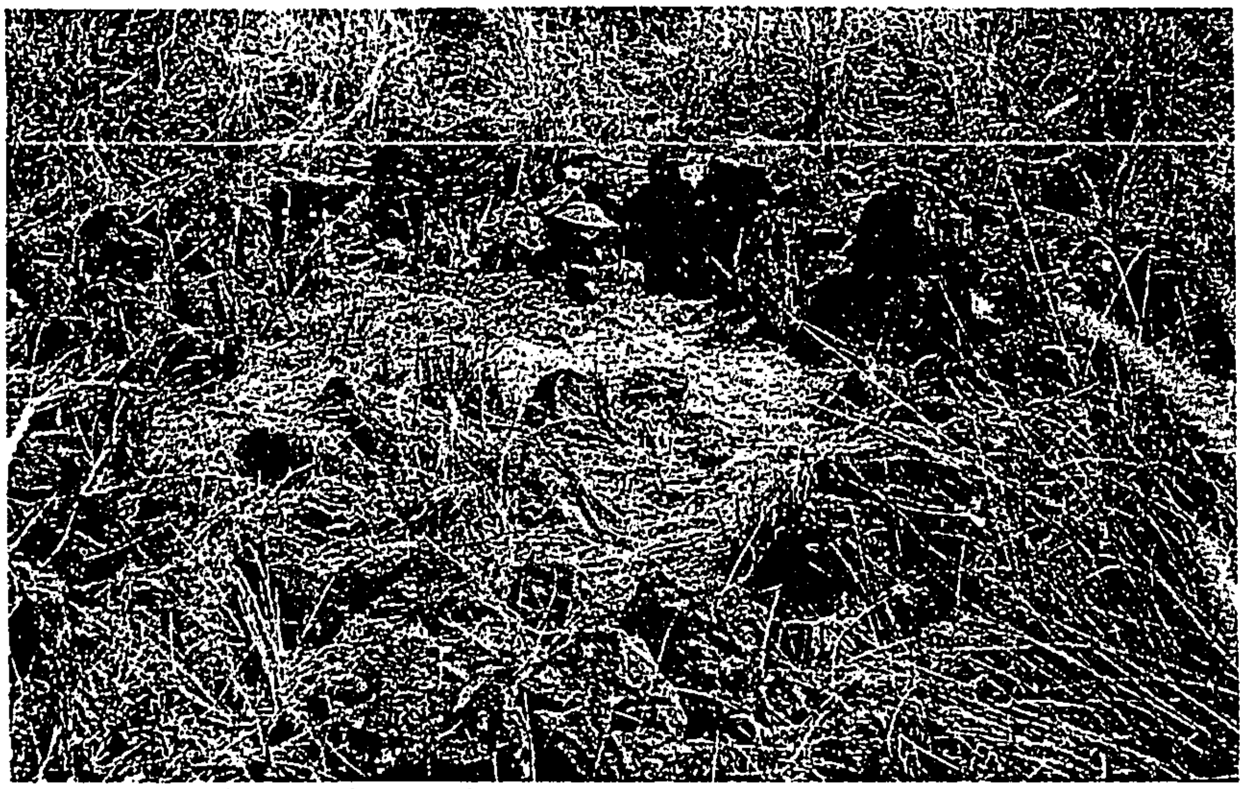


Figure 265. SIHP Site 23892 view to northeast.

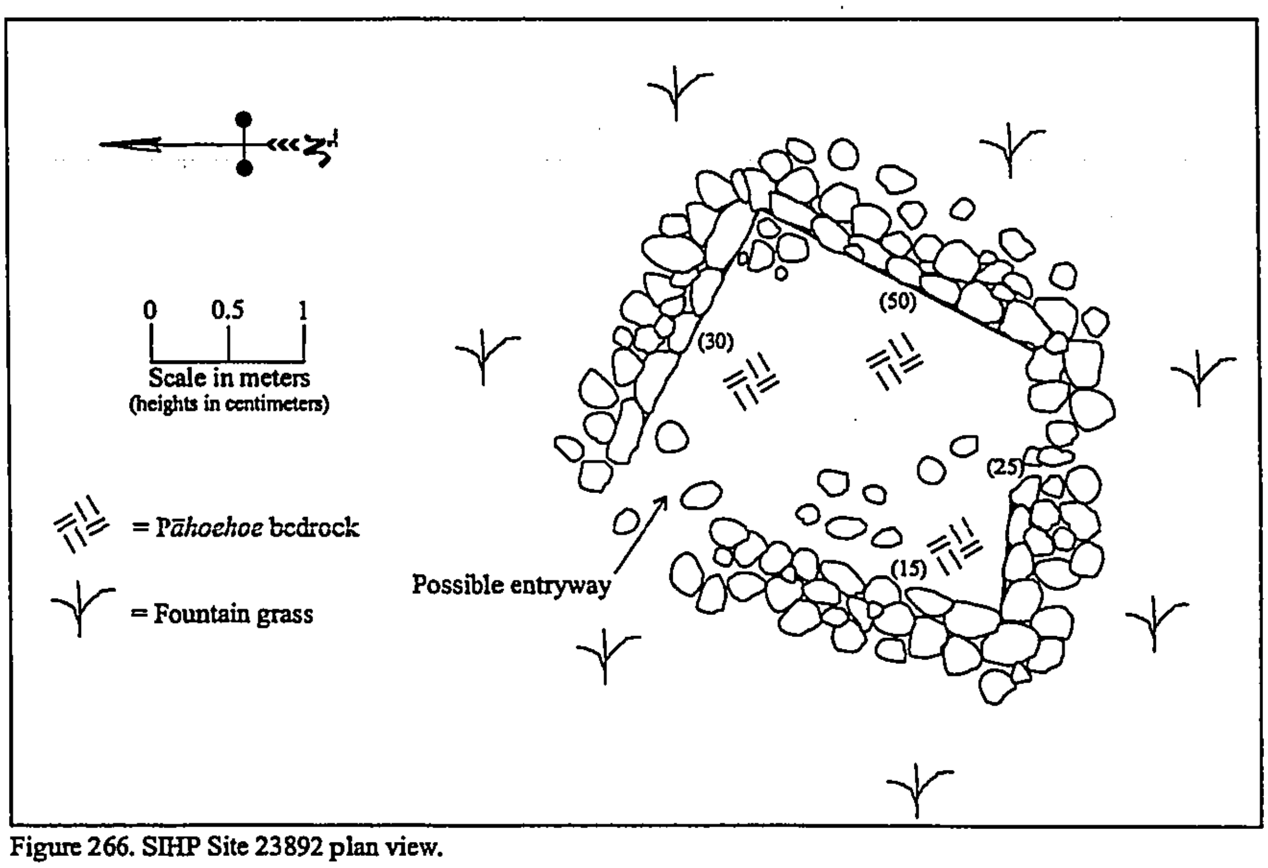


Figure 266. SIHP Site 23892 plan view.

SIHP Site 23893

Site 23893 is a collapsed lava tube entrance in the *pāhoehoe* bedrock (8 meters in diameter by 1 meter deep) located in the east-central portion of the project area near the northern property boundary (see Figure 5). A narrow lava tube runs 20 meters east and 20 meters west of the collapsed tube opening. No architectural modifications were found within the tube opening or the sub-surface passageways, but 1 urchin spine and 2 *kukui* fragments were discovered at the entrance to the eastern tube. Based on the presence of this imported cultural material, it is probable that Site 23893 was utilized sporadically as a temporary habitation (Cordy 1981, 1995). The overhangs at the entrances to the tubes, although cobble filled and small (generally not very comfortable), would have provided shelter from sun and inclement weather, making the site adequate for shelter on an "as needed" basis.

SIHP Site 23894

Site 23894 is a Precontact temporary habitation complex located in the east central portion of the project area on either side of the main access road (see Figure 5). The site consists of three features; a rectangular enclosure (Feature A), a habitation tube (Feature B), and a modified outcrop (Feature C). The features are contained within a 30-square meter area that is divided by the bulldozed main access road (Figure 267). Various grasses and a few scattered koa haole trees cover the entire site area. Feature C was partially impacted by the creation of the access road. A 1 x 1 meter test unit (TU-14) was excavated within Feature A. Site 23894 is considered a temporary habitation site because of the small size of the features and their insubstantial construction (Cordy 1981, 1995), along with the fact that scattered fragments of Precontact habitation debris (i.e. marine shell, *kukui*, urchin, etc.) were discovered at Features A and B. Individual descriptions for each feature follow below and their locations can be seen on Figure 267.

Feature A

Feature A is a roughly rectangular enclosure located at the western edge of Site 23894. The interior of the enclosure measures 2.7 meters long by 1.9 meters wide and consists of thin soil covered by vegetation. The walls are constructed of loosely stacked *pāhoehoe* cobbles and slabs, now mostly collapsed, standing up to 0.6 meters high and 1.2 meters wide (Figure 268). The southern edge of the feature rests against, and is partially formed by, an exposed *pāhoehoe* bedrock outcrop. An 85-centimeter wide constructed entryway is centrally located within the feature's west wall. A 1 x 1 meter test unit TU-14 was excavated within the interior of Feature A.

Excavation of TU-14 revealed a single soil layer (Layer I) resting on bedrock (see Figure 267). Layer I consisted of black (10YR 2/1) very fine silt containing approximately 10% gravel content mixed with roots and decaying organic matter. The soil was passed through ¼-inch mesh screen and all cultural material was collected. Recovered cultural remains included a marine shell fragment, a *kukui* fragment, and charcoal (Table 20), suggesting that Feature A was utilized for habitation purposes. Excavation of TU-14 terminated at bedrock 10 centimeters below the unit's surface (Figure 269).

Table 20. Recovered cultural material from SIHP Site 23894

ACC#	*Layer*	*Material*	*Species/type*	*Count*	MNI	*Weight (g)*
112	I	Shell	*Cypraea*	1	1	0.9
113	I	Organic	*Kukui*	1	1	<0.1
114	I	Organic	Charcoal	-	-	2.7

The charcoal recovered from Layer I (ACC # RC-0137-114) was shipped to Beta Analytic, Inc. for radiocarbon analysis (Beta-173875; see Appendix A). The sample produced a modern date indicating that the material was living within the last 50 years. The modern date suggests that the charcoal is probably not related to Feature A, but is most likely the result of a modern brush fire. It is interesting to note that the vegetation on the north side of the main access road (the side Features A and B are on) is much smaller, younger, and generally less dense than the vegetation on the south side (the side Feature C is on). It appears as though the access road may have originally served as a firebreak used to prevent the spread of fire to its south side. The occurrence of a modern brush fire could also explain the black color of the Layer I soil.

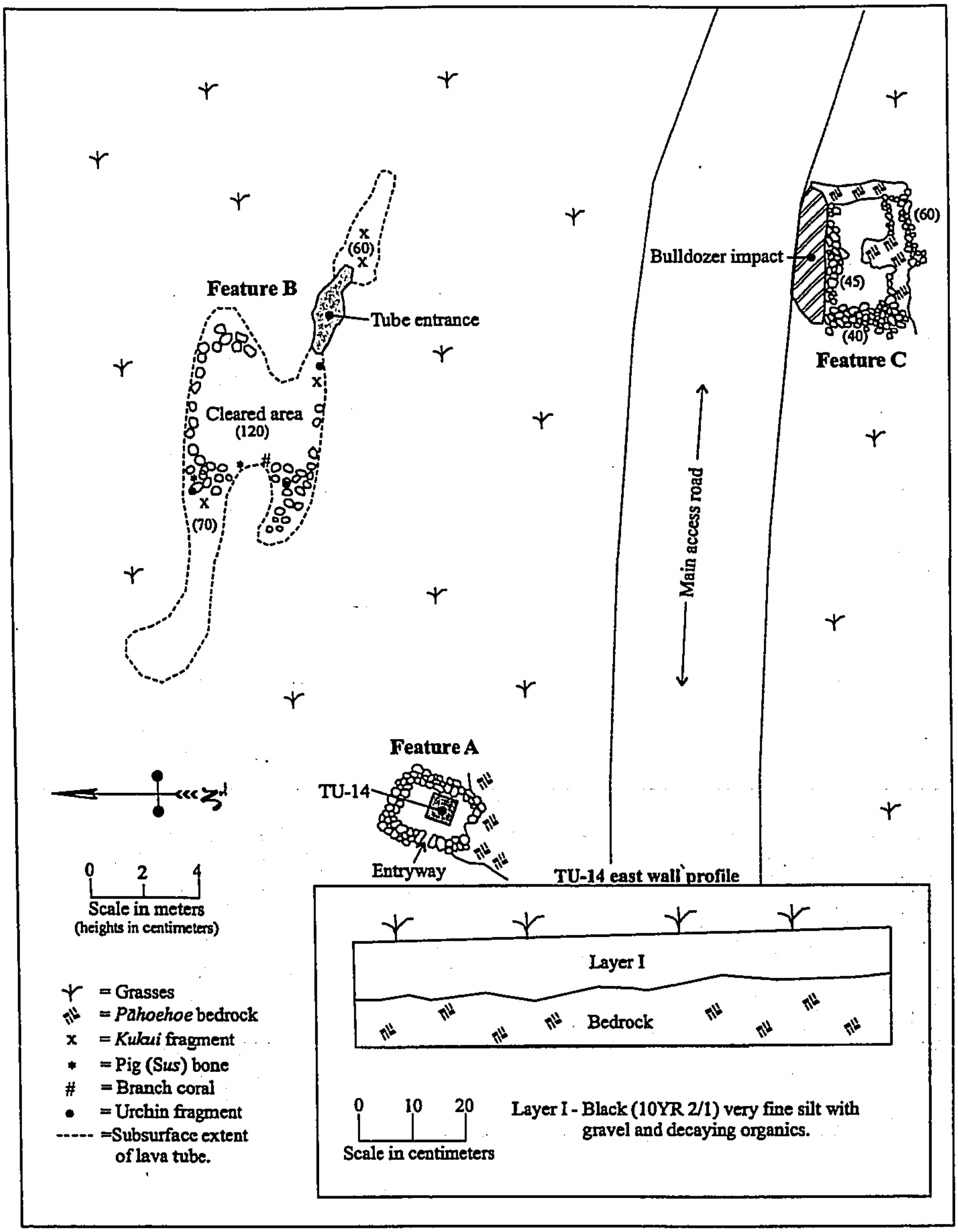


Figure 267. SIHP Site 23894 plan view and TU-14 profile.

Figure 268. SIHP Site 23894 Feature A view to west.

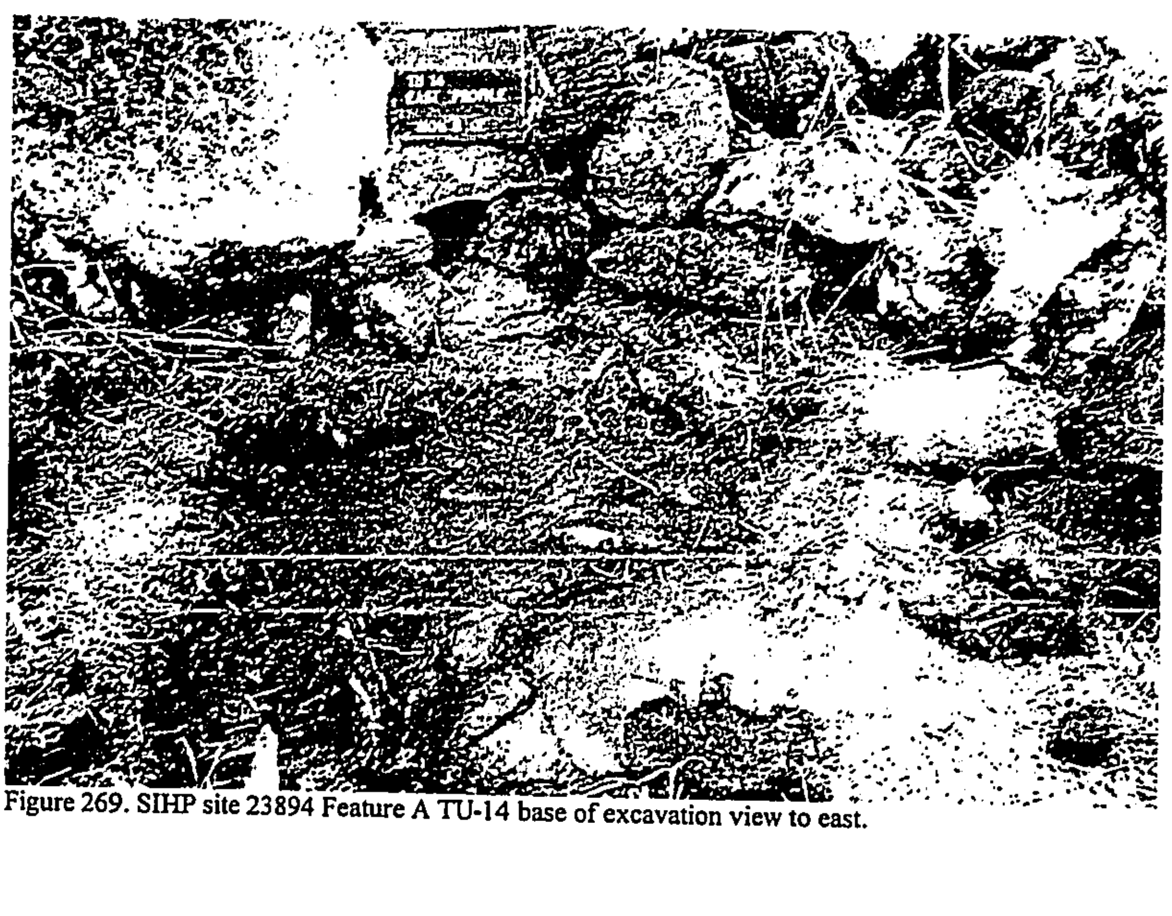


Figure 269. SIHP site 23894 Feature A TU-14 base of excavation view to east.

Feature B

Feature B is a small habitation tube located 16.5 meters east of Feature A along the northern extent of Site 23894 (see Figure 267). The tube is accessed through an opening in the *pāhoehoe* bedrock 3.2 meters long by 1.0 meter wide by 1.0 meter deep. The entrance leads to a subsurface passageway running east and west from either of its ends. The eastern passage runs east for 4 meters, but is very narrow (60 centimeters from floor to ceiling) and pinches out almost immediately. Two *kukui* fragments were observed within this portion of Feature B. The western passage opens up approximately one meter west of the opening to 6.0 meters wide and 1.2 meters high (Figure 270). The tube floor in this portion of Feature B has been cleared of cobbles leaving smooth bedrock covered by a thin layer of soil (less than 5 centimeters thick). The cleared cobbles have been removed to the edges of the tube. This area most likely functioned as the habitation section of Feature B. Imported cultural material discovered within the tube included urchin fragments, *Sus* bone, branch coral, and *kukui* fragments, indicating that Feature B was indeed utilized for habitation purposes.

Figure 270. SIHP Site 23894 Feature B, cleared area within western passageway, view to west.

Feature C

Feature C is a modified outcrop located along the southern edge of the main access road in the southeast corner of Site 23894 (see Figure 267). The northern edge of Feature C has been severely impacted by bulldozing along the access road. What remains of the feature is a low-lying natural *pāhoehoe* bedrock outcrop modified into a rough enclosure (Figure 271). The eastern edge of the feature, and most of the southern edge, consists solely of a raised linear segment of bedrock. Portions of the southern edge have been slightly modified with loosely stacked and piled *pāhoehoe* cobbles. The western edge is completely constructed of cobbles, while the northern edge consists of bulldozer push. Wall heights range from 30—60 centimeters above the surrounding ground surface. The interior of the enclosure consists primarily of bedrock with pockets of thin soil. Feature C, based on its small size and insubstantial construction, was likely utilized for temporary habitation purposes (Cordy 1981, 1995).

Figure 271. SIHP Site 23894 Feature C view to north.

SIHP Site 23895

Site 23895 is a modified outcrop located in the east-central portion of the project area (see Figure 5). The feature is constructed on a *pāhoehoe* bedrock outcrop that rises approximately 2.0 meters above the surrounding ground surface along its north and west sides, but is relatively level with ground surface to the south and east. The height of the outcrop gives Site 23895 a commanding view in all directions (Figure 272). The top of the outcrop has been leveled with small *pāhoehoe* cobbles creating a pavement measuring 2.4 meters (north/south) by 1.7 meters (east/west) (Figure 273). Rough walls, standing up to 40 centimeters high along their interior edges, are constructed with loosely stacked *pāhoehoe* slabs and cobbles around the pavement (Figure 274). There is an entryway in the southwest corner of Site 23895 that is constructed with two *pāhoehoe* slabs laid flat. It appears that this site, based on its small size and relatively insubstantial construction (Cordy 1981, 1995), along with the results of subsurface testing at Site 23888 (a similar modified outcrop to the southwest of this feature that yielded habitation debris; see description above), was most likely utilized for temporary habitation purposes.

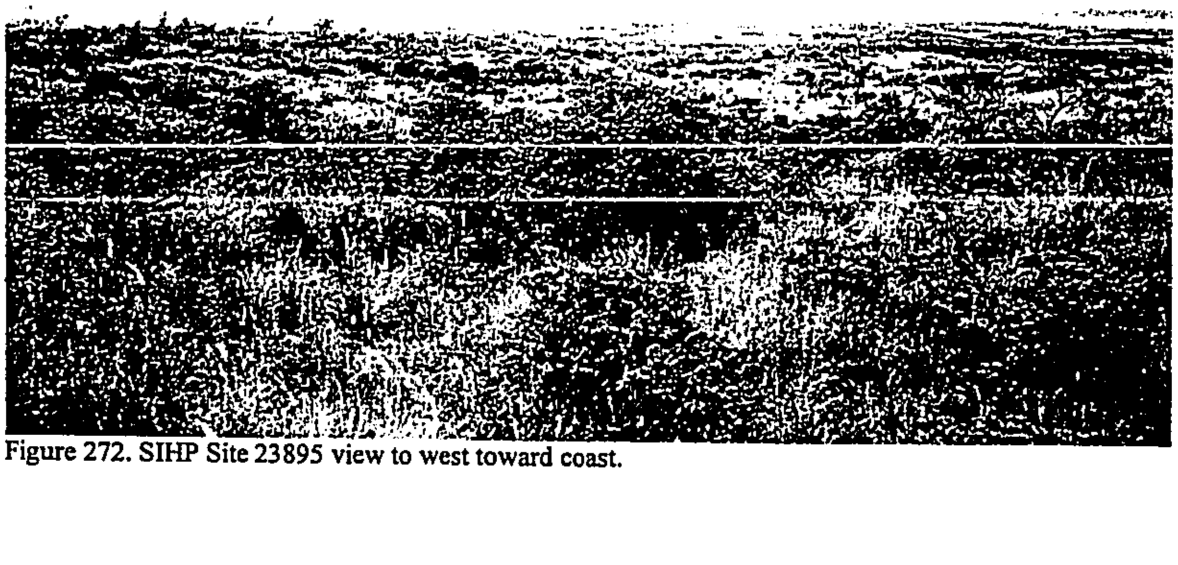


Figure 272. SIHP Site 23895 view to west toward coast.

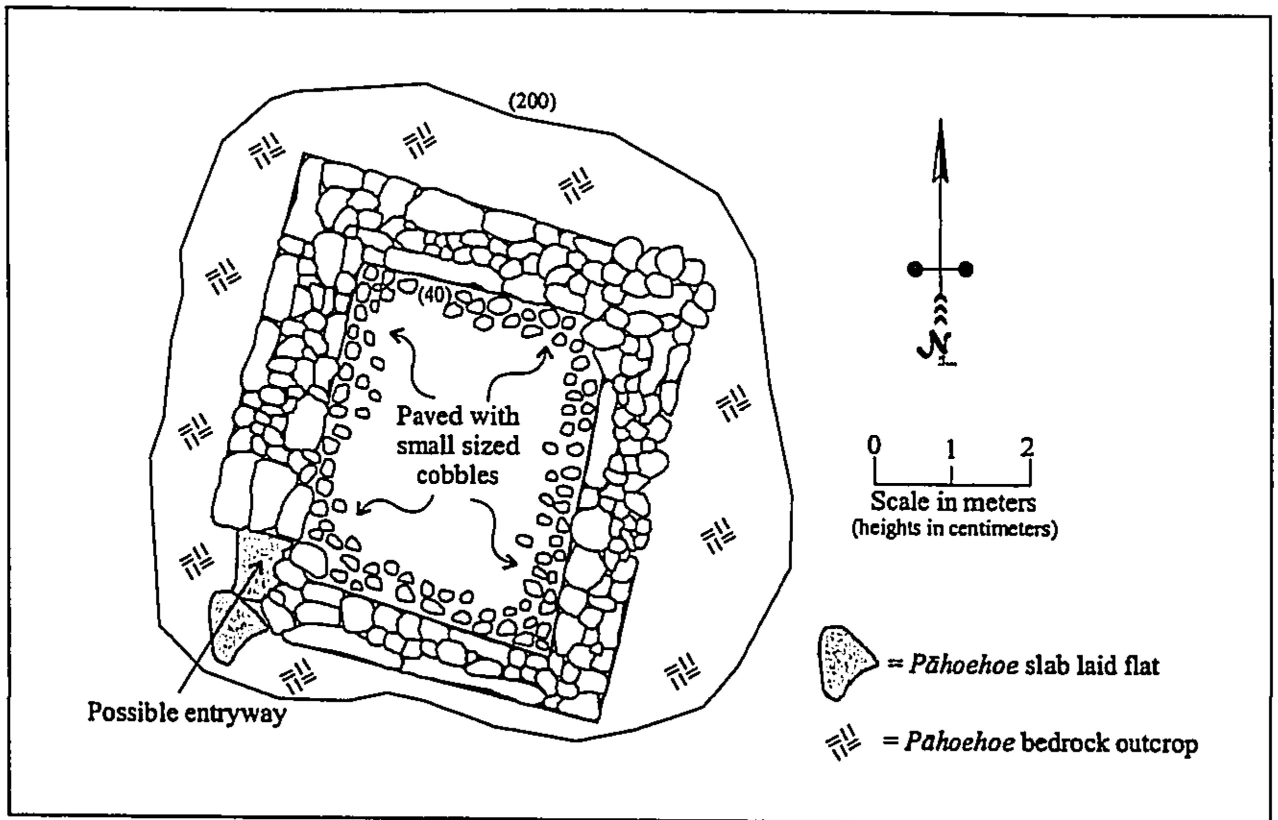


Figure 273. SIHP Site 23895 plan view.

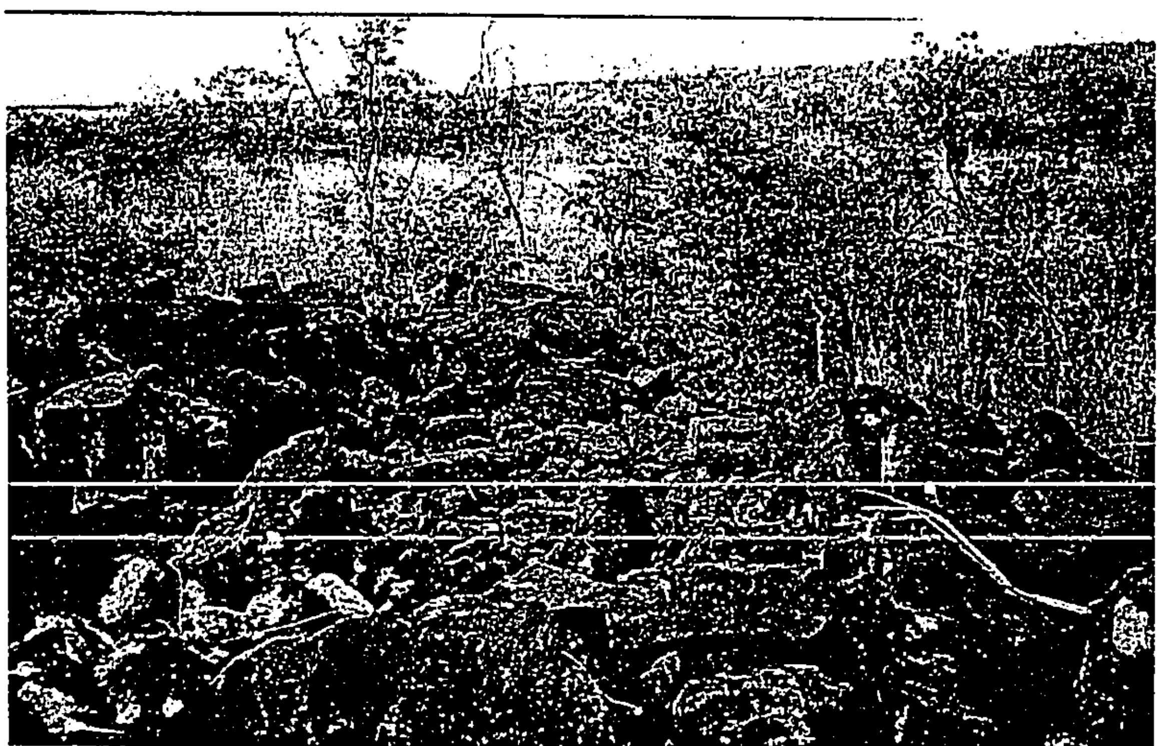


Figure 274. SIHP Site 23895 view to north.

SIHP Site 23896

Site 23896 is an excavated lava blister located in the eastern portion of the project area along the north edge of the main access road (see Figure 5). The site consists of a natural *pāhoehoe* lava blister from which the cobble and slab rubble has been removed and placed (loosely stacked 2-3 courses high) around the exterior edges on the bedrock ground surface (Figure 275). The excavated blister measures 5.8 meters long by 2.0 meters wide by 49—62 centimeters deep (Figure 276). A short subsurface passageway (not large enough for human use) runs east from the feature's eastern end (Figure 277) for approximately 1.5 meters. The passageway has a second smaller opening at its eastern end measuring 25 centimeters in diameter. The interior floor of the feature consists of smooth bedrock covered by thin pockets of soil (less then 5 centimeters thick) and vegetation. No portable cultural debris was observed at this site. The function of Site 23896 is not at all clear. It may have—based on its opportunistic and insubstantial construction, along with its small size—served a Precontact temporary habitation function (Cordy 1981, 1995). Further study at this site (in the form of subsurface testing during data recovery) may help elucidate its function, despite that fact that there is very little soil present.

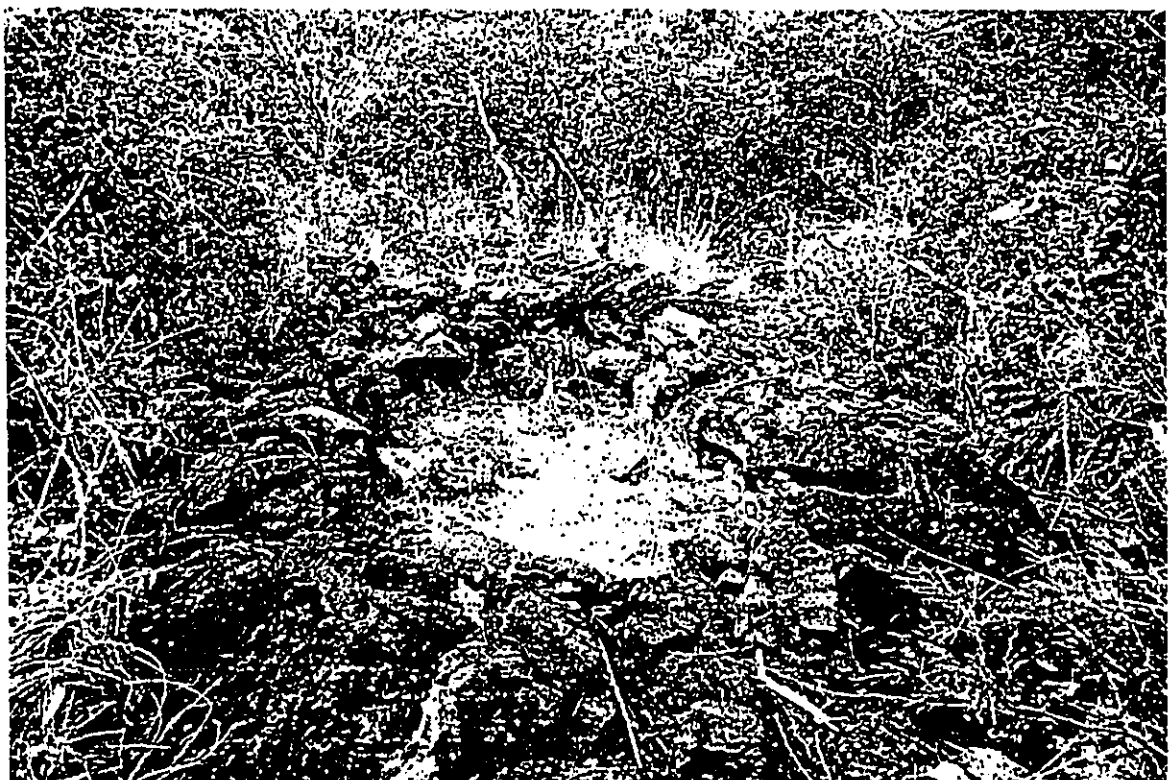


Figure 275. SIHP Site 23896 view to west.

SIHP Site 23897

Site 23897 is a habitation complex located in the eastern portion of the project area along the north side of the main access road (see Figure 5). The site consists of three separate features (Features A—C) within an area 18 meters (east/west) by 15 meters (north/south) located on *pāhoehoe* bedrock ground surface that slopes to the northwest and is covered by vegetation. Feature A is a terrace, Feature B is an enclosure, and Feature C is a pavement. A 1 x 1 meter test unit (TU-11) was excavated at Feature A. A carbon sample recovered from that unit returned a 2 sigma calibrated result of A.D. 1440-1650, indicating that the site was constructed during Precontact times. The type and amount of cultural debris recovered from TU-11, along with the features' insubstantial construction and small size, are consistent with a temporary habitation function for Site 23897 (Cordy 1981, 1995). Individual descriptions for each feature are presented below and their locations are shown on Figure 278.

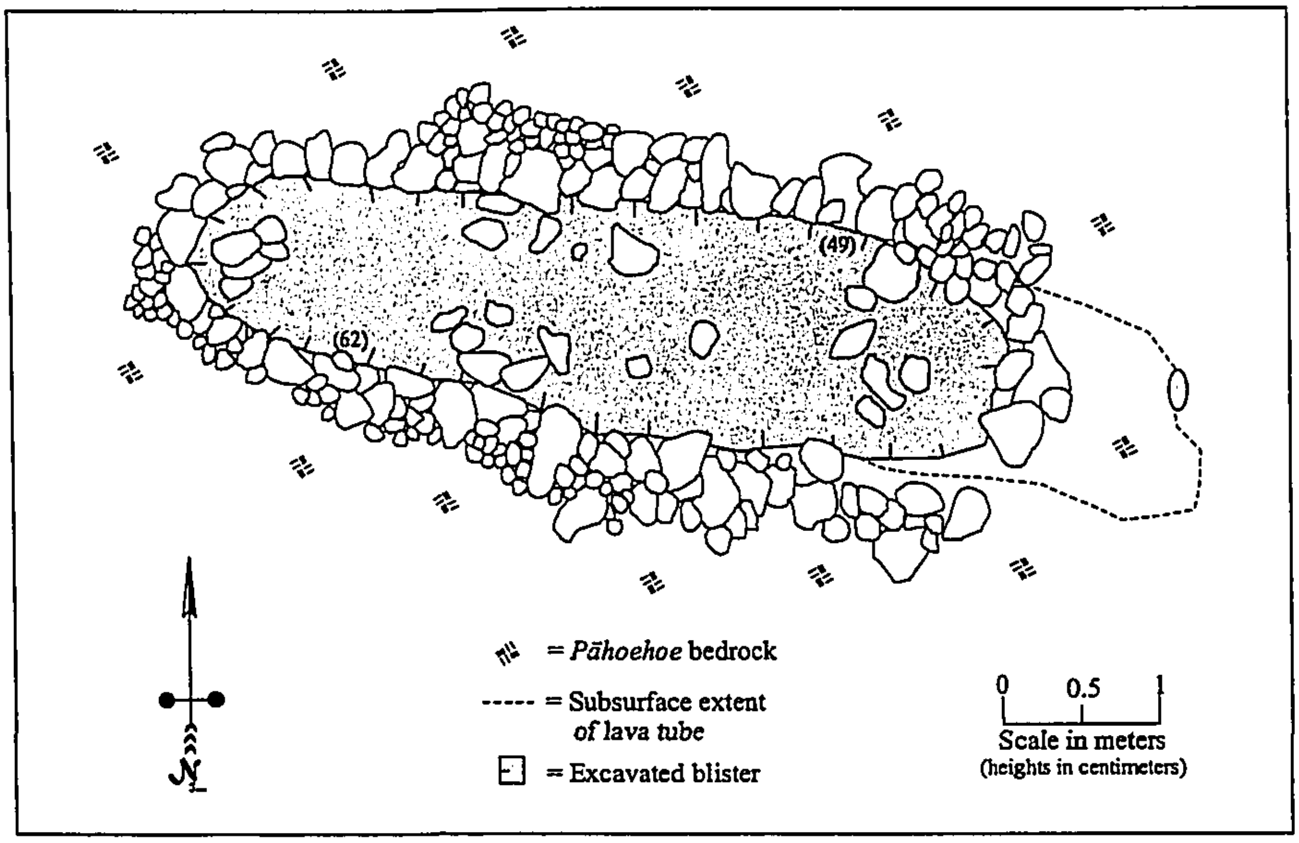


Figure 276. SIHP Site 23897 plan view.

Figure 277. SIHP Site 23897 view to east.

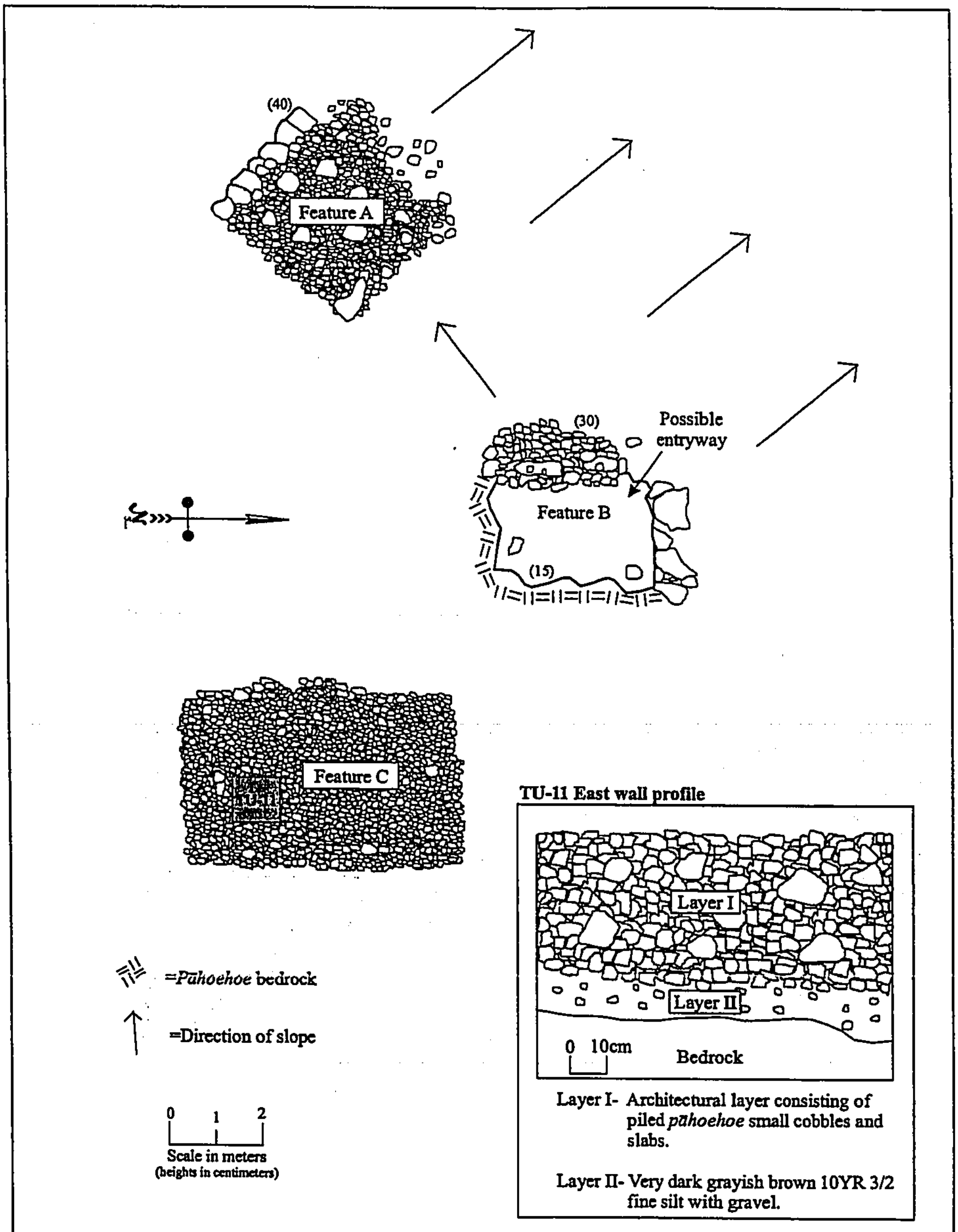


Figure 278. SIHP site 23897 plan view and TU-11 profile.

Feature A

Feature A is a rough terrace remnant located at the western edge of Site 23897 (see Figure 278). The terrace, which measures 3.5 meters long by 2.9 meters wide, is mostly collapsed, but some stacking remains along the 40-centimeter high southwest edge (Figure 279). The southeast edge of the feature is level with the surrounding bedrock ground surface. The northeast and northwest sides, although collapsed rise up to 30 centimeters above ground surface. The surface of Feature A has been roughly leveled with small*pāhoehoe* cobbles.

Figure 279. SIHP Site 23897 Feature A view to northeast of stacked southwest side.

Feature B

Feature B is a natural *pāhoehoe* bedrock depression that has been modified along two sides to form a rough enclosure with a smooth bedrock floor (Figure 280). Feature B is located 5.6 meters northeast (upslope) of Feature A (see Figure 278). The feature measures 2.9 meters long by 2.4 meters wide. The western (downslope) edge is formed of piled *pāhoehoe* cobbles standing 42 centimeters high and 90 centimeters wide. Six large *pāhoehoe* slabs, possibly removed from the enclosure's interior, form the north side of the feature. A linear bedrock face measuring 15 centimeters tall along the feature's interior delineates the east and south sides. A possible entryway (90 centimeters wide) is located in the northwest corner of Feature C.

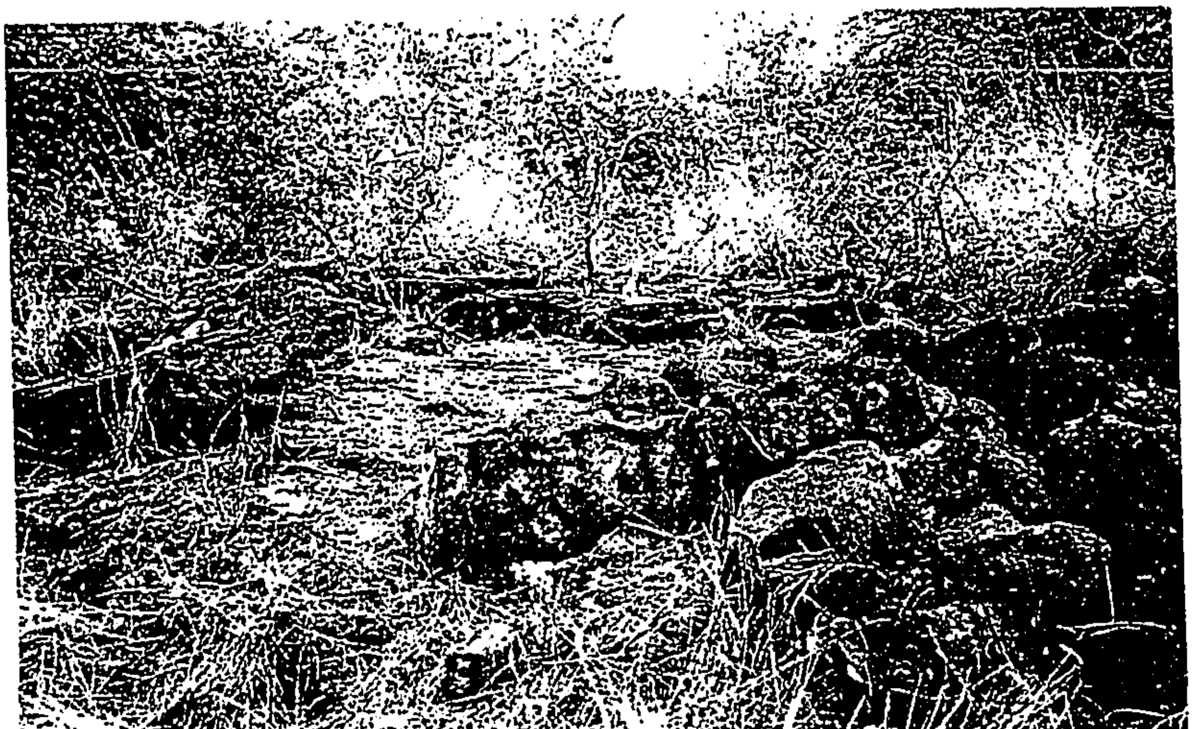


Figure 280. SIHP Site 23897 Feature B view to east (possible entryway in foreground).

Feature C

Feature C is a rough pavement of small sized *pāhoehoe* cobbles located 3.0 meters northeast (upslope) of Feature B (see Figure 278). The pavement is roughly rectangular, measuring 6.0 meters (north/south) by 3.5 (east/west). The feature's surface is mostly level with the surrounding bedrock ground surface (Figure 281). A 1 x 1 meter test unit (TU-11) was excavated in the southeast corner of Feature C.

Excavation of TU-11 revealed a two-layer stratigraphic profile resting on bedrock (see Figure 278). Layer I, the 45-centimeter thick architectural layer, consisted primarily of small *pāhoehoe* cobbles piled on Layer II. Cultural material recovered from Layer I included bird bone, marine shell fragments, and charcoal (Table 21). Layer II (15 centimeters thick) consisted of very dark grayish brown (10YR 3/2) fine silt mixed with gravels and decomposing bedrock resting on bedrock. Cultural material recovered from Layer II included marine shell and volcanic glass flakes. Excavation of TU-11 terminated at bedrock 60 centimeters below the pavement's surface (Figure 282).

Table 21. Recovered cultural material from SIHP Site 23897 TU-11.

ACC#	*Layer*	*Material*	*Species/type*	*Count*	MNI	*Weight (g)*
94	I	Bone	Bird	1	1	0.2
95	I	Shell	Unknown	2	1	<0.1
96	I	Organic	Charcoal	-	-	4.0
97	II	Volcanic glass	Flake	3	-	1.1
98	II	Shell	*Cypraea*	1	1	0.3

The charcoal recovered form TU-11 at the base of Layer I (ACC # RC-0137-96) was sent to Beta Analytic, Inc. for radiocarbon age determination (Beta-173873; see Appendix A). The carbon sample produced a conventional radiocarbon age of 360±50 B.P., or a 2 sigma calibrated result of A.D. 1440-1650, indicating that Feature C was most likely constructed during Precontact times. Since the features of Site 23897 are contained in such a tight area and show a similar amount of deterioration, it is likely that they alldate from a similar period of construction.

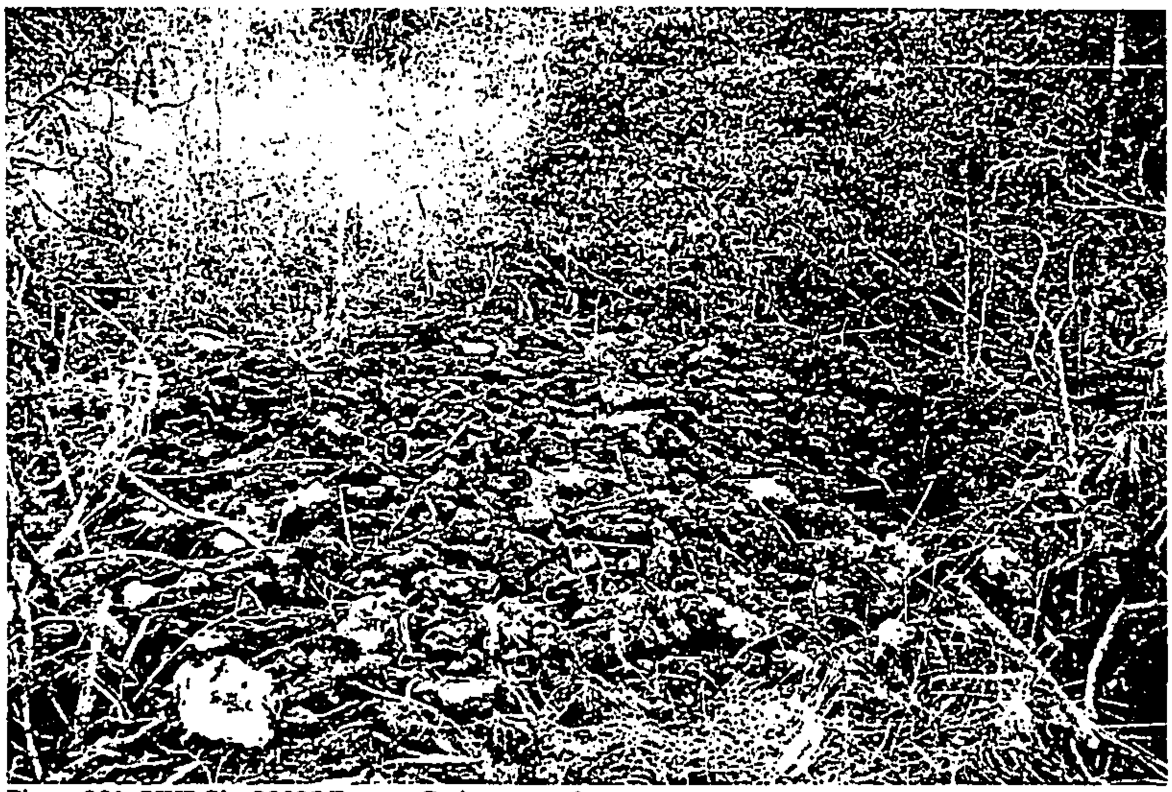


Figure 281. SIHP Site 23897 Feature C view to northeast.

Figure 282. SIHP Site 23897 Feature TU-11 base of excavation view to east.

SIHP Site 23898

Site 23898 is a three-sided historic habitation enclosure with core-filled walls located north of the main access road, in the eastern half of the project area (see Figure 5). Vegetation in the vicinity of the site consists of fountain grass, *koa haole*, silver oak, and Christmas-berry growing out of *pāhoehoe* bedrock. The enclosure (Figure 283), which opens to the west, measures 5.5 meters (north/south) by 3.2 meters (east/west) (Figure 284). The walls average 75 centimeters wide, and stand up to 90 centimeters above the surrounding ground surface. They are constructed of stacked *pāhoehoe* cobbles and slabs (Figure 285), but a high degree of collapse has occurred along the north/south trending east wall. The enclosure is built on level *pāhoehoe* bedrock. A dark green, hand-blown bottle with a round base was observed resting on ground surface near the northwest corner of the enclosure. The bottle is hand stamped/embossed with "VIEUX COGNAC" on a seal near the base of the neck.

Figure 283. SIHP Site 23898 view to south.

Site 23898 may represent an early historic residence, possibly related to ranching activities within the project area. This feature is very similar to Site 23907 Feature A, a three-sided enclosure to the south of Site 23898 that also contained historic habitation debris. This formal feature type (three-sided enclosure with core-filled walls) may represent a shift in resident populations from a time when the upland gardens fell into disuse and new historic populations began moving in, primarily for ranching purposes. Further data recovery efforts at Site 23907, which offers the opportunity for subsurface testing unlike Site 23898, will help shed light on this subject. Site 23898 is located just south of Site 14346 (a lava tube habitation) and may also be temporally related to that site.

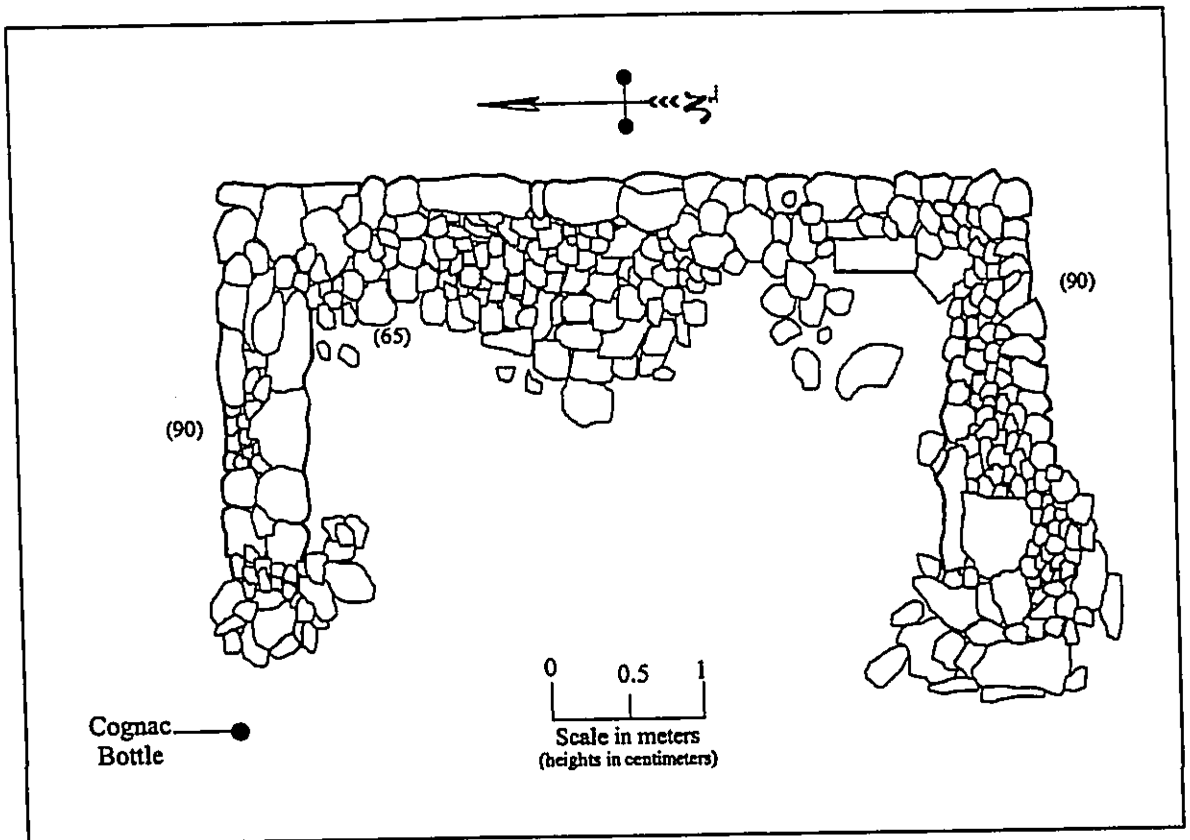


Figure 284. SIHP Site 23898 plan view.

Figue 285. SIHP Site 23898 close up of north wall view to north.

SIHP Site 23899

Site 23899 is an enclosure located in the extreme eastern portion of the project area centrally located near the eastern project area boundary (see Figure 5). Vegetation in the vicinity of the site consists of fountain grass, *koa haole*, *kukui*, Christmas-berry, and silver oak. The enclosure measures 3.8 meters (north/south) by 3.5 meters (east/west), with walls that stand up to 68 centimeters high and 1.0 meter wide (Figure 286). The feature is constructed of loosely stacked *pāhoehoe* and *a'ā* cobbles; the north and east walls are more intact than the collapsed south and west walls. A pebble-covered area in the southwest corner of the feature may have served as an entrance to the enclosure (Figure 287). The interior of the feature consists mainly of exposed bedrock containing small pockets of soil. A small lava tube opening (1.1 meter wide by 65 centimeters high) is located adjacent to the southwest corner of the enclosure (Figure 288). A underground lava tube runs approximately 20 meters east from this entrance before pinching out and becoming impassable. Two marine shell fragments (*Cypraea* and *Conus*) were found in the entrance of the tube, but no architectural modification or cultural debris was present within. Site 23899, based on its small size and opportunistic construction, likely served a Precontact temporary habitation purpose (Cordy 1981, 1995). The tube area could have been utilized for storage and shelter when necessary.

Figure 286. SIHP Site 23899 view to east.

SIHP Site 23900

Site 23900 is a rough terrace built of *pāhoehoe* and *a'ā* cobbles against a natural *pāhoehoe* bedrock outcrop (Figure 289). The site is located south of the main access road in the eastern half of the project area near the eastern property boundary (see Figure 5). Vegetation in the area consists of fountain grass, *koa haole*, Christmas-berry, and silver oak trees. The terrace measures 4.3 meters (east/west) by 2.7 meters (north/south) and stands up to 1.1 meters above ground surface along its southern edge. It is constructed with large *pāhoehoe* cobbles roughly stacked (but collapsed along its south edge) and filled behind with small *'a'ā* and *pāhoehoe* cobbles level with the bedrock ground surface to the north. Based on its small size and insubstantial construction, Site 23900 may have been used for Precontact temporary habitation purposes (Cordy 1981, 1995).

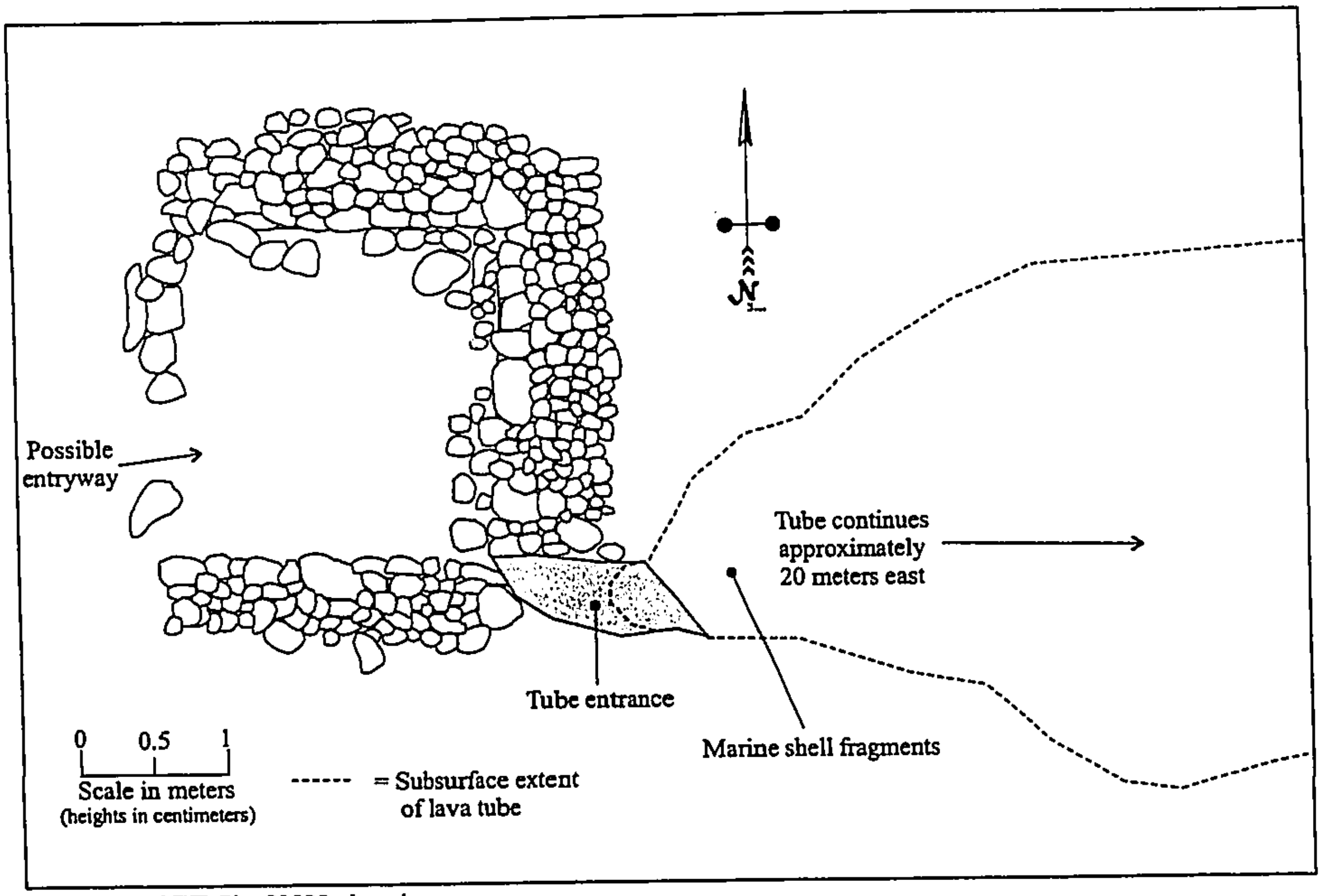


Figure 287. SIHP Site 23899 plan view.

Figure 288. SIHP Site 23899 view to east of tube entrance.


Figure 289. SIHP Site 23900 view to west.

SIHP Site23901

Site 23901 is a cairn *(ahu)* located in the southeastern portion of the project area (see Figure 5). The cairn is constructed of stacked *pāhoehoe* cobbles on *pāhoehoe* bedrock. It measures 0.9 meters in diameter and stands up to 1.3 meters tall (Figure 290). Site 23901 may mark the former route of Site 23910 (a *mauka/makai* trail traceable to the west of the cairn; see description below), which is no longer visible across the *pāhoehoe* bedrock landscape in this portion of the project area.


Figure 290. SIHP Site 23901 view to northeast.

SIHP Site 23902

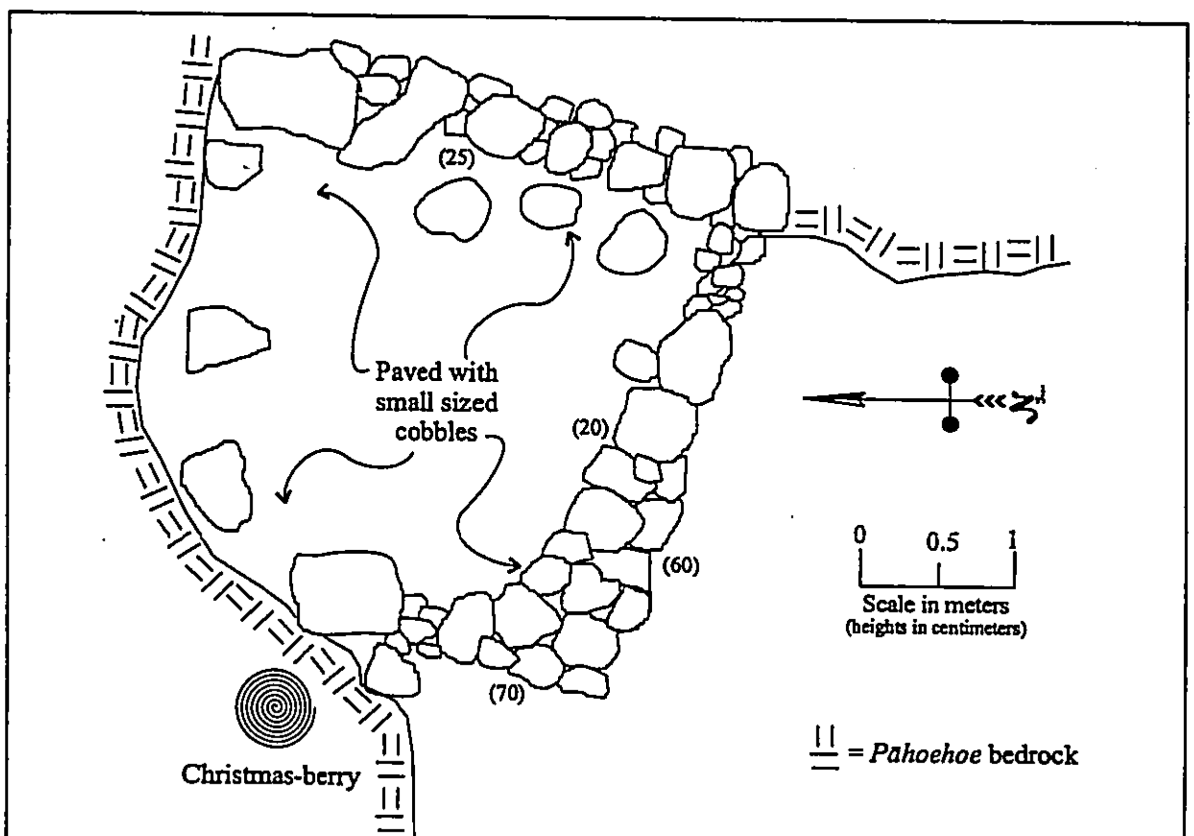
Site 23902 is a small habitation terrace located in the east-central portion of the project area north of the main access road (see Figure 5). Vegetation in the vicinity of the site consists of Christmas-berry, *koa haole*, and silver oak. The feature is built on *pāhoehoe* bedrock and measures 3.4 meters (east/west) by 3.0 meters (north/south). It is constructed with *pāhoehoe* cobbles and slabs forming terraced alignments along the south, east, and part of the west sides (Figure 291). The north edge and part of the west edge are delineated by bedrock. The interior area (Figure 292), which is slightly recessed from the top of the exterior alignments and level with the bedrock, has been paved with small *pāhoehoe* cobbles. The exterior southwest corner rises 70 cm above ground surface, while the northeast corner is level with ground surface (Figure 293). Despite the fact no habitation debris was observed, Site 23902, based on its form, small size, and insubstantial construction, was likely utilized for Precontact temporary habitation purposes (Cordy 1981, 1995).

Figure 291. SIHP Site 23902 exterior view to northeast.

SIHP Site 23903

Site 23903 is a temporary habitation complex located north of the main access road in the east-central portion of the project area (see Figure 5). Vegetation in the vicinity of the site consists primarily of fountain grass and *koa haole* covering a *pāhoehoe* bedrock ground surface. A north/south trail route (Site 14357) passes by the western edge of the site near a possible junction point with a *mauka/makai* trail route (Site 14362). Site 23903 consists of two separate habitation features constructed on a *pāhoehoe* flat; a small terrace (Feature A) and a rough C-shaped enclosure (Feature B). A Historic glass bottle and a coral fragment were found on ground surface within the site area. The features were likely constructed in Precontact times for temporary habitation purposes, judging by their form, small size, and insubstantial construction (Cordy 1981, 1995). The nature of the habitation may have been related to travel along the trail routes. Site 23903 could have offered weary travelers a place to rest for the night before continuing their journey the next day. Based on the presence of the bottle at the site, these features (or the nearby trails) may also have seen continued Historic use. Individual feature descriptions followbelow.

Figure 292. SIHP Site 23902 interior view to west.



Fgure 293. SIHP Site 23902 plan view.

Feature A

Feature A is a small habitation terrace located in the northeast corner of the site area approximately 20 meters distant from Feature B. The terrace measures 3.2 meters (north/south) by 2.8 meters (east/west). Its west and north edges are constructed of *pāhoehoe* slabs stacked up to 40 centimeters high on *pāhoehoe* bedrock. The remaining edges are level with bedrock, but the terrace is partially collapsed along the southern side. The central area is paved with small *pāhoehoe* cobbles and slabs (Figure 294). A coral fragment was found 6.0 meters east of the feature on a bedrock outcrop, and an aqua machine-finished bottle with no markings was found 4.0 meters to the southwest.

Figure 294. SIHP Site 23903 Feature A view to west.

Feature B

Site 23903 is a rough C-shaped enclosure located in the southwest corner of the site area approximately 20 meters distant from Feature A. The enclosure is constructed on *pāhoehoe* bedrock of *pāhoehoe* slabs and cobbles with its opening facing west (Figure 295). It measures 2.5 meters (east/west) by 2.6 meters (north/south), and the walls achieve a maximum height of 30 centimeters above ground surface. The interior of the C-shape is very roughly paved with *pāhoehoe* slabs and small cobbles. No habitation debris was observed within or around Feature B, but it likely served as a temporary habitation.

Figure 295. SIHP Site 23903 Feature B view to east.

SIHP Site 23904

Site 23904 is a modified outcrop located in the southeast corner of the project area (*see Figure 5*). Vegetation in the vicinity of the site consists of air plants, *koa haole*, and Christmas-berry. The outcrop is linear, runs east/west, and has been modified along its south (Figure 296) and north (Figure 297) edges with loosely stacked and piled *pāhoehoe* cobbles to form a roughly level terraced area 8.0 meters long by 7.0 meters wide. The central area of the feature consists of relatively level exposed bedrock (Figure 298). Judging by its form and minimalistic construction, Site 23904 could have been utilized for Precontact temporary habitation purposes (Cordy 1981, 1995). According to Cordy's model (1981, 1995), however, the size of the feature (56 square meters) would suggest that it was utilized as a permanent habitation. This interpretation seems doubtful though, as no habitation debris was observed in the vicinity of the site. Another possible interpretation for Site 23904 is that it marks the route of a *mauka/makai* trail that followed the linear bedrock outcrop, and that the cobble modification was to allow for easier passage, but no trail route could be followed either to the east or the west of the feature. Further data recovery efforts at this site will help clear up the function of Site 23904.

Figure 296. SIHP Site 23904 south edge view to northeast.

Figure 297. SIHP Site 23904 north edge view to southeast.

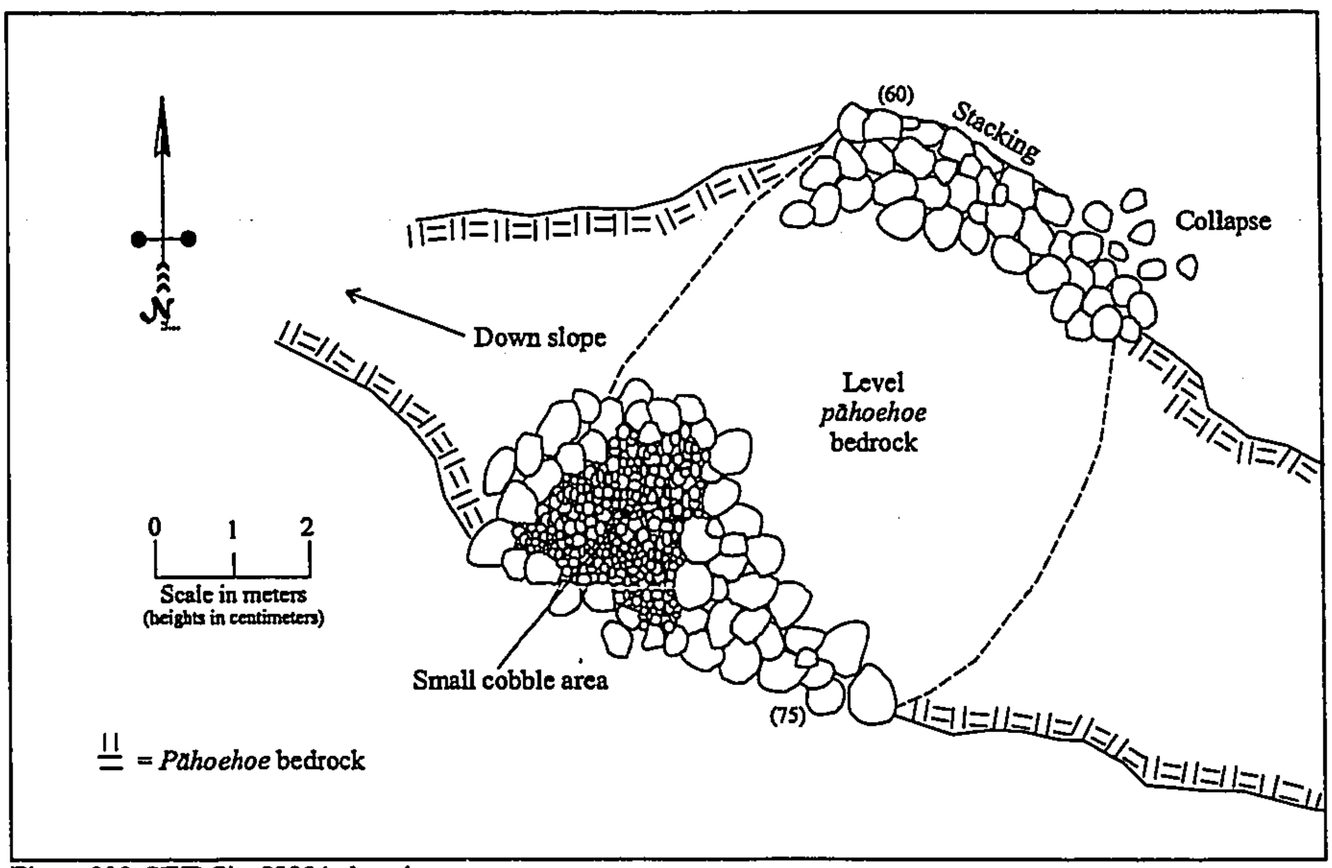


Figure 298. SIHP Site 23904 plan view.

SIHP Site 23905

Site 23905 is a rough three-sided enclosure located south of the main access road in the southeastern corner of the project area (see Figure 5). Vegetation in the vicinity of the site consists of air plants, *koa haole*, and Christmas-berry. The enclosure opens to the west and is constructed with *'a'ā* cobbles piled along the three remaining sides (Figure 299). It measures 5.0 meters (north/south) by 4.5 meters (east/west), and the walls have an average height of 60 centimeters above ground surface. The central area of the enclosure contains a thin soil layer overlying bedrock. Site 23905 resembles a large C-shaped enclosure, although its corners are more angular (squared) than other C-shapes on the property. Based on its form and minimalistic construction, Site 23905 appears to have served a Precontact temporary habitation function, despite the fact that it slightly larger than Cordy's (1981, 1995) model allows for. Subsequent data recovery efforts at this feature will help further refine the interpretation of the type of habitation that took place at Site 23905.

Figure 299. SIHP Site 23905 view to east.

SIHP Site 23906

Site 23906 is a very rough enclosure located in the extreme southeastern portion of the project area (see Figure 5). The enclosure is constructed at the base of a steep slope at the western edge of an *'a'ā* lava flow where it transitions to *pāhoehoe* bedrock (Figure 300). When discovered, the site was blanketed by dense vegetation. The interior of the enclosure measures 6.0 meters long by 5.3 meters wide. The walls, although largely collapsed, were formerly constructed of *'a'ā* cobbles loosely stacked (up to 60 centimeters high) along the feature's interior edges (Figure 301). The walls measure approximately 1.2 meters wide, but fade into the surrounding *'a'ā* cobble field. The interior of the enclosure has a very rough pavement of *pāhoehoe* slabs mixed with cobble rubble resting on bedrock. A large *pāhoehoe* slab is laid flat on a bedrock outcrop in the central portion of the feature's east wall. A possible entryway, marked by a low-lying section of small cobbles, is located in the enclosure's southwest corner. Site 23906, based on its formal attributes and opportunistic construction within an *'a'ā* flow, was likely used for temporary habitation purposes, even tough its size is slightly larger than Cordy's model alows for (Cordy 1981, 1995).

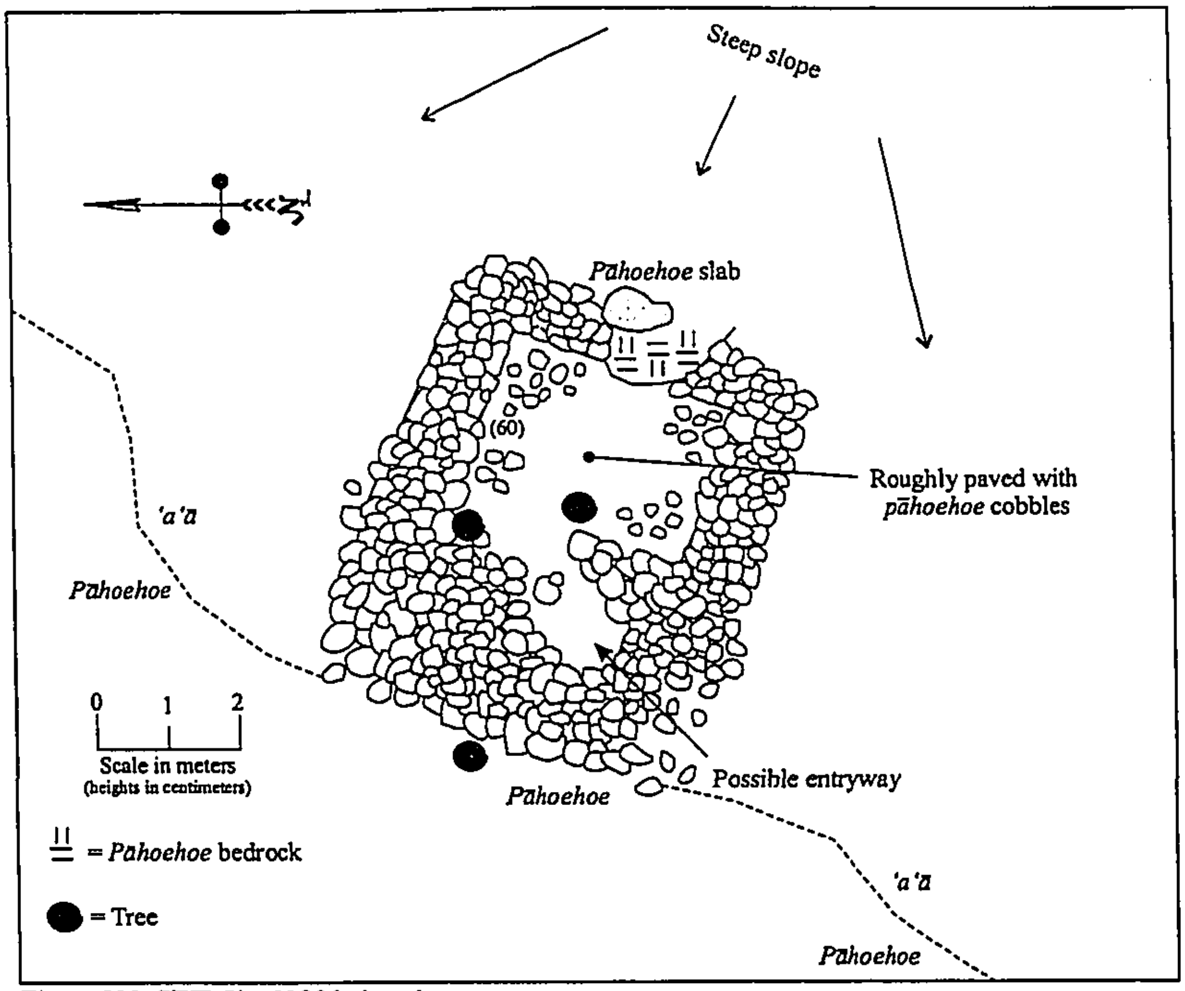


Figure 300. SIHP Site 23906 plan view.

Figure 301. SIHP Site 23906 view to west.

SIHP Site 23907

Site 23907 is a Historic habitation complex consisting of four features (A—D) located in the eastern portion of the project area near the southern property boundary (see Figure 5). The features are contained within a 30-square meter area and include a three-sided, core-filled wall enclosure (Feature A) located on a leveled terrace area at the top of a steep slope (Feature B), with a walled animal enclosure (Feature C) at the base of the slope and a path (Feature D) linking Features A and C. Site 23907 is blanketed by fairly dense vegetation including, *koa haole*, silver oak, *kukui*, air plants, and various grasses. A plethora of historic habitation debris was observed in the vicinity of Feature A (see description below). Site 23907 likely served as a historic habitation area with a main dwelling structure (Feature A) and an attached animal (cattle) pen (Feature C). Further data recovery efforts will help refine the interpretation of the duration and original occupation of the site. Individual feature descriptions follow below and their locations are shown on Figure 302.

Feature A

Feature A is a three-sided, core-filled enclosure opening to the west (see Figure 302). The north and south walls are 4.0 meters long, average 50 centimeters wide, and stand up to 85 centimeters tall (Figure 303). The east wall measures 5.0 meters in length, 1.0 meter thick (including collapsed sections), and stands up to 75 centimeters tall (interior height). Extending north of the north wall are two 1.0-meter long wall segments, one in the middle of the north wall, and the other an extension of the east wall. Artifacts found in and adjacent to Feature A include: 3 cow butchered bones, 1 modern beer bottle, 1 horseshoe (found grown into a *koa haole* tree), 1 undiagnostic green glass bottle shard, and 1 *Cellana* shell fragment (*kukui* was also observed, but is most likely naturally occurring at the site).

Feature A is the main (only) habitation feature at Site 23907. It most likely supported a roofed structure that housed early historic individuals, possibly ranchers. As previously mentioned in the description for Site 23898 (a similar feature to the north; see above), this formal feature type (three-sided enclosure with core-filled walls) may represent a shift in resident populations from a time when the upland gardens fell into disuse and new Historic populations began moving in, primarily for ranching purposes. Further data recovery efforts at Site 23907, which offers the opportunity for subsurface testing, unlike Site 23898, will help address this subject.

Feature B

Feature B is the flat soil and grass-covered terrace (18.0 meters long by 10.0 meters wide) on which Feature A is constructed. The flat yard-like area abruptly gives way to a steep slope to the west (*makai*). Its surface has been cleared of cobbles and boulders and its edges may have been minimally reinforced to prevent erosion. Feature B could also simply be a natural formation, but due to its relevance to Feature A, and uniqueness in the surrounding natural environment, it is treated here as a cultural feature.

Feature C

Feature C is a large enclosure wall that is constructed on level ground surface at the base of a steep west-facing slope below Feature B. From the southern end of Feature B, Feature C trends east/west for 10.0 meters, then north/northwest for 20.0 meters, then back southeast toward Feature B for 14.0 meters, where it ends at the northern slope of Feature B. The steep slope below Feature B forms the east wall of Feature C. Feature C is very broad and appears piled, but may have been formerly stacked; it averages 90 centimeters in height, and is 1.0—1.7 meters wide. No cultural modification was present within the enclosure. Feature C, based on the presence of butchered cow bones at Feature A, may have served as a household cattle pen. Or, on the other hand, if the entire property was being used as grazing lands at the time Site 23907 was occupied, then Feature C could have functioned as an exclosure used to keep cattle out of a garden area or living space. Further data recovery efforts at Site 23907 will add valuable information to this topic.

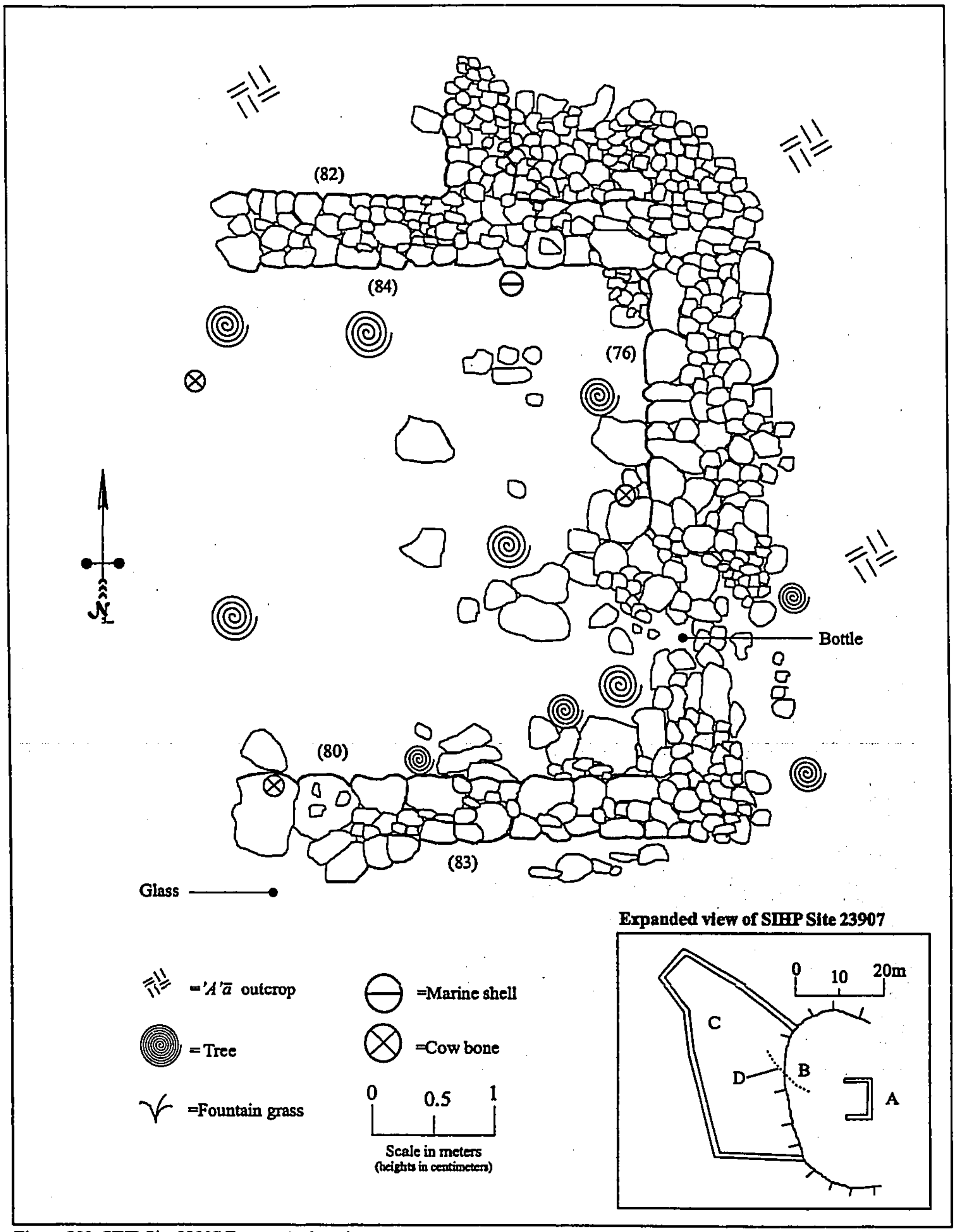


Figure 302. SIHP Site 23907 Feature A plan view.

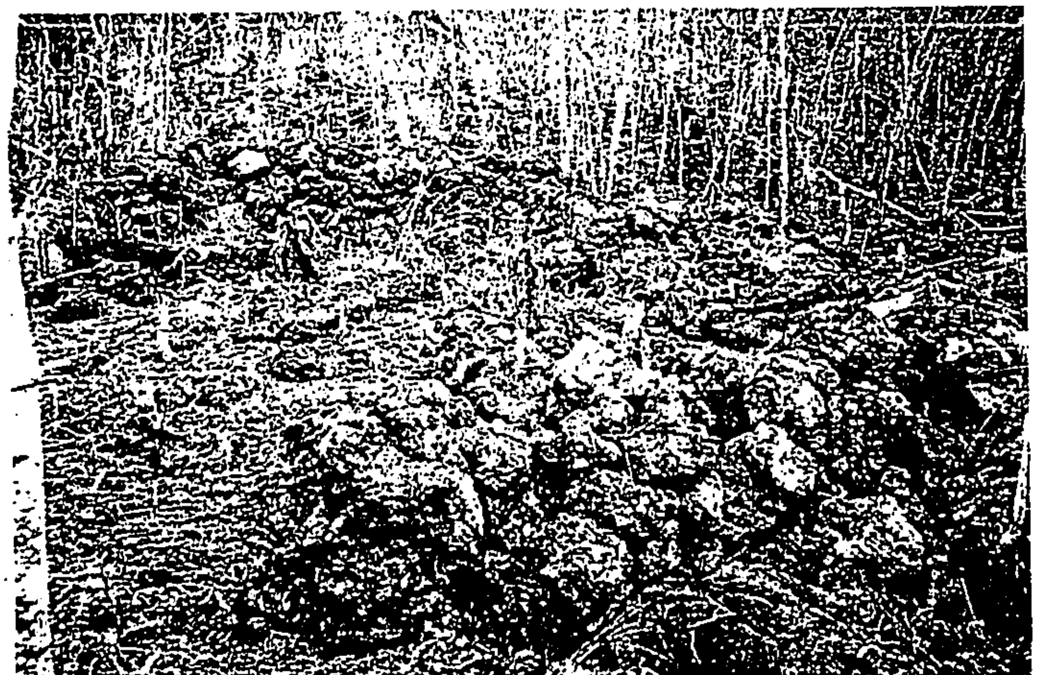


Figure 303. SIHP Site 23907 Feature A view to northeast.

Feature D

Feature D is a short pathway, trending northwest/southeast, which leads from the top of the terraced area (Feature B) downslope into Feature C. The path is approximately 90 centimeters wide, and only visible for 8.0 meters along the slope. It is marked by leveled soil (cut into the slope) cleared of cobbles and boulders (Figure 304).

Figure 304. SIHP Site 23907 Feature D view to east.

SIHP Site 23908

Site 23908 is a small east/west trending lava tube located 15 meters south of Site 23909 in the southeastern portion of the project area (see Figure 5). The entrance to the tube, which measures 1.1 meters (east/west) by 0.65 meters (north/south), is located in *pāhoehoe* bedrock (Figure 305). Inside the entrance, the subsurface passageway measures 2.2 meters wide and 1.1 meters high with a smooth bedrock floor containing some cobble rubble and soil. The tube runs 1.0 meter west of the entrance before pinching out, and there is a stacked cobble barricade 4.0 meters east of the entrance; this barricade was not disturbed so further exploration of the tube was not conducted. One *Cellana* shell fragment was observed within the tube. Based on the presence of this debris, Site 23908 is thought to have served a Precontact temporary habitation function. Site 23908 is slated for preservation.

Figure 305. SIHP Site 23908 tube entrance view to northeast.

SIHP Site 23909

Site 23909 consists of a habitation platform (Feature A) and two *pāhoehoe* excavations (Feature B) located 15 meters north of Site 23908 in the southeastern portion of the project area, south of the main access road (see Figure 5). The site is positioned on a relatively open fountain grass-covered *pāhoehoe* lava field. Feature A is a long, somewhat rectangular platform constructed between two *pāhoehoe* bedrock outcrops. The outcrop north of Feature A exhibits two areas of *pāhoehoe* excavation (Feature B); some of the excavated boulders have been incorporated into the construction of Feature A. Site 23909, based on its formal attributes and size (Cordy 1981, 1995), likely served a Precontact permanent habitation function. Individual feature descriptions follow below and the features' locations are shown on Figure 306.

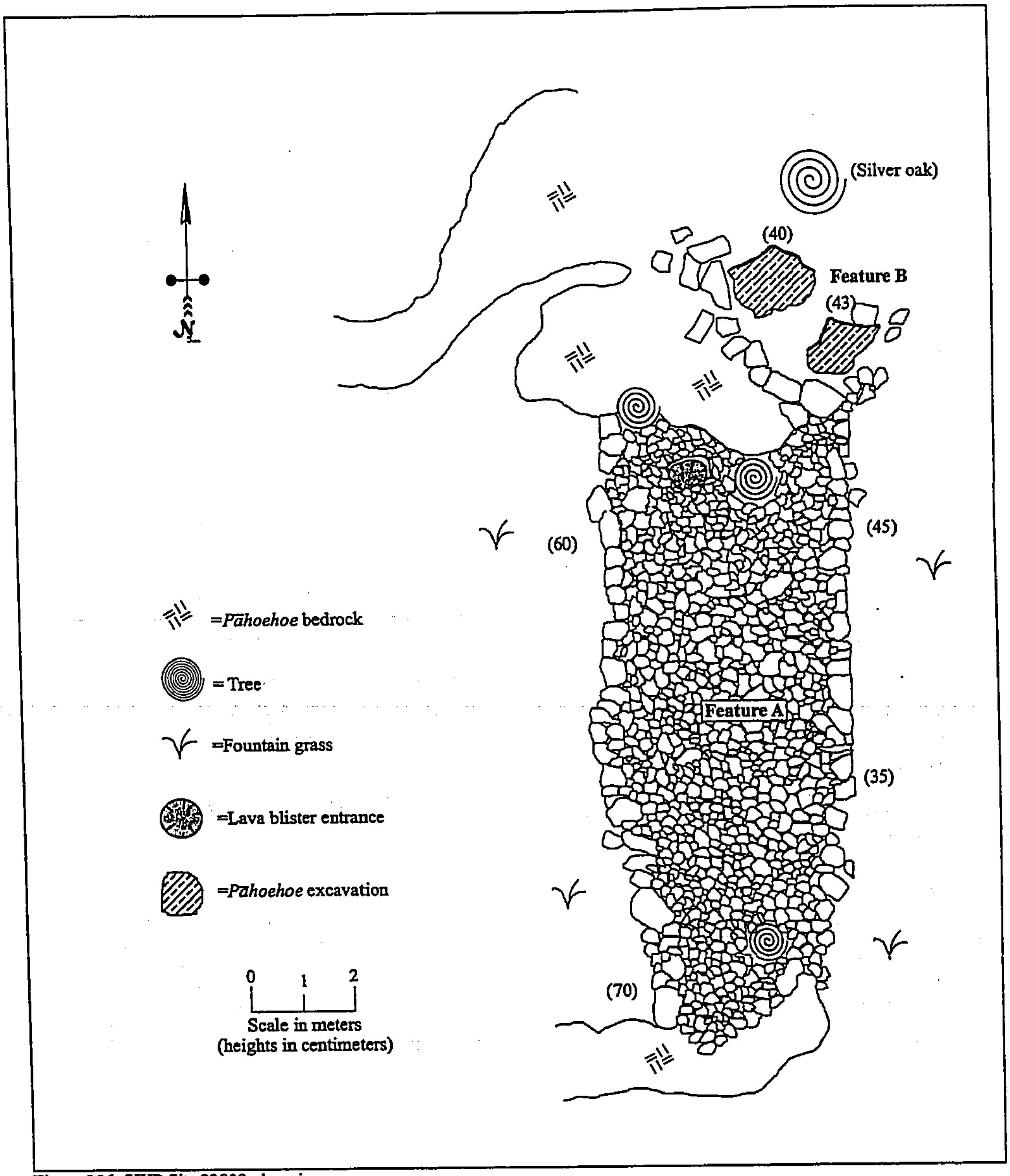


Figure 306. SIHP Site 23909 plan view.

Feature A

Feature A is a platform that measures11.0 meters long (north/south) by 5.0 meters wide (east/west). The western and eastern sides are neatly stacked; the eastern side is constructed of a single course of small *pāhoehoe* boulders averaging 40 centimeters high, while the western side stands 2 or 3 courses (65 centimeters) high. The level surface of the platform is paved with small (3—8 centimeter) to medium (8—20 centimeter) sized *pāhoehoe* cobbles (Figure 307). To the north and south, the platform is built level with *pāhoehoe* outcrops. In the northwestern portion of the platform, near the bedrock, is a small lava blister that measures 50 centimeters in diameter and 1.0 meter deep. It is inaccessible to humans, but was perhaps utilized as a storage area.

Figure 307. SIHP Site 23909 Feature A view to north.

Feature B

Feature B consists two *pāhoehoe* excavations in the bedrock adjacent to the north end of Feature A (see Figure 306). The two excavations sit side by side in a northwest/southeast line, and are separated by an unexcavated portion that resembles a bridge between the two holes (Figure 308). The larger of the two excavations measures 1.6 meters long by 1.0 meter wide by 40 centimeters deep. The other excavation measures 1.5 meters long by 0.7 meters wide, and 43 centimeters deep. Both excavations have a thin layer of soil at their base. Medium sized boulders, presumably taken from the excavation, are lined around the western side of the excavated holes. Additional material collected from the excavations may have been used for the construction of Feature A.

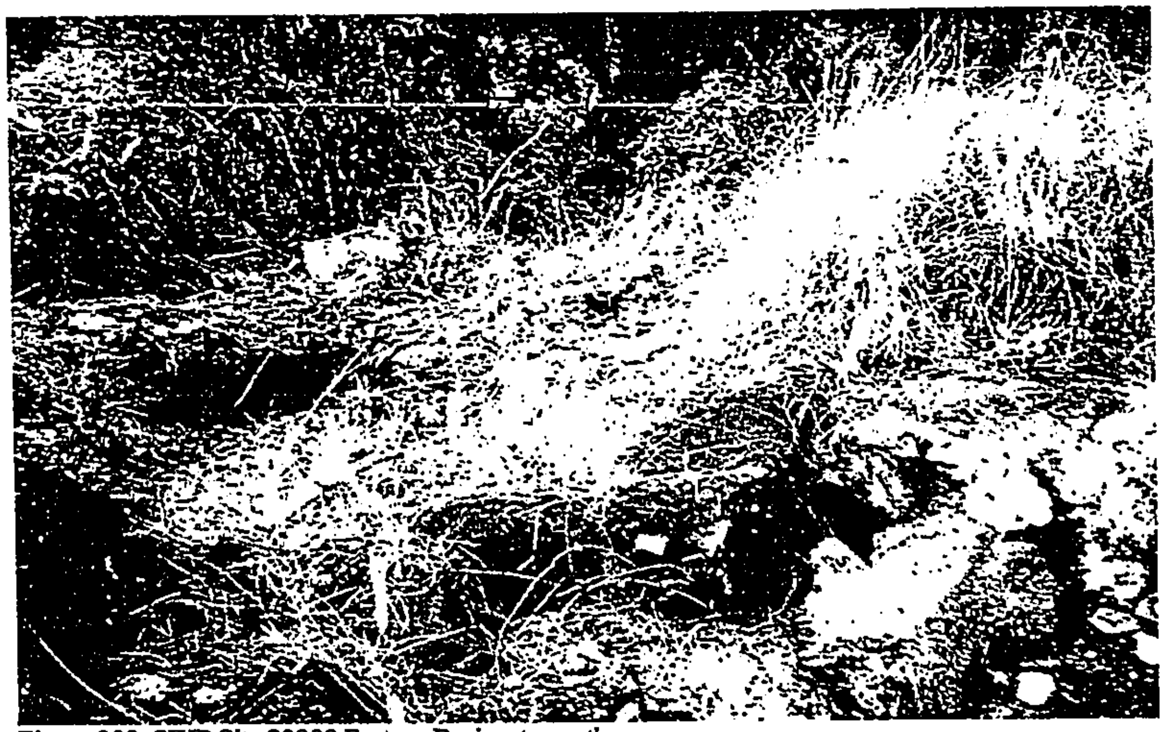


Figure 308. SIHP Site 23909 Feature B view to north.

SIHP Site 23910

Site 23910 is a *mauka/makai* trail segment located in the southeast portion of the project area (see Figure 5). The trail is evidenced, in a single 40-meter section, by a linear alignment of *'a'ā* cobbles (presumably a rough kerbing following one of its sides). Site 23910 is very rough, covered by dense vegetation, and difficult to follow for any length. The trail may have continued east to Site 23901 (a cairn) when in use, but the former route is no longer traceable.

SUMMARY

As a result of this addendum study eighty-three archaeological sites were recorded within the boundary of the project area. The most frequent site type is Precontact temporary habitation (n=41). Of these, twelve are enclosures (including 3 C-shapes), ten are lava tubes, six are multi-feature complexes, four are terraces, four are modified outcrops, four are platforms, and two are pavements. The distribution of these sites is shown on Figure 309.

Six sites were interpreted as Precontact permanent habitations; three of these are platforms, one is a terrace, and two are multi-feature complexes. One of these latter site (SIHP Site 23862) may have been associated with the large fishpond (*Pa'aiea*) reported to have existed along this section of coastline prior to being destroyed by the 1801 lava flow. The distribution of permanent habitation sites is shown on Figure 310.

There were fourteen trails and trail segments recorded, three cairn sites, three *pāhoehoe* excavations, two isolated finds in lava tubes, and one ceremonial site. Situated among a complex of agricultural features, this latter site is interpreted as an agricultural *heiau*. Two groupings of petroglyphs were found, one associated with a trail and temporary habitation, and one with a permanent habitation complex.

Nine Historic Period sites were identified: two animal enclosures, two boundary markers, a wall, a hunting blind, a road, and two habitation sites. These sites date from the late nineteenth and early twentieth centuries and appear to have been associated with Hu'ehu'e ranch activities.

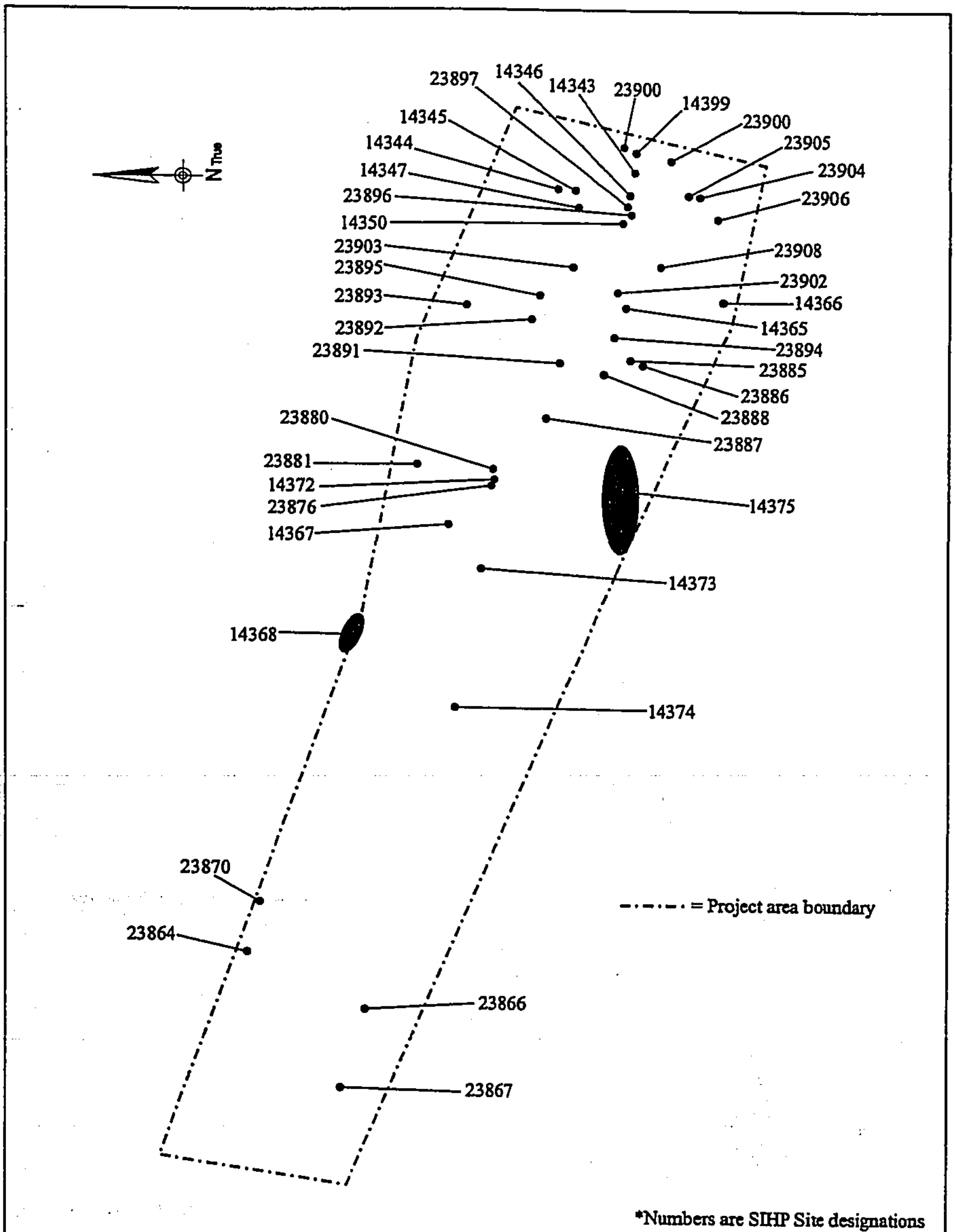


Figure 309. Distribution of Precontact temporary habitation sites.

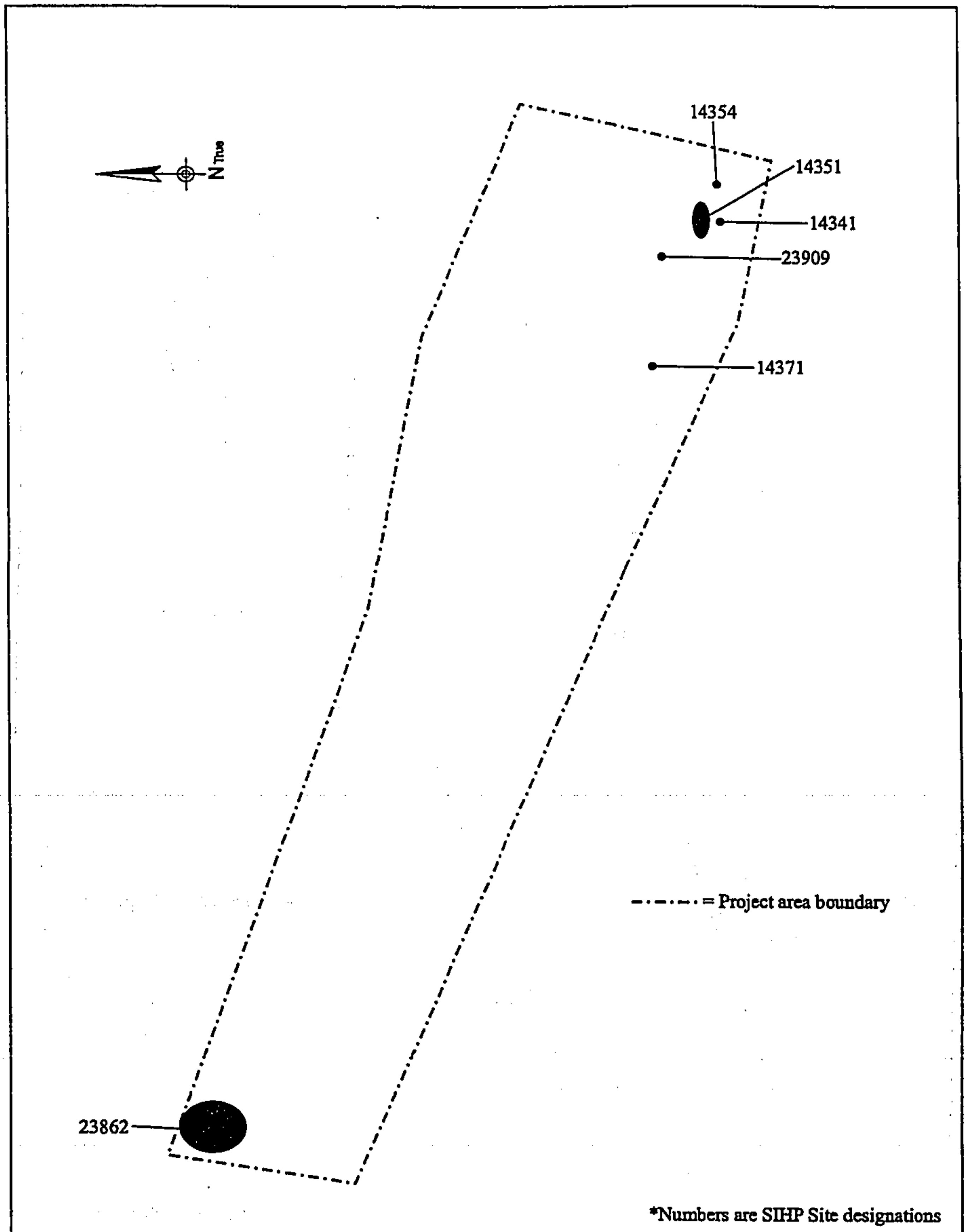


Figure 310. Distribution of Precontact permanent habitation sites.

SIGNIFICANCE ASSESSMENT AND TREATMENT RECOMMENDATIONS

The sites recorded on the property are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the *draft* Hawai'i Administrative Rules 13§13-284-6, dated 1998. These significance evaluations are intended to override those for sites previously assessed (Schilz et al. 1990) and should be considered as preliminary until DLNR-SHPD provides concurrence. For a resource to be considered significant it must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A) Be associated with events that have made an important contribution to the broad patterns of our history;

B) Be associated with the lives of persons important in our past;

C) Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D) Have yielded, or is likely to yield, information important for research on prehistory or history;

E) Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

All of the sites retain sufficient integrity for further evaluation, and that evaluation indicates the sites (except for SIHP sites 14369 and 23871) are considered significant under Criterion D at a minimum. Site 14369 and 23871 are not considered significant. Four of the sites (SIHP Sites 14360, 14367, 23862 and 23864) are also considered significant under Criterion E based on their religious/ceremonial (presence of petroglyphs or shrine) association (Table 22).

Table 22. Site significance and recommended treatments.

SIHP Site #	*Site Description*	*Significance*	*Treatment Recommendation*
14338	Isolated find in lava tube	D	No further work
14339	Precontact temporary habitation lava tube	D	Data recovery
14340	Animal pen	D	No further work
14341	Precontact permanent habitation platform	D	Data recovery
14342	Precontact agricultural complex	D	Data recovery
14343	Precontact temporary habitation terrace	D	Data recovery
14344	Precontact temporary habitation enclosure	D	Data recovery
14345	Precontact temporary habitation C-shape	D	Data recovery
14346	Precontact temporary habitation lava tube	D	Data recovery
14347	Precontact temporary habitation enclosure	D	Data recovery
14348	Alignment	D	No further work
14349	Mound	D	No further work
14350	Precontact temporary habitation lava tube	D	Data Recovery
14351	Precontact temporary habitation complex	D	Data Recovery/Preservation
14354	Precontact permanent habitation terrace	D	Data recovery
14357	Trail	D	Data recovery
14358	Isolated find in lava tube	D	No further work
14359	Cattle enclosure	D	No further work
14360	*Heiau*	D, E	Preservation
14362	Trail	D	Preservation /NFW

Table 22 continued on next page.

Table 22. Continued.

SIHP Site #	Site Description	Significance	Treatment Recommendation
14365	Precontact temporary habitation lava tube	D	Data recovery
14366	Precontact temporary habitation platform	D	Preservation
14367	Precontact temporary habitation lava tube	D, E	Preservation
14368	Precontact permanent habitation complex	D	Preservation
14369	"Hunting blind"	Not Significant	No further work
14371	Precontact permanent habitation platform	D	Data recovery
14372	Precontact temporary habitation platform	D	Data recovery
14373	Precontact temporary habitation lava tube	D	Data recovery
14374	Precontact temporary habitation complex	D	No further work
14375	Precontact lava tube habitation complex	D	Data recovery
14376	Trail	D	No further work
14377	Wall	D	No further work
14378	Cairns	D	No further work
14404	Trail	D	No further work
23862	Precontact permanent habitation complex	D, E	Preservation
23863	Cairn	D	No further work
23864	Precontact temporary habitation enclosure/shrine	D, E	Preservation
23865	Historic road bed	D	Preservation/NFW
23866	Precontact temporary habitation pavement	D	Data recovery
23867	Precontact temporary habitation C-shape	D	No further work
23868	Trail	D	No further work
23869	Historic boundary marker	D	No further work
23870	Precontact temporary habitation complex	D	Preservation
23871	Historic fence line	Not Significant	No further work
23872	*Pāhoehoe* evcavation	D	No further work
23873	Trail	D	No further work
23874	*Pāhoehoe* excavation	D	No further work
23875	Trail	D	Preservation
23876	Precontact temporary habitation modified outcrop	D	No further work
23877	Trail	D	No further work
23878	Trail	D	No further work
23879	*Pāhoehoe* excavation	D	No further work
23880	Precontact temporary habitation platform	D	No further work
23881	Precontact temporary habitation C-shape	D	No further work
23882	Trail	D	No further work
23883	Trail	D	No further work
23884	Trail	D	No further work
23885	Precontact temporary habitation complex	D	Data recovery
23886	Precontact temporary habitation enclosure	D	No further work
23887	Precontact temporary habitation pavement	D	Data recovery
23888	Precontact temporary habitation modified outcrop	D	No further work
23889	Trail	D	No further work
23890	Trail	D	No further work
23891	Precontact temporary habitation terrace	D	No further work
23892	Precontact temporary habitation enclosure	D	No further work
23893	Precontact temporary habitation lava tube	D	No further work

Table 22 continued on next page.

Table 22. Continued.

SIHP Site #	*Site Description*	*Significance*	*Treatment Recommendation*
23894	Precontact temporary habitation complex	D	Data recovery
23895	Precontact temporary habitation modified outcrop	D	Data recovery
23896	Precontact temporary habitation enclosure	D	Data recovery
23897	Precontact temporary habitation complex	D	Data recovery
23898	Historic habitation enclosure	D	No further work
23899	Precontact temporary habitation enclosure	D	Data recovery
23900	Precontact temporary habitation terrace	D	No further work
23901	Cairn	D	No further work
23902	Precontact temporary habitation terrace	D	Data recovery
23903	Precontact temporary habitation complex	D	Data recovery
23904	Precontact temporary habitation modified outcrop	D	Data recovery
23905	Precontact temporary habitation enclosure	D	Data recovery
23906	Precontact temporary habitation enclosure	D	No further work
23907	Historic habitation complex	D	Data recovery
23908	Precontact temporary habitation lava tube	D	Preservation
23909	Precontact permanent habitation platform	D	Data recovery
23910	Trail	D	No further work

End of Table 22.

Treatment recommendations fall into three categories: Preservation, Data Recovery, and No further work. Of the 83 sites recorded during the current study, twelve (14%) are recommended for preservation and thirty (36%) are recommended for data recovery; no further work is the treatment recommendation for the remaining forty-one (50%) sites. At three of the preservation sites, only selected features or portions of the site will be preserved and the other features or portions of the sites will either be data recovered (SIHP Site 14351) or receive no further work (SIHP Sites 14362 and 23865). A Data Recovery Plan will be developed and submitted to DLNR-SHPD for review and approval for all sites recommended for data recovery; likewise, a Preservation Plan will be prepared and submitted.

REFERENCES CITED

Burtchard, G.C.
1995 Population and Land Use on the Keauhou Coast, the Mauka Lands Inventory Survey, Keahou, North Kona, Hawai'i Island. Part I: Narrative Volume. InternationalArchaeological Research Institute, Inc. Prepared for Belt Collins and Associates and Kamehameha Investment Corp.

Carter, L. A.
1985 An Archaeological Reconnaissance of the *Makai* Parcel of Kaupulehu *Ahupua'a*, North Kona, Hawaii Island. Report Ms. 020585. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Ching, F.K.W., Jr.
1970 Surface Survey and Limited Salvage of a Two-mile Portion (Keahole Point Area) of the Kailua-Kawaihae Road Corridor. Draft Report. Department of Land and Natural Resources, State Parks Division.

1971 The Archaeology of South Kohala and North Kona: From the Ahupua'a of Lalamilo to the Ahupua'a of Hamanamana. Surface Survey Kailua-Kawaihae Road Corridor (Section III). *Hawaii State Archaeological Journal* 71-1. Department of Land and Natural Resources.

Ching, F.K.W., Jr., and P.H. Rosendahl
1968 The Archaeology of North Kona: From the Ahupua'a of Kealakehe to the Ahupua'a of Puukala, Section I: Archaeological Surface Survey of the Kailua-Kawaihae Road (Section II, Honokohau to Keahole Point) and the Keahole Point Airport. Division of State Parks, Department of Land and Natural Resources. Prepared for the Department of Transportation, Airports and Highways Divisions.

Cordy, R.H
1981 A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands. New York: Academic Press.

1995 Central Kona Archaeological Settlement Patterns. State Historic Preservation Division, DLNR, State of Hawaii. Prepared for the Planning Department, County of Hawaii.

2000 *Exalted Sits the Chief. The Ancient History of Hawai'i Island.* Mutual Publishing: Honolulu Hawai'i.

Cordy, R., J. Tainter, R. Renger, and R. Hitchcock
1991 An Ahupua'a Study: The 1971 Archaeological Work at Kaloko Ahupua'a, North Kona, Island of Hawai'i. U.S. Department of the Interior, Western Archaeological and Conservation Center Publications in Anthropology 58.

Hart, P.
2003 Floral Survey of Kaū Project Area, Kaū Ahupua'a, North Kona District, Island of Hawai'i. Prepared by Patrick Hart, Ph.D. for Hiluhilu Development, LLC. Kamuela, HI.

Haun, A., J. Henry, J. Jiminez, M. Kirkendall, K. Maly, and T. Wolforth
1998 Ali'i Highway Phased Mitigation Program Phase I-Archaeological Intensive Survey, Summary, Vol.I PHRI Report 1320-052758.

Kirch, P.V.
1985 *Feathered Gods and Fishhooks*: An *Introduction to Hawaiian Archaeology and Prehistory.* Honolulu: University of Hawaii Press.

Kolb, M.J.
1991 Social Power, Chiefly Authority, and Ceremonial Architecture, in an Island Polity, Maui, Hawaii. Dissertation, University of California, Los Angeles. UMI Dissertation Services, Ann Arbor.

Komori, E.
1981 Archaeological Reconnaissance Survey of Makai Area (TMK:7-2-3:2) at Ka'upulehu, Hawaii Island. Manuscript 071081. Department of Anthropology, B.P. Bishop Museum, Honolulu.

Kwiatowski, P.F.
1991 *Na Ki'I Pohaku, A Hawaiian petroglyph Primer*. Ku Pa'a Incorporated, Honolulu, Hawai'i.

Ladefoged, T., G.F. Somers, and M.M. Lane-Hamasaki
1987 A Settlement Pattern Analysis of a Portion of Hawaii Volcanoes National Park. National Park Service, Department of the Interior.

Orr, M. E.
2003 Cultural Impact Study, Hiluhilu Application Process Project, Kaū Ahupua'a, Land of Kekaha, North Kona District, Island of Hawai'i. Prepared by Maria E. Orr, M.A. for Group 70 International and Hiluhilu Development, LLC, Kamuela, HI.

Raab, M., and A. Goodyear
1984 Middle-range Theory in Archaeological: a Critical Review of Origins and Applications. *American Antiquity* 49(2):255-268.

Rechtman, R.B.
1999 Historic Sites Preservation and Interpretation Plan Hualālai at Historic Ka'ūpūlehu. Ka'ūpūlehu Ahupua'a, North Kona District, Island Of Hawai'i. PHRI Report 1675-060199.

Rechtman, R. and M. Clark
2002 Archaeological Inventory Survey of Conservation District Land in Kauleolī Ahupua'a (TMK: 3-8-5-05:19, 20), Kauleolī Ahupua'a, South Kona District, Island of Hawai'i. Report RC-0103. Prepared for Mr. Steven Jiran, Ki'ilae Estates, LLC.

Rechtman, R., K. Maly, D. Dougherty, M. Clark, and O. Maly
2001 Archaeological Inventory Survey of the Ki'ilae Estates Development Area (TMK:3-8-5-05:19, 22, 26, 27), Ki'ilae and Kauleolī Ahupua'a, South Kona District, Island of Hawai'i. Report RC-0034. Prepared for Mr. Steven Jiran, Ki'ilae Estates, LLC.

Rosendahl, P.H.
1973 Archaeological Salvage of the Ke-ahole to 'Anaeho'omalu Section of the Kailua-Kawaihae Road (Queen Kaahumanu Highway), Island of Hawaii. Departmental Report Series 73-3. Department of Anthropology, B.P. Bishop Museum, Honolulu.

1990 Archaeological Inventory Survey, Phase I-Site Identification, Kau Waterline/Roadway Project Area, Land Of Kau, North Kona District, Island of Hawai'i (TMK:3-7-2:Por.1). Paul H. Rosendahl, Ph.D. Inc., Letter Report 760-022290 to Nansay (Hawai'i), Inc., Honolulu.

Schilt, R.
1984 Subsistence and Conflict in Kona, Hawaii. An Archaeological Study of the Kuakini Highway Realignment Corridor. Departmental Report Series 84-1. Department of Anthropology, B.P. Bishop Museum, Honolulu. Prepared for the Department of Transportation, State of Hawaii.

Schilz, A.J., K. Shun, S. Williams, and R. Nees
1990 Archaeological Survey and Evaluation, Lands of Kau, North Kona, Hawai'I Island. Prepared for Nansay Hawai'I, Inc., Kamuela, Hawai'i

APPENDIX A

Dr. Bob Rechtman

Rechtman Consulting

Report Date: 1/17/03

Material Received: 12/16/02

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 173871 SAMPLE : RC-0137-61 ANALYSIS : Radiometric-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1640 to 1950 (Cal BP 310 to 0)	150 +/- 60 BP	-23.3 o/oo	180 +/- 60 BP
Beta - 173872 SAMPLE : RC-0137-80 ANALYSIS : Radiometric-Standard delivery (with extended counting) MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1400 to 1650 (Cal BP 550 to 300)	250 +/- 80 BP	-14.0 o/oo	430 +/- 80 BP
Beta - 173873 SAMPLE : RC-0137-96 ANALYSIS : Radiometric-Standard delivery (with extended counting) MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal AD 1440 to 1650 (Cal BP 510 to 300)	330 +/- 50 BP	-23.1 o/oo	360 +/- 50 BP
Beta - 173874 SAMPLE : RC-0137-108 ANALYSIS : Radiometric-Standard delivery (with extended counting) MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : (result is outside of the calibration range)	130 +/- 90 BP	-25.9 o/oo	110 +/- 90 BP
Beta - 173875 SAMPLE : RC-0137-114 ANALYSIS : Radiometric-Standard delivery (with extended counting) MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : (result is outside of the calibration range) COMMENT: reported result indicates an age of post 0 BP and has been reported as a % of the modern reference standard, indicating the material was living within the last 50 years.	103.0 +/- 0.82 pMC	-17.5 o/oo	101.45 +/- 0.82 pMC

Dr. Bob Rechtman

Report Date: 1/17/03

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 173876	210 +/- 60 BP	-25.1 o/oo	210 +/- 60 BP
Beta - 173877	230 +/- 70 BP	-23.1 o/oo	260 +/- 70 BP
Beta - 173878	570 +/- 110 BP	-24.0 o/oo	590 +/- 110 BP
Beta - 173879	170 +/- 80 BP	-23.0 o/oo	200 +/- 80 BP

Beta - 173876
SAMPLE : RC-0137-120
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1520 to 1580 (Cal BP 430 to 380) AND Cal AD 1630 to 1890 (Cal BP 320 to 60)
Cal AD 1910 to 1950 (Cal BP 40 to 0)

Beta - 173877
SAMPLE : RC-0137-123
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1460 to 1690 (Cal BP 490 to 260) AND Cal AD 1730 to 1810 (Cal BP 220 to 140)
Cal AD 1920 to 1950 (Cal BP 30 to 0)

Beta - 173878
SAMPLE : RC-0137-194
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1240 to 1490 (Cal BP 710 to 460)

Beta - 173879
SAMPLE : RC-0137-204
ANALYSIS : Radiometric-Standard delivery (with extended counting)
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 1500 to 1950 (Cal BP 450 to 0)

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.3:lab. mult=1)

Laboratory number: Beta-173871

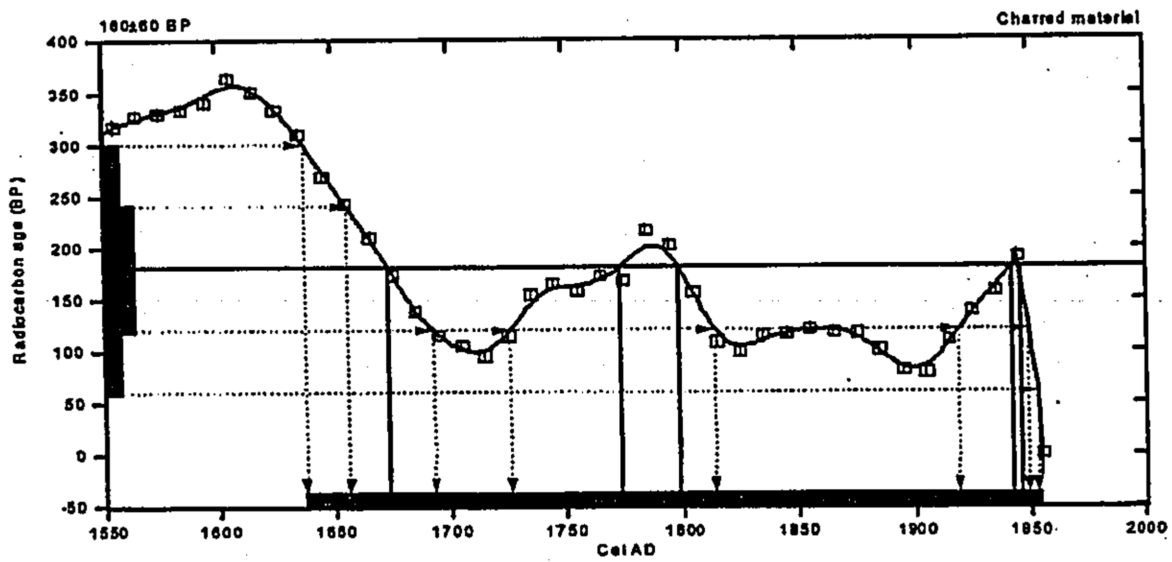
Conventional radiocarbon age: 180±60 BP

2 Sigma calibrated result: (95% probability) Cal AD 1640 to 1950 (Cal BP 310 to 0)

Intercept data

Intercepts of radiocarbon age with calibration curve:
Cal AD 1670 (Cal BP 280) and
Cal AD 1770 (Cal BP 180) and
Cal AD 1800 (Cal BP 150) and
Cal AD 1940 (Cal BP 10) and
Cal AD 1950 (Cal BP 0)

1 Sigma calibrated results: (68% probability)
Cal AD 1660 to 1690 (Cal BP 290 to 260) and
Cal AD 1730 to 1810 (Cal BP 220 to 140) and
Cal AD 1920 to 1950 (Cal BP 30 to 0)



References:
Database used

Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-14:lab. mult=1)

Laboratory number: Beta-173872

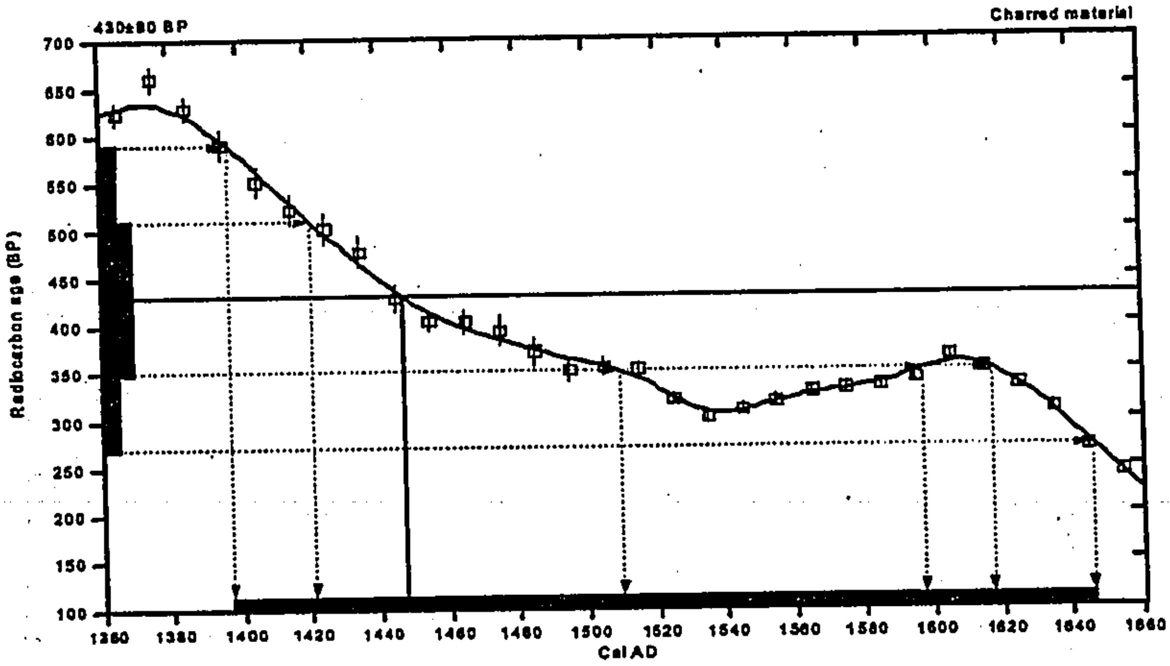
Conventional radiocarbon age: 430±80 BP

2 Sigma calibrated result: Cal AD 1400 to 1650 (Cal BP 550 to 300)
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1450 (Cal BP 500)

1 Sigma calibrated results: Cal AD 1420 to 1510 (Cal BP 530 to 440) and
(68% probability) Cal AD 1600 to 1620 (Cal BP 350 to 330)



References:
Database used

Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.
4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.1:lab. mult=1)

Laboratory number: Beta-173873

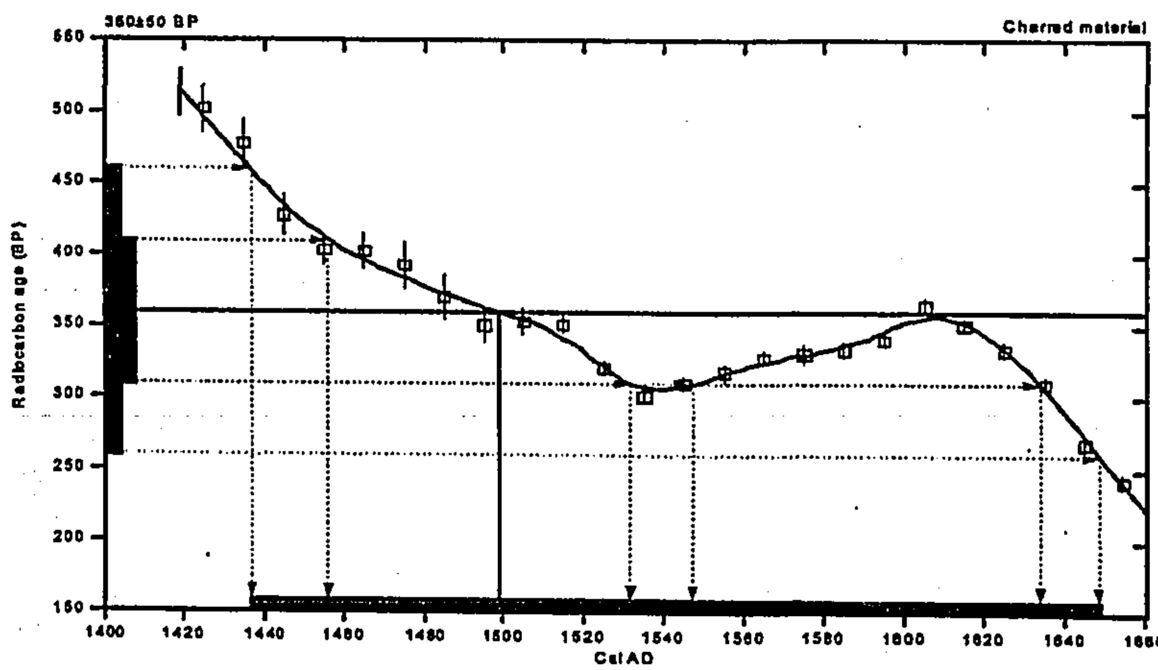
Conventional radiocarbon age: 360±50 BP

2 Sigma calibrated result: Cal AD 1440 to 1650 (Cal BP 510 to 300)
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1500 (Cal BP 450)

1 Sigma calibrated results: Cal AD 1460 to 1530 (Cal BP 490 to 420) and
(68% probability) Cal AD 1550 to 1630 (Cal BP 400 to 320)



References:

Database used

Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.1:lab. mult=1)

Laboratory number: Beta-173876

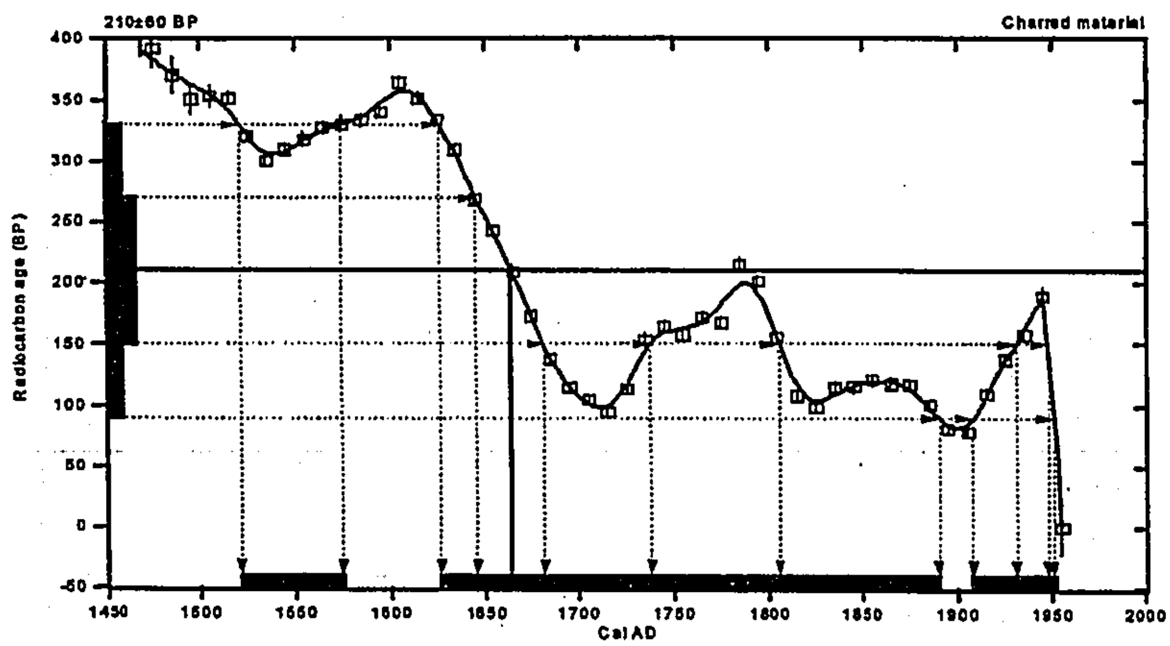
Conventional radiocarbon age: 210±60 BP

2 Sigma calibrated results: (95% probability)
Cal AD 1520 to 1580 (Cal BP 430 to 380) and
Cal AD 1630 to 1890 (Cal BP 320 to 60) and
Cal AD 1910 to 1950 (Cal BP 40 to0)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1660 (Cal BP 290)

1 Sigma calibrated results: (68% probability)
Cal AD 1650 to 1680 (Cal BP 300 to 270) and
Cal AD 1740 to 1810 (Cal BP 210 to 140) and
Cal AD 1930 to 1950 (Cal BP 20 to 0)



References:

Database used

Calibration Database

Editorial Comment

· *Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii*

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.1:lab. mult=1)

Laboratory number: Beta-173877

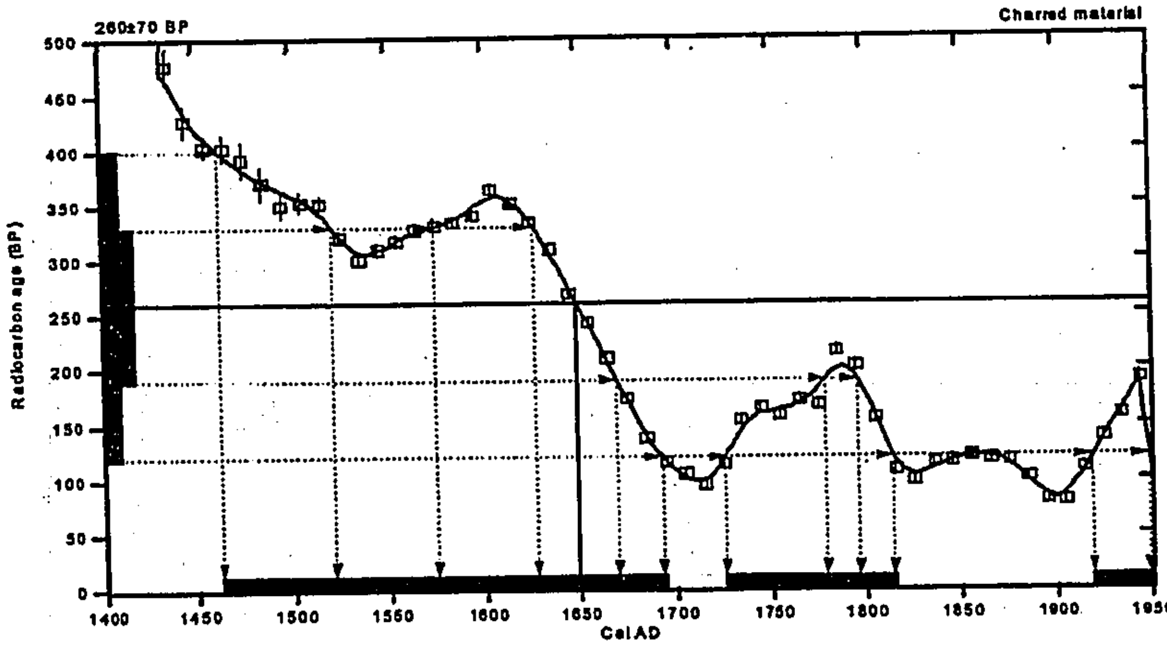
Conventional radiocarbon age: 260±70 BP

2 Sigma calibrated results: (95% probability) Cal AD 1460 to 1690 (Cal BP 490 to 260) and
Cal AD 1730 to 1810 (Cal BP 220 to 140) and
Cal AD 1920 to 1950 (Cal BP 30 to 0)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1650 (Cal BP 300)

1 Sigma calibrated results: (68% probability) Cal AD 1520 to 1580 (Cal BP 430 to 380) and
Cal AD 1630 to 1670 (Cal BP 320 to 280) and
Cal AD 1780 to 1800 (Cal BP 170 to 150)



References:
Database used

Calibration Database
Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii
INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24:lab. mult=1)

Laboratory number: Beta-173878

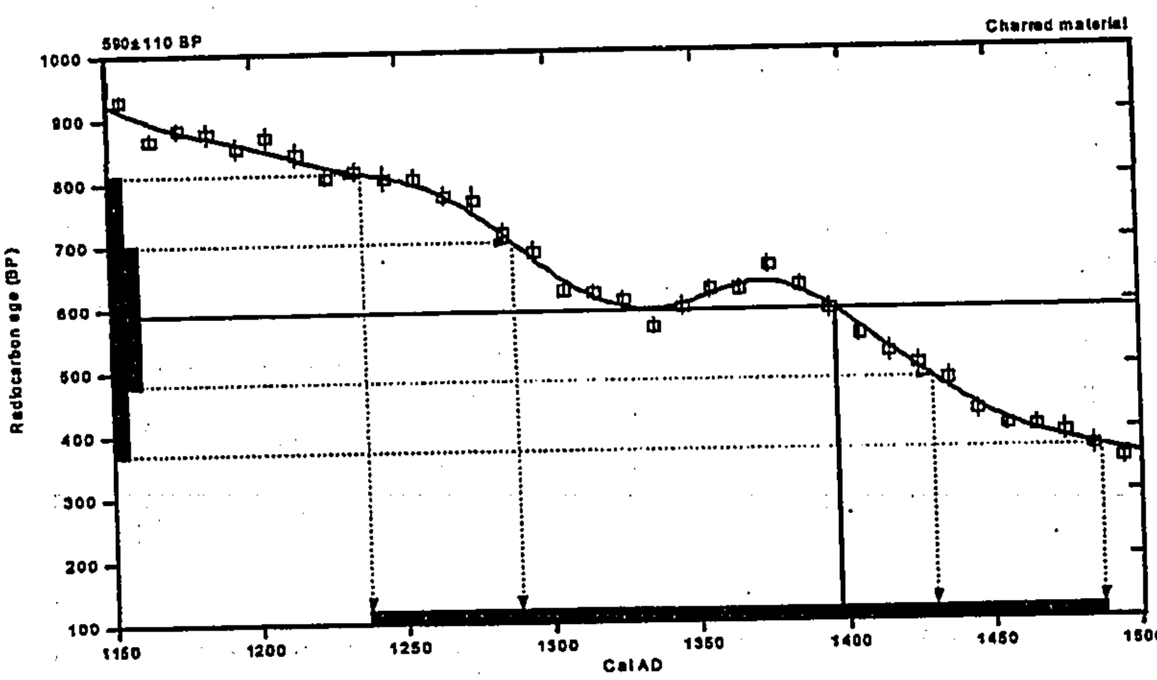
Conventional radiocarbon age: 590±110 BP

2 Sigma calibrated result: Cal AD 1240 to 1490 (Cal BP 710 to 460)
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal AD 1400 (Cal BP 550)

1 Sigma calibrated result: Cal AD 1290 to 1430 (Cal BP 660 to 520)
(68% probability)



References:

Database used

Calibration Database

Editorial Comment
Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration
Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

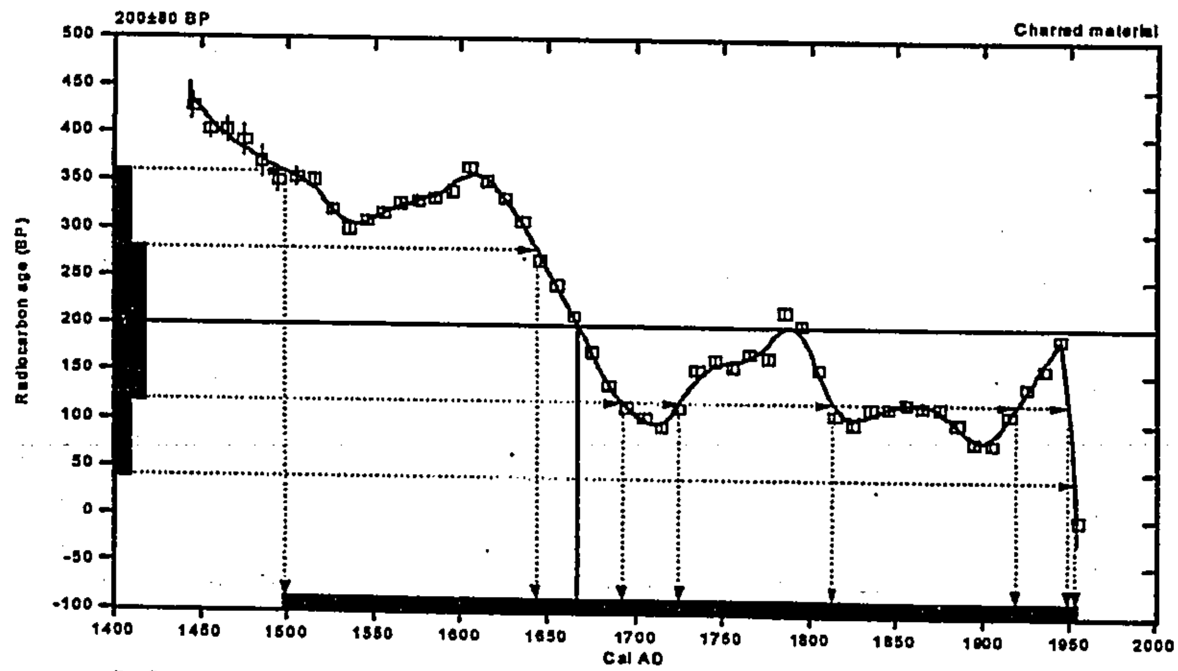
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23:lab. mult=1)

Laboratory number:	Beta-173879
Conventional radiocarbon age:	200±80 BP
2 Sigma calibrated result: (95% probability)	Cal AD 1500 to 1950 (Cal BP 450 to 0)

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal AD 1670 (Cal BP 280)
1 Sigma calibrated results: (68% probability)	Cal AD 1640 to 1690 (Cal BP 310 to 260) and Cal AD 1730 to 1810 (Cal BP 220 to 140) and Cal AD 1920 to 1950 (Cal BP 30 to 0)



References:

Database used

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Inc.

4985 SW 74 Court, Miami, Florida 33155 USA • Tel: (305) 667 5167 • Fax: (305) 663 0964 • E-Mail: beta@radiocarbon.com

Appendix D

Cultural Impact Study, Hiluhilu Application Process Project, Kaū Ahupua'a, Land of Kekaha District of North Kona, Hawai'i Island, Hawai'i

Cultural Impact Study
Hiluhilu Application Process Project
Kaū Ahupua`a, Land of Kekaha
District of North Kona, Hawai`i Island, Hawai`i

Prepared for
Group 70
Hiluhilu LLC

By Maria E. Ka`imipono Orr

June 13, 2003

Cover Page: `Ohia lehua from Kaū Ahupua`a
All photos unless otherwise cited are by the author.

Petroglyphs graphics are from (Williams et. al., 2001)
Site 50-10-28-14292; Feature 23
Kaū Ahupua`a

EXECUTIVE SUMMARY

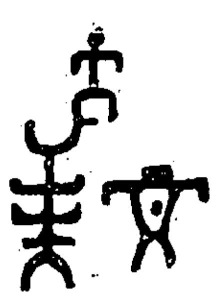
At the request of Hiluhilu LLC a Cultural Impact Study [CIS] of Kaū Ahupua`a [TMK: 7-2-05-01], North Kona, Hawaii Island, was conducted intermittently between September 2002 [Site Field Trip and meetings] and June 2003. This study was part of a larger study prepared Group 70 Planners.

This study is in compliance with Act 50 SLH 2000 (HB 2895 H.D.1) as it amends the State of Hawaii Office of Environmental Quality Control [OEQC] Guidelines for Environmental Impact Statement law [Chapter 343, HRS]. To this end, the targeted "audience" of this report is the people who will be reviewing it. Therefore, it was written with this in mind and includes an overview of the history of land use by entities such as Hu`ehu`e Ranch. The literature review included *mo`olelo* or Hawaiian stories and legends of the vicinity, ethno-historic works from the 19th and early 20th centuries, other pertinent archival material, and an InterNet search.

A medium level of effort ethnographic survey was conducted, primarily because the area that will be impacted by this undertaking has been a working ranch for over one hundred years; and the project site has been impacted by ranching activities and feral animals such as goats, pigs, and donkeys. There are people currently living in the vicinity [Kekaha lands] who are fourth and fifth generation descendants of the original owners of Hu`ehu` Ranch. There are also people currently living who worked on the ranch for a number of years. While the project site appears to be devoid of cultural remains, due to the preponderance of lava from several ancient flows, a closer study reveals numerous sites and features or cultural resources that attest to the ancient use of the area.

Despite the dismal accounting of Kaū in the archival material, when one walks the land, one can find an abundance of cultural resources that dot the landscape, in the form of ancient cave shelters, water-collection caves, trails, burials, ceremonial features and a range of agricultural features. Kaū also has a diverse range of endemic and indigenous flora, both in species and in habitat zones. It was a privilege to see so many thriving and in bloom.

The *kupuna* who were able to go on a site visit, enjoyed the experience and were happy to share their *mana`o* both during the field trip and in later interviews. Regrettably not all of the potential consultants were able to participate. However, a recommended follow-up would be to pursue that goal.



ACKNOWLEDGEMENTS

This project could not have been completed without the assistance, support and *mana`o* of my ethnographic consultants: Uncle George Kinoulu Kahananui, Sr. (Uncle Kino) and Ms. Hannah Kihalani Springer for taking the time to be interviewed and participate in a site field trip. To Kupuna Annie Coelho and Ruby McDonald for their *mana`o* on the field trip.

Special mahalo to Kupuna Maile and Ikaika Napoleon for their hospitality; to Mr. Roger Harris, representative of Hiluhilu Development LLC for his kokua and support; and to Jessica Orr for technical support.

Additional mahalo also goes out to SHPD archaeologists Dr. Pat McCoy; Dr. Sara Collins and Muffet Jourdane for their continuing help;

Mahalo to Mr. Roger Harris, Dr. Bob Rechtman and Matthew Clark for helping with the kupuna site visit/field trip.

And last but certainly not least, a big MAHALO to Dr. Robert "Bob" Rechtman of Rechtman Consulting for recommending me for the CIS, for without his support I would not have had this project.

MAHALO!

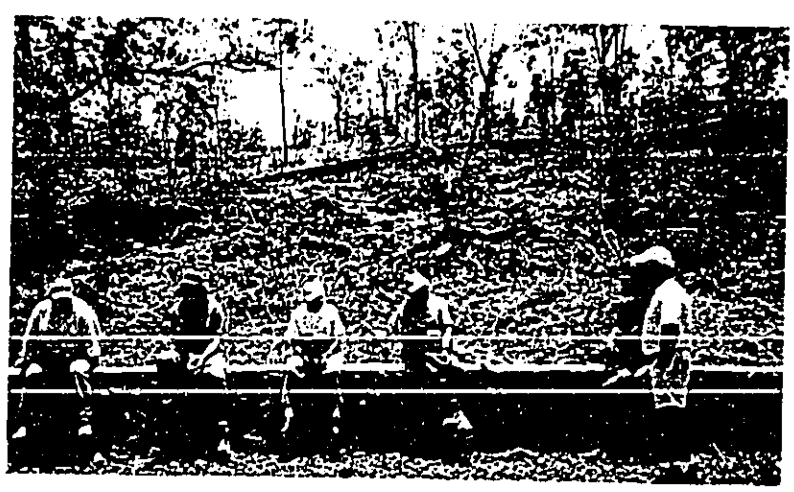


TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

INTRODUCTION

At the request of Mr. Roger Harris representing Hiluhilu Development LLC a Cultural Impact Assessment/Study [CIS] for the lands of Kaū Ahupua`a (TMK: 7-2-05:01) was conducted. This Cultural Impact Study was in accordance with the State of Hawaii Office of Environmental Quality Control [OEQC] Guidelines for Assessing Cultural Impacts [1997]. This study is in compliance with Act 50 SLH 2000 (HB 28 H.D.1) as it amends the State of Hawai`i Environmental Impact Statement law [Chapter 343, HRS] to include:

> *effects on the cultural practices of the community and State. Also amends the definition of "significant effect" to include adverse effects on cultural practices.*

The purpose of this CIS was to gather information about traditional cultural practices, ethnic cultural practices and pre-historic and historic cultural remains that may be affected by the implementation of the development project. This study is in compliance with Act 50 SLH 2000 (HB 2895 H.D.1) [Appendix A] as it amends the State of Hawaii Environmental Impact Statement law [Chapter 343, HRS] to include:

> *effects on the cultural practices of the community and State. Also amends the definition of "significant effect" to include adverse effects on cultural practices.*

This study also addresses the mandates of the Supreme Court of the State of Hawaii in *Ka Pa`akai O Ka`aina v.Land Use Commission*, September 11, 2000 [http://mano.icsd.hawaii.gov/jud/21123.htm 9/1/2002:3]:

(1) the identity and scope of "valued Cultural, historical, or natural resources" in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area;

(2) the extent to which those resources – including traditional and customary native Hawaiian rights – will be affected or impaired by the proposed action

This study is being conducted at a moderate *level of effort* [5-10 oral histories; broad background review of North Kona] due to a preliminary assessment that the Hu`ehu`e Ranch historically utilized the project lands where they free-roamed their cattle. A cursory site inspection also indicated that probable prehistoric sites were vandalized, and may be on going as screening equipment was found at one site.

This report is organized into five parts. Part I describes the project area in terms of location, in the context of *ahupua`a*, district and island, as well as a generalized description of the natural environment [geology, flora and fauna]. Part II explains the methods and constraints of this study. Part III summarizes the review of the traditional and historical literature in the context of the general history of Hawai`i, the island of Hawai`i, the district of North Kona, and the local history of Kaū as it pertains to cultural resources, land, water and marine resources and use in the project vicinity. Part IV presents the analysis of the ethnographic survey based on the supporting data (oral history transcripts). Part V summarizes the findings of this cultural impact assessment/study.

SCOPE OF WORK

The scope-of-work (SOW) [Appendix B] was based on the OEQC *Guidelines for Assessing Cultural Impacts* (1997) [Appendix C] and focuses on three cultural resource areas (traditional, historical and archaeological), conducted on two levels: archival research (literature review) and ethnographic survey (oral histories). Since independent contractors have already conducted the archaeological inventory survey of Kaū, this study will only include brief summaries of previous archaeological studies of the project area and vicinity, focusing on information regarding cultural/historical significance.

Scope of Work: Cultural Impact Assessment [in accordance with OEQC Guidelines]

1. identify and consult with individuals with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or *ahupua`a*; or with knowledge of the area potentially affected by the proposed action;

2. receive information from or conduct ethnographic interviews and oral histories with person(s) having knowledge of the potentially affected area;

3. conduct ethnographic, historical, anthropological, and other culturally related documentary research;

4. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

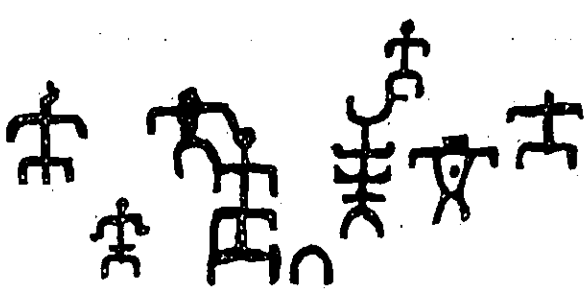
5. assess the impact of the proposed action on the cultural resources, practices and beliefs identified.

Research on traditional resources entailed a review of the literature of Hawaiian *mo`olelo* (stories, legends or oral histories) of late nineteenth and early twentieth century ethnographic works, and interviews with knowledgeable consultants who met the following consultant criteria:

- Had/has Ties to Project Location(s)
- Referred By Office of Hawaiian Affairs (OHA)
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People

Historic research focused on the ranching influence. Literature from the following institutions were reviewed: State Historic Preservation Division Library; University of Hawai`i-Manoa Hamilton Library-Hawaiian Collections; Bishop Museum Archives and Library; Waihona `Aina Corp.; State Bureau of Conveyances; personal library and InterNet searches.

Archaeological research entailed a limited review of the literature located in the DLNR State Historic Preservation Division Library; and a site visit.



PART I: PROJECT AREA

Project Location

The project site is located in the *ahupua`a* (traditional land division) of Kaū (TMK: 07-02-05:1), approximately one mile north of the Ke-āhole International Airport, from Queen Ka`ahumanu Highway at about the 150 feet to 800 feet elevation above sea level (Rechtman 2003b) in the *moku* (district) of North Kona, on the island of Hawai`i (Figures 1 and 2).

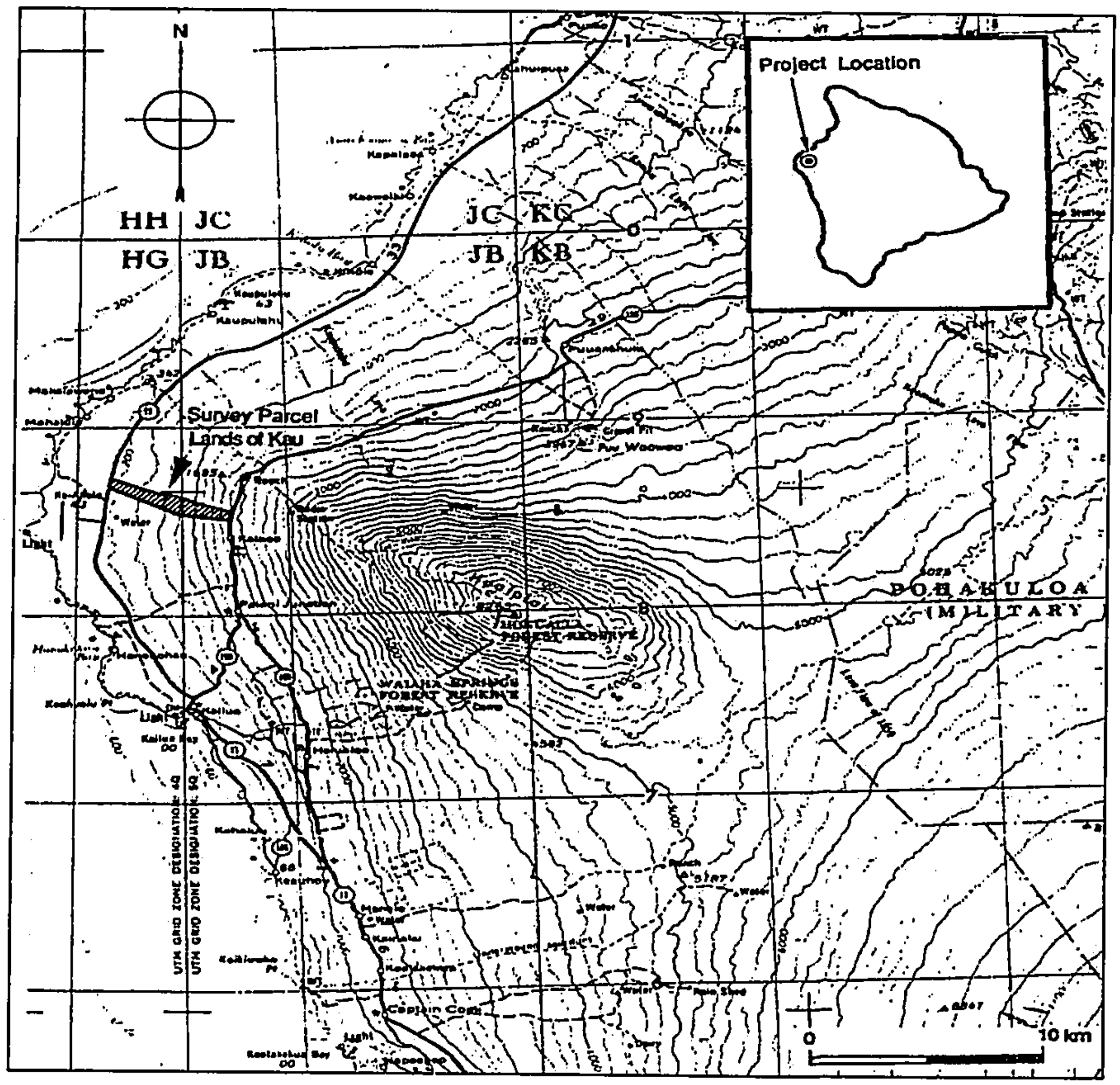


Figure 1. Project Location, North Kona (from Williams et. al., 1993:2).

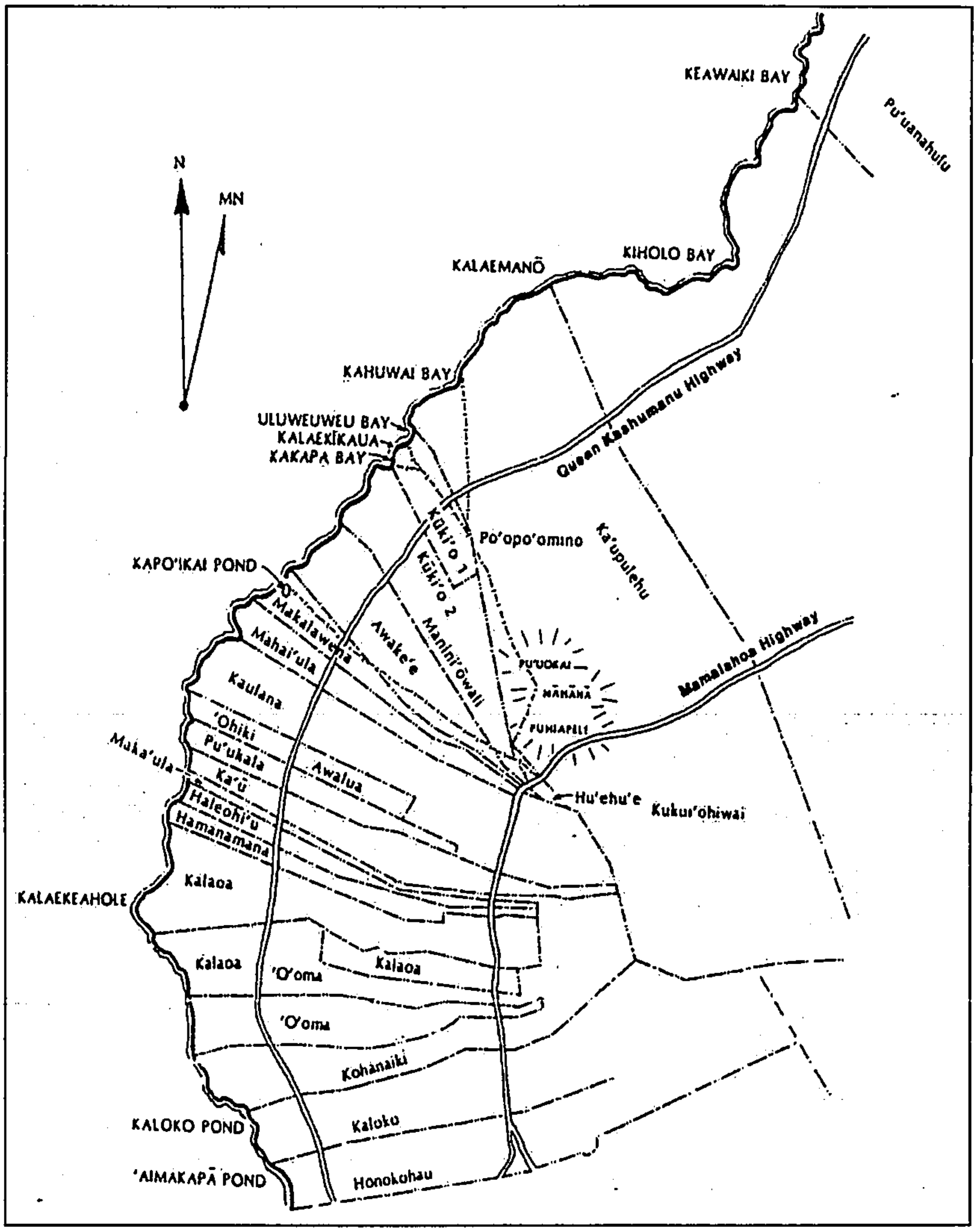


Figure 2. Kaū Ahupua`a in Kekaha Lands (from Springer In Donham 1986-Appendix B).

Geology.

The ahupua`a of Kaū from the 150 feet level upwards, lies primarily on lava flows (pahoehoe and aa) dating from as "recent" as 1500-3000 years before present to as late as 5-10,000 years ago. However, in the *makai* (seaward direction), outside and west of the project location and Queen Kaha`amanu Highway, lies part of the 1801 or Ka`ūpūlehu Lava Flow from Hualālai, a post-shield volcano that makes up the Kona lands.

Hualālai Volcano is the most dominant geologic feature in the *ahupua`a* of Kaū and North Kona in general. There are several websites (e.g., USGS, Hawaii Volcanology Center, NASA, University of North Dakota) that present information about the Hualālai Volcano and the Ka`ūpūlehu and Huehue Flows. A graphic (Figure 3.) by Ken Rubin for the *Hawaii Center for Volcanology* provides a visual interpretation of flows and elevations (HCV 2003). The following excerpts describe the volcano and its flows.

> Hualālai, Hawaii (19.7N, 155.8W); Elevation: 8,278 feet (2,523 m). Hualālai is the westernmost shield volcano on the Island of Hawaii. Three rifts radiate to the north, south, and northwest. The shield-building stage was completed by 120,000 years ago. About 105,000 years ago a trachyte cone, Puu Waawaa, formed on the north rift and generated flows that traveled about 6 miles (10 km). Post-shield volcanism began 100,000 years ago and covered the entire surface of the volcano. The most recent eruptions of Hualālai occurred in 1800-1801. Two large flows reached the ocean. The Kona airport is built on the 1801 flow. This view [not included here] of the volcano is to the southeast and shows the 1800-1801 lava flows. The long slope of the flank of Mauna Loa volcano is in the background (UND.2003).
>
> Though Hualālai is not nearly as active as Mauna Loa or Kilauea, our recent geologic mapping of the volcano shows that 80 percent of Hualālai 's surface has been covered by lava flows in the past 5,000 years. In the past few decades, when most of the resorts, homes, and commercial buildings were built on the flanks of Hualālai, earthquake activity beneath the volcano has been low. In 1929, however, an intense swarm of earthquakes lasting more than a month was most likely caused by magma rising to near the surface. For these reasons, Hualālai is considered a potentially dangerous volcano that is likely to erupt again in the next 100 years (Kauahikaua 1996).
>
> Twenty-five percent of the volcano is covered by flows less than 1,000 years old. Hualālai last erupted in 1800-1801 from several vents on the northwest rift zone. Large flows spilled down both sides of the ridge formed by the rift zone and quickly reached the ocean. One of these flows lies south of Kiholo Bay, and part of the Kona Village resort is built upon it. Another flow underlies the northern end of the Ke-āhole (Kona) Airport. Other major eruptions occurred about 300 and 700 years ago. A large flow from the 700-year-old eruption forms the north side of Keauhou Bay, south of Kailua. All of Hualālai is included in Zone 4. The flanks of the volcano do not have a distinctly lower hazard than its rift zones because the distance from the vents to the coast is short and the slopes are steep (Watson 1997).
>
> The Kaupulehu flow was the larger of two large lava flows -- the other is the Huehue flow (Jackson and Clague, 1982) -- that comprised the eruption of 1800-1801. Together, the flows cover an area of approximately 46 square miles, and have a total volume of 300,000,000 cubic meters. The Kaupulehu flow originated from the main vent at an elevation between 1,650 and 1,800 meters above sea level, and flowed north 16 kilometers to the sea. There have been no more recent flows, but Hualālai did spawn several thousand earthquakes on Hawaii in 1929. Some did damage in Kona and were felt in Honolulu (Macdonald, Abbott, and Pearson, 1983:60 In McGreevy 1994:1)
>
> The Kaupulehu flow is considered remarkable because it contains a huge abundance of fragments of dunite, a rock consisting mostly of the mineral olivine, and related rocks. At the field site, these inclusions "are almost unbelievably abundant." The individual fragments range from one to several tens of centimeters across, and have thin coatings of lava. In places at the site, aggregations of the rounded fragments "resemble a huge heap of potatoes; broken open and

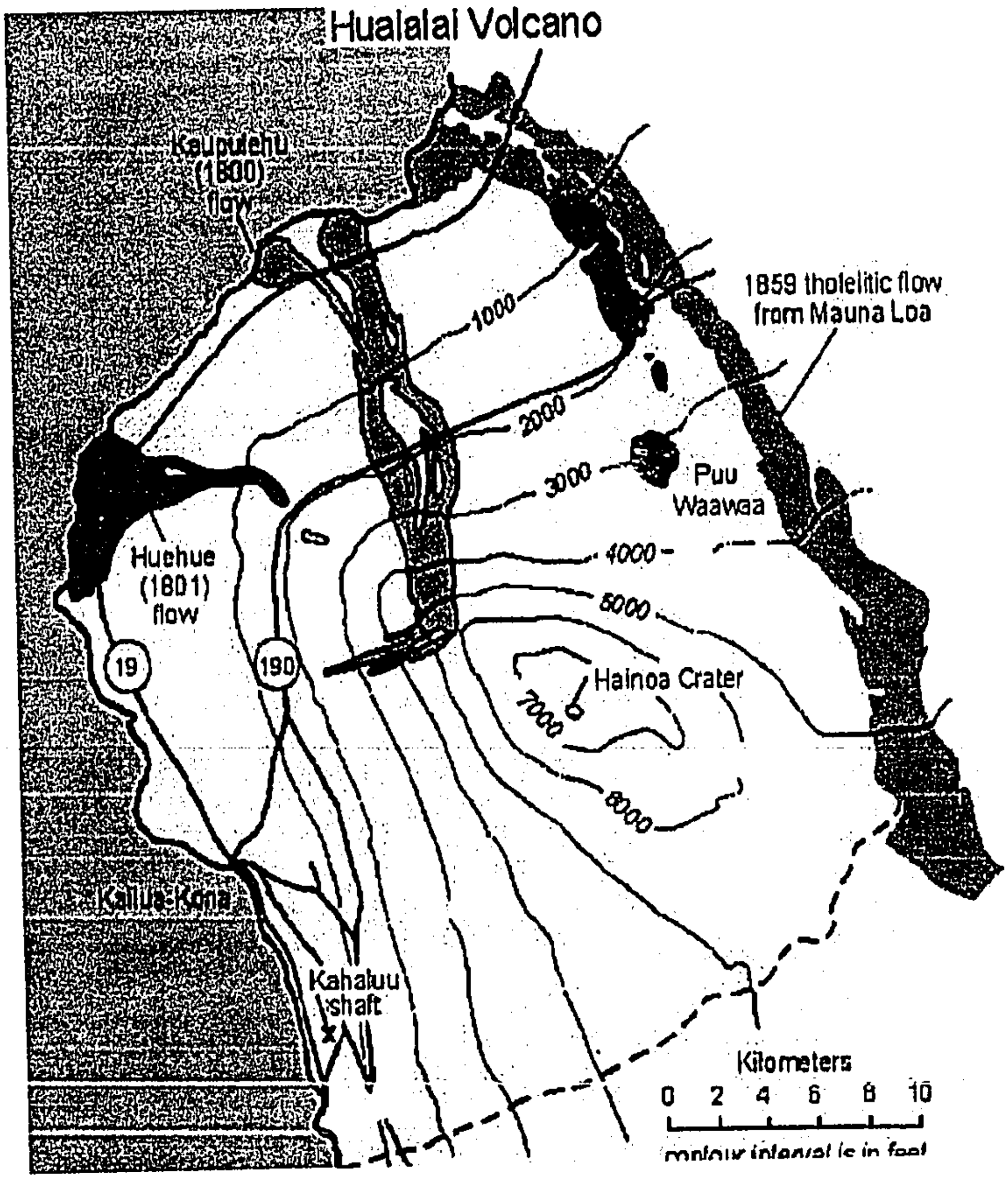


Figure 3. Hualalai Volcano Lava Flows-WEBgraphic by Ken Rubin (HCV 2003:2)

viewed at close range they look more like big bonbons, with a chocolate shell enclosing bright green or gray centers." Microscopic bubbles of carbon dioxide are contained in the inclusions. Their gas pressure is very high, indicating that the crystals containing them were formed at depths of 10 to 14 kilometers, near the upper part of the mantle or the lower part of the crust. (Macdonald, et al., 1983:131-132 In McGreevy 1994:1).

This [1801] eruption produced very fluid, high velocity lava flows that entered the ocean off western Hawaii. Overall, 5 vents issued alkalic basalt lavas, with 2 of these vents producing flows that reached the sea. The total volume of erupted lava has been estimated as >300 million m^3. This eruption brought abundant xenoliths (xeno = foreign; lith = rock) up from the mantle source that originally produced the lava. The highest elevation vent produced an enormous aa flow (the Kaupulehu flow) that entered the ocean as 2 discrete lobes. One of these lobes destroyed a Hawaiian village in its path. This eruption at Hualālai is believed to be concurrent with an eruption at neighboring Mauna Loa volcano.... Hualālai still presents a volcanic hazard as it is near populated areas. For instance, it's summit is only 15km away from the town of Kailua-Kona and a flow as voluminous as the [1800-1801] eruption could cover that distance in a few hours (HVC 2003).

The eruptive recurrence interval of Hualālai for all of Holocene time is on the order of 50 years (about 200 eruptions in 10,000 years). However, mapping and 14C dating studies have indicated that eruptions have occurred in clusters (groups of several eruptions over a few hundred years), separated by several centuries of inactivity (HVC 2003).

The Hawaiian Volcano Observatory (HVO) has maintained a seismic station located 3 km east of Hualālai 's summit since 1971, which is used to monitor the volcano for signs of activity. During this period, no microearthquake swarms or harmonic tremors (both indicative of magma migration) have been recorded, although each year Hualālai experiences several magnitude 4 earthquakes. These earthquakes are usually from a deep source off the coast of the Northwest rift zone (HVO unpublished data). This seismicity is apparently not related to movement of magma. However, in 1929 an intense swarm of earthquakes struck Hualālai for a period of a month, which has been interpreted as being due to a magma intrusion to near the surface, without a surface eruption (HVC 2003).

The most historically interesting lava flows from Hualālai, the Kaupulehu and Huehue flows, occurred a little over 200 years ago destroying entire Hawaiian villages and one of the largest traditional fishponds on the Kona coast. The following excerpts from websites describe these flows and observations written about them, including Robert Louis Stevenson, W.D. Westervelt and John Young.

Robert Louis Stevenson described the Kona lava fields in travel sketches published contemporaneously in the New York Sun during 1891, and later in collections of his works (Stevenson, 1973). His description is important here because it illustrates how the terrain is described by a non-scientist of acute sensibility. "We traversed a waste of shattered lava; spires, ravines; well-holes showing the entrance to vast subterranean vaults, in whose profundities our horses' hoofs doubtless echoed. The whole was clothed with stone florituri, fantastically fashioned, like debris from the workshop of some brutal sculptor; dogs' heads, devils, stone trees, and gargoyles broken in the making. From a distance, so intricate was the detail, the side of a hummock wore the appearance of some coarse and dingy sort of coral or a scorched growth of heather. Amid this jumbled wreck, naked itself and the evidence of old disaster, frequent plants found root..." (Stevenson, 1973 In McGreevy 1994:2).

The eruption of Hualālai Volcano in 1800-1801 was a fiery, frightening, and traumatic series of events (Westervelt, 1963). After eating Hue-hue, a breadfruit forest owned by the legendary King Kamehameha I, and the King's extensive fishponds, Pele, the fire goddess, was said to be still angry and hungry. Many hogs were thrown alive into the torrents of molten lava to appease Pele. The rivers of fire destroyed several villages, plantations and fishponds, and filled a deep bay twenty miles long. At last, the King, afraid for his life but resolute, offered a lock of his own hair,

> a part of himself, as a sacrifice to Pele, and she was appeased. At the time of the eruption, John Young... an advisor to the King, was living 30 kilometers to the north at Kawaihae. Though he kept no known written records, in 1823 he told Rev. William Ellis the approximate date of the eruption (Macdonald, et al., 1983 In McGreevy 1994:2-3).

The following excerpt of an article written by *Hawaii Volcano Observatory* (July 1997) and revises the information about the point-to-point extension of the Pa`aiea Fishpond and includes how much land mass was added to the North Kona coastline from the Hu`ehu`e Lava Flow.

> The largest fishpond was probably Pa`aiea located between Keahole Point (actually Ho`ona) and Mahai`ula (actually Kaelehuluhulu). It was said to have been three miles long and about one-half mile wide and consisted of relatively shallow water with many small islets within the pond. Some say that it was a *loko pu`u one*, or a fishpond bounded by a natural sand berm. The fishpond Pa`aiea was completely covered by the Hu`ehu`e flow from Hualālai in 1801. There are no pieces left untouched. Recent mapping of stranded beach and ocean entry deposits within the Hu`ehu`e flow shows that this flow extended the coastline out at least one mile and added nearly four square kilometers (nearly 1000 acres) to the island (USGS-HVO 1997b).

Kamakau, one of a handful of native Hawaiian historians in the 19th century, wrote extensively about the event of the 1800-1801 lava flow that destroyed the lands of Kekaha and Kamehameha's involvement (see Part III **Kaū and the Lands of Kekaha**).

The following are additional websites that have information about Hualālai Volcano, the Ka`upulehu and Hu`ehu`e Lava Flows, and the Pu`u Wa`awa`a trachyte dome:

http://www.geocities.com/oheposts/Feb02/2-24.html

http://www.soest.hawaii.edu/GG/HCV/hualalai.html

http://pubs.usgs.gov/gip/hazards/hualalai.html

http://www.hawaii-forest.com/essays/9704.html

http://www.geocities.com/oheposts/April01/4-11.html

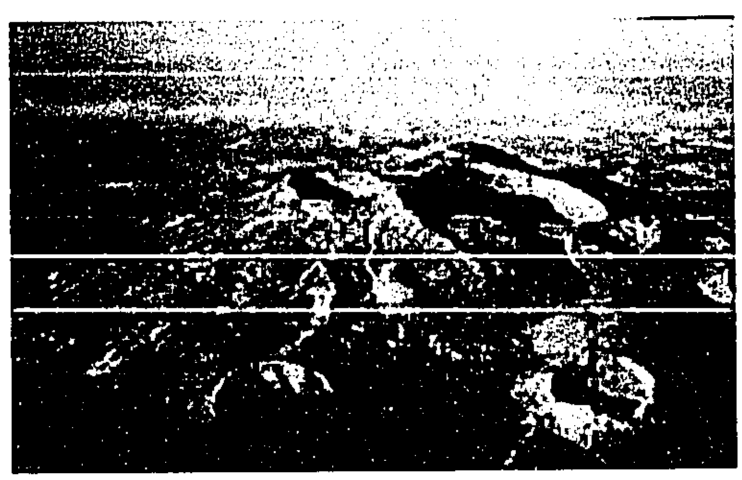


Photo 3. Hualalai Summit Craters. Photo by USGS (HFT 2003:1)

Flora.

For the last several decades the project area has been primarily a mixture of alien or exotic fountain grass (*Pennisetum setaceum*) used for free-ranging cattle, with a scattering of other exotic and native flora. However, towards the middle to upper sections of the project area, as the elevation changes, there is a profusion of endemic and indigenous species that have cultural significance. These flora appear to be clustered in bio-zones. However, an observation made by consultant Hannah Springer, is that while a certain specie may grow in one elevation level, it can also be found in other elevation levels with obvious changes in appearance [height, blooms, durability]. In a lower level the same plant may show signs of duress due to lack of water [shrubby or skimpy looking]; while in a higher elevation that gets more moisture, the same specie is more robust and grows much taller. A recent field trip (April 30, 2003) with a small group of kupuna consultants and archaeologists revealed a number of endemic and indigenous species in bloom, along with at least one Polynesian-introduced specie. This will be discussed elsewhere in this report.

These lands have gone through several modifications over time. In *Hawaii a Natural History*, Carlquist divides each island into six regions: Coast, Dry Forest, Wet Forest, Epiphytic Vegetation, Bog and Alpine. The coastal vegetation are plants that grow near the shore. Most of the native coastal plants consisted of shrubs and herbaceous vegetation such as *naupaka kai* (*Scaevola taccada*), *'ilima* (*Sida fallax*) and *Ipomoea* sp. (Carlquist 1980:269, 300). Within the 0-500' elevation the only native tree is the *hala* (*Pandanus spp*). Both pre-contact and post-contact humans have introduced other coastal vegetation in this zone (Carlquist 1980:267).

The Dry Forest Region [lower and upper] has suffered the most impact by man. This is the area the early Polynesians modified extensively in slash and burn cultivation to expand their subsistence level, intensifying food production with complex irrigated agricultural systems of various crops in some areas (Kirch 1985:217). Some of the Dry Forest vegetation that may have been affected by early Hawaiian cultivation practices are the *naio* (*Myoporum sandwincense*), *wiliwili* (*Erythrina sandwincensis*), *`ohe* (*Reynoldsia sandwincensis*), *'iliahi* (*Santalum sp*), *`ohi`a* (*Metrosideros sp*), *koa* (*Acacia koa*), as well as several species of shrubs [i.e., (*Sida cordifolia*), *`ulei* (*Osteomeles anthyllidifolia*)], vines and ground cover (Carlquist 1980: 275-300). These "typical" dry-land forest species however, can be found higher up-slope on leeward coasts (Carlquist 1980:285).

The distinction of a Hawaiian Wet Forest is that it gets more than 70 inches of rain per year, and its most predominant native plant is the multi-range *'ohi`a*. Other native species of this region are the *loulu* palm (*Pritchardia macdanielsii*), *uluhe* (*Dicranopteris*), *hapu* (*Cibotium*), *maile* (*Alyxia oliviformis*) and an abundant variety of fern, mosses, liverworts, fungi and lichens. The significance of the *'ohi`a* or wet forest is that it is the most bio-diverse region of the Islands. It is here that the greatest evolution and diversification of plants and animals take place, and it was a region relatively unoccupied at first [by early Hawaiians] on the Islands (Carlquist 1980:301, 306).

Epiphytes of the Hawaiian wet forests are limited to the many species of mosses, liverworts, lichens, ferns, about 50 species of Peperomia, and *'ie'ie* (*Freycinetia arborea*), a plant of early Hawaiian ethno-botanical significance that displays qualities of an epiphyte and a climber (Carlquist 1980: 333-5).

Bogs are usually found at higher elevations where rainfall exceeds the porosity level of the soil, and on old volcanic domes with steep slopes and natural damming. They usually consist of mud, very small pockets of standing water and tussocks of sedge (*Oreobolus sp*) or grass (*Panicum sp*). Plants that grow in the bog are usually dwarfed (Carlquist 1980: 351-355).

Pratt and Gon (In Juvik and Juvik 1998: 121-129) define five ecological zones in the Hawaiian terrestrial ecosystems, based on elevation, moisture (Dry, Mesic, Wet), dominant life forms and vegetation structures (Forest and woodlands, Shrublands, Dwarf shrublands, Grasslands, herblands and desserts): Alpine (>9,000 feet); Subalpine (6,000 – 9,000 feet); Montaine (3,000 – 6,000 feet); Lowland (0 – 3,000 feet); and Coastal (0 -100 feet) and Multizonal (with tidepools and anchialine ponds) now classified as *land transformed by human activity.*

Lowland Dry and Mesic Forest, Woodland, Shrubland & Dry Shrubland.

Distribution:	lower leeward slopes; on old lava flows
Climate:	20-80 inches, warm to hot, with seasonal drought
Biota:	Plains, lower slopes, dry ridge tops, and cliff support grasslands of *pili* (*Heteropogon contortus*) Dry or mesic shrublands of *`a`ali`i* (*Dodonaea viscosa*), *`ākia* (Wikstroemia *species), ko`oko`olau* (*Bidens* species), *`ūlei* (*Osteomeles anthyllidifolia*), *`ākoko* (*Chanaesyce* sp) Dry forests of *`ōhia* (*Metrosideros polymorpha*), *koa* (*Acacia koa*), *lama* (*Diospyros sandwicensis*), *wiliwili* (*Erythrina sandwicensis*) and *naio* (*Myoporum sandwicensis*) on older cinder and *pāhoehoe* substrates. Mesic forest of *`iliahi* (*Sanatalum freycinetianum*) [now nearly extinct], *`ōhia, koa* or *lama* and rarely *olopua* (*Nestegis sandwicensis*) or *halapepe* (*Pleomele* species) occur in gulches, and on lower slopes and less disturbed sites.
Threats:	Christmas–berry (*Schinus terebinthifolius*) and other alien plants. Much of the Dry Shrubland and Grassland were altered in ancient Hawaiian times. This zone is also threatened by ferral goats, mongoose, cattle grazing donkeys and development.
Significance:	Forested zone was the realm of Hawaiian gods, especially Kū and culturally significant. Sandalwood exploitation of the early 1800s occurred in lowland mesic forests. *Pili* grasslands, a source of thatch material; medicinal plants and hardwoods were gathered. Some mesic lands were converted to dryland *kalo* or taro (*Colocasia esculenta*) and *`uala* (*Ipomoea batatas*) agriculture. The Dry Shrubland and Grassland was ideal for burial and storage caves along the leeward coast of Hawai`i (Pratt & Gon In Juvik & Juvik 1998:121-129).

Coastal Communities (0-100 feet).

Biota:	Greatly influenced by proximity to the ocean with many salt-tolerant species. Dwarf shrublands of *naupaka-kahakai* (*Scaevola sericea*), *`ilima* (*Sida fallax*), *naio, hinahina* (*Heliotropium anomalum*), *`akulikuli* (*Sesuvium portulavastrum*), *`aki`aki* grass (*Sporobolus virginicus*) or sedge (*Fimbristylis cymosa*). Coastal forests of *hala* (*Pandanus* sp). Local consultants say they grew up with *hala* forests in the upper Lowland Dry and Mesic Forest zones of the project lands.
Significance:	Most populated zone in ancient times and continues to be culturally important.

The early Polynesians brought a wide range of cultigens, referred to as "canoe plants" or Polynesian-introduced species. A list compiled by Dr. Harold St. John is provided (Appendix D); only the *noni* (*Morinda* sp) was observed on the April 30, 2003 Kupuna Site Visit (more later).

Fauna.

Terrestrial fauna in pre-colonized Hawaii consisted of only one endemic mammal, the hoary bat (*Lasiurus cinereus*), thousands of endemic insects [i.e., damselflies (*Ischnura ramburii* and *Ischnura posita*) found around ponds and streams], and about 100 species of endemic birds (Berger, 1972:7, Kirch, 1985:28). The project area lies within the zone of the Lowland Dry and Mesic Forest, Woodland and Shrubland. Native birds once found there in ancient times were *`elepaio* (*Chasiempis sandwichensis*), *`apapane* (*Himatione sanguinea*) and *`amakihi* (*Hemignathus virens*). The *nēnē* (*Branta sandvicensis*) is slowly making a comeback. The Hawaiian hoary bat (*`ōpe`āpe`a, asiurus cinereus semotus*) favored this zone. Early Polynesian-introduced animals included the Southeast Asian pig (*Sus scrofa*), jungle fowl (*Gallus gallus*), dog (*Canidae*), and the Polynesian rat (*Rattus exulans*). Rats, alien birds and mongoose have replaced native species in this zone (Pratt & Gon In Juvik & Juvik 1998:121-129), as has some feral animals such as goats, pigs and donkeys in the case of the project area.

The project area is located a distance away from the Coastal zone. However, as once part of the self-sustainable *ahupua`a* system, the Coastal zone was very significant. This is where densely populated fishing villages thrived on the marine resources in the tidepools, anchialine ponds, near-shore and off shore areas. The Kaū Coastal zone was once part of a very large traditional *loko* or fishpond, traversing three miles (N/S) and one mile wide (E/W) from Kiholo to Ke-āhole *ahupua`a*. Local consultants and literature references relay that the fishpond once belonged to Kamehameha I, called *Pa'aiea* and extended from Kalaoa to Mahaiula (various TMKs) and now belongs to the State (NOAA 2001). USGS Hawaii Volcano Observatory website provided two articles (March and July1997) about the fishpond being covered with a flow other than the Ka`ūpūlehu Lava Flow.

> Eye-witness John Young, a western advisor to Kamehameha, reported that the eruption was very loud and sent lava crusts into the air (probably at the ocean entry). The ocean entry was so hot that it could not be approached in a canoe closer than 50 yards. The coastal waters were heated to the point that numerous fish were killed and canoes in the water were softened.
>
> The Hu`ehu`e flow was particularly devastating because it destroyed a very valuable fishpond named Pa`aiea that belonged to Kamehameha. Pa`aiea was reported to be 5 km (3 miles) long and 1 km (0.5 mile) wide. It is now completely covered by the flow. In addition, agricultural and habitation areas around the fishpond were inundated.
>
> A story is told about how Kamehameha stopped the flow with a lock of his hair thrown into a raging channel full of lava. We now know that the final phase of the Hu`ehu`e flow was a slowly emplaced pahoehoe that is very similar to the pahoehoe produced by Kilauea during the latest eruption. The earlier phases of the Hu`ehu`e were emplaced through large, wide channels. Kamehameha may have committed his sacrifice to stop the earlier, channelized pahoehoe (USGS-HVO 3/1997).
>
> The North Kona Coast of the Big Island is fortunate to have several Hawaiian fishponds preserved. These ponds were major construction feats by which Hawaiians cultivated fish. Good examples are `Aimakapa and Kaloko in the Kaloko-Honokohau National [Historical] Park, Ku`uali`i and Kahapapa in front of the Royal Waikoloan Hotel, and several others on the grounds of the Orchid at Mauna Lani. It is not generally known that there were two larger fishponds in the same Kona coast area that were refurbished and maintained by Kamehameha before each of them was destroyed by lava flows (HVO 7/1997).
>
> The largest fishpond was probably Pa`aiea located between Keahole Point (actually Ho`ona) and Mahai`ula (actually Kaelehuluhulu). It was said to have been three miles long and about one-half mile wide and consisted of relatively shallow water with many small islets within the pond. Some say that it was a loko pu`u one, or a fishpond bounded by a natural sand berm. The fishpond Pa`aiea was completely covered by the Hu`ehu`e flow from Hualalai in 1801. There are no pieces left untouched. Recent mapping of stranded beach and ocean entry deposits within the Hu`ehu`e

flow shows that this flow extended the coastline out at least one mile and added nearly four square kilometers (nearly 1000 acres) to the island.

The first phase of the eruption moved fairly rapidly and built several large pahoehoe channels and tubes to transport the lava from the vent to the ocean. The last phase was much slower and was very much like pahoehoe formed by the current eruption of Kilauea. The pahoehoe of the last phase also moved through a tube. Kamehameha is said to have offered a lock of his hair to stop the eruption from destroying more property.

After the destruction of Kamehameha's favorite fishpond, Pa`aiea, he ordered another fishpond to be rebuilt as a replacement. That pond was named Wainanali`i and was located on the north side of Kiholo Bay. Laborers from at least three districts worked several tens of thousands of hours to complete this effort by about 1812. Wainanali`i was said to have been a deep-water pond capable of keeping ahi and aku within stone walls said to be not less than two mile in circumference. As with Pa`aiea, this pond was destroyed by lava from Mauna Loa in 1859. Only a portion of one wall is said to remain along with pieces of a shore platform.

This particular eruption of Mauna Loa also occurred in two phases - the first was a very rapid `a`a flow that traveled 50 km (31 miles) in 8 days. The last phase was a much slower pahoehoe flow that fed lava into the ocean for approximately five months (HVO 7/1997).

However a passage in Kamakau (1992:56) appears to make the fishpond more ancient than from just Kamehameha's time. When Maui high chief Kama-lala-walu sent spies to Hawai`i Island (ca AD 1580) to reconnoiter prior to his impeding invasion, a spy was questioned after briefly scouting the near-by lands and asked to describe the places he visited. The following appears to include a description of the fishpond named for Kamehameha, Pa`aiea:

> I went visiting from here (Kawaihae) to the lava bed and the pond that lies along the length of the land." "Kaniku is the lava bed and Kiholo, the pond." "Then did you turn back?" No, I went on the long stretch of sand, to the small bay with a point on that side and one on this side. There are large inland ponds," "The sandy stretch is `Ohiki, and the wall-in ponds are Kaloko and Honokohau."

A 2003 research project mentioned by KECK is using Geophysical Magnetic Surveying Methods to try to locate the buried Pa`aiea Fishpond wall (James 2003).

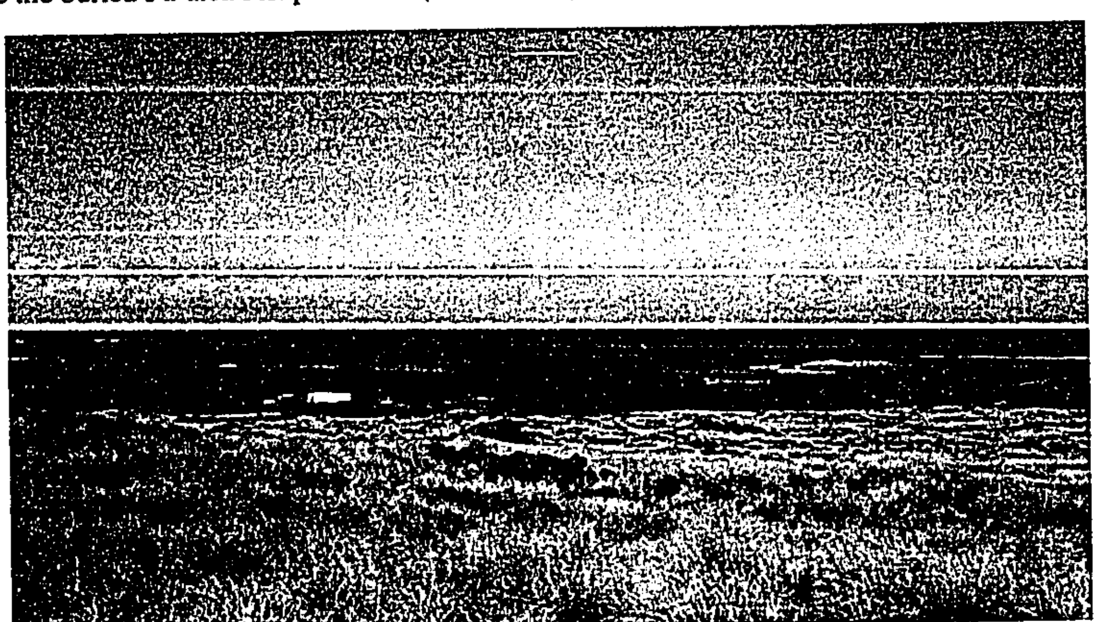


Photo 4. Lava Flow of 1801 covered *makai* Kaū and Pa`aiea Fishpond.

PART II: METHODS

The Cultural Impact Assessment/Study for Kaū Ahupua`a was conducted between the months of March through June 2003, with one site field trip in September 2002, and one in April 2003. The study consisted of three phases: (1) cultural and historical archival research (literature review); (2) ethnographic survey (oral history interviews), transcribing interviews, analysis of ethnographic data; and (3) report writing.

Personnel. The personnel consisted of the researcher who has a masters degree in Anthropology, with a graduate curriculum background in the archaeology track as well as anthropology theory, cultural resource management, ethnographic research methods, and public archaeology; an undergraduate curriculum background that included Hawaiian History, Hawaiian Language, Hawaiian Archaeology, Pacific Islands Religion, Pacific Islands Archaeology, Cultural Anthropology, as well as a core archaeology track, Geology, and Tropical Plant Botany; and ethnographic field experience that includes over 140 interviews to date.

Level of Effort. This study is being conducted at a moderate *level of effort* [5-10 oral histories; broad background review of North Kona] due to a preliminary assessment that the Hu`ehu`e Ranch historically utilized the project lands where they free-roamed their cattle. A cursory site inspection also indicated that probable prehistoric sites were vandalized, and may be on going as screening equipment was found at one site.

Theoretical Approach. This study is loosely based on *Grounded Theory,* a qualitative research approach in which "raw data" [transcripts and literature] are analyzed for concepts, categories and propositions. Conceptual labels or codes are generated by topic indicators [i.e., fishing, agriculture, flora, ranching]. Categories are generated in a similar manner by forming groupings such as "Land Resource & Use," or "Water Resource & Use," or "Traditional History." Since this was a semi-focussed study, categories were pre-selected as part of the overall research design. However, it is not always the case that these research categories are supported in the data. In the *Grounded Theory* approach, theories about the social process are developed from the data analysis and interpretation process (Haig 1995; Pandit 1996). This step was not part of this cultural impact assessment as the research sample was too small.

Archival Research. Archival research included a broad background literature review. Compiling data took several weeks of intermittent archival research. The majority of the archival research [primary and secondary sources] took place in the State Historic Preservation Division library, State Bureau of Conveyance, University of Hawaii Hamilton Library-Hawaiian Collections, Bishop Museum Archives and Library, the researcher's private library and a broad InterNet search. Primary source material included land records, maps, genealogies, oral histories and other studies. Secondary source material included translations of 19th century ethnographic works, historical texts, indexes, archaeological reports, and Hawaiian language resources [i.e., proverbs, place names and dictionary].

Consultant Selection. The selection of the consultants was based on the following criteria:

- Had/has Ties to Project Location(s)
- Referred By Office of Hawaiian Affairs (OHA)
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People

Interview Process. The interview process included a brief verbal overview of the study. Then the consultant was provided with a consent or agreement to participate form to review, which was drafted for the edification and protection of each consultant (Appendix E). An ethnographic research instrument (Appendix F) was designed to facilitate the interview; a semi-structured and open-ended method of questioning based on the person's response ('talk-story' style). Each interview was conducted at the convenience (date, place and time) of each consultant. A *makana* or gift was given to each consultant in keeping with a traditional reciprocal protocol.

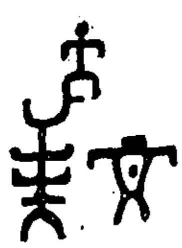
Ethnographic Interview Procedures. Three interviews were conducted after a site field trip, using a Vox Optimus cassette tape recorder. Two were conducted at Koloko Beach Park at the suggestion of one of the consultants. One interview was conducted at the office of the consultant at her request. Two more will be conducted at a later, more convenient time for the consultants. Notes were also taken, but more attention was given to listening intently to each consultant.

Transcribing Process. The taped interviews were transcribed verbatim by the principal investigator using a Sony Dictator/Transcriber (BM-87DST). Each consultant was sent a *mahalo* letter that explained the transcript review process, along with two hard copies of the interview transcripts, two *Release of Information* forms, and a self-addressed, stamped envelope for return of one signed release form and one copy of the edited transcripts. This process allows for corrections (i.e., spelling of names, places), as well as a chance to delete any part of the information if so desired or to make any stipulations if desired.

Analysis Process. The analysis process followed a more traditional method, as a qualitative analysis software program was not necessary. The interview was manually coded for research thematic indicators or categories (i.e., personal information; land and water resources and uses; site information-traditional and/or historical; and anecdotal stories). For the purpose of this study, it was also not necessary to go beyond the first level of content and thematic analysis, as this was a more focussed study. However, sub-themes or sub-categories were developed from the content or threads of each interview [i.e., irrigation system, ranching, and agriculture].

Research Problems. A typical constraint for most studies is not enough time for archival research as there is a lot of material to review. However, several unforeseen circumstances prevented some interviews from taking place.

- Not all of the potential consultants were available in the same period of time (same week).
- One potential consultant could not commit to any time; said to call when I got into town and if available would do it.
- Three potential consultants felt they really had nothing substantial to offer; one did it anyway.
- Three potential consultants could only be reached through an intermediary, who started a full-time job and couldn't be reached in a timely manner.
- As is proper, potential consultants are given the choice by the person referring them, to allow contact to be made, however, often nothing happens and it's too uncomfortable to pester the person making the referral. As is also proper and expected; the *kupuna* are protected or sheltered by the *makua*....
- One consultant, just before the Draft was to be turned in, decided not to release any information.



PART III: CULTURAL & HISTORICAL BACKGROUND REVIEW

The Cultural and Historical Background Review entailed a search of primary and secondary source literature. The majority of this research took place in the State Historic Preservation Division library, State Bureau of Conveyance, University of Hawaii (Manoa Campus) Hamilton Library Hawaiian Collections, Bishop Museum Archives and Library, the researcher's private library, and the InterNet. Primary source material included Land Court records, maps, visitor journals, genealogies, oral histories and other studies. Secondary source material included translations of 19th century ethnographic works, historical texts, indexes, archaeological reports, and Hawaiian language resources (i.e., proverbs, place names and Hawaiian language dictionary). A review of the archival material is presented in this section as an overview of the chronology of the *moku* (district) of North Kona, within the context of the broader history of the *moku `āina* (island) of Hawai`i and Greater Hawaii, along with specific review of traditional and historic literature as they pertain to Kaū Ahupua`a and the Kekaha district.

A. Models of Hawaiian Chronology.

Models of Hawaiian Chronology such as Cordy (1974/1996), Hommon (1976/1986) or Kirch (1985) provide a temporal view of settlement patterns as well as cultural changes through time, from initial settlement through first contact with the western world. Cordy's (1974) first model of a cultural development sequence looked at Initial Settlement Period, New Adaptation Period and a Complex Chiefdom Period. He has since modified this model (1996). Hommon's (1976) model of sociopolitical development sequence included four phases: Phase I AD 500-1400; Phase II AD 1400-1550; Phase III AD 1550-1650; and Phase IV AD 1650-1778. This model was later modified (1986) to three phases: Phase I AD 400-1400 Exploration and Settlement; Phase II AD 1400-1600 Expansion; and Phase III AD 1600-1778 Consolidation. Kirch (1985) believed that initial settlement occurred much earlier than AD 600. His culture-historical sequence model has four phases: Phase I Colonization Period (AD 300-600); Phase II Developmental Period (AD 600-1100); Phase III Expansion Period (AD 1100-1650); and Phase IV Proto-Historic Period (AD 1650-1795) (Kirch, 1985:296-308; Kolb, 1991:205).

It should be noted that a study (Tuggle & Spriggs 2001) refutes the 'early colonization' dates supposition. For decades, the consensus among Hawaiian archaeologists was that evidence from Bellows and Ka`u supported early Polynesian colonization dates of AD 300 to AD 600 (Tuggle 1997; Kirch 1985). However, Tuggle and Spriggs (2001) have since studied new data and re-evaluated past dates and dating methods and have concluded that acceptable early dates fall within AD 700-1100. These dates appear to coincide with data that eastern Polynesia was settled much later than previously thought (Rolett 1989).

While Kirch's chronology model may need to be revised, his basic period system is still a valid model. Therefore for this cultural impact study, Kirch's (1985) model will be used with the following modifications and additions: the dates for the Colonization and Development periods will not be used; Early Historic Period (AD 1795-1899), Territorial History (AD 1900–1949), and Modern Historic Period (post AD 1950) will be added. The reasoning behind using Kirch's model is the belief of many native Hawaiian people that based on oral histories or legends, the migrations of their Polynesian ancestors to Hawai`i took place prior to AD 700. According to Fornander (1917:IV: II: 406), there are seventy-five generations from Wakea to Kamehameha I who was born around AD 1753. If just eighteen years were allotted to each generation (typically a generation is twenty years) that would make the time of Hawaiian progenitors Wakea and Papa Haumea (who settled in Nu`uanu, Oahu) approximately AD 403. [McKenzie (1983:12) gives thirty years per generation, which would make first migration even earlier.]

The following overview highlights significant events and people and encapsulates cultural changes over time. More corroborating details follow this overview section with traditional *mo`olelo* and *mele*, and a review of historical works and various studies.

An Overview of Human Impact, Settlement and Socio-economic Development in North Kona in the context of Greater Hawaii

B-1. Colonization Period. First voyager dating is scanty at best, however, based on early site dates from Bellows, Oahu and South Point, Hawaii, Kirch (1985) estimated that the Colonization Period of the Hawaiian Islands was somewhere between AD 300-600. These first Polynesian voyagers to Hawaii "followed the tracks of migratory birds. Mainly they traveled by the stars.... On a voyage of migration, from sixty to a hundred persons could exist for weeks on a large canoe, which might be a hundred feet in length" (Day 1992:3). This feat was "remarkable in that it was done in canoes carved with tools of stone, bone, and coral; lashed with handmade fiber; and navigated without instruments" (Teruia 1995:vii).

Reconstructing the cultural sequence for the North Kona district and other places in Hawai'i during the colonization period would involve the 'founder effect' and time necessary to adjust and adapt to a new environment. The colonizers were not able to bring all of the gene pool or cultigens from their homeland, so their new culture consisted of what survived the journey, what was remembered and what could be applied to the new environment (Kirch 1985:285-6). Although early Hawaiians were farmers and felt spiritually tied to the *'āina* (land) in many ways (Waters, n.d.), when they first arrived they had to modify both their subsistence practices and the land. Faunal remains analyses indicate that early Hawaiian subsistence depended on fishing, gathering, bird hunting (extinct fossil remains, see Olson and James, 1982), as it took time to clear the dryland forests, plant their crop cultigens, breed their animals, and construct suitable living quarters. Creation chants such as the *Kumulipo* depict a very deep philosophical bond with the land and nature and "the respectable person was bound affectionately to the land by which he was sustained" (Charlot 1983: 45,55). Ancient sites of various *ko'a* (fishing and bird shrines) also imply a spiritual respect for their sustenance.

As the founding groups grew, they fissioned into subgroups anthropologists refer to as *ramages*, with the senior male of the original ramage as chief of the conical clan, although hierarchical ranking was not just relegated through the patrilineal line of descent (Kirch 1985:31). Bellwood refers to these groups as tribal and related by blood (Bellwood 1978:31). In *Ka Po'e Kahiko* Kamakau refers to Hawaiian ranking in the following passage:

> For 28 generations from Hulihonua to Wakea, no man was made chief over another, and during the 25 generations from Wakea to Kapawa, various noted deeds are mentioned...Kapawa was the first chief to be set up as a ruling chief...from then on the group of Hawaiian Islands became established as chief-ruled kingdoms - Maui from the time of Heleipawa, son of Kapawa...this was the time that records (oral) began to be kept of the chiefs (Kamakau 1964:3)

B-2. Developmental Period. According to Fornander (1969) certain practices were universal Polynesian customs which the Hawaiians brought from their homeland; such as the major gods *Kane, Ku* and *Lono*; the *kapu* system of law and order; *pu'uhonua* (place of refuge); *'aumakua* (ancestral guardian) concept; and the concept of *mana* (supernatural or divine power) (Fornander 1969:61, 113,118,127-8). However, during the Developmental Period, changes occurred bringing about a uniquely Hawaiian culture, documented by the material culture found in archaeological sites. The adze (*ko'i*) evolved from the typical Polynesian variations of plano-convex, trapezoidal and reverse-triangular cross section to a very standard Hawaiian quadrangular-tanged adze. A few areas in Hawaii produced quality basalt for adz production. Mauna Kea on the island of Hawaii was a well-known adze quarry. The two-piece fish hook and the octopus lure breadloaf sinker are Hawaiian inventions of this period, as are the *'ulu maika* stones and the *lei niho palaoa.* The later was a status item worn by those of high rank, indicating a trend toward greater stratification (Kirch 1985:184,204,306). The evidence also indicates that the "ancestral pattern of corporate descent groups" were still in place (Kirch 1985:302-3). The early culture evolved as the population grew, and many of the changes were related to significant socio-economic changes.

B-3. Expansion Period. The Expansion Period, AD1100-1650, is significant in that most of the "ecologically favorable zones," the windward and coastal areas of all major islands, were now settled, and the more marginal leeward areas were being developed. This was also the period of high population growth, the development of large irrigation field system projects, and dryland farming (Bellwood 1978:98; Kirch 1985:298,303-4). Early dates AD 1300-1650 from Kaū Ahupua`a (Williams et al., 2001) support this very well as several types of shelters (lava tubes, C-, L-, and U-shaped enclosures, and over-hangs) were being modified, constructed and used. The coastal areas all along the Kehaka lands had an abundance of marine resources and several lava tubes in the *mauka* landswere modified and used as water collection resources (Williams et al., 2001:20, 37-40, 66-83).

It was during the early part of this period that a second major migration settled in Hawaii, this time from Samoa and/or Tahiti in the Society Islands (Fornander 1969:33-35). It was also during this leeward expansion movement that voyaging canoes from the Southern islands brought Mo`ikeha (Oahu), La`maikahiki (Kauai), Pilika`aiea or Pili (Hawai`i) and *kahuna* Pa`ao who settled in the islands during the 13th century (Kamakau 1976:125). Pa`ao was the keeper of the god Ku`ka`ilimoku who had fought bitterly with his older brother, the high priest Lonopele. After much tragedy on both sides, Pa`ao escaped Lonopele's wrath by fleeing in a canoe from Kahiki. Kamakau (1991) told the following story in 1866:

> Puna on Hawai`i Island was the first land reached by Pa`ao, and here in Puna he built his first *heiau* for his god Aha`ula and named it Aha`ula [Waha`ula]. It was a *luakini*. From Puna, Pa`ao went on to land in Kohala, at Pu`uepa. He built a *heiau* there called Mo`okini, a *luakini*. It is thought that Pa`ao came to Hawaii in the time of the *ali`i* La`au because Pili ruled as *mo`i* after La`au. You will see Pili there in the line of succession, the *mo`o kū`auhau*, of Hanala`anui. It was said that Hawaii Island was without a chief, and so a chief was brought from Kahiki; this is according to chiefly genealogies. Hawai`i island had been without a chief for a long time, and the chiefs of Hawai`i were *ali`i maka`āinana* or just commoners (Kamakau 1991:100). There were seventeen generations during which Hawai`i island was without chiefs--some eight hundred years (Kamakau 1991:101, 102).

There are several versions of this story which are discussed by Beckwith (1976), including the version where Mo`okini and Kaluawilinau, two of Moikeha's men decide to stay on at Kohala (Beckwith 1976:352, 353, 370-373). Pa'ao brought with him the Ku practice of human sacrifice, used in monumental *luakini heiau* or war temples. Pili started a line of *ali'inui* that would continue to the Kamehameha "dynasty." The evolution of the *luakini heiau* is difficult to place archaeologically, and although the arrival of Pa'ao may have been a real event, the uniqueness and complexity of *heiau* were most likely a local (Hawaiian) development (Kolb 1989:3). The bones of *kahuna* Pa`ao are said to be deposited in a burial cave in Kohala in Pu`uwepa [possibly Puuepa] (Kamakau 1987:41).

The uniquely Hawaiian invention, the *loko* or fishpond aquaculture, was developed in the fifteenth century or the later half of this period (Kirch 1985: 303). Both the *mo`olelo* or stories, archaeological evidence verify that the Kekaha lands had an abundance of fishponds. There are also several *mo`olelo* about significant personalities from this expansion time period; from Pa`ao to Liloa and Umi. During the last 200 years of the Expansion Period, the concept of *ahupua'a* was established, as well as class stratification, territorial groupings, powerful chiefs and *"mo'i"* or king (Kirch 1985:303-6). This land unit became the equivalent of a local community, with its own social, economic and political significance. Ahupua'a were ruled by *ali'a 'ai ahupua'a* or lesser chiefs, who for the most part, had complete autonomy over this generally economically self-supporting piece of land, which was managed by a *konohiki*. Ahupua`a were usually wedge or pie-shaped, incorporating all of the eco-zones from mountain to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1976:15,16).

The *ali'i* and the *maka'ainana* (commoners) were not confined to the boundaries of the ahupua`a. Not only did the *makai* (ocean direction) and *mauka* (mountain direction) people share seafood and produce by lighting a fire when there was a need, they also shared with their neighbor *ahupua'a ohana* (Hono-ko-hou 1974:14,15). The ahupua'a was further divided into smaller sections such as the *'ili, mo'o'aina, pauku'aina, kihapai, koele, hakuone* and *kuakua* (Hommon 1976:15; Pogue 1978:10). The chiefs of these land units gave their allegiance to a territorial chief or *mo'i* (king). *Heiau* building flourished during this period as religion became more complex and embedded in a socio-political climate of territorial competition. Monumental architecture such as heiau, "played a key role as visual markers of chiefly dominance" (Kirch 1990:206).

It was during this time, during the reign of `Umi-a-Līloa that the island of Hawaii was divided into six *moku* or districts (Fornander 1973 v II: 100-102). The district of Kona is sub-divided into *`okana* or *kalana* (regions) North and South Kona and extends from Keahualono (Kona/Kohala boundary) to Manukā (Kona/Ka`u boundary). Kekaha or *Kekaha-wai-`ole o nā Kona* (Waterless Kekaha of the Kona district) extends from Keahualono, Kanikū to the hill of Pu`uokaloa, Keahuolu (Maly 1998:4-5).

Mo`olelo* about events that took place in the early to mid 1600s were revealing in that they illustrate that many of the battles of this period were relatively quickly contained by the opposing *ali`i [see *History of Kualii* (Kualii ca. 1630-1660s) in Fornander 1917:IV: II: 364-434]. These stories also illustrate the on-going inter-relationships between the people of the various islands. In the *History of Kualii*, the exploits of Kualii (great-great grandson of Kahuihewa, *ali`inui* of Oahu) take him to every island and he eventually unites all the islands "from Hawaii to Niihau" (Fornander 1917:IV: II: 406).

B-4. Proto-Historic Period. The Proto-Historic Period, A. D. 1650-1795, appears to be marked with both intensification and stress. Many wars took place during this time between intra-island chiefdoms and inter-island kingdoms. There is evidence of refuge caves in the *ahupua`a* of Kaū (Williams et al., 2001; Williams & Nees 1993) as well as nearby *ahupua`a* (Hammatt and Folk 1980) that appear to support this need.

During the early part of this period Maui *ali`inui* Kama-lala-walu ignored the advice of his counsel and sent his half-brother Ka-uhi-o-ka-lani (both sons of Kiha-a-Pi`ilani) to spy on Hawai`i island, to see how large the population was. They landed in Kawaihae.

> Ka-uhi-o-ka-lani ran about that same evening and returned before the canoes were dismantled and placed in the house. The keepers of the gods at Mailekini were servants of Kama, and so they concealed the canoes of the spies. When Ka-uhi-o-ka-lani returned his fellow spies and hosts asked, where did you go?" "I went visiting from here to the lava bed and Kiholo, the pond. Then did you turn back?" "No, I went on to the long stretch of sand, to the small bay with a point on that side and one on this side. There are large inland ponds." "The sandy stretch is `Ohiki, and this walled-in ponds are Kaloko and Honokohau. Then you came back?" No, I went on..." (Kamakau 1992:56).

The next morning the spies began a circuit of Hawaii, then they returned to Maui and reported to Kama-lala-walu the following:

> 'We went all around Hawaii. There were many houses, but few men. We went to Kohala and found the men only on the shores....' The spies had seen the land of Kohala but had failed to see the people for on all of the fields where sports were held from inner Kohala to outer Kohala, from Kohala of the coastal cliffs to Kohala of the inland, a crowd of people gathered every day from morning to night to play. Kohala was known as a thickly-populated land. The spies thought that if Kohala was conquered, Kona, Ka`u and Puna would be easily taken, and they felt that Hilo and Hamakua would lend no assistance. This was true, for the chiefs of these districts were cousins of the chiefs of Maui (Kamakau 1992:56-57).

While most of the prophets and seers supported Kama-lala-walu's war on his cousins of Hawaii Island, children of his father's sister Pi`ikea and `Umi-a-Liloa. Some warned that if he did go, he would die and not return to Maui alive. They landed at Kohala and began the destruction of the people of Kohala.

Kanaloa-kua`ana, son of Keawe-nui-a`Umi was captured and treated cruelly. "His whole skin was tattooed, his eyelids turned inside out and tattooed." He was renamed Ka-maka-hiwa.

> From Kohala, Kama-lala-walu set forth for Kawaihae, and found no one there. The people had gone up to Waimea, for all observed the services at the heiau of Mailekini. Only those of lower Kawaihae and Puako remained. The battlefield was at Waimea. Kama-lala-walu's counselors said, "Waimea is not a battle site for strangers because the plain is long, and there is no water.... It is better to go to Kona..." (Kamakau 1992:58).

Kama-lala-walu did not take heed and listened instead to two old men of Kawaihae who gave him false information and suggested that he cut up his canoes before heading up to Waimea so that Maui warriors would not be tempted to retreat to Maui. Then they headed for the plains of Waimea. When they got there they looked back towards the sea and saw the men of Kona advancing toward them.

> The lava bed of Kaniku and all the land up to Hu`ehu`e was covered with men from Kona. Those of Ka`u and Puna were coming down from Mauna Kea, and those of Waimea and Kohala were on the level plain of Waimea. The men covered the whole of the grassy plain of Waimea like locusts (Kamakau 1992:58).

The battle of Pu`u`oa`oaka commenced just outside these plains. The light-weighted lava rocks here contributed to the defeat of the Maui warriors who were used to heavier water-worn rocks. The Maui warriors retreated; some to Kawaihae, others to Kohala. And because of the lack of canoes, very few escaped alive. Ka-uhi-a-Kama, son of Kama-lala-walu who was killed on the plain of Puako, escaped to Kekaha, found a canoe and fled to Maui. He was saved by Hinau, the foster son of Lono-i-ka-makahiki. Many of the chiefs of Kona were relatives of Ka-uhi-a-Kama through his mother Kapu-kini-akua (Kamakau 1992:59-60

After the death of Hawai`i Island *ali`inui* Lono-i-ka-makahiki, his children did not succeed him. Instead Hawai`i Island was divided into smaller divisions. The descendants of Kanaloa-kua`ana [Keawe, Ke`eaumoku, Kalani`opu`u and Keoua] later ruled Kohala, Kona and Ka`u. The descendants of Keawe-nui-a-`Umi ruled Hilo and Hamakua. This was not a peaceful period. The chiefs of Kona and Hilo fought each other for the various resources each area had [Hilo's bird feathers, war canoes, fine tapa; Kona's food, drinking water and fish]. These wars lasted for several decades with the Hilo chiefs usually defeating the Kona-Kohala chiefs, especially during the reigns of Kua`ana, Kuahu`ia, Ka-lani-ku-kau-la`ala`a and Moku. Ke-aka-mahana (w) was the ruler of Kona during the wars with Hilo. "The rulers of Kona who succeeded Ke-aka-mahana were her daughter Keakea-lani and her son, Keawe [Ke-awe-i-kekahi-ali`i-o-ka-moku]." "Keakea-lani was the ruler of Kona and Kohala. The Mahi clan were the war leaders, that is they were in charge." "But the chiefs of Hilo were always victorious over those of Kona...after they won the battle of Hu`ehu`e the secret places and burial caves in Kona were broken open..." In the battle of Mahiki, Ka-lani-ku-kau-la`ala`a and Moku were the chief war leaders of Hilo. After Moku the Hilo chiefs ceased to reign (Kamakau 1992:61-63).

It was during the later part of the Proto-Historic period that the *Royal Kolowalu Statute* or Kualii's Law was enforced. Kualii Kuniaakea Kuikealaikauaokalani lived for an extremely long time, was said to sometimes have supernatural powers, and was the first to "unite" all the islands. This *ali`inui* of Oahu died at Kailua in Ko`olaupoko in AD 1730, supposedly at the age of one hundred and seventy five.

> It (Kualii's Law) was strict, unvarying and always just. It was for the care and preservation of life; it was for the aged men and women to lie down in the road with safety; it was to help the husbandmen and the fishermen; to entertain (morally) strangers, and feed the hungry with food. If a man says, "I am hungry for food," feed (him) with food, lest he hungers and claims his rights by swearing the *kolowalu* law by his mouth, whereby that food becomes free, so that the owner thereof cannot withhold it; it is forfeited by law. It is better to compensate.... A transgressor, or one who is about to die, is, under the application of this law exonerated of his death or other penalty...(Fornander 1917:IV: II: 432).

However, this law did not prevent the continuing battles between families, factions and district chiefs. Kohala's Ka-lani-kau-lele-ia-iwi was the mother of Alapa`i-nui-a-Ka-uaua, who went to live on Maui with his half sister, Ke-ku`i-apo-iwa-nui (wife of Ke-kau-like, Maui *ali`inui*) after his father's (Ka-uaua-nui-a-Mahi) death at the hands of the Hilo chiefs in the battle of Mahiki. When Alapa`i heard of (his uncle) Keawe's death and the unrest between the district chiefs, he went back to Hawai`i Island with plans to make war on all the chiefs. He captured the chiefs of Kohala and Kona, and became ruler of those districts. However, when his brother-in-law Ke-kau-like heard about Alapa`i's victory, Ke-kau-like made war on Alapa`i in order to return Kohala and Kona to their chiefs. He wasn't successful, however, Ke-kau-like's warriors prevented Alapa`i from conquering the Hilo and Ka`u chiefs (Kamakau 1992:64-65). During these battles a lot of damage was done on the landscape including Kekaha.

> The fighting began with Alapa`i at Kona. Both sides threw all their forces into the fight. Ke-kau-like cut down the trees throughout the land of Kona. Obliged to flee by canoe before Alapa`i, he [Ke-kau-like] abused the country people of Kekaha. At Kawaihae he cut down all the coconut trees. He slaughtered the country people of Kohala, seized their possessions and returned to Maui (Kamakau 1992:66).

In retribution, Alapa`i decided to carry the battle to Maui. While Alapa`i and his warriors were encamped in Kohala, Kamehameha was born to Ke-ku`i-apo-iwa (II) in Kapakai (`I`i, John Papa 1983:3), in the *ahupua`a* of Kokoiki, in the *moku* of North Kohala [Kamakau (1992:67) says it was AD 1736; however others say it was between AD 1753 and 1758 with more leaning towards AD 1753 [Cahill 1999:56-57)] near the Mo`okini *heiau*. He was quickly taken by Kohala chief Nae-`ole and hidden in Halawa (Kamakau 1992:67-69), his ancestral homeland (Williams 1919:121). Ke-ku`i-apo-iwa (II) was the daughter of Kekela and Ha`ae. Kamehameha's father was Keoua, younger brother of Ka-lani-`opu`u. Because of her weakened condition, Ke-ku`i-apo-iwa did not accompany the Alapa`i expedition to Maui. The infant Kamehameha was placed in the charge of Nae-`ole and his younger sister Ke-ku-nui-a-lei-moku until he was five. He was then returned to Alapa`i who placed the child in the care of his wife, Ke-aka (Kamakau 1992:68-69).

However, before Alapa`i reached Maui, a dying Ke-kau-like [Ka-lani-ku`i-hono-i-ka-moku] made his son Kamehamehanui his successor. Ke-kau-like died enroute to Kula (Kamakau 1992:69). When Alapa`i heard of his death, he decided not to make war on his sister's son. While visiting them on Maui, Alapa`i heard that the O`ahu chiefs attacked his relatives on Molokai, so he went there to help (Kamakau 1992:70).

Alapa`i was said to have been a good ruler and loved by the common people, but his rule had come about by slaying *ali`inui* Ka-lani-nui-`i-a-mamao [father of Kalani`opu`u and Keoua] and his brother Ka-lani-ke`e-au-moku, rightful *ali`inui* of Hawaii island, and taking control. This would be the cause of several battles between Alapa`i and his nephew, Kalani`opu`u (Kamakau 1992:75-78).

In 1754 Alapa`i became ill and moved to Kikiako`i in Kawaihae. As his illness progressed "at Kikiako`i in the *heiau* of Mailekini, Kawaihae, he appointed his son Keawe-`opala to be ruler over the island" (Kamakau 1992:77). However, this was short-lived due in part to shifting allegiances of Keawe-`opala's chiefs (i.e., his relative Ke`eaumoku) and *kahuna,* to go with Kalani`opu`u. "A canoe arrived from Kekaha and brought word to Ke`eaumoku that Ka-lani-`opu`u was at Kapalilua (in south Kona) and was coming to make war against Keawe-`opala. Ke`eaumoku therefore made up his mind to join forces with Ka-lani-`opu`u" (Kamakau 1992:78). It was that same year that Kalani`opu`u, a lover of war, became *ali`inui* of Hawaii island (Kamakau 1992: 78-79). Kalani'opu'u was the son of Ka-lani-nui-i-a-mamao (ruling chief of Ka`u whom the *Kumulipo* was composed for) however, his biological father was said to be Pele-io-holani, *ali`inui* of Oahu (Kamakau 1992:110; see also `I`i 1983). About 1759 Kalani'opu'u conquered East Maui from his wife's brother the Maui king Kamehamehanui (son of Kekaulike) by using Hana's prominent Pu'u Kau'iki as his fortress. He appointed one of his own Hawaii chiefs, Puna, as governor of Hana and Kipahulu. "Many chiefs from Hawaii at this time settled on Maui, some of them grandchildren of Keawe" (Kamakau 1992:79-80).

Conflict between Hawai'i chiefs continued. Ke'eaumoku, son of Keawe-poe-poe rebelled against Kalani'opu'u and set up a fort at Pololū and Honokane. He was attacked by Kalaniopu'u so he moved to Maui. In 1766 Maui *ali'inui* Kamehameha-nui became ill in Hana and ceded his lands to his younger brother Ka-hekili-nui-'Ahu-manu (Kahekili), a fierce warrior and "manipulator." Following the death of Kamehameha-nui, Ke'eaumoku "married" his widow Namahana, a cousin of Ku-nui-akea Kamehameha (Kamehameha I). Their daughter Ka'ahumanu, would later become a favorite wife of Kamehameha I (Kamakau 1992:79-84, 309).

Between 1775 and 1779 fighting continued between Kalani'opu'u and Kahekili. In 1775 Kalani'opu'u and his Hana forces raided and severely destroyed the neighboring Kaupo district, before continuing several more raids on Molokai, Lanai, Kaho'olawe and parts of West Maui. It was at the battle of Kalaeoka'ilio that Kamehameha, nephew and favorite warrior of Kalaniopu'u, was first recognized as a great warrior and given the name of Pai'ea (hard-shelled crab) by the Maui chiefs and warriors (Kamakau 1992:84). Kalani'opu'u returned again to Maui in 1776, but was severely defeated by Kahekili's warriors.

> Ka-lani-'opu'u returned to Hawaii embittered against Kahekili...and spent a year in preparing an army made up of a body of men from each of the six districts...he gave to each division a name: I, Ahu, Mahi, Palena, Luahine, and Paia. The was chief was called a Keawe.... He built houses for his war god Ka'ili...as heaiu against sedition and for vengeance upon the chief of Maui. Holo'ae was his leading kahuna, whose grandchildren were Pu'ou and Hewahewa, and he belonged to the oder of Pa'ao (Kamakau 1992:84-85).

In January 1778 Cook landed in Waimea, Kauai and the culture of old Hawaii began its spiraling change (see Day 1992). Captain Cook left an English saw and boar on Ni'ihau and observed chickens on Kauai. (Takeguchi et al.,1999:1). Cook left Hawaii for several months, but returned later in the year. Kalani'opu'u was fighting Kahekili's forces in Wailua, Maui on November 19, 1778 when Cook's ship was sighted on his return trip to the islands. Kalaniopu'u visited Cook on the *Resolution,* while Kahekili visited Clerke on the *Discovery* (Kuykendall and Day 1976:16).

When Cook sailed into Kealakekua Bay on January 17, 1779, Kalani'opu'u was still fighting Kahekili on Maui. At this time Kahekili's brother Ka'eo-kulani was ruling chief of Kauai; Ka-hahana was ruling chief of Oahu and Molokai; Kahekili'ahumanu of western Maui, Lanai and Kaho'olawe; and Kalaniopu'u was ruling chief of Hawaii and Hana (Kamakau, 1992:84-86, 92, 97-98). On January 25th Kalaniopu'u visited Cook again at Kealakekua Bay, presenting him with several feather cloaks. By February Cook's scheme to kidnap Kalaniopu'u as a hostage were thwarted and Cook was killed following a skirmish over a stolen cutter (Kuykendall and Day 1976:18).

The off and on warring between the Hawaii and Maui forces continued, but Kalani'opu'u was aging. Kalanio'opu'u schemed for peace by having his son Kiwala'ō by Kalola, sister of Kahekili - and their twin half-brothers - to go to Kahekili, who in turn had the battles cease (Kamakau 1992:88-89; Desha 2000:49-50). "It was the custom, when blood relatives went to war with each other and both sides suffered reverses, for some expert in genealogies to suggest a conference to end the war; then a meeting of both sides would take place" (Kamakau 1992:72).

Kalanio'opu'u declared his young son Ka-lani-kaui-ke-a-ouli Kiwala'ō to be his heir; to his nephew Kamehameha he gave the war god, Ku-ka'ili-moku (Kamakau 1992:107). But even before the death of Kalani'opu'u in 1772, chiefs and *kahuna* were already taking sides between Kiwala'ō and Kamehameha. Kamehameha and a few other chiefs were concerned about their land claims which Kiwala'ō did not seem to honor, so after usurping Kiwala'ō with a sacrificial ritual, Kamehameha retreated to his district of Kohala. While in Kohala, Kamehameha farmed the land growing taro and sweet potatoes (Handy and Handy 1978:531). After Kalani'opu'u died civil war broke out and the wars between Maui and Hawaii also continued (Kuykendall and Day 1976:23, 24; Handy and Handy 1978:528; King 1990).

In 1781 after Kahekili heard about the death of Kalani'opu'u, Kahekili, split his forces and sent them through Maui's south-eastern Kaupo Gap and the north-eastern Ko'olau Gap into Hana. After damming and diverting the supply of spring water to Pu'u Kau'iki, the Hawaii chiefs were finally defeated, and the Maui *ali'inui* regained control of Hana in1782 (Kamakau, 1992:84-86; 115-116; Fornander 1900:Vol II 146-7, 150, 216). Following his Hana victory, Kahekili went on to gain control of all the islands except Hawaii, by trickery and warfare (Kamakau 1992:116, 128-141).

Kiwala`ō was killed in 1782 by Ke`eaumoku (Kamakau 1992: 121; Cahill 1999:62), but the warring between the forces of Hawai`i Island districts continued. Demographic trends during the Proto-Historic Period indicate a population reduction in some areas, yet show increases in others, with relatively little change in material culture. There was a continuum of craft and status material, intensification of agriculture, *ali'i* (chief) controlled aquaculture, upland residential sites, and oral records which were rich in information. The Ku cult, along with its *luakini heiau,* and the *kapu* (restriction or regulation) system were at their peak, although western influence was already altering the cultural fabric of the islands (Kirch 1985:308, Kent 1983:13).

In 1790 when Captain George Vancouver made his first stop in the Hawaiian islands he was told that Kalaniopu`u was dead; Hawai`i was ruled by Keoua Kuahu`ula (half-brother of Kiwala`ō), his uncle Keawe-mau-hili, and Keoua's cousin, Kamehameha (Day 1984:77). Vancouver went on to trade with Kalanikūpule in Waikiki. He then found that the ruling chief of Kauai, Ka-umu-ali`i, was a mere child; his father Ka`eo was on Maui with his brother, Kahekili. Vancouver also noted a decrease in the population and the number of chiefs since the arrival of Cook (Kamakau 1992: 162-163).

In early 1790 the *Eleanora,* lay off the village of Ka`ūpūlehu. Before heading to Kealakekua Bay there was an altercation between Capt Metcalfe and high chief Kame`eiamoku. For revenge the next ship, the *Fair American,* was attached and all on board were killed except for crewmember, Isaac Davis. As the attach was going on, *Eleanora*'s boatswain John Young was on shore trading for supplies. Fearing retaliation by the crew of the *Eleanora,* Kamehameha detained Young and allowed his ship to sail without him. Kamehameha took both Davis and Young under his care (Cahill 1999:11-12).

By 1790 Kamehameha I had gained enough control of the island of Hawaii, that he could leave to join the war parties on Maui. Kamehameha also had at his disposal western weapons, and an armed schooner (n.a. 1967:5). Kamehameha brought a cannon from the *Eleanora* along with the expertise of Isaac Davis and John Young, who were now advisors and *aikane punahele* (favorites) of Kamehameha I (Kamakau 1992:147-148). "At Kawaihae and Kealakekua, Young and Davis built up an army and navy for Kamehameha along European lines, introduced firearms to Hawaiian warfare, and directed their use in Kamehameha's conquest of Maui, Lanai and Molokai" (n.a. 1967:5). His canoe fleet "beached at Hana and extended from Hamoa to Kawaipapa" to battle Kalanikūpule, son of Kahekili (who now ruled Oahu). After several battles along the East Maui coast, Kamehameha's forces reached Wailuku where the "great battle" took place. This would be the beginning of the end of independent ruling chiefs because of the inequity of battle strategy and weaponry I (Kamakau 1992:147-148).

Back on Hawai`i island in 1790, Keoua Kuahu`ula [twin brother of Keoua Pe`e`ale, sons of Kalaniopu`u and Kane-kapo-lei (Kamakau 1992:120)] ravaged Kamehameha's birthlands of Kohala. At the advice of Ka-pou-kahi, a *kahuna* from Kauai (Kelly 1974:6), Kamehameha personally helped to construct the heiau Pu`u Koholā in the summer of 1791, to assure his victory over his cousin, Keoua Kuahu`ula, who was to be sacrificed at the *heiau* (Day 1984:77; Kamakau 1992:154-157).

> After the death of his older brother [Kiwala-ō] Keoua lived in Ka`u, successfully fighting off Kamehameha's generals. Following the new strategy, Kamehameha sent Keoua's uncles, Keaweaheulu and Kamanawa, to convince Keoua that Kamehmahea was offering him a truly respectful peace. Apparently trustful at first, Keoua consented to go with them, but at some point on the trip to Kawaihae he evidently suspected he was being led into a trap. His canoes landed briefly at the sacred place of Luahinewai near Kiholo. There, in the beautiful fresh-water pool, he

> bathed.... After bathing he cut off the end of his..*`omu`o,* an act which believers in sorcery call 'the death of Uli' and which was a certain sign that he knew he was about to die.... 'The death of Uli' refers to death caused by the vengeance of the sorcerer, since Uli is the goddess worshipped by sorcerers. The part cut off is used for the purpose of sorcery so that those who do a man to death may themselves be discovered and punished.... Just as Keoua was stepping from the canoe onto the beach at Kawaihae, Keeaumoku and the other chiefs of Kamehameha's forces attached him and the occupants of his canoe (Kamakau 1961:156-157).

John Young reportedly noted that "Kamehameha offered 11 human sacrifices at the dedication of the *heiau.* The principal offering was the body of Keoua Ku-ahu`ula" (Llopis & Sharp 1994:1).

On his second voyage to Hawaii in 1793, Vancouver counseled the chiefs to stop making war on each other. He gave Kamehameha some cows and sheep (at Vancouver's advice Kamehameha put a ten-year *kapu* on them). Vancouver went on to visit Kahekili in Lahaina and made the same request; then on to Waikiki to Kalanikūpule. When Vancouver returned in January 1794 on his third and last visit, he gave Kamehameha three bulls and more cows and sheep [horses came later in1803 from Captain Richard J. Cleveland]. Kahekili had recently died (late 1793) in Waikiki at the age of eighty-seven and his brother Ka`eo was now ruling Maui (Kamakau 1992:162-166; Brennan 1995:15-23, 31-34).

By 1794 at least eleven foreigners were living on the island of Hawaii; these included American, English, Irish, Portuguese, Genoese, and Chinese (Day 1992:23-25) most likely holdovers of the sandalwood trade. In November and December 1794 a great battle was fought in `Aiea, Oahu between Ka`eo and his nephew Kalanikūpule. Ka`eo was killed and his young son Ka-umu-ali`i became ruling chief of Kauai (Kamakau 1992:168-169).

B-5. Early Historic Period. The Early Historic Period (AD 1795-1900) is marked by very significant events. In February 1795 Kamehameha's war fleet landed in Lahaina and covered the coast from Launiupoko to Mala. All the food patches and cane fields were overrun by Hawaii warriors; and on Molokai the coast from Kawela to Kalama`ula was also covered by warrior-laden canoes (Kamakau 1992:171). Kamehameha also invaded O`ahu in 1795, covering the beaches from Wai`alae to Waikiki. Several foreigners were living with Kalanikūpule at that time (Kamakau 1992:172, 174). Kamehameha brought the daughter of Kalola, Ke-ku`i-apo-iwa Liliha and her daughter, Kalanikauiaka`alaneo to O`ahu to witness the Battle of Nu`uanu Pali and the defeat of Oahu. It was during this trip that the name Keōpūolani was given to Kalanikauiaka`alaneo (Kleiger 1998:21). Kamehameha's forces defeated Kalanikūpule's forces. After several months of hiding, Kalanikūpule was found and sacrificed to Kamehameha's war god (Kamakau 1992:174).

By 1796 Kamehameha had conquered all the island kingdoms (with the help of western advice and technology), except Kauai; it wasn't until 1810 when Kaumuali`i ceded his kingdom of Kauai, Ni`ihau, Lehua and Ka`ula. Ka``umuali`i gave his allegiance to Kamehameha and the Hawaiian Islands were unified under one rule (Kuykendall and Day 1976:26-29, 32). This marked the end of the Proto-Historic Period. Hawaii's culture and economy continued to change radically as capitalism and industry established a firm foothold.

At this time the sandalwood (*Santalum sp*) trade in Hawaii was flourishing; the Fijian and Marquesan supply of sandalwood was exhausted, so Hawaii became known as the "sandalwood mountains" to entrepreneurs of Southern China. Sandalwood came under the personal control of Kamehameha I, who had become "a fervent consumer of high-priced western goods" (Kent 1983:17-20). The sandalwood industry, discovered by Euro-Americans in 1790, and turned into commerce by 1805 (Oliver 1961:261), was flourishing in Hawai`i by 1810 to the point where the subsistence level fell apart, as farmers and fishermen were ordered to spend most of their time logging, causing famine to set in, and resulting in a population decline. However, Kamehameha did managed to keep some control on the trade (Kuykendall and Day 1976:43; Kent 1983: 23, 29; Bushnell 1993:212). In 1813, Don Francisco de Paula y Marin, Spanish advisor to King Kamehameha I introduces coffee and pineapple to Hawaii, but it wasn't until a little later that John Wilkinson brought 30 coffee plants from Brazil, the type that would become known as "Hawaiian coffee" (Takeguchi et al., 1999).

By the mid-1800s ranching became a flourishing economic factor in the Kohala and North Kona areas with cattle being shipped out of Kawaihae (Rosendahl 1995:11). In 1815 John Palmer Parker, an ex-seaman, made his home at Kawaihae where he began hunting cattle that roamed the slopes of Mauna Kea. By this time the Vancouver's cattle of 1793 had increased to destructive numbers and Parker was hired to thin the wild herds. Since people had not yet developed a taste for beef, Parker salted the meat with Kawaihae salt and tanned the hides to trade with ships that stopped at Kawaihae. He later built pens to confine the cattle and horses (n.a. 1967:14-15).

Kamehameha I died on May 8, 1819 in Kailua-Kona "and at the close of the purification the kahuna Hewahewa said, 'Where shall the ruling chief stay?" The chiefs responded in unison, "Where indeed? Are not you the one to chose the place?" "Since Kona is unclean, there are but two places for him to stay, Ka`u and Kohala." The chiefs chose Kohala because they believed the people there to be more loyal to Kamehameha (Kamakau 1992:213). "When the people of Kona and of neighboring places heard of the death of the chief the voice of weeping and wailing arose and the sound of lamentation and general mourning, recalling their regret and reciting their love for their chief" (Kamakau 1992:213-214).

Once again the culture of Hawaii was to change radically; six months after the death of Kamehameha, his son and successor Liholiho, met with his mother Keōpūolani, *kuhina nui* Ka'ahumanu, and a council of chiefs and chiefesses at Kawaihae. His advisors, which included his father's *kahuna* Hewahewa, convinced the new king Kamehameha II to abolish the *kapu* system. He signified his agreement by sitting down and eating with his mother Keōpūolani, breaking the *`ai kapu*. (Oliver 1961:260; Kuykendall and Day 1976:41; Kamakau 1992:222-228).

Liholiho's cousin Kekuaokalani, caretaker of the war god Ku-Kailimoku, disagreed and revolted. By December of 1819 the revolution was quelled. Kamehameha II sent edicts throughout the kingdom renouncing the ancient state religion, ordering the destruction of the *heiau* images and the *heiau* structures to be destroyed or abandoned and left to deteriorate, allowing the personal family religion, the *'aumakua* worship, to continue (Oliver 1961:260; King 1990; Kamakau 1992:222-228).

Regarding this subject Fornander wrote the following:

> When the tabus were abrogated, when the Heiaus were doomed, when Christian zealots proved the genuineness of their new faith by burning the objects of faith of their fathers, and when the ancient gods were striped of their kapas and feathers and their altars overturned, then many a devotee, a Kahu or servant of special Heiaus or individual gods, hid the object of his adoration in caves, in streams, in mountain recesses, in the mud of swamps or other unfrequented places, in hopes of the better days which never came. Thus many a Kahu died and made no sign, and the idol he cherished has only been discovered by accident (Fornander: 1879-80:37-38 vII

Ironically, in October of 1819, seventeen Protestant missionaries had set sail from Boston to Hawaii. They arrived in Kailua-Kona on March 30, 1820 to a markedly changed culture; one with a "religious" void, and a growing appetite for western products. Many of the *ali'i* who were already exposed to western material culture welcomed the opportunity to become educated in a western style and adopt their dress and religion. Soon they were rewarding their teachers with land and positions in the Hawaiian government (King 1990). During this period, the sandalwood trade was wreaking havoc on the commoners who were weakening with the heavy production, exposure, and famine just to fill the coffers of the ali`i who were no longer under any control constraints (Oliver 1961:261; Kuykendall and Day 1976:42; Bushnell 1993:212). On a stopover in the Kohala district in the early 1800s Ellis wrote the following:

> About eleven at night we reached Towaihae [Kawaihae], where we were kindly received by Mr. Young...Before daylight on the 22nd, we were roused by vast multitudes of people passing through the district from Waimea with sandal-wood, which had been cut in the adjacent mountains for Karaimoku, by the people of Waimea, and which the people of Kohala, as far as the north point, had been ordered to bring down to his storehouse on the beach, for the purpose of its being shipped to Oahu. There were between two and three thousand men, carrying each from one to six pieces of sandalwood, according to their size and weight. It was generally tied on their backs by bands of ti leaves, passed over the shoulders and under the arms, and fastened across their breasts.... (Kuykendall and Day 1976:42, 43, Ellis 1984:397)

The lack of control of the sandalwood trade was to soon create the first Hawaiian national debt as promissory notes and levies were initiated by American traders and enforced by American warships (Oliver 1961:261, 262). In 1825, Kuhina-nui Ka`ahumanu [King Kamehameha III was just a child] placed a *kapu* on cutting sandalwood trees. She saw what it was doing to the people; neglecting their crops and fishing and getting into debt (Brennan 1995:48). During this period the free-ranging cattle were also taking its toll; any chances of re-growth of the forests were squelched by the wild cattle. They even ate the grass-thatched roofs of native houses (Handy and Handy 1972:18).

However, beef soon became a barter item (Brennan 1995:48); and in 1832, Kamehameha III sent a high chief to California to bring some *vaqueros* back to Hawaii to help with the training of horse and cattle handling. Although the cattle were being slaughtered by the thousands for their hides and tallow, their numbers were increasing beyond belief. Over 100,000 wild cattle were roaming the mountains of Waimea alone. Many crops were ruined by the hordes of cattle (Brennan 1995:51-54). The solution was for the *vaqueros* or *paniolo* as Hawaiians called them, to first train Hawaiian and *haole* men to be good horsemen or wrangler or cowboy (*paniolo*). This was the beginning of Hawai`i's cattle kingdom (Brannen 1995:70). Paniolo Jack Purdy and John Parker, Kamehameha III's chief cattle killer, partnered to furnish the king with badly needed beef for bartering with foreign ships (Brennan 1995:74).

Population records of 1835 record 1,233 individuals in the Kekaha region, from Kapalaoa to Kealakehe, the native population was in a decline and as were native residency patterns (Maly 1998:12-13). The Hawaiian culture was well on its way towards Western assimilation as industry in Hawaii went from the sandalwood trade, to a short-lived whaling industry, to cattle ranching, and the more lucrative, but insidious sugar industry.

"For the first time Hawaiian masses were drawn to a cash economy as workers and producers." In 1836 the first sugar plantation was established on Kauai (Kent 1983:22, 23, 29). However, sugar cane (*Saccharum officinarum* L.) was originally Polynesian introduced and served a variety of uses. The *ko kea* or white cane was the most common, usually planted near Hawaiian homes for medicinal purposes, and to counteract bad taste (Handy and Handy 1978:185). Sugar cane was a snack, a condiment, a famine food, fed to nursing babies, and helped to strengthen children's teeth by chewing on it (Handy and Handy 1978:187). It was used to thatch houses when *pili* grass (*Heteropogon contortus*) or *lau hala* (*Pandanus odortissimus*) were not abundant (Malo 1987:121, 124). Sugar cane was also used in relation to taro and sweet potato. Handy and Handy (1978) explain:

> In wet-taro farming, cane was planted along the embankments separating the flooded terraces and flats. In dry-taro and sweet potato fields on the sloping *kula* or in the lower forest zone, cane was planted as hedges along the lines of stone and rubbish thrown up between the fields. Thus it helped the planter to utilize to the maximum his soil and water, and acted as a windbreak against the gusty breezes which blow in most valley bottoms, along the coasts, and on the uplands where taro is grown (Handy and Handy 1978:186).

Sugar cane was grown on all islands and when Cook arrived, he wrote of seeing sugar cane plantations. The Chinese on Lanai are credited with first producing sugar as early as 1802. However, it was not until 1835 that sugar became established commercially, primarily to replace a waning sandalwood industry

(Oliver 1961:263; Kuykendall and Day 1976:92). Many of the Hawaiian chiefs became involved in the early days of the sugar industry. Hawai'i's Governor (John Adams) Kuakini, son of Ke'eaumoku and Namahana (Kamakau 1992:149) grew sugar cane and had a mill in South Kohala; he also had a sugar plantation in North Kohala in the 1830s-1840s (Dorrance 2000:17).

In the 1840s a political act of the Hawaiian Kingdom government would change forever, the land tenure system in Hawai'i and have far-reaching effects. The historic land transformation process was an evolution of concepts brought about by fear, growing concerns of takeovers, and western influence regarding land possession. King Kamehameha III, in his mid-thirties, was persuaded by his *kuhina nui* and other advisors to take a course that would assure personal rights to land. One-third of all lands in the kingdom would be retained by the king; another one-third would go to *ali'i* as designated by the king; and the last one-third would be set aside for the *maka'ainana* or the people who looked after the land. In 1846 he appointed a Board of Commissioners, commonly known as the Land Commissioners, to "confirm or reject all claims to land arising previously to the 10th day of December, AD 1845." Notices were frequently posted in *The Polynesian* (Moffat and Kirkpatrick, 1995). However, the legislature did not acknowledge this act until June 7, 1848 (Chinen 1958:16; Moffat and Kirkpatrick 1995:48-49), known today as *The Great Mahele*. In 1850, the Kingdom government passed laws allowing foreigners to purchase fee simple lands (Speakman 2001:91).

The 1840s also heralded other changes as well. King Kamehameha III passed a law making all forests, government property in 1946 (Takeguchi et al. 1999). The Hawaiian government, with the aid of the missionaries, encouraged the sugar industry as well as other enterprises such coffee, cotton, rice, potatoes, and silk worms (Speakman 2001: 93). Subsistence crops were ruined by displaced dirt and dust, natives were being asked to grow sugar cane on their lands in exchange for money, only to find themselves indebted, and forced to surrender homelands; land-use disputes between natives and other cultures ensued; and restrictions on government lands prevented subsistence hunting and gathering. Subsistence-based culture was eventually lost with the escalating dependence on purchased goods and the growing development related to sugar production (Tomonari-Tuggle 1988:50, 51).

Disease also had a devastating affect on the population and the landscape, killing *ali'i* and *maka'ainana* alike; measles epidemics in 1848 and 1849, was followed by the horrendous smallpox epidemic in 1853. Ten thousand people are said to have died of this disease in Hawaii (Kamakau, 1992:411, 418). John Papa 'Ī'i in *Fragments of Hawaiian* History (1984) talks about the impact of this disease and as *kahu* or guardian of several young *ali'i*; he had to take several of them off of Oahu island. They just kept sailing from island to island and usually were not allowed to land as Oahu was thought to be the source of the smallpox ('Ī'i 1984:171).

While other places were getting established with growing sugar cane in the 1850s, cattle ranching was becoming an industry for the island of Hawaii, as was livestock such as goats. A law had been passed "requiring livestock owners to register their brands or the animals would be considered government property." Ranching activity in Kekaha was recorded as early as 1855. In 1861 letter was sent to Lot Kamehameha V who owned Ka'upulehu, reporting that his goat-herd had increased and were moving into the uplands (Maly 1998:31).

By 1858 at least 2,119 foreigners lived in Hawaii. Many were merchants who traded and provided provisions, ranchers and missionaries who lived in various locations throughout the islands. "Foreigners engaged in agricultural pursuits with the idea of reaping a profit from the land, in contrast with the Hawaiians, who carried on...subsistence agriculture" (Coulter 1971:11). In the 1860s the U. S. Civil War brought about a boost for the sugar industry in Hawai'i as sugar plantations in the South were boycotted or destroyed. The industry brought in tens of thousands of laborers from Asia, Europe, the Americas, Oceania, and Africa to work on the many plantations and mills that were being established on all major islands, which had a profound effect on life in Hawaii (Oliver 1961:123). This influx not only radically changed the culture, but also drastically altered ethnobotanical agricultural lands, destroying traditional architectural features in the process as lands were cleared for mono-crops, domestic settlements and large-scale ranching.

For Kona, the sugar industry did not take hold, however, the coffee industry did. The coffee plants were introduced to Kona in 1828 (KPMC 2000), by H. N. Greenwell (Takeguchi et al., 1999) and the industry boomed in the 1850s. "In the early years, Hawaiians and Chinese were hired to work on large coffee plantations. Later, Portuguese, Japanese, and others, who had either fulfilled or broken their contracts with Hawai'i's sugar plantations, came to work the lands" (COH 1997). Several Japanese laborers did not like the sugar plantation lifestyle, but were afraid of being deported, so they fled to Kona to a new start of life in the coffee industry.

> There were lots of people who'd run away from sugarcane plantations before their contracts had expired. . . . There were some people who changed their last names. I knew this because some of them told me that their real name was such-and-such. . . . And most of them started in coffee farming. –Torahichi Tsukahara (COH 1997).

> By the 1890s, however, the industry experienced financial difficulties. So the lands were divided into small three- to five-acre lots and sold or leased to individuals. By 1915, tenant farmers, largely of Japanese descent, were cultivating most of the coffee. Many hours were spent cleaning and weeding the land, pruning the trees, harvesting the crop, pulping the berries, and drying them for the mills (COH 1997).

While the coffee industry was making an impact in South Kona, cattle ranching was expanding in the Kekaha lands as both private and leased lands were used for ranching operations. Additional industry for Hawai'i Island included macadamia nuts, introduced in 1881 by William H. Purvis; and John Ackerman and Waldemar Muller began canning pineapple commercially in Kona in 1882 (Takeguchi et al., 1999).

B-6. Territorial History (AD 1900-1949). Several events, which took place in the early 1900's eventually, created a downward spiral effect on the sugar industry. Mainland labor union leaders went into the fields organizing membership drives, the military began a major drive to install airfields and encampments, and the Federal government imposed quota restrictions on sugar exports (Oliver 1961:147, 148). This period saw Native Hawaiians running for Congress (Daws 1974 297); and much of the lands being sold in fee simple. In 1920 Hawaii delegate to Congress, Prince Joanah Kuhio Kalanaianaole authored the Hawaiian Homes Act. Lands were set aside on all islands for homesteading by Hawaiians with 50% or more native blood (Takeguchi et. al., 1999). Lands on several *ahupua'a* within the Kekaha lands became Homestead tracts.

B-7. Modern History (AD 1950-). Post World War II brought about an influx of people and industries to Hawai'i, allowing the tourism industry and offshoot enterprises to flourish. 1950 also marked the introduction of radiocarbon analysis which shifted the focus of study in archaeology from relative dating excavated material cultural remains to carbon dating; this was followed by a research focus on settlement and subsistence patterns, and land and marine use.

Along with the rise of the tourism industry, and competing sugar markets abroad, the sugar companies saw a sharpening decline in business (the Sugar Acts of 1934 and 1937, and ILWU Strike of 1946 didn't help). The 1950s and 1960s were the bleakest years for the sugar industry and it was becoming apparent that the sugar industry was beyond salvage (Kent 1983:107-108). More changes were soon to take place on the landscapes of Hawaii. The lack of jobs in Kohala caused an exodus to O'ahu during the construction boom of the sixties. As an economic remedy, Kohala Sugar Company offered its employees an option to purchase lots in newly created subdivisions. On the heels of this offer, new jobs were being created in the tourist industry as Mauna Kea Hotel, followed a few years later by other hotels in Waikoloa, were built and occupied in the late 1960's and early 1970's (Tomonari-Tuggle 1988:159-62).

In the 1960s, various federal and state environmental and historic preservation laws and regulations were passed, mandating surveys and impact studies of the landscape, prior to development. Technology and mechanization initiated in the 1950s to 1970s helped to bring about the decline of plantation camps and lifestyles, yet in 1959 "one out of twelve people employed in Hawaii was in the sugar industry" (Vorfeld 2002:1). However, technology could not save the sugar industry, which could not compete with unfavorable sugar markets and higher costs. By the 1990s most of the sugar plantations reluctantly closed down operations. The vacant lands soon gave way to various development projects and the need for more Environmental Impact Studies (EIS).

However, the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) and its implementing regulations (43 CFR Part 10) shifted the focus of studies to include a greater interaction with indigenous peoples, and a lesser focus on invasive methods of study. In 2000 Hawai'i Legislature passed an EIS amendment resolution which the governor signed as Act 50. This legislation has broadened the scope of environmental impact studies to include cultural impact studies in order to assure that traditional Hawaiian and other ethnic cultural practices are not adversely impacted by proposed projects, as vacant sugar fields give way to the ever-growing population, expanding tourist and real-estate industries, and other development projects.

C. Traditional Literature

The ethnographic works of the late 19th and early 20th century contribute a wealth of information that comprise the traditional literature--the *mo'olelo, oli,* and *mele*--as well as glimpses into snippets of time, and a part of the Hawaiian culture relatively forgotten. The genealogies handed down by oral tradition and later recorded for posterity, not only give a glimpse into the depth of the Hawaiian culture of old, they provide a permanent record of the links of notable Hawaiian family lines. The *mo'olelo* or legends allow *ka po'e kahiko,* the people of old, the *kupuna* or ancestor, to come alive, as their personalities, loves, and struggles are revealed. The *oli* (chants) and the *mele* (songs) not only give clues about the past, special people and *wahi pana* or legendary places, they substantiate the magnitude of the language skills of *na kupuna kahiko* (the people of old).

C-1. Genealogies. *Po'e ku'auhau* or genealogy *kahuna* (masters) were very important people in the days of old. They not only kept the genealogical histories of chiefs "but of *kahunas*, seers, land experts, diviners, and the ancestry of commoners and slaves.... An expert genealogists was a favorite with a chief." During the time of 'Umi-a-Liloa, genealogies became *kapu* (restricted) to commoners, which is why there "were few who understood the art; but some genealogists survived to the time of Kamehameha and even down to the arrival of the missionaries" (Kamakau 1992:242).

There are several chants from Hawaii and other Polynesian islands referred to as migration chants that expand on the travels of ancient Polynesians and not only explain why they traveled from place to place, and where the traveled, they also give their genealogy illustrating how families are connected from one Polynesian island-nation to another. An example are the chants and stories about Hawaii-loa and famous ancient navigator and discoverer of the islands named after him by Kamakau and Kepelino (PVS 1999; Daniel 2003) [see Appendix G and H].

Surviving genealogies illustrate that the ruling families of each island were interrelated quite extensively. The chiefs of O'ahu, Kauai, Hawaii, Maui and Molokai had one common ancestry. Families branched out, but conjoined several times in succeeding generations (Kamakau in McKenzie, 1983:xxv). Not only were the chiefs or *ali'i* related to each other, they were also related to the commoners. In *Ruling Chiefs*, Kamakau states that "there is no country person who did not have a chiefly ancestor" Kamakau (1992:4). "It is said that the chiefs of Hawai'i island were from Maui and from O'ahu and Molokai between the times of 'Aikanaka and Hanala'anui" (Kamakau, 1991:101). Table 1. Lists various ruling chiefs of Hawai'i Island.

Table 1. Hawaii Line extracted from McKenzie (1983, 1986) and Kamakau (1992).

Kane	Wahine	Keiki
*Hanala`anui	Mahuia	Lanakawai [14 generations before the following]
[*twin of Hanala`aiki progenitor of the Maui Pi`ilani Lines]		
Kauholanuimahu	Neula	**Kihanuilulumoku** [Kiha 1]
Kiha 1	Waoilea [Ewa, Oahu Chfs]	**Liloa-a-Kiha**
Liloa	Pinea 1 [yngr sib of Waoilea]	Hakau [later killed by Umi]
"	Haua [Maui Chfs]	Kapukini
"	Akahiakuleana [←Hana]	Umi-a-Liloa I
Hakau	KukukalaniaPae	Pinea 2
Umi	Ohenahena/Hehena	Kamolanuiaumi
"	"	Kahekilinuialokapu
"	Kulamea	Kapunahahuanuiaumi
"	Makaalua	Nohowaaumi
"	**Kapukini/Kapulani**	Kealiiokaloa→Kalaniopu`u/Kamehameha I
"	"	Kapulani
"	"	**Keawenuiaumi**
"	Piikea-a-Pi`ilani	Aihakoko
"	"	Kumalae→ Aikanaka/Lili`u
"	Kuihewamakawalu	Papaikaneau
"	"	Kuimeheua (k)
"	"	Uluehu
"	Mokuahualeiakea	Akahiilikapu→ Liholiho/Kamamalu
Keawenuiaumi	Koihalawai [Kauai Chfs]	Kanaloakua`ana
"	Hoopiliahae	*Umiokalani*
"	"	Keawepaikana
Keawe	Hoopilihae	Lililoa 2
Keawenuiaumi	"	Hoolaaikaiwi
Kaulahea [Maui king]	Kalanikauleleaiwi	**Kekuiapoiwa Nui**
Keawe [Hawaii king]	"	Kalani**Keeaumoku**
"	"	**Kekelakekeaokalani**
Kauaunuimahioloii "		Alapainui [Hawaii king]
Lonoikahaupu [Kauai king]	"	Keawepoepoe [Chief-Hawaii/Maui/Oahu/Kauai]
Kaulaheanuiokamoku	Papaikaniau	Kalaninuikuihonoikamoku **Kekaulike**
Kekaulike [sibs]	**Kekuiapoiwa Nui**	**Kamehameha Nui** [Ruling Chf Maui]
"	"	**Kalola**
"	"	**Kahekilinuihumanu** 2 [Iron king of Maui]
"	"	Kuhooheiheipahu (w)
"	"	Naaiakalani
"	"	Manuailehua
"	?	**Namahanaikaleleokalani** [→ Ka`ahumau]
Kalaninuimamao [Ka`u]	Kamakaimoku	**Kalaniopu`u** *[Hawaii king]
"	"	**Keouakalanikupuapaikalaninui**→K-I
*[Two fathers: also Begotten by Pele-io-holani, ruling chief of Oahu and Kamakaimoku of Waikele]		
Kalaniopu`u	Kalola [Maui High Chfs]	**Kiwalao**
"	"	Liliha Kakuiapoiwa
"	Kaneikapolei [Maui line]	**Keoua Kuahu`ula** [Ka`u]
"	"	Keoua Peeale
"	Mu`olehu	Manoua→ Peter Kaeo of Kauai
"	Halau	Kawelaokalani
"	Kamakolunuikalani	Pualinui [→a Lahaina line]
"	Manoua [Ka`u]	Manono [Died in battle/placed on Mookini altar]
"	"	Kukanaloa [mo`opuna of 3 kings]
Haae	Kekelaokalani	**Kekuiapoiwa** 2 [Oahu/Maui Chiefess]
Keaoua Kalanikupu	**Kalola** [→Keopuolani]	Kekuiapoiwa 3 Liliha
Keoua KupuapaiKalani	Kekuiapoiwa 2	**Kamehameha I**
"	"	Keliimaikai [Kalanimalokuloku-Kepookalani]
"	?	Kalaimamahu
Keawe Ka`iana	"	KaluaiKonahale Kuakini/John Adams

Table 1. Continued. Hawaii Line extracted from McKenzie (1983, 1986) and Kamakau (1992).

Kane	Wahine	Keiki
Kiwalao [Hawaii Chf] [Sibs]	**Kekulapoiwa Liliha 2**	Kalanikauika`alaneo **Keopuolani** [Wailuku]
"	Manoua	Kaaimalolo→ Kaeo of Kauai
Kamehameha Nui [sibs]	**Kalola** [Maui]	Kalaniakuaiokikilo/Kalaniwaiakua [Kapu]
" [Cousins]	Namahanaikaleleonalani	Pele-io-holani
"	"	Kuakiniokalani
Kamehameha I	**Kalola-a-Kumuko`a**	?
"	Kanekapolei	Pauli Kaoleioku
"	Peleuli	Kapulikoliko
"	"	Kahoanoku Kina`u
"	**Keopuolani** [Kapu chiefess]	Liholiho [b Hilo]
"	"	Kalanikauikeaouli Kiwala`o [b Keauhou]
"	"	Harriet Nahienaena
"	Kanekapolei	Kaoleioku
Kalaimamahu [K1 sib]	Kaheiheimalie	Kahahaika`ao`aokapuoka/Kekauluohi
Kamehameha 1	"	Kamehameha Kapuaiwa
"	"	Kamehamehamalu Kekuiwaokalani
"	"	Kaho`anoku Kina`u
"	Kauhilanimaka	Kahiwa Kanekapolei [mother of Kepelino]
"	Peleuli	Kinau
"	Kaheiheimalie	Kekuaiwa [Lunalilo Kamehameha]

Ruling chiefs of the various islands came from combinations of genealogies or branches. In this list of Hawai`i Island chiefs most of the people are in a loose chronological order, however, the multiple unions of a particular person is not necessarily in a chronological order, as much of that information was not provided in most cases. This list is not by any means inclusive as many lesser unions (mates and offspring) were not listed or recorded in official genealogies.

Malo (1987) also wrote about the connection between the *maka'ainana* and the chiefs. "Commoners and *alii* were all descended from the same ancestor, Wakea and Papa" (Malo, 1987:52). This is evident in the genealogies. Genealogies were very important to the chiefs, because ranking was very important. The genealogies not only indicated rank, they ascertained a link to the gods. The following excerpt explains the idea and importance of rank and the role of genealogies:

> Position in old Hawaii, both social and political, depended in the first instance upon rank, and rank upon blood descent—hence the importance of genealogy as proof of high ancestry. Grades of rank were distinguished and divine honors paid to those chiefs alone who could show such an accumulation of inherited sacredness as to class with the gods among men...a child inherited from both parents.... The stories of usurping chiefs show how a successful inferior might seek intermarriage with a chiefess of rank in order that his heir might be in a better position to succeed his parent as ruling chief...a virgin wife must be taken in order to be sure of child's paternity—hence the careful guarding of a highborn girl's virginity (Beckwith:1990:11).

One could defend and/or prove their rank by knowing or having one's genealogist recite one's genealogy. "To the Hawaiians, genealogies were the indispensable proof of personal status. Chiefs traced their genealogies through the main lines of 'Ulu, Nana'ulu, and Pili, which all converged at Wakea and Papa (Barrère, 1969:24). Two well-known genealogy chants are the *Kumuhonua* and the *Kumulipo.*

C-1-a. Kumuhonua. The *Kumuhonua*, first published by Fornander in 1878, in *The Polynesian Race* Vol. I, was based on information from Kamakau and Kepelino. Kumuhonua, the man, was of the Nanaulu line, and the older brother of Olopana and Moikeha (McKenzie 1986:14-15). However, the birth chant *Kumuhonua* has been a subject of controversy as noted in following *Preface* by Kenneth P. Emory:

> We have become painfully aware that the Kumuhonua 'legends' are not ancient Hawaiian legends, nor is the genealogy which accompanies them a totally authentic genealogy...in his second volume (1880) when he relates events from the period of the arrival in Hawaii of migrant chiefs from Tahiti to the time of Kamehameha, in these writings he is dealing with relatively untampered, authentic Hawaiian traditions and genealogies...we must ever be on guard against the effects of this impact in what was recorded subsequently about the pre-contact period..... The world of the Polynesian began to be transformed overnight by Western influence." (In Barrère, 1969:i)

Barrère (1969) explains that some of the *Kumuhonua* legends were recorded by Kamakau and Kepelino between the years 1865 and 1869, however, the 'genealogy' of the *Kumuhonua*, published by Fornander, was given to him "to provide credibility to the legends...this 'genealogy' (was) constructed from previously existing genealogies--the *Ololo* (*Kumuhonua*) and the *Paliku* (*Hulihonua*) which are found in the *Kumulipo* chant (see Beckwith 1951:230-234) and interpolations of their own invention" (Barrère, 1969:1).

C-1-b. Kumulipo. A better example is the famous Creation Chant *The Kumulipo.* Feher (1969) asks several notable Hawaiian scholars to write passages in his *Kumulipo: Hawaiian Hymn of Creation-Visual Perspectives by Joseph Feher.* In the *Introduction* Momi Naughton states "The Kumulipo belongs to a category of sacred chants known as *pule ho'ola'a ali'i,* 'prayer to sanctify the chief,' which was recited to honor a new-born chief (Feher, 1969:1).

In her passage, Edith McKenzie states:

> "The *Kumulipo* is a historical genealogical chant that was composed by the court historians of King Keaweikekahiali'iokamoku of the island of Hawai'i about 1700 AD in honor of his first born son Ka-lani-nui-'I-a-mamao. This important chant honors his birth and shows the genealogical descent of both the *ali'i* (chiefs) and the *maka'ainana* (commoners) from the gods, in particular Wakea...." (Feher, 1969:1).

In a passage by Roger T. Ames, he corroborates this idea and states that "what is of particular humanistic interest is the way in which the *Kumulipo* as a repository of cultural authority served Hawaiian society in transmitting its cultural legacy and organizing its community. In doing so, it combines both a linear sense of temporal development, and the richness of one particular moment in time" (Feher, 1969:3).

C-1-c. Hawaiian Genealogies. Edith McKenzie completed the first volume of *Hawaiian Genealogies* in 1983, based on genealogy articles translated from 19th Century Hawaiian newspapers such as *Ka Nonanona* and *Ka Nupepe Kuokoa* in the late 19th century and early 20th century. These articles were in response to a call to preserve the Hawaiian heritage. Some of the information came from Malo's (1838) *Hawaiian History*, and in Fornander's (1880), *The Polynesian Race* (Book I) (McKenzie, 1983:1).

Youngblood (1992) found that he could draw on both Fornander and Beckwith's translations of *The Kumulipo* to sketch a socio-political history of Hawaii (Youngblood, 1992:34). In his re-creation he found that stemming from Wakea and Papa are two major Hawaiian genealogies: the *Nana'ulu* and the *'Ulu.* The *Nana'ulu* was the wellspring for the *ali'i* of O'ahu and Kauai, while the *'Ulu* line supplied the chiefs of Maui and the Big Island.

Using thirty years to account for one generation, McKenzie determined that Wakea was born in AD 190; Umi-a-Liloa in 1450; Keawekehahialiiokamoku in 1650, Kalanihuiikupuapaikalanui Keoua in 1710; and Kamehameha I in 1740" (McKenzie, 1983:12). Volume Two of *Hawaiian Genealogies* was published in 1986 and consists of information extracted from genealogical lists published in thirteen newspapers from 1858 to 1920. It compliments genealogies found in other works, such as Fornander's (1880) *An Account of the Polynesian Race...* and David Malo's *Hawaiian Antiquities* (McKenzie, 1986:v).

The following excerpt is from Kamakau's article in *Ka Nupepa Kuokoa* October 7, 1865, and was translated by McKenzie (1986). It illustrates some of the mid-19th century sentiment regarding genealogies:

> *I na makaainana, he mea waiwai ole, no ka mea ua papa ko lakou mau makua o hoohalikelike, a hoohanau keiki o ke kuaaina a pii aku i na li'i. Nolaila ia ao ole ia ai na keili a na makaainana, ma kahi makuakane a makuahine, a kupuna aku no.... Ia kakou i ka poe o keia wa, aole waiwai o keia mea he mooalii aole a kakou mau kuleana nui iloko. Aka, ma ko kakou noonoo iho he waiwai nui. Ua komo kakaou iloko, ua waiwai na'lii i na kupuna; a ua waiwai pu kakou i koo kakou ike ana. No ka mea, ua kapu i ka makaainana aole e ike i keai mea. Aka, no ka pii ana i ka naauao a me ke akamai o na keiki a na makaainana; nolali, ua noa na wahi kapu, ua pii waleia. O ke koeana mai o na kupuna oia kahi waiwai.*
>
> To the commoners, a genealogy was of no value because their parents forbad (sic) it lest comparisons should occur and country children be born and rise up as chiefs. Therefore, the children of the commoners were not taught beyond father, mother, and perhaps grandparents.... To us, the people of this time, there is no value of this thing of a chiefly lineage; we have no great interest in it. But in our thoughts it is of great value. We have entered into discussion of it; the chiefs valued the chiefs and ancestors; and we also value our knowledge of it. Because it was forbidden to the commoners, they were not to know this. However, due to the rise of wisdom and skill of the children of the commoners, therefore, all of the ranking privileges were no longer restricted; it was only lifted. What remains of the ancestors is something of value (McKenzie 1986:18-19).

C-2. Mo'olelo. Legends, stories or *mo'olelo* are a great cultural resource as well as entertaining. Leib and Day (1979) state in their annotated bibliography of Hawaiian legends, that legends "are a kind of rough history." They noted Luomala's idea of the value of legend and myth in the serious study of a culture and her following quote. "To a specialist in mythology, a myth incident or episode is as objective a unit as an axe, and the differences and similarities of these units can be observed equally clearly and scientifically." Leib and Day also expressed concern about authenticity, and sometimes found it difficult to determine if a legend was a primary or secondary source. The following definitions of terminology, including the Hawaiian classification of prose tales--*mo'olelo* or *ka'ao,* come from their work (Leib and Day 1979:xii, 1):

Tradition	used to refer to that which is handed down orally in the way of folklore
Folklore	a rather inclusive term, covering the beliefs, proverbs, customs, and literature (both prose and poetry) of a people
Myth	a story of the doings of godlike beings
Legend	deals with human beings and used interchangeably with 'myth'... because the collectors and translators of the tales often failed to make the strict distinction
Ka'ao	"pure fiction"
Mo'olelo	deals with historical matters and somewhat didactic in purpose... included tales of the gods, as well as tales of historical personages... many have recurring patterns, plots, and types of characters

C-2-a. History of Mo'olelo Collecting. According to Leib and Day (1979) a substantial number of legends were collected and written in Hawaiian, during the century following Cook's arrival in Hawaii. A few accounts of the mythology were printed in the journals of missionaries and travelers, and a few of the Hawaiian lore were printed in languages other than English. The following synopses are excerpts from the works of Leib and Day's (1979), and gives an overview of the first collectors and compilers of Hawaiian myths and legends.

The first printed narrative legend of any importance is the epic "Song of Lono" in Byron's *Voyage of H.M.S. Blonde to the Sandwich Islands* (1826), credited by Byron to the American missionaries. Byron had hoped that the missionaries 'will obtain a correct knowledge of the creed and traditions of the Islanders.' Unfortunately, the missionaries were at first more anxious to supplant the native beliefs with new ones than to perpetuate the old ones, with the result that a good many of the legends became altered or were lost. However, the missionaries did a more thorough job of writing down the legends than did the explorers and voyagers (Leib and Day 1979:5). William Ellis, who toured Hawaii in 1823, is credited as "chronologically the first important source of Hawaiian mythology. Although (Ellis) deplored the content of the legends, they showed that the Hawaiians had mental powers which might later be 'employed on subjects more consistent with truth' (Leib and Day 1979:6).

About 1836 a movement was started under the influence of Reverend Sheldon Dibble, to write down in Hawaiian some of the material dealing with the native legendary history, customs, and other lore. Results of the research were published at the Lahainaluna press in 1838. A partial translation made by Rev. Reuben Tinker was issued serially in 1839 and 1840—the first four installments appearing in ***The Hawaiian Spectator*** and the last four in ***The Polynesian***. In 1841 the Royal Hawaiian Historical Society was formed at Lahainaluna. Some of their research and the earlier *Ka Moolelo Hawaii* were incorporated into Dibble's *History of the Sandwich Islands* (1843). After his death in 1843 his work was carried on principally by two of his outstanding native pupils, David Malo and Samuel M. Kamakau. Malo wrote his own *Moolelo Hawaii* about 1840 at the request of Rev. Lorrin Andrews, which was later translated by Emerson as *Hawaiian Antiquities*. In 1858 the Rev. John F. Pogue of Lahainaluna printed a third *Moolelo Hawaii*, based on the 1838 history, but included additional material. Kamakau did not print any of his material for thirty years (Leib and Day 1979:7, 8, 9).

The increase in the amount of Hawaiian lore appearing in the native press in the 1860's and thereafter was at least in part the result of an organized effort to collect and preserve such material. At Kamakau's instigation a Hawaiian society was formed in 1863 to collect material for publication in the native press at the time, and also to aid Fornander's research. Fornander was the greatest collector of Hawaiian lore. He credits as sources, several natives whom he sent on tours of the Hawaiian Islands to collect all available Hawaiian lore, as well as Kalākaua, Lorrin Andrews, Malo, Dibble, Dr. John Rae, Kamakau, Naihe, S.N. Hakuole, Kepelino, and Remy. The culmination of this effort was Fornander's (1880) *An Account of the Polynesian Race: Its Origin and Migrations and the Ancient History of the Hawaiian People to the Times of Kamehameha I.* Fornander's collection remains the most important single source of Hawaiian legends (Leib and Day 1979:9, 12, 13).

In June 1865 Kamakau began publishing in *Ka Nupepa Kuokoa*, articles on traditions and legends. His series of articles dealing with Hawaiian history, particularly from the late eighteenth century on, and especially of Kamehameha, appeared weekly in the same publication in October 1866. When the newspaper ceased in 1869, this series continued in *Ke Au Okoa* for nine months. Kamakau then wrote a series on ancient Hawaiian religion, customs, and legendary history in *Ke Au Okoa* until February 1871. All of his writings were in Hawaiian (Leib and Day 1979:8, 9).

Very little work was done in translating Hawaiian mythology into English until late in the nineteenth century. It wasn't until 1888, over a hundred years after the discovery of the Hawaiian Islands, that the first book in English dealing exclusively with Hawaiian mythology was printed; *The Legends and Myths of Hawaii* by King Kalākaua. However, it was more likely authored by former United States Minister to the Hawaiian Islands, R.M. Daggett (Leib and Day 1979:5, 7).

Thrum is one of the most frequently cited authorities on Hawaiian lore. He was born in Australia in 1842 and arrived in Honolulu in 1853. In 1875 he began publication of the *Hawaiian Almanac and Annual*, later known as *The Hawaiian Annual* or *Thrum's Annual*, which appeared yearly under his editorship until his death in 1932. Thrum's contribution is as editor, compiler, and publisher of translations, not translator. By providing in his *Annual* a place for the publication of such material, and perhaps by persuading authors to provide him with translations, he was instrumental in much legendary matter appearing in printed form. Thrum wrote or rewrote a large portion of his own material (Leib and Day 1979: 17).

Thrum's first book *Hawaiian Folk Tales* was published in 1907 and consisted largely of tales that had previously been published in *Thrum's Annual.* Only 35 of the 260 pages were translated by Thrum, the rest were credited to Rev. A.O. Forbes, Rev. C.M. Hyde, William Ellis, J.S. Emerson, Mrs. E.N. Haley, N.B. Emerson, Mrs. E.M. Nakuina, Walter M. Gibson, Joseph M. Poepoe, and M.K. Nakuina. His second book *More Hawaiian Folk Tales,* published in 1923 was similar. A number were translations from Hawaiian language newspapers of half a century earlier, often with no translator cited. Translators credited were A. F. Knudsen, Henry M. Lyman, W. D. Westervelt, J. H. Boyd, and Lahilahi Webb. Some of the chapters were reprinted or abridged from the Bishop Museum translations of the *Fornander Collection,* of which Thrum was editor. His greatest work, *Fornander's Collection of Hawaiian Antiquities and Folklore,* was published by Bishop Museum in 1916 and 1920 in three volumes. The original editor was W. D. Alexander and most of the work completed under his supervision. However, he died in 1913 and Thrum was appointed to complete the production. Beckwith credits John Wise with the original translation of that work. In 1920 or 1921 Thrum completed another work "Ancient Hawaiian Mythology" which was never published (Leib and Day 1979: 18-19).

A great resurgence of interest in Hawaiian folklore began in the early twentieth century, in part caused by the annexation to the United States. People on the mainland wanted to know more about 'their new island possessions.' The funds of the Bureau of American Ethnology were made available for Hawaiian studies i.e., Emerson's *Unwritten Literature* and Beckwith's *Laeiekawai.* The most important twentieth-century translators of Hawaiian legends have been N. B. Emerson, Thomas G. Thrum, William D. Westervelt, William Hyde Rice, Laura C. S. Green, Martha Warren Beckwith, and Mary Wiggins Kawena Pukui. Emerson's extensive notes were a major contribution to Hawaiian scholarship. Most of them explain the meanings of Hawaiian words. In many, Emerson alludes to legends, giving a number of them briefly and relating a few in some detail. Some of these probably do not exist anywhere else in print (Leib and Day 1979:14).

C-2-b. Mo'olelo List of Sources. A cursory review of *mo'olelo* sources was done. While there were no stories specifically about Kaū, there were several about the Kekaha lands. The following is a list of *mo'olelo* about Kekaha lands; various versions:

Armitage, George (1944)	Maniniowali, legend of Kona (pp18-23)
Armitage, George (1944)	The Catch of the Gods. (pp37-39)
Armitage, George (1944)	The Cave of Mākālei (pp53-56)
Armitage, George (1944)	Two girls roasting breadfruit. (pp82-85)
Armitage, George (1944)	The Fishpond of Pa'aiea (77-81)
Armitage, George (1944)	The Hill of Moemoe (pp122-125)
Emerson, Nathaniel Bright (1974)	*Pele and Hiiaka*
Fornander, Abraham (1917)	The Story of Umi (v. 1 pp178-235)
Fornander, Abraham (1917)	Legend of Kaulanapokii (v. 1 pp560-569)
Fornander, Abraham (1917)	Legend of Pupuhuluena (v. 1 pp570-573)
Fornander, Abraham (1917)	Legend of Kuapakaa (v. 2 78-135)
Fornander, Abraham (1917)	Legend of Pupukea (v. 2 pp436-451)
Fornander, Abraham (1917)	Brief Sketch of Kamehameha (v. 2 pp464-485)
Fornander, Abraham (1917)	The Story of Umi (pp114-177)
Kalākaua (1990)	Umi, the Peasant Prince of Hawaii (pp247-315)
Kalākaua (1990)	The Prophesies of Keaulumoku ((pp351-367)
Maguire, (2000)	'Akahipu'u (pp9-12)
Maguire, (2000)	The Fishpond of Pa'aiea (pp13-17)
Maguire, (2000)	Two Girls Roasting Breadfruit (pp18-20)
Maguire, (2000)	The Cave of Mākālei (pp28-32)
Maguire, (2000)	Maniniowali (pp33-37)
Maguire, (2000)	The Waters of Kāne (pp38-42)
Maguire, (2000)	The Catch of the Gods (pp43-46)
Maguire, (2000)	The Hill of Moemoe (pp47-53)
Maguire, (2000)	The Pond of Wainānāli'i (pp54-55)

Monopo (n.d.)	Ka Wai A Kane at Kaupulehu (Reinecke 1930:185-186)
Pukui (1994)	The Cave of Mākālei (pp111-113)
Yanagi (1930)	Alapai of Kapalaoa and His Family (Reinecke 1930:187)
n. a. (1930)	Stones at Kukio (Reinecke 1930:188)

**C-3. `Ōlelo No'eau.** *`Ōlelo no'eau* or proverbial/traditional sayings usually had several layers of meanings. They reflected the wisdom, observations, poetry and humor of old Hawai'i. Some of them referenced people, events or places. The following *`Ōlelo no'eau* were compiled by Pukui between 1910 and 1960 with both translations and an explanation of their meaning (Williamson, et al. in Pukui, 1983:vii), which are often more *kaona* (hidden or double meaning) than obvious. Most are references to place names, although a few refer to people.

'Ōlelo no'eau:	*Kekaha wai `ole o na Kona*
Translation:	Waterless Kekaha of the Kona district.
Meaning:	Kekaha in Kona, Hawai`i, is known for its scarcity of water but is dearly loved by its inhabitants (#1716, p 185).
'Ōlelo no'eau:	*Ola aku la ka `āina kaha, ua pua ka lehua kai..*
Translation:	Life has come to the *kaha* lands for the *lehua* blooms are seen at sea.
Meaning:	"Kaha lands" refers to Kekaha, Kona, Hawai`i. When the season for deep-sea fishing arrived, the canoes of the expert fishermen were seen going and coming (#2478, p 271).
'Ōlelo no'eau:	*Makani `Eka aheahe o Makalawena.*
Translation:	The gentle `Eka breeze of Makalawena (#2095, p 228)
'Ōlelo no'eau:	*O na hōkūo ka lani luna, o Pa`aiea ko lalo.*
Translation:	The stars are above, Pa`aiea below.
Meaning:	Refers to Kamehameha's great fishpond, Pa`aiea, in Kona, Hawaii. Its great size led to this saying – the small islets that dotted its interior were compared to the stars that dot the sky. The pond was destroyed during a volcanic eruption (#2515, p 275).
'Ōlelo no'eau:	*E ho`i na keiki oki uaua o na pali.*
Translation:	Home go the very tough lads of the hills.
Meaning:	These lads of the hills were the cowboys of Pu`uwa`awa`a and Pu`uanahulu, who were well known for their endurance (#288, p 36).
'Ōlelo no'eau:	*Ho`okāhi no Hāwa`e, lauhue Kona.*
Translation:	Only one Hāwa`e, and poisonous gourds grow all over Kona.
Meaning:	In Kona, Hawai`i, a priest named Hāwa`e lived during the reign of Ehukaipo. In every important *heiau* in that district, an image named for this priest was kept. Many people were sacrificed to these evil namesakes of Hāwa`e (#1072, p 114).
'Ōlelo no'eau:	*Ka makani kūkulu pe`a nui, he 'Eka..*
Translation:	The `Eka, the wind that sets up the big sails.
Meaning:	When the `Eka wind blew in Kona, Hawai`i, the fishermen sailed out to the fishing grounds (#1467, p 159).
'Ōlelo no'eau:	*Ke `Eka, makani ho`olale wa`a o na Kona.*
Translation:	The `Eka breeze of Kona that calls to the canoemen to sally forth to fish.
Meaning:	Refers to Kona, Hawai`i (#1690, p 182).

'Ōlelo no'eau:	*Kona `ākau, mai Keahualono a Pu`uohau.*
Translation:	North Kona, from Keahualono to Pu`uohau.
Meaning:	The boundary of North Kona, Hawai`i (#1839, p 198).

'Ōlelo no'eau:	*Kona, kai malino a Ehu.*
Translation:	Kona, land of the calm sea of Ehu.
Meaning:	Ehunuikaimalino was a chief of Kona, Hawai`i, under the ruler Liloa (#1843, p 199).

'Ōlelo no'eau:	*Kona, mauna uliuli; Kona mauna ulupō.*
Translation:	Kona of the green mountains; Kona of the dense forest.
Meaning:	North and South Kona, Hawai`i (#1846, p 199).

'Ōlelo no'eau:	*Kona po`o ku`i.*
Translation:	Kona of the added head.
Meaning:	Said of farmers of Kona, Hawai`i, returning from the fields with a load on the shoulders and a child sitting atop the load (#1847, p 199).

'Ōlelo no'eau:	*Pili aloha o Kona, ho`oipo I ka mālie.*
Translation:	Love remains close to Kona, who woos the calm.
Meaning:	Kona is a land beloved for its calm and pleasant weather (#2645 p 290).

The following *'ōlelo no'eau* was translated and compiled by Kepā Maly (1998, 1999).

'Ōlelo no'eau:	*Ola aku la ka `āina kaha, ua pua ka lehua I ke kai*
Translation:	The natives of Kaha lands have life, the *lehua* blossoms are upon the sea! (John Whalley Hermosa Isaac Kihe in *Ka Hōkū o Hawai`i, 2/21/28*
Meaning:	This saying describes the seasonal practice of natives of the Kekaha region, who during the winter planting season, lived in the uplands, where they cultivated their crops under the shelter of the *lehua* trees. Then when the fishing season arrived with the warmer weather, the natives would travel to the shore, where the fishing canoe fleets could be seen floating upon the sea like *lehua* blossoms. It was as a result of this knowledge of seasons, and the relationship between land, ocean, and community, that the residents of Kekaha were sustained by the land (Maly 1998:v).

C-4. Place Names. Hawaiians of old generally named everything; from winds and mountains, to rocks, springs, canoes, taro patches, fishing stations, and "the tiniest spots where miraculous or interesting events are believed to have taken place" (Elbert in Pukui et al., 1974:x). They all represented a story, some known only locally, while others became legendary.

Table 2. Annotated place names of Kekaha lands and vicinity.*

`Anaeho`omalu	Village, bay...well-known for spectacular petroglyphs (Cox and Stasack 85). Pua-kō qd. North Kona, Hawai`i. Bishop Museum archaeologists in 1971 believed the site was occupied in AD 800 byt that most of the petroglyphs date from after 1500. *Lit., restricted mullet* (Pukui et al., 1976:12).
Awake`e	Bay and land section, Ke-āhole qd., North Kona, Hawai`i; *Lit. bent harbor* (Pukui et al., 1976:15).
`Awa-lua	Land sections, Ke-āhole qd., North Kona, Hawai`i; *Lit. double harbor* (Pukui et al., 1976:15).
Hale`ohiu	Ahupua`a. [Not mentioned at all in *Place Names of Hawaii* (1976).]

Hamanamana	Ahupua`a. [Not mentioned at all in *Place Names of Hawaii* (1976).]
Honokāhau	Village, bay and ancient surfing area (Finney and Houston 26), Ke-āhole qd., Hawai`i; House sites, fishponds and *heiau* have been found here. *Lit., bay tossing dew.* Same as Honokōhau (Pukui et al., 1976: 49).
Hualālai	Large volcano, Kailua qd., North Kona, Hawai`i; it last erupted in 1801 (Pukui et al., 1976: 52).
Ka-laoa	Land section, stream, homesteads, Kailua qd., Kona, Hawai`i; *Lit. the choker (as a stick for catching eels)* (Pukui et al., 1976: 75).
Ka-loko	Land section and fishpond near Kailua, North Kona, Hawai`i; *Lit. the pond.* Kamehameha's bones may have been hidden near here (RC 215); the Kamehameha family reserved the pond for themselves in 1848. A Bishop Museum archaeological survey in 1970 reported the existence of burial caves, petroglyphs, house structures, and other remains (Pukui et al., 1976: 77-78).
Kaū	Ahupua`a. [Not mentioned at all in *Place Names of Hawaii* (1976).]
Kaulana	Ahupua`a. [Not mentioned at all in *Place Names of Hawaii* (1976).]
Ka`ūpūlehu	Land division near the sea. Kailua and Puakō qd., North Kona, Hawai`i. The Ka`ūpūlehu lava flows of 1801 started above here at 5,000 to 6,000 feet on Hualālai and flowed to the sea (Macdonald and Abbott 51-52) *Lit., the roasted breadfruit* (`*ū* is short for `*ulu*). Pele met two girls, Pā-hinahina and Kolomu`o, roasting breadfruit here (known then as Manu-ahi). Only Pā-hinahina shared her breadfruit. That night Hualālai erupted near Hu`ehu`e and destroyed the village, but spared the home of Pā-hinahina.... In another legend, the name is a contraction of Ka-imu-pūlehu-a-ke-akua (the roasting oven of the god) (Pukui et al., 1976: 96).
Ke-āhole	Quadrangle; land section; point and airport, Ke-āhole qd. Hawai`i. *Lit., the āhole fish* (Pukui et al., 1976: 100).
Ke-ahu-o-Lū	Land section and point, Kailua and Ke-āhole qd., Hawai`i. *Lit., the heap of Lū* (Pukui et al., 1976: 101).
Kīholo	Bay. Pua-kō qd., Kona, Hawai`i; also the name of a fishpond said to have been built by Kamehameha I; it was destroyed by a [Mauna Loa] lava flow in 1859 because, the story goes, Pele was hungry for the *awa* and mullet there (Westervelt 1963: 148). *Lit. fishhook* (Pukui et al., 1976: 110).
Kohana-iki	Land sections, Kailua and Ke-āhole qd., North Kona, Hawai`i. *Lit., small barrenness* (Pukui et al., 1976: 115).
Kona	Leeward districts on Hawai`i. *Lit., leeward* (Pukui et al., 1976: 117).
Kūki`o	Land section, North Kona, Hawai`i (Pukui et al., 1976: 121).
Lua-o-Milu	A deep legendary pit said to be on the summit of Hualālai, Hawai`i. *Lit., pit of the underworld* (Pukui et al., 1976: 135).
Mahai`ula	Coastal area, bay, village, and ancient surfing area (Finney and Houston 26), Ke-āhole qd., Hawai`i. A stone fish goddess about a fathom from the shore was named Pōhaku-o-Lama; she was brought gifts by fishermen except during May, June, and July. During these months the sea thereabout turned yellowish and the people thought the deity was menstruating. (Fornander. *Selections....* 286) (Pukui et al., 1976: 137).

Makala-wena	Village and land section, Ke-āhole and Pua-kō qd., Hawai`i; The legendary hero Ka-miki destroyed some ghosts fishing here at a spot called Ku`una-a-ke-akua (net setting of ghosts); these ghosts made mullet (`*anae*) and goatfish (*weke*) bitter. *Lit., release of glow* (Pukui et al., 1976: 140).
Mākālei	Place. A fish-attracting branch believed owned by the goddess Hau-mea, mother of Pele (Beckwith, *Hawaiian Mythology* 276-287) (Pukui et al., 1976: 140).
Maka`ula	Land section, Kailua and Ke-āhole qd., Kona, Hawai`i. *Lit., red eye* (so named because of a fire there) (Pukui et al., 1976: 142).
Manini-`ōwali	Land section, Ke-āhole and Pua-kō qd.; undersea spring and rock between Awa-ke`e and Kūki`o, Hawai`i. A girl named Manini-`ōwali was betrothed as a child to Ulu-weuweu because their parents were close friends. When the wedding day approached the boy became ill. A *kahuna* made the diagnosis that he was in love with someone else. The *kahuna* prayed for the girl, but the gods turned both young people into rocks that can be seen at low tide. *Lit., weak manini fish* (Pukui et al., 1976: 146).
`O`oma	Land sections and homesteads, Kailua and Ke-āhole qds., Kona, Hawai`i. *Lit. concave* (Pukui et al., 1976: 171).
Puhi-a-Pele	Spatter cone visible from the highway, built around the vent of the 1801 eruption of Hualālai (Macdonald and Abbott 52) (Pukui et al., 1976: 192).
Pu`u-kala	Land section, Kailua and Ke-āhole qds., Hawai`i, where fishponds were destroyed by the lava flow of 1801. *Lit., kala fish hill* (Pukui et al., 1976: 198).
Pu`u-wa`awa`a	Land divisions, Hono-`apo, Pua-kō, and Kailua qds., and peak (3, 824 feet high). *Lit., furrowed hill* (Pukui et al., 1976: 206).

*[Street names are not mentioned here]

D. Historic References.

By and large "Historic References" pertain to notable historic events, overviews of important place names and land tenure within the project area and districts. One of the most significant practices in the history of the Hawaiian people was their concept of the stewardship of the land. However, over time, these practices were replaced by more western methods of land use, as the lands of North Kona went from the domain of the *ali`inui* to the monarchy, to various individuals and corporate entities.

D-1. History of Land Divisions. It was during the time of Kahaukapu of Hawaii and Kaka'alaneo of Maui [also said to be the time the Spanish first came with Ku-kanaloa (Kamakau 1991:324] that the division of lands is said to have taken place under a *kahuna* named Kalaihaohi'a. He portioned out the lands into districts, sub-districts, and smaller divisions, each ruled over by an agent appointed by the landlord of the next larger division, and the whole under control of the ruling chief over the whole island or whatever part of it was his to govern (Beckwith 1970:383). Each island was divided into *moku* or districts that were controlled by an *ali'i 'ai moku.* Within each of the *moku* on each island, the land was further divided into *ahupua'a* and controlled by land managers or *konohiki*. The boundaries of the *ahupua'a* were delineated by natural features such as shoreline, ridges, streams and peaks, usually from the mountain to the sea, and ranged in size from less than ten acres to 180,000 acres (Moffat and Kirkpatrick 1995:24-29, see also Chinen 1958:3).

Each *ahupua'a* was often divided and sub-divided several times over (i.e., *ili, kuleana, mo'o, pauka, koele, kiha pai*), answerable to *ali'i* where the lesser division was located. However the *ili kupono* or the *ili ku* was "completely independent of the *ahupua'a* in which it was situated...tributes were paid directly to the king himself" (Chinen 1958:4). Rights to lands were mutable or revocable; a ruling chief or any "distributor" of lands could change these rights if displeased, or as favors--usually after a victorious battle, and after the death of the *ali'inui* (Chinen 1958:5).

During the period between 1839 to 1855, several legislative acts transformed the centuries-old Hawaiian traditions of *ali'inui* land stewardship to the western practice of private land ownership. In the first stage, King Kamehameha III (Kauikeaouli) divided up his lands among the highest-ranking *ali'i* (chiefs), *konohiki* (land managers), and favored *haole* (foreigners) (Chinen 1958:7-14; Moffat and Fitzpatrick, 1995:11, 17). This historic land transformation process was an evolution of concepts brought about by fear, growing concerns of takeovers, and western influence regarding land possession. Kamehameha III, in his mid-thirties, was persuaded by his *kuhina nui* and other advisors to take a course that would assure individual personal rights to land.

One-third of all lands in the kingdom would be retained by the king; another one-third would go to *ali'i* or chiefs as designated by the king. In 1846 he appointed a Board of Commissioners, commonly known as the Land Commissioners, to "confirm or reject all claims to land arising previously to the 10th day of December, AD 1845." Notices were frequently posted in *The Polynesian* (Moffat and Kirkpatrick, 1995). However, the legislature did not acknowledge this act until June 7, 1848 (Chinen 1958:16; Moffat and Kirkpatrick, 1995:48-49), known today as *The Great Mahele*. "The *mahele* did not actually convey title to the various *ali'i* and *konohiki*; it essentially gave them the right to claim the lands assigned to them--these lands became known as the *konohiki* lands. The *konohiki* chiefs were required to present formal claims to the Land Commission and pay a commutation fee, which could be accomplished by surrendering a portion of their land to the government." The government could later sell these lands to the public in the form of Grants. Upon payment of the commutation fee, the Minister of Interior issued a Royal Patent to the chief or *konohiki*. The last one-third was originally designated to the *maka'ainana*, but not acted on--instead it was set aside to the government, "subject always to the rights of the tenants" (Moffat and Kirkpatrick, 1995:41-43; see also Chinen 1958:15-21).

Ili kupono were the only *ili* (parcel) recognized in this process, all the *ili* and lesser divisions were absorbed into the *ahupua'a* claim (Chinen 1958:20). In 1892 the legislature authorized the Minister of Interior to issue Royal Patents to all *konohiki* or to their heirs or assignees where the *konohiki* had failed to receive awards for their lands from the Land Commission. The Act further stipulated "that these Royal Patents were to be issued on surveys approved by the Surveyor General of the kingdom" (Chinen 1958:24; Moffat and Fitzpatrick 1995:41-43). Kamehameha III formalized the division of lands among himself (one-third) and 245 of the highest-ranking *ali'i* and *konohiki* (one-third) between January 27 to March 7, 1948. He acknowledged the rights of these individuals to various land divisions in what came to be known as the *Buke Mahele* or 'sharing book.'

D-2. Kaū Land Commission Awards (LCA). An internet search of the Waihona Mahele and Boundary Commission Databases www.waihona.com (*Waihona `Āina, Inc.*) (Appendix I) produced one LCA claim (MA #13-B/RP 8265) in the *ahupua`a* of Kaū, District of North Kona, which was awarded to Paalua (v35:687-689). An application was made to the Commissioner of Public Lands on behalf of Paalua by Julia B. Egan for the [Royal] Patent and a sum of $156.90 was paid. Thc lands of Kaū (1560 acres "more or less") were granted to Paalua in fee simple by the Governor of the Territory of Hawaii on January 28, 1911. The lands were described as follow:

> Beginning at a point on the 1801 lava flow, about 45 feet from the sea, on the boundary between Kau and Makaula, marked (o with four strikes around it, North, East, South, West] on solid pahoehoe, the coordinates of which point from Akahipuu Triangulation Station are North 1646.1 feet and West 2731.1 feet, and from which point Lae o Puukala Triangulation Station is by true azimuth 172°56'24" and distant 1743.4 feet, and running by true azimuths: [see Appendix I for the actual coordinates.]

Mahele Award 13-B (Kau, Kona, Hawaii: Royal Patent Grant #880 (Waimea, Koolauloa, Oahu). Mahele Book 57-58 (62-63). Relinquished: ½Waimea Ahupua`a, Koolauloa, Oahu and Puuepa, Mookini, Kohala, Hawaii. Received: ½ Waimea Ahupua`a, Koolauloa, Oahu and Kau Ahupuaa, Kona, Hawaii (Aw Bk 3:327: *Indices* 138)

Claim #6237 "Not awarded."

> **Native Register 265.5** claimed for her by her husband, unsigned (K/A Kaeliwai),
> [Note: don't know if K/A means *konohiki ahupua`a*]:
> ½Waimea, Koolauloa, Oahu with *pahale* and sweet potato patches;
> Kau *ahupua`a* in Kona, Hawaii.
>
> **Foreign Testimony 16.5** claimed "for his wife" (unnamed); Kaeliwai claimant
>
> **Native Testimony 330.10** "True copy" (*Kope Oiaio*) of Mahele Book (signed) by A.G. Thurston, Secty. January 30, 1854
>
> **Annotated:** "Waimea has been sold by the Minister of Public Instruction as School Land to Kaeliwai."

D-3. Paalua. Scant information about Paalua was readily available, but what little there was came from *The King's Mahele: The Awardees and Their Lands* (Barrère 1994:500-501). Paalua claimed (Native Register 288.2) the following lands as "the only living granddaughter of Hewahewa, *kahuna nui*" of Kamehameha I, whose lands these belonged to:

<u>Lands on Hawaii</u>
Iliokola in Kau
Pulama in Puna
Kahalii in Hilo
Kalua in Hilo
Opelukui in Hilo
Kau in Kona (Mahele Award)
Makalawena in Kona
Kiolo in Kona
Koholalele in Hamakua
Puuepa in Kohala (relinquished in Mahele)
Waikaalulu in Hamakau

<u>Lands of Kauai</u>
Kaole

<u>Lands of Maui</u>
Aleamai in Hana
Keaweakapu in Honuaula
Puunoa in Lahaina

<u>Lands of Molokai</u>
Kawaikapu

<u>Lands of Oahu</u>
Pawaa in Honolulu
Kawaiki
Waimea (Koolau) (Mahele)
Kauwila

Paalua was married three times: (1) to Kaeliwai up to around December 1860; (2) to J. N. Kanaulu, married about 1874; and (3) to Mikaele Kaiwinui, married between 1875-1878. She had no children with any of her husbands.

> Waimea was originally granted in name of Paalua's husband Kaeliwai as R.P.G 880 in 1852 (*Index to All Grants* Pt. I p, 53, with no acreage shown.) In 1860 Kaeliwai deed this grant to Paalua. Deed says: "The reason for the conveyance...is that my name was wrongly written in Royal Patent (Grant) No. 880...the land has been conveyed to Paalua..." DEED, Kaeliwai to Paalua, Waimea, Koolauloa, Oahu 1, 289.50 acres, December 31, 1860 (Bureau of Conveyances L 58 pp 1500151).

When she died July 3, 1886, she wanted all of her property in Kaū, (North) Kona, Hawaii; Waimea, Oahu; and a house in Kauluwela, Honolulu, to go to her husband Kaiwinui. "Her Will to be drawn in such a way that the paper (Will) cannot be broken – 'because I have so many relatives.'" The following is her **(Mahi genealogy)** and descent from Hewahewa *kahuna nui*:

Kane	Wahine	Keiki
Umiokalani	Piimauilani	Hoolaakaiwi, w
Kanaloa-uoo	Hoolaakaiwi	Mahiopelea
Mahiopelea	Kauakahi-heleikaiwi	Kaohuki-okalaipohina
Holoae	Kaohuki-oakalaipohina	Paílili
		Pine, w
Pailili	Haalolou	Puou
Puou	Kamakona	**Hewahewa** (kahuna)
Hewahewa	Kailakaoa	Kamokumaia
Kamokumaia	Kualii	**PAALUA**, w

D-4. Hewahewa. It is clear from the literature that Hewahewa was a significant person because he was so involved with Kamehameha I as his *kahuna nui,* and after the death of Kamehameha, as guardian and advisor to Liholiho, Kamehameha II; but more importantly because he was the descendent of Pa`ao (more following). [Note: Hewahewanui was also married to Piipii who was the grandmother of Sam Parker and his sister Thelma (McKenzie 1986:108)].

The Kahunanui line from Pa`ao was passed on from father to son; Pa`ao to Holoa`e to Pailili to Pu`ou to Hewahewa. "He was born on the island of Hawaii at Kohala, and like his father and their fathers, did not limit their practice to one field of kahunaism. They were seers, prophets, healers, both in prayer and medicine, they were chanters and they performed the dreaded sacred practice of human sacrifice." Hewahewa and his father Pu`ou accompanied Kamehameha I on his war campaigns, advising and performing the necessary ceremonies to appease the war-god Kuka`ilimoku (Mitchell:1979:7). Hewahewa was also instrumental in carrying out the abolishment of the old *kapu* system after the death of Kamehameha I. Before his death, Kamehameha I appointed Hewahewa to be the *kahu* and *kahunanui* for Lihiliho. A few months after the death of his father in May 1819, the new king, Liholiho-Kamehameha II, was convinced by his mother, Keōpūolani and Ka`ahumanu to break the *kapu `ai*. After spending a few days out at sea to think about it, he agreed.

> Hewahewa - the highest kahuna under Kamehameha I and a direct descendant of Pa`ao, was the first to torch a heiau (Hawaiian temple) when the kapu was broken. He said, "I knew the wooden images of deities, carved by our own hands, could not supply our wants, but (we) worshipped them because it was the custom of our fathers... My thought has always been, that there is one only great God, dwelling in the heavens." (Richards 1885:17) The kapu system was broken before the missionaries arrived. After torching the heaiu he retired to Kawaihae to await the coming of a "new and greater God." When the missionaries arrived he was there to greet them, telling all who would listen that these who were coming would tell them of this new God (n.a. 2003).

With the abrogation of the old religion, there was no longer any need for a *kahunanui*. Hewahewa joined some missionaries in Waiohinu, Ka`u to help with the building of a church made of cut stone. "Hewahewa found that the white *kahuna* had no magic at all. They were as helpless as the wooden gods which had been burnt" (Mitchell 1979:15). He was asked to join the church but refused.

Hewahewa was given many tracts of land on several islands by Kamehameha: the *ahupua`a* of Kaū was only one of those lands. He was also given the *ahupua`a* of Waimea, O`ahu by Kamehameha I. So around 1826 he left Ka`u and settled in Waimea Valley. It was a place that had for centuries been associated with *kahuna*: Lono-a-Wohi, Kaopulupulu, Keopiupu`u, and Koi. Hewahewa became the chief of the people there. Shortly after his arrival he noticed that many people were being afflicted with epidemics that caused the deaths of thousands. Governor Boki and Hewahewa gathered other *kahuna* of great *mana*: Kaao, Kuauau, Kinopu, Kahiola, Nahinu and Kekaha. These healers were sent to Pu`u-O-Mahuka Heiau, overlooking Waimea Valley, "to render their skills in the practice of healing to the people of Waimea and its surrounding district of Waialua" (Mitchell 1979:15-16).

Makeua, make a Waimea
Oahu, February 16, 1837

Oia ke kahuna nui O Kamehameha i ka wa`e hoomana ai i na ki`i. Eha paha hebedoma kona ma`i ana; Ua like kona ma`i me ko Kaahumanu ma`i hope loa. I kona mama wa`e mo`i ai ua weliweli nui ia ka hewa, a i kona ia e make ai ua noni oia i ke kahi hoahanau a pule pine ia ke akua nona, a ua pule no oia nana iho ka weliweli. Poma ikai ka poe lohe ia ka ke akua olelo i ka wa ka ma lii ke malama lakou ia ia.
(Mitchell 1979:19-29)

Died at Waimea, Oahu, February 16, his illness lasted for about four weeks. He was the high priest of Kamehameha when images were worshipped. Probably his illness was dropsy. It was like the illness of Kaahumanu in remote past. The day he died he asked one of his relatives to pray continuously to God for him, as he prayed for himself in fear. Blessed are Those who listen to the word of God in their youth. If they keep him. (*Ke Kumu Hawaii* April 26, 1837).

> After Hewahewa's death, the land passed to his son, Kamokumaia (Probate 2480). In Emerson's records, the *konohiki* did not live in the area, although his wife, Kualii did. But government documents produced gave evidence that Paalua, the daughter of Kamokumaia and Kualii lived in Honolulu and controlled all the affairs of the valley from there (Mitchell 1979:25).
>
> In 1884, Paalua sold the land to her foster son, Albert K. Kuniakea, the natural son of Kamehameha III, but the young man gave back the land soon afterwards; the transfer was a way for the konohiki to avoid foreclosure on the heavily mortgaged land.... When Paalua died in 1886, she willed the land and all her possessions to her third husband Mikaele Kawainui (Probate 2480). Since her husband was unable to keep up the mortgage payments, the land was foreclosed and picked up by Julia Anthon Paty through her lawyer, Mr. Carter. When Julia Paty died, the land was willed to two of her daughters, Mary Frances Van Valkenburg and Annie Elizabeth Mott-Smith.... Finally the land was given up by the two sisters and sold at public auction in the 1930s (Mitchell 1979:26).

**D-5. Pa`ao.** North Kona was most likely inhabited long before Pa`ao migrated from Society Islands and constructed the Waha`ula Heiau in Puna or the Mo`okini Heiau in North Kohala in the *ahupua`a* of Kokoiki [ca. 11th to 13th century]. The *mo`olelo* tells of Pa`ao voyaging to the Hawaiian Islands and finding no suitable *ali`inui,* goes back to `Upolu [place name in both Samoa and Tahiti] to bring back a chief named Pili to rule. The royal line had been compromised through intermarriages with commoners (Stokes 1928:40).

There are several versions of the legend of Pa`ao and Pili (Fornander 1880; Emerson 1893; Thrum 1923; Malo 1898/1987, and Westervelt 1923) to cite a few. The following are excepts from Pukui and Green (1995) "The Story of Pā`ao and Lonopele." Their version is a little different from Stokes' (1928) summary below. ["This story was told by Mrs. Kanui Kainaina of Hilo (Pukui and Green 1995:71).

In Pukui-Green's version, Lonopele and Pā`ao are brothers who are priests of the gods Lono and Kū; Pā`ao the priest of Kūkā`ilimoku, "Kū, the Snatcher of Islands, who later became the war god of Kamehameha I." They each had sons whose pranks often led to quarrels between the brothers. Tragically they ended up killing each other's sons. Lonopele, the older brother ordered Pā`ao to leave and seek a new home. "Pā`ao went to Tahiti, where he gathered a number of followers who called themselves *manahuna....*" "On the way, a lizard *kupua* begged to join them and was allowed...*kupua* after *kupua* from different islands joined the company" (Pukui and Green 1995:68). In the meantime, Lonopele resorted to sorcery and called upon the gods to destroy his brother with a huge storm. Pā`ao prayed to Kanakaokai, a god of the sea who sent *ōpelu,* then *aku* to keep them safe.

> They landed at Puna on the Island of Hawai`i. There Pā`ao built the temple of `Aha`ula, or Red Assembly, so named because of the red feather cloaks worn by the god Kūka`ilimoku and the

> other gods. He left priests there to care for the temple and to cover the lava rock with soil brought in pandanus baskets from the hill country, to plant rare trees, and dig a well, thus making an oasis in that desert place. The priests kindled a fire in the temple grounds, which was consecrated to their gods and kept burning night and day. Whatever man the smoke of that fire fell upon, whether high or low in rank, became a sacrifice to the gods. Hence the name of that temple was changed to Waha`ula, Red Mouth, because it devoured men....
>
> Pā`ao saw how the chiefs had sinned by intermarriage with commoners, thus diluting the sacred blood. He sailed back to Tahiti and returned with a chief and his family from there to restore the ancient rank of chiefs in Hawai`i. The chied was Pili`ao`ao, ancestor of Kamehameha I. Pā`ao set him up as the highest ruler on Hawai`i and served Pili`ao`ao until his death. The son of Pā`ao served the son of Pili`ao`ao and so on for succeeding generations. Hewahewa, who was high priest in the time of Kamehameha I, was a descendant of Pā`ao (Pukui and Green 1995:69).

Stokes (1928) presented a paper to the Hawaiian Historical Society trying to establish the origin of Pa`ao by summarizing accounts by Fornander, Emerson, Thrum and Westervelt. Stokes discerned that certain elements and practices relayed in each version were "more characteristic of influence from the Society Islands than from other parts of Polynesia; in particular, the temple forms..." (Stokes 1928:41). One of the investiture rituals involved the sacred red-feather girdle, practiced by the royal Raiatean family who occupied the throne of Tahiti; the only place in Hawai`i where this was found was on the island of Hawai`i – "where it appears in the investiture of the sacred kings descended from Pili." Kalakaua left a note that it was used in the time of Liloa. Pa`ao used the girdle when installing Pili in Westervelt's version. A Pa`ao name search in all of the southern islands does not turn up anything in Samoa or Tonga. "Pili is said to have come from 'Kahiki' or 'Savaii'"- 'Kahiki' means 'Tahiti' and 'Savaii' is Samoanized for Havaii, and "Havaii as is now known, was also the ancient name of Raiatea" (Stokes 1928: 41-45). Based on his summary, Stokes was convinced that Pa`ao came from Tahiti in the Society Islands.

> The walled *heiau* was introduced to Hawai`i about AD 1100 by Pa`ao, according to Fornander. Pa`ao was a Southern Polynesian (Fornander 1880, 2:36/1969:2; 36) who arrived with the flood of southern migration to the Hawaiian Islands in the eleventh and succeeding centuries. With this form of *heiau* came changes or introductions in religious forms and probably human sacrifices. The stone-walled form might be typified today in Waha`ula Heiau, which tradition says was the first walled *heiau* built in Hawai`i and the first to be built by Pa`ao (Stokes 1991: 22).
>
> The migration of Pā`ao belongs to the same period as that of Mo`ikeha and `Olopana, and it is clear from a reference to the story of the migration of Mo`ikeha to Hawai`i, published in the *Fornander Collection* 4:114, that the two stories draw from the same source. These two *kupua* women are there claimed as the sisters of Mo`ikeha, and the priest of Mo`ikeha has the same name (Mo`okini) as the temple claimed to be erected by Pā`ao in Kohala [Beckwith In Pukui and Green 1995:71-72]

D-6. Kaū Land History. Prior to her death on July 3, 1886, Paalua and her husband Kaiwinui mortgaged the Kaū lands to H. Diamond. After her death, the mortgage was assigned on October, 1886 to Joseph O. Carter in trust for Mrs. Julia Anton Paty (BLC 57:305). On July 3, 1888 a foreclosure affidavit and mortgage sale transferred Kaū to Julia Paty with W. R. Castle, trustee (BLC, Liber 113:89). Under the will of Julia A. Paty, Kaū was inherited by Julia Bishop Egan, Mary van Valkenburg, Annie Mott-Smith, Kate Makee Weight, and Lillian Bolles Paty. On December 20, 1907, the partitioned deed was sold to Julia Egan, then sold by Julia Egan to Allen Wall in 1916 (BLC 300:166-171; 462:319) (In Williams et al., 1993:15). On October 19, 1917 John A. Maguire purchased Kaū from Allen Wall (BLC 393:337), beginning the relationship between Kaū and Hu`ehu`e Ranch. Land history 1938-1974 (Appendix J).

D-7. The Early History of John Maguire and the Puuhue Ranch/Kahuā Ranch Connections. The early history of Puuhue Ranch and Kahuā Ranch is based on letters sent home to England by the early owners of Kahuā Ranch, in *Little Britan: Letters from the Hawaiian Kingdom* by Joan Burchardt, a daughter, of Ernest Ashton Burchardt [1853-1932], and niece of Arthur Godfrey Burchardt [1854-] and

Frederic Burchardt [1859--1893]; and later summaries by Ernest Burchardt. They wrote letters home to their mother, Jane Ashton Burchardt [1818-1908], in Liverpool and their sister Christina (Chrissie) Burchardt [1856-19??], but only letters written between 1884 and 1891 survived. Their father, Otto Ernest Lebrecht Burchardt [1808-1882] was the Prussian consul in Liverpool during this period. In 1996 Joan's sister Eleanor found 56 letters from their father and uncles in her attic (Burchardt 2002:v, 19).

Godfrey was the first to leave England in 1878; first to New York, then by rail to San Francisco where he met Theo H. Davies, who became his agent. Godfrey took a steamer to Hilo, then rode [animal] to Ka`u where he had purchased some land above Honoape "under contract with Hutchinson of Naahelu [sic] Plantation" (Burchardt 2002:9-11). Ernest followed in 1879 to help Godfrey along with "his gang of ten Chinamen", a Japanese "and a native or two" and Frederic came shortly after (Burchardt 2002:12). Ernest later summarizes their earliest experiences in Hawai`i:

> Our cane was ready before the new mill at Honoapo was finished and it suffered badly from the delay. We had 140 acres of it... [Fern Hill Plantation, Honuapo; agent W. G. Irwin and Co.; Spreckels was a partner of Irwin (Burchardt 2000:16)]. Godfrey then took some cane belonging to Naahelu Plantation which had been bought by Spreckels, the San Francisco "sugar king." Then he went to Aamano, in Hamakua, & looked after a place belonging to Theo. H. Davies & Co. of Honolulu. And we decided to give up the Kau [Ka`u] venture, on which we had lost money, and I got a job from Davies to work a plantation at Hawi, Kohala, Hawaii, that belonged to the estate of James Woods, who died just then [December 1883 at age 38 (Burchardt 2002:89)] and who also owned Puuhue Ranch. John Maguire, a half white, ran the ranch and put me in the way of working the sugar. And I kept the estate books. This was the beginning of a friendship that has lasted till his death in 1919. He was one of the very best. He married after his first wife died, Eliza Low, who was governess at Puuhue....
>
> There was a lawsuit between the trustees of the Woods estate and the widow [Mary Parker Woods, later Stillman (Burchardt 2002: 90)], and I had to give evidence and produce my books, and got through it very well. I had a lay readers licence (sic), and read the service at the little church [St. Augustine's in Kapa`au (Burchardt 2002:22-23, 26)] when the clergy went once a month to Hamakua. And I read the lessons on the other Sundays.... After two years of that, Uncle Sam Ashton left us a legacy; and the three of us bought Kahua Ranch with John Maguire [Maguire was at the time manager of Woods' Puuhue ranch (Burchardt 2002:24)], from George E. Holmes. It lies on the Kohala mountain, above Puuhue, and on the Waimea road. Fred and I managed it. And Godfrey shortly afterwards went to Maui, where he started a dairy ranch, taking a lot of half bred Jersey cows from us. We branded 970 calves, and reckoned our stock at about 5000 head (Burchardt 2002: 12-15).

The following excerpt is from a letter from Ernest Burchardt to his sister Chrissie in England, dated January 28, 1886:

> *I have at last to tell you that we have settled to go into Kahua Ranch, & have bought 5/8 of the same, Maguire taking 3/8. Please send me out £1300 as soon as convenient. You can send it in a marginal draft, or any other way you prefer, that I can cash at Bishop's Bank. The ranch is a fine one, with certainly over 3000 & probably over 4000 head of cattle on it, & all the necessary horses etc. for working it. There are 3000 acres land in fee simple, & I suppose 13 or 14000 leased. It is a good steady sort of thing, safer than cane. Fred and I will manage it...*(Burchardt 2002:121).

In a letter to his mother dated the same day, Frederic Burchardt writes the following:

> *I have told Chrissie our latest news about our having at last come to terms for the purchase of 5/8ths. Of Kahua ranche* (sic) *& I do not grudge in the least having given up the last six months to searching for an investment, it is entirely a cattle ranche, for the purpose of raising beef, & though of course I know better than to expect it to be a gold mine, yet I have every reason to hope it will be safe, steady business in a small way, we can't yet tell how many head of cattle there are on it, certainly over 3000 head, perhaps nearer 3500, but we have bought in cheap as the market*

is low at present, owing to some of the ranches being obliged to clear the cattle off their land & sell at any price, in order to clear the land to sell it & at any rate at present prices, cattle show a decent return if reasonably well managed.... I shall want rather an outfit now we are going to live on the ranche, as it is often cold up there & one wants warm clothing as well as cool.... The ranche house is I think about 3000 feet above sea level, & a much more bracing climate than here [Hawi]...(Burchardt 2002:121-122).

Fred writes in another letter to his mother:

> *The ranch is a very safe one indeed, as it runs from the sea, to an elevation of about 3500 feet in the hills, a gradual slope all the way, is the best watered ranch on Hawaii, & is not as liable to drought as most of them, in fact a large portion is never affected in the driest time; further it is not at all a dangerous country to ride over, as there are no cave pitfalls on it. The stock on it are better bred than on most ranches...*(Burchardt 2002:123).

In a letter dated February 7, 1886 Ernest wrote to his mother about the ranch as he had more time to go into detail. He describes the ranch, its boundaries and landscape:

> *I have had little time to write any but business letters lately, but now I have a quiet Sunday I can tell you about Kahua. If you look on the map you will see, on our West coast, Kawaihai or Towyhai. That is our south boundary, about. Thence we have five miles of coast northwards; the ranch all lies straight inland from that to the top of Kohala mountain, about six miles away. There are over 15000, probably 20000 acres of land. 3000 are fee simple; the rest leased. There is on the road from Puuhue to Waimea, 5 miles from Puuhue, 12 from Waimea. The upper portion of the ranch is good feed, & well watered, & partly fenced; the lower is rough land, & only to be counted on after rains. It may be much improved by piping down the water.... It is a fine place & will run at least 4000 head. Holmes claims there are that number now.... We shall join with Puuhue & start some butcher's shops here & run out the small Chinese butchers. The cattle are good for this country, but lots of room for improvement yet...*(Burchardt 2002:123-124).

The following month in a letter dated March 7, 1886 Frederic wrote to his mother telling her about his going to Honolulu to take care of Kahua Ranch partnership transfers:

> *I have been very busy, down to Honolulu with Holmes & John Maguire, getting our transfer & partnership papers made out, also our principal lease renewal for fifteen years, then back here again...Holmes is still in charge of the ranche, but I go up tomorrow & shall stay there with him, & Ernest will be up there just as soon as another man comes up to relieve him in his present position. I shall be awfully busy for the next month or so...the work mostly consists of seeing after the young calves, we drive them into a pen about once a month with the mothers & brand them, & then let them go again & never have to bother with them again until they are driven into the paddock kept for fattening them previous to killing. Most of our beef, i.e..all the best of it goes to Honolulu, & the smaller beats are eaten by the people here...*(Burchardt 2002:125).

In the same letter Fred explains to his mother about their firewood business; subsequent letters from both Frederic and Ernest mention this activity:

> *One of our principal sources of income from the ranche outside of beef will be firewood which is scarce here, & which we sell for $5 a cartload, also pigs can be made to pay very well & there is a steady demand for pork amongst both natives & Chinese. I feel confidant we can make the ranche pay, not in the gold mine sense of the word, but still a very high rate of interest on the money we are investing...*(Burchardt 2002:125).

The following excerpt is from the summary of Ernest who wanted to go back to England; it is followed by an excerpt from a letter to his mother dated April 3, 1890 noting the event of selling Kahua Ranch to John Maguire:

> In December 1889, Uncle Ben died, leaving his property to Godfrey and Fred. I had already consented to stand for the Legislature, and had to go through with it. Godfrey gave me his share of

the ranch, and I sold out to Maguire, meaning to go home as soon as the Legislature was over (Burchardt 2000:15).

> *Left in six days for Honolulu with J. Maguire, & half the planters in Hamakua & Hilo on board. Smooth run this time, except for a short time in the channel: got in by dawn...then down town doing all sorts of business connected to the sale of the ranch to Maguire.... I am to put all accounts in order & generally hand over the business.... Maguire takes all my goods & chattels that he can, at a valuation: and I don't anticipate any trouble in selling the horses, as people are after them on all sides...I expect all papers to be signed by the end of next week, before I leave for Maui.... How it does blow! & the thermometer at 50 deg. & once at 47 deg. at night. Never was such weather* (Burchardt 2002:184-185).

According to information from State of Hawaii Archives Ernest Burchardt was given permission by the Ministry of the Interior on August 29, 1891 to resign from office; yet his own account states that he got home to England in October 1890, perhaps leaving before he received permission (Burchardt 2002:179).

In her Epilogue, Burchardt (2002) writes the following about her father:

> Ernest...got home in October 1890.... In 1907 he married Viola Mary Bruce Joy, the daughter of George W. Joy, the painter. They had seven children of which I am the sixth.... John Maguire came to visit my father in England...Harrods would not serve him because he was "black," after which we were never allowed to go near the place. He sold the Kahua ranch to James Wood's son Frank Woods, in 1895, and...returned to the Huehue ranch in North Kona (Burchardt 191-192).

D-8. Maguire-Woods-Parker Connections: Kahua Ranch, Puuhue Ranch & Hu`ehu`e Ranch. Information regarding this period comes from several sources--from a descendant of John Maguire, Internet infomercials about Parker Ranch, newspaper articles and reports. In a conversation with consultant Hannah Springer, she explained some of the family genealogy and her ancestor's connections. The following information comes from that conversation.

John Avery Maguire was the son of Charles and Hi`ilawe Maguire. He was half-Hawaiian and half-Scottish. He was born at Pa`ohau Landing in Mānā, Hawai`i Island. John Maguire's first wife was Luka Hopula`au [her inheritance formed the nucleus of Hu`ehu`e Ranch in North Kona]. Hannah Springer is descended from this union. When John's first wife died (1898), he married Eliza Davis Low. John Maguire was a friend and in-law of Samuel Parker [son of Parker Ranch founder John Palmer Parker who came from England, jumped ship off Hawai`i shores in 1809 as a 19 year-old youth. In 1815 after returning from a stint in China during the War of 1812, he became the first person Kamehameha I allowed to the maverick cattle that roamed the plains and valleys of Hawai`i by the thousands. That same year he married chiefess Kipikane in 1815 (Parker Ranch 2002)]. John and Luka's son Charles Lauluheimalama Maguire married Samuel's daughter Mary Kihalaninui Parker in a double wedding with cousins Hannah Low and Robert Hind. Hannah Low was the sister of Eliza Low. Princess Ka`iulani came to this wedding in Mānā. Samuel Parker's sister Mary Parker married James Woods who died early at the age of 38. Their son Frank Woods married his cousin Eva, daughter of Samuel Parker (Springer 2003). Aileen Ruth Kihalani Maguire was born at Kahua in 1893 to Charles and Mary Maguire and was raised at her grandparents house, John and Luka Maguire at Hu`ehu`e until Luka's death; then by Eliza. Aileen later married Arthur Joseph Kahiwahiwa Stillman; in 1919 they became parents of Thelma Kihalani Stillman Springer [mother of Hannah Kihalani Springer], at Hu`ehu`e Ranch (Springer 1986:129, 13777),.

In her article about Kahua Ranch in *The Waimea Gazette,* Melrose (1998) provides a little more information about the Maguire-Woods-Parker connection.

> Pioneer rancher John Palmer Parker started his ranching career in Kohala at Waiapuka. Later, he encouraged his granddaughter Mary Ann to marry Englishman James Woods, future owner of Pu'uhue Ranch in North Kohala. The 1868 marriage produced eight children, including a son

named Frank, who was eager to get on out and start a ranch on his own. In 1895, he purchased half-interest in the fee simple lands at Kahua Ranch from John Maguire. The previous owners, three English brothers, Godfrey, Ernest and Fred Burchardt, had bought the land in 1886 from George Holmes. After five years of struggle, the brothers sold the land to Maguire, and headed back to England. Maguire later sold his full interest in Kahua to Woods and devoted his energy to Hu'ehu'e Ranch in North Kona. Woods also leased land surrounding Kahua homestead from Captain Austin. It was Austin's good fortune to marry one of Kamehameha's nieces and she owned the lands of Kawaihae. Eventually, the control of that land fell to the Austin Estate managed from Boston, Massachusetts. With Kahua safely in hand, Frank married his young and beautiful cousin, Eva Parker, and prepared to start his own family.... Frank Woods invested heavily in a new scheme to turn Kahua into a sugar plantation....

Pu'uhue, the old Woods property, was Kahua's neighbor to the north. For years it was managed by Sam Woods, Frank's brother. (...After Eva Parker's early death, Frank married Kahanu, the widow of Prince Jonah Kuhio Kalanianaole. Sam, not to be outdone, married Tootsie Dowsett, the widow of John Parker III and Thelma Parker's mother.) After Sam's death, the numerous heirs, unable to reach any workable agreement, decided to sell Pu'uhue....

D-9. Hu`ehu`e Ranch and Kaū. In 1888 and 1896 John Avery Maguire acquired Land Grants 3438 and 3953. In 1895 he sold Kahuā Ranch to concentrate on Hu`ehu`e Ranch. Then in 1906 the J. A. Maguire Estate obtained a 21-year lease (General Lease No. 590) of grazing land in North Kona from the Territorial Government; and other parcels of land in Holualoa and North Kona in 1913. In 1916 Maguire purchased the "Star Brand" used to brand Hu`ehu`e Ranch cattle, from W. P. and George W. McDougall (BLC 284:166). The ahupua`a of Kaū became a part of Hu`ehu`e Ranch in 1917 when Maguire purchased Kaū from Allen Wall. Hu`ehu`e Ranch was incorporated and in 1918 John A. Maguire of Hu`ehu`e, North Kona, Hawaii became the lessor for 16 years to the John A. Maguire Estate, Ltd.; this included 1,560 acres of Royal patent 8265/LCA 13B to Paalua as well as other awards and grants (BLC 473:273-276). By 1929 Hu`ehu`e Ranch owned 15,000 acres and leased another 25,000 acres. Hu`ehu`e Ranch extended "from sea level to about 6,000 feet" (Henke 1929:28) in the *ahupua`a* of Kūki`o with lease-lands in Ka`upūlehu, Manini`ōwali and Kaulana (Maly 1998:31). The ranch's Holstein cattle were branded in stone-enclosed corrals and driven on cattle drives down Koloiki Trail to Kailua where they were shipped off island (William et al., 1993:15).

Later, as part of the Maguire Estate, Hu`ehu`e Ranch was inherited by Thelma K. Stillman (Springer), Nancy S. Stillman (Oliver), and Mary S. Robinson (Holt), the grandchildren of John and Eliza Davis [Low] Maguire and managed in Trust by Alfred Carter (HSTO 1942-1943), [Descendant (?) of Alfred Welling Carter who was the manager of Parker Ranch in the late 1800s; prior to that position, he was a Honolulu businessman and judge (Parker Ranch 2002)]. A twenty-one year lease was renewed by Carter in 1940 (HA 1940:1, 4). The Honolulu Advertiser announced on February 13, 1941 that Hollywood movie star Errol Flynn had purchased the 50,000 acre Hu`ehu`e Ranch (HA 1941:1, 3). Thelma Springer, Mary Holt and Nancy Oliver appear as owners in 1955-1956 as beneficiaries under trust (HSTO) (Williams et. al., 1993:16). A 1961 Hawaii survey of ranches lists Thelma K. Stillman Trust as owner of Hu`ehu`e Ranch with 9,615 acres in-use and 6,199 acres not in-use (SOH 1967:118). Hu`ehu`e Ranch was purchased in 1961 by the "Kona Corporation" (Carl Adair, Mrs. Blanch Hill, Randolph H. Hearst and M/M Robert Cheeseman) who was planning on resort developments. However, the sale was defaulted and reverted back to the Stillman Trust (HA 1961:1.1; 1964:1.1). Hu`ehu`e Ranch was resold in 1966 to the Bellevue Cattle Company of Beverly Hills (HA 1966:1.1-7). In 1966 the State tax records for TMK 7-2-05:01 list the Foothill Land, Kaloko Land, and Mauna Loa Cattle Corporation as owners; in 1967 Charles C. McCarthy and L. M. Prince, Jr. joint tenants in ownership. In 1974 Kau-Kona Land Company is listed as owner (Williams et al., 1993:16).

D-10. Kaū and the Lands of Kekaha. Kaū is one of the *ahupua`a* within the sub-district of Kekaha; once considered to be a part of "Kahuna lands," explained below by Kamakau (1992):

> The chiefs did not rule alike on all the islands. It is said that on Oahu and Kauai the chiefs did not oppress the common people. They did not tax them heavily and they gave the people land where they could live at peace and in a settled fashion. When Oahu came under the rule of Kama-pua`a, he gave the land containing the word *wai* to the kahuna Lono-a-who; but later the land was redistributed by Kahiki`ula and the older brothers of Kamapua`a because the kahunas had a monopoly of the well-watered lands, and the kahuna class were given the lands of Waimea, Pupukea, Waiahole, and Hakipu`u in perpetuity, and these were held by them until the days of Ka-hahana. Kahekili and Kalanikupule confirmed this gift to the kahunas, and so did Kamehameha. Waimea [O`ahu] was given to the Pa`ao kahuna class in perpetuity and was held by them up to the time of Kamehameha III when titles had to be obtained. But there was one land title held by the kahuna class of Pa`ao for many years and that was Pu`uepa in Kohala. In the same way the land of Kekaha was held by the kahuna class of Ka-uahi and Nahulu (Kamakau (1992:230-231).

> [Although] Pu`ou and his son Hewahewa [were] of the Pa`ao priesthood; Kuaiwa and Holo`io-lena of the Nahulku class; Ka-pou-kahi of the class of Hulihonua kahunas who point out locations and superintend the building of heiau (Kamakau 1992:187). These Kauahi and Nahulu lines of priesthood assumed active and influential roles well into the historic period. They served as counsel to kings and later even dared to voice strongly their disapproval over Liholiho's "free-eating" and his general disregard of traditional precepts. Their Kekaha lands thus guaranteed by chiefs such as Kalaniopuu and passed quietly to their progeny. Individuals descending from one of these priestly line, the Nahulu, included the twin Chiefs of Kameeiamoku and Kamamawa (Silva 1986:110).

Kamakua commented that Kameeiamoku's son Ulu-mahaihei Hoapili "was well-trained in all of the arts of this esteemed lineage...Hoapili "belonged to the priesthood of Nahulu and was as expert in priestly knowledge, He had been taught astronomy and the ancient lore...debate knowledge of history and rule of the chiefly lines, ancient protocol, royal genealogies, and proficiency in the English language as well (Kamakau 1961:215, 354-355 In Silva 1986:110).

And if these were *kahuna* lands it would have been a place where the kahuna had their school to train their students on the various plants, and rituals. There would be people who were retained to look after them; to care for the fishponds, that provided the fish and sea birds; and to go fishing for the fish, and crabs, and *limu* and other ocean delicacies; and to cultivate the land and produce the staples such as taro and sweet potatoes.

> Whenever a little soil could be heaped together along the dry coast of North Kona, a few sweet potatoes were planted by the fishermen at such places as Honokohau, Mahai`ula, Makalawena, Ka`upulehu, Kiholo, Keawaiki and Kapalaoa. Doubtless potatoes were planted on the upland of North Kona, on the lower slopes of Hualalai toward Pu`uwa`awa`, up to a considerable altitude in rainy seasons. In recent times the flatlands of Pu`u Anahulu, having an elevation of 2,300 feet, have supported a number of patches planted by Hawaiian cowboys (Handy, Handy and Pukui 1972:527-528 In Springer 1986:126).

The majority of Kekaha lands are barren, a result of relatively young lava flow, and was known as *Kekaha-wai-ole*, the desolate land without water, where Pele the volcano has eaten the heart out of this section (Silva 1986:108). However, up until the 1801 lava flow, there appears to have been several coastal settlements that enjoyed the abundant marine resources from the ocean and the fishponds. Although the lava flow destroyed hamlets and fishponds, there are still remnant beaches in areas such as Ka1upulehu, Kuki`o, Manini`owali, Makalawena and Mahai`ula (Springer 1986:121); the lava flow spared the fishponds and beaches of Kaloko and Honokohau.

In the mid-to-late 1800s Kamakau, a native Hawaiian historian wrote about this lava flow that greatly affected the people of Kekaha as well as Kamehameha, his chiefs and *ohana.* The following is his story of the event.

Another important event which occurred in the fourth year of Kamehameha's rule was the lava flow which started at Hu`ehu`e in North Kona and flowed to Mahai`ula, Ka`upulehu, and Kiholo. The people believed that this earth-consuming flame came because of Pele's desire for *awa* fish from the fishponds of Kiholo and Ka`upulehu and *aku* fish from Ka`elehuluhulu; or because of her jealousy of Kamehameha's assuming wealth and honor for himself and giving her only those things which were worthless; or because of his refusing her the tabu breadfruit of Kameha`ikana which grew in the uplands of Hu`ehu`e where the flow started.... Kamehameha was in distress over the destruction of his land and the threatened wiping-out of his fishponds (Kamakau 1992:184-185).

None of the kahunas, orators, or diviners were able to check the fire with their skill. Everything they did was in vain. Kamehameha finally sent for Pele's seer (*kaula*), named Ka-maka-o-ke-akua (KNK 1867) and asked what he must do to appease her anger. "You must offer the proper sacrifices," said the seer. "Take and offer them." Replied the chief. "Not so! Troubles and afflictions which befall the nation require that the ruling chief himself off the propitiatory sacrifice, not a seer or a kahuna." "But I am afraid lest Pele kill me." "You will not be killed." The seer promised. Kamehameha made ready the sacrifice and set sail for Kekaha in Mahai`ula (Kamaka 1992:185).

When Ka-`hu-manu and Ka-heihei-maile heard that the chief was going to appease Pele they resolved to accompany him and if necessary die with him. Ulu-lani also went with them because some of the seers had said, "That consuming fire is a person; it is the child of Ulu-lani, Keawe-o-kahikona, who has caused the flow, (Hawaiians believe that the fires of Pele are dead persons who have worshipped the goddess and become transformed into the likeness of her body.) and she [Ululani] was sent for to accompany them to Kekaha. Other chiefs also took the trip to see the flow extinguished (Kamaka 1992:185).

From Keahole Point the lava was to be seen flowing down like a river in a stream of fire extending from the northern edge of Hualalai westward straight toward Ka`elehuluhulu and the sweet-tasting *aku* fish of Hale`ohi`u. There was one stream whose flames shot up the highest and which was the most brilliant in the bubbling mass as it ran from place to place. "Who is that brightest flame?" asked Ulu-lani of the seer." "That is your son." He answered. Then Ulu-lani recited a love chant composed in honor of her first-born child as his form seemed to stand before her :

O ka maka o ku`u keiki ka lamaku`,	The eye of my son are like a burning torch,
Ke kukui momopu wela a haunonoli,	Glowing like the red-hot *kukui* nut,
Oia ka makamua o ke ahi `ena`ena,	It is the first flame to be seen in the burning fire,
Oia kai loko I ke ahi makukuku,	It is there in the bubbling fire,
Kino kuku o Kanaloa-mahe-walu,	The body of Kanaloa-mahe-walu* stands forth,
O ka moholi iki ka`u e mana`o iho,	I suppress my cry of affection,
E mana`o, ke aloha mai la ka ipo e.	It overpowers me, my love, like that of a lover.

[*The editor in Kamakau (1992) explains that a chief had several names. Keawe-o-kahikona is the name of Ulu-lani's son used by people in general, while the name in the chant was used by members of the immediate family (Kamakau 1992: 185-186).]

The flow had been destroying houses, toppling over coconut trees, filling fish ponds, and causing devastation everywhere. Upon the arrival of Kamehameha and the seer and their offering of sacrifices and gifts, the flow ceased; the goddess had accepted the offering. The reasons given for the flow may be summed up as:

(1) Pele's wanting the *aku* of Hale`ohi`u and the *`ahi* fish of Kiholo;
(2) Her anger at being denied the breadfruit of Kameha`ikana in upper Hu`ehu`e;
(3) Her wrath because Kamehameha was devoting himself to Ka-heihei-maile and neglecting Ka`ahu-manu.

It was said that Pele herself was seen in the body of a woman leading a procession composed of a multitude of goddesses in human form dancing the hula and chanting:

Lilo ka makou kane i ka ha`awe `olo`olo e	Our husband has gone to carry the bigger load (Ka-heihei-maile)
Ha`alele ia ka ha`awe leilei e leilei e.	While the lighter load (Ka`ahu-manu) is neglected.

(KNK - *Ka Nupepa Ku`oko`a,* July 20, 1867 In Kamakau 1992:186.)

Not many years after the flow (ca. 1812-1813), Kamehameha decided to leave Honolulu and return to Hawai`i. A young ten-year old John Papa `I`i (1959) was a part of this [four ships] voyage, as he was just charged with taking care of the personal things of the then 16-year-old Liholiho. Young I`i was leaving his mother Kalaikane and his lush homelands of Waikele, O`ahu to venture to a new place. Towards the end of their journey they sailed along the Kekaha shoreline to Kailua-Kona:

> The next day the ship arrived outside of Kaelehuluhulu, where the fleet for *aku* fishing had been since early morning hours. The sustenance of those lands was fish. When the sun was rather high, the boy [I`I] exclaimed, "How beautiful that flowing water is!" Those who recognized it, however, said, "That is not water, but pahoehoe. When the sun strikes it, it glistens, and you mistake it for water. This is not like your land, which has water from one end to the other."
>
> Soon the fishing canoes from Kawaihae, the Kaha lands, and Ooma, drew close to the ship to trade for the pa`i`ai (hard poi) carried on board, and shortly a great quantity of *aku* silvery-hued on the deck. The fishes were cut into pieces and mashed; and all those on board fell to and ate, the women by themselves. The gentle Eka sea breeze of the land was blowing when the ship sailed past the lands of Mahaiula, Awalua, Haleohiu, Kalaoa, Hoona, on to Ooma, Kohanaiki, Kaloko, Honokohau, and Kealakehe, then around the cape of Hiiakanoholae, which was two long points of land. (I`i !959:103-110). [

They landed at Honoaula where the young chief lived and I`i found that his uncle and namesake Papa, was ill. The boy was told by Papa to go with another uncle Kaleiheana; together they went to check on Liholiho. A few days later Kaleiheana took young I`i's to see his father Malamaekeke, who had just landed. Before Liholiho had gotten settled in, they all left for Kahaluu for the *Makahiki.* But that evening I`i insisted in going with his father to Kailua, to their place in Papaula. "The following days were ones of intense famine in Kailua, and the followers of the young chief suffered." It was here that I`i met his *makuakane* Kaiwikokoole, who came with the king's farmers from Kuahewa. "They brought food from the store houses of the king's kept for just such times as this." Kaiwikokoole, who had taken care of I`i on Oahu, wanted to him to stay with him on the farm at Kuahewa until after the "great famine" was over (I`i 1959:111-114).

John Ka`elemakule was a resident of Mahai`ula in the late 19th and early 20th centuries and wrote about a small pond that exists at the back of the sand beach at Ka`elehuluhulu:

> In the church where Mr. Thurston held the prayer service (at Makalawena), long *koa* benches were placed along the walls, and in the center of the church, the *makaloa* sedge had been spread on the floor. The *makaloa* was obtained from what remained of the famous pond that was covered by the eruption. It was the pond Paaiea, a portion of which remains at Kaelehuluhulu to this day. This is what remains of the great pond that was several miles long, but is now covered by the stone plain that spreads across Kekaha (Ka`elemakule 1928:4 [translated by Maly] In Carpenter et al., 1998:10).

Lava Flows were not the only act of nature to devastate the lands of Kekaha. In 1837 and again in 1946, the shores and coastline were battered by tsunami. The tsunami of 1837 was recorded by Missionary Forbes.

> On the 7th (November) about 7 oclk at night the sea at this place receded a number of feet, leaving the shore dry far below low water mark. The phenomenon produced greate [sic] excitement among the natives & fish. The cause was unknown as we had no earthquake nor any sensible cause. The

evening was perfectly calm & pleasant. The moon was in her first quarter. At Kekaha where the shore is low the return of the sea, tho` very gentle swelled far above high water mark and swept away some houses, tho' no lives were lost. At Hilo the return of the sea was very violent and rose high above high water mark and did great damage as many people there lived on the shore. Eleven or twelve souls were suddenly swept into eternity and multitudes of others carried, by the receding waves, far from land but effected a return & some were picked up by the boat of a whaleship lying at anchor. The phenomenon occurred at Hilo about 7 o'clock, being earlier than at this place, tho' not much earlier (Forbes 1984:59 In Carpenter et al., 1998:10-11).

Kelly (1973) discusses the 1946 tsunami that wiped out all of the houses in the village of Makalawena. In 1930 John Reinecke conducted an archaeological survey along the coastline; for some areas this represents the last observation and record of structures in the area prior to the 1946 tsunami. Ka`elemakule was a consultant for Reinecke's study (Carpenter et al., 1998:17).

Several people from the late 19th and early 20th centuries have written about the various *ahupua`a* within the lands of Kekaha and have been compiled recently by Kelly (1973), Silva (1986), Springer (1986), Hurst (1990) and Maly (1998). Unfortunately, other than Hurst (1990) who focuses on the historic ranching period of Kaū land use, traditional Kaū is not mentioned. All of the historical compilations are presented under the motif of "Kekaha Lands" in general, with ethnographic excerpts about specific places, usually relating to coastal sites, a few *mauka-makai* trail references, and historic information about the uplands and homesteads.

E. Review of Previous Archaeology and Other Studies

The following is a review or listing of studies that have been conducted in the Kekaha lands; the Kaū Ahupua`a is a part of this sub-district in the *moku* of North Kona. Most of the reports of the studies listed here were reviewed and basic information was highlighted below in a synopsis format. However, several reports have information that is significant when considering the broader (sub-district) view, therefore they are covered in greater detail, either by direct quotes or paraphrasing/condensing the text.

Pukui (n.d.). "Index to Hawaiian Ethnological Notes" [HEN]-Bishop Museum Library/Archives.

Thrum (1907). "Tales from the Temples" Part II. 'Heiaus of Kona' [From Kailua-Kona area and south. The *heiau* mentioned below are not of the Kekaha lands, but have interesting ethnographic information.]

> Of the heiaus of Kona, too few particulars are gleaned to satisfy the enquirer, either from the historic or traditional standpoint, considering their number and the importance many of them held in this once numerously populated district.... The heiau of Ahuena...since the abolition of idolatry in 1819 the governor has converted it into a fort.... Three idols are still upon the walls, one at each end and one in the center, one of which stood sixteen feet above the wall, was upwards of three feet in breadth, carved out of a single tree...(p69).
>
> Keikiphui was the Kailua heiau of Kamehameha...while of but 100x80 feet in size, its paehumu, or surrounding fence, contained forty images. Its erection is credited to Liloa, and is listed among those repaired by Kalaniopuu at the time of his war against Kahckili, of Maui, hence of pookanaka class [luakini] (p 70).

Stokes (1906/1907 – pub 1991). *Heiau of the Island of Hawai`i: A Historic Survey of Native Hawaiian Temple Sites.* In 1906 and 1907 Stokes surveyed and mapped the *heiau* of Hawai`i Island. However, ongoing internal problems at Bishop Museum as well as other tasks/assignments, philosophical and technical differences of opinions of directors and trustees put the publishing of Stokes' findings on-hold indefinitely...until 1991.

Figure 4. is a map of *heiau* in Kona recorded by Stokes (1991) during his 1906-1907 survey of Hawaiian temples of Hawai`i Island. There appears to be a dearth of *heiau* in the Kekaha lands. Some were destroyed in the 19th century lava flows; others may have been destroyed by even earlier lava flows.

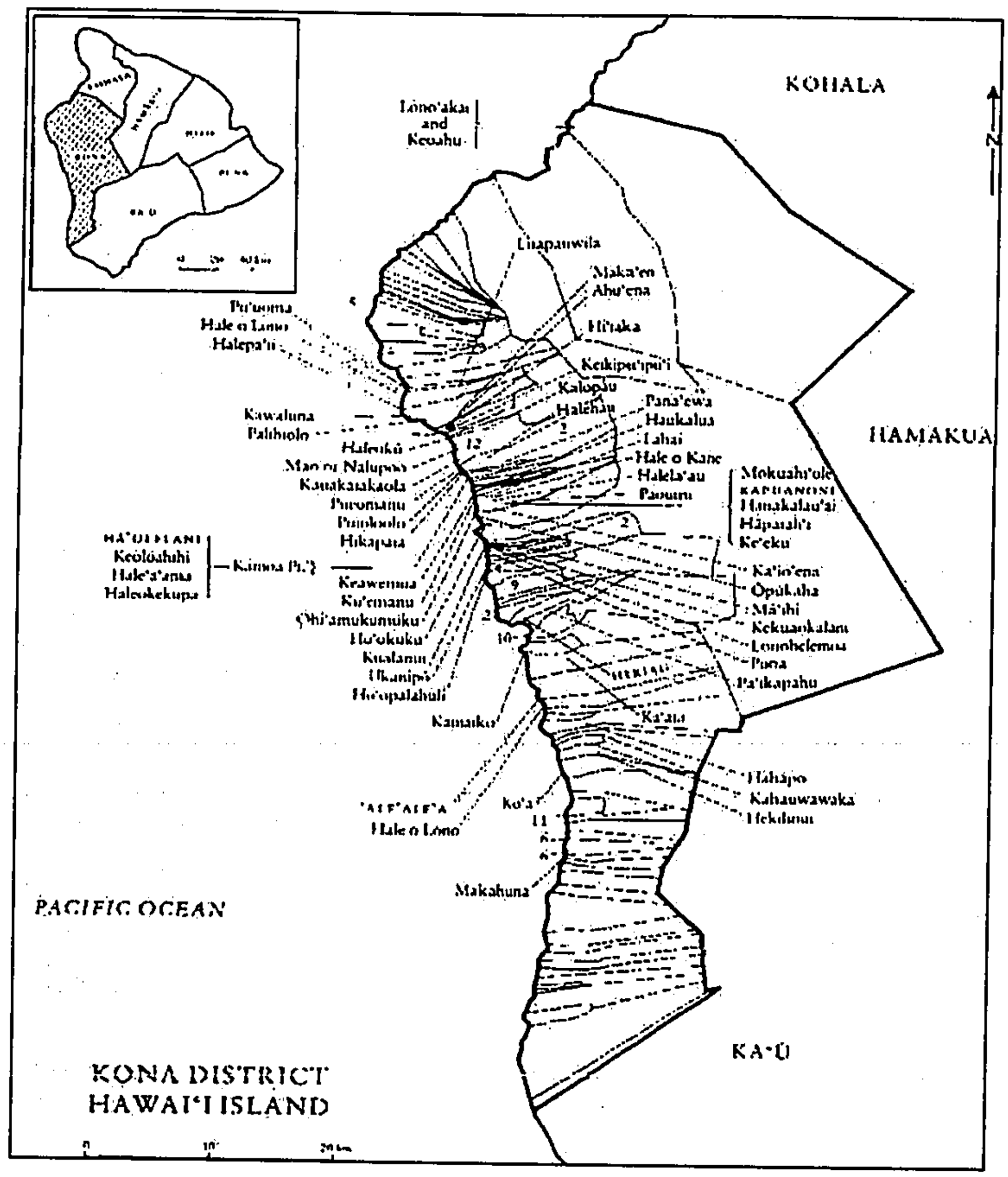


Figure 4. Heiau of the Kona District (from Stokes 1991:41)

> The basis on which these *kahuna kuhikuhipu`uone* worked according to accounts, was that if a certain form of ancient temple had caused its builder to succeed in his enterprise, it would be equally lucky for his patron. I believe that it was not merely the form but also particular features and their arrangements; otherwise, but one type of temple would have survived.... At many of the sites examined, the stone foundations and walls were gone, taken for public or private uses. At most of the others, the lines of the pavements have been destroyed by cattle or by other agencies such as earthquakes, which have shaken down the walls, leaving only stone mounds (p 21).

The following is a list of *heiau* from the North Kona, recorded by Stokes (1991).

Table 3. Selected Heiau of North Kona recorded by Stokes (1906-1907/1991: 40-93)

Lono-akai	Keawiki, Pu`uanahulu	Platform heiau built by Lono-akai, destroyed in 1859 flow.
Keoahu	Keoahu	Destroyed by [Mauna Loa] 1859 lava flow.
Luapauwila	Kealakehe	Walled, `Elemakule homestead, Grant #3765, 3.5 miles/sea.
Halepa`u Ko`a	Keahuolu	Fishing *heiau*, 100' from sea in coconut grove, stand 4' high.
Kawaluna	Keahuolu	Beach ¼ mile from Lanihau, `ili of Pawai, enclosure, luakini.
Palihiolo	Waikilohi, boundary of Keahuolo	On beach in coconut grove, luakini rebuilt on orders from Kalakau (1890) who promised to have a sacrifice on *heiau* on his return from America. Surrounding grove is where Kalakaua's grandfather was hanged for murder. Kalakaua ordered the rebuilding of four *heiau* in the area: Kawaluna, Palihiolo, Halepa`u and Mākāeo.
Mākāeo	Lanihau	Small pen 200' from ocean, ½mile SW of Palihiolo Heiau.
`Ahu`ena	Lanihau	Kawahaokaki`i Point, west of Kailua Bay 650' SW Pa-o-Umi changed between 1819 and 1823. The name `Ahuena is from Ellis and not known locally.... Thrums notes that `Ahu`ena was 'an ancient *heiau*, of or prior to the time of Liloa..., and the first one to be repaired by Kamehameha I' (1907:43). It might also be remarked that `Ahu`ena was probably the first to be destroyed, as the *kapu* was officially broken in 1819 at the royal residence which adjoined the *heiau*, and the destruction of temples began immediately (p 47).
Hi`iaka	Lanihau	Head of Kailua Bay, 100' north of Pa-o-`Umi, a hotel there now. Hotel steps and other stones in yard are stones, and church 800' west, are referred by Fornander (1880, 2:101) as "hewn stones of `Umi." One of these *pōhaku kālai a `Umi* stands in the yard of Bishop Museum. Nahale and Malanui say the *heiau* was built by `Umi – once had 30 *ki`i* described by Arago (1823:72) as magnificent...and who witnessed four young "Sandwich Islanders" in a prayer ceremony around one of the idols on one of the corners of the morai ...(p47-48).
Pu`uoina	Honokōhau 2	Near shore.
Unknown	Makalawena	Ko`a
Haleohiu	Mahai`ula	Ko`a
Unknown	Ka`elehuluhulu	Unknown

Stokes (1928). "Whence Pa`ao?" An investigations into the probable location of the homeland of Pa`ao, a priest, chief, navigator and magician who came to the Hawaiian Islands in the 12th or 13th century. [more information in "Historic References – Pa`ao" above.

Reinecke (1930). "Survey of Hawaiian Sites from Kailua, Kona to Kalahuipuaa, Kohala." His survey included four sections:

Lanihau	adjoining Kailua village, a district fairly rich in remains, especially petroglyphs and papamu;
Honokahau-Kaloko	another district recently inhabited and with considerable remains;
Coast	to Keahole Light
Coast	past the Light, consisting of alternate hamlets on sandy beaches and waste stretches of lava flow and beach (usually coral) The pahoehoe about Lae Mano is of special interest.

> This coast formerly was the seat of a large population. Only a few years ago Keawaiki, now the permanent residence of one couple, was inhabited by about thirty-fie Hawaiians. Kawaihae and Puako were the seat of several thousands, and the smaller places numbered their inhabitants by the hundreds. Now there are perhaps fifty permanent inhabitants between Kailua and Kawaihae – certainly not over seventy-five (p 1-2).
>
> When the economy of Hawaii was based on fishing and hoeculture [sic] this was a fairly desirable coast; the fishing is good; there is a fairly abundant water supply of brackish water, some of it nearly fresh and very pleasant to the taste; and while there was no opportunity for agriculture on the beach, the more energetic Hawaiians could do some cultivation at considerable distance mauka (p 2).

Reinecke lists the coastal sites in a northward direction, giving them site numbers, describing and measuring them as he goes from one *ahupua'a* to the next. Keahole is the starting point for this CIS report:

> Site 84. Keahole boundary ahu: small platform and enclosure, with a walled cave behind.
> Site 85. A broken series of ruined platforms, some apparently large, running along the coast
> Site 86. This series continues past the lighthouse almost to the dwelling by the 1801 Flow.
> (a) dwelling site on edge of pahoehoe with a *papamu* 12x11
> (b) ruined dwelling site and shelter, by a modern pen
> (c) ruinous pen with two house platforms
> (d) trace of another house site makai
> (e) a house platform
> (f) house platform and pen with a modern shelter superimposed
> (g) small, old, ruined platform makai of "f"
> (h) small modern pen
> (i) modern house site by dwelling; opihi shell midden nearby
> (j) very brackish pools
> (k) several rough basin stones and three or more traces of platforms of sea-worn rocks on edge of flow
>
> There are many walled sites on this coast, and it is very hard to tell whether they are the remains of old huts or more recent fishermen's shelters.
>
> Site 87 Tiny recent shelter
> Site 88. Floor of pebbles and shelter; traces of another floor marked by two ahu
> Site 89. Natural shelter caves
> Site 90. North edge of Kaulana, at edge of the flow, and where the coral beach encroaches upon it; concrete salt pans; six house platforms; stagnant pool. [several walls, enclosures] and 4 *papamu*: one 15x13, and three 9x9.

Reinecke recorded and described a number of sites and features from Kaulana northward. Because of the absence of sites between Keahole and Kaulana on the coast it can only be assumed that this was the result of the 1801 lava flow that inundated that area.

Reinecke includes a mo'olelo of Kaupulehu in his report "Ka Wai Hue A Kane at Kaupulehu" by Manuia Monopu from Mrs. L. Yanagi.

Ching and Rosendahl (1968). "Archaeological Surface Survey of the Kailua-Kawaihae Road (Section II. Honokohau to Keahole Point) and the Keahole Point Airport: Archaeology of North Kona."

Adams (1969). "Hydrogeophysical Survey from Kawaihae to Kailua-Kona, Hawaii. Water Resources Research Center-University of Hawaii, Honolulu."

Ching, Cluff and Riley (1969). "Preliminary Report of Archaeological Surface Survey and Salvage Operations at Keahole, North Kona, Hawaii Island : Section II Keahole Point Airport, Kailua-Kawaihae Road." Appendices: Trails / by Jennie Peterson -- Preliminary excavation of feature T-120 (cave shelter), a summarization / by Roy Nishimura -- A formal classification of Hawaiian archaeological features / by Robert J. Hommon -- Notes on a formal classification of archaeological features / by Robert J. Hommon -- Artifact numbering system.

Ching (1971). "The Archaeology of South Kohala and North Kona from the Ahupua'a of Lalamilo to the Ahupua'a of Hamanamana; Surface Survey Kailua-Kawaihae Road Corridor (Section III)." This study covered a corridor 23 miles long and 2,000 feet wide. The Kailua-Kawaihae Road is now the Queen Ka'ahumanu Highway. A total of 1052 features were documented and 259 surface artifacts were collected. Also surveyed were the fishponds for Kekaha.

> The archaeological remains located with in the Highway Corridor and described in the following report reflect Hawaiian occupational adaptations and land us patterns. In the area traversed by the study three major zones of cultural activity have been noted. They have been designated as the coastal or *makai* zone, the transitional or middle zone, and the inland or *mauka* zone.... The archaeological evidence documents a primary dependence on marine resources, undoubtedly by agrarian resources from the uplands. .... The corridor survey provided the opportunity to sample the archaeological remains between the ahupua'a of Lalamilo and the ahupua'a of Kau as an environmental zone.

In the course of the survey a large number of caves were encountered; those that did not appear to have been modified (physically or presence of human activity) were left to be checked during "salvage operations." Similar caves were investigated and contained burials. Burials endangered by highway construction were slated to be relocated.

> William Ellis seems to have been the only traveler visiting this coast who left a record. In 1823, eleven years after Ti made his observations Ellis took a canoe trip from Kawaihae in South Kohala to Kailua in North Kona. Along the way he stopped off at Kaparaoa (Kapalaoa). Here he mentioned a "small village on the beach, containing twenty-two houses, ...carved wooden idols..." (1917:306), and an abandoned *heiau*. He also visited the village of Wainanarii (Wainana'lii) and mentioned the name of it's chief, Waipo. Later that day his canoe put in at Kihoro (Kiholo) which he described as "a strangling village, inhabited principally by fishermen." (1917:306) The Fishpond of Wainana'lii at Kiholo Bay must have been quite impressive as this is the only one of the nineteen fishponds along this coast which he described. This pond was destroyed thirty-six years later by the Mauna Loa pahoe'hoe flow of 1859. However, in 1823 when Ellis saw it, this fishpond was still in operation, "well stocked with fish" (1917:308). Kaupulehu was his last stop before completing his journey to Kailua. Nothing was noted about the village because he arrived so late the villagers were sleeping (Ching 1971:35).

In addition to the *mauka-makai* interaction, which many allude to, Ching (1971) wanted to demonstrate "that the land between Kawaihae and Kailua supported a larger aboriginal habitation more varied and complex than that mentioned in the ethno-historical material for the area" (Ching 1971:37).

> The corridor exhibits a wide variety of features and is a fine example of the adaptability of the Hawaiian culture to a harsh terrain. Eliza D. Maguire describes the area: 'Kekaha, (barren, desolate) was the name given to that section of North Kona from Honokohau, North of Kailua, to Napuu (the hills) meaning Puuwaawaa and Puuanahulu, and along the coast to Anaehoomalu, the boundary of South Kohala...." The major portion of the corridor extends over areas of dry barren fields of a`a and pahoe`hoe lava. Here man has taken advantage of the many lava tubes and bubbles for habitation, for temporary shelter in his *mauka-makai* travels, and for burial of his dead. Where convenient caves were not found, he resorted to stonewall structures. These usually take the form of C-shape, U-shape, L-shape, linear or rectangular shelters.... Other features found in the corridor include enclosures, burials trails, *ahu*, special purpose features (i.,., *holua* slide, cave of refuge, abrader manufacturing areas, petroglyph areas) and miscellaneous features (i.e., stone mounds, terraces, walls, unassociated fire pits, a storage vault...). In all cases the terrain was used to its best advantage for construction and building materials (Ching 1971:39-40).

Aside from the numerous sites and features that were described in the Corridor (Figure 5.), nine burials were found, eight were in lava tube or bubble caves – five caves were previously inhabited; most of the burials appeared to be disturbed. One monument/platform burials was identified. Twenty-seven trails were recorded in the corridor; paralleling the coast or are *mauka-makai*. A *mauka-makai* trail was located in the *ahupua`a* of Kaū (Figure 6).

> *Ahu* [115 identified within the corridor] are cairn or mound-like structures of piled chunks or slabs of lava. In all cases available material was used for construction. They serve a variety of functions, including: trail markers, habitation site or complex markers, *ahupua`a* or boundary markers, burial structures and altars. All of the above functions are difficult to determine, and cannot be confidently assigned to *ahu* in the corridor without further investigation, particularly of the apparent burial structures (Ching 1971:46). [One *ahu* was identified in the *ahupua`a* of Kaū, Site 1189.

Kelly (1972). "Exploring Hawaiian Coastal Trails: Anaehoomalu, South Kohala to Kukio, North Kona, Hawaii." A report of a small group of people who were going to hike the old Hawaiian coastal trail from Anaehoomalu to Keahole Airport but only covered Anaehoomalu to Kukio.

Barrera and Kelly (1974). "Archaeological and Historical Surveys of the Waimea to Kawaihae Road Corridor Island of Hawaii." A reconnaissance survey of the Mudlane-Waimea-Kawaihae Road realignment project--an approximately 2000-ft-wide highway corridor. Ninety-eight sites composed of over 531 features were described although "nearly 5,000" were located. They were predominantly enclosures for shelters, canoe shed, or house sites, walls, platforms, agricultural features, a salt pan, midden scatters, hearths, C-shapes, shelter caves, a cemetery and numerous artifacts including abraders, adze frags, volcanic glass, grindstones, hammer stones, sinkers, and basalt pounders. Historic artifacts such as buttons, bottle and ceramic frags were also located and described.

*Volcanic glass dating (Hydration-rind age estimates) produced a range from AD1698±39 to AD1788±27 for Kawaihae 1 compared to Waikoloa, which ranged from AD1643±27 to AD 1867±22

*A petroglyph was located in the Kawaihae area [Site # 50-10-05-6530] on a vertical boulder face near the edge of a dry gully. It measures 15 by 15 cm and is lightly pecked into the rock.

Kirch (1974). "Aerial Archaeological Reconnaissance Survey of Queen Kaahumanu Highway Power-line Alignment, Hawaii Island : Kawaihae-to-Anaehoomalu Segment. December 1974.

Figure 5. Kaū sites within Kailua-Kawaihae Road Corridor (Adapted from Ching 1971).

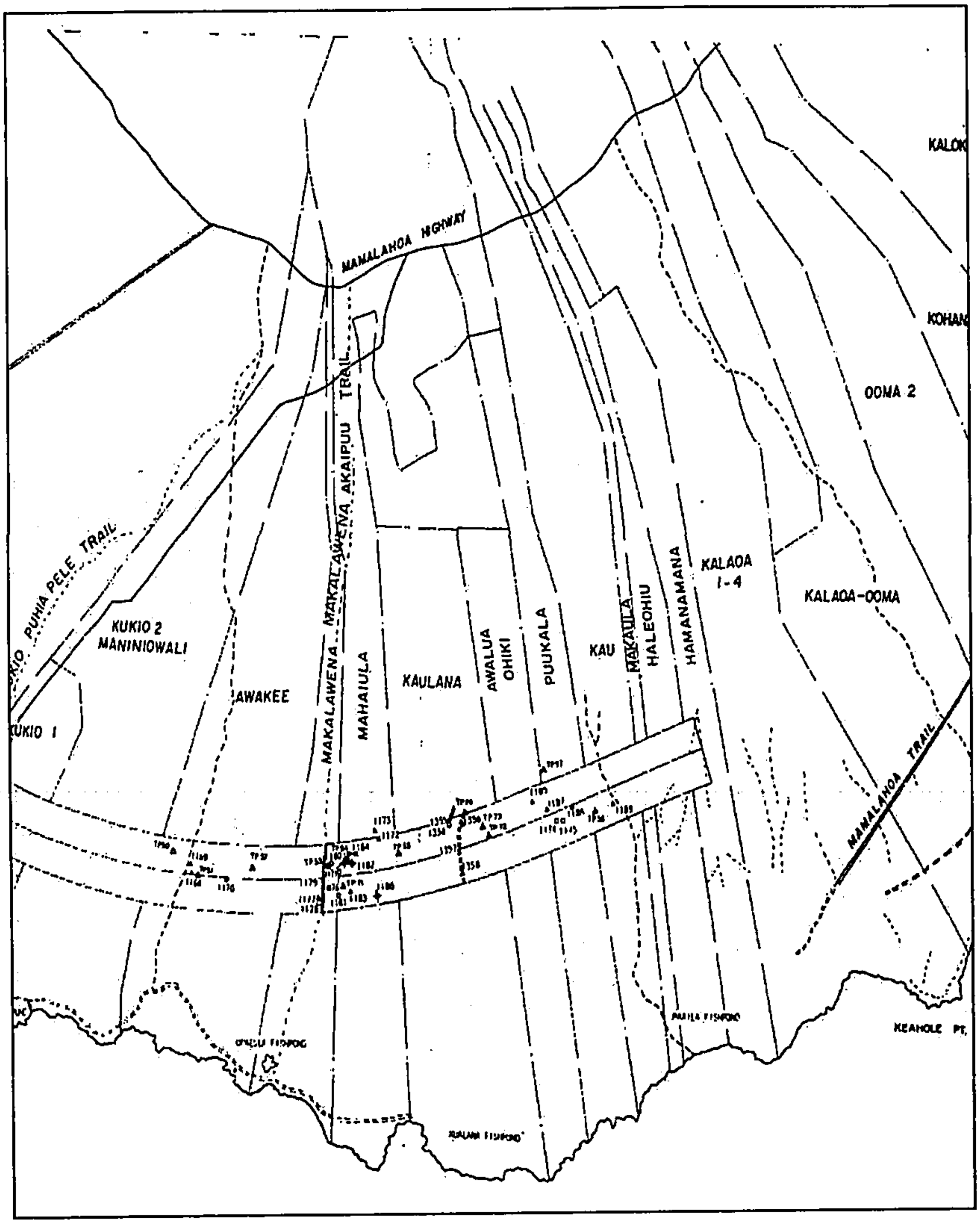


Figure 6. Kaū trails within Kailua-Kawaihae Road Corridor (Adapted from Ching 1971).

Hammattt & Folk (1980). "Archaeological Excavations within the Proposed Keahole Agricultural Park, Kalaoa-Ooma, Kona, Hawai`i Island." This archaeological investigation included a reconnaissance survey of a parcel in the north of the park and excavations in three large sink and lava tube sites, a number of smaller caves, shelters and surface sites. Two of the sink and cave sites contain petroglyphs with features and strata of domestic occupation (AD 1480 to AD 1700s) directly below the petroglyph walls. The strata containing the domestic occupation partly covers the lower petroglyph. One cave is believed to be a place of refuge during the post-1700s war period. "Archaeological clearance" is recommended for all sites except the two sink/cave sites that contain petroglyphs, which are planned for preservation. The subject parcel of study was about 4,400 feet by 3,700 feet and encompasses portions of Makaula, Haleohiu, Hamanamana and Kalaoa *ahupua`a* (*mauka*) of Queen Ka`ahumanu Highway. Eighteen sites were found: ten ahu, a small wall partly destroyed by bulldozing, a circular enclosure, platform, trail, four lava tubes. The enclosure, platform, wall and four ahu comprised a small complex 50 feet east (*mauka*) of the highway. A prehistoric Hawaiian trail passes 60 feet south of this complex, parts of which have flat pahoehoe stepping stones. Six of the ten ahu are situated along the trail marking its location. Possible platform feature was in one of the lava tubes, the others had little evidence of occupation. Further study is recommended.

Cave #262. A large sink area with evidence of extensive modification on the sink floor including cooking area. Three major tubes extend from it and all three have evidence of extensive domestic occupation and consists of small platforms, sleeping enclosures, walls, a paved walkway, a high central platform in south tube, numerous small hearths and scattered surface artifacts, organic material and shell midden. Both the north and south tubes contain burials and the north tube contains a large frieze of petroglyphs (pre-date upper occupation level because they are buried by it). Radiocarbon dating for the hearth far back in the tube yielded a date ca. AD 1500-1600-1700. #50-19-27-262. Excavation of platform in north tube near petroglyph wall: midden included shell (3 types), Pandanas keys, charred wood fragments, charcoal, fish bone and scales, bird bone, and fragments of grass matting. The trench continued northward to another platform: artifacts recovered included two small basalt adzes, adze fragment, basalt glass, pearl shell fishhook blanks, three bone fishhooks, worked bone, shell and wood, bone picks, coral file and pig and dog tooth ornaments. (this area is near the entrance). Two others trenches in the middle of the sink produced midden, but only one had artifacts; the one without artifacts appeared to be a major cooking area. The modified "refuge" wall post-dates the occupation period and blocks off and buries parts of it. This sink and cave shows three distinct phases of use: petroglyph; domestic occupation; and refuge phase.

Cave #6418. The sink area has a central platform formed of roof rubble, which served as a cooking area. Domestic occupation is concentrated in the northeast corner under a broad roof overhang and below a large group of petroglyphs, some partially buried by the rock platform. Petroglyphs AD <1700. (North/east) Intensive occupation of the cave...traditional domestic and craft activities. Artifacts consisted of bone and shell fishhooks, lava and coral tools, adze fragments, basalt glass flakes and flake tools. Midden included fish bones, shells, kukui nut shells, raw material for tools and wood for charcoal. South and *mauka/makai* lava tubes hardly used. While there is evidence that some use continued into post contact, there were no modern artifacts. The sink is currently frequented by feral goats.

Lava Tube Sink #6418B. series of terraces and platforms in a lava tube sink. The sink is 23 meters long by 13 meters wide and ranges from 2 meters to 6 meters below ground level. Three platforms are associated with craft activity; one for sleeping. A historic period layer consisted of ceramic shard, leather and buckle fragments, -hewn pieces of wood, and large opihi shells; stone pounder and pestle also recovered.

Cave #6420. Cooking area not located in the sink (21m x 8m x 3m)...small *mauka* tube used for domestic occupation, some surface artifacts. Platforms and terraces. South extension of the tube is 9m wide x 4m high.

Cave #6422. Small shelter caves. Lava blister 11m x 7m x110cm high. Ahu situated on top of blister near entrance – coral fragments and pebbles are present. Upright slabs form a feature. Excavation near entrance to cave: wood fragments, Pandanus keys, gourd fragments, kukui nut shells, shellfish remains and coral fragments. Sparse scatter of midden on bedrock floor in central and rear of cave: large cowry shell and a coral fragment in rear; mammal bone (poor state of preservation-could be dog) and kukui nut shell in central area near north wall. Artifacts include hammer-stone, yellow, spindle-shaped multi-faceted glass bead. Both ahu contained midden: shell fish, sea urchin, periwinkle, pipipi, rock shells, opihi, and isognomon, charcoal flecks, kukui nut shells, Pandanus and seeds (maybe gourd). Temporary shelter used into historical period.

Cave # 6423. Main tube 12 feet wide and 5 feet high. Three branching tube off main *makai* tube; the main *mauka* tube has 5 or more branching tubes. Both main tubes were explored to a distance of 200-300 feet. No cultural material observed except in main sink area. Removal of surface platforms uncovered a few shell fragments and some goat bones. In another tube four scoria abraders were found and waterworn coral pebble.

Cave #6421. Sink (7m x 8m x 3m) area contains paving which served as cooking area. Occupation concentrated in high ceiling mauka chamber which contains three separate platforms-excavated. Two platforms were craft work places (wood and fishhook); the third was sleeping – upper platform built on lower one with a mat between layers. Lava tube extends *makai;* charcoal, kukui nut shells and isolated marine shells. On *makai* side is a 3m slope into *mauka* tube with high ceiling, 24m x 10m, narrows then extends another 100 meters to the east. In main chamber are platforms for sleeping and cooking. Platform 1: mammal bone fragments and charcoal. Platform 2: organic material such as coconut fiber, grass matting, Pandanus keys and marine shell were scattered on and between the rocks. The deposit below included worked shell and bone, coral files and abraders (6), sea urchin files (2), bone fishhook blank, bone pick, fire plow, wooden shavings from adze working and gourd fragments. No "end products" were found in this craft working area. Platform 3: On cave floor, organic material including grass matting and Pandanus keys, with small amounts of shell midden (pipipi). Artifacts included two finished bone fishhooks and a complete adze which looked like it was deliberately hidden. Platform 4: in center of *mauka* chamber, partially decomposed *lauhala* matting. Platform had multiple layers: below the top layer was a grass layer, under that was an organic humus layer 4-12 cm over the bedrock, on this was grass, badly decomposed *lauhala* with plaiting not discernable and two sections of *ti* leaf rope double stranded, a third has a knot at one end. An opihi scraper located there. The *mauka* tube chamber was high, well ventilated and cool. It was mostly dry except for isolated drip areas, which could supply a slow but constant supple of water. Determined to be a single-use domestic occupation site.

Three major lava tubes. South Tube: explored to 250 meters; habitation up to 100 meters. There were two burials, 13 separate sleeping enclosures, 4 small platforms and a high central platform...more than ten "hearth" areas. West Tube: the floor drops down four meters onto smooth bedrock floor, approximately 50 meters long and 8-9 meters wide with no side chambers, small stone-lined hearth, rectangular alignment of uprights with open top, a prominent ceiling drip falls close to the center of this feature, which was probably a support for water gourds. North Tube: extends north and north-east approximately 124 meters through a passage way which varies from six to ten meters wide, entrance a break in wall and descends two meters to rocky floor, small platform, on east wall of tube, adjacent to platform and piled roof-fall are petroglyphs which extend 12 meters. Two other isolated places of petroglyphs (south wall). Beyond the 25 meter point is a secondary tube that runs under the main tube floor – inside the crack is a human burial – adult skeleton complete, but disturbed; skull set upright on a rock facing the entrance.

Feature #6417. Remnant of a Homestead.

Donham (1986). "Archaeological Reconnaissance Survey Makalawena Coastal Development Area: Land of Makalawena North Kona, Island of Hawaii (TMK: 3-7-2-04:1)." A total of 49 sites with 121 component features were identified within the project area (353 acres) including nine sites previously identified by Soehren (1963), and several features within three sites previously identified by Reinecke (1930). Descriptions, locational data and significance assessments are presented; as well as a description of field procedures, environmental and cultural-historical background information, and a summary of previous studies. Included in the appendices are historical documentary research by Silva and an ethnographic survey by Springer.

Makalawena is situated in central North Kona, bounded by Mahaiula Ahupua`a on the south; Awakee Ahupua`a on the north; the Pacific ocean on the west; and an upland portion of Kaupulehu Ahupua`a on the east terminating at Akahipu`u (2,232' elevation), just above the Huehue Ranch cemetery (7.7 km from the coast). The ahupua`a is extremely narrow and may have been re-delineated during the Mahele period after it was awarded to Akahi, a cousin of Bernice Pauahi Bishop in 1851 (LCA 5368/RP 7731).

Prehistoric pahoehoe (coastal zone and barren rocklands) and historic aa lava flows form the present land surface. The aa lava flow are from the Puhi-a-Pele Flow of 1801 and covers Makalawena above the project area between 600 and 1,200 "elevations. Puhi-a-Pele vent is at the 1,637' elevation north of Makalawena; the flow reached the coast at the southern border of Mahaiula, south of Opaeula Pond (Macdonald, Abbot and Peterson 1983:60). Aa from a prehistoric Hualalai flow covers a narrow band along the northern border of Makalawena and contains a number of anchialine ponds. Groundwater flows directly under the surface into the ocean and into depressions in lava near the coast forming anchialine ponds.

Vegetation is sparse in the barren rocklands; Char (1986) identified two vegetation zones for the Makalawena rocklands: grass-scrub dominated by fountain grass, scatters of *`ilima*, indigo, and *noni* with isolated Christmas-berry and *kiawe*. An inland zone consists of a dense *kiawe* forest, concentrated on the northwestern portion of the project area.

The Makalawena coastline is 1.2 km long and consists of two broad, gentle bays; Puu Alii bay is larger and beach sand deposits occur in a narrow band along the bay. The smaller bay extends inland to 100m from Opaeula Fishpond, also known as Kapoikai Fishpond, the largest existing pond between Kiholo and Kaloko, and the "premier Hawaiian stilt habitat of Hawaii Island" (Macioleck and Brock 1974:18). Opaeula Fishpond is also a habitat for *`opae`ula* (*Halocardina rubra*), raised for fishbait (Kelly 1973:78). The Makalawena coastline provides very rich marine resources; 79 fish species alone were identified by Brock and Brock (1974), as well as a number of crustacea, gastropods, bivalves, mollusks, and echinoid species. A more recent study (Brewer 1986) that the area was low in diversity and numbers of coral, invertebrates, fish, and algae; this is attributed to a recent major storm-wave attack, heavy fishing pressure, and to tropical fish collecting.

Reinecke (1930) identified a pen, series of little ponds, and waterholes, a few house sites, and a graveyard at the north end of the hamlet . Soehren (1963) identified a large goat pen, walled ponds, and a number of human bones scattered on the surface of the graveyard, along with structural debris deposited by the 1946 tsunami, two house sites, a second goat pen, the Kaikalaia church site, and additional walled ponds. Ching (1971) recorded five sites in Makalawena: three small C- or U-shaped shelters; a rectangular walled shelter; and the Makalawena-Akahipu`u Trail (BMP no. 50-Ha-D20-12). Kelly (1973) described Makalawena as follows:

> A beautiful set of small bays with many legends, Makalawena was the most prominent town of this area in the first decade of this century. Essentially a fishing village, it boasted a church, school, store, and at least seven or eight houses at one time. All houses were wiped out in the 1946 tsunami. Only one house was rebuilt, that of Annie Una. Her last husband, Porto Almodober, still lives at Makalawena. In the late 1800s in areas such as Kukio and Makalawena residents raised

goats for market. Today raising goats and chickens, and going fishing are Porto's principal occupations (Kelly 1973:103).

The *ahupua`a* of Makalawena was awarded to Chiefess Akahi who placed a restriction on squid and silverside fish, but not on settlement. Chiefess Akahi was a cousin of Konia, the mother of Princess Pauahi Bishop and when she died in 1877 Makalawena was passed on to the Bishop Estate as requested in her will.

The largest number of features (71 or 59%) included cairns, overhang shelters, single wall, terraces, cave shelters, and cleared ponds/pools. Seven graves were identified in the Makalawena Cemetery; all of the features have been disturbed by storm waves. The sand dunes of Makalawena at Puualii Bay were reported by Emerson (1882) to be and "ancient burying ground" where skeletons were disinterred by the waves at times. Four general temporal periods are assigned: Prehistoric (prior to 1779); early historic (1779-1850); late 19th early 20th centuries (1850-1930), and modern (1930-present).

In her "Regional notes from Kekaha: Makalawena" Springer (1986) talks with and/or shares stories from ten *kama`aina* from the Makalawena area: they share what is was like growing up there or visiting the area; sharing good times, sharing resources. They also shared their concerns; that the fresh water ponds were not being cared for; need for better access to traditional places; maintenance of the *ala kaha kai* trails; proper treatment for burials; and to assure that the intent of Princess Pauahi's Will is honored.

Rosendahl (1989). "Archaeological Inventory Survey, Phase I Site Identification, Kau Well Field Site Project Area Land of Kau, North Kona, Hawaii (TMK: 7-2-05:Por. 1)." A letter report to Nansay & Helber, Hastner & Kimura Planners, regarding the Kaū Well Field Site Phase I inventory survey conducted on December 11, 1989 by Supervisor archaeologist Alan Walker and a crew of five field archaeologists. The Kaū Well Field Site consisted of 15 acres at 1,800 ft AMSL; bounded on the north by Kona Ocean View Properties and the Land of Puukala; on the south by Makaula Subdivision and the Land of Maka`ula; on the east by Mamalahoa Highway (Hawaii Belt Road); and on the west by undeveloped land within the Land of Kaū. The following is a list of vegetation: moderately dense Christmas-berry, scattered `ohia, lama, kukui, alahe`e, guava, kupukupu, silver oak, ki, airplant, and various grasses. Rainfall ranges between 40-50 inches/year.

Prior archaeological work was conducted in the coastal lands of Kaū by Riley (1969) and Ching (1970). Other studies in the general vicinity include: Soehren (1978, 1980, 1982, 1985); Cordy (1985, 1987); Telea and Rosendahl (1987); Walker and Haun (1987, 1988); and Walker and Rosendahl (1989).

The 100%-coverage surface survey, uncovered evidence of previous bulldozing activity. Two cobble walls were identified; one forms the north boundary between the lands of Kaū and Puukala; the second wall is on the south edge forming the boundary between the lands of Kaū and Maka`ula. "The walls are in fairly good condition and are most likely historic period boundary walls." "No agricultural or temporary habitation features were identified within the project area.... The upland-forest zone was exploited for various raw materials by early Hawaiians, but rarely inhabited." The walls were assessed significant for information purposes only, therefore no further work was recommended, with a qualifier that significant sub-surface cultural remains or lava tubes may be encountered. Recommendation included leaving the walls intact and incorporating them into landscaping designs..

Rosendahl (1990). "Archaeological Inventory Survey, Phase I Site Identification, Kau Waterline - Roadway Project (TMK: 7-2-05:Por. 1)." Letter report to Nansay, and Helber, Hastner & Kimura Planners, regarding the Kaū Waterline/Roadway Phase I inventory survey; presence/absence of sites. The project consists of a corridor approximately 18,000ft long by 100 ft wide and includes a reservoir site situated at 250 ft AMSL. The actual survey was from 160 ft (*makai*/west), 1.8 miles from the coast to 18,040 ft AMSL (*mauka*/east) or 4.7 miles inland. The project is bounded on the north by undeveloped lands of Kaū; on the south by Maka`ula Subdivision and lands of Maka`ula - previously staked by R. M. Towill - wooden staked 100-200 ft apart.; on the east by Mamalahoa Highway; and on the west by Queen Ka`ahumanu Highway. The 250ft AMSL point is the proposed reservoir site. An old bulldozer-cut road, overgrown vegetation, extends between 700-1,800 ft AMSL.

A list of vegetation found above 700 ft AMSL: moderately dense Christmas-berry, with scattered *`ohia lehua, lama kukui, wiliwili, alahe`e,* guava, *kupukupu,* silver oak, *ki,* airplant and variety of grasses. Vegetation below 700 ft AMSL is generally very sparse and consists predominantly of fountain grass. Rainfall ranges between 40-50 inches/year.

Previous archaeological work conducted within the project area includes a reconnaissance survey of Queen Ka`ahumanu corridor by Ching (1971) and salvage excavation by Rosendahl (1973) – no sites identified. Ching (1971:49) shows a trail may cross the project area. Prior archaeological work conducted within the land of Kaū by Ching (1970) and Riley (1969); work in the vicinity Soehren (1978, 1980, 1982 and 1985); Cordy (1985 and 1987); Telea and Rosendahl (1987); Walker and Haun (1987 and 1988) and (Walker and Rosendahl (1989).

The 100%-coverage surface survey identified 25 sites containing 96+ component features, within or adjacent to project area. The typical feature were rock mounds in various sizes related to agricultural activities or burials (23 of the sites were above the 700 ft AMSL). Most of the sites would have just information/interpretive value; the trail and burials would be evaluated culturally significant. There is a remote possibility that some sites could have significant sub-surface Cultural remains.

Schilz, Shun, Williams, Nees and Hurst (1990/1994). "Archaeological Survey and Evaluation Lands of Kau North Kona, Hawaii Island (TMK: 07-02-05:01)." A field survey of 1000 acres completed between June 4 and June 22, 1990; additional fieldwork conducted between December 7-23 and 28-31, 1992; and again January 11-22, 1993. A total of 132 sites including 25 previously recorded sites were located within the parcel. Site types include ceremonial, markers, trails, multi-function, agricultural, and habitation. Data Recovery was recommended, to include detailed mapping and subsurface excavation. Ten sites were recommended to be preserved and protected. [Bulk of report same material as 1993 report with more detailed site reports.]

Shun & Schilz (1990). "Archaeological Survey and Evaluation, Lands of Kau, North Kona, Island of Hawaii."

Stokes (1991). *Heiau of the Island of Hawai`i: A Historic Survey of Native Hawaiian Temple Sites.*

Yent (1991). "Archaeological Reconnaissance Survey: Makaula-Ooma Mauka Tract, North Kona, Island of Hawaii (TMK: 7-3-01:2)." The Makaula - Ooma Mauka Tract encompasses (1,252 acres) the upper levels of the ahupua`a of Makaula, Haleohiu, Hamanamana, Kalaoa 1-5, Ooma 1-2, and Kohanaiki. And bounded by the ahupua`a of Kaū on the north, the ahupua`a of Kaloko to the south and Ka`upulehu to the east. It is State lands and has been leased for pasture in the past. "The Division of Forestry and Wildlife is studying the area for a planting project in which selected exotic plants will be replaced with native ones." Due to time constraints and limited scope. only two small portions were addressed.

The lands are marked by successive lava flows and collapsed lava bubbles and lava tubes are common. The Makaula - Ooma Mauka Tract is included in the broad expanse of lava fields known collectively as Kekaha' from Kaloko to Anaehoomalu. In 1823 Rev. Thurston and Rev. Bishop "observed coastal settlements with coconut and *kou* trees and small gardens with sweet potato, watermelon, and some tobacco (Kelly 1971:2)."

> These coastal settlements reflect the favorable conditions for fishpond construction, the fringing reef with abundant marine resources, and the coastal freshwater seeps. Paaiea Fishpond, also known as Kamehameha's fishpond, is said to have stretched from Keahole to Kaelehuluhulu, a distance of almost 5 miles (Kelly 1973:3). Handy reported that dry taro once flourished in the uplands of North Kona, between the 1,000 and 3,000 foot elevations. During his study in the 1930s, he noted that some Hawaiians still had taro plantations above Kalaoa (Handy 1972:523). He also recorded that the old methods of planting taro in Kona was to plant the cuttings in the lower, warmer zone and then to transplant them to the higher forest zone where the soil and moisture were ample (ibid:525). Interspersed amongst the taro fields in the forest zone were banana, ti, and sugarcane.

Many *ahupua`a* in Kekaha were Crown lands, especially those with fishponds or springs. Kamehameha III grew up in Ooma, but he claimed the lands of Haleohiu, which contained the ponds, and Puuwaawaa, the springs of Kiholo. Kamehameha V claimed rights to the lands of Kaloko and Kaupulehu, both had fishponds. The Kuleana Act of 1850 gave commoners the opportunity to file a claim for house-lots, and gardens. Grants were awarded for mauka lands from the 800' to 2,200' level between Makaula and Ooma. Hewahewa was awarded Grant #1870 in Makaula. The grants constitute homesteads; Haleohiu Homestead, Hamanamana Homesteads and Kalaoa Homesteads. "In the 1800s there was a population shift from the coastal area to the *mauka* uplands along the present Mamalahoa Highway." Coffee replaced taro in the uplands from about the 800 to 1700 foot elevations throughout much of North and South Kona. Emerson's 1889 map shows that Mamalahoa was the only road through the area, however, there is a mauka-makai trail, Alanui Kuahini, from Kalaoa 3-4 to Makaula – Ooma Mauka Tract. Emerson's 1888 map (Reg. No. 1449) shows lands *mauka* of Mamalahoa Highway: Haleohiu as *kukui* and `*ohia* forest, fine coffee and fruit lands; Makaula – Ooma Tract depicted as Lot 1 (1,093 acres) – "heavy `ohia forest with rich soil, quite free from rocks" and Lot 5 (115 acres) – "ohia forest and dense ie`ie jungle with rich soil suitable for coffee." The uplands of Kohanaiki is also recorded as "ohia forest and dense *ie`ie* jungle with soils suitable for coffee." Outside of the agricultural zone, the lands were used for ranching activities and pasture for cattle and goats – "lands *makai* of Mamalahoa Highway are described as good grazing land."

"Several archaeological projects conducted in the last several years have addresses the area between the Queen Kaahumanu Highway and Mamalahoa Highway, roughly the 160' to 1800' elevations, as part of the planning for new housing subdivision projects. The uplands *mauka* of Mamalahoa Highway are generally unsurveyed." The following is a review of the *ahupua`a* of Kau:

> In 1990, a mauka-makai transect was surveyed along the southern boundary of Kau between the Queen Kaahumanu Highway (160' elevation) and the Mamalahoa Highway (1840' elevation) (Rosendahl 1990). The sites located during this survey included agricultural features (mounds and terraces), ahu, habitation sites (C-shaped shelters, enclosures), a trail, and possible burials. It was noted that mounds were the most numerous feature. This survey was later expanded to include the entire width (north-south) of the ahupuaa between the two highways (Shun and Schilz 1990). This survey indicated that most of the sites occur between the 700' and 1300' elevations. These sites included platforms, enclosures, mounds, walls, trails, ahu, modified lava tubes, petroglyphs, probable burials, and historic ranching features. At present the distribution of these sites by site type and elevation has not been fully analyzed. Two radiocarbon dates were obtained from hearths in sinkholes. A date of AD 1420 – 1650 was obtained from site 14346 at the 840' elevation and a date of AD 1660 – 1950 was obtained from site 14365 at the 720' elevation (Yent 1991:7).

Yent (1991) also presented and evaluation of the "Settlement-Subsistence Model for Kekaha" by reviewing studies done by Cordy (1985) – Kalaoa-Ooma; Tainter in Cordy et al., (1975) – Kaloko; and Tainter in Cordy et al., (1975) – the Kona Field System; and Cordy (1985) – three environmental zones"

Coastal Zone. 100m inland (0-20' elevation) (1) permanent occupation sites along the shoreline: features include platforms, enclosures, pavings and associated cultural deposits; earliest dates ca. AD 1400. (2)

temporary occupation sites along the shoreline: features include lava tube caves and C-shaped shelters. Two probable heiau sites have been inventoried along the coast in Ooma 2 [no heiau classification]. The fishponds and reef provided abundant resources for inhabitants; supplemented by small gardens around coastal housesites and the mauka agricultural fields. The makai and mauka zones were connected by trails. Reinecke (1930) suggested that populations were in the hundreds except for population centers such as Kawaihae which may have been in the thousands. Cordy (1975, 1985) contends that the Kekaha populations were never large.

Barren Zone. (40' to 120' elevation) .5 to .9 mile inland of the coast and marked by barren lava flows that characterize Kekaha: low density of sites suggesting temporary or small-scale occupation; features include C-shaped shelters, lava tubes caves, ahu, and trails.

Upland Forest Zone. (450' to 1,000' elevation) 1.6 – 2.2 miles inland of the coast: sites include agricultural features, enclosures, platforms, walls, mounds and ahu; dates from Kau indicate upland zone occupied circa AD 1400, making it contemporaneous with the coast, however it was probably not until AD 1500-1600 that the agricultural systems were developed and populations increased (Cordy 1985:37). The upland forest zone in Kalaoa and Ooma extends up to the 1,000 foot elevation, but archaeological work in neighboring areas indicate that it extended even further mauka.

Kaloko Upland Field System. (1700' to 5600' elevation) agricultural features up to the 3450 foot elevation with subzones by elevation (Tainter 1971) – archaeological survey:

(2150' to 2300' elevation): formal field system consisting of a series of stone walls (N/S), parallel to contour and perpendicular to the runoff; low E/W walls connect the N/S walls and create terraces "to hold the limited soil"—other features include enclosures, platforms, linear depressions (averaging 1-2mD, 3-10mL, 2-3mW parallel to and alongside walls), mounds and ahu (smaller and higher than mounds).

(2900' elevation) lower frequency of sites; features include short retaining walls (5mL), small terraces, linear depressions, enclosures and mounds.

(3450' elevation) lower frequency of terraces and walls and a larger size of mounds, averaging 4-5m in diameter.

(4000' to 5000' elevation) No sites located in the limited survey.

Historical study of Kaloko (Cordy 1975:454-469) (1200' to 1700' elevation): kuleana awards were concentrated alongside government road (Mamalahoa); claims for cultivation of taro with some sweet potato, but surprisingly few houselots claimed; claims also mention fern and ohia forest mauka of agricultural zone and an `ohe tree line just makai. The findings indicated that the forests moved down slope as the upland agricultural fields were abandoned due to the creation of homesteads in the late 1800s and a shift from subsistence to cash crops, especially coffee with small-scale ranching. Large-scale ranching was developed in the 1900s.

Kona Field System. (500' to 2,500' elevation) This very well documented extensive agricultural complex extended 18 miles in length and three miles in width from Hookena to Honokohau where the major crops were (0-500') Kula Zone-sweet potatoes, wauke; (500-1000') Kaluulu Zone-breadfruit, sweet potatoes, wauke; (1000-2500') `Apa`a Zone-sweet potatoes in lower part, dry taro in upper part, ti and sugarcane along field boundaries; (2500-3000') `Ama`u Zone-banana, tree ferns. This was a dryland system which depended on rainfall, however water diversion features were found in the upland northern portion that were part of the terraced field complex at elevations between 1600-2600' elevation in the ahupuaa of Puapuaa/Holualoa (Allen 1984); Puaa 2 (Kawachi 1989) and Hienaloli (Yent 1991).

The Kaloko upland field system suggests a continuation of the Kona Field System with the barren zone of the Kekaha lava fields being the major factor differentiating the two field systems, with some minor differences that include the field orientation: the walls in Kaloko Field System orient N/S due to runoff/erosion circumstances, while most of Kona Field System is oriented E/W. Water diversion (auwai/walls) found in Kona but not Kaloko although the large depressions may have functioned as a water control system.

Summary. Northern section of the Makaula-Ooma Mauka Tract indicated to presence of agricultural features at 2280-2600' elevation: features included mounds, short retaining walls and pits - the greatest density between 2280 and 2330 ' elevation. Ethnographic data suggest the mounds are clearing mounds or used for sweet potato; the pit features may be for agriculture, but the depth, 2-3 meters suggest it could also be water catchment. The assessment of the Makaula-Ooma Mauka Tract is that it does not indicate a close affinity with the upland Kaloko Field System, however it does show continuity with the mounds of upland Kau. Unfortunately no survey was done prior to clearing these lands.

Borthwick, Colin and Hammatt (1992). "Archaeological Inventory Survey of the 24-Acre Parcel in the Ahupua`a of Makaula, in the District of North Kona, Island of Hawai`i (TMK: 7-3-3:07 & 17)." Two sites were identified during a surface survey; a cultural material scattered in a bulldozed swath; and remaining sections of a cobble cattle wall also the result of bulldozing. The project parcel is located *makai* of Mamalahoa Highway between 1,020 ft to 1,500 ft AMSL and was grubbed in the early 1970s and again in the 1990s. There is an absence of archaeological sites, but there are a few large bulldozer push piles.

Reinecke (1930) recorded five sites between Kaulana and Mahaiula Bay as part of his coastal survey; they include platforms, concrete salt pans, walled pools, cave shelters, *papamu* and pens. Later a heiau was identified by Kaelemakula, a *kama`aina*, on the beach at Kaelehuluhulu; a fishing *heiau* called Hale O Hiu. There are also petroglyphs on the pahoehoe about 1.5 miles from Mahiula. Rosendahl (1973) recorded 62 features (Complex D) located from 150 to 170 ft AMSL in the *ahupua`a* of Kaū, nearest Makaula. Complex D included a dwelling cave, L & C shapes, stone mounds, platforms, pavement, walls, enclosures, surface midden areas, cairns, rock-filled depressions, and petroglyphs (In Rosendahl 1973:23-30). Five square meters of the interior of the dwelling cave were excavated; portable artifacts included abraders, debitage, ornaments, fishing gear, domestic implements, and two slingstones (Rosendahl 1973:50-51). In 1990 Shun & Schilt conducted a 1,000-acres survey of Kaū, between Mamalahoa and Queen Ka`ahumanu Highways. A total of 132 sites or site complexes were recorded. There is a high site density between 650 feet and Mamalahoa Hwy. There are three clusters of sites at 800 feet, 1,200 feet and 1,600 feet levels along the Kaū-Makaula boundary. More agricultural sites and habitation sites were anticipated, however, it is believed that the bulldozer swaths are the cause (Hammatt et al., 1992:8).

A 1920s map indicates a large forest extending to 3,350 feet elevation. Makaula means "red eye" because of a fire there (Pukui et al 1974). The expansive lava field of North Kona was called "Kekaha or Kekahawai`ole - desolate land without water (Kelly 1973:74). The settlement pattern of the region includes: (a) Coastal: relatively narrow, with small villages or hamlets at sandy beach areas with associated fishponds; (b) Intermediate zone: "the barren zone" (Rosendahl 1973:60) – zone of volcanics, sparse vegetation; However in prehistoric times this zone was heavily occupied with an array of archaeological features and sites; and (c) Upland zone: Extensive agricultural exploitation with scattered small residential hamlets – surveys in Kaū (Shun & Schilz,1990 recorded 54 ag sites or site complexes.) 38% were located between 1,300 to 1,800 feet; 29% from 1,000 to 1,300 feet. As for habitation sites 89% were located within the upland zone. Charcoal radiocarbon dates from the upland zone fell between AD 1280 to AD1440 up to present. During the Mahele, Makaula was Crown lands. Interior Department records indicate that Makaula was utilized to graze goats and cattle; then became Homestead lands, but involved ranching activity. A 1920s USGS map shows one modern house in Makaula along the Mamalahoa Highway.

Greene (1993). "A Cultural History of Three Traditional Hawaiian Sites on the West Coast of Hawai`i Island: Pu`ukohol¯a Heiau, National Historic Site, Kawaihae, Hawai`i, Kaloko-Honok¯ohau, National Historical Park, Kaloko-Honok¯ohau, Hawai`i, Pu`uhonua o Hōnaunau, National Historical Park, H¯onaunau, Hawai`i."

Williams, Nees and Hurst (1993). "Data Recovery Plan, Lands of Kau Above 950 Ft Elevation North Kona, Hawai`i Island (TMK: 07-0205:01)." This project survey area ranged from 160'elevation to 1840' elevation and covered 1000 acres. In a prior survey (Rosendahl 1990) 132 sites were identified [primarily agriculture-related, with some permanent and temporary habitation sites] and "considered significant because they have the potential to yield information important to history or prehistory (criterion d);" ten of these sites were also determined to be significant because of their structural character (criterion c); and for their "ethnic value" (criterion e). The treatment plan focussed on sites above the 950' elevation; data recovery at 14 sites, and interpretive excavations at another six sites. There were over 800 component features comprising ten functional site types and three combinations of types. Of the 132 sites 88% are between 700' and 1800 ' elevation, with dense concentrations of sites between 900' and 1300' elevation. Four sites were burials; one site was a large lava tube system with the remains of at least three individuals and possibly more. It also contained stacked stone walls, terraces and platforms with associated midden deposits. Three burial sites were previously disturbed and skeletal parts were missing.

Two sites contained features associated with pre-Contact religious or ceremonial practices. One has an enclosure built around two lava tubes, the entrances marked by upright stones. The second site is a sinkhole with a large lava tube at its south end. Enclosures and Boulder alignments are located in the tube. Sixteen sites were identified as boundary marker sites including walls, cairns or ahu. One site is the northern ahupua`a wall, nearly 1000 meters longs and relatively intact. One site is the southern ahupua`a boundary wall. Two trails were located. Five sites were considered to be from the ranching activities.

Nagata's (1990) botanical survey was reviewed and summarized indicating five major plant communities within the project lands; Pennisetum grasslands, Pennisetum scrub, Diospyros-Canthium forest, Schinus-Canthium forest and Schinus thickets (Appendix K).

Kelly's (1973) historical study was reviewed, as were other historical accounts (Pukui et al., 1989; Forbes 1992; King 1989; Broeze 1988; French 1842). An excellent history of Hu`ehu`e Ranch and Kaū was provided.

Settlement Pattern Discussion. Site frequencies for the 132 sites recorded in the *ahupua`a* of Kaū were highest for agricultural sites (47 or 36%); temporary habitation sites (27 or 20%); permanent habitation sites (18 or 14%). All site types, with the exception of transportation sites, are more frequent at the higher elevations because of better soil development and rainfall. Of the boundary marker sites, cairns are more common at lower elevations and walls common at higher elevations. This is related to different land use patterns in the pre- and post-contact periods and between the barren and upland zones; walls tend to be associated with agricultural fields or ranching or property markers which are concentrated in the uplands while cairns tend to be associated with trails and location markers, perhaps just better preserved in the barren zone. An unexpected land use pattern was the high number of permanent 19th century house sites in the upland zone. This is likely because of the influx of people to the uplands after the 1801 lava flow which destroyed miles of the coastal zone. However, the upland and higher upper forest zone had probably been utilized for agriculture for a least 300-400 years prior to the establishment of permanent houses. Prior to this influx, these zones were most likely temporary habitation as people worked in the fields and returned to permanent coastal homes, as evidenced by the traditional artifacts and midden found in the lava tubes and overhang shelters. A decrease in density above 1300' elevation is likely related to 20th century ranching and 18th and 20th century practices of building large boundary walls using stones from features that were handy.

The following is a set of hypotheses formulated, to be tested during the data recovery and mitigation work, detailing architectural elements; temporal diagnosis of artifacts; and radiocarbon dating.

> (1). The lava tubes, sinkholes shelters, and small enclosures represent pre-Contact temporary occupation of the Upland zone, and were utilized between AD 1400-1800; at least one site represents a refuge cave utilized in the late pre-contact or the transitional period of early post-contact times, between AD 1750 and AD 1800.
>
> (2) The larger enclosures represent 19th century permanent occupation of the project area. These sites represent a short span of occupation after the 1801 lava flow destroyed coastal settlements, but before the Mahele in the mid-19th century.

Nees (1994). Letter: "Inadvertent Burial Discoveries During the Interpretative and Data Recovery Excavations at Lands of Kau, Kona District, Hawai'i Island, (TMK: 07-02-05:01)." A letter to Archaeology Chief of the State Historic Preservation Division reporting four additional burial sites at approximately the 900 ft (274m) to approximately 1840 ft (560m) elevation at Mamalahoa Highway. The letter also served as a "planning document to treat burials discovered during the interpretative and data recovery excavations for sites above 900 ft elevation."

> Three sites (Sites 14281, 14292, 14313 and 14327) containing burials were discovered and recorded during the interpretative and data recovery excavation. All of the burials were discovered in lava tubes at sites investigated between September and December 1993. The burial sites are summarized below and their locations are shown on the attached map [map not in folder].
>
> Site 14281. Post-contact ranching site of paving and linear rock mound. After road grubbed, two lava tubes were located on either side of the road. The mauka tube had a waterworn cobble; the makai tube had fragmented bones of a child; as well as cow, dog, bird and pig bones and a spade.
>
> Site 14292. A large lava 5-tube system containing remains of at least five previously recorded burials, habitation deposits, a variety of architectural features (walls and stone terraces) and a single panel of petroglyphs; the site has been recommended for preservation. Additional burials were discovered....
>
> Site 14313. A habitation complex consisting of one enclosure, one C-shape, two platforms, several sinkholes, and numerous rock mounds. Another sinkhole/lava tube was discovered.... At the base of the talus slope leading down into the lava tube was an overhang. The floor under the overhang is paved with pebbles and small cobbles.... There are three lava tubes extending off the overhang, two are blocked with rocks which were removed and nothing was found. The third tube was not blocked, but narrow...inside the tube was an adult burial...skull and long bones missing.
>
> Site 14327 is a habitation complex...rectangular enclosure with an internal terrace and numerous rock mounds. Other features and several lava tubes were later found and recorded. One tube had a burial, also missing the skull and long bones. It was proposed that all of the inadvertent burials be removed and placed into Site 14292 lava tube which will be sealed to protect the remains....

Carpenter, Major and Yent (1998). "Archaeological Reconnaissance Survey Kekaha Kai State Park, Mahai'ula Section Kaulana and Mahai'ula Ahupua'a, North Kona, Island of Hawai'i." The survey was conducted in conjunction with preparation of a park conceptual plan and a Phase I park development plan for Mahai'ula section of Kekaha Kai State park, formerly the Kona Coast State Park, which consists of two discontinuous shoreline parcels between Kaulana and Kukio 1st, separated by the privately owned *ahupua'a* of Makalawena. The park spans approximately three and a half miles of coastline. This report addresses all of the *ahupua'a* of Mahai'ula and includes a large portion of the *ahupua'a* of Kaulana, *makai* of the Queen Ka'ahumanu Highway. Several studies have already been conducted in the other sections of the Kekaha Kai State Park: from the Makalawena-Awake`e boundary to Kuki`o 1st-Kuki`o 2nd boundary and includes portions of Awake`e, Maniniowali, and Kukio 1st *ahupua`a.*

The Mahai`ula section of the park has had very little archaeological work conducted within it and has been open to the public and subjected to impacts from park visitors since 1995. Some of the features recorded in Mahai`ula were: trails (at least 6), ahu (at least 9), pools (at least 7), platforms, C-shelters, complexes (over 15), enclosures, shelters, rockshelters, sinkholes, *papamū*, depressions, walls, and Pohaku o Lama. The 1801 lava flow "destroyed nearly all vestiges of prehistoric archaeological features in Kaulana; any sites described date post 1801 with a few exceptions: *papamū* (6), complexes (5), enclosure, platforms, petroglyphs (11 places), burial platforms, walls, trail (4), sinkhole, pool, walled pond, salt pans, shipwreck. A total of 71 sites were identified; the majority (41) were single feature sites, while the rest were multiple-feature sites with a total of at least 368 features. One petroglyph sites had an estimate of over 100 petroglyphs. Because these sites are located in a State Park "they will naturally be afforded certain protections" (Carpenter et al., 1998:99)

Maly (1998). "Kekaha Wai `Ole O Nā Kona" A Report on Archival and Historical Documentary Research, and Oral History Interviews for Kekaha Kai State Park: Ahupua`a of Kaulana, Mahai`ula, Makalawena, Awake`e, Manini`ōwali, and Kūki`o, District of North Kona, Island of Hawai`i (TMK Overview: 7-2). An extensive study of these particular lands in Kekaha, which presents a background review of primary source archival material (original translations) and ethnohistorical translations of Kekaha-overview of Hawaiian settlement; mo`olelo; land tenure; native traditions; historical excerpts; and oral histories. Two men from Kekaha (born around 1850) were "prolific writers" ca. 1907-1929. J.W.H. Isaac Kihe and John Ka`elemakule wrote independently and with Rev. Steven Desha and John Wise (Kihe and Wise also worked on the Fornander translations- 1917-1919); in particular the accounts of the 1800-1801 lava flows of Kekaha. Missionary William Ellis toured parts of Kona in 1823 and described what they saw. He was also told about the lava flows and wrote about its effects.

> Inundated several villages, destroyed a number of plantations and extensive fishponds, filled a deep bay twenty miles in length...stone walls, trees, and houses, all gave way before it...numerous offerings were presented, and many hogs thrown alive into the stream, to appease the anger of the gods, by whom they supposed it was directed, and to stay its devastating course.... All seemed unavailing, until one day the king Tamehameha went, attended by a large retinue of chiefs and priests, and, as the most valuable offering he could make, cut off pert of his own hair, which was always considered sacred, and three it into the torrent. A day or two after, the lava ceased to flow. The gods, it was thought, were satisfied (Ellis 1963:30-31).

Charles Wilkes (1840-41) traveled through Kekaha on his exploring expedition and noted the trade between north and south Kona, where the inhabitants of the barren Kekaha "are principally occupied in fishing and the manufacture of salt, which are bartered with those who live in the more fertile regions of the south, for food and clothing" (Wilkes 1845:4, 95-97).

Maly (1999). "Nā Ala Hele Ma Kai O Kohala Hema (The coastal trails of South Kohala): Archival-historical Documentary Research, Oral History-Consultation Study, and Limited Site Preservation Plan Kawaihae-`Anaeho`omalu trail section: Lands of Kawaihae 2nd, `Ōuli, Lālāmilo, Waikōloa, Puakō, Waimā, Kalāhuipua`a and `Anaeho`omalu; district of Kohala, Island of Hawai`i (TMK:6-2, 6-8 & 6-9)."

Rechtman (1999). "Historic Sites Preservation and Interpretation Plan Hualālai at Historic Ka`ūpūlehu: Ka`ūpūlehu Ahupua`a, North Kona District Island of Hawai`i." Archaeological investigations were first conducted in Ka`ūpūlehu Ahupua`a in 1930 by Bishop Museum (Reinecke n.d.); reconnaissance survey in the 1960s (Soehren 1963); and reconnaissance survey (Ching 1871) for Queen Kaahumanu Highway; and more reconnaissance surveys for Ka`ūpūlehu in the 1980s - Komori (1981) and Carter (1985); Kelly (1985) completed extensive documentary research; a variety of studies were completed in the late 1980s and 1990s – Walker and Rosendahl (1988); Jensen and Rosendahl (1989); Kalima (1991, 1994); Maly and Rosendahl (1993), 1997); Silva (n.d.); Spear et al., (1993); and Sullivan (1996).

As a result 53 archaeological sites were recorded, ten traditional cultural places were identified, and a logical depiction of past settlement practices and land use emerged; ten sites were slated for preservation.

> The interpretation of these resources for the public will conform to specific historic themes that are used to characterize the nature of the properties by placing them within the larger contexts of settlement pattern, resource distribution, and social interaction.... The picture that will be painted of coastal Ka`ūpūlehu is that of a typical Kekaha *ahupua`a,* with dispersed residential settlements and ceremonial sites connected by a network of trails. These settlements are typically open-air sites with multiple architectural features as well as cave or shelter sites with internal platforms.... The location of residential sites was likely a function of resource access and availability, primarily the access to fishing areas and the availability of fresh water. In such a dry landscape predictable sources of water were regarded as sacred and were ritually protected.

Site identification; Site description; Preservation Strategy; Interpretation Strategy were written up for nineteen historic and traditional properties.

Cleghorn (2000). "Conceptual Historic Preservation Plan for the Proposed University Center at West Hawai`i North Kona, Hawai`i Island." A conceptual historic preservation plan (HPP) of a 275-acres parcel, chosen for the development of the University Center at West Hawai`i was prepared with consultation of the Kalaoa Advisory Council (KAC). KAC prefers the term "cultural resource" rather than "archaeological site;" and "conservation and protection" instead of "preservation." However, because the codification of laws, the old terms must still be used. KAC is adamant that cultural resources that are present on the property needs to be protected and incorporated into all aspects of the University Center; as they provide a context for present and future activities in the area. The 275-acres parcel includes Kalaoa 1-4 and Hamanamana; the original 500-acres parcel included Kalaoa 1-4, Hamanamana, Haleohi`u, and Maka`ula. 43 sites were identifies and charcoal samples were retrieved. Radiocarbon dates range from AD 1487 to late 1800s. Several sites were recommended for preservation

Williams, Eblé, O' Hare, Moorman and Murakami (2001). "Archaeological Data Recovery of Selected Sites Above 950-Feet Elevation Makalei Estates Subdivision, Kau Ahupua`a, North Kona, Hawai`i Island." The overall project area comprised 1000 acres on the west slope of Hualālai between Queen Ka`ahumanu and Mamalahoa Highways. Archaeological surveys were done in phases in June 1990, December 1992, and January 1993 (Schilz et al., 1994). The data recovery plan (Williams et al., 1993) was based on those surveys. The data recovery was limited to sites above 950 ft in elevation., the area where the subdivision is to be built. Data recovery was conducted on three levels: (1) least intensive – vegetation clearing, detailed mapping and recording of certain sites whose function remained "undetermined" after inventory survey; limited excavation to determine function; (2) interpretive excavation at sites scheduled for preservation with vegetation clearing, detailed mapping and recording of site features; both limited and extensive excavations; units backfilled and features reconstructed; (3) extensive excavations at selected sites, clearing vegetation, detailed mapping and recording of site features, and excavation of both isolated units and blocks of units. The project was temporarily halted when owners Nansay Hawaii, Inc. were forced to abandon their subdivision project. It was subsequently acquired by Hiluhilu Development.

> With one exception, no test unit produced any introduced, non-traditional artifacts that provided tighter chronological control. The lack of introduced material goods is in itself a form of 'negative evidence' that such materials were not present at the sites and that the occupation of such sites predates Western contact and influence. Although it is possible that the limited excavations at many of the sites missed deposits containing introduced materials, this seems unlikely given the abundance of traditional Native Hawaiian artifacts and architecture (Williams et al., 2001:3).

Kekaha appears to have been considered a marginal area in terms of economic viability and independence, at least in modern times. At various times native crops, coffee, and fruit were grown there. In more recent times a great portion of Kekaha, including the lower sections, was given over to animal grazing, including goat grazing and cattle ranching (Williams et al., 2001:10). Most puzzling, and possibly of importance to interpreting the archaeological remains investigated during the data recovery, is why the area between 900-1300 ft was not cleared for ranching. Based on the extent of ranching in North Kona in general and the Kau area in particular, it seem reasonable that the area below 1300 ft should have been mechanically cleared to improve it for pasture. That the area wasn't cleared may have something to do with the types of sites in the area. The results of the inventory survey are summarized below, but briefly within the area that was not cleared there is a *heiau*, a large burial tube with ritual components, a large water collection cave, several large house complexes, and a pandanus grove that was considered sacred into the latter part of the 20th century (Hannah Springer, pers som). That grove has a historical wall built around it, as if to protect it and the archaeological remains within it from cattle. The possibility that the sites between 900-1300 ft were purposefully spared from destruction by ranch personnel who thought they were significant will be discussed in the conclusion of the report (Williams et al., 2001:20).

The following is a list of site and feature types found within the Kaū project area (Table 4):

Table 4. Kaū Sites by Type and Feature (Williams et. al., 2001)

Site Type*	Totals	Feature types
Agricultural Sites	47	oval/circular mounds, linear mounds, modified outcrops
Habitation Sites	31	permanent (13), temporary (18); rectangular enclosures, L-, C-, and U-shaped enclosures, lava tubes, sinkholes (only one house site contain historical artifacts – may have been during the ranching period) one temporary site contains two lava tubes with midden and two petroglyphs; another temporary site is a large lava tube system containing burials, ten petroglyphs and traditional artifacts
Burials Sites	6	All except one are lava tubes that contain fragmentary remains of single individuals; one burial site is a large lava tuve system that contains the remains of multiple individuals; stacked stone walls, terraces, platforms with associated midden deposits...possibly a refuge cave or for ritual. One site contains an historical burial with corrugated metal and wooden planks associated with it. This burial was in a small lava tube; three burials consist of only a few scattered bones, suggesting that they were disturbed in the past.
Ceremonial Sites	4	These sites contain features often associated with pre-contact religious or ceremonial practices. One is an enclosure of upright slabs surrounding a platform on a terrace with hearths; another is an enclosure around two lava tubes, the entrances are marked anad partially blocked by uprights. Another is a notched *heiau*. The last is a platform with an upright, likely a field shrine.
Marker Sites	16	These sites include walls marking boundaries and cairns or *ahu* marking possible trails or temporary shelters; nine are walls or short wall segments; seven contains cairns. Marker sites occur throughout the project, although walls are more common above 800 ft and cairs are more common below 800 ft. Walls all appear to be post-contact.

Transportation Sites	2	Trails – toward *makai* boundary at 200' and 300' – both within the a`a and may be part of same trail.
Ranching Sites	5	Four appear to be features relatd to bulldozing; one is a stone animal enclosure with a metal gate and concrete trough inside. There is a complex that consists of a wire fence corral, livestock loading ramp, and a wooden water tank with a date 10-23-57 painted on it. It was not given a site number.
Multi-Function Sites	14	Twelve are a combination of agricultural features and either permanent or temporary habitations; two sites are lava tubes used for temporary habitation and burial

*(Figure 8. Site Locations.)

Kau Settlement Pattern (Williams et al., 2001). Rosendahl (1991) recognized the same environmental zones as Cordy (1985) [coastal zone, barren zone and upland forest zone] but added a fourth – higher elevation exploited, but uninhabited zone. Rosendahl (1991) also delineated five soil/terrain types and seven vegetation types. Cordy et al., (1991) updated the zone type: Coastal, Middle, Upland, and Upland Forest.

Coastal Zone	Temporary occupation and smaller sites interspersed between larger more substantial sites
Middle/Barren Zone	Scattered tempoary occupation; markers (rock cairns) and *mauka* trails
Upland Zone	Nearly continuous occupation between 430 – 2000 ft; agricultural and temporary habitation sites; later permanent occupation post-1800AD
Upland Forest Zone	

> Various studies seem to be in accord in placing the timing of the first permanent settlement in Kekaha north of Kaloko in the early AD 1400s…there also seem to be a general consensus that permanent population was concentrated on the coast, with inland habitation being temporary and related to tending agricultural systems until late prehistory…a breakdown of the temporal distribution of sites within the pre- and post-contact periods is hampered by a paucity of reliable dates on archaeological material, and interpretation of settlement patterns and demographic trends has been largely dependent on ethnohistoric sources (Williams et al., 2001:26).

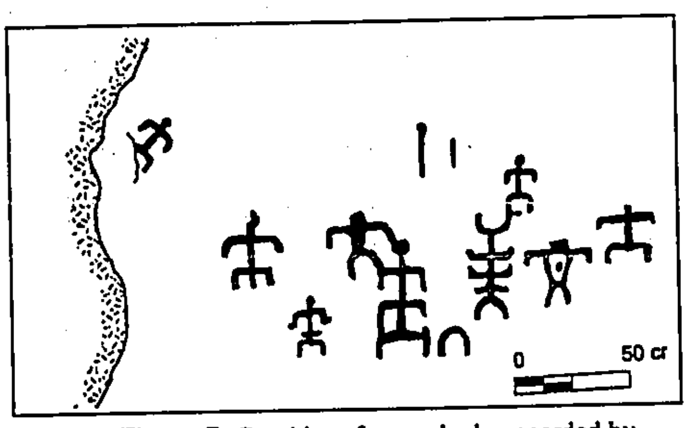


Figure 7. Graphics of petroglyphs recorded by Williams et. al., (2001)

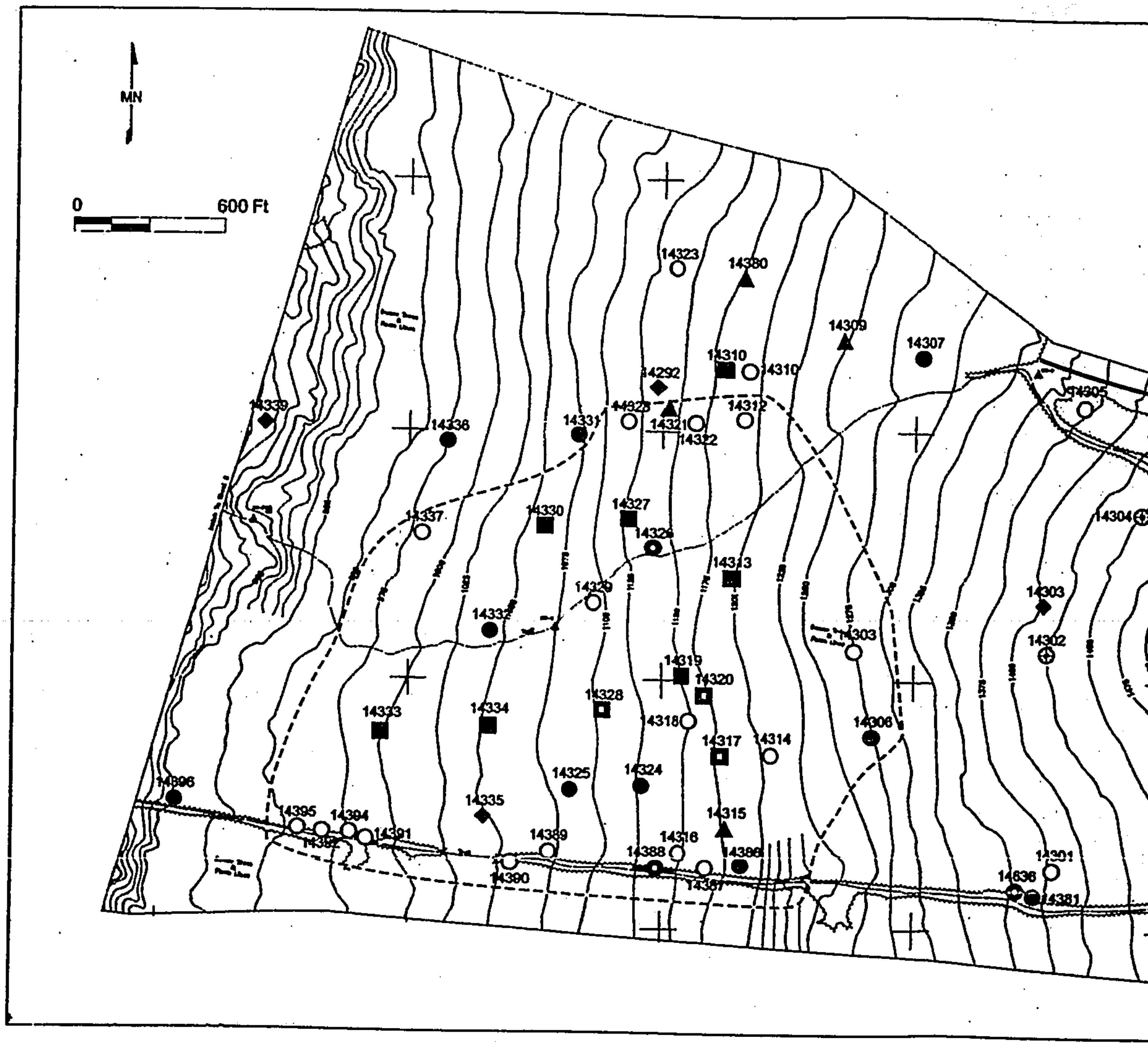
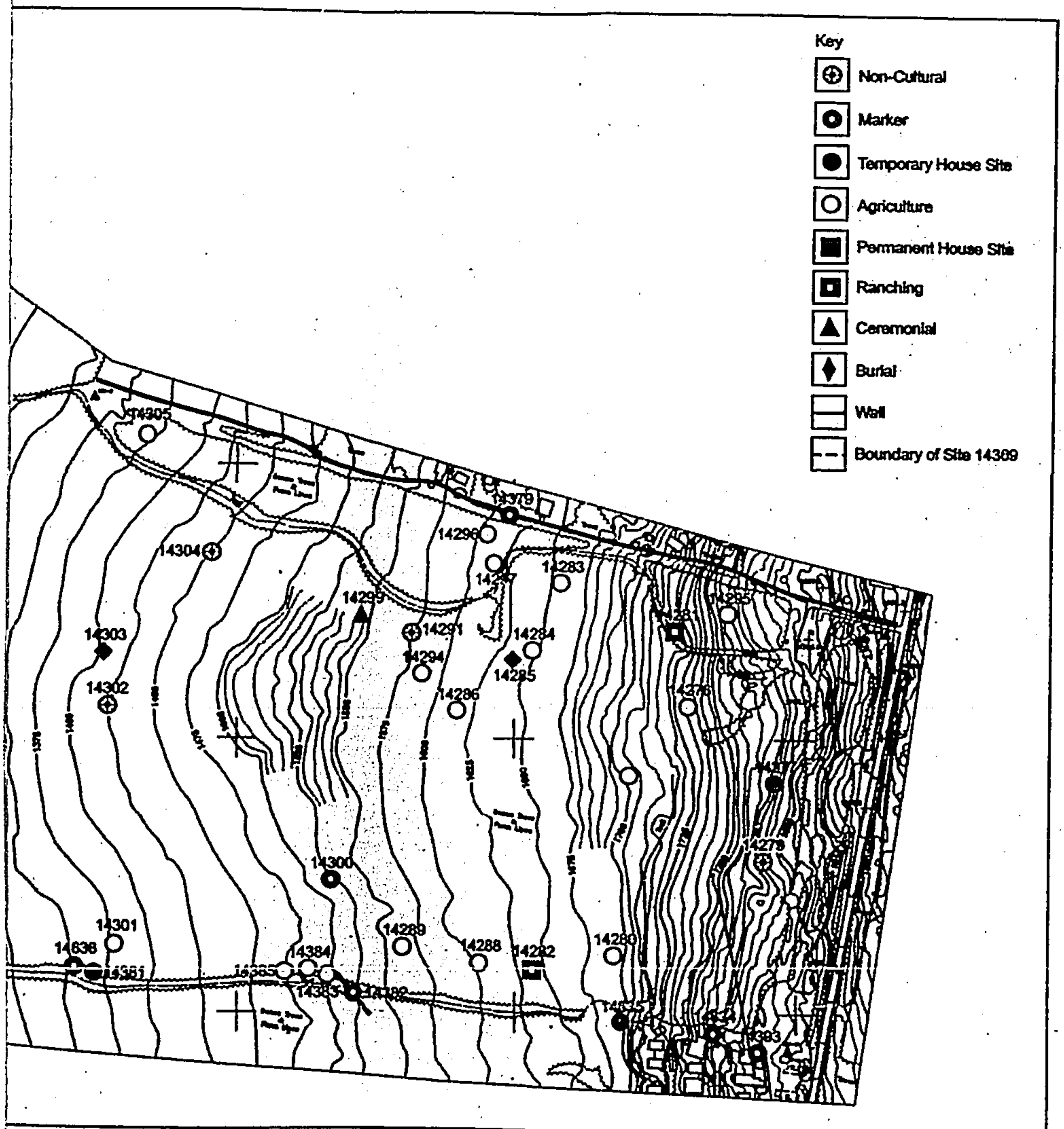


Figure 8. Site locations in Upper Kaū (Williams et al., 2001:Appendix A-2).


Key
Non-Cultural
Marker
Temporary House Site
Agriculture
Permanent House Site
Ranching
Ceremonial
Burial
Wall
Boundary of Site 14389
14305
14304
14303
14302
14301
14636
14381
14385
14384
14383
14300
14299
14291
14294
14296
14283
14284
14285
14286
14289
14288
14280
14279
14276
14393

Twenty-two sites were investigated during data recovery; fourteen were not scheduled for preservation and various levels of data recovery were conducted. Eight sites were scheduled for preservation and underwent additional recording or limited interpretive excavations. All sites were assigned State Inventory of Historic Places site numbers beginning with "50-10-28-number"- only the "number" will be used below in this site summary (Table 5) below:

Table 5. Kaū Sites by Site number, Type and Function (Williams et. al., 2001)

Site number	Type	Function	Comments
14281	Lava tube with burial Pavement, Linear Mound	Burial, Ranching 1700'asl	HIBC recommended cave be collapsed during subdivision construction to preserve burial in place. Pre-/Post-contact.
14285	Mound, Lava Tube 1630'asl	Burial, Water collect Pre-contact.	10 features. Marker mound; basalt gourd holder for water collection-5; alignments
14291	Lava Tube	Non-cultural	No recovery. 1575'asl.
14292	Sinkhole, Lava Tube Complex 950-1200'asl	Multi-function Burial/Temporary Habitation	Extensive lava tube system with 5 sinkhole entrances; 4 main tubes; several artifacts, Tube A: cow/pig skeletons; human burials with no cultural material; skeletal parts in 2 other tubes; several tubes extend from main tubes-more burials possible; Tube B: several Features; several side tubes; possible burial; Tube C: long, cultural material at entrances to several side tubes; several features in side tubes (platform/terraces); midden/artifacts in one side tube; several sinkholes-one with fire pit/other features; Tube D: sinkholes; bone frags in one; trail remnants; several features (terraces); midden, burial bundle in cavity; more charcoal and midden; cave widens with more features. Total 60 features in tube system. Petroglyphs. Pre-contact.
14299	Lava Tube Rock alignments 1545'asl	Water collection Pre-contact	Sinkhole/lava tube with 83 rock features; footpath into lava tube; (81) oval-shaped alignments to hold a gourd; charcoal.
14303	Sinkhole/Lava Tubes 1405'asl	Burial/Post-contact	Corrugated metal placed over human infant. Preserved in place.
14306	Mounds, Sinkhole Lava Tube, C-shape Modified outcrops 1264-1300'asl	Multi-functional Temporary Habitation Agricultural Pre-contact	37 features .Several planting or agricultural clearing mounds-18; temporary habitation - 30 (C-shape enclosures, terraces); sinkhole, modified lava tube; marker mounds.
14309	Enclosure, Stone Paving, Mounds 1255'asl	Multi-function Religious; Agricultural Pre-contact AD 1435-1650	2 adjoining rectangular enclosures, small paving and a series of small rock mounds: notched *heiau*, associated altar. Pieces of branch coral found; ramp, terrace. Preserved
14313 1200'asl	Complex Pre-contact, AD 1315-1490	Multi-functional Permanent Habitation Agricultural, Burial	47 features: enclosures, C-shape, platform, modified sinkhole, rock mounds, hale mua, midden, branch coral, artifacts, terraces

14315	Complex Pre-Contact Post-Contact 1175'asl	Specialized activity Lauhala collecting Long-term use of Temporary habitation	22 Features. Enclosure surrounds grove pandanus trees-to keep cattle out; terraces, platforms, walls, cairns, C-shape enclosure, several hearths.
14319	Complex Pre-Contact 1155'asl	Permanent habitation House site	Terraces, mounds, linear wall, platform, burial, depression, modified sinkhole, pahoehoe slab, 2 lava tubes, 2 mounds midden, burial tube of youth-preserved.
14321	Enclosure Pre-Contact 1150'asl	Ceremonial	Ceremonial enclosure, terrace, platform, coral frags, midden, hearth, numerous Upright pahoehoe slabs. Unique.
14325	Complex Pre-Contact 1050'asl	Ceremonia ? Permanent habitation	2 enclosures, paved terraces, 2 modified lava tubes, C-shape enclosure, collapsed lava tube with internal modification, midden, artifacts, hearths.
14327	Complex Pre-Contact 1125'asl	Permanent Habitation Burial Agricultural	37 features. Enclosure of high status individual or *hale mua*; paved terrace, *kōnane* game board (*papamū*); modified outcrop, petroglyphs, small complex walled platform, 3 retaining walls, small cobble paving; enclosure-habitation; lava tube with walls, midden, volcanic glass-activity area; modified lava tube with human burial-skull and long bones missing; lava tube with pig remains; platforms, terraces and ag mounds
14334	Complex Pre-Contact 1050'asl	Permanent Habitation	Enclosures, midden, coral, volcanic glass; large C-shape-midden, volcanic glass, coral; partial enclosure-midden; small enclosure; 2 modified lava tube; 2 terraces; hearths.
14335	Rectangular Mounds Pre-Contact	Ag Clearing	Large mounds-no midden/burials 980-1000'asl.
14336	Lava Tube/990'asl	Temporary habitation	Lave tube with midden. Pre-Contact.
14350	Lava Tube Pre-Contact Post-Contact 805'asl	Multi-functional Temporary habitation Burial	Sinkhole with mound, midden; large lava tube-midden, Asian pottery, metal frags; burial 8m east of tube entrance-in excellent condition, but skull and long bones are missing
14380	Platform Pre-Contact	Religious 1200'asl.	Paved platform with upright stone. 4.5m x 4.0m x .2m-.4m.

Artifact Analyses (O'Hare In Williams et. al., 2001:199-214). List of artifacts and types:

Worked bone	8	Drilled Cone Shells	13
Tool bone-bird	6	Drilled Nerita shell	1
Tool bone-fish	1	\`Opihi scaper	1
Tool bone-?	1	Fishook frag-pearl shell	2
Fishhook frag-bone	1	Coral abraders	28
Basalt flakes/frags	68	Scoria Abraders	89
Volcanic Glass frags	1245	Historic artifacts	25

Radiocarbon Data/Screening Results (Williams 2001:215-226).

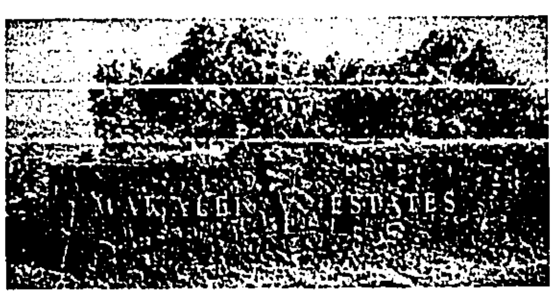
Very few post-Contact, non-traditional Hawaiian artifacts were found in site deposits (only one site contained historic artifacts). Seventeen charcoal samples were submitted for radiocarbon dating. The majority of the samples contained mixed tree and shrub species and some *kukui* nut endocarps; only one sample contained a mixture of native and historically-introduced plants. The types of species (native or Polynesian-introduced) in the samples are as follows: (Native) *`akoko, lama, `a;ali`i, naio, naupaka kahakai, `ilima, māmane, `ōlei, olopua, hō`awa, alahe`e, `āheahea, `ōhi` lehua, olomea, ko`oko`olau, kaua, pilo, kamani, `ohe, kulu`ī, kolomona* (native and 3 introduced); (Polynesian-introduced) *niu*, and *kukui.* After calibration, eight dates range from AD 1300-1650; eight range from AD 1650 to <modern; one from AD 1500 to present; four produced <than modern results suggesting some kind of contamination of the samples or deposits (Williams 2100:215). [modern vandals?]

Discussion/Conclusion (Williams & Nees 2001:228-232)

Judging by the artifacts, midden inventories, presence of traditional burials and architectural features within sites, the lava tube and sinkhole overhang shelters, as well as the small enclosures typified by C-, L-, and U-shaped walls, were used during the pre-Contact period. It is likely that such shelters were in use shortly after the upland areas came into use, by at least the 14th century – there is no evidence that they pre-date the use of the use of the large, permanent habitation complexes. Some of the "temporary habitations" sites may actually be storage places." Contrary to hypothesis, all the data recovered during the project suggest that the large surface site complexes...[with one exception] were pre-Contact permanent house sites, rather than post-Contact sites occupied after the lava flow of 1801 (Williams and Nees 2001:228).

Cordy et al., (1991:473) reported on archaeological studies at uplands of Kaloko Ahupua`a and found "that there was a substantial pre-Contact occupation that rapidly disappeared at or shortly after Contact." There were no artifacts found that would be indicative of a "high status" habitation, however there were sites that had both pig and dog remains and given the time period, were most likely associated with religious ritual activity. The upper walled field systems found in the Kaloko study "were also at higher elevations than the area investigated in Kaū" (Williams and Nees 2001:230). The period of the most intensive use of Kaū was in the AD 1600-1800; while these settlements may not have been as dense as [perhaps earlier] coastal settlements, they were permanent. Between 950-1300 ft elevation there were a high number of large residential complexes, a possible refuge cave, a *heiau*, and at least two shrines. There was also the large water collection cave nearby (Site 14299), as well as the pandanus grove (Site 14315) and burials. Unfortunately the area above 1300 ft was previously bulldozed and cleared for pasture, in early 20th century; both Kaū and adjoining *ahupua`a* were cleared and developed before cultural resource protection laws were established (William and Nees 2001:323).

F. Makalei Estates/Makalei Golf Course. Adjacent (east) to the project lands (Figure 8.) in the 1,000 to 1,800 foot elevation, is the developing *Makalei Estates* agricultural subdivision, consisting of 80 three-acre lots (Appendix L) *makai* of Mamalahoa Highway (KCRC 2003). Just *mauka* of the Mamalahoa Highway at the 2,000 - 3,000 foot elevation is the semi-private, Dick Nugent-designed Makalei Country Club (BIVM 2003). The Club advertises that it promotes the preservation of native Hawaiian flora and fauna (GVI 2002).



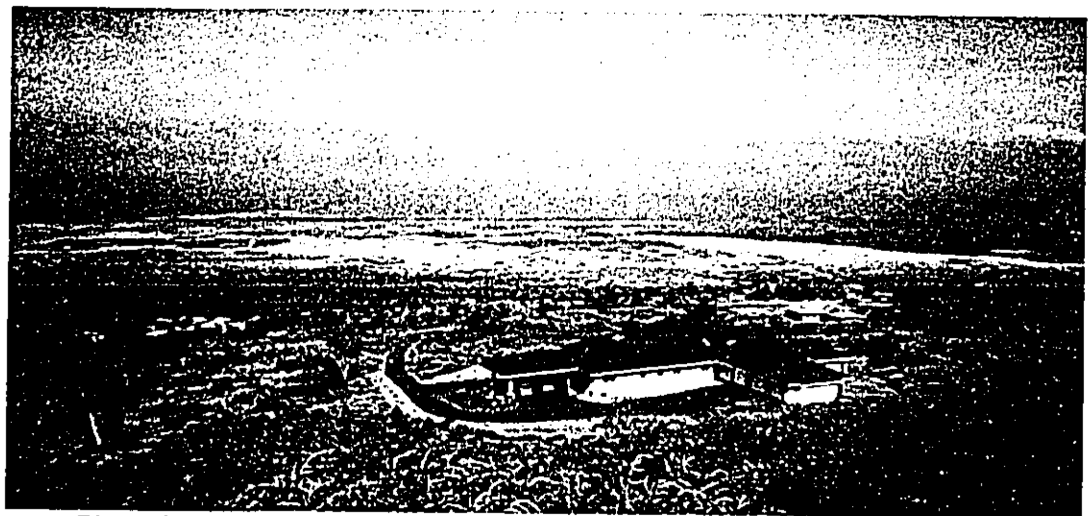


Photo 6. Makalei Estates subdivision: soon to be 80 houses on three-acre lots.

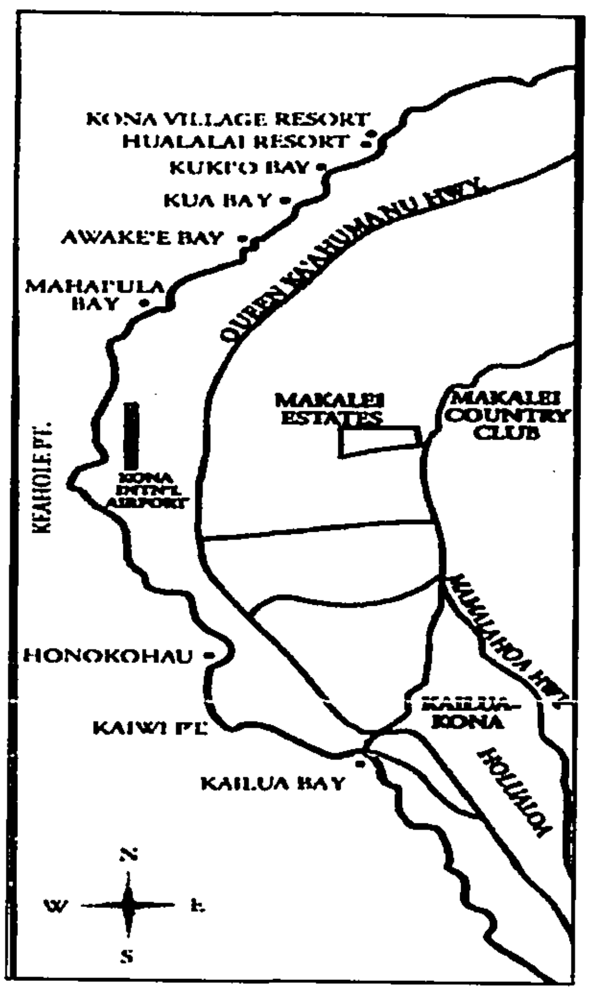


Figure 9. Map of *Makalei Estates* (KCRC 2003).

Photo 7. Kekaha Kupuna.

Photo 8. Rare *hala pepe* protected.

PART IV. ETHNOGRAPHIC SURVEY

The Ethnographic Survey (oral history interviews) is an essential part of the Cultural Impact Study or Assessment (CIS) because they help in the process of determining if an undertaking or development project will have an adverse impact on the cultural practices or access to cultural practices. The following are initial consultant selection criteria:

- Had/has Ties to Project Location(s)
- Referred By Office of Hawaiian Affairs (OHA)
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People

The consultants for this CIS were selected because they met the following criteria: (1) consultant grew up, lives or lived in Kekaha lands; (2) consultant is familiar with the history and *mo'olelo* of Kekaha; (3) consultant referred by Hawaiian Cultural Practitioner(s); and/or (4) consultant referred by Staff of Office of Hawaiian Affairs or Hiluhilu LLC. Copies of signed "Consent" and "Release" forms are provided in Appendices (Appendix M and Appendix N).

Research Themes or Categories

In order to comply with the scope of work for this cultural impact study (CIS), the ethnographic survey was designed so that information from consultants interviewed would facilitate in determining if any cultural sites or practices would be impacted by the implementation of the Hiluhilu application process /development project. To this end the following basic research categories or themes were incorporated into the ethnographic instrument: Consultant Background, Land Resources & Use, Water Resources & Use, Marine Resources and Anecdotal Stories. Except for the 'Consultant Background' category, all the other research categories have sub-categories or sub-themes that were developed based on the ethnographic data or responses of the consultants. These responses or clusters of information then become supporting evidence for any determinations made regarding cultural impacts.

A. Consultant Background and Demographics

Each consultant was asked to talk about their background; where they were born and raised, where they went to school and worked, and a little about their parents and grandparents. This category helps to establish the consultant's connection to the project area, their area and extent of expertise, and how they acquired their proficiency. In other words, how the consultant met the research consultant criteria. Nine individuals were identified as potential consultants. However, due to scheduling circumstances only three were interviewed. It is recommended that the other six be contacted again and try and interview at least two or three of them. Two consultants were born in Kona; one raised elsewhere, one consultant was born on O'ahu, but raised in Kona. Table 3 provides the demographics of the consultants.

Table 6. Consultant Demographics in relation to North Kona/Kekaha Lands.

Consultant	Hawaiian	Born/Raised	Work	Live	Kekaha Ties	Kaū Ties
Kinoulu Kahananui	X	X	X	X	X	X
Hannah Springer	X	X		X	X	X
Rescinded	X		X	X	X	

There is always a danger of not allowing the consultant's "voice" to be heard; of making interpretations that are not theirs; and of asking leading questions. To remedy this, the "talk story" method is used and allows for a dialogue to take place, thereby allowing the consultant to talk about a general topic in their own specific way with their own specific words. All of the excerpts used are in the exact words of each consultant or paraphrased to insert words that are "understood" or to link sentences that were brought up as connected afterthoughts or additions spoken elsewhere in the interview. The following excerpts in "Consultant Background" provide a summary of each consultant, as well as information about their parents and grandparents. First names of each consultant are used to identify quotes used.

A-1. George "Uncle Kinoulu" Kahananui, Sr. Mr. Kahananui was a long-time employee of the Hu`ehu`e Ranch; they utilized the *ahupua`a* of Kaū for ranching activities and cattle free-ranging. He is also a well-known cultural resource person for the Kekaha lands.

> Well I'm Kino`ulu Kahananui. And I was born and raised in Kona. My birthplace is Holualoa. And the day I was born was the day that they took me. They never give me the chance to stay with my mother and father. Right off the bat they took me. And I stayed with my kau hanai, which is Kinoulu Kahananui and Hattie K. Kahananui. And these are my hanai parents. And we lived up in the vicinity of Kalaoa. And that is something that I will cherish until the day I leave the light of this Earth. There are times, remembrances that set my tears down, to look at all these things of which we are perpetuating today. I never know, I never dream, I never know the day gonna come where I'm going to be part of this kupuna; to be part of telling the whole history of Kona.
> And as I grow up I went to Kalaoa school under the supervision of Mr. Smyth and Mrs. Smyth. I went to eight grade in those days. I never go continue on [Kinoulu].
>
> And we grew up at Kalaoa and now we down here at Koloko. This our stomping ground; we come down and we sleep and go fishing. And Kinoulu, my kau hanai, who have brought me up, he didn't have much, but they had something to give us. And important that they have their aloha spirit within themselves. They gave us the origin to carry on; that's what I carry on until today. And I say of myself that I'm happy to have the opportunity that I never dream that I would be part of this discussion to bring that origin of that past. And as I said to many groups already, you cannot bring the past back again, we have to look from now to the future. The past is gone already [Kinoulu].

Photo 10. Kaloko-Honokohau National Historical Park.

A-2. Hannah Kihalani Springer. Ms. Springer has been involved with cultural activities for a long time, is a well-known cultural resource person in Kona, especially for the Kekaha lands, and is especially familiar with ethno-botanical plants.

I'm Hannah Kihalani Springer. I was born in Kona in 1952. When I was 6 months old we moved to California so my dad could attend UCLA. When we returned from California there were more job opportunities on Oahu so we resided there. I attended Punahou School from elementary through high school and 3 years after high school I returned to Kona. I live in our family home in Ka`upulehu. And my ancestry is such that I am Hannah Kihalani Springer I am the daughter of Thelma Kihalani Stillman Springer and Pilipo Springer. Thelma is the daughter of Eilene Ruth Kihalani Maguire Stillman and her father was Arthur Kahivahiva Stillman. Eilene is the daughter of Charles Uhemalama Maguire and Mary Kihalaninui Parker Maguire. Charles is the son of Luka Hokula`au, the wife of John Avery Maguire. (Photo 11. Hannah on Trail)

Luka is the daughter of Kealoha and Kamailei. Kealoha is the daughter of Haihā and Kahokula`au. And Haihā is the daughter of Ha`ilau and Kinalau. And these are people who are truly of Kekaha, North Kona. And I come to this information from family accounts, including the family bible and work done by Marion Kelly for Hu`ehu`e Ranch; a monograph prepared for the Bishop Museum on Koloko where we are situated for the purpose of this interview; and Koki`o [Hannah].

Photos 12. Endemic tree in transition zone of Kaū.

B. Land Resources & Uses.

Land resources and use changes over time. Evidence of these changes are often documented in archival records. Cultural remains are also often evident on the landscape and/or beneath the surface and provide information regarding land resources and use. However, oral histories can give personal glimpses of how the land was utilized over time and where the resources are or may have been. Oral histories can also provide confirmation of cultural practices.

For at least one hundred years, the most dominant use of the land in the project area has been ranching with cattle grazing in the uplands. However, the consultants remember agricultural practices in nearby *ahupua'a* as various cultural features of Kaū bring back memories

B-1. Kaū Ahupua'a. The lands of Kaū remain somewhat mysterious in that not very much is known about the ancient uses of the land. It's also a puzzle to people not from North Kona, as to how to pronounce it. To the local residents, it was once "*kahuna*" lands as it was associated with a very powerful *kahuna* during the time of Kamehameha I.

> I have always heard the lands called Kaū, not Kau. That comes to me from my mother who was part of the genealogy, which I shared with you. Her great-grandfather, John Avery Maguire who was the husband of Luka Hokula'au, started Hu'ehu'e Ranch in 1886. And so that is how I have had access to these lands from my youth... And of the lands of Kaū the thing that has been most profound to me about that land is the quality of the botanic resources there [Hannah].

> My understanding that I have from reviewing the archival records is that this land was associated with Hewahewa. And the sense that I have from talking to some of the old folks like Keala Haleama'u Lindsey are the kahuna who are associated with the area [Hannah].

Photo 13. Lands of Kaū range from grasslands to fertile forests, covering ancient sites.

B-1-a. Native Flora. Prior to the interviews, the consultants and others went on a site field trip through the project lands. Therefore, the landscape and plants were fresh in their minds, as they recalled the native species found in Kaū, especially a very special grove.

> When I was young the lehua from the mauka side of the Mamalahoa Highway were among the prettiest lehua in the Hu`ehu`e area. When I became older and went onto the subject property [Kaū] and traversed the lands between the Mamalahoa Highway and the Ka`ahumanu Highway I have been struck by the diversity and density of the native species. We've seen in the upper area were the Makalei Estates are situated now where the `ohia grows. When we get a little bit below of that, we get into the area where the elama grows to great height. Among the companions of the elama there before the Makalei Estates was the wala he`e. There was `ohe found there. There was `iliahi. There was māmane. The shrubs: the a`ali`i. A little bit further down the wiliwili. Also `ulei was found in the upper portion [Hannah].
>
> Also that was around the first time that I visited the hala grove there. The name of that grove was told to me by Keala Haleama`u Lindsey was Pā-lama. And by the time that I visited that hala grove most of the plants were senescent, but there were about a dozen trees still hanging on there. And it was near to Pā-lama that the largest of the ohe grew, the Reynoldsia [Hannah].

Photos 14-17. Various endemic species that are thriving in the *ahupua`a* of Kaū.

B-1-b. Traditional-style Planting. During the Kaū field trip, the consultants saw stone features that made them recall using similar methods when they were young. They referred to it again in the interviews.

> I've been involved when after school we come back [from fishing] go mahiai, plant taro and Kahananui was one of the biggest taro patch grower. Besides his was Joe Kahananui, a nephew of my father Kino`olu. Beside that Kapehe and he was one of the taro planters. And these are the three great taro planters in Kona here. And of course I was happy to learn what I learned today and what I can share today through the love of Kino`olu and Haliaka, which is my kau hanai [Kinoulu].

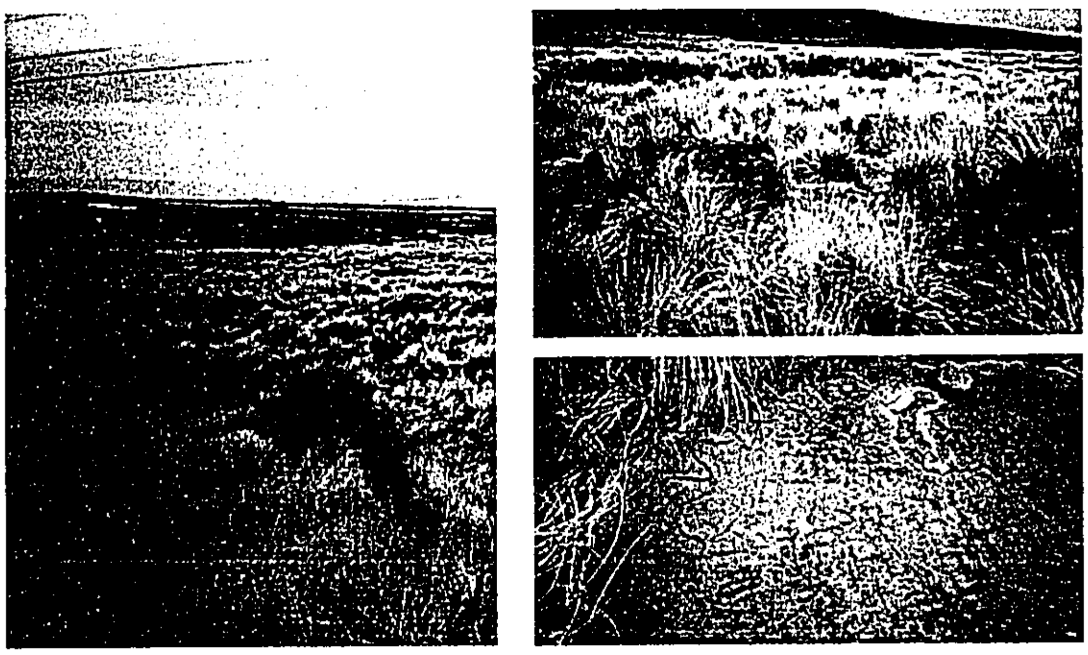
B-1-c. Kaū Cultural Sites & Burials. One consultant talked about the *heiau* within the *ahupua`a* of Kaū and other cultural elements.

> We know that there are a number of cultural sites in that area. I was approached by the Hawai`i Island Burial Council to help give them a geographical context on a field trip they took into the lands of Kaū to view the burials found on that land. At that time we visited the heiau, which we visited earlier today.... I don't know [the name for the heiau]. As far as I know, it was identified by the Ogden archaeological crew. I first visited it with Ross Cordy in the mid-80s or the early '80s and I've not learned of a name for it [Hannah].
>
> The subject [project] area goes from approximately 800 feet in elevation down to the Ka`ahumanu Highway. So that's in the area of the shorter trees, but there's still good density. A good dispersal of the trees across the ahupua`a, from side to side. And there's not much fountain grass there. These tree species are part of the cultural resources of Kaū. We saw in the Makalei Estates how they were able to protect the burials and other cultural features such as heiau and keep them in context with the native plant species that are found there. I hope the same can be done in the lower portion of the property where any cultural features that are designated for preservation, the native plant cover surrounding them can be preserved maximally [Hannah].

Photo 18. Heiau in the midst of Makalei Estates agricultural subdivision.

Photo 19. Cultural Resource of Kaū.

Photos 20-24. Various sites: petroglyphs, shell midden, holua slide/ramp, pavement.



B-2. Life on Kekaha Lands. None of the consultants actually grew up in Kaū, but they did grow up, spend time, work, or now live on Kekaha lands, a sub-district of North Kona of which the *ahupua'a* of Kaū is a part of. The consultants shared about various *ahupua'a* within the Kekaha lands.

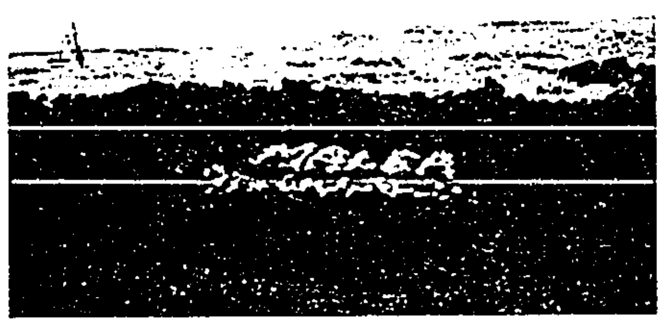


Photo 25. Typical site along highway in today's Kekaha

**B-2-a. Ahupua`a/Place names of Kekaha.** Most of the consultants seemed to know a lot about the *ahupua`a* where they grew up and in the near vicinity, however, one consultant in particular traveled to many *ahupua`a* in the Kekaha lands as part of his job.

> Attending a lecture by Edith McKenzie I heard from her, the association of the Kalēkini line with the lands of O`oma which are situated between Koloko where we are now and Kaū, where we were for the earlier field trip today [Hannah].

> So there are my memories of my days, and in my days I have to know where all these ahupua`a. And I think the ahupua`a was an important part in those days. And as I say the biggest ahupua`a from Keahou went all the way to Hilo. And then come Holualoa. And Honokohau goes up again to the side of Hualalai and hit Keauhou. Koloko is the same thing going up right next to Honokohau, Then Ka`upulehu covers up all the way up again up to Hualalai and down and meet Keauhou and Keauhou continue on. So I would like you all to know where all these ahupua`a. And they have small ahupua`a that goes little bit like Makalawena, Mahi`ula, Kuki`o, Awake`e and all the small ahupua`a, but I have to cover the big ahupua`a [Kinoulu].

B-2-b. Ethno-botanical Plants of Kekaha & Traditional Uses. A couple of consultants mentioned ethno-botanical plants that were gathered from the uplands, the kula lands and the *makai* lands.

> Elama is such a cool plant; there are not that many native species that were useful food plants. But the elama yielded a fruit; its a member of the persimmon family, it yields a fruit that is indeed edible. Even from the Island of O`ahu we have reference to this in Mānoa Valley there is the `Aihualama Trail. "`Ai" to eat, "hua" the food and "lama" the plant. Eating of the lama is certainly part of the tradition of the people of Kekaha, North Kona. Of course the elama was also building material. And I've heard reference to it that elama stakes was among the preferred stakes to be placed into the mākahā on kuapa`a seawalls such as the one near to us at Koloko [Hannah].

> Also an un-carved block of elama was put on the ku`ahu`ula to represent Laka, the patron of that dance. And I had a personal experience in this regard. In 1993 at my home ahupua`a of Ka`upulehu, which is immediately adjacent to the lands of Kaū at their uppermost boundary, An elama tree blew over during a big weather due to insect damage right at the ground line. And along with Jean Gregory whose mother is Adell of the Kea`āina family we went with Jack Straka the wood-worker and we were able to salvage, with the permission of the land agent, Roger Harris, who was on the field trip with us earlier today, we were able to salvage a section of the elama; 3 bowls were made from it. One for Jack, one for Jean and one for ourselves and the remainder piece of elama about 2 feet tall I gifted to the Hālau Kekuhi. So if you go into Hālau Kekuhi in Hilo and you see that handsome block of lama on their ke`ahu`hula that is elama that came truly from Ka`upulehu, that came from Kekaha where we are situated today [Hannah].

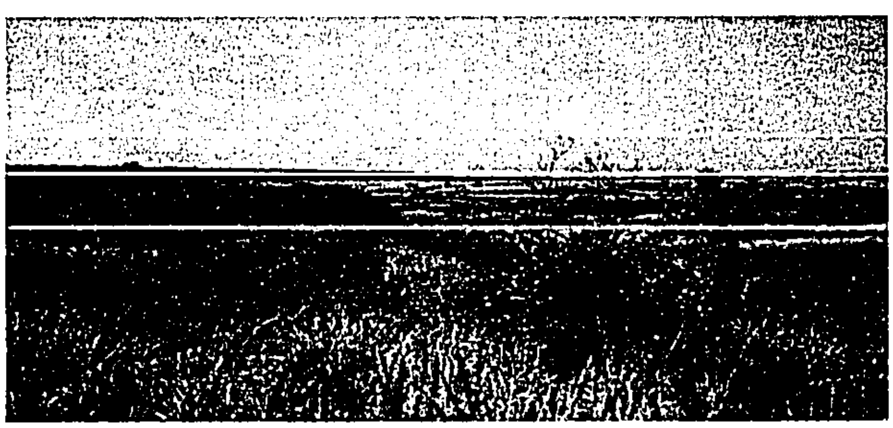


Photo 26. `A`ali`i dot the landscape in the shrubland zone of Kaū.

Photos 27-28. Three endemic species thriving in Kaū.

B-2-c. Hualālai Volcano & Lava Flows. The volcano can't help but be a huge part of the lives of the Kekaha inhabitants; it is on its slopes that they live and work and play. Over the course of time, it spews forth molten lava that courses down its slopes, where it will go is anybody's guess. Many legends were passed on about the flows and the goddess, Pele, who makes it happen. The consultants share some of their stories.

> **Legend of Kukiʻo.** And there was a legend of Kukiʻo in the early days before the volcano came down, before 1801. And they said that time there was a big village there in Kukiʻo. And when Pele came down it wiped the whole thing right off. And I'd like to share that origin of how Pele came. When Pele came they saw the glow and had these two girls was pulehu ʻulu. Well anyway they saw this big glow coming down and this old lady came out. Well the old lady never stop she went look. She went ask these people, there was a big pond that covers from Kukiʻo all the way to Keauhole Lighthouse--great, great big pond. So Pele went up to these people the owner, "Well I want to fish?" "No. no more fish, not ready." So Pele turn around and ask him, "Well can I have the scale?" "No, no more scale cause we no can catch the fish." Well Pele say "Well okay." She never say nothing, she went back up to Puhi-a-Pele and talked to these two girls who was pulehu ʻulu. And she talked to the first one and she say "No wai ko ʻulu?" The girl said "It's for the shark." And she ask the second girl "Na wai hoʻi kau? "Nāu." which means "It's yours." "Auwe! Ua moʻa?" How can be cooked? So she grab the ulu from the charcoal and she slap and she tear em in half. And shared with this girl. And after they ate everything Pele turn around and tell the two girls "A hea ko ʻāina ki hapai. Hele o lua a kūkulu ina peʻa. Mana kaha ʻehā ki o ka ʻāina. " And peʻa is the flag, the marker of this four corners. So these two girls went and do what Pele said. Then they came back and said "Ua pau?" "ʻAe." And this old lady disappeared. And they didn't know it was Pele herself. And they saw this glow coming down. And right above Huʻehuʻe and there's a hill there they call Kileʻo. And where it blow up is from Kileʻo; there's a big crater up there. Then right on the new Mamalahoa Highway, and the same line with Kileʻo, there's an ana there, one puka and it blew up again over there. And disappear and blow up again on the lava as you see Puhi-a-Pele. And from there the Pele went down, wipe out all the pond, went all the way over to Kaʻupulehu and turn around and come back and wipe out the whole village and everything. And this was a big history [Kinoulu].

I've always heard that it [Puhi-o-Pele] was just Pele...or how it was translated to me, was "Pele's smoke" or "Pele's bonfire" [not "puhi" the eel] [Hannah]

Where the Kona Airport today, and that covers it all according to the legend of Tutu Palakiko who told me the whole story. So that's what the whole story that you said and there are others who talk about the same story. So you just can see that the mana of Ke`akua is nothing something which...well who we are talking? God? Well I would say, yeah we talking God who have made heaven and earth and all these things. Nothing was not made but made by Him. And this Pele was in charge of all different districts like what we have today. We have the governor who is in charge of Hawaii here, the moku `āina of this island here, we have the governor. But we have the President to cover everything, so these people are under. So perhaps that's what happen to God and this with Pele [Kinoulu].

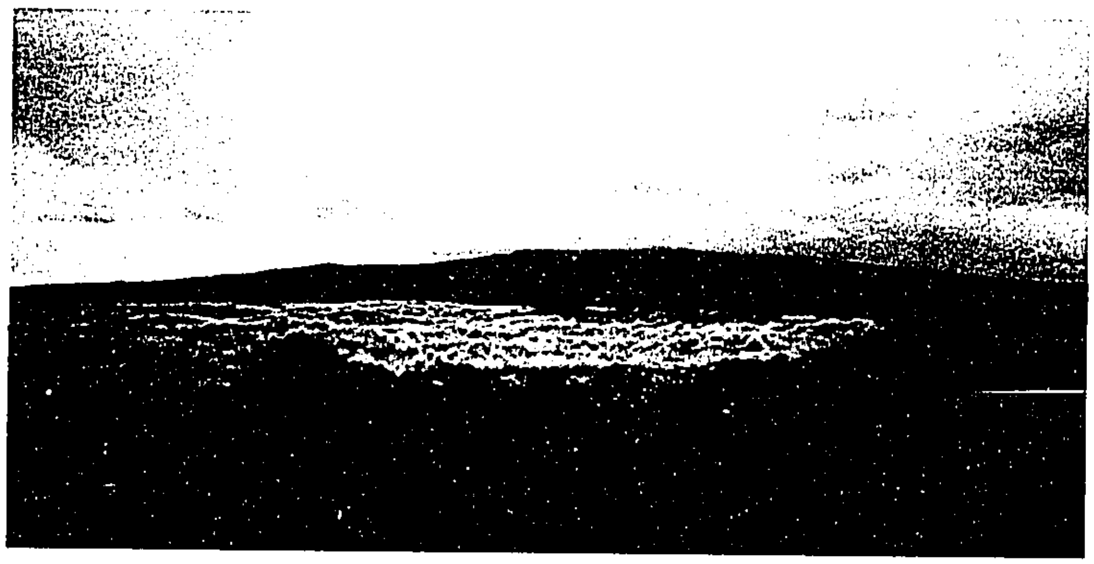


Photo 29. Hualālai in background of old lava flow.

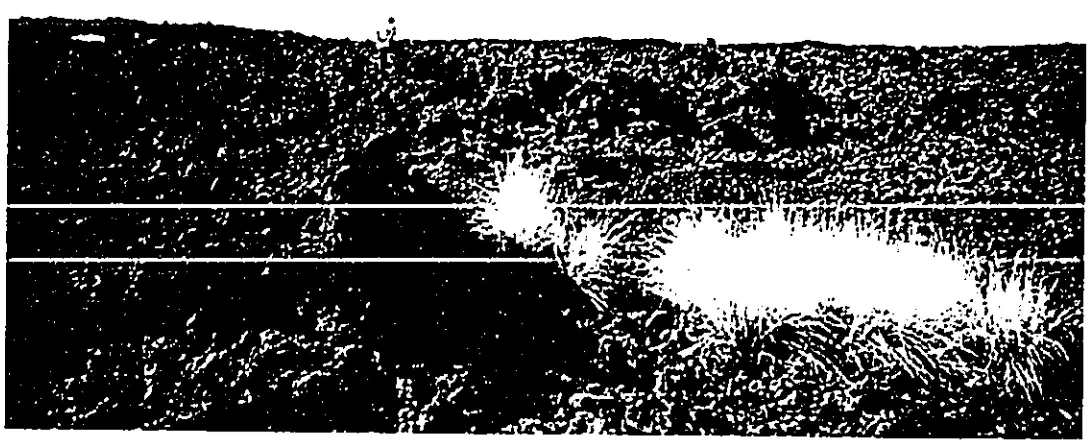


Photo 30. Kaū has lava from different periods.

B-3. Hu`ehu`e Ranch. Ranching-era related activities in Kaū/Kekaha spanned at least one hundred years. Two of the consultants had first-hand experience with ranch history; one consultant in particular was a ranch supervisor for Hu`ehu`e Ranch and re-counts some of his life as a cowboy, the people who worked with him, his responsibilities; and the various animals on the ranch.

> The lands of Koloko and Koki`o were both part of Hu`ehu`e Ranch as were the lands of Kaū. I began coming to Hu`ehu`e in 1958 when I was 6 years old and that's when I first met Uncle Kinoulu and who is with us today, who was a cowboy for Hu`ehu`e [Hannah].
>
> And going through this area [Kaloko/Kekaha] while going to school until I graduate and then finally I become part of the Hu`ehu`e Ranch through the supervision of Mr. Writtenberg. And there was a lot of old timers was there and during WWII in '41, then I became a ranch hand for Hu`ehu`e. And I was the only one who never been draft and draft was coming at that time. Then Mr. Writtenberg was Hu`ehu`e manager; he went to Parker Ranch and talk to Mr. Carter. "You can take all my men, but not this young boy." So I never know this was happening [Kinoulu].
>
> Well anyway, he held me back and I never know the day that I gonna come, I gonna be one of his lead men, until one morning he called me in. And I went in, I sit down have breakfast with him. He said "Come in, sit down." He started telling me that as of today you going be the foreman for all the ranch hand. So it was just a surprise to me. And I told him straight, I said "You know Writtenberg, why you hire me as a foreman, while you have all these old timers out there who have been with you and they know the ranch." He said "No. You right, but no." And he put the "no" right at that point. And I was stunned that he say well I going hire you today. You are able to do all things, and if I send them I don't know whether they gonna do it or no." In other words he put the trust to me. So I carried out. So as I went for a few years—two, three years, then he called me again. Into the kitchen again we have breakfast. And then after our breakfast he said as of today you going be my assistant. I said "Writtenberg why you do this to me? I don't know nothing." He said "No. You know. You have shown me everything and I work together with you." But Irene his wife turn around and said to me, "Ako, you better take it now. And Writtenberg is putting all the trust in you. He know you can do all these things." Then I accepted [Kinoulu].
>
> Then he went out and talked to the boys. He said "As of today, Ako is going to be my assistant and he has the full power just like with me. He didn't have to come back to tell me to fire you. He didn't have come back and tell me I'm going to fire, he just fire you right on the spot." And that was the full power that he had given me. And I was in charge from that time on. And I really surprised and I kind of hold back. But you know, but he didn't give up, he went get something else for me. And he order one jeep from Honolulu. And this time was under the supervision of Ed Hustuce; he came as one of the Trustees to Hu`ehu`e. So this jeep came on *Homoula* and he went and pick em up and bring em home. Then he called me he said "Well Ako, this is your car." What I gonna say, I cannot say anything. It just stunned to me...why he doing this for me? He said that's why I hired you, you my assistant and you gonna go anywhere. You don't have to drive your own car. You want it serviced, right here the service." We had our service tank for gas. So I had the pleasure to go the mountain, Holualoa; I in charge for both ways; Hu`ehu`e and Holualoa. So there's a big responsibility. And everything he do he never go and talk to nobody, he talk to me first. And I was the consultant and we talk together. And all these old timers became under my supervision. So I think that was an honor for me already. So I stayed with him for the many long years and I stayed with Hu`ehu`e for the past 19 years [Kinoulu].
>
> And my job was at that time was to check the fences, check the cattle and check the water. Everything was under my supervision. And all he tell me where you gonna be today. So I going to be down makai, then I go going reach up Koloko. And these are all kaua [?] from end of Honokohau all the way to Kalaemano and these are my areas. I covering all these whole area and are my responsibility; either I ride on a horse or I ride on the car. I can go with this car anywhere else; there's no place is gonna stop me. And all I put on my report to where I was [Kinoulu].
>
> And Richard Punihaole was the old timer and had Apela Kalua`u, he was an old timer, and Kaui Hao, he was an old timer. These are all cowboys. And then Eddie Kauau and Louie Kepano, Carl Holtz, Henry Hao these are young boys who came in. And Henry Hao he came as a bulldozer

trainer. And even at that Mr. Writtenberg say under your supervision. You don't want any of these guys you just fire them, but I don't have the heart but you say no, you do it. So I didn't fire anybody. I had Carl Holtz and I had Kazo Wasamoto who was a carpenter at that time. And these are the people who were under my supervision. Under the supervision of Mr. Writtenberg, who anything I do I always consult with him in our working schedule where you going to work [Kinoulu].

Either the Christmas tree gang or wire fence and the worst part that I didn't like too much was when a storm come in rain and thunder and all of that, I have to go out. And it is my responsibility to send the men to different places. Either go to `Ainaho which is next to Puaoa or either go to Holualoa go up Luawai and Hulaau and all of that. Although we had a man down there by the name of Henry Wassman, he's an old man. And had Manuel Gomes, and his son is still living, Manuel Gomes died. So these are the people for Holualoa. Then I leave in the morning and he tell me "Where you gonna be today?" "I go Holualoa." And then that's all he ask "Where you gonna be?" So I go to Holualoa and cover all Holualoa and ride up and look at cattle going be or they report [to] me. And so every report goes to him and comes to me or comes to me and go back to him [Kinoulu].

So this was my history and everything was put on my lap. And I have to go on and the only thing I never do is drive cattle all the way from Hu`ehu`e to all the way down to Kailua. And during my time was the truck and the only time I take the horses to down there, to ship cattle. And we have special horses to ship cattle in the water. But today we just drive the cattle right on to the boat in Kawaihae. And when we ship cattle to Kawaihae and Writtenberg say "Well you going with this, with the truck and haul them to Kawaihae until we ship the cattle." and I have to go on my own [Kinoulu].

Today none one can tell me I used to ship cattle in the water. And we had special horses to ship cattle in the water. And my job is to oversee the whole thing. Then if cattle runaway from the *Homoula*, then I have to go down and chase em back again, up. Or swim out to take this cattle back to the [boat]. But this cattle they really smart, they don't want to go back to *Homoula*. They go back in this pen [Kinoulu].

So this is part of my life and I'm happy to have this opportunity with this little instrument here to record all of this. And I know what I say did happen at that time. And what I say is not something that which I'm trying to match with other people. No, this is my experience. And my last word is not what good that you do will be benefit not for myself, but for others. What good that I'll share will help others. And I have seen all the hard times. And I have seen life at this early years and how things. And today you see in Kona is not the same Kona. They are people say oh they want to go back to the old days. They never seen how suffering the old days was. Yeah they can go back to the old days, maybe a week or so, but not in months. There was no store. You have to go far away for store. You have no markets like we have today. But today I can say we have different markets right in Kona here. You have KTA one of the old supermarket. And now you have Safeway coming in. And you get Costco coming in. Now you get Home Depot coming in. So you can just see all these different improvement of today. So what you gonna do about it. Are we gonna wait, go back to those old days where there's nothing at all? So I leave this question this way. It's for you who hear this to answer that. I cannot answer or you. But I just showing you the remnants of the past. And you can just how much hardship that we had in the early days [Kinoulu].

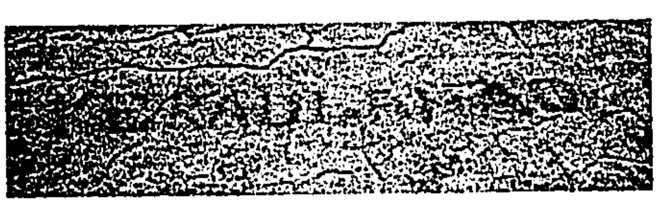


Photo 31. KEKAULAHAO – a historic name glyph.
"The Iron Rope" or "Chain"

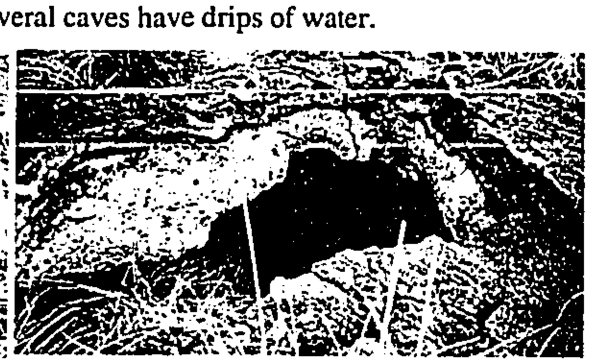
C. Water Resources & Uses

The Hawaiian word for fresh water is *wai;* the Hawaiian word for wealth is *wai wai.* This is because of the value the ancient Hawaiians placed on fresh water, which was crucial for growing taro, the staple of the Hawaiian people. Water was also critical for the people of barren Kekaha, who, based on archaeological survey interpretations and *mo'olelo* passed down in consultant families, were very resourceful in acquiring water.

C-1. Water Caves of Kekaha. Water was also critical for the people of barren Kekaha, who, as it turns out were very resourceful in acquiring water.

> We've heard Uncle Kinoulu talking to us today and Ruby Keana'aina McDonald who was on the field trip also, talk about how they and their elders would plant in the stony soils of Kona, whether it was 'uala or pumpkin in the lower lands or taro in the upper lands. The folks who garden in Kona have had it harder than the people from la'āina momona around the islands where there is actually water and soil. So here in Kona and the leeward side of the island [Kekaha] and the dry land of these places where water caves were and where water could be collected, were tremendously important. In the gardens besides the stony mulch, again we have references from the Hawaiian language newspapers and perhaps from Handy and Handy I'm not quite sure, but descriptions of gardening in Kona where mulch was employed. And we heard also Uncle and Ruby talking about the ferns that were placed [palapalai] fern used to hold the moisture and mulch along with the stones. So in terms of water resources, perhaps there are water caves in this area, were some significant caves in the lands of Kaū. I don't know whether or not they were used as water caves, but we know that near by was Makalei, which was one of the famous water caves of this region [Hannah].

Photo 32. Large cave shelter – several caves have drips of water.



Photos 33-34. Smaller lava tube caves, perhaps temporary shelters or water collection sources.

C-2. Makalei Legend. There is a famous legend in Kekaha about a boy who found a water source for his family. Makalei Estates located east of the project lands [1000'-1800'asl] was so named because of this famous legend.

> I am wondering up to Makalei Estates. Makalei takes it's name from the cave of Makalei which was name for the boy who found it. And this information can be found in Kona Legends by Eliza Davis Low Maguire. Eliza Maguire translated and edited the stories found in Kona Legends from accounts by Issac W. Kihei in the Hoku o Hawaii newspaper. Eliza Davis Low Maguire was also my great-great-grandfather's second wife. And so among the stories that I learned growing up are the stories that came into our family from Aunt Eliza's work [Hannah].
>
> The name Makalei Estates that we hear for the subdivision above the project area and below the Mamalahoa Highway was derived from the Makalei Golf Course on the makua side of the Mamalahoa Highway, and that name was gifted to them by Keala Haleama'u Lindsey. And Keala as I understand it gifted them that name because a time is coming in our history that not many people know the story of the cave of Makalei which was named for the boy who found it in the vicinity of Akahi pu'u in the uplands of Hu'ehu'e. And in order to perpetuate his name whether or not people know the story of the cave of Makalei and the boy who found it, every time they call the name of the golf course or tell where they have played golf, his name has life. So Keala Haleama'u Lindsey felt that it was important for that name to carry on. Now what is significant about the name of the boy is that he gave, by finding this cave, he was able to secure an important water resource for his family. And this again comes to us in the abbreviated form of Kona legends by our Gaga. Again, translated by Eliza Low Maguire. It's said that Gaga and her husband John Avery Maguire had a red wood tank built in the cave of Makalei and the water from that tank piped to their home there at Hu'ehu'e, so that they would have water. There were many water caves, as I understand it, or what few water caves there were, they were significant resources to the people of the region. During times of rain, the water would percolate through the ceiling of lava tubes. Lava tubes that were large enough had troughs made from local woods or umeke, gourds, placed inside of them to catch the drip from the ceiling during the times of rain. Then during times of draught there would be a supply of water [Hannah].

Photo 35. "I could have sworn it was here." Lost site? Lost Pipeline?

C-3. Pipeline and Water Tanks. While working on the ranch, one of the consultants had to check the water sources for domestic use and the cattle. He relates some of this activity below, such as looking for pipeline leaks.

> Kaū, well I rode horse on the pipeline and laid pipeline from Hu`ehu`e all the way to Ka`uka`u and until to Koloko, and that's where we are. And I think in those days, was really a big responsibility for me. And I was in charge of all the water. And anything broke; if come back and report that Writtenberg and Writtenberg come call me and say "There's no water going down to the troughs." So I have go down there and go look. We send the boys and finally he say "You go, I want you to go yourself." The boys they go down, they go on the trail, I don't know what they do, but I cannot say of them. Then when I go, I go on my own. And I go look where there's a lot of track going down, pigs or cows. Then I know the pipe broke down there, I find them. And I fix within an hour. I go home to the ranch. And he's surprised to him that I'm home. And these boys it takes them days, they no can find. And after that he get `nough of that so I was in charge of making the water and everything. And when the month dry, and this is where my concern, no more water down the trough and we really have to pinch the water. And I have to go more and this is why I have my own car. And no more water coming to Hu`ehu`e, then I have to go on the pipeline, I have to send the boys and so we go look for break. Where have a lot of cattle or pig going down, then I tell the boys we stop, we go walk down. And we find the break right quick. And all I carry is the unit and carry the pipe bag. And we cross to Holualoa and Holualoa water head report that there's no water and then I have to go up there look. Just like I was water-maker, but no. I go try open some streams that were now water going someplace else; we bring water to the water head and down to the tank. And Holualoa we had the fleet tank was 50,000 gallons. And we had three big 100,000-gallon tanks. And these tanks feed em to Hu`ehu`e, Moanihea, down to the ranch house, where Writtenberg, down to Kaū, down to Koloko. And these are all these area. But we have special tanks for each one. And the same tank the water line goes to Puawawa. So I don't check on the Puawawa line, they get men coming and if there's anything happen. But I check and I say "Hey the water is going too fast. I used to measure them by inch and I know how much exactly they are drawing water and how much we are drawing water. But Puawawa comes up and find out if line broke and this is where my concern, and why it's in my hand. And without water the cattle will all die...they have to drink water. So this is a big responsibility and checking the fence and all of that. And I have to send the boys out. Or I go myself and look at all these fences, especially where the cattle where we going to ship to Honolulu for market [Kinoulu].
>
> And this is why I have to go look at all these places. And way up now, as where we call `Oheali`ili`i is back again to the government it's self. And you name the mountains which I been; and one of the outstanding mountain that we look from down here is Hinakapo`ula. And that is one of the outstanding mountain that stands up. And sometimes we go up there and we can't get the cattle I have to in myself either walk or go with horse and bring em out. And take bearings...instrument myself to go on, so perhaps I had more guts than brains to go, but it's my responsibility. And today now I'm talking, telling and re-living this story of this area where when I was a little boy, at Koloko here. And today we have gone on to Kaū area -- this is the Kona Kaū [Kinoulu].

Photo 36. Uncle Kinoulu looking lands he once worked on.

D. Marine Resources & Use.

The sea can be a great resource to people with access to its bounty. The consultants benefited from the resources of the nearby coastal environs of Kekaha; went fishing there or had family members who went fishing or gathering. It is also a place of recreation. Unfortunately, the 1890-1801 lava flows inundated the a large swath of coastal lands of Kekaha, destroying many villages, fishponds, pools and cultural resources, both terrestrial and marine. However, the flow does not hinder local residents from enjoying the coasts of Kekaha.

D-1. Fishponds. One of the most famous and largest fishpond of Kekaha was Pa`aiea Fishpond, which once belonged to Kamehameha I. It was ravaged by the lava flow of 1801.

> Of course when we talk about the marine resources of this region, when we talk about the 1801 Puhi-a-Pele flow, that calls to mind the Pond of Pa`aiea, which has been described variously including Kamakau in *Ruling Chiefs,* and *Fragments of Hawaiian History* by `I`i; as well as in the Hawaiian language newspapers. We know that the Pond of Pa`aiea was a very large fishpond. Maybe it was a hyperbolic description of it to say that it was one mile wide and three miles long, but what we know is that it was a large fishpond. Well that was destroyed by the 1801 flow, so that's something that I only know of through mo`olelo and what I've read [Hannah].
>
> I've never read a description of a kua pa for it, so maybe it was a giant loko `ia pu`uhonua...I don't know. None of the descriptions that I have are as clear as say the description of the pond that was built in Kiholo in 1810. And I suspect that Kamehameha marshaled his people down to Kiholo to build that large fishpond there in response to the destruction of the Pond of Pa`aiea. William Ellis describes the pond at Kiholo as being 600 acres under water. So there again we have just a tremendously large aqua culture effort. I guess another aside, Pa`aiea, well I don't know what the `ike, what the knowledge was to name that pond, I have this mana`o, and the `aiea is a plant that is found in this region. And it is now federally registered endangered species, but we find it growing at low elevation at the Kiholo-Hu`ehu`e Trail. So perhaps it's a place. And we know also that `aiea grows in the near-by lands of Kealakehe. So perhaps that's a reference to the `aiea that grew near to there. But this is conjecture on my part [Hannah].

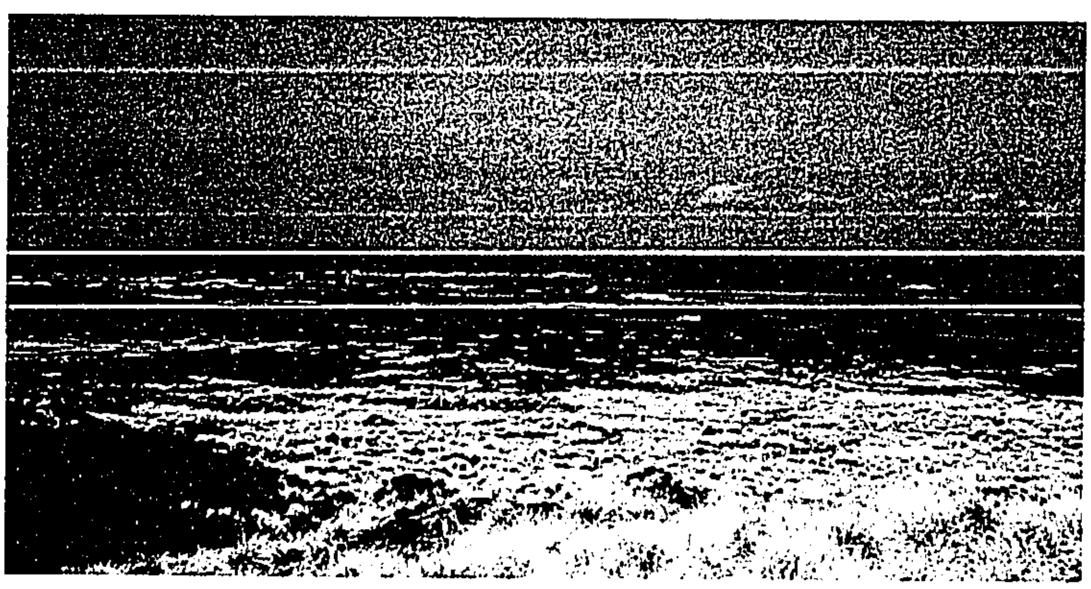


Photo 37. Ke-āhole International Airport on the flow that covered Pa`aiea Fishpond.

D-2. Fishing & Gathering. The consultants noted the various fish or other marine species found in the coastal lands of Kekaha, and shared fishing adventures and what they caught and gathered.

> Along the shoreline at Kaū, we're already onto the 1801 Puhi-a-Pele flow. The lands we traversed today are older, imagining that they are three to five thousands years, maybe 5-7000 years before present. That information can be gotten from Moore & Kleg and their geological map of Hualalei; an important resource tool when working in the Kaha lands here. But along the low sea cliffs of the Puhi-a-Pele flow there were, and I haven't been to the area of the shoreline of Kaū for about 20-25 years. We used to go there, traverse that area when we used to go to Mahai`ula to visit with my high school classmate Keoki Magoon. But as I recall, the fellows we traveled with would go and collect `opihi. They'd pull and throw net. I think when we used to drive we would see and I'm not sure if the were `opelu or `akule, but we used to see fish that would travel the way `opelu do and maybe Uncle has more insights on this. But you could see them from the shore as you were driving along the flow front of the Puhi-a-Pele flow. We only fished or collected `opihi as we might on our way to Mahai`ula. I never visited the shoreline of Kaū as a destination. It was always just some place that we passed through to go somewhere else [Hannah].

Photo 38. Lava flow covers shoreline; ocean in a distance.

> Well in those days the fish was there, a lot of fish. You talk about fish, you can walk; you don't have to go all day for fishing. You get any kind fish that you like. And go dive and get fish, bring em out. And even down here. And today you gotta walk and walk and walk and you gonna see fish only everything is migrating away from the shoreline. Well people say, well too many people fish. So I say, "No, it's just migrating away. Pau." The past is already gone. So like what happen with the people today, get more people than fish [Kinoulu].

Photo 39. Endemic *nai`o* of Kaū.

Photo 40. Ocean access no longer possible in Kaū Ahupua`a due to highway and airport.

E. Project Concerns.

Change often meets with resistance, especially change of lifestyle brought about by outside entities. People who grew up on the lands often don't want to see it changed, especially if it provided resources, recreation and respite. They also understand that things don't stay the same. However, change could occur with cultural sensitivity. Therefore, the consultants shared their *mana`o* and their suggestions for future development in Kaū.

E-1. Landscaping & Salvage Cultural Plants. One of the greatest resources of Kaū is the plethora of native species that exist on the project lands. It was a thrill for the consultants to see the wonder of the various species in bloom and thriving in a land that appear at first glance to be desolate and barren. One of the consultants suggested different measures of preserving this resource.

> We've talked about the botanical resources of the lands of Kaū, I don't have anecdotes or family reminisces about the heiau, or about the burials, or about the trails there, but as a Hawaiian, as someone who has had the opportunity to sit with teachers of the mea Hawaii, when I see the elama, when I see the wala he`e, these are all important timber resources to us. It may be that some of the trees of the species may need to be obliterated in the course of construction. I understand that we're moving with care in the ahupua`a of Kaū, that we're being mindful of our proximity to and forging rapport with the University, which is in the lands adjacent. If there could be some way, that if the wiliwili or the wala he`e or the big elama need to be destroyed, perhaps they could be salvaged by the practitioners of the culture of Hawaii. Maybe even removed by the developer and stock-piled if there are insurance issues with letting people come on to the land and handling chainsaws for the purpose of salvaging the timber. But my point being, perhaps the plants could be transplanted or if they cannot be transplanted, if any usable timber could be salvaged and made available for practitioners, whether hula people for the ku`ahu`hulu. When they were re-furbishing Ahu`ena Heiau I had requests for wala he`e to be used in the anu`u. I did not know until I knew the wala he`e of Kaū how tall the wala he`e could grow; how large around, the diameter the trunk could attained. So already the lands of Kaū have taught me about the plants of my homeland [Hannah].

Photo 41. Endemic specie in Kaū shrubland.

And if we could landscape using plants within the zones that they occur naturally. The a`ali`i for example and the maiapilo or pua-pilo, the native caper, occurs in the lower elevations along with the nai`o. Then we get up a little higher and we begin to see the mamane. And then the quality of the lama improves as we get higher. When I say improves I mean it grows to a taller stature. The lower elevation is so dry that the plants that do live there are water stressed to be sure. So if we can, for example where the Pā-lama, where the hala grove was, if we could use hala perhaps as a road-side planting in that vicinity. Some of that is information that we can get from existing archaeological surveys [Hannah].

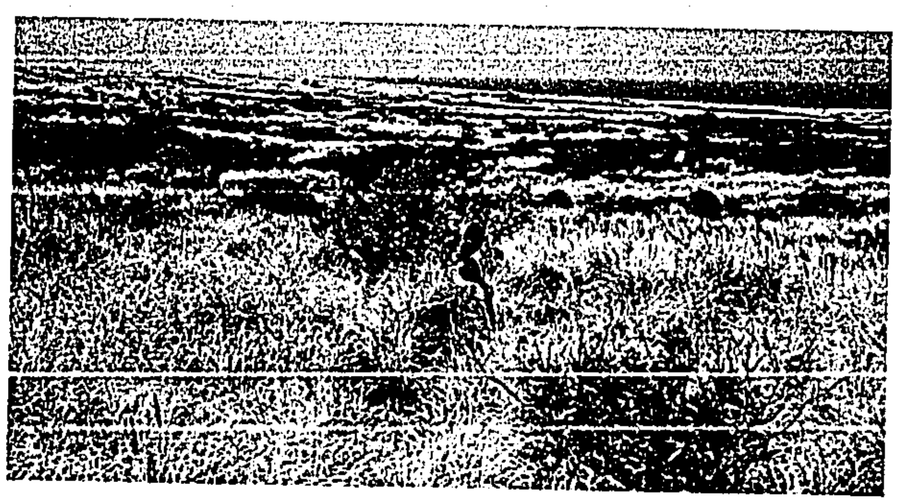
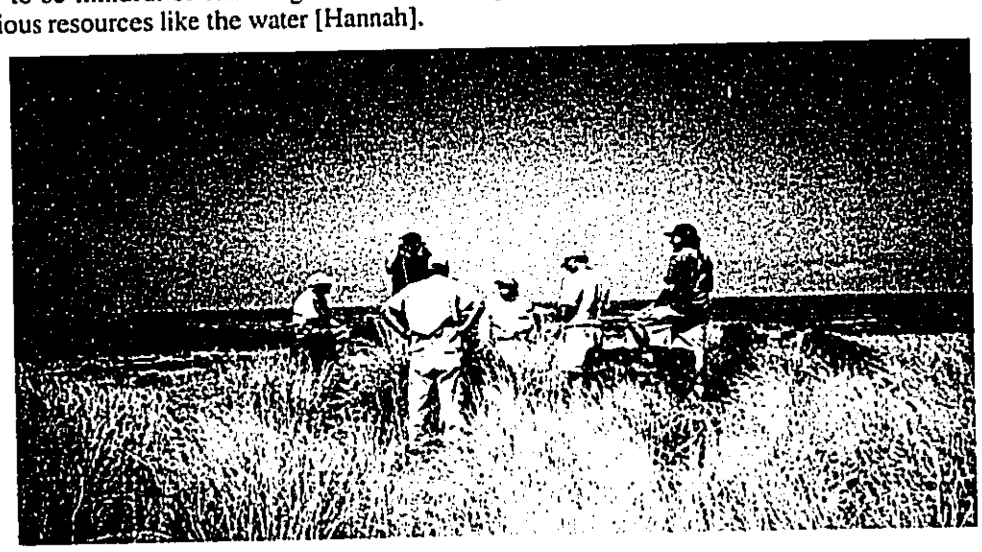


Photo 42. Endemic `a`ali`i in Kaū shrubland.

E-2. Sense of Kekaha. One concern was the loss of what makes Kekaha, Kekaha. It is made up of lava flows, some hundreds of thousand years old. What one consultant didn't want to see was a total greening of Kekaha.

So we don't lose the sense of Kekaha just because water wells can be drilled and pipelines can be laid, I would hope that there are portions of the landscape that can retain their Kaha-ness...so that the lava-scape doesn't get greened over. It's not that I don't like greenery, but we live in a dry land. This place is sometimes called Kekaha wai `ole...wai - water; `ole - without. I don't know how much we know about the aquifer. We're being blessed this year with fine rainfall. In years when there is not fine rainfall we run the risk of discharge from the aquifer exceeding recharge to the aquifer. So one of the things that the lands of Kekaha can remind us is that the Hawaii word for wealth is wai wai--water, water. We live in Kekaha wai `ole, we should be mindful of the land as it is and not in our zeal to greenify it, forget where we are. I shudder to think that there may come a time when we cannot maintain the greens. We've seen some of the places in South Kona, some of the developments in South Kona where the water wells are increasing in salinity. So we need to be mindful of choosing well our landscaping and making good choices about the use of precious resources like the water [Hannah].



Photos 43-44. Two views of Kaū in lands of Kekaha.

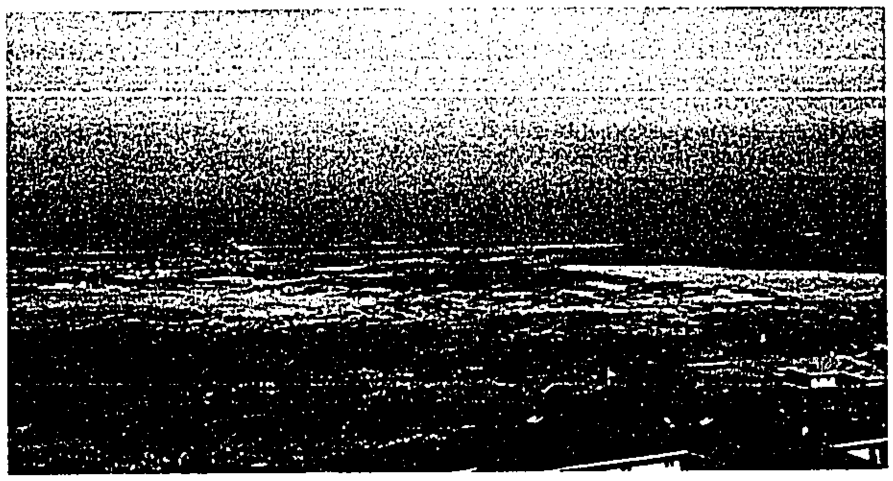


Photo 45. A grand vista of Kaū in the land of Kekaha, North Kona.

E-3. The Planeview of Kaū. The elevation of the project area goes from 160 feet above sea level to about the 900 ' elevation. Therefore there are natural rises that provide spectacular vistas of Kona to Kohala. One place in particular was near a cultural site; it provided a wonderful planeview.

> We want to be mindful of view planes. That first sight that we visited with the ramp and the outcropping, that is close to the Kohala side boundary of Kaū, it offers a wonderful vantage point to Kohala and Maui and Mahai'ula and the shoreline. And looking up mauka to the hills; to Nahaha, Puhi-a-Pele, I'o, Akahipu'u, Moanuiahea, Alala, the 'Ohias. That seems to be a feature that would be a good candidate for preservation It would be pōhō if you preserve that site that we were talking about having a lovely view plane. You preserve that site and then build a building next to it and you can't see from it [Hannah].

E-4. Trails of Kaū. On maps and on the land there are at least a couple of trails within the project area; one may even be part of a *mauka-makai* trail used by ancient Hawaiians to go from the ocean to the uplands. On the field trip the consultants were shown a trail remnant.

> I understand there's a good trail linkage to the sites at the bottom of the project of the subject area. So there's a good linkage there. Maybe the trail in between the two would be modified in places, but if both sites could be designated for preservation and some sort of trail linkage between them could either be maintained or a so-called functional replacement, be put in so that the two sites could be linked. I think that would be a nice cultural experience for attendees of the University as well as others who may be in the area [Hannah].

Photo 46. Segment of trail system in Kaū.

E-5. Naming. Naming is so important, it is how a place will be know for perpetuity. A culturally sensitive approach would be to give names that relate to the *mo'olelo*, natural resources and significant people of the lands. One consultant had a suggestion of naming in relation to the native plants of the area.

And because of my interest in the natural and cultural histories of Hawaii I have found both the archival records, any mo'olelo that kama'āina can share with me and also the botanical elements found in Kaū, to be of great interests to me. I had the pleasure of taking Dietrik Muller-Dumbois, who is one of the eminent Pacific region botanists into the lands of Kaū as well as Sam Gon from the Nature Conservancy Hawaii. And they were impressed also with the quality of the forest there. Because of the quality of the plant community I always hoped that any of the landscaping that is done as part of any development there, we can take our cue from what occurs there naturally....

[Photo 47. Uncle Kino and *wala he'e*.]

That whether it is naming places; we talked about that a little bit on our filed trip into Kaū earlier today. If we want to name something with reference to the ala he'e for example, and that name is taken up and may not be used as a street name, perhaps we can add a characteristic of the ala he'e Kona pronunciation or parts of Kona pronunciation wala he'e. And by naming the characteristics of the plant, still incorporate it both into the place names and perhaps also the landscaping [Hannah].

Photo 48. Wili wili growing in transition zone

PART V: SUMMARRIES & CULTURAL IMPACT ASSESSMENT

The following summaries are based on the information presented in the previous sections: the traditional and historical literature review and the ethnographic data and analyses. References are not cited unless it is new information and not already cited in the text above. These summaries condense the information above, but also serve to focus on a few significant individuals and events in North Kona's history in relation to Kaū and the Kekaha lands, as well as give a broad overview of land and water resources and uses in the general area, as they reflect cultural practices. The cultural impact study is based on two guiding documents, Act 50 and OEQC Guidelines [see Appendices A & B], as well as the *Criteria for Historic Preservation* cited below.

State Historic Preservation Division Draft Rules (1989)

Criteria for Historic Preservation. The "significance" of a site is determined by a set of criteria. The following is the State of Hawaii criteria for historic preservation:

Criterion A:	Be associated with events that have made an important contribution to the broad patterns of our history.
Criterion B:	Be associated with the lives of persons important in our past.
Criterion C:	Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value.
Criterion D:	Have yielded, or be likely to yield, information important for research on prehistory or history.
Criterion E:	Have an important historical cultural value to an ethnic group of the state.

Summary of Significant People and Events.

According to traditional and historical material, the North Kona District, specifically the lands of Kekaha has gone through a number of significant changes, and witnessed the comings and goings of many significant people over time. Some of these people contributed substantially not only to the history of North Kona, but of Hawai`i Island and the rest of the Hawaiian Islands. There were several people and events noted in the oral histories and later recorded by explorers, missionaries, native Hawaiian scholars and ethno-historians, from the time of Pa`ao to Kamehameha I who caused the various island kingdoms to come under one realm. These significant people lived in North Kona and vicinity, and were responsible for land modifications, shifts in polity and commerce, and the gene pool of Hawaii's *ali`i* and monarchs. Some of these people and events are noted below.

Mythical Entities.

The most significant mythical entity to impact North Kona, the lands of Kekaha and Kaū, as well as greater Hawai`i Island, was the volcano or fire goddess Pele, who left evidence of her visits in the form of *pu`u* which dot the landscape, but especially the residuals of her monumental lava flows. In her wake she annihilated villages, shelters, trails, temples, shrines, water sources, fishponds, pools, holua slides, and countless other structures and features, forever changing those lives affected by the destruction. Even those outside of the direct flows of lava were affected as resources on the land, in the fishponds and pools, and in the marine environment were forever extirpated. Through time here in the Kekaha lands, the people have had to alter their lifestyle, look for other resources and start all over again. Often, though time has passed, archaeologists with the help of oral histories are able to reconstruct the life of the ancient ones through the clues left by their abandoned shelters, house sites, sacred places and remains of the food they ate. This cannot be done in the places visited by Pele; the few stories left will have to suffice. However, the flows of Pele created more land mass, more possible lava tube shelters should they be needed someday, a kind of contrasting beauty unique to Kekaha, as the consultants so eloquently expressed, and always a sense of awe.

Ali`i nui.

One of the first legendary *ali`inui* was the priest Pa`ao who is said to have arrived on Hawai`i Island between AD 1100-1200. However, according to traditional genealogy chants it was constructed around AD 480 (James 1998:143-144). In the oral histories, he is credited with constructing at least three *heiau*, specially *luakini* or temples of human sacrifice, thereby radically changing the religious system and political structure of the people of Hawai`i. Pa`ao not only brought about a significant change in religious practices (i.e., the Ku cult, human sacrifices), he brought high chief Pili to rule in place of chief's he believed had lost their *mana* or power due to too many intermarriages with commoners and/or ineffective rule. His new system introduced the concept of hierarchical or *ali`i* rule to the islands and a new order of *kahuna* or priests.

Many battles took place across this landscape as relative fought relative for supreme rule. A couple relatively recent names that stand out are Kalani`opu`u and his nephew Kamehameha I who not only successfully conquered the local island polities, he went on to conquer those on the neighbor islands as well, situating himself in a position that only Kuali`i was said to have done, to have all the island polities under one rule. His advantage was foreign weapons and foreign advisors who knew how to use the weapons skillfully and strategically, as well as powerful *kahuna* or priests who were also knowledgeable in their own right. Two of these were Pu`ou and his son Hewahewa. The lands of Kekaha are said by some to have been *kahuna* lands; places where the *kahuna* resided, and even did their training. Although the common translation for "kahuna" is priest, they are actually masters who studied all their lives in their particular craft and arts. Some were astronomers, others water managers, and some were architects in the building of temples or fishponds. Pu`ou and Hewahewa were masters of many arts, and were considered *kahuna nui*, the highest rank of a *kahuna*.

Kamehameha chose to live in Kailua-Kona during the final years of his life. After he died in 1819, his son who also lived nearby, chose to capitulate to his mother, Queen Ke`ōpūolani and his *Kuhina Nui* (co-ruler in this case) Queen Ka`ahumanu, and break the *`ai kapu*. This signaled the end of the old way, the religion of Pa`ao. Hewahewa, who had been given the role of guardian and priest for Liholiho, resigned his position and helped the missionaries. He eventually left Hawai`i Island and moved to Waimea, Oahu.

The lands of Kaū, and others lands in the vicinity, were passed down to Hewahewa, from his father. Both were descendants of Pa`ao, the first *kahuna* to honor the war god, Kūka`ilimoku. His story, in regards to this land, is currently lost. His granddaughter Paalua, who received the land from her father, son of Hewahewa, did not appear to live on the land, as she lived on O`ahu. She was childless and left the land to her third husband Kaiwinui. Their trails ends there.

Historic People

In regard to the lands of Kaū, the most significant person(s) would have to be John Avery Maguire and his wife Luka, founders of Hu`ehu`e Ranch. Historically the land of Kaū is more associated with him (other than Pu`ou, Hewahewa, and Paalua who also lived during the Post-Contact/Historic Period).

Significant Events.

The most significant (historic) event in Kaū, other than events mentioned above, would have to be the 1801 lava flow, which destroyed the *makai* lands of Kaū. It is not known if anyone was living in the coastal area at that time. What is known is that the Great Fishpond of Kamehameha, the Pa`aiea Fishpond, was flourishing. A pond that size would have had to have had manpower (and womanpower) to maintain it. They would most likely have lived nearby and farmed in the uplands. There is (archaeological) evidence that upland shelters and permanent habitation sites were used through periods of time as well. There was also evidence of fresh water collection places. Therefore it is highly likely that the 1801 lava flow changed the lives of the people of Kaū as well.

Summary of Land Resources and Use

Various land use patterns are physically evident as well as recounted in the literature. The physical evidence is in the form of stone ruins that are fortunate to have been preserved relatively intact. Clues regarding function and use can sometimes be extrapolated from the stories, songs, chants and ethno-historical observations that were also fortunately recorded, as well as from the cultural remains identified during surface and sub-surface studies (artifacts, midden, charcoal for dating). Several of these stone cultural remains were recorded during studies of Kaū lands and also mentioned by the consultants (i.e., *heiau*, caves, platforms, mounds, walls, enclosures, and burials). These are all evidence of both permanent and temporary use of the land and it's diverse natural resources

Ancient Land Use

While the traditional literature is somewhat silent of the subject of Kaū, the cultural resources found on the landscape speak volumes. The permanent and temporary shelters, the midden clues at those sites, and in the caves, the extended use of the lava tube systems, the habitation and agricultural complexes, and especially the burials and the heiau tell a story of ancient use of the land. People lived and died here. People worked and worshipped here. People cultivated the diverse natural resources (endemic/indigenous plants; bountiful marine resources; bountiful aquaculture), as well as cultivated their own Polynesian-introduced cultigens; their staples and their medicine ad ritual plants. In spite of current appearances, Kaū and Kekaha was not barren. Neighbors to the north and south had extensive field systems (Lapakahi, Kalaoa, Kona Field Systems); and trade was always possible, even during times of war.

Historic Land Resources and Use (post 1801).

Although the fishpond resource was destroyed, the marine resources have survived as countless families of Kekaha still take advantage of the entire coastline. The diverse botanical resources of Kaū are still apparent today. There was an abundance of *hala* until recently; there still is an abundance of other medicine, craft and specialty lumber plants. There was a time, even historically (recent) when people were allowed to share the bounty of the land, all they did as a courtesy was to let the *konohiki*, or the *kahu* of the land know that they were going to go gather or go fishing. That tradition is still a way of life in many communities. If one's mango tree is laden with fruit all you have to do is ask and the owner will gladly share with you. Neighbor still trades with neighbor for fruits, vegetables, *hula* plants, wood and fish. Therefore access to resources is a traditional way of life, a cultural practice.

Summary of Water Resources and Use.

Although there are no streams, springs, or wells on Kaū, there is evidence of fresh water resources using ancient water-collection methods of placing a gourd under drips in caves. Several of these cave resources were discovered during archaeological surveys. During a recent site visit. Some moisture was detected in a cave.

Summary of Survey Findings (Cultural Practices)

It is evident that at one time the lands of Kaū were part of an ancient Hawaiian life system. Archaeological surveys indicate a multi-use of the land because of the *heiau*, burials, enclosures, house platforms, petroglyphs, walls and mounds and numerous cave/sinkhole and lava tube systems in Kaū. Perhaps the biggest cultural resources still evident are the diverse collection of endemic ethno-botanical plants. Many of these are medicine plants still used today by *la`au lapa`au*; plants used as dyes by crafters of *kapa*; and various species used for *hula* and *lua* practices and specialized wood crafters. It would be disastrous to see these plants destroyed and/or wasted.

Summary of Consultants Concerns.

There were some concerns expressed by the consultants and are listed below:

Concern	Comments
Landscaping and Salvaging Cultural Plants:	Kaū has important timber resources; elama, walahe`e, wiliwili, if need to be destroyed, salvage for cultural practitioners; or if removed by developer, stockpile for salvage. But try first to transplant, if can't then salvage.
Sense of Kekaha:	Hope that portions of the landscape can retain their Kaha-ness so that the lava-scape doesn't get greened over. Should be mindful of the land as it is and not forget where we are. Be mindful of making good choices about the use of precious resources like water.
View plane of Kaū:	Be mindful of the view planes; of view vantage points to Kohala and Maui and Mahai`ula and the shoreline and mauka to the hills: to Nahāhā, Pūhi-a-Pele, I`o, Akahipu`u, Moananuiahea, `Alala, the `Ohi`as. (The ramp area) would be a good candidate for preservation...but don't put a building in front and obstruct the view.
Trails of Kaū:	There's a good trail linkage to the sites at the bottom of the project...maybe the trail in between the two would be modified in places, but if both sites could be designated for preservation and some sort of trail linkage [between them could either be maintained or a functional replacement be put in so that the two sites could be linked. I think it would be a nice cultural experience for attendees of the University as well as others who may be in the area.
Naming:	Because of the quality of the plant community (in Kaū) I always hop that any of the landscaping that is done as part of any development there we can take our cue from what occurs there naturally. That whether it is naming places, if we want to name something and if the name is already taken up, perhaps we can add a characteristic of the plant, the Kona pronunciation...to incorporate both into the place names and perhaps also the landscaping

Cultural Impact Study (CIS) Assessment/Recommendations.

According to the OEQC Guidelines, the types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, religious and spiritual customs. None of these particular cultural practices will be affected by this project (between 150' and 800' elevation), although access to rare medicinal plants or other plants used by qualified *la'au lapa'au* practitioners and their students should be considered. However, having said that, and keeping in mind that the project area not only has diverse collections of endemic and indigenous plants, some endangered (*'iliahi*), and it has a range of traditional sites that were used in antiquity and some up to historic times, it would be culturally irresponsible to say that any future development of the property would not have any adverse effects or impacts. Consultants expressed concern that certain sites be protected and preserved; any action/activity contrary to this would constitute an adverse affect.

Adaptation to life on the lava fields is unique to Kekaha; the lava tube habitation, water-collection practices, cave habitation, petroglyphs, agricultural complexes that exist in a place that appears to be a barren waste-land...but really wasn't, and it really isn't, which is why the plants continue to thrive. How many examples of this adaptation are left in Kekaha? The irony is that a University is being planned for the adjoining *ahupua'a*. It would be a shame it the students lost the perfect opportunity to learn more about the practices of ancient Hawaiians, right in their "back yard."

Also some recognition, some part of any interpretive program for Kaū, should recognize the connection between Hewahewa and these lands. Just as some recognition, as well as preservation, should be accorded the water-collection caves as they represent an important aspect of the lifestyle and adaptability of ancient Hawaiians to these lands. It would be considered *pono* to allow the Hewahewa and Mahi families to contribute to any further interpretive planning for the *ahupua'a* of Kaū; just as it would be apropos to include the consultants in discussions regarding the future of the endemic/indigenous ethno-botanical plants in Kaū.

It should also be noted that for over a hundred years, native Hawaiians have lived in a culturally repressed state. It has only been within the last thirty years, due to evolved awareness, that native Hawaiians have been aggressively trying to reclaim their *wahi pana* (sacred and/or legendary places). The passage of Act 50 in 2000 legally recognizes and supports this effort. It is in this spirit that the recommendations above have been made.

Qualifier. When considering any future action(s) in regard to the project area (150' to 800' asl) based on the results of this study, one should be mindful that although much effort was made to locate people who are knowledgeable about Kaū and/or the lands of Kekaha in general, there may be others who have even more pertinent knowledge specifically about Kaū and the people who were the traditional guardians of this land. Consideration should be given to them should they come forth as information about the land and development project is made public.

Follow-up/Phase II.

- **Additional interviews**
- **Transcribe Kupuna Site Visit Tape**
- **Summarize Kupuna Site Visit**
- **Hewahewa-Mahi Research**
- **Grantor-Grantee Index Research**
- **KEKAULAHAO Research**

PART V: SUMMARRIES & CULTURAL IMPACT ASSESSMENT

The following summaries are based on the information presented in the previous sections: the traditional and historical literature review and the ethnographic data and analyses. References are not cited unless it is new information and not already cited in the text above. These summaries condense the information above, but also serve to focus on a few significant individuals and events in North Kona's history in relation to Kaū and the Kekaha lands, as well as give a broad overview of land and water resources and uses in the general area, as they reflect cultural practices. The cultural impact study is based on two guiding documents, Act 50 and OEQC Guidelines [see Appendices A & B], as well as the *Criteria for Historic Preservation* cited below.

State Historic Preservation Division Draft Rules (1989)

Criteria for Historic Preservation. The "significance" of a site is determined by a set of criteria. The following is the State of Hawaii criteria for historic preservation:

Criterion A:	Be associated with events that have made an important contribution to the broad patterns of our history.
Criterion B:	Be associated with the lives of persons important in our past.
Criterion C:	Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value.
Criterion D:	Have yielded, or be likely to yield, information important for research on prehistory or history.
Criterion E:	Have an important historical cultural value to an ethnic group of the state.

Summary of Significant People and Events.

According to traditional and historical material, the North Kona District, specifically the lands of Kekaha has gone through a number of significant changes, and witnessed the comings and goings of many significant people over time. Some of these people contributed substantially not only to the history of North Kona, but of Hawai`i Island and the rest of the Hawaiian Islands. There were several people and events noted in the oral histories and later recorded by explorers, missionaries, native Hawaiian scholars and ethno-historians, from the time of Pa`ao to Kamehameha I who caused the various island kingdoms to come under one realm. These significant people lived in North Kona and vicinity, and were responsible for land modifications, shifts in polity and commerce, and the gene pool of Hawaii's *ali`i* and monarchs. Some of these people and events are noted below.

Mythical Entities.

The most significant mythical entity to impact North Kona, the lands of Kekaha and Kaū, as well as greater Hawai`i Island, was the volcano or fire goddess Pele, who left evidence of her visits in the form of *pu`u* which dot the landscape, but especially the residuals of her monumental lava flows. In her wake she annihilated villages, shelters, trails, temples, shrines, water sources, fishponds, pools, holua slides, and countless other structures and features, forever changing those lives affected by the destruction. Even those outside of the direct flows of lava were affected as resources on the land, in the fishponds and pools, and in the marine environment were forever extirpated. Through time here in the Kekaha lands, the people have had to alter their lifestyle, look for other resources and start all over again. Often, though time has passed, archaeologists with the help of oral histories are able to reconstruct the life of the ancient ones through the clues left by their abandoned shelters, house sites, sacred places and remains of the food they ate. This cannot be done in the places visited by Pele; the few stories left will have to suffice. However, the flows of Pele created more land mass, more possible lava tube shelters should they be needed someday, a kind of contrasting beauty unique to Kekaha, as the consultants so eloquently expressed, and always a sense of awe.

Ali`i nui.

One of the first legendary *ali`inui* was the priest Pa`ao who is said to have arrived on Hawai`i Island between AD 1100-1200. However, according to traditional genealogy chants it was constructed around AD 480 (James 1998:143-144). In the oral histories, he is credited with constructing at least three *heiau,* specially *luakini* or temples of human sacrifice, thereby radically changing the religious system and political structure of the people of Hawai`i. Pa`ao not only brought about a significant change in religious practices (i.e., the Ku cult, human sacrifices), he brought high chief Pili to rule in place of chief's he believed had lost their *mana* or power due to too many intermarriages with commoners and/or ineffective rule. His new system introduced the concept of hierarchical or *ali`i* rule to the islands and a new order of *kahuna* or priests.

Many battles took place across this landscape as relative fought relative for supreme rule. A couple relatively recent names that stand out are Kalani`opu`u and his nephew Kamehameha I who not only successfully conquered the local island polities, he went on to conquer those on the neighbor islands as well, situating himself in a position that only Kuali`i was said to have done, to have all the island polities under one rule. His advantage was foreign weapons and foreign advisors who knew how to use the weapons skillfully and strategically, as well as powerful *kahuna* or priests who were also knowledgeable in their own right. Two of these were Pu`ou and his son Hewahewa. The lands of Kekaha are said by some to have been *kahuna* lands; places where the *kahuna* resided, and even did their training. Although the common translation for "kahuna" is priest, they are actually masters who studied all their lives in their particular craft and arts. Some were astronomers, others water managers, and some were architects in the building of temples or fishponds. Pu`ou and Hewahewa were masters of many arts, and were considered *kahuna nui*, the highest rank of a *kahuna.*

Kamehameha chose to live in Kailua-Kona during the final years of his life. After he died in 1819, his son who also lived nearby, chose to capitulate to his mother, Queen Ke`ōpūolani and his *Kuhina Nui* (co-ruler in this case) Queen Ka`ahumanu, and break the *`ai kapu.* This signaled the end of the old way, the religion of Pa`ao. Hewahewa, who had been given the role of guardian and priest for Liholiho, resigned his position and helped the missionaries. He eventually left Hawai`i Island and moved to Waimea, Oahu.

The lands of Kaū, and others lands in the vicinity, were passed down to Hewahewa, from his father. Both were descendants of Pa`ao, the first *kahuna* to honor the war god, Kūka`ilimoku. His story, in regards to this land, is currently lost. His granddaughter Paalua, who received the land from her father, son of Hewahewa, did not appear to live on the land, as she lived on O`ahu. She was childless and left the land to her third husband Kaiwinui. Their trails ends there.

Historic People

In regard to the lands of Kaū, the most significant person(s) would have to be John Avery Maguire and his wife Luka, founders of Hu`ehu`e Ranch. Historically the land of Kaū is more associated with him (other than Pu`ou, Hewahewa, and Paalua who also lived during the Post-Contact/Historic Period).

Significant Events.

The most significant (historic) event in Kaū, other than events mentioned above, would have to be the 1801 lava flow, which destroyed the *makai* lands of Kaū. It is not known if anyone was living in the coastal area at that time. What is known is that the Great Fishpond of Kamehameha, the Pa'aiea Fishpond, was flourishing. A pond that size would have had to have had manpower (and womanpower) to maintain it. They would most likely have lived nearby and farmed in the uplands. There is (archaeological) evidence that upland shelters and permanent habitation sites were used through periods of time as well. There was also evidence of fresh water collection places. Therefore it is highly likely that the 1801 lava flow changed the lives of the people of Kaū as well.

Summary of Land Resources and Use

Various land use patterns are physically evident as well as recounted in the literature. The physical evidence is in the form of stone ruins that are fortunate to have been preserved relatively intact. Clues regarding function and use can sometimes be extrapolated from the stories, songs, chants and ethno-historical observations that were also fortunately recorded, as well as from the cultural remains identified during surface and sub-surface studies (artifacts, midden, charcoal for dating). Several of these stone cultural remains were recorded during studies of Kaū lands and also mentioned by the consultants (i.e., *heiau*, caves, platforms, mounds, walls, enclosures, and burials). These are all evidence of both permanent and temporary use of the land and it's diverse natural resources

Ancient Land Use

While the traditional literature is somewhat silent of the subject of Kaū, the cultural resources found on the landscape speak volumes. The permanent and temporary shelters, the midden clues at those sites, and in the caves, the extended use of the lava tube systems, the habitation and agricultural complexes, and especially the burials and the heiau tell a story of ancient use of the land. People lived and died here. People worked and worshipped here. People cultivated the diverse natural resources (endemic/indigenous plants; bountiful marine resources; bountiful aquaculture), as well as cultivated their own Polynesian-introduced cultigens; their staples and their medicine ad ritual plants. In spite of current appearances, Kaū and Kekaha was not barren. Neighbors to the north and south had extensive field systems (Lapakahi, Kalaoa, Kona Field Systems); and trade was always possible, even during times of war.

Historic Land Resources and Use (post 1801).

Although the fishpond resource was destroyed, the marine resources have survived as countless families of Kekaha still take advantage of the entire coastline. The diverse botanical resources of Kaū are still apparent today. There was an abundance of *hala* until recently; there still is an abundance of other medicine, craft and specialty lumber plants. There was a time, even historically (recent) when people were allowed to share the bounty of the land, all they did as a courtesy was to let the *konohiki*, or the *kahu* of the land know that they were going to go gather or go fishing. That tradition is still a way of life in many communities. If one's mango tree is laden with fruit all you have to do is ask and the owner will gladly share with you. Neighbor still trades with neighbor for fruits, vegetables, *hula* plants, wood and fish. Therefore access to resources is a traditional way of life, a cultural practice.

Summary of Water Resources and Use.

Although there are no streams, springs, or wells on Kaū, there is evidence of fresh water resources using ancient water-collection methods of placing a gourd under drips in caves. Several of these cave resources were discovered during archaeological surveys. During a recent site visit. Some moisture was detected in a cave.

Summary of Survey Findings (Cultural Practices)

It is evident that at one time the lands of Kaū were part of an ancient Hawaiian life system. Archaeological surveys indicate a multi-use of the land because of the *heiau,* burials, enclosures, house platforms, petroglyphs, walls and mounds and numerous cave/sinkhole and lava tube systems in Kaū. Perhaps the biggest cultural resources still evident are the diverse collection of endemic ethno-botanical plants. Many of these are medicine plants still used today by *la`au lapa`au*; plants used as dyes by crafters of *kapa*; and various species used for *hula* and *lua* practices and specialized wood crafters. It would be disastrous to see these plants destroyed and/or wasted.

Summary of Consultants Concerns.

There were some concerns expressed by the consultants and are listed below:

Concern	Comments
Landscaping and Salvaging Cultural Plants:	Kaū has important timber resources; elama, walahe`e, wiliwili, if need to be destroyed, salvage for cultural practitioners; or if removed by developer, stockpile for salvage. But try first to transplant, if can't then salvage.
Sense of Kekaha:	Hope that portions of the landscape can retain their Kaha-ness so that the lava-scape doesn't get greened over. Should be mindful of the land as it is and not forget where we are. Be mindful of making good choices about the use of precious resources like water.
View plane of Kaū:	Be mindful of the view planes; of view vantage points to Kohala and Maui and Mahai`ula and the shoreline and mauka to the hills: to Nahāhā, Pūhi-a-Pele, I`o, Akahipu`u, Moananuiahea, `Alala, the `Ohi`as. (The ramp area) would be a good candidate for preservation...but don't put a building in front and obstruct the view.
Trails of Kaū:	There's a good trail linkage to the sites at the bottom of the project...maybe the trail in between the two would be modified in places, but if both sites could be designated for preservation and some sort of trail linkage [between them could either be maintained or a functional replacement be put in so that the two sites could be linked. I think it would be a nice cultural experience for attendees of the University as well as others who may be in the area.
Naming:	Because of the quality of the plant community (in Kaū) I always hop that any of the landscaping that is done as part of any development there we can take our cue from what occurs there naturally. That whether it is naming places, if we want to name something and if the name is already taken up, perhaps we can add a characteristic of the plant, the Kona pronunciation...to incorporate both into the place names and perhaps also the landscaping

Cultural Impact Study (CIS) Assessment/Recommendations.

According to the OEQC Guidelines, the types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, religious and spiritual customs. None of these particular cultural practices will be affected by this project (between 150' and 800' elevation), although access to rare medicinal plants or other plants used by qualified *la'au lapa'au* practitioners and their students should be considered. However, having said that, and keeping in mind that the project area not only has diverse collections of endemic and indigenous plants, some endangered (*'iliahi*), and it has a range of traditional sites that were used in antiquity and some up to historic times, it would be culturally irresponsible to say that any future development of the property would not have any adverse effects or impacts. Consultants expressed concern that certain sites be protected and preserved; any action/activity contrary to this would constitute an adverse affect.

Adaptation to life on the lava fields is unique to Kekaha; the lava tube habitation, water-collection practices, cave habitation, petroglyphs, agricultural complexes that exist in a place that appears to be a barren waste-land...but really wasn't, and it really isn't, which is why the plants continue to thrive. How many examples of this adaptation are left in Kekaha? The irony is that a University is being planned for the adjoining *ahupua'a*. It would be a shame it the students lost the perfect opportunity to learn more about the practices of ancient Hawaiians, right in their "back yard."

Also some recognition, some part of any interpretive program for Kaū, should recognize the connection between Hewahewa and these lands. Just as some recognition, as well as preservation, should be accorded the water-collection caves as they represent an important aspect of the lifestyle and adaptability of ancient Hawaiians to these lands. It would be considered *pono* to allow the Hewahewa and Mahi families to contribute to any further interpretive planning for the *ahupua'a* of Kaū; just as it would be apropos to include the consultants in discussions regarding the future of the endemic/indigenous ethno-botanical plants in Kaū.

It should also be noted that for over a hundred years, native Hawaiians have lived in a culturally repressed state. It has only been within the last thirty years, due to evolved awareness, that native Hawaiians have been aggressively trying to reclaim their *wahi pana* (sacred and/or legendary places). The passage of Act 50 in 2000 legally recognizes and supports this effort. It is in this spirit that the recommendations above have been made.

Qualifier. When considering any future action(s) in regard to the project area (150' to 800' asl) based on the results of this study, one should be mindful that although much effort was made to locate people who are knowledgeable about Kaū and/or the lands of Kekaha in general, there may be others who have even more pertinent knowledge specifically about Kaū and the people who were the traditional guardians of this land. Consideration should be given to them should they come forth as information about the land and development project is made public.

Follow-up/Phase II.

- **Additional interviews**
- **Transcribe Kupuna Site Visit Tape**
- **Summarize Kupuna Site Visit**
- **Hewahewa-Mahi Research**
- **Grantor-Grantee Index Research**
- **KEKAULAHAO Research**

REFERENCES CITED/REVIEWED

n.a.
2003 "Hewahewa." http://www.freehawaii.org/hewa.html

Armitage, George
1944 *Ghost dog and Other Hawaiian Legends.* Advertiser Publishing Co., Ltd., Honolulu.

Barrera, William, Jr. and Kelly, Marion
1971 *Archaeological and Historical Surveys of the Waimea to Kawaihae Road Corridor, Island of Hawaii.* Departmental Report Series 74(1). Bernice P. Bishop Museum, Honolulu. DOT-Hawaii. [On file at SHPD Library #H-19]

Barrère, Dorothy B.
1969 *The Kumuhonua Legends: A Study of Late 19th Century Hawaiian Stories of Creation and Origins.* Pacific Anthropological Records No. 3, Bishop Museum. [First published in 1878 by Abraham Fornander in *The Polynesian Race*] [Barrère also 1971]

1983 *Notes on the Lands of Waimea and Kawaihae.* Hawaii Historic Preservation Report 83-1. Bernice P. Bishop Museum, Honolulu.

Barrow, Terence
1985 *More Incredible Hawaii.* Charles E. Tuttle Company, Inc. Vermont.

Beaglehole, J. C. (editor)
1967 *The Journals of Captain James Cook on His Voyages of Discovery, Vol. III.* The University Press, Cambridge.

Beckwith, Martha W.
1919 *The Hawaiian Romance of Laieikawai.* Government Printing Office, Washington.

1940 *Hawaiian Mythology.* Yale University Press, New Haven. [1970]

1951 *The Kumulipo: A Hawaiian Creation Chant.* University of Hawaii Press, Honolulu. [1990]

1995 [Editor's notes] "The Story of Pā`ao and Lonopele." In Pukui and Green 1995. pp71-73.

Bellwood, Peter
1978 *The Polynesians: Prehistory of an Island People.* Thames and Hudson Ltd., London.

Berger, Andrew J.
1972 *Hawaiian Birdlife.* The University Press of Hawaii, Honolulu.

BIVM – Big Island Visitor's Magazine
2003 http://www.bigislandvisitor.com/act_mhcc.html

Bonk, W. J.
1968 "An Archaeological Survey of a Coastal Tract in North and South Kohala, Hawaii." Prepared for the Department of Land and Natural Resources, Division of State Parks, State of Hawaii.

Borthwick, Douglas K., Colin, Brian L. and Hammatt, Hallett H.
1992 "Archaeological Inventory Survey of the 24-Acre Parcel in the Ahupua`a of Makaula, in the District of North Kona, Island of Hawai`i (TMK: 7-3-3:07 & 17)." Cultural Surveys Hawaii. Prepared for White Hat Development Corp. [On file at SHPD Library #H-1065].

Brennan, Joseph
1995 *Paniolo.* Ku Pa`a Publishing Inc., Honolulu. [Original 1978]

Brewer, William A & Associates
1986 "Baseline Marine and Coastal Pond Surveys, Makalawena, North Kona, Hawaii." In Makalawena Resort Draft Environmental Impact Statement." [In Donham 1993]

Brock, Julie H and Brock, Richard E.
1974 "The Marine Fauna of the Coast of Northern Kona, Hawaii: an Inventory of Fishes and Invertebrates Recorded During Summer 1972. *Sea Grant Advisory Report* University of Hawaii. [In Donham 1993]

Burchardt, Joan
2002 *Little Britain: Letters from the Hawaiian Kingdom.* C. J. Burchardt, Sherborne.

Bureau of Conveyance
1870-1884 *Grantor Index* [A-J; K; L-Z]
1885-1894 *Grantor Index* [A-J; K; L-Z]
1895-1899 *Grantor Index* [A-J; K; L-Z]

BLC – Bureau of Land Conveyances
1874-1918 *Liber.* Bureau of Conveyance, Honolulu. [In Williams et.al., 1993]

Cahill, Emmett
1999 *The Life and Times of John Young: Confidant and Advisor to Kamehameha the Great.* Island Heritage Publishing, Aiea.

Carlquist, S.
1980 *Hawaii and Natural History.* S.B. Printers, Inc., Honolulu.

Carpenter, Alan B., Major, Maurice, and Yent, Martha
1998 "Archaeological Reconnaissance Survey Kekaha Kai State park, Mahai`ula Section Kaulana and Mahai`ula Ahupua`a, North Kona, Island of Hawai`i." DLNR Division of State Parks, Archaeology Section. [On file at SHPD Library #H-1503].

Carter, Laura A.
1989 "Archaeological Excavations of Six Features Within the Right-of-way for the Proposed Spencer Beach Park Entrance road: Pu`ukohola Heiau National Historic Site, island of Hawai`i."

COH – Center for Oral History-UHM
1997 *A Social History of Kona.* http://www2.soc.hawaii.edu/css/oral_hist/kona.html

Char, Winona P.
1986 Appendix A: loral Survey, Makala-wena Resort Development Project, North Kona, Island of Hawaii. In "Makalawena Resort Draft EIS. [In Donham 1993]

Charlot, Jon
1983 *Chanting the Universe: Hawaiian Religious Culture.* Emphasis International, Honolulu.

Chinen, Jon J.
1958 *The Great Mahele: Hawaii's Land Division of 1848.* University of Hawaii Press, Honolulu.

Ching, Francis
1970 "Surface Survey and Limited Salvage of a Two-mile Portion (Keahole Point Area) of the Kailua-Kawaihae Road Corridor. Dept. of Land and Natural Resources, State Parks Division.

1971 *The Archaeology of South Kohala and North Kona: Surface Survey, Kailua-Kawaihae Road Corridor.* Hawaii State Archaeological Journal 71(1). Department of Land and Natural Resources, Honolulu.

Ching, Francis, and Rosendahl, Paul H.
1968 "The Archaeologgy of North Kona, From the Ahupua`a of Kealakehe to the Ahupua`a of Puukala`a, Section I: Archaeological Surface Survey. DLNR, Division of State Parks. [In Williams et.al., 1993]

Ching, Francis, Cluff, D. and Riley, T.
1969 "Preliminary Report of Archaeological Surface Survey and Salvage Operations at Keahole, North Kona, Hawaii Island: Section II Keahole Point Airport Kailua-Kawaihae Road. DLNR, Division of Parks. [In Williams et.al., 1993]

Ching, Francis K. W.
1971 *Archaeology of South Kohala & North Kona: From the ahupua`a of Lalamilo to the ahupua`a of Hamanamana; Surface Survey Kailua-Kawaihae Road Corridor* (*Section III*). DLNR [On file at SHPD #H-45]

Clark, Jeffrey
1983 "The Waimea-Kawaihae Region: Historical Background." In *Archaeological Investigations of the Mudlane-Waimea-Kawaihae Road Corridor, Island of Hawai`i: An Interdisciplinary Study of an Environmental Transect,* edited by Jeffrey T. Clark and Patrick V. Kirch, pp 39-57. Hawaii Historic Preservation Report 83(1).

Clark, Jeffrey and Kirch, Patrick V. (editors)
1983 In *Archaeological Investigations of the Mudlane-Waimea-Kawaihae Road Corridor, Island of Hawai`i: An Interdisciplinary Study of an Environmental Transect,* Hawaii Historic Preservation Report 83(1).

Cleghorn, Paul L.
2000 "Conceptual Historic Preservation Plan for the Proposed University Center at West Hawai`i North Kona, Hawai`i Island." Pacific Legacy, Inc. Prepared for Wil Chee Planning, Inc. July (On file at SHPD #H-1717).

Cordy, Ross
1973 "Traditional History of O`ahu Political Units: Its Use for Explaining the Origin of Complex Rank Cultural Systems in the Hawaiian Islands." Ms. January.

1985 "Working Paper 1: Hawaii Island Archaeology, Ooma and Kalaoa Ahupua`a, Kekaha, North Kona." Ms. April. [On file at SHPD Library]

1989 "Overview of Historic Site Patterns, Kailua-Keahole Point Subregion, North Kona, Hawaii Island. Ms. On file at SHPD Library. [In Williams et.al., 1993]

1996 "The Rise and Fall of the O`ahu Kingdom: A Brief Overview of O`ahu's History." In *Oceanic Culture History: Essays in Honor of Roger Green,* pp591-613. New Zealand Journal of Archaeology Special Publication.

Cordy, Ross, Renger, Robert, Hitchcock, Rober and Tainter, Joseph
1975 "Archaeologu at Kaloko: A Generalized Model of a Hawaiian Community's Social Organization and Adaptation." Ms. [UHM-Anthropology Sept.]

Cordy, Ross, Tainter, Joseph, Renger, Robert, and Hitchcock, Rober
1991 *The 1971 Archaological Work at Kaloko Ahupua`a, North Kona, Hawaii Island.* Western Archaeological and Conservation Center Publications in Anthropology No. 58. National Park Service. [In Williams et.al., 1993]

Coulter, Jon Wesley
1971 *Population and Utilization of Land and Sea in Hawaii, 1835.* Bernice P. Bishop Museum Bulletin 88, Krauss Reprint Co., New York [Originally published by BPBM 1931].

Daniel, Frank
2003 "The First Wave: Ancient Timesl Hawaii-loa and The First Hawaiians." http://www.formaui.org/3wave2-1.htm

Day, A. Grove
1984 *History Makers of Hawaii.* Mutual Publishing, Honolulu. [In Dorrance 2000:139]

1992 *Hawaii and Points South: True Island Tales.* Mutual Publishing, Honolulu.

Daws, Gavan
1974 *Shoal of Time: History of the Hawaiian Islands.* University of Hawaii Press, Honolulu.

de Vis-Norton, Lionel W.
1819 *The Story of the Naha Stone.* The Board of Trade of Hilo, Hilo.
1820

Donham, Theresa
1986 "Archaeological Reconnaissance Survey Makalawena Coastal Development Area: Land of Makalawena North Kona, Island of Hawaii (TMK: 3-7-2-04:1)." PHRI, Inc. Prepared for The Kamehameha Schools/Bernice P. Bishop Estate. [On file at SHPD Library #H-541].

Dorrance, William H. and Morgan, Francis S.
2000 *Sugar Islands: The 165-Year Story of Sugar in Hawai`i.* Mutual Publishing, Honolulu.

Doyle, Emma Lyons
1953 *Makua Laiana, the story of Lorenzo Lyons.* Advertiser Publishing Co., Honolulu.

Earle, John
1980 "Mummy Cave." (E6-8) Description. Ms. On file Department of Anthropology, B. P. Bishop Museum, Honolulu.

Ellis, William
1984 *Polynesian Researches Hawaii: Journal of William Ellis.* Charles E. Tuttle Company, Inc., Japan. (Fifth Edition)

Ellis, William Rev.
1823/1979 *Journal of William Ellis: narrative of a tour of Hawaii, or Owhyhee.* Tuttle, Rutland

Emerson, Joseph S.
1888 Registered Survey Map No. 1449. [On file at State Survey Office]

1889 Homesteads map No. 6. [On file at State Survey Office]

Emerson, Nathaniel B.
1893 "Long Voyages of the Hawaiians." Paper of the *Hawaiian Historical Society* No. 5 p 22 [In Stokes 1928] [see also 1978 Krauss Reprint Co., Millwood]

1997 *Pele and Hiiaka, a myth of Hawaii.* `Ai Pōhaku Press, Honolulu.

Feher, Joseph [Compiled by Edward Joestring (Part I) and O.A. Bushnell (Part II) [Text By]
1969 *Hawaii: A Pictorial History.* Bishop Museum Special Publication No. 58. Bishop Museum Press, Honolulu.

Feigenson, M. D.
1982 *A Dynamic Model for Temporal Variation in Magma Type and Eruption Interval at Kohala Volcano, Hawaii.* Princeton University, Princeton.

Forbes, David W.
1992 *Encounters with Paradise, Views of Hawaii and Its People. 1778-1941.* Honolulu Acadmeny of Arts, Honolulu. [In Williams et. .al., 1993]

Fornander, Abraham
1880 *An Account of the Polynesian Race: Its Origins and Migrations and the Ancient History Of the Hawaiian People to the Times of Kamehameha I.* Truber and Company, Ludgate Hill. v II, pp22, 33 [In Stokes 1928:40] (1969)

1917 *Fornander Collection of Hawaiian Antiquities and Folk-Lore: Memoirs of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History* Vol IV, Part II. Bishop Museum Press, Honolulu.

1916-1920 "Collection of Hawaiian Antiquities and Folk-lore." Ser 1-3. *Memoirs Bernice Pauahi Bishop Museum* Vols 4-6, Honolulu

1959 *Selections from Fornander's Hawaiian Antiquities and Folk-lore.* Samuel H. Elbert, editor, Jean Charlot, illustrator. University of Hawaii Press, Honolulu.

1996 *Ancient History of the Hawaiian People to the Times of Kamehameha I.* Mutual Publishing, Honolulu. [Originally published as Volume II of *An Account of the Polynesian Race, Its Origin and Migrations* in the 1870s.]

Freycinet, Louis Claude de Saulses de
1978 *Hawai'i in 1819: A Narrative Account By Louis Claude de Saulses de Freycinet.* Notes and Comments by Marion Kelly. Translated by Ella Wiswell. Pacific Anthropological Records 26. Bernice P. Bishop Museum, Honolulu.

GVI – Golf Vision, Inc.
2002 Makalei Country Club. http://www.gvhawaii.com/makalei/makalei.htm

Gowen, Herbert Rev
1908 "Lono's Last Martyr." *Hawaiian Idylls of Love and Death.* Cochrane Publishing Co., New York.

Haig, Brian D.
1995 "Grounded Theory as Scientific Method." In *Philosophy of Education Society* [1996-2001], University of Cambridge. http://www.ed.uiuc.edu/EPS/PES-Yearbook/95_docs/haig.html

Hammatt, Hallett H. and Folk, William H.
1980 "Archaeological Excavations within the Proposed Keahole Agricultural Park, Kalaoa-Ooma, Kona, Hawai'i Island." [On file at SHPD Library #H-177].

Hammatt, Hallett H., Shideler, David W., Borthwick, Douglas K., Stride, Mark, McDermott, Matt, and Nakamura, Kirstie.
1991 "Archaeological Survey and Testing, Kawaihae 1 (Komohana), South Kohala, Hawai'i. Cultural Surveys Hawaii. Prepared for Department of Hawaiian Home Lands." [On file at SHPD Library #H-852]

Handy, E.S. Craighill
1940 *The Hawaiian Planter, Volume I: His Plants, Methods and Areas of Cultivation.* Bernice P. Bishop Museum Bulletin 161. Bishop Museum, Honolulu. [In Williams et.al., 1993]

Handy, E. S. C., and E. G. Handy
1978 *Native Planters in Old Hawaii: Their Life, Lore, and Environment*. Bernice P. Bishop Museum Bulletin 233, Bishop Museum Press, Honolulu.

HVC - Hawaii Volcanology Center
2003 http://www.soest.hawaii.edu/GG/HCV/hualalai.html

HFT - Hawaii Forest and Trail (Rob and Cindy Pacheco)
2002 "The Volcano I Sleep On." Essay by Rob Pacheco. Hualalai Photo by USGS. http://www.hawaii-forest.com/essays/9704.html

HSTO - Hawaii State Tax Office
1938-1967 Tax Records. Honolulu [In Williams et.al., 1993]

Hommon, Robert J.
1976 "The Formation of Primitive States in Pre-Contact Hawaii." Ph.D. Dissertation, University of Arizona, Tucson.

1986 "Social Evolution in Ancient Hawaii." In *Island Societies* [ed] Patrick Vinton Kirch. Cambridge University Press, New York.

HA - Honolulu Advertiser, The
1941 "Errol Flynn Turns Cowboy. May Breed Horses at New Ranch Too." February 13. [In Williams et.al., 1993]
1961 "Kona Ranch Sold for $6 Million." December 27. [In Williams et.al., 1993]
1964 "Huehue Ranch Up for Sale." Novemeber 20. [In Williams et.al., 1993]
1966 "Huehue Ranch in Kona Sold for $6 Million." January 21. [In Williams et.al., 1993]

`Ī'i, John Papa [Translated by Mary Kawena Pukui; Edited by Dorothy B. Barrère]
1983 *Fragments of Hawaiian History.* Bishop Museum Press, Honolulu. [Original 1959. Translations of newspaper articles (*Kuokoa*) written in 1866-1870].

James, Dawn E.
2003 "Using Geophysical Magnetic Surveying Methods In Locating The Buried Wall Of The Hawaiian Fishpond, Pa'aica." Franklin and Marshall College. http://keck.carleton.edu/archives/symposium/97/97toc.html

Juvik, Sonia P. and Juvik, James O.
1998 *Atlas of Hawaii* (Third Edition). University of Hawai`i Press, Honolulu.

Ka`elemakule, John
1928-1930 *Ko Keone Kaelemakule Mooleo Ponoi* (The True Story of John Kaelemakule). In *Ka Hōkū o Hawai`i*. May 29, 1928 to March 18, 1930. Translated by Kepā Maly. In Carpenter et al., (1998).

Kalakaua, D.
1990 *The Legends and Myths of Hawaii: The Fables and Folk-Lore of a Strange People.* Mutual Publishing, Honolulu. [Originally published in 1888 by Charles Webster and Co., New York.]

Kamakau, Samuel Mānaiakalani
1987 *Ka Po`e Kahiko: The People of Old.* Bishop Museum Special Publication 51. Bishop Museum Press. [From articles in *Ku`oko`a* and *Ke Au `Oko`a* from 1866 to 1871. Translated in 1931-34 by Mary Kawena Pukui; Arranged and edited by Dorothy B. Barrère in 1964.]

1991 *Tales and Traditions of the People of Old: Nā Mo`olelo a Ka Po`e Kahiko.* Bishop Museum Press, Honolulu. [From newspaper articles of 1868 and 1870, translated from newspapers *Ka Nupepa Kuokoa* and *Ke Au Okoa* by Mary Kawena Pukui; Edited by Dorothy B. Barrère]

1992 *Ruling Chiefs of Hawaii.* [Revised] Kamehameha Schools Press, Honolulu. [1842 and 1870.]

KNK-*Ka Nupepa Ku`oko`a*
1867 *Ka Nupepa Ku`oko`a.* Hawaiian newspaper. Articles written by S. K. Kamakau July 13 and 20.

Kauahikaua, J.
1996 *Hualalai, Hawai`i's Third Active Volcano.* USGS. http://hvo.wr.usgs.gov/volcanoes/hualalai/main.html

Kelly, Marion
1971 "Kekaha: `Aina Malo`o. Historical Survey and Background of Kaloko and Kuki`o Ahupua`a, North Kona, Hawaii. Bishop Museum Report 71-2. Bishop Museum, Honolulu.

1972 "Exploring Hawaiian Coastal Trails: Anaehoomalo to Kukio, North Kona, Hawaii." Julu-August. [On file at SHPD #H-18]

1973 "Historical Background of Kekaha, North Kona, Hawaii." Appendix B in "Archaeological Salvage of the Ke-ahole to Anaehoomalu Section of the Kailua-Kawaihae Road (Queen Kaahumanu Highway), Island of Hawaii," pp74-121, Paul H. Rosendahl. [from Williams et.al., 1993]

1974 "Historical Survey of the Waimea to Kawaihae Road Corridor Island of Hawaii." In *Archaeological and Historical Surveys of the Waimea to Kawaihae Road Corridor, Island of Hawaii.* By William Barrera, Jr. and Marion Kelly. Departmental Report Series 74(1). Bernice P. Bishop Museum, Honolulu.

Kent, Noel J.
1983 *Hawaii: Islands Under the Influence.* Monthly Review Press, New York.

Kirch, Patrick V.
1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory.* University of Hawaii Press, Honolulu.

1983 "Indigenous Artifacts." In *Archaeological Investigations of the Mudlane-Waimea-Kawaihae Road Corridor, Island of Hawai`i: An Interdisciplinary Study of an Environmental Transect.* Edited by Jeffrey T. Clark and Patrick V. Kirch, pp 341-347. Hawaii Historic Preservation Report 83(1).

Knudsen, Eric
1946 *Teller of Hawaiian Tales.* Mutual Publishing, Honolulu.

Kolb, Michael
1991 *Social Power, Chiefly Authority, and Ceremonial Architecture in an Island Polity, Maui, Hawaii.* Ph.D. Dissertation, University of California, Los Angeles.

Komori, Eric
1981 "Archaeological Reconnaissance Survey of Makai Area (TMK: 7-2-3:2) at Ka`ūpūlehu, Hawai`i Island. MS.071081. Department of /anthropology, B.P. Bishop Museum, Honolulu.

KCRC – Kona Coast Realty Corporation
2003 "About Makalei Estates." In Kona Coast Realty Corporation sales flyer (see Appendix K). http://www.makaleiestates.com/makestates/makalotinfo.html

KPMC – Kona Purple Mountain Coffee
2000 *Kona Coffee's Historical Beginnings.* http://www.konapurplemountain.com/coffee.htm

Kuykendall, Ralph S. and Day, A. Grove
1976 *Hawaii: A History from Polynesian Kingdom to American State.* Prentice-Hall, Englewood.

Ladd, Edmund
1986 *Ruins Stabilization and Restoration Record Pu`ukohola Heiau National Historic Site Kawaihae, Hawaii, Pu`ukohola Heiau.* National Park Service, Honolulu.

Langlas, Charles M.
1994 "Pu`u of Mauka Kawaihae and Kalalā Ahupua`a, District of Kohala, Hawai`i Island: Report of an Investigation of the Hawaiian Cultural Significance of Candidate Sites for the Kamuela Area (Hawai`i) NEXRAD Installation. Part 1: Candidates Sites for the NEXRAD Installation: Ethnographic Background and Site Assessment." Prepared for SRI International. [On File at SHPD Library #H-1317.]

Leib, Amos P. and Day, A. Grove
1979 *Hawaii Legends in English: An Annotated Bibliography.* Second Edition. The University Press of Hawaii, Honolulu.

Loo, Virginia and Bonk, William J.
1970 "A Historical Site Study and Evaluation of North Hawaii."

Luomala, Katherine
1986 *Voices on the Wind: Polynesian Myths and Chants.* [Revised Edition] Bishop Museum Special Publication 75. Bishop Museum, Honolulu.

Maguire, Eliza D.
2000 *Kona Legends.* Petroglyph Press Ltd., Hilo.

Malo, David
1987 *Hawaiian Antiquities.* Bishop Museum Press, Honolulu. [Original 1903– translated by N.B. Emerson from Malo's works of 1898.]

Maly, Kepā
1998 "Kekaha Wai `Ole O Nā Kona" A Report on Archival and Historical Documentary Research, and Oral History Interviews for Kekaha Kai State Park: Ahupua`a of Kaulana, Mahai`ula, Makalawena, Awake`e, Manini`ōwali, and Kūki`o, District of North Kona, Island of Hawai`i (TMK Overview: 7-2). [On file at SHPD Library #H-1669].

McDonald, Marie and McPeek, Flo
1977 "Places Names." In *Kohala Keia.* Stephenson, Larry K. Kohala Library Fund, Kohala. Pp 80-87.

McEldowney
1983 "A Description of Major Vegetation Patterns in the Waimea-Kawaihae Region During the Early Historic Period."

McGreevy, M. W.
1994 *An Ethnographic Object-Oriented Analysis of Explorer Presence in a Volcanic Terrain Environment.* NASA TM-108823. Ames Research Center, Moffett Field, California. http://human-factors.arc.nasa.gov/IHpublications/mcgreevy/

McKenzie, Edith Kawelohea [Edited by Ishmael W. Stagner, II]
1983 *Hawaiian Genealogies: Volume I.* University of Hawaii Press, Honolulu.

1986 *Hawaiian Genealogies: Volume II.* University of Hawaii Press, Honolulu.

Mission Station Reports
1832-70 Mission Station Reports: Waimea, Hawaii. Hawaii Mission Children's Society Library.

Mitchell, Rudy
1979 "From God to God: Hawaii's Seven Centuries of Religious Influence – Pa`ao to Hewahewa ca. 1100 – 1820 AD" Ms. Personal copy.

Moffat, Riley M. and Fitzpatrick, Gary L.
1994 *Surveying the Mahele: Mapping the Hawaiian Land Revolution. Palapala`āina.* Editions Limited, Honolulu.

Moore, et al.,
1987 "Hualalai Volcano: A preliminary summary of Geologic, Petrologic, and Geophysical data," In: *Volcanism in Hawaii*, USGS Professional Paper 1350, pages 571-585. [Referenced in Hawaii Volcanolgy Center website, http://www.soest.hawaii.edu/GG/HCV/hualalai.html]

Nagata, K. M.
1990 Lands of Kau Botanical Survey. Prepared for Nansay Hawaii, Inc. July. [In Williams et.al., 1993]

Nakuina, Emma Metcalf
1904 *Hawaii, its People, their Legends* [by] Emma Metcalf. TH

Nees, Richard
1994 Letter: "Inadvertent Burial Discoveries During the Interpretative and Data Recovery Excavations at Land of Kau, Kona District, Hawai`i Island, (TMK: 07-0205:01)." Ogden. To: Ross Cordy, DLNR. May. [On file at SHPD Library #H-1332].

NOAA [National Oceanic and Atmospheric Administration]
2001 *Hawaii Fishponds.* National Oceanic and Atmospheric Administration, Project No. R/AQ-60 sponsored by the University of Hawaii Sea Grant College Program, SOEST, under Institutional Grant No. NA36RG0507 Year 31 from NOAA Office of Sea Grant, Department of Commerce. http://oceaneng.eng.hawaii.edu/~fishpond/acknowledge.html

O`ahu Cattlemen's Association [OCA]
2000 *Paniolo Hall of Fame Oral History Interviews.* O`ahu Cattlemen's Association, Ewa Beach.

Olson, Storrs L. and James, Helen F.
1982 "Fossil Birds from the Hawaiian Islands: Evidence for Wholesale Extinction by Man before Western Contact." *Science* Vol. 217.

Orr, Maria E. Ka`imipono
2003 "Cultural Impact Assessment, Kahua Ranch DAGS Rainbow Tower & Facilities, Pu`u Waiakanonula, Kahua Ranch, Ahupua`a of Kahuali`ili`i, District of Kohala, Hawai`i Island, Hawai`i." Prepared for Haun & Associates, Wilson Okamoto & Associates and DAGS, State of Hawai`i. February 25.

Pandit, Naresh R.
1996 "The Creation of Theory: A Recent Application of the Grounded Theory Method." *The Qualitative Report*, Volume 2, Number 4, December. http://www.nova.edu/ssss/QT/QR2-4/pandit.html

Parker Ranch
2003 Website: www.parkerranch.com

PVS – Polynesian Voyaging Society
1999a *Plants Introduced to Hawai'i by the Ancestors of the Hawaiian People* (St. John & Jendrusch)

1999b "Hawai`iloa and the Discovery of Hawai`i; The Discovery and Settlement of Hawai`i." http://leahi.kcc.hawaii.edu/org/pvs/traditionsloa.html

Pratt, Helen Gay
1996 *The Hawaiians, An Island People.* Charles E. Tuttle Company, Inc., Japan.

Pratt, Linda and Gon, Sam III
1998 "Terrestrial Ecosystems." In Juvik and Juvik (pp 121-129).

Probate
n.d. No. 2480. Paalua. [On file at Archives, State of Hawaii] In Mitchell (1979).

Pukui, Mary Kawena
1983 *`Ōlelo No`eau: Hawaiian Proverbs and Poetical Sayings* Bernice P. Bishop Museum Special Publication No. 71. Bishop Museum Press, Honolulu.

1994 *Tales of the Menehune.* Kamehameha Schools Press, Honolulu.

Pukui, Mary Kawena, Elbert, Samuel E. and Mookini, Esther T.
1974 *Place Names of Hawaii.* University of Hawaii Press, Honolulu.

Pukui, Mary Kawena and Elbert, Samuel E.
1986 *Hawaiian Dictionary.* University of Hawaii Press, Honolulu.

Pukui, Mary Kawena and Green, Laura C. S.
1995 "The Story of Pā`ao and Lonopele." In *Folk Tales of Hawaii:He Mau Ka`ao Hawaii.* Bishop Museum Press, Honolulu.

Pyle, Leilani
n.d. "The Kolea Stone." Ms. Anth 460B-UHM. [On file at SHPD Library #H-1528]

Rechtman, Robert B.
1999 "Historic Sites Preservation and Interpretation Plan Hualālai at Historic Ka`ūpūlehu: Ka`ūpūlehu Ahupua`a, North Kona District Island of Hawai`i." PHRI, Inc. Prepared for Hualalai Development Company. [On file at SHPD Library #H-1584].

2003a Map/list of sites passed out on April 30, 2003 Site Visit Field Trip.

2003b Email communication, May 24th

Reinecke, John
1930 "Survey of Sites on West Hawaii – Archaeology of Kona, Hawaii." Ms. [On file at SHPD #814].

Richards, W. Rev.
1885 *Memoir of Keopuolani, Late Queen of the Sandwich Islands.* Crocker & Brewster, Boston

1904 *Memoir of Keopuolani, Late Queen of the Sandwich Islands.* Reprinted by W.D. Alexander, Honolulu. [On file at UHM Hamilton Library-Hawaiian Collections].

Riley, T. J.
1969 "Kailua-Kawaihae Road Section II Survey and Salvage. IN Ching et al., (1969). [In Rosendahl 1989].

Rolett, Barry V.
1989 *University of Hawaii Archaeological Research on Bellows Air Force Station: Report of the 1989 Field School and a Proposal for Further Research in 1990.* Dept of Anthropology-University of Hawai`i, Honolulu.

Rosendahl, Paul
1973 "Archaeological Salvage of the Ke-ahole to Anaehoomalu Section of the Kailu-Kawaihae Road (Queen Kaahumanu Highway), Island of Hawaii," PHRI. No. 73-2. [In Williams et.al., 1993]

1989 "Archaeological Inventory Survey, Phase I Site Identification, Kau Well Field Site Project Area Land of Kau, North Kona, Hawaii (TMK: 7-2-05:Por. 1)." PHRI, Prepared for Nansay Hawaii, Inc. March [On File at SHPD Library #H-809].

1990 "Archaeological Inventory Survey, Phase I Site Identification, Kau Waterline/Roadway Project (TMK: 7-2-05:Por. 1)." PHRI, Prepared for Nansay, Inc. March [On File at SHPD #H-804].

Schuster, Laura Carter
1992 "Bulldozers and Archeology at John Young's Homestead: Archeology at Pu`ukohola Heiau National Historic Site." National Park Service, Honolulu. [On file at SHPD Library #H-1117]

Schilt, Rose
1984 *Subsistence and Conflict in Kona, Hawaii: An Archaeological Study of the Kuakini Highway Realignment Corridor.* Dept of Anthropology, Bishop Museum, Series 84-1. [In Williams et.al., 1993]

Schilz, Allan, Shun, Kanalei, [Revisions by] Williams, Scott, Nees, Richard, [History] Hurst, Gwen
1990/1994 "Archaeological Survey and Evaluation Lands of Kau North Kona, Hawaii Island (TMK: 07-02-05:01)." Ogden Environmental and Energy Services Co., Inc. Prepared for Nansay Hawaii, Inc. [On file at SHPD Library #H-1118].

Shun, Kanalei and Schiltz, Allan
1990 "Archaeological Survey and Evaluation, Lands of Kau, North Kona, Island of Hawaii."

Silva, Carol
1986 "Preliminary Historical Documentary Research." Appendix A In "Archaeological Reconnaissance Survey Makalawena Coastal Development Area: Land of Makalawena North Kona, Island of Hawaii (TMK: 3-7-2-04:1)." PHRI, Inc. Prepared for The Kamehameha Schools/Bernice P. Bishop Estate.

Smith, Jared G.
1942 *The Big 5: A Brief History of Hawaii's Largest Firms.* The Advertiser Publishing Co. Ltd., Honolulu

Soehren, Lloyd J.
1973 "Archaeology and History in Kaupulehu and makalawena, Kona, Hawaii. Ms. BPBM. [In Donham 1993]

1964 "An Archaeological Reconnaissance of the Mahukona-Kawaihae Highway, Kohala, Hawaii." Dept of Anthropology, B.P. Bishop Museum, Honolulu.

1980 "An Archaeological Reconnaissance Survey of a Portion of Kawaihae 2, South Kohala, Hawaii." For Mauna Kea Land Corp., Honolulu.

Springer, Hannah K.
1985 Appendix B: "Regional Notes from Kekaha: Kuki`o. [In Donham 1993]

1986 Regional Notes from Kekaha: Makalawena. Appendix B in "Archaeological Reconnaissance Survey, Makalawena Coastal Development Area, Land of Makalawena, North Kona, Island of Hawaii." Pp121-141; Theresa Donham. PHRI No. 245-091886. Prepared for Kamehameha School/B.P. Bishop Estate, Honolulu.

St. John, Harold and Jendrusch, Kuaika
1999 *Plants Introduced to Hawai'i by the Ancestors of the Hawaiian People.* In PVS- Polynesian Voyaging Society 1999a. http://leahi.kcc.hawaii.edu/org/pvs/migrationsplants.html

Stokes, John F. G.
1907/1991 *Heiau of the Island of Hawai`i: A Historic Survey of native Hawaiian Temple Sites.* Bishop Museum Press, Honolulu

1928 "Whence Pa`ao?" In *Hawaiian Historical Paper* No. 15. [On file at UHM-Hawaiian Collections]

Takeguchi, Ann; Hollyer, Jim; Koga, Wendell; Hokada, Miles; Rohrbach, Ken; BittenBender, HC Skip; Buckley, Brent; Friday, JB; Bowen, Richard; Manshardt, Richard; Leary, James; Teves, Glenn; Herring, Eileen; Zaleski, Halina; Leonhardt, Ken; Eger, Bill
1999 "Some History of Hawaii Agriculture." http://www.hawaiiag.org/history.htm

Taylor, Frank J.
1976 *From Land and Sea.* Chronicle Books, San Francisco

Thrum, Thos G.
1907 "Tales From the Temples-Heiaus of Kona." In *Hawaiian Almanac and Annual for 1908.* Thos G. Thrum, Honolulu. Pp69-77).

1923 "More Hawaiian Folk Tales" pp46 Chicago. [In Stokes 1928:40]

Tuggle, H. David and Spriggs, Matthew
2001 "The Age of the Bellows Dune Site 018, O`ahu, Hawai`i, and the Antiquity of Hawaiian Colonization." In *Asian Perspectives,* Vol 39, No. 11-2. pp. 165-188. University of Hawai`i Press, Honolulu.

[UND] University of North Dakota
2003 Hualalai Volcano. http://volcano.und.nodak.edu/vwdocs/volc_images/north_america/hawaii/hualalai.html

USGS-HVO [Hawaii Volcano Ovservatory]
1997a "The next Hualalai eruption." A weekly feature provided by scientists at the Hawaiian Volcano Observatory. March 28, 1997. http://hvo.wr.usgs.gov/volcanowatch/1997/97_03_28.html

1997b "Fishponds versus lava flows." A weekly feature provided by scientists at the Hawaiian Volcano Observatory. USGS. April 25th. http://hvo.wr.usgs.gov/volcanowatch/1997/97_07_25.html

Vancouver, George
1801 *A Voyage of Discovery to the North Pacific Ocean and Round the World.* John Stockdale, London.

Waihona `Aina Corporation (WAC)
2003 Mahele Database, Honolulu. www.waihona.com;

Water, Lynne (Produced by)
n.d. "The Hawaiians Part I" (video].

Watson, Kathie (Webmaster)
1997 USGS: Science for a Changing World: HUALALAI. http://pubs.usgs.gov/gip/hazards/hualalai.html

Westervelt, William D.
1913 "Legend of Pa`ao." Honolulu. [In Stokes 1928:40]

1987 *Myths and Legends of Hawaii.* (Selected and Edited by A. Grove Day) Mutual Publishing Company, Honolulu. [Originally published in the early 1900s.]

1991 *Hawaii Legends of Volcanoes.* Charles E. Tuttle Company, Japan. [Originally published in 1916.]

1995 *Hawaiian Legends of Ghosts and Ghost-Gods.* Charles E. Tuttle Company, Japan. [Originally published in 1916.]

1996 *Hawaiian Historical Legends.* Charles E. Tuttle Company, Japan

Wilcox, Carol
1996 *Sugar Water: Hawai`i's Plantation Ditches.* University of Hawaii Press, Honolulu.

Wilfong, George W.
1882 "Sugar Plantations in the Early Days in the Hawaiian Islands," *The Planter's Monthly,* Honolulu. December [In Dorrance 2000:3]

Williams, Scott. S., Eblé, Francis Jr., O' Hare, Constance, Moorman, Tara, Murakami, Gail
2001 "Archaeological Data Recovery of Selected Sites Above 950-Feet Elevation Makalei Estates Subdivision, Kau Ahupua`a, North Kona, Hawai`i Island." AMEC Earth and Environmental, Inc. Prepared for Island Advisors Inc. [On File at SHPD #H-1793].

Williams, Scott, Nees, Richard, Hurst, Gwen
1993 "Data Recovery Plan Lands of Kau Above 950 Ft Elevation North Kona, Hawai`i Island (TMK: 07-0205:01)." Ogden Environmental and Energy Services Co., Inc., Nansay Hawaii, Inc. [On File at SHPD #H-1147].

Williamson, Eleanor et al.
1983 "Preface" In *`Olelo No`eau.* Pukui. Bishop Museum Publication No. 71. Bishop Museum Press, Honolulu.

Yent, Martha
1991a "Archaeological Reconnaissance Survey: Hienaloli 1st, North Kona, Island of Hawaii (TMK: 7-5-13: 13 and 22)." Prepared for DLNR Division of Forestry. [On File at SHPD Library #H-868]

1991b "Archaeological Reconnaissance Survey: Makaula-Ooma Mauka Tract, North Kona, Island of Hawaii (TMK: 7-3-01:2)." DLNR State Parks. Prepared for Division of Forestry and Wildlife. [On file at SHPD Library #H-868].

Young, John
n.d. Log Book, 1809-1817. Ms. On file, State of Hawaii, Department of Archives, Honolulu.

Youngblood, Ron
1983/1992 *On the Hana Coast.* Emphasis International, Inc. and Carl Lindquist, Hong Kong.

APPENDIX A
A BILL FOR AN ACT RELATING TO
ENVIRONMENTAL IMPACT STATEMENTS
[UNOFFICIAL VERSION]

HOUSE OF REPRESENTATIVES H.B. NO, 2895 H.D.1
TWENTIETH LEGISLATURE, 2000
STATE OF HAWAII

A BILL FOR AN ACT
RELATING TO ENVIRONMENTAL IMPACT STATEMENTS.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawai'i's culture, and traditional and customary rights.

The legislature also finds that native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit' in Hawaii. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.

Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

The purpose of this Act is to: (1) Require that environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and (2) Amend the definition of "significant effect" to include adverse effects on cultural practices.

SECTION 2. Section 343-2, Hawai'i Revised Statutes, is amended by amending the definitions of "environmental impact statement' or "statement" and "significant effect", to read as follows:

""Environmental impact statement" or "statement" means an informational document prepared in compliance with the rules adopted under section 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic [and] welfare, social welfare, and cultural practices of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects.

The initial statement filed for public review shall be referred to as the draft statement and shall be distinguished from the final statement which is the document that has incorporated the public's comments and the responses to those comments. The final statement is the document that shall be evaluated for acceptability by the respective accepting authority.

"Significant effect" means the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic [or] welfare, social welfare[.], or cultural practices of the community and State."

SECTION 3. Statutory material to be repealed is bracketed. New statutory material is underscored.

SECTION 4. This Act shall take effect upon its approval.

Approved by the Governor as Act 50 on April 26, 2000

APPENDIX B

Scope of Work (SOW)

Cultural Impact Assessment [in accordance with OEQC Guidelines]

1. identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua`a;

2. identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3. receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4. conduct ethnographic, historical, and other culturally related documentary research;

5. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6. assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Methods

The specific tasks listed below expand on the above scope of work:

- Conduct historical and cultural background research (i.e., business records, land records; archival documents, literature, reports, letters, photographs, journals, or newspaper files) to locate material that will provide broad patterns of the history of the project area such as subsistence, religious, recreational, and commercial uses of the land; as well as settlement and residential patterns of the area and region; major family groups that inhabited, used or controlled lands within the project area and region; documented legends, myths, or traditional histories associated with the area; and descriptions of traditional practices, customs and beliefs associated with identified traditional cultural practices;

- Prepare a semi-structured ethnographic research instrument that will include questions that will generate general biographical information, association with and knowledge of the project area, its history and use

- Prepare a consent form to be used as written agreement with any individual interviewed concerning the review of content and use of information recorded during the interview

- Identify individuals knowledgeable with the project area e.g., Kau; Kekaha Lands

- Conduct and record ethnographic interviews with knowledgeable individuals. If feasible individuals shall participate in field inspections (Makana to be given)

- Transcribe recorded interviews (Approximate time, 3-4 hrs/per hr of recording)

- Prepare a report that will include an overview of the archival material, and an analysis of the ethnographic data;

APPENDIX C

Guidelines for Assessing Cultural Impacts
Adopted by the Environmental Council, State of Hawaii
November 19, 1997

I. INTRODUCTION

It is the policy of the State of Hawaii under Chapter 343, HRS, to alert decision makers, through the environmental assessment process, about significant environmental effects which may result from the implementation of certain actions. An environmental assessment of cultural impacts gathers information about cultural practices and cultural features that may be affected by actions subject to Chapter 343, and promotes responsible decision making.

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups. Chapter 343 also requires environmental assessment of cultural resources, in determining the significance of a proposed project.

The Environmental Council encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area. The Council provides the *following methodology and content protocol* as guidance for any assessment of a project that may significantly affect cultural resources.

II. CULTURAL IMPACT ASSESSMENT METHODOLOGY

Cultural impacts differ from other types of impacts assessed in environmental assessments or environmental impact statements. A cultural impact assessment includes information relating to the practices and beliefs of a particular cultural or ethnic group or groups.

Such information may be obtained through scoping, community meetings, ethnographic interviews and oral histories. Information provided by knowledgeable informants, including traditional cultural practitioners, can be applied to the analysis of cultural impacts in conjunction with information concerning cultural practices and features obtained through consultation and from documentary research.

In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. Thus, for example, a proposed action that may not physically alter gathering practices, but may affect access to gathering areas would be included in the assessment. An ahupua'a is usually the appropriate geographical unit to begin an assessment of cultural impacts of a proposed action, particularly if it includes all of the types of cultural practices associated with the project area. In some cases, cultural practices are likely to extend beyond the ahupua'a and the geographical extent of the study area should take into account those cultural practices.

The types of cultural resources The historical period studied in a cultural impact assessment should commence with the initial presence in the area of the particular group whose cultural practices and features are being assessed. The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs.

The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural, including submerged cultural resources, which support such cultural practices and beliefs.

The Environmental Council recommends that preparers of assessments analyzing cultural impacts adopt the following protocol:

1.identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua`a;

2.identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3.receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4.conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;

5.identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6.assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Interviews and oral histories with knowledgeable individuals may be recorded, if consent is given, and field visits by preparers accompanied by informants are encouraged. Persons interviewed should be afforded an opportunity to review the record of the interview, and consent to publish the record should be obtained whenever possible. For example, the precise location of human burials are likely to be withheld from a cultural impact assessment, but it is important that the document identify the impact a project would have on the burials. At times an informant may provide information only on the condition that it remain in confidence. The wishes of the informant should be respected.

Primary source materials reviewed and analyzed may include, as appropriate: Mahele, land court, census and tax records, including testimonies; vital statistics records; family histories and genealogies; previously published or recorded ethnographic interviews and oral histories; community studies, old maps and photographs; and other archival documents, including correspondence, newspaper or almanac articles, and visitor journals. Secondary source materials such as historical, sociological, and anthropological texts, manuscripts, and similar materials, published and unpublished, should also be consulted. Other materials which should be examined include prior land use proposals, decisions, and rulings which pertain to the study area.

III. CULTURAL IMPACT ASSESSMENT CONTENTS

In addition to the content requirements for environmental assessments and environmental impact statements, which are set out in HAR §§ 11-200-10 and 16 through 18, the portion of the assessment concerning cultural impacts should address, but not necessarily be limited to, the following matters:

1.A discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.

2.A description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.

3.Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.

4.Biographical information concerning the individuals and organizations consulted, their particular expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.

5.A discussion concerning historical and cultural source materials consulted, the institutions and repositories searched, and the level of effort undertaken. This discussion should include, if appropriate, the particular perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.

6.A discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.

7.A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area, affected directly or indirectly by the proposed project.

8.An explanation of confidential information that has been withheld from public disclosure in the assessment.

9.A discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs.

10.An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.

11.A bibliography of references, and attached records of interviews which were allowed to be disclosed.

The inclusion of this information will help make environmental assessments and environmental impact statements complete and meet the requirements of Chapter 343, HRS. If you have any questions, please call 586-4185.

APPENDIX D

Plants Introduced to Hawai'i by the Ancestors of the Hawaiian People
Dr. Harold St. John and Kuaika Jendrusch

Plants are arranged in botanical order from least evolved to most evolved. Further research might indicate that additional species were brought. Each entry includes the Hawaiian name of the plant, the common English name (if there is one), and the scientific name, followed by the place of origin of the plant, the method of growing it, and its uses. For more information about and illustrations of these plants, visit 24 Canoe Plants of Ancient Hawai'i.

1. Ko (Sugar Cane; Saccharum officinarum): India; Upper-stalk cutting; Food, Medicine, Religion, etc.

2. 'Ohe (Bamboo; Schizostachym glaucifolium): Pacific Islands; Root; Knives, Kapa stamps, etc.

3. Niu (Coconut Palm; Cocos nucifera): South Pacific?; Sprouted coconut; Food, Cordage, etc.

4. 'Ape (---; Alocasia macrorrhiza): Tropical Asia and Oceania; Tuber; Food in times of famine, etc.

5. Kalo (Taro; Colocasia antiquorum): Tropical Asia; Tuber; Main food plant: Hawaiian-Polynesian "Staff of Life"

6. Ki (Ti Plant; Cordyline terminalis): Tropical Asia and Australia; Stem cuttings; Food, Medicine, etc.

7. Pia (Polynesian Arrowroot; Tacca Leontopetaloides): Malay Archipelago; Tuber; Food, Medicine, etc.

8. Uhi (Yam; Dioscorea alata): Asia; Tuber; FoodÑmost important kind of yam

9. Hoi (Biner Yam; Dioscorea bulbifera): Tropical Asia; Tuber; Food during famine

10. Pi'a (Five-Leafed Yam; Dioscorea pentaphylla): Tropical Asia, Pacific; Tuber; Food during famine. etc.

11. Mai'a (Banana; Musa paradisiaca): Cultigen (Obscure Origin); Suckers; Food and its preparation

12. 'Olena (Tumeric; Curcuma domestica): Tropical Asia; Root; Dye, Purification. etc.

13. 'Awapuhi (Wild Ginger; Zingiber Zerumbet): India; Root; Scenting, Medicine, etc.

14. 'Awa (Kava; Piper methysticum): Pacific Islands; Sprouting stem; Relaxing beverage, etc.

15. 'Ulu (Breadfruit; Artocarpus altilis): Pacific Islands, probably Guam; Root sprouts (dig up small plants growing from large tree. Leave 6 inches of root or more on each side); Food, Craft, etc.

16. Wauke (Paper Mulberry; Broussonetia papyrifera): East Asia; Root sprouts (follow same procedure as above); To make kapa and clothing

17. Pa'ihi (---; Nasturtium sarmentosum): Polynesia; Transplant small plant; Food, Medicine.

18. Auhuhu (Fish Poison Plant; Tephrosia purpurea): Tropical South Asia and Pacific; Seed; Fish poison, etc.

19. Kukui (Candlenut Tree; Aleurites moluccana): Asia, Pacitic Islands; Seed or seedling transplant; Lighting, Food, Craft. etc.

20. Hau (Hibiscus; Hibiscus tiliaceus): Tropical Pacific and Old World; Stem cutting; To make fire, canoes, medicine, fertilizer, etc.

21. Milo (PortiaTree; Thespesiapopulnea): Coasts of Eastern Tropics; Seed; To make calabashes. etc.

22. Kamani (Alexandrian Laurel; Calophyllum Inophyllum): Tropical Asia and Pacitic; Seed; Calabashes, Leis, etc.

23. 'Ohi'a 'Ai (Mountain Apple; Eugenia malaccensis): Tropical Asia, Oceania; Seed or seedling transplant; Food, Craft. etc.

24. 'Uala (Sweet Potato; Ipomoea Batatas): Tropical America; Slips or stem cuttings; Food: vegetable from leaves, starch from tubers

25. Kou (---; Cordia subcordata): Africa to Polynesia; Seed; Best wood for calabashes

26. Noni (Indian Mulberry; Morinda citrifolia): Asia, Australia, and Pacific Islands; Root sprout, Seed; Medicine, etc.

27. Ipu (Bottle Gourd; Lagenaria siceraria): Tropical Asia or Atrica; Seed; Containers for food storage, musical instruments, etc.

http://leahi.kcc.hawaii.edu/org/pvs/migrationsplants.html

APPENDIX E

Agreement to Participate in this Cultural Impact Study

Project Title:	**Kaū Ahupua`a Cultural Impact Study** **North Kona, Hawai`i** **(TMK: 07-02-05:01)**
Investigator:	Maria E. Ka`imipono Orr, M.A.

You are being asked to participate in a cultural impact study conducted by an independent investigator contracted by Hiluhilu LLC as part of a larger Environmental Impact Study by Group 70 for the application process for Hiluhilu Development Project in the ahupua`a of Kaū, North Kona, Hawai`i. The investigator will explain the purpose of the study, the procedures to be used, the potential benefits and possible risks of participating. You may ask the investigator any question(s) in order to help you to understand the study or procedures. A basic explanation of the study is written below. If you then decide to participate in the study, please sign on the second page of this form. You will be given a copy of this form to keep.

I. Nature and Purpose of the Study

The purpose of this cultural impact study is to gather information about the lands of Kaū Ahupua`a through interviews with individuals who are knowledgeable about this area; including traditional and historic information such as legends, songs, chants or other information. The objective of this study is to facilitate in the identification and location of any possible pre-historic and/or historic cultural resources, or traditional cultural practices in the area mentioned above, in accordance with applicable historic preservation laws, regulations, and guidelines, including:

Office of Environmental Quality Control [OEQC] Guidelines
and Act 50 HB2895 [A.D.2000], HRS Chapter 343

II. Explanation of Procedures

After you have voluntarily agreed to participate and have signed the consent page, the investigator will tape record your interview and transcribe it later. Data from the interview [ethnographic research] will be used as part of the background history summary for this project. The investigator may also need to take notes and/or ask you to spell or clarify terms or names that are unclear.

III. Discomforts and Risks

Foreseeable discomforts and/or risks may include, but are not limited to the following: having to talk loudly for the recorder; being recorded and/or interviewed; providing information that may be used in reports which may be used in the future as a public reference; knowing that the information you give may conflict with information from others; your uncompensated dedication of time; possible miscommunication or misunderstanding in the transcribing of information; loss of privacy; and worry that your comment(s) may not be understood in the same way you understand them. It is not possible to identify all potential risks, however reasonable safeguards have been taken to minimize risks.

IV. Benefits

This study will give you the opportunity to express your thoughts (*mana`o*), and your opinions will be listened to and shared; your knowledge may be instrumental in the preservation of significant resources and information.

V. Confidentiality

Your rights of privacy, confidentiality and/or anonymity will be protected **if you so desire.** You may request, for example, that your name and/or sex not be mentioned in write-ups, such as field notes, on tape, on files (disk or folders), drafts, reports, and future works; or you may request that some of the information you provide remain "off-the-record" **and not be recorded in any way.** In order to ensure protection of your privacy, confidentiality and/or anonymity, you should immediately advise the investigator of your desires. The investigator will ask you to specify the method of protection, and note it on this form below.

VI. Refusal/Withdrawal

You may, at any time during the interview process, chose to not participate any further and ask the investigator for the tape and/or notes. Please note that you will be given an opportunity to review your transcript, and to revise and/or delete any part of the interview.

VII. Waiver

Part I: Agreement to Participate

I, ________________________, understand that Maria E. Ka'imipono Orr, an independent investigator contracted by Hiluhilu LLC, will be conducting oral history interviews with individuals knowledgeable about the lands of Kaū Ahupua`a. The oral history interviews are being conducted in order to collect information on possible pre-historic and/or historical cultural resources associated with these lands, as well as traditional cultural practices.

I understand I will be provided the opportunity to review my interview to ensure that it accurately depicts what I meant to say about any of these lands.

______ *I am willing to participate.*
______ *I am willing to participate, under the following conditions:*

____

Interviewee **Date**

____

Investigator **Date**

MAHALO NUI LOA

Part II: Personal Release of Interview Records

I, ______________________, have been interviewed by Maria E. Ka'imipono Orr, an independent investigator contracted by Hiluhilu LLC. I have reviewed the written transcripts of tape recordings of the interview, and agree that said documentation is complete and accurate except for those matters specifically set forth below the heading "CLARIFICATION OR CORRECTIONS."

I further agree that Haun & Associate may use and release my identity and other interview information, both oral and written, for the purpose of using such information in a report to be made public, subject to my specific objections, to release as set forth below under the heading "SPECIFIC OBJECTIONS TO RELEASE OF INTERVIEW MATERIALS."

CLARIFICATION OR CORRECTIONS:

SPECIFIC OBJECTIONS TO RELEASE OF INTERVIEW MATERIALS:

____

Interviewee **Date**

____

Investigator **Date**

MAHALO NUI LOA

APPENDIX F

Ethnographic Survey

Basic Research Instrument for Oral History Interviews

Kaū Ahupua`a

North Kona, Hawai`i

This research instrument includes basic information as well as research categories which will be asked in the form of open primary questions which allow the individual interviewed (Consultant) to answer in the manner he/she is most comfortable. Secondary or follow-up questions are asked based on what the Consultant has said and/or to clarify what was said. The idea is to have an interview based on a "talk-story" form of sharing information. Questions will NOT be asked in an interrogation style/method, NOR will they necessarily be asked in the order presented below. This research instrument is merely a *guide* for the investigator and simply reflects general categories of information sought in a semi-structured format. Questions will be asked more directly when necessary.

The Consultants were selected because they met one or more of the following criteria:

- Referred By Hawaiian Cultural Practitioner
- Had/has Ties to Project Location(s)
- Referred By Staff of OHA
- Referred By Hiluhilu People

[NOTE: This part of the interview, #1-4 is mutual sharing and rapport building. Most of the information for research categories "Consultant Background" and "Consultant Demographics" come from this section, but not exclusively.]

1. *Name?* *Birth Year?* *Email address?*
   Address? *Phone #?*

   [This information can be addressed in a couple of ways. After the investigator first turns on the tape recorder, the following information will be recorded: Day/Date/Time/Place of Interview/Name of Consultant (if authorized by Consultant)/Name of Investigator/Questions: Have you read the Agreement To Participate?/Do you have any questions before we begin?/Will you please sign the Consent page. The investigator will explain again the purpose of the interview.

   The investigator will then ask the Consultant to "Please tell me about yourself--when/where were you born? where did you grow up? where did you go to school?" This general compound question allows the Consultant to share as much or as little as he/she wants without any pressure. Most of the information for #1 may already be known to the investigator.]

2. *Family Background: History? Hawaiian connection (if any)?*

   [Much of the information for questions #2, 3, and 4 usually comes from the "monologue" answer to Question #1. If it does not, then these questions will be asked. The answers in this section usually establishes how the Consultant meets the criteria; how the Consultant developed his/her information base, etc.]

3. *Youth? Where lived?*

4. *Schooling?*

[NOTE: This part of the interview, #5-7 reflects information sought for the following research categories: "Significant Properties," "Significant People," "Significant Events," "Traditional Cultural Practices," 'Traditional Arts/Crafts," and Oral History/Folklore/Place Names." The questions are open-ended so as NOT to "put words in the mouths" of the Consultants.]

5. *Can you tell me what you know about the lands of Kaū? And the area known as Kekaha Lands?*

   [NOTE: Generally when people share information about a specific topic/place, they usually state where their information came from. If it isn't volunteered, it is asked as a follow-up question(s). A map of the project area should be available to confirm that investigator and consultant are talking about the same place. Photos would also help if a field trip is not possible. The best scenario would be to be "on-site" at some part of the interview...although this is not always practical.]

6. *What are your recollections and/or personal experiences of this area?*

   [NOTE: If Consultant is related to any Land Commission Awardee [LCA] or subsequent land-owner in the project zone, or former resident or employee of Hu`ehu`e Ranch, the follow-up question(s) is asked.]

7. *How are you related to the Awardee? Or subsequent land owner? Or former resident?*

8. *Do you know any stories/legends/songs/chants associated with these areas?*

   [NOTE: Possible follow-up questions for Kaū or Hu`ehu`e Ranch:

   - How are you or your family connected to the lands of Kaū or Hu`ehu`e Ranch?
   - What year(s) were you and/or your family associated with these lands?
   - What was this place/area called when you were growing up?
   - Can you describe what the area looked like--what kinds of natural and/or man made things?
   - To your knowledge what kind of activities took place in this location?
   - Do you know of any traditional gathering of plants, etc in the area?
   - To your knowledge please describe any gathering practices nearby?
   - Any other land/water use?
   - What was the historic land use? Ranching Agriculture? Habitation? Dwellings?
   - Where were these "features" located? **[Have map ready for marking.]**
   - Can you describe any stream/fresh water use?
   - Do you know about any burials in the project area?

9. *Is there anyone you know who can also tell me about the project area?*

   [NOTE: Usually in the course of the interview, Consultants suggest other people to interview.]

10. *As soon as I have transcribed this interview I will send you two copies. Please review the transcript, make any corrections and/or additions. If you're satisfied, please sign the attached third page of the Consent Form thereby releasing the information. Then mail one set back to me in the enclosed stamped addressed envelope.*

MAHALO NUI LOA

APPENDIX G
Hawai'iloa and the Discovery of Hawai'i
(Samuel M. Kamakau and Z. Kepelino)
By *Polynesian Voyaging Society*

The Discovery and Settlement of Hawai'i

Hawai'i Loa, or Ke Kowa i Hawai'i, was one of the four children of Aniani Ka Lani.1 The other three were Ki, who settled in Tahiti, Kana Loa, who settled the Marquesas, and Laa-Kapu. The ocean was called Kai Holo-o-ka-I'a (Ocean where the fish run). Only two islands existed and both were discovered and settled by Hawai'i Loa. The first he named Hawai'i after himself; the second Maui, after his eldest son. (The other islands were created by volcanoes during and after the time of Hawai'i Loa. [See note 5.])

Hawai'i Loa and his brothers were born on the east coast of a land called Ka 'Aina kai melemele a Kane (the land of the yellow or handsome sea of Kane).2 Hawai'i Loa was a distinguished man and noted for his fishing excursions which would occupy months, sometimes the whole year, during which time he would roam about the ocean in his big canoe (wa'a), called also an "island" (moku), with his crew and his officers and navigators (poe ho'okele and kilo-hoku).

One time when they had been at sea for a long time, Makali'i, the principal navigator said to Hawai'i Loa, "Let's steer the canoe in the direction of Iao, the Eastern Star, the discoverer of land [Hoku hikina kiu o na 'aina]. There is land to the eastward , and here is a red star, hoku 'ula (Aldebaran), to guide us, and the land is there in the direction of those big stars which resemble a bird." And the red star, situated in the lap of the goats [a constellation], was called Makali'i after the navigator. Some other red stars in the circle of the Pleiades were called the Huhui-a-Makali'i ("Cluster of Makali'i").

So they steered straight onward and arrived at the easternmost island of the Hawaiian chain.3 They went ashore and found the land fertile and pleasant, filled with 'awa, coconut trees, and so on, and Hawai'i Loa, the chief, gave that land his name. Here they dwelt a long time and when their canoe was filled with vegetable food and fish, they returned to their native country with the intention of returning to Hawai'i-nei, which they preferred to their own country. They had left their wives and children at home; therefore, they returned to get them. When Hawai'i Loa and his men arrived at their own country and among their relatives, they were detained a long time before they set out again for Hawai'i.

At last Hawai'i Loa sailed again, accompanied by his wife and his children. He settled in Hawai'i and gave up all thought of ever returning to his native land. He was accompanied on this voyage by a great crowd of menNsteersmen, navigators, shipbuilders, and others.4 Hawai'i Loa was chief of all these men. He alone brought his wife and children; all the others came singly, without women, so he was the progenitor of this nation. On their voyage here, the Morning Star (ka Hoku Loa) was the special star the y steered by. And Hawai'i Loa called the islands after the names of his children and the stars after his navigators and steersmen. [The island of Maui was called after Hawai'i Loa's first born son. The island of O'ahu was called after Hawai'i Loa's daught er, and her foster parent was Lua, and hence the name O'ahu-a-Lua. Kaua'i was called after Hawai'i Loa's younger son; his wife's name was Waialeale, and they lived on Kaua'i, and the mountain was called after her because there she was buried. And thus oth er islands and districts were called after the first settlers.]5

After Hawai'i Loa had been some time in Hawai'i-nei, he made another voyage to find his brothers to see if they had any children who might become husbands or wives to his own. They left from Lae o Kalae, in Ka'u, and followed the stars Ke Ali'i-o-Kona-i-k a-Lewa [Canopus] and the stars of Hoku-kea o ka Mole Honua ["Star-cross of the bottom of the earth," or Southern Cross] to Tahiti and other islands to the south. On Tahiti, he found his brother Ki who had settled there and called the island after one of his own names. They sailed together southward (i ka mole o ka honua), and found an uninhabited island, which Hawai'i Loa gave his name, and another smaller island, which he named for his daughter O'ahu.

When they had finished their business here, they returned to Hawai'i, to Lae o Kalae, steering by the Hoku-'Iwa stars and the Hoku Poho ka 'Aina. On this return voyage, Hawai'i Loa brought Tu-nui-ai-a-te-Atua, the first born son of his brother Ki, who bec ame the husband of Hawai'i Loa's favorite daughter O'ahu. The couple had a child called

Kunuiakea, who was born at Keauhou in Puna, Hawai'i. Puna was a fertile and fine land and it was called Puna by Kunuiaiakeakua [Tu-nui-ai-a-te-Atua] after his own birt hplace, Puna-Auia, in Tahiti.

Kunuiakea, on both father's and mother's side, became a chief of the very highest rank (kapu loa). From him sprang the race of chiefs here in Hawai'i (welo ali'i) and from Makali'i sprang the race of common people (welo kanaka). The first has been kept se parate from the most ancient times, and the second has been kept separate from the time of chaos (mai ka Po mai). But the priestly race (welo kahuna) was one and the same with the race of chiefs from the beginning.6

Hawai'i Loa's Descendants

Kunuiakea's son Ke Lii Alia, and his grandson Kemilia, were born at Tahiti along with the Aoa, the royal tree; but his great grandson, Ke Lii Ku (Eleeleualani), was born on Hawai'i.

Eleeleualani was the grandfather of Papa-Nui-Hanau-Moku (w). His wife was called Ka Oupe Ali'i and was a daughter of Kupukupunuu from Ololoimehani (supposed to be either a name for the island of Nu'uhiwa, or of a place on that island). They had a son call ed Kukalani'ehu, whose wife was Ka Haka-ua-Koko, the sixth descendant from Makali'i, and they two were the parents of Papa-Nui (w).

Papa-Nui-Hanau-Moku (w) first married Wakea, who was the son of Kahiko (k) and Tupu-rana-i-te-hau (w), who was a Tahitian woman. Papa's first child with Wakea was a daughter called Hoohokukalani.

Papa, having quarreled with Wakea on account of their daughter [i.e., Wakea slept with their daughter], went to Tahiti and there she took to Te Rii Fanau for husband and had a son called Te Rii i te Haupoipoi. She afterwards returned to Hawai'i under the name of Huhune and had a son with Waia and called him Hinanalo. Domestic troubles now made her crazy and she returned to Tahiti where she had another son with Te Ari'i Aumai, who was said to be the fourth generation of the Tahiti chiefs, and she called hi s name Te Ari'i Taria, and he became chief over that part of Tahiti called Taharu'u.

Because she was the mother of chiefs, both here and in Tahiti, she is called Papa Nui Hanau Moku ["Great Papa, the Mother of Islands"]. She is said to have been a comely, handsome woman, very fair and almost white.7

Papa is said to have traveled eight times between Tahiti and Hawai'i, and died in a place called Waieri, in Tahiti, during the time of Nanakelihi the fifth descendant from her and Wakea.

Wakea was a wicked and bad man. He instituted the bad and oppressive kapu, such as that men and women could not eat together; that women could not eat red fish, hogs, fowl or other birds, and some kinds of bananas. These kapu were put on to spite and worry Papa, on account of her growling at and reproaching him for his wickedness. Wakea also departed from the ancient worship and introduced idol worship, and many people followed him, because they were afraid of him.

Other Travels of Hawai'i Loa

Hawai'i Loa was born on the eastern shore of the land of Kapakapaua-a-Kane. One of Hawai'i Loa's grandchildren was called Keaka-i-Lalo (w) whom he married to Te Ari'i Aria, one of his brother Ki's grandchildren, and he placed them at Sawai'i [Samoa?], whe re they became the ancestors of that people, Sawai'i being then called Hawai'i-ku-lalo [Hawai'i rising downwind].

Afterwards Hawai'i Loa revisited Tahiti and found that his brother Ki had forsaken the religion in which they were brought up, that of Kane, Ku and Lono, and adopted Ku-waha-ilo [maggot-mouthed Ku], the man-eating God (ke akua 'ai kanaka), as his God. Aft er quarreling with his brother on this account, Hawai'i Loa left Tahiti and brought with him Te Ari'i Apa as a husband for Eleeleualani, his mo'opuna (grandchild) From these two was born Kohala (w), a girl, from whom the Kohala people sprang.

Afterwards Hawai'i Loa went again to Tahiti and Hawai'i-ku-lalo (Sawai'i) and held a meeting with those peoples at Tarawao, but finding that they persisted in following after the God Ku-waha-ilo and that they had become addicted to man-eating, he reproved and repudiated them, and passed a law called "he Papa Enaena," forbidding anyone from

Hawai'i-Luna (upwind Hawai'i) from ever going to the southern islands, lest they should go astray in their religion and become man-eaters.

When Hawai'i Loa returned from this trip he brought with him Te Ari'i Tino Rua (w) to be a wife to Kunuiakea, and they begat Ke Ali'i Maewa Lani, a son, who was born at Holio in North Kona, Hawai'i, and became the Kona progenitor.

After this Hawai'i Loa made a voyage to the westward, and Mulehu (Hoku Loa) was his guiding star. He landed on the eastern shore of the land of the Lahui-makalilio (the people with the turned up, oblique eyes, i.e., Asians). He traveled over it to the nor thward and to the westward to the land of Kuahewahewa-a-Kane, one of the continents that God created, and thence he returned, by the way he had come, to Hawai'i nei, bringing with him some white men (po'e keokeo kane) and married them to native women (a h o'omoe i ko'onei po'e wahine). On this return voyage the star Iao was his guiding star to Hawai'i.

After this Hawai'i Loa made another voyage to the southern and eastern shore of Kapakapaua-a-Kane and took with him his grandchild Kunuiakea in order to teach him navigation, etc. When they had stayed there long enough they returned and Kunuiakea brought with him "he mau ha'a elua" (two stewards), one called Lehua and the other Nihoa, and they were settled on the two islands which bear their names, as konohiki (land stewards) and put under the charge of Kaua'i, the youngest son of Hawai'i Loa.

When Hawai'i Loa returned from the conference with his brother Ki and his descendants, his wife Hualalai bore him a son who was called Hamakua, and who probably was a bad boy (keiki 'ino'ino), for so his name would indicate. Ten years later, Hualalai died and was buried on the mountain of Hawai'i that has been called after her name ever since.

After Hawai'i Loa was dead and gone, in the time of Kunuiakea, came Tahitinui from Tahiti and landed at Ka-lae-i-Kahiki (the southwest point of Kaho'olawe, a cape often made by people coming from or going to Tahiti.) Tahiti-nui was a mo'opuna of Ki, Hawai 'i Loa's brother, and he settled on East Maui and died there.

The descendants of Hawai'i Loa and also of Ki (which are one, for they were brothers) peopled nearly all the Polynesian islands. From Ki came the people of Tahiti, Borabora, Huahine, Taha'a, Ra'iatea and Mo'orea [the Society Islands].

From Kanaloa [brother of Hawai'i Loa] were peopled Nukuhiwa, Uapou, Tahuata, Hiwaoa and those other islands [the Marquesas Islands]. Kanaloa married a woman from the man-eating people, Taeohae [Taiohae, on Nukuhiwa], from whom spring those cannibals who l ive on Nukuhiwa, Fiji, Tarapara, Paumotu [the Tuamotus], and the islands in western PolynesiaÑso is it reported in the Hawaiian legends and prayersÑbut the people of Hawai'i and the Tahiti (properly speaking) did never addict themselves to cannibalism.

Notes

This English version of the Hawai'i Loa story is from Fornander, Vol. VI, 278-281. Another version entitled "Hawaii-nui," in Hawaiian and English, appears in Kepelino's Traditions of Hawaii (Honolulu: Bishop Museum, 1932, 74-77). The authenticity of the Hawai'i Loa tradition has been questioned:

"The legend seems to be a summary of statements contained in many other Hawaiian legends and genealogies. At the time it was recorded in writing, many Hawaiian had become Christianized and were familiar with Biblical history. The temptation to interpret certain incidents similar to those in Biblical history as being in fact the Hawaiian rendering of Biblical events seems to have influenced the translators. This unfortunate condition has more or less discredited the ancient legends on which the legend of H awaii-loa is based, branding them , in the opinion of many modern students as "doctored accounts, influenced by Christianity" (Cartwright 105)

Both Kamakau and Kepelino, the authors of the tradition of Hawai'i Loa, were Chrisitian converts The tradition includes the notion that Hawaiians worshipped one God formed by a trinity of gods (Kane, Ku, and Lono). It also contains an account of the creat ion of the first man (Kumuhonua) out of clay and the first woman (Lalo Honua) out of the rib of the first man. Kanaloa, angry that he was denied 'awa, rebelled against God and later seduced the first woman, after which the first man and woman broke the la w of Kane and fell from grace. The Hawaiian Noah in this tradition is called Nu'u; he survived a flood in a large vesssel with a house on it; after the flood subsided, he landed on top of Mauna Kea, etc.

Cartwright points out, however, that "many of the persons mentioned [in the genealogy] are and have been accepted by Hawaiians of chieftain rank as their ancestors." He concludes that the tradition is authentic, though the Hawai'i in the story is actually Ra'iatea (formerly called Hawaiki) rather than the Big Island of Hawai'i. He offers no evidence for this conclusion.

Randie Fong notes "the Hawai'ii Loa portion [of the tradition of Hawai'i Loa] bears no resemblance to any Biblical account. The names, places, settings, and plots give us no reason to question their age and authenticity. Further, Patience Bacon of the Bis hop Museum remembers kupuna being interviewed by Tutu Puku'i. The kupuna spoke of Hawai'i Loa as their 'reality,' and this was somewhere in the 1920's and 30's. Mrs. Bacon feels that the tradition is sound" (Unpublished commentary on Hawai'iloa; the name has been used for a Hawaiian voyaging canoe that will retrace in 1995 an early settlement route to Hawai'i from the Marquesas Islands.)

1. The story begins with the genealogy of Hawai'i Loa for many generations, from the first man, Kumu Honua, and his wife Lalo Honua, who lived in a land called Kalana i Hauola, down to Aniani Ka Lani, Hawai'i Loa's father and Ka Mee Nui Hikina, his mother.

2. Kepelino's version: Hawai'i-nui sailed from a land called Kahiki-Honua-Kele.

3. Kepelino's version states that the canoe made landfall at the western end of the archipelago: "First he saw the island of Kaua'i, but he kept on sailing and found O'ahu and then the islands of the Maui group, then, seeing the mountains of Hawai'i, he k ept on until he reached that island. There he lived and named the island after himself. The other islands from Maui to Kaua'i were named for his children and for some who sailed with him. Here are the names of this children: Maui was the eldest, O'ahu yo unger, and Kaua'i the youngest. These names he gave to the three large islands, but the smaller islands were perhaps named for those who accompanied him."

4. Kepelino's version: Hawai'i-nui sailed to Hawai'i with his eight steersmen: Here are their names: Makali'i, a famous steersman and great farmer; Iao; Kahiki-Nui; Hoku 'Ula [perhaps the star Aldebaran]; Maiao; Kiopa'a ["fixed," one name for Polaris, the north star; also called Hokupa'a]; Unulau; Polohilani [perhaps the star Schedir in Cassiopeia]. And because of their skill in observing the stars, each one called the star he observed after his own name. One steersman, Kahiki-Nui, has a land district on Maui named after him.

5. Another passage in Fornander says "When Hawai'i Loa arrived here, there were only the two islands of Hawai'i-Loa and Maui-au-Ali'i; but during his time and close afterwards the volcanoes on Hawai'i and on Maui began their eruptions; and earthquakes and convulsions produced or brought to light the other islands" (279).

6. Earlier in the story we are told that only Hawai'i Loa came with a wife and children so he was "the special progenitor of this nation" (278). Kepelino concludes, "Hawai'i-nui was perhaps a chief or perhaps not; he was a man of high standing (ke kanaka ko'iko'i), as I see it. He had a granddaughter Ku-ka-lani-ehu, who lived in ancient times." A note at the end of the Fornander version states, "In the first age, from Hawai'i Loa to Wakea, the royal authority and prerogative were not very well defined. T he chiefs were regarded more in the light of parents and patrons (haku), than as moi and ali'i-kapu, although they enjoyed all the honor and precedence due to their rank. This state of things was considerably altered by Wakea, his priest and successors, y et even so late as the time of Kanipahu, who refused the government, it is evident that the royal authority was not well settled in the olden times ('aole he ano nui o na ali'i i ka wa kahiko loa 'ku) (281).

7. See Kamakau, Tales and Traditions (133-135) for one version of the story of Papa and Wakea. Papa and Wakea are considered by many as the first female and male ancestors of the Hawaiian people: "Wakea, from whom all Hawaiian genealogies stem as the anc estors of the Hawaiian people, 'both chiefs and commoners,' is regarded as a man in Hawaiian tradition, not as a god as in southern groups [of Polynesia]." (Beckwith 294)

http://leahi.kcc.hawaii.edu/org/pvs/traditionsloa.html

PVS - Polynesian Voyaging Society 1999

APPENDIX H
The First Wave: Ancient Times
By Frank Daniel

Hawaii-loa and the First Hawaiians

The South Pacific island of Ra'iatea was home to Chief Hawaii-Loa, (ca. 88 B.C.). A navigator and explorer, he had just returned from exploring the north Pacific to find his family and friends near starvation.

Chief Hawaii-Loa commissioned Hagoth, a Maori kahuna kalai waa, to build three double hull canoes, each 100 feet long, large enough to carry three hundred people. The largest was named Uruao. Uru was the name of the Maori homeland known to the Hawaiians as Ulu-nui.

Chief Hawaii-Loa was going to settle the uninhabited islands he discovered in the center of the Pacific Ocean that he named the Hawaiian Islands. There he believed they could live in peace and harmony with sufficient food, where they would no longer be threatened in any way. It was about 53 B.C.

He asked Matariki, also known as Makalii, an old friend and navigator, to be his head steersman. Matariki would decide when the tides, winds and moon phase were favorable to begin the voyage.

Matariki and Hawaii-Loa asked eight other steersmen to bring their families. Kii, Maui-Loa and Kana-loa, the brothers of Hawaii-Loa, and their families and friends began the months of preparation. Matariki was also a farmer and it was he who decided what plants to bring.

After consulting with the gods, studying the tides and moon phase, Matariki decided it was time to begin their voyage. Using the stars A'a and Hokule'a, ancient chants and their knowledge of the currents and winds they pointed their canoes north. The voyage took several weeks.

Early one morning, as the edge of dawn was separating from the darkness of the sea, a very large white cloud appeared floating on the ocean seemingly held in place by a sky full of stars. As dawn lit up the sky they could see the cloud was the snow on top of a mountain. They named the mountain Mauna Kea. It was on the island of Hawai'i. The star Hokule'a rested in the sky above. Their destination had been reached.

Their first homes were in caves. Crops of fast growing taro and other crops from the 27 species of plants brought with them were planted. At first their food was dried fruits, vegetables and livestock they brought with them, fresh fish and limu. There were no animals except the honu that walked on all fours on the islands.

Chants tell of a peace that reigned for more than 600 years during which time great works were accomplished by the ka po'e kahiko. Large waterways were engineered, great walls of stone for heiaus , and loko i'a kuapa. Many stand today as testament to their skills and ability to live in peace and harmony with the 'aina and kai.

Those who came with Hawaii-Loa ultimately settled the other islands, building villages, farms and fishponds. The population of the islands in 400 A.D. had grown considerably.

From Hawai'i, across the channel Hawaii-Loa could see Kauiki Head on the island Ihikapapalaumaewa, and the mountain Aleheaakala. Ever the explorer, Hawaii-Loa, and his wife Hualalai moved to Maui where he died as a very old man. His bones are buried on Kauiki Head, near Hana.

Hawaii-Loa discovered the Hawaiian Islands and was the leader of the First Wave. More would follow in the centuries to come!

http://www.formaui.org/3wave2-1.htm

Frank Daniel.

APPENDIX I

Waihona `Aina, Corp.

Mahele & Boundary Commission Datebase

Paalua

Mahele Award 13B/RP 8265

PAALUA (w)

M.A. 13-B (Kau, Kona, Hawaii)
R.P.G. 880 (Waimea, Koolauloa, Oahu)

MAHELE BOOK 57-58 (62-63)
Relinquished:
1/2 Waimea, ahp., Koolauloa, Oahu
Puuepa i Mookini, Kohala, Hawaii (Signed)
Received:
1/2 Waimea, ahp., Koolauloa, Oahu
Kau, ahp., Kona, Hawaii

M.A. 13-B
(RP 8265) **Kau, Kona, Hawaii** 1,560.00 ac/1 ap
(Aw. Bk. 3:327; *Indices* 138)

Claim 6237 "Not Awarded" (Numerical Index to Awards 1160)
NR 265.5 claimed for her by her husband, unsigned). [At the time he was the K/A Kaeliwai]
1/2 Waimea, Koolauloa, Oahu, with pahale and sweet potato patches;
Kau, ahupuaa in Kona, Hawaii
FT 16.5 Claimed "for his wife" (unnamed; Kaeliwai claimant)
NT 330.10 [For. & Nat. Test; micro Reel 4]:
"True copy" (Kope Oiaio) of Mahele Book
(Signed) by A.G. Thurston, Secty. Jan. 30, 1854
Annotated: "Waimea has been sold by the Min. Pub. Instr. as School Land to Kaeliwai" See Kaeliwai's file].

Waimea was originally granted in name of Paalua's husband Kaeliwai as R.P.G. 880 in 1852 (*Index to All Grants* Pt. I p. 53, with no acreage shown). In 1860 Kaeliwai deeded this grant to Paalua. Deed says: "The reason for the conveyance...is that my name was wrongly written in Royal Patent [Grant] No. 880....the land has been conveyed to Paalua...."
DEED, Kaeliwai to Paalua, Waimea, Koolauloa, Oahu 1,289.50 acres, December 31, 1860 (Bureau of Conveyances L 58 pp 150-151).

Claim 600 "Not Awarded" (Numerical Index to Awards 902)
NR 288.2: claims following lands and a houselot in Honolulu because she is the only living granddaughter of Hewahewa, the kahuna nui:
"These are my lands on Hawaii" [? Hewahewa's former lands]:
Iliokoloa in Kau
Pulama in Puna
Kahalii in Hilo
Kalua in Hilo
Opelukui in Hilo
Kau in Kona [Mahele Award]
Makalawena in Kona
Kiolo in Kona
Koholalele in Hamakua
Puuepa in Kohala [relinquished in Mahele]
Waikaalulu in Hamakau

Island of Maui:
Aleamai in Hana
Keaweakapu in Honuaula
Puunoa in Lahaina
Island of Molokai:
Kawaikapu
Island of Oahu
Pawaa in Honolulu
Kawaiki
Waimea, [Koolau] [Mahele Award]
Kauwila
Island of Kauai
Kaohe

159: Paalua had three husbands:
K/A Kaeliwai, at least to December 1860 (Deed, Kaeliwai to Paalua)
J.N. Kanaulu; married about 1874
Mikaele Kaiwinui; married between 1875-1878.
She had no issue by any of the above husbands.

PROBATE 2480 (1st CC; 1886) Paalua died July 3, 1886.
Wanted all her property: Kau, Kona, Hawaii; Waimea, Oahu; and house in Kauluwela [Honolulu], to go to her husband Kaiwinui; her will to be drawn in such way that the paper [will] cannot be broken--"because I have so many relatives."

601: PAALUA (Mahi genealogy)
BM 6:41, 10:8; AH 15:66

Umiokalani	Piimauilani	Hoolaakaiwi, w.
Kanaloa-uoo	Hoolaakaiwi	Mahiopelea
Mahiopelea	Kauakahi[heleikaiwi]	Kaohuki[okalaipohina], w.
Holoae	Kaohuki[okalaipohina]	Paılili
		Pine, w.
Paılili	Haalolou	Puou
Puou	Kamakona	Hewahewa [kahuna]
Hewahewa	[Kailakanoa]	Kamokumaia
Kamokumaia	Kualii	PAALUA, w.

No. 8265, Paalua, Kau Ahupuaa, District of North Kona, Island of Hawaii, Volume 35, pps. 687-689

Royal Patent No. 8265 In Confirmation of Land Commission Award

Whereas, the Board of Commissioners to quiet Land Titles did by Land Commission [ ] Mahele Award No. 13B award to Paalua an estate of Freehold less than Alodial in the land hereafter described;

And whereas proper application has been made to the Commissioner of Public Lands by Julia B. Egan, for a Patent to the herein described land, the boundaries of which have been determined by a Commissioner of Boundaries, and the Government Commutation thereon in the sum of One Hundred and Fifty-six and 90/100 ($156.90) Dollars has been paid.

Therefore, the Governor of the Territory of Hawaii, in conformity with the laws of the United States of America and of the Territory of Hawaii, by this Patent makes known to all men, that he has this day granted and confirmed absolutely, in Fee Simple, unto Paalua all of the land situate at Kau, In the District of North Kona, Island of Hawaii, bounded and described as follows:

Beginning at a point on the 1801 lava flow, about 45 feet from the sea, on the boundary between Kau and Makaula, marked [o with four strikes around it, North, East, South, West] on solid pahoehoe, the coordinates of which point from Akahipuu Triangulation Station are North 1646.1 feet and West 27313.1 feet, and from which point Lae o Puukala Triangulation Station is by true azimuth 172° 56' 24" and distant 1743.4 feet, and running by true azimuths:

1. 295° 04' 00" 18773.0 feet along Makaula to x marked on pile of stones at Hoohila at makai corner of Homestead Lots, from which point Akahipuu Triangulation Station is by true azimuths 238° 32' 54" and distant 12093.3 feet;
2. 280° 15' 30" 2018.5 feet along Lots 17 and 25 (Homestead Map No. 6, Makaula), to x on top of large ahu;
3. 278° 06' 00" 2069.5 feet along said Lots 27 and 25 to x on ahu;
4. 273° 40' 00" 3367.0 feet along Lot 45 (Grant 3741 to W.H. Kailiino), to the Northeast corner of said Lot 45, at the corner of stonewall on makai side of the Government road;
5. 261° 44' 00" 36.0 feet across the Government Road to a [triangle with dot in center] marked on stone and ahu at the Northwest corner of Grant 1870 to Hewahewa;
6. 278° 51' 00" 287.0 feet along said Grant 1870 to Hewahewa to x marked on solid ledge of aa and ahu;
7. 263° 52' 00" 550.5 feet along said Grant 1870 to Hewahewa to x marked on stone and ahu;
8. 268° 07' 30" 566.0 feet along said Grant 1870 to Hewahewa to [triangle with dot in center] marked on stone and ahu on an old iwi just mauka of stonewall;
9. 270° 19' 00" 648.5 feet along said Grant 1870 to Hewahewa to [triangle with dot in center] marked on rock and ahu on iwi;
10. 276° 26' 00" 160.0 feet along said Grant 1870 to Hewahewa to x marked on stone and ahu at head of iwi at a place called Eleele; [page 688]
11. 259° 40' 30" 288.0 feet along said Grant 1870 to Hewahewa to x marked on stone ahu just North of iwi;
12. 264° 51' 30" 428.5 feet along said Grant 1870 to Hewahewa to x marked on pahoehoe and ahu on iwi at ahua;
13. 268° 46' 30" 164.0 feet along said Grant 1870 to Hewahewa to [triangle with dot in center] marked on stone and ahu on iwi;
14. 276° 58' 30" 317.0 feet along said Grant 1870 to Hewahewa to x marked on stone and ahu on iwi;
15. 267° 37' 30" 172.0 feet along said Grant 1870 to Hewahewa to x marked on pahoehoe and ahu on iwi;
16. 283° 16' 00" 146.0 feet along said Grant 1870 to Hewahewa to : marked on stone and ahu at the Northeast corner of said Grant 1870 to Hewahewa at a place called Aipapai, where the punawai kukui marked by Fuller formerly stood, the coordinates of which point from Akahipuu Triangulation Station being South 7179.4 feet and East 834.7 feet;
17. 255° 33' 00" 483.0 feet along Makaula to galvanized nail and ahu;
18. 273° 52' 30" 660.0 feet along Makaula to [triangle with dot in center] marked on stone and ahu at a place called Maialoa where Haleohiu cuts off Makaula;
19. 282° 31' 30" 334.0 feet along Haleohiu to x marked on large lava ball and ahu;
20. 280° 52' 00" 593.0 feet along Haleohiu to x marked on stone and ahu at old cultivating ground called Kaaipuaa;

21. 268° 37' 30" 859.0 feet along Haleohiu to x marked on pahoehoe and ahu on kualapa;
22. 264° 13' 30" 236.5 feet along Haleohiu to x marked on stone and ahu at Puu Liolio;
23. 257° 55' 00" 521.0 feet along Haleohiu to x marked on stone and ahu;
24. 263° 49' 00" 825.0 feet along Haleohiu to x marked on stone and ahu on ahua;
25. 261° 34' 00" 259.0 feet along Haleohiu to x marked on stone on an aa hill;
26. 255° 26' 00" 666.0 feet along Haleohiu to x marked on the South edge of a large pahoehoe slab and ahu;
27. 265° 20' 00" 207.5 feet along Haleohiu to [triangle with dot in center] marked on stone with large ahu on an ahua;
28. 258° 23' 00" 267.5 feet along Haleohiu to Puu Nahuina at the Southeast corner of this land, this point being by true azimuths 78° 23' 00" and distant 14 feet makai from a galvanized spike driven in a stone, said spike being 9 feet mauka of a large stone ahu;
29. 163° 30' 40" 552.0 feet along Kaupulehu to the Southeast corner of Grant 5067 to A.S. Wall this point being by true azimuths 345° 1' 20" and distant 306.8 feet from [triangle with dot in center] marked on stone and large ahu on a small kualapa; and being also by true azimuths 343° 30' 40" and distant 1415.5 feet from the corner of Kaupulehu marked [square with dot in center], Moanuiohea;
30. 94° 06' 20" 2170.0 feet along said Grant 5067 to A.S. Wall to [triangle] marked by J.S. Emerson on a large Ohia tree at the Southeast corner of Grant 2410 to Kuapuu; the coordinates of which point from Akahipuu Triangulation Station are South 6084.8 feet and East 4340.0 feet;
31. 85° 33' 30" 2065.0 feet along said Grant 2410 to Kuapuu to [triangle with dot in center] marked on stone and ahu;
32. 84° 27' 00" 343.0 feet along said Grant 2410 to Kuapuu to lava tree mold and ahu on ahua;
33. 77° 15' 30" 204.6 feet along said Grant 2410 to Kuapuu to galvanized nail and ahu;
34. 53° 47' 00" 107.6 feet along said Grant 2410 to Kuapuu to [triangle with dot in center] marked on stone and ahu at North edge of gulch;
35. 80° 15' 00" 350.7 feet along said Grant 2410 to Kuapuu to galvanized nail and ahu;
36. 95° 44' 00" 117.5 feet along said Grant 2410 to Kuapuu to x marked on stone and ahu;
37. 93° 17' 30" 246.0 feet along said Grant 2410 to Kuapuu to [triangle with dot in center] marked on stone and ahu;
38. 100° 04' 00" 203.3 feet along said Grant 2410 to Kuapuu to x marked on pahoehoe and ahu;
39. 123° 50' 00" 262.7 feet along said Grant 2410 to Kuapuu to [triangle with dot in center] marked on stone and ahu;
40. 130° 15' 30" 204.0 feet along said Grant 2410 to Kuapuu to x marked on stone and ahu South of Keomo ana;
41. 105° 05' 00' 193.4 feet along said Grant 2410 to Kuapuu to x marked on stone and galvanized nail and ahu on the makai side of stonewall;
42. 88° 42' 00" 185.0 feet along said Grant 2410 to Kuapuu to x marked on stone and ahu;
43. 88° 19' 00" 204.0 feet along said Grant 2410 to Kuapuu to x marked on stone and ahu just makai of stonewall at a place called Kukuiiole;
44. 101° 39' 00" 506.0 feet along said Grant 2410 to Kuapuu to x marked on pahoehoe and ahu;
45. 107° 03' 00" 334.6 feet along said Grant 2410 to Kuapuu to x marked on stone and galvanized nail and ahu;
46. 108° 24' 30" 303.6 feet along said Grant 2410 to Kuapuu to [triangle with dot in center] marked on stone and ahu;
47. 99° 20' 00" 488.5 feet along said Grant 2410 to Kuapuu to x marked on stone and ahu;
48. 92° 15' 30" 313 feet along said Grant 2410 to Kuapuu to galvanized nail and ahu;
49. 97° 17' 30" 109.0 feet along said Grant 2410 to Kuapuu to x marked on stone and galvanized nail and ahu; [page 689]
50. 101° 55' 00" 386.0 feet along said Grant 2410 to Kuapuu to the corner of the stonewall on mauka side of the Government Road, being the Southwest corner of said Grant 2410 to Kuapuu, and being by true azimuths 191° 22' 00" and distant 2.5 feet from x marked on solid pahoehoe, said x being by true azimuths 11° 22' 00" and distant 243 feet from Puakala sub. Triangulation Station;
51. 111° 16' 00" 23.7 feet across the Government Road to the Northeast corner of Lot 65 (Homestead Map No. 14 Puukala) being Grant 3968 to Pahukula at corner of stonewall;
52. 106° 10' 30" 2026.0 feet along said Lot 65 (Grant 3968 to Pahukula), Lot 67 (Grant 3786 to Kaaikaula), Lot 69 (Grant 3772 to Maianu), and Lot 71 (Grant 3968 to Pahukula), to x on pahoehoe by ahu, and from which point Keanawiliwili Triangulation Station is by true azimuths 343° 30' 00" and distant 201.5 feet.;
53. 110° 58' 30" 5603.0 feet along Puukala to x marked on aa rock and ahu in aa, the coordinates of which point from Akahipuu Triangulation Station are South 2720.3 feet and West 10757.6 feet;

54. 100° 26' 30" 2814 feet along Puukala to x marked on rock and huge ahu at the mauka end of a large pit and cave called Keakuakakawahie; 600 feet Southwest of the lava flow of 1801;
55. 111° 47' 00" 15079.0 feet along Puukala to x marked on solid pahoehoe on the lava flow of 1801, this point being known as the Lae of Puukala, Triangulation Station, from which point Akahipuu Triangulation Station is by true azimuths 276° 57' 33" and distant 27734.0 feet;
56. 111° 47' 00" about 280 feet along Puukala to the sea;
57. Along the sea coast to Makaula boundary;
58. 295° 04' 00" about 45 feet along Makaula to point of beginning..

Containing an area of 1560 Acres, more or less.

Containing an area of 1560 Acres, more or less.

To Have and to Hold the above granted Land in Fee Simple unto the said Paalua and his heirs and assigns forever.

In Witness whereof, the Governor of the Territory of Hawaii, has hereto set his hand, and caused the Great Seal of the Territory to be affixed, this 28th day of January, 1911.

(Great Seal)
By the Governor, (signed) W.F. Frear
(signed) Marston Campbell, Commissioner of Public Lands

[Royal Patent 8265, Paalua, Kau Ahupuaa, District of North Kona, Island of Hawaii, 1560 Acres, 1911]

APPENDIX J
KAŪ LAND HISTORY
1938 – 1974
(Bureau of Conveyance)

SOURCE D.&L. LOCATION NORTH KONA, HAWAII

BY H.H. DATE 2/28/39

THIRD DIVISION

ZONE	SEC	PLAT	PARCEL
7	2	05	1

1938

4559-27

Route Slip
(change name)

TAX MAPS	H.H. ✓
TAX OFFICE	✓
TRACING	H.H. ✓
ROUTE-SLIP	H.H. ✓
SKETCH	✓
ADJOINING PARCELS	✓
F.B.	LEDGER
RETURN	PLATE

FINAL DATA AS SHOWN ON TAX MAPS AS OF 2/28/39

FORMER KEY: ZONE	SEC.	PLAT	PARCEL	CHANGE	FINAL DATA: ZONE	SEC.	PLAT	PARCEL	AREA	OWNER	INT.
7	2	05	1	owner	7	2	05	1	1339 Ac	John H. Maguire Trust Estate	

SOURCE Land Office	LOCATION N. Kona	DIVISION ZONE 7 SEC 2 PLAT [illegible] PARCEL [illegible]

BY M. Kerr DATE 2/13/41

1940

Date: Dec. 5, 1940 1791-7/5
Term: 21 years.
Ann. Rent: $600.00
Payable: Semi-Annually
Expires: Dec. 5, 1961
C. S. F. 9042-43-44 & 45

GENERAL LEASE # 2860

Territory of Hawaii to Thelma Stillman, Mary Stillman, Nancy Stillman, Minor, Alfred W. Carter - Gdn.

Tract 2 (Mahaiula-Puukala Section)
Being portions of the lands of Mahaiula, Kaulana, Awalua, Ohiki and Puukala; together with Lots 72 to 76 incl., and Lots 80 to 85, incl. 7-2-06-7 7-2-06-12
Area 4615 acres 7-2-05-2
Excepting therefrom Gr. 4723, Lot 2 Area 1 Ac. NET AREA 4614 Acres.

Also excepting therefrom the Huehue Ranch pipe line R/W 5 ft. wide which crosses this tract. Further excepting therefrom all existing roads and trails and other rights of way that may be required for public purposes.
Further reserving to the public the right of free access to and along the coastline of this tract for the purpose of bathing and fishing.

TAX MAPS	TAX OFFICE	TRACING	ROUTE SLIP	SKETCH	ADJOINING PARCELS	F B	LEDGER	RETURN	PLATE
[illegible]	✓	[illegible]	[illegible]	✓	✓ [illegible]				

see T.M.B. -1865 & 1866

FORMER KEY ZONE	SEC	PLAT	PARCEL	CHANGE	FINAL DATA AS SHOWN ON TAX MAPS AS OF 2/24/41 ZONE	SEC.	PLAT	PARCEL	AREA	OWNER	INT.
				G.L. 2860	7	2	05	2	4273.22Ac	T. H.	
7	2	06	[illegible]	24 [illegible]	7	2	06	12	187.73Ac	Thelma Stillman	
7	2	06	[illegible]	" "	7	2	06	17	153.05Ac	Mary "	
										Nancy " Gdn. Trust	
										A. W. Carter Gdn. [illegible]	

SOURCE Record | LOCATION

BY P.K. DATE 5/14/42

246 ✓

ROUTE SLIP **1942**

DIVISION			
ZONE	SEC	PLAT	PARCEL
7	2	05	1

TAX MAPS	
P.K.	
TAX OFFICE	
	✓
TRACING	
ROUTE SLIP	
	✓
SKETCH	
	✓
ADJOINING PARCELS	
	✓
F.B.	LEDGER
RETURN	PLATE

John A.Maguire Estate to Thelma K.,Mary A. and Nancy M.Stillman. Liber 1691, Page 330, dated 3/6/42, recorded 3/20/42.

Being a portion fo Mahele Aw. 13-B, situate at KAU, Noth Kona, Hawaii.

Area 1339.0 ac.

****

Nancy M.Stillman (Pro. 689 F.O.11/14/41) now of age.

FOR FURTHER REFERENCE SEE 7-2-07-4 T.M.B.-67 '42

FORMER KEY				CHANGE	FINAL DATA AS SHOWN ON TAX MAPS AS OF 5/14/42						
ZONE	SEC.	PLAT	PARCEL		ZONE	SEC.	PLAT	PARCEL	AREA	OWNER	INT.
				Owner	7	2	05	1	1339.0ac.	Thelma K.Stillman	1/3
										Mary A. Stillman	1/3
										Nancy M.Stillman	1/3

(733 - 1

SOURCE | LOCATION

BY P.K. DATE 7/22/43

ZONE	SEC	PLAT	PARCEL
7	2	05	1

1943

TAX MAPS	
P.K.	✓ 7/22
TAX OFFICE	
	✓
TRACING	
EC	✓
ROUTE SLIP	
	✓
SKETCH	
	✓
ADJOINING PARCELS	
	✓
F.B.	LEDGER
RETURN	PLATE

Portion Of ~~[illegible]~~ Mahele Award 13-B, R.P.8265, Kau, N.Kona.

FOR FURTHER REFERENCE, SEE
Z 4 S 8 P 08 P 1
Inst. NO. 65778
DATED 5/29/43 REC. 6/17/43
LIBER 1763 PAGE 18
T.M.B.-#544 '43 ✓

FORMER KEY				CHANGE	FINAL DATA AS SHOWN ON TAX MAPS AS OF 7/22/43						
ZONE	SEC.	PLAT	PARCEL		ZONE	SEC.	PLAT	PARCEL	AREA	OWNER	INT.
				Status	7	2	05	1	1339.Oac.	Thelma K., Nancy E.Stillman	
										and Mary S.Robinson Trust.	
										Alfred H.Carter- Trustee	

1759 - 1781

SOURCE:	LOC. & TITLE: Mahaiula-Kau, North Kona Mahele Aw. 13 - B	1954	DIV. 7 2 05 I
BY D. Lake DATE 1/25/55	DEED. ETC.:	TMB NO.	
BY DATE			

NO	GRANTOR ETC. (Page-1)	AREA OF PARCEL	GRANTEE ETC.
1	As shown on Tax Maps	1339.0 ac.	Thelma K Stillman &
			Nancy E Stillman &
			Mary S Robinson Trust
			Alfred H. Carter - Tr.
2	TMB 1336'54 (7-2-04-6) DL 1/25/55		
	Gr: Stillman Trust by Trustee TO T. H.	1339.00 ac	Thelma K Stillman &
	Right of entry. Inst 184111 bk 2878 p 139		Nancy E Stillman &
	Cons: None RS: None 7/2/54 10/13/54 et al		Mary S Robinson Trust
			Alfred H Carter - Tr.
3	TMB 1495'55 (7-2-04-Haw. Belt Rd) DL 1/16/56		
	D: Edward C Eustace, Temporary Successor	1336.692 ac	Thelma K Stillman &
	Tr to Alfred H Carter TO Territory of		Nancy E Stillman &
	Hawaii 2.288 ac) Dropped into road.		Mary S Robinson Trust
	Inst 212343-44 Bk 3046 p 338 Cons: $5102.		Alfred H Carter - Trustee
	RS: $6.05 10/3/55 12/8/55 etc		
	Thelma S Springer, Mary S Holt and Nancy		
	S Oliver, beneficiaries under said Trust		
	hereby approve and consent to foregoing.		
	To 7-2-05-5 (1) 0.02 ac.		
	F/D: 7-2-05-1, area 1336.692 ac.		

NOTE: LAST AREA & GRANTEE FINAL DATA AS SHOWN ON TAX MAPS.

SOURCE:

LOC. & TITLE: 4 Div, N Kona

BY: wd DATE: 5/12/58 DEED, ETC.:

BY: DATE:

TMB NO.: 1958 | 7 | 2 | 05 | 1

DIV.

NO	GRANTOR ETC. (Parc. E)	AREA OF PARCEL	GRANTEE ETC.
3	As shown on Tax Maps	1336.692 Ac.	Thelma K, Nancy E Stillman &
			Mary S Robinson Trust
			Alfred H Carter - Trustee
4	TMB 19 '58 7/15/58 wd 5/12/58		
	R/S: The marriages of the three Stillman	1336.692 Ac.	To: Thelma K Springer, Nancy E
	girls & change of Trustee A H Carter to		Oliver & Mary S Holt Trust
	E C Hustace. Names & status changed to:		
	Thelma K Springer, Nancy E Oliver & Mary		
	S Holt Trust.		
	F/D: owners & status. Trustee out.		
5	TMB 2022'62 (6504-30etc)RYT/pl 11/1/62		
	D: Edward C Hustace, Trustee of the	do	To: Kona Corporation
	Stillman Trust. Bk 4313 p 245 $500,000		
	dn RS$6,127. 7/9/62 eff 3/17/62 7/10/62		
6	TMB 766'65(6504-30 etc)RYT/sy 4/15/65		
	AFFDVT: Foreclosure/mtg: Edward C Hustace,	1336.692 Ac.	Thelma K Springer,
	affiant Bk 4986 p 61 3/8/65 3/11/65		Nancy E Oliver,
	Affiant deposes & says that he is the		Mary S Holt Trust
	Trustee of the Stillman Trust, named as		
	mtgee in purchase-money mtg, that on		
	10/2/63 he did enter upon real prop &		
	retook possession of land for purpose of		
	foreclosing mtg for various breaches of mtgor,		
	that rt of redemption of mtgor has been		
	forever barred, etc.		
	F/D: 7205-1; Ownership		

NOTE: LAST AREA & GRANTEE FINAL DATA AS SHOWN ON TAX MAPS.

TAX MAPS BRANCH HISTORY SHEET

DATE: 1/10/67

LOCATION: Kau, No Kona

TITLE: Por Mahele Aw 13-B

DIV. Z	S	PLAT	PAR
7	2	05	1

NO.	GRANTOR, ETC.	AREA OF PARCEL	GRANTEE ETC
	PAGE 3		
7	TMB 6324'66 (6504-30etc) RYT/yo 1/10/67		
	D: Edward C Hustace, Trustee of the	1336.692 Ac	To: Foothill Land Corp.
	Stillman Trust Bk 5543 p 188		Kaloko Land Corp.
	Cons: $250,000 12/29/66 12/30/66		Mauna Loa Cattle Corp.
	Thelma S Springer et al, adult beneficiaries		
	of trust do hereby consent		
8	TMB 4872'67 LB/js 11/6/67		
	D: Bk 5846 p 394 SCT-3700.00 Inst-42253	1336.692 Ac	To: Charles C McCarthy (M)
	10/27/67 10/30/67 DES		L M Prince, Jr (M) - J/T
9	TMB 754 '70-71, 2/2 RYT/sy 7/29/70		
	R/S: 348.3 Ac (Lot 6) To 7343-2(New)	988.392 Ac	do
	F/D: 7205-1; Area, bdry		
10	TMB 11327'70-71,2/2 RYT/en 6/8/71		
	R/S: 30.6 Ac fr por 7343-2(2)	1018.992 Ac	do
	Being the difference in area which was		
	revised fr 988.392 Ac to 1018.992 Ac of		
	said parcel - which originally emanated fr		
	this parcel 7205-1. Also, Lis Pendens by		
	State of Hawaii, Civil No 2070, 3rd Cir		
	dated 10/8/70 over Rd Par 2 (rvsd) fr		
	13.954 Ac to 14.019 Ac). New subareas		
	(1004.973 Ac) & (14.019 Ac).		
	F/D: 7205-1; Area & subareas (bdry o.k.)		
	& Lis/Pendens over por		
		Continued	

NOTE: INFORMATION ON THIS SHEET IS SUBJECT TO CHANGE

FORM P-10 HISTORY SHEET

TAX MAPS BRANCH HISTORY SHEET

DIV.			
3rd			
Z	S	PLAT	PAR
7	2	05	1

DATE:

LOCATION: Kau, No Kona, Hawaii

TITLE: Por RP LP 8265, Mahele Aw 13-B to Paalua

NO.	GRANTOR, ETC.	AREA OF PARCEL	GRANTEE, ETC.
	Page 4		
11	TMB 1615 '71-72, ryt, 8/12/71	1004.973 Ac	Charles C McCarthy &
	R/S:14.019 Ac(Rd Par 2, Proj No BD-67-391,		L M P Prince, Jr - J/T
	Kailua-Kawaihae Rd, Sec III)to State &		
	drpd into rd by F/O/C, Civil No 2070, 3rd		
	Cir dated 7/7/71.(Civil returned to T/O-Hora)		
	F/D:7205-1, Area & bdy,		
12	TMB 2745'71-72 RYT/en 10/18/71		
	F/O/C: State of Hawaii Civ 2070, 3rd Cir	do	do
	VS:Charles C McCarthy & L M Prince, Jr		
	Bk 7783 p 38 7/7/71 9/8/71 DES		
	KEYED ONLY - Note: Condemened area drpd		
	into rd by copy of F/O/C rec'd fr R Hora.		
	R/S: TMB 1615-71-72 (Des in folder)		
13	D: Bk 10330 p 201 SCT$00 12/18/74 12/20/74	~~do~~ 1001.74	To: Kau-Kona Land Co
	F/D: Owner & area revised		
	NOTE: Des in folder		

NOTE: INFORMATION ON THIS SHEET IS SUBJECT TO CHANGE

FORM P-19 HISTORY SHEET

APPENDIX K
Nagata (1990)
List of Plant Species in Kaū
(In Schilz and Shun 1990/1994)

Vegetation Summary

Common Name	Genus and Species
Christmas Berry	*Schinus terebinthifolius*
Fountain Grass	*Pennisetum setaceum*
O`hia	*Metrosideros polymorphia*
Laua`e	*Microsorium scolopendria*
Airplant	*Kalanchoe pinnata (Lam.) Pers.*
Ti	*Cordyline terminalis*
Guava	*Psidium guajava*
Strawberry Guava	*Psidium cattleianum*
Kukui	*Aleurites moluccana*
Jacaranda	*Jacaranda mimosifolia*
Koa Haole	*Leucaena leucocephala*
Coffee Senna	*Senna occidentalis*
Lantana	*Lantana camara*
Silk Oak	*Grevillea robusta A. Cunn.*
Papaya	*Carica papaya*
Noni	*Morinda sp.*
Pandanas	*Pandanus tectorius*
`Ilima	*Sida fallax*
Alahe`e	*Canthium odoratum*
A`ali`i	*Dodonaea riscosa*
Mamane	*Sophora chrysophylla*
Liliko`i	*Passiflora edulis*
Naio	*Myoporum sandwicense*
Koali	*Ipomoea cairica*
Creeping Gloxinia	*Lophospermum erubescens*
Sandalwood	*Santalum freycinetianum*
Jamaica Vervain	*Stachytarpheta jamaicensis*
Cactus	*Unknown*
Wiliwili	*Erythrina sandwicensis*
Pleomele	*Ploemele sp.*
Comb Hyptis	*Hyptis pectinata*
False Mallow	*Malvastrum coromandelianum*
Fern	*Fern*
Guinea Grass	*Panicum maximum jacq.*
Cocculus	*Cocculus triobus*

APPENDIX L

Makalei Estates

(Copy of *Kona Coast Realty Corporation* sales flyer)

About Makalei Estates.

Makalei Estates is an agricultural subdivision consisting of 80 three-acre home sites, approximately six miles north of Kailua-Kona. Located on the slopes of Hualalai with elevations ranging from 1,000 to 1,800 feet, there are views from the harbor to Maui. Individual lots are designed for privacy and are ideal for cultivation of fruit trees. These properties are now being offered for sale.

Design philosophy.

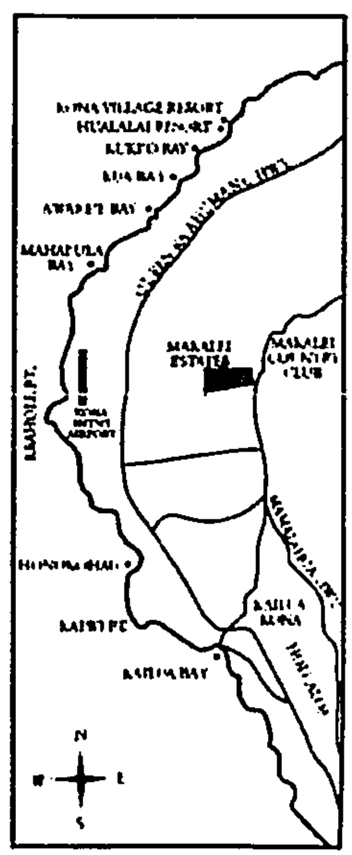
The developer of Makalei Estates is endeavoring to create, maintain and enhance the general attractiveness of the subdivision through Covenants, Conditions and Restriction (CC&Rs) and design review guidelines. The primary goal is to create a subdivision that has a strong sense of community and harmony within the site. There is also a desire to encourage freedom of individual expression of owners. These guidelines will serve to shape the future growth of Makalei Estates subdivision and will help provide protection for all owners within the project.

The objectives are to create a subdivision that blends in with the natural environment and to develop a community of residences that is unified and harmonious in its use of form, materials and color. The owners are encouraged to use natural materials and colors, as well as incorporate designs that respond architecturally to climate and environmental opportunities and constraints. Low-profile buildings, when viewed from all angles, are preferred.

Summary of building information.

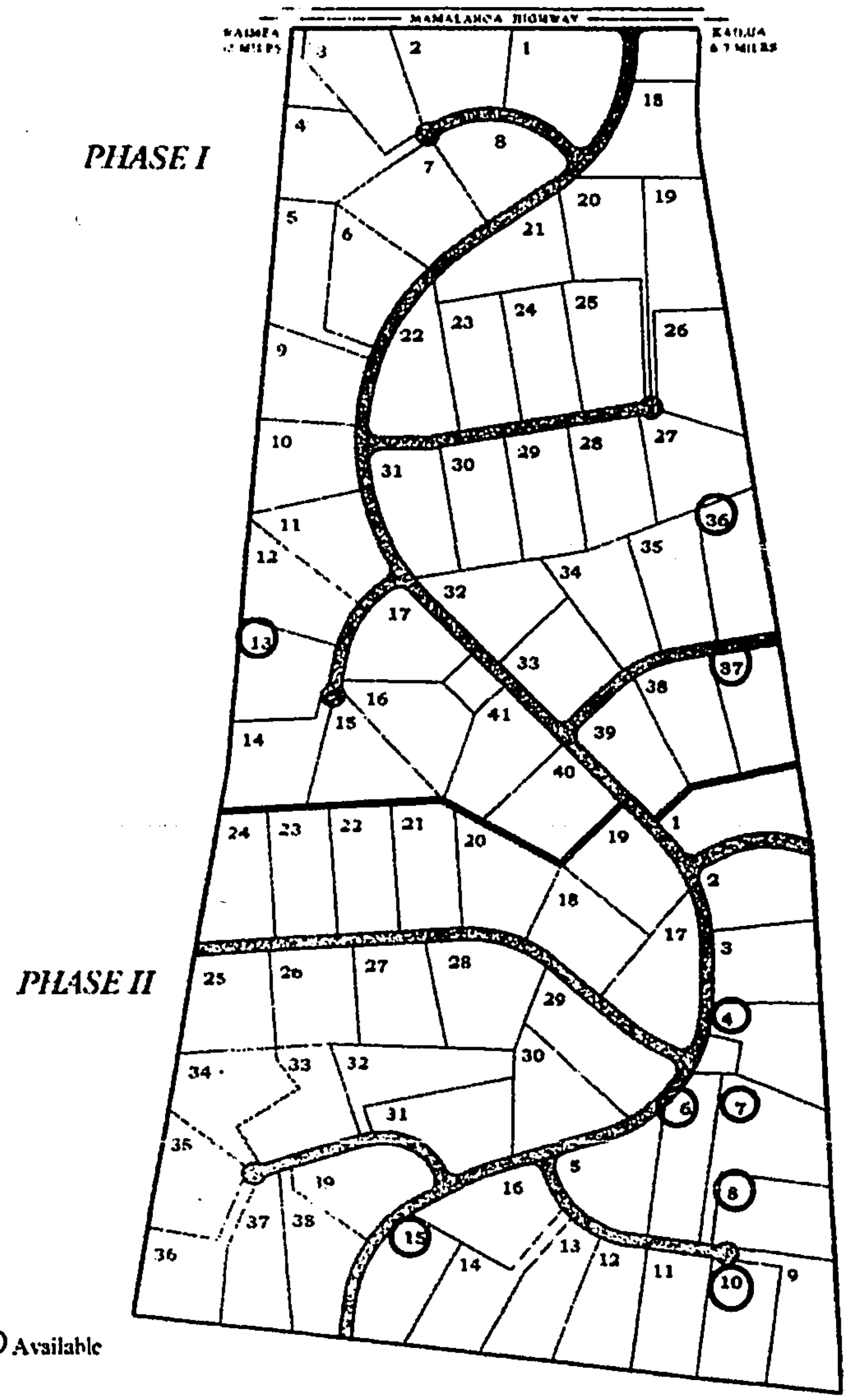
The following is a summary intended to address the most common questions encountered by potential owners. It is not intended to take the place of a purchaser's responsibility to carefully read and understand the CC&Rs of Makalei Estates subdivision.

1. House size: Minimum enclosed living area, 1800 square feet
2. Height: Two-story permitted, subject to guidelines
3. Car storage: Minimum two-car garage
4. Single family residence only
   - Ohana, CPR prohibited
5. Design review by design review committee
6. Building setbacks: 50 feet from road frontage; 20 feet side and 30 feet rear boundaries
7. Utilities: County water, underground electric/ cable/ phone service and individual septic tanks



MAKALEI ESTATES

Makalei Estates



O Available

Kona Coast Realty Corp.
329-2991

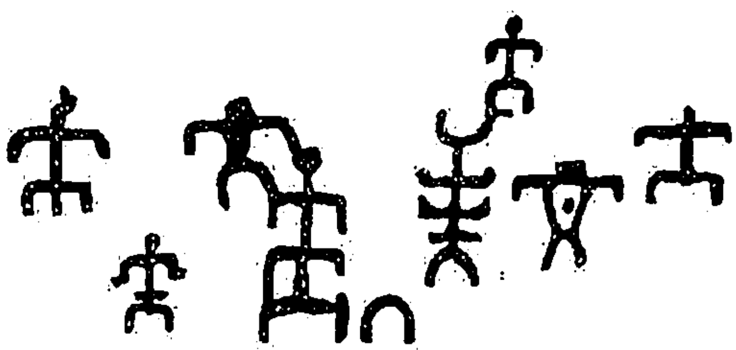
Lot	Price	Status
	Phase I	
13	$254,000	Available
36	$254,000	Available
37	$259,000	Available
	Phase I I	
4	$254,000	Available
6	$259,000	Available
7	$274,000	Available
8	$264,000	Available
10	$269,000	Available
15	$274,000	Available

The above lots are the remaining Developer lots. All other lots have been sold.

For immediate information, call :
Ron Aronson, 960-5711(Cell)

For more information please call:
Ron Aronson, 960-5711

Updated 4/28/03



Appendix E

Traffic Impact Report, Hiluhilu
Project, Kau North Kona, Hawaii

TRAFFIC IMPACT REPORT
HILUHILU PROJECT
KAU, NORTH KONA, HAWAII

DRAFT

July 10, 2003

Prepared for:

Hiluhilu Development LLC
c/o Group 70 International, Inc.
925 Bethel Street, 5th Floor
Honolulu, Hawaii 96813

ATA

Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817-5031
Telephone: (808) 533-3646
Facsimile: (808) 526-1267
E-mail: atahnl@atahawaii.com
Honolulu • Wailuku, Hawaii

TRAFFIC IMPACT REPORT
HILUHILU PROJECT
KAU, NORTH KONA, HAWAII

DRAFT

Prepared for

HILUHILU DEVELOPMENT LLC
c/o Group 70 International, Inc.
925 Bethel Street, 5th Floor
Honolulu, Hawaii 96813

Prepared by
Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
Honolulu • Wailuku, Hawaii

July 10, 2003

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

FIGURES

TABLE OF CONTENTS

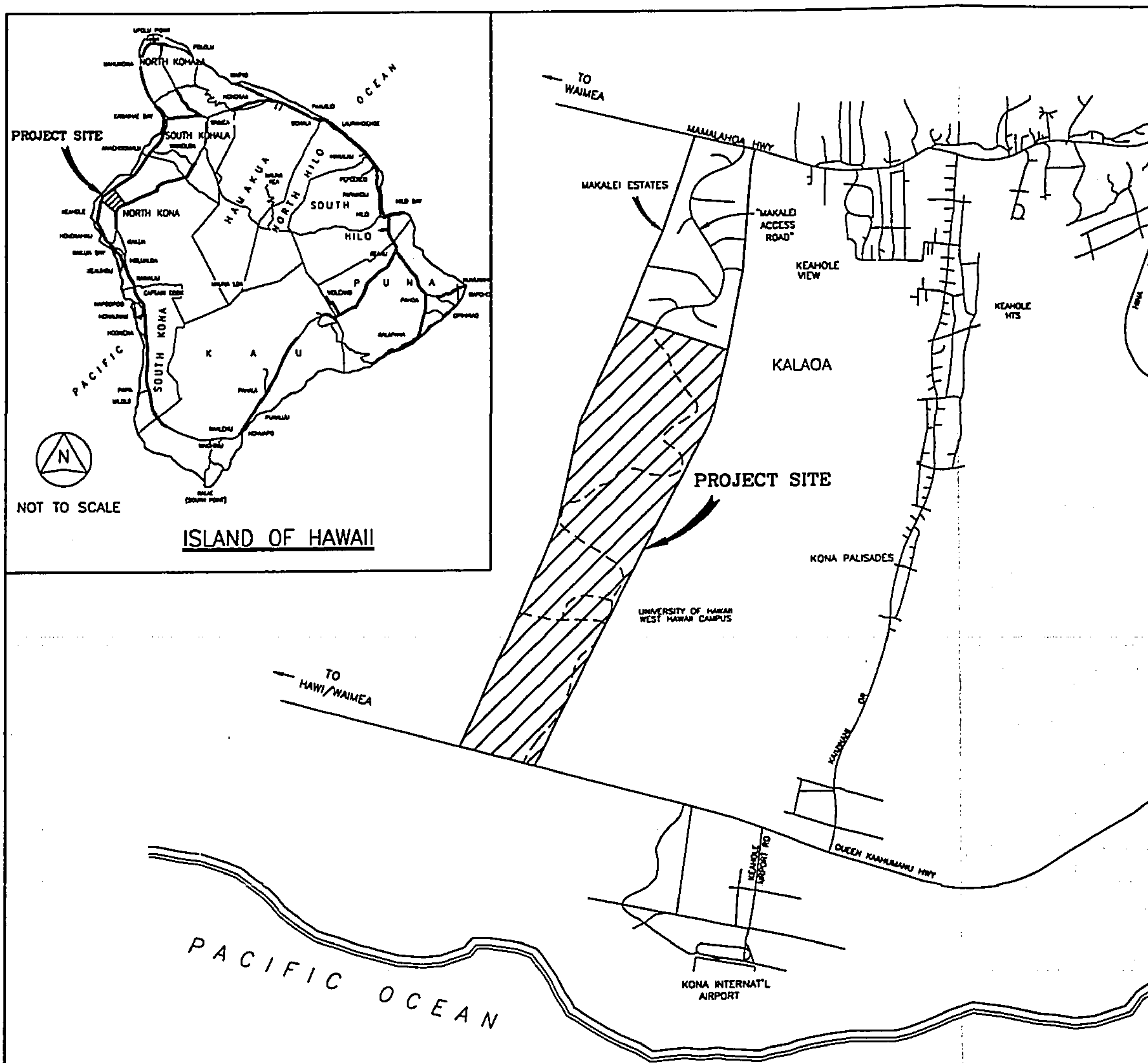
TRAFFIC IMPACT REPORT
HILUHILU PROJECT
Kau, North Kona, Hawaii

I. INTRODUCTION

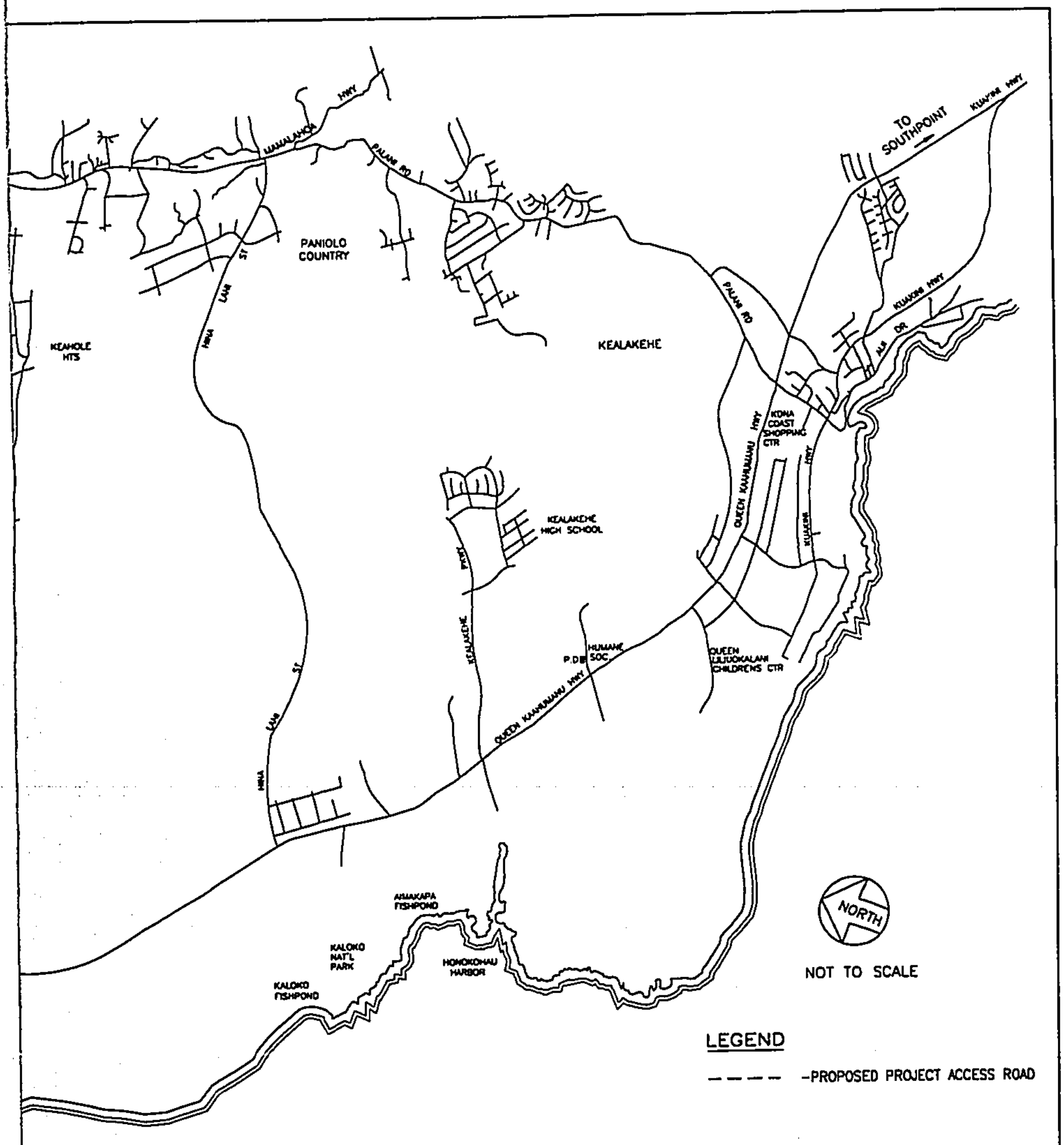
Hiluhilu Development Company, LLC proposes to develop the Hiluhilu Project (hereinafter referred to as the "Project") in Kau, North Kona on the Big Island. The approximate 725.5 acre master planned community seeks to provide single and multiple family residential units, elderly housing, a hotel, an 18-hole golf course, medical wellness facilities, commercial areas, and other facilities that will integrate into the development of the adjacent University of Hawaii West Hawaii campus. This report documents the findings of a study to evaluate the traffic impacts of the proposed Project.

A. Location

The project site is located on the Island of Hawaii, north and west of the Kona International Airport. The Project contains approximately 725.5 acres, is bordered by Queen Kaahumanu Highway to the west, Makalei Estates to the east, and the future University of Hawaii West Hawaii Campus to the south, as shown in Figure 1. The project site is more specifically identified as TMK: 3-7-2-05:01. Presently, the majority of the project site is vacant and overgrown with vegetation.



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCI ENGINEERS, SURVEYORS LOCATION MAP



TSUMI & ASSOCIATES, INC.
RS • HONOLULU, HAWAII

CATION MAP

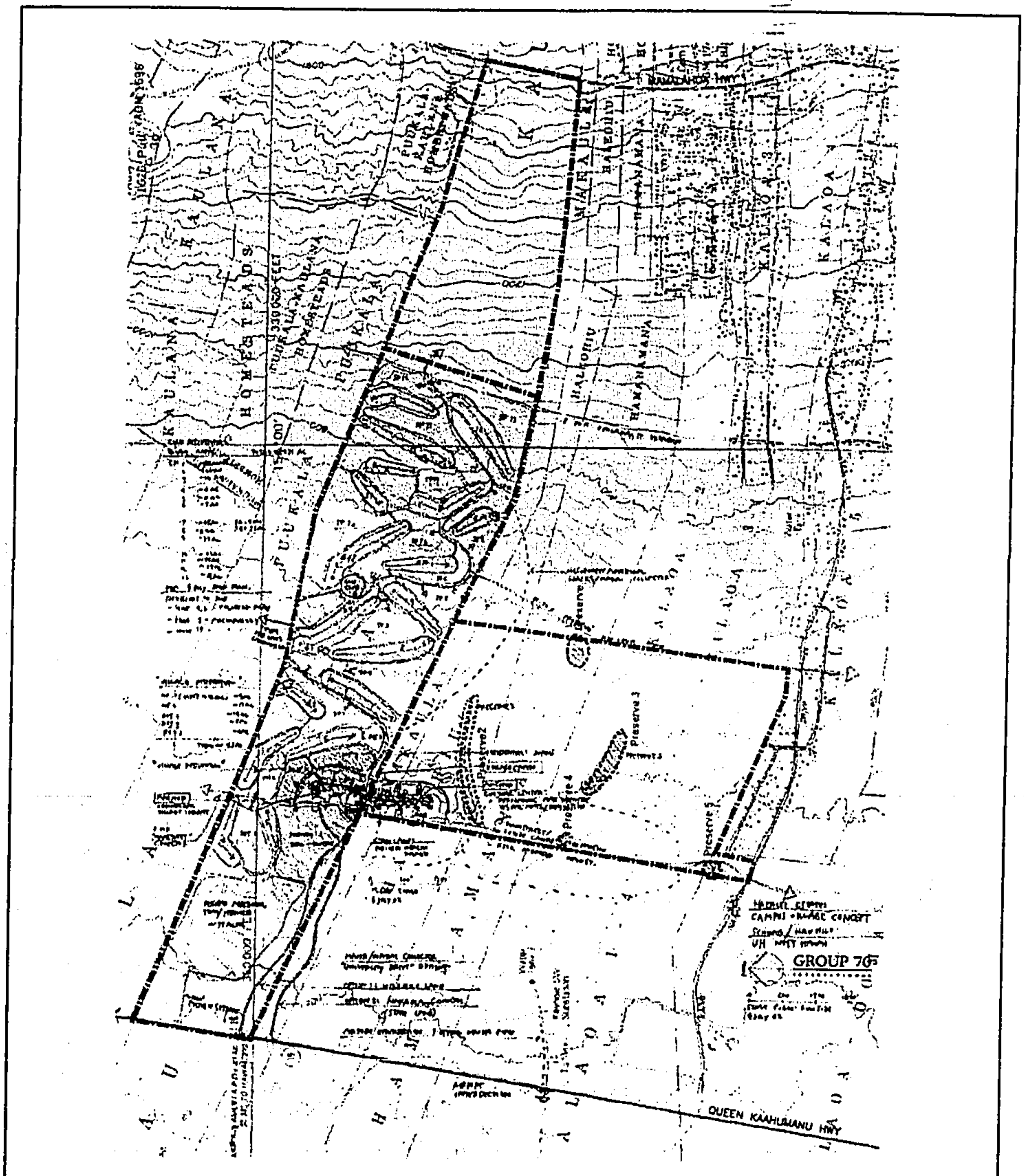
FIGURE 1

B. Project Description

The proposed Project calls for the development of a 120-unit hotel, 765-single family attached and detached dwelling units, elderly housing, an 18-hole golf course and clubhouse, 80,000 square feet of Research and Development area, 80,000 square feet of commercial area, 60,000 square feet of medical facilities, a mixture of classrooms and teaching labs, and other facilities. The Project will be implemented in three phases with completion of each phase by Year 2007, Year 2009, and Year 2010, respectively. Table 1 summarizes the land uses proposed for the three phases of the Project. Figure 2 shows the detailed project site plan.

Table 1 **Hiluhilu Land Use**	Phase 1 Year 2007	Phase 2 Year 2009	Phase 3 Year 2010	Total
Single-Family (Dwelling Unit)	215	185	70	470
Multi-Family (Dwelling Unit)	20	60	40	120
Apartment (Dwelling Unit)	25	100	50	175
Senior Housing (Dwelling Unit)	--	80	--	80
Hotel (Rooms)	--	120	--	120
Golf Course (Acres)	180	--	--	180
University Village (Students)	375	250	125	750
Medical Offices (Square Feet)	20,000	40,000	--	60,000
Research and Development (Gross Floor Area, Square Feet)	--	40,000	40,000	80,000
Commercial (Gross Floor Area, Square Feet)	25,000	25,000	30,000	80,000

The primary access to the project site will be through Queen Kaahumanu Highway. Consequently, the Project has considered constructing one of two primary access alternatives on Queen Kaahumanu Highway. The first access alternative would construct a new roadway intersecting Queen Kaahumanu Highway with access to the project site located north of the existing Queen Kaahumanu Highway/Keahole Airport Road intersection and adjacent to the southern Project border. The other access alternative would construct a new roadway to the project site intersecting Queen Kaahumanu Highway across from its intersection with Keahole Airport Road, to form the forth leg of the intersection.



HILUHILU DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS
HONOLULU, HAWAII

SITE PLAN

FIGURE 2

A secondary access to the project site will be constructed through the existing Makalei Estates roadway ("Makalei Access Road") with connections to Mamalahoa Highway.

C. Purpose and Scope

The purpose of this study is to project the future traffic demand in the study area and recommend roadway improvements, which will mitigate the traffic impacts due to the future traffic volumes without and with the proposed Project. The following traffic scenarios are analyzed in the study:

- Existing Conditions: The analysis of existing traffic conditions is intended to provide the basis for the remainder of the study. The analysis includes existing traffic volumes and current operating conditions.
- Future Traffic Conditions Without Traffic Generated by the Project: An estimate of non-project traffic is required to analyze base year conditions- that is, without the project site being developed. The base years used for this study coincides with the completion of the three phases of the Project, which occurs in Year 2007, Year 2009, and Year 2010.
- Future Traffic Conditions With Project-Generated Traffic with Northern Project Access Road: This is an analysis of future traffic conditions with the Project access north of the existing Queen Kaahumanu Highway/ Keahole Airport Road intersection. The Northern Project Access Road will intersect Queen Kaahumanu Highway to form a new "Tee" intersection. The objective of this analysis is to forecast future traffic conditions for the study area Year 2007, Year 2009, and Year 2010 and recommend roadway improvements with the proposed Northern Project Access Road.
- Future Traffic Conditions With Project-Generated Traffic with Airport Access Road Alternative: This alternative analysis of future traffic conditions will evaluate the Project access to be located across Keahole Airport Road on Queen Kaahumanu Highway in lieu of the previously discussed Northern Project Access Road. The Airport

Access Road alternative will form the forth leg at the existing Queen Kaahumanu Highway/Keahole Airport Road intersection. This analysis will focus on the intersection impacts with the Airport Access Road at the existing Queen Kaahumanu Highway/Keahole Airport Road intersection for Year 2007, Year 2009, and Year 2010 in lieu of the Northern Project Access Road.

D. Study Methodology

This study will address the following:

1. Existing traffic operating conditions at the key intersections within the study area.
2. Base Year (build-out years for the three phases of the proposed project) traffic projections without project-generated traffic for each development phase.
3. Trip generation and traffic assignment characteristics.
4. Determination of the potential impact of project-generated traffic on each of the base years traffic operation.
5. Recommendations of mitigation measures, as appropriate, to reduce or eliminate adverse impacts resulting from traffic generated by the Project.

II. EXISTING CONDITIONS

A. Roadway System

Queen Kaahumanu Highway is a two-way, two-lane, State arterial highway that is oriented in the north-south direction, and provides regional access between Kawaihae and Kona. Queen Kaahumanu Highway forms a "Tee" intersection with Kawaihae Road on its northerly terminus and terminates to the south at its intersection with Kuakini Highway. The posted speed limit on Queen Kaahumanu Highway is generally 55 miles per hour (mph), decreasing to 35 mph near Kailua-Kona.

Mamalahoa Highway in the vicinity of the Project is a two-way, two-lane, major State collector roadway that is oriented in the north-south direction from Waimea to Kailua-Kona, as a portion of the Hawaii Belt Road. At the Palani Junction in Honokohau, the major vehicle movement is from the northern portion of Mamalahoa Highway to Palani Road. The southern portion of Mamalahoa Highway at the Palani Junction is the stop sign-controlled stem of a "Tee" intersection. The southern portion of Mamalahoa Highway becomes a two-way, two-lane, County collector roadway that is oriented in the north-south direction bypassing Kailua-Kona and provides access to the agricultural and residential areas on the slopes above Kailua-Kona. The posted speed limit on Mamalahoa Highway north of Palani Junction is generally 55 mph. The posted speed limit on Mamalahoa south of Palani Junction is generally 55 mph and drops to 35 mph through portions that are narrow with sharp vertical and horizontal curves and relatively short sight distances.

Keahole Airport Road is a two-way, two-lane, State collector roadway that is oriented in the east-west direction and is the primary access to the Kona International Airport from Queen Kaahumanu Highway. On its eastern end, Keahole Airport Road terminates as the stem of the "Tee" intersection with Queen Kaahumanu Highway.

Kaiminani Drive is a two-way, two-lane, County collector roadway that is oriented in the east-west direction providing access between Mamalahoa Highway and Queen Kaahumanu Highway in the Keahole region. Kaiminani Drive is the primary access to the Keahole View, Keahole Heights, and Kona Palisades Estates subdivisions. Kaiminani Drive is the stem of the "Tee" intersections with Mamalahoa Highway on its eastern end and Queen Kaahumanu Highway on its western end.

Palani Drive is a two-way, two-lane, County collector roadway between Mamalahoa Highway and Queen Kaahumanu Highway. Mamalahoa Highway and Palani Road form major vehicle movement at the "Tee" intersection (Palani Junction), with the southern portion of Mamalahoa Highway being the stop sign-controlled stem. Palani Road provides access to downtown Kailua-Kona on a northeast to southwest alignment. Between Queen Kaahumanu Highway and Kuakini Highway, Palani Road widens to a four-lane divided roadway and narrows down to a two-lane roadway between Kuakini Highway and its southern terminus with Alii Drive at the Kailua-Kona wharf. Large commercial shopping centers adjoin both sides of Palani Road between Queen Kaahumanu Highway and Kuakini Highway.

"Makalei Access Road" is a two-way, two-lane, future county roadway that is oriented in the east-west direction and is the only access to the Makalei Estates Subdivision. On its eastern end "Makalei Access Road" terminates at its intersection with Mamalahoa Highway, forming the stop sign-controlled stem of a "Tee" intersection. On its western end "Makalei Access Road" terminates at its border with the proposed Project. An official street/road name is not documented in published sources for this access road segment and therefore, for purposes of this report, will be referred to as "Makalei Access Road" (refer to Figure 1).

B. Study Intersections

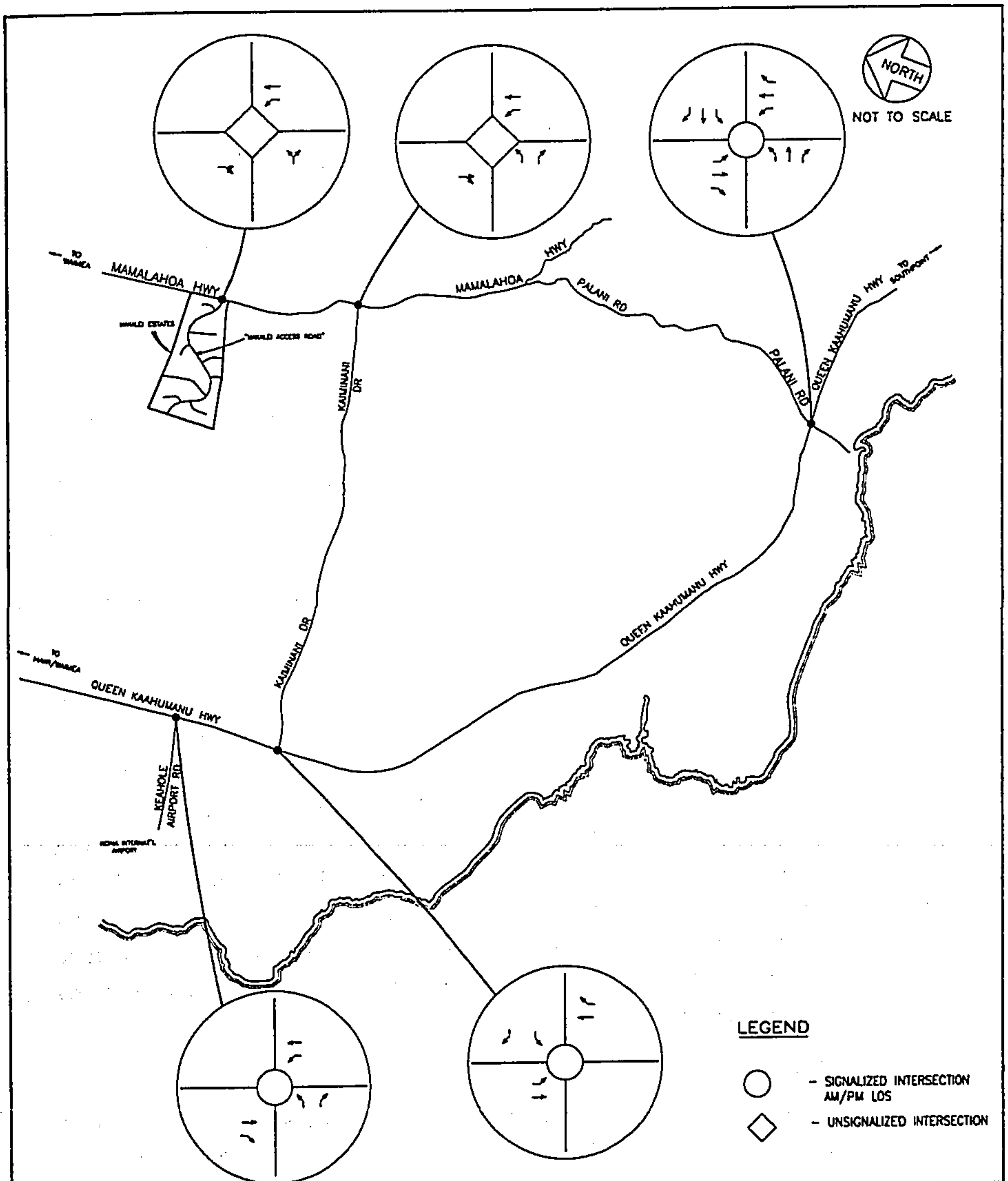
Manual peak hour of traffic turning movement counts were conducted at the following study intersections on Tuesday, April 8, 2003, and on Wednesday, April 9, 2003.

- Queen Kaahumanu Highway/Keahole Airport Road
- Queen Kaahumanu Highway/Kaiminani Drive
- Queen Kaahumanu Highway/Palani Road
- Mamalahoa Highway/Kaiminani Drive

Twenty-four hour machine counts were also obtained at the Mamalahoa Highway/"Makalei Access Road" intersection and Queen Kaahumanu/Kaiminani Street intersection.

The traffic count data collected at the study intersections indicated that the weekday AM peak hour of traffic occurs from 7:15 AM to 8:15 AM and that the weekday PM peak hour of traffic occurs from 3:30 PM to 4:30 PM. The turning movement count data and twenty-four hour machine count data is provided in Appendix A.

The study intersections are described below; Figure 3 shows the existing lane configurations at these intersections.



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	EXISTING LANE CONFIGURATION	3

Mamalahoa Highway/"Makalei Access Road"

"Makalei Access Road" forms the stem of a stop sign-controlled "Tee" intersection with Mamalahoa Highway. The Mamalahoa Highway northbound approach provides an exclusive left-turn lane and a through lane, and its southbound approach provides for a shared right-turn/through. The "Makalei Access Road" eastbound approach provides a single-lane, which operates as a shared right/left-turn lane.

Mamalahoa Highway/Kaiminani Drive

Kaiminani Drive forms the stem of a stop sign-controlled "Tee" intersection with Mamalahoa Highway. The Mamalahoa Highway northbound approach provides an exclusive left-turn lane and a through lane, and its southbound approach provides a shared right-turn/through lane. The Kaiminani Drive eastbound approach is striped as a single lane approach; however, the eastbound approach was observed to operate as a separate left-turn lane and a separate right-turn lane, with a two to three storage lane for the right-turn traffic.

Queen Kaahumanu Highway/Palani Road

Palani Road forms a traffic signal controlled "cross"-intersection with Queen Kaahumanu Highway. The Queen Kaahumanu Highway northbound approach provides an exclusive left-turn lane, a through lane, and an exclusive right-turn lane. The Queen Kaahumanu Highway southbound approach provide an exclusive left-turn lane, a through lane, and an exclusive right-turn lane that connects to an exclusive westbound lane on Palani Road forming a "free" right-turn. The Palani Road westbound and eastbound approaches provide an exclusive left-turn lane, a through lane, and right-turn lanes that connect to exclusive southbound and northbound acceleration lanes on Queen Kaahumanu Highway, forming "free" right-turn lanes.

Queen Kaahumanu Highway/Kaiminani Drive

Kaiminani Drive forms the stem of a traffic signal controlled "Tee" intersection with Queen Kaahumanu Highway. The Queen Kaahumanu Highway northbound approach provides an exclusive right-turn lane and a through lane. The Queen Kaahumanu southbound approach provides an exclusive left-turn lane and a through lane. The Kaiminani Drive westbound approach provides an exclusive left-turn lane and a right-turn lane that connects to an exclusive northbound acceleration lane on Queen Kaahumanu Highway, forming a "free" right-turn.

Queen Kaahumanu Highway/Keahole Airport Road

Keahole Airport Road forms the stem of a traffic signal controlled "Tee" intersection with Queen Kaahumanu Highway. The Queen Kaahumanu Highway northbound approach provides a left-turn lane and a through lane. The Queen Kaahumanu Highway southbound approach provides an exclusive right-turn lane and a through lane. The Keahole Airport Road eastbound approach provides an exclusive left-turn lane and a right-turn lane that connects to an exclusive southbound acceleration lane on Queen Kaahumanu Highway, forming a "free" right-turn.

C. Existing Traffic Operations

1. Field Observations

The Kaiminani Drive eastbound left-turn and right-turn approach at its intersection with Mamalahoa Highway was observed to experience long delays due to insufficient gaps in traffic that would allow traffic to enter Mamalahoa Highway during the weekday AM and PM peak hours of traffic. Since Kaiminani Drive is on an approximate eight to ten percent grade, vehicles on this approach have to wait for sufficient gaps on Mamalahoa Highway to accelerate onto the roadway. Occasionally, the Kaiminani Drive eastbound right-turn traffic was observed to be blocked by the eight to ten vehicle queue turning left on Mamalahoa Highway.

The Queen Kaahumanu Highway/Palani Road intersection was observed to have queues of over ten vehicles for the eastbound and westbound approaches during the weekday PM peak hour of traffic. The westbound through lane queued back to block the free right-turn lane during the weekday PM peak hour of traffic whereby the right-turning vehicles needed to wait for the westbound green phase at the intersection in order to make the right turns. During the weekday AM peak hour of traffic the queues were approximately four to five vehicles for the eastbound left-turns and the southbound approach.

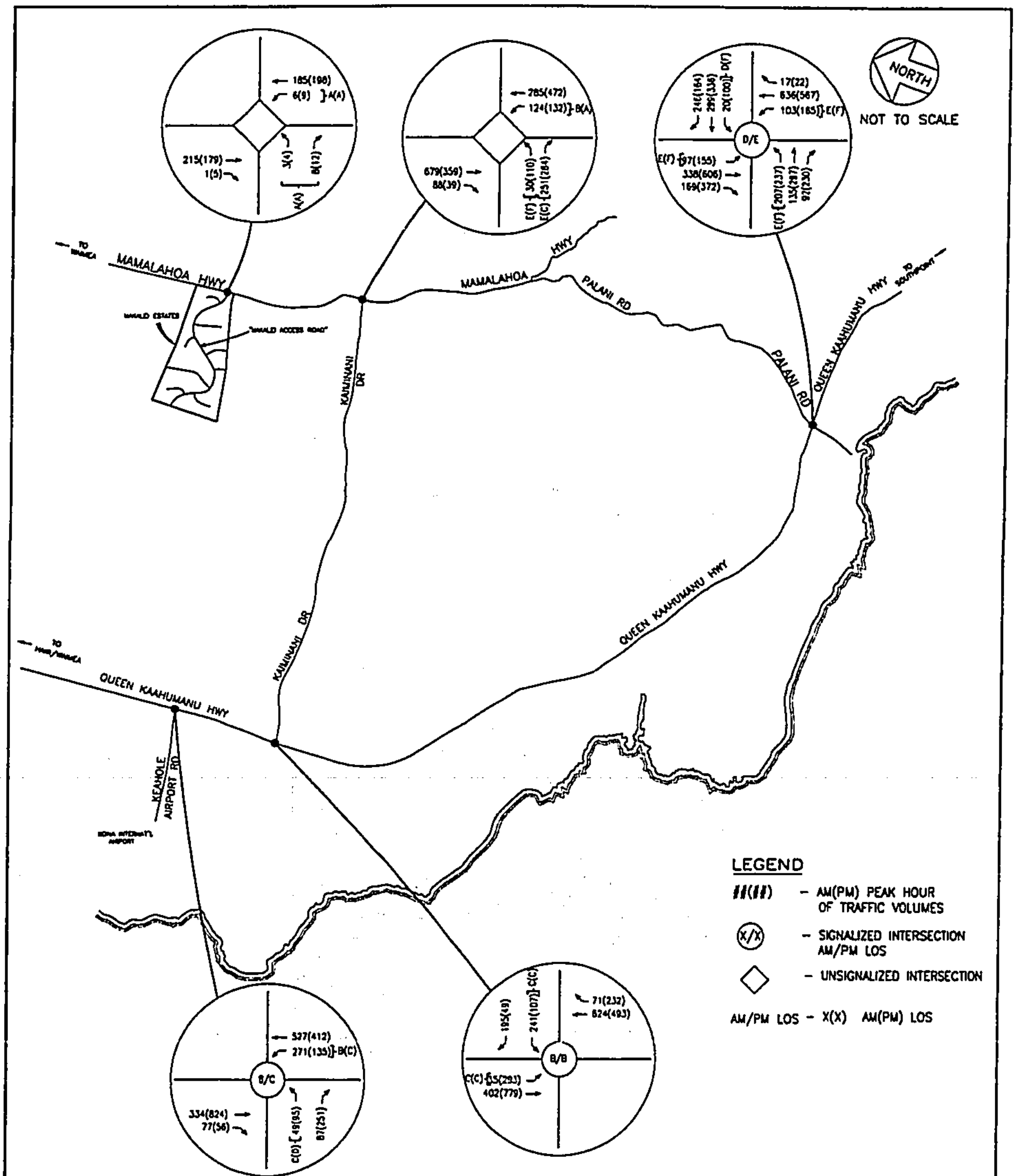
The Queen Kaahumanu Highway/Kaiminani Drive intersection operated with limited queuing of traffic with the longest queues observed to be approximately three to four vehicles for the Queen Kaahumanu Highway southbound left-turn traffic during the weekday PM peak hour of traffic. Queuing was observed to be more prominent during the weekday PM peak hour of traffic.

The Queen Kaahumanu Highway/Keahole Airport Road intersection operated with limited queuing of traffic as the longest queues were observed to be approximately five to six vehicles for the Queen Kaahumanu Highway northbound left-turn traffic and approximately four to five vehicles for the Keahole Airport Road eastbound left-turn movement during the weekday PM peak hour of traffic. Queuing at the Queen Kaahumanu Highway/Keahole Airport Road intersection was observed to be more prominent during the weekday PM peak hour of traffic.

2. Existing Traffic Condition Analyses

Peak hour traffic volumes at the study intersections were analyzed using procedures for unsignalized and signalized intersection analysis outlined in the Highway Capacity Manual – HCM 2000. Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow ranging from free-flow conditions, LOS A, to congested conditions, LOS F. The descriptions of LOS for unsignalized and signalized intersections are provided in Appendix B. It should be noted that overall unsignalized intersection LOS is no longer calculated in the HCM 2000 procedure; LOS is only calculated for the stop-controlled (minor) approaches and for left turns from the major roadway.

Figure 4 shows the peak hour of traffic volumes. Table 2 summarizes the intersection LOS.



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS HONOLULU,HAWAII	FIGURE
	EXISTING TRAFFIC VOLUMES AND LEVEL OF SERVICE	4

Table 2
Existing
Level of Service Summary

	Existing Year 2003			
	AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway				
NB LT	A	7.7	A	7.7
EB LT/RT	A	9.8	A	9.9
Kaiminani Drive/Mamalahoa Highway				
NB LT	B	10.6	A	8.7
EB LT	E	42.8	F	69.2
EB RT	E	36.1	C	16.3
Palani Road/Queen Kaahumanu Highway				
NB LT	E	73.8	F	117.9
NB TH	E	59.2	E	57.2
NB RT	B	15.0	C	22.1
SB LT	E	68.1	F	105.5
SB TH	C	26.2	E	65.2
SB RT	free right-turn			
EB LT	E	76.5	F	107.6
EB TH	C	29.6	D	51.2
EB RT	free right-turn			
WB LT	D	52.6	F	126.5
WB TH	E	65.1	F	91.2
WB RT	free right-turn			
Overall	*D*	*54.7*	*E*	*77.4*
Kaiminani Drive/Queen Kaahumanu Highway				
NB TH	C	21.3	C	21.2
NB RT	A	2.3	A	6.4
SB LT	C	25.5	C	27.1
SB TH	A	5.5	A	5.6
WB LT	C	31.7	C	29.1
WB RT	free right-turn			
Overall	*B*	*17.6*	*B*	*14.4*
Keahole Airport Road/Queen Kaahumanu Highway				
NB LT	B	19.1	C	30.2
NB TH	A	3.7	A	2.6
SB TH	B	18.2	C	26.5
SB RT	A	7.0	A	2.8
EB LT	C	24.8	D	42.7
EB RT	free right-turn			
Overall	*B*	*11.9*	*C*	*20.5*

Mamalahoa Highway/"Makalei Access Road"

Since Makalei Estates is approximately twenty-five percent complete, the volumes entering and exiting the "Makalei Access Road" were light and resulted in LOS A conditions during both the weekday AM and PM peak hours of traffic.

Mamalahoa Highway/Kaiminani Drive

The Kaiminani Drive eastbound left-turn traffic operates at LOS E during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. The eastbound right-turn traffic operates at LOS E during the weekday AM peak hour of traffic and at LOS C during the weekday PM peak hour of traffic.

Based upon data obtained from the 2002, State of Hawaii Department of Transportation (SDOT) 24 hour machine counts, the intersection does not warrant the installation of a traffic signal system.

Queen Kaahumanu Highway/Palani Road

Due to the heavy demand on Queen Kaahumanu Highway and Palani Road, several of the traffic movements operated at LOS E during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway northbound left-turn traffic operates at LOS E during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. The northbound through traffic operates at LOS E during the weekday AM peak hour of traffic and at LOS D during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway southbound left-turn traffic operates at LOS E during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. The southbound through traffic operates at LOS C during the weekday AM peak hour of traffic and at LOS E during the weekday PM peak hour of traffic. The Palani Road eastbound left-turn traffic operates at LOS E during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. The Palani Road westbound left-turn traffic operates at LOS D during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. The westbound through lane operates at LOS E during the weekday AM peak hour of traffic and at LOS F during the weekday PM peak hour of traffic. Overall, the Queen Kaahumanu Highway/Palani Road intersection operates at LOS E during both the weekday AM and PM peak hours of traffic.

Queen Kaahumanu Highway/Kaiminani Drive

The signalized Queen Kaahumanu/Kaiminani Drive intersection operates overall at LOS B during both the weekday AM and PM peak hours of traffic. The Queen Kaahumanu Highway northbound through traffic operates at LOS C during both the weekday AM and PM peak hours of traffic. The Queen Kaahumanu Highway southbound through traffic operates at LOS A during both the weekday AM and PM peak hours of traffic. The southbound left-turn lane operates at LOS C during both the weekday AM and PM peak hours of traffic. The Kaiminani Drive westbound left-turn lane operates at LOS C during both the weekday AM and PM peak hours of traffic.

Queen Kaahumanu Highway/Keahole Airport Road

The signalized Queen Kaahumanu Highway/Keahole Airport Road intersection operates overall at LOS B during the weekday AM peak hour of traffic and at LOS C during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway northbound through traffic operates at LOS A during both the weekday AM and PM peak hours of traffic. The northbound left-turn traffic operates at LOS B during the weekday AM peak hour of traffic and at LOS C during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway southbound through traffic operates at LOS B during the weekday AM peak hour of traffic and at LOS C during the weekday PM peak hour of traffic. The Keahole Airport Road eastbound left-turn traffic operates at LOS C during the weekday AM peak hour of traffic and at LOS D during the weekday PM peak hour of traffic.

III. FUTURE TRAFFIC CONDITIONS WITHOUT TRAFFIC GENERATED BY THE PROJECT

The methodologies used to develop future forecast without traffic generated by the Project are described below:

A. Background Traffic Growth

The background annual growth rate which was applied to existing traffic volumes to estimate the Year 2007, Year 2009, and Year 2010 traffic conditions was based on information from the 1998, Hawaii Long Range Land Transportation Plan by Frederic Harris, Inc. The projected daily traffic volumes along Queen Kaahumanu and Mamalahoa Highway in the vicinity of the Project site indicates that the traffic volumes will experience an average annual growth rate of about five percent per year. A growth factor of 1.22, 1.34, and 1.41 was applied to the existing traffic volumes to reflect the Year 2007, Year 2009, and Year 2010 traffic volumes, respectively.

B. Other Nearby Development(s)

The following is a description of the new/future development near the Project:

- Makalei Estates: There are currently about 20 lots completed and occupied with 60 vacant parcels remaining to be sold or developed. At build-out, there will be a total of 80 parcels on three-acre lots. The existing construction rate of Makalei Estates is approximately six parcels per year, indicating that by the Year 2010 there will be approximately 62 completed houses with full build-out by Year 2015. This study assumes that all 80 units will be completed and occupied by the last phase (Phase III) of the Project, Year 2010.

Figure 1 shows the location of Makalei Estates relative to the Project.

The development of traffic projections for Makalei Estates will involve trip generation, trip distribution, and traffic assignment. Descriptions of each process are as follows:

1. **Trip Generation**

   Trip generation rates were based upon data from Trip Generation 6th Edition, published by Institute of Transportation Engineers (ITE), 1997. The application of these trip rates provides an estimate of the increase in future traffic expected to be generated by Makalei Estates. Traffic generated by Makalei Estates was estimated by applying the trip generation rates shown in Table 3. Table 4 shows the trips generated by the remaining Makalei Estates for the Year 2007, Year 2009, and Year 2010.

2. **Trip Distribution**

   The directional distribution pattern developed for Makalei Estates was based on the existing traffic counts taken at the Mamalahoa Highway/"Makalei Access Road" intersection, which is currently the only access to Makalei Estates. The distribution pattern is as follows:

   - North of Makalei Estates – 25%
   - South of Makalei Estates – 75%

3. **Traffic Assignment**

   Trips generated by the remaining 60 lots of Makalei Estates were assigned to the existing roadway network based upon the above trip distribution.

Table 3

**Trip Generation Rates
For Remaining Makalei Estates**

Land Use (ITE Code)	Units	Daily Trip Rate	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
			Trip Rate	% Enter	Trip Rate	% Enter
Single Family (210)	Dwelling Units	9.57	a	25%	b	64%

KEY:

a $T = 0.7*X+9.477$

b $T = EXP(0.901*LN(X)+0.527)$

Table 4

**Trip Generation Summary
For Remaining Makalei Estates**

Land-Use Designation	No. of Units	Average Daily Trips (vpd)	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
			Enter (vph)	Exit (vph)	Enter (vph)	Exit (vph)
Year 2007						
Single Family Home	24	279	6	20	19	11
Year 2009						
Single Family Home	12	147	4	14	10	6
Year 2010						
Single Family Home	24	279	6	20	19	11
Subtotal Year 2007 to 2010	60	**705**	**16**	**54**	**48**	**28**

vpd = vehicles per day vph = vehicles per hour

C. Traffic Projections

The traffic volumes generated by the remaining Makalei Estates parcels to be developed and the application of the growth rate were added to the existing Year 2003 traffic volumes to project the Base Years 2007, 2009, and 2010 traffic without the Project.

D. Planned Roadway Improvements

SDOT is planning to widen Queen Kaahumanu Highway. Currently, SDOT is moving forward with Phase I, which will be completed by Year 2007. Phase I will widen Queen Kaahumanu Highway between Kealakehe Parkway and Henry Street from two lanes to four lanes. Phase II of the widening project calls for the widening of Queen Kaahumanu Highway between Kealakehe Parkway and Keahole Airport Road from two lanes to four lanes. Although the completion of Phase II is unknown at this time, this traffic study assumes that Phase I and II of the widening will be completed by the Year 2007.

E. Base Year 2007 Traffic Operations Without Traffic Generated by the Project

1. Base Year 2007 Traffic Condition Analysis

With the widening of Queen Kaahumanu Highway from Henry Street to Keahole Airport Road, traffic at all study intersections will operate at LOS D or better, except at the following intersections:

<u>Mamalahoa Highway/Kaiminani Drive</u>

The Kaiminani Drive eastbound left-turn traffic will operate at LOS F during both the weekday AM and PM peak hours of traffic. The Kaiminani Drive eastbound right-turn approach will operate at LOS F during the weekday AM peak hour of traffic.

Queen Kaahumanu Highway/Palani Road

The Queen Kaahumanu Highway northbound and southbound left-turn traffic will both operate at LOS D during the weekday AM peak hour of traffic and at LOS E during the weekday PM peak hour of traffic. The Palani Road westbound and eastbound left-turn traffic will both operate at LOS D during the weekday AM peak hour of traffic and at LOS E during the weekday PM peak hour of traffic.

Figure 5 shows the Base Year 2007 traffic volumes and LOS.

2. **Base Year 2007 Traffic Mitigation Measures**

Mamalahoa Highway/ Kaiminani Drive

A traffic signal system will most likely be warranted at this intersection. As a signalized intersection, the intersection overall will operate at LOS C during the weekday AM peak hour of traffic and at LOS B during the weekday PM peak hour of traffic.

Figure 6 shows the Base Year 2007 traffic volumes with mitigative measures and LOS. The study intersections LOS for Base Year 2007 conditions are summarized in Table 5.

F. **Base Year 2009 Traffic Operations Without Traffic Generated by the Project**

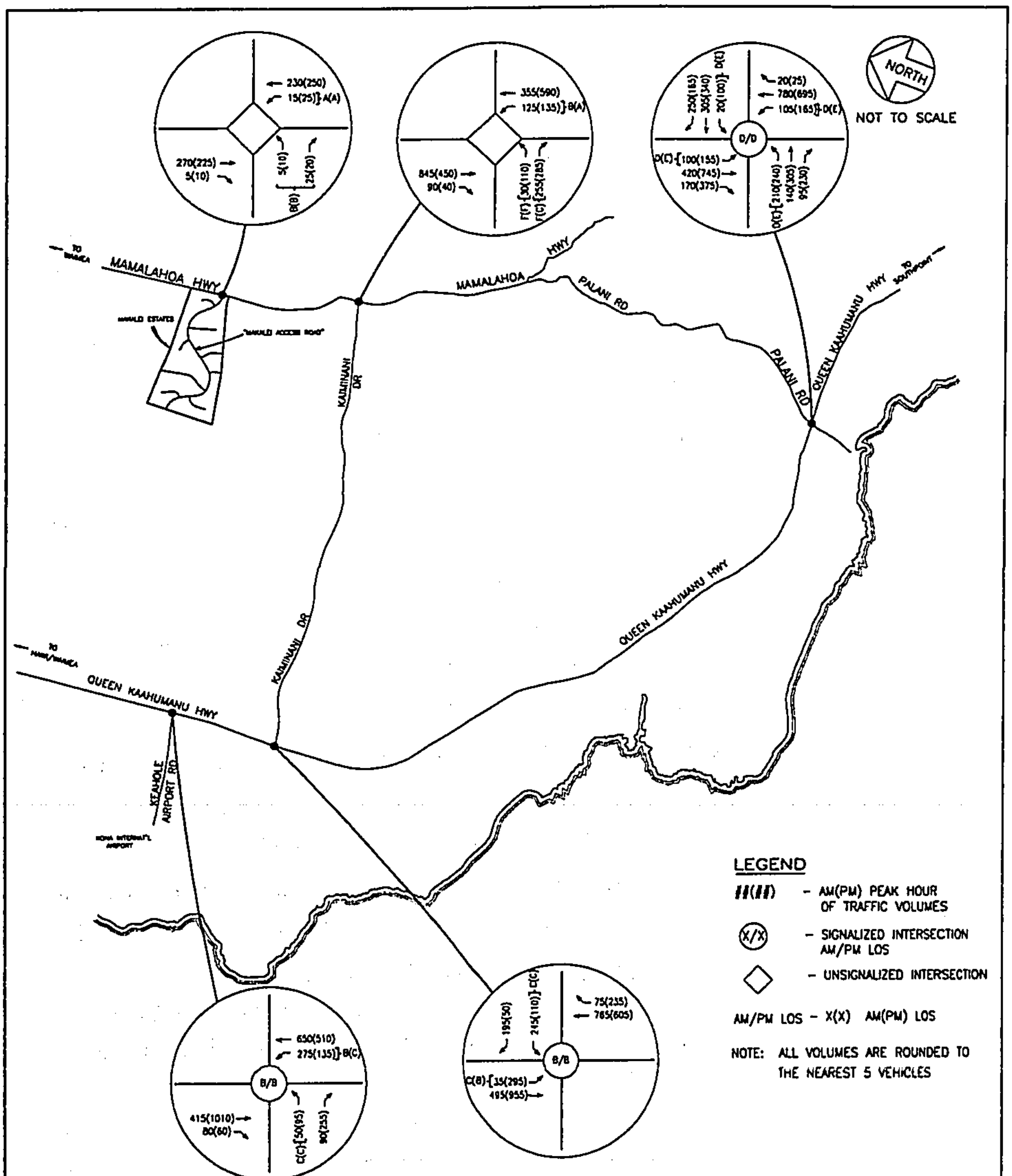
1. **Base Year 2009 Traffic Condition Analysis**

Operating conditions will generally remain unchanged from Base Year 2007 conditions except at the following intersection(s):

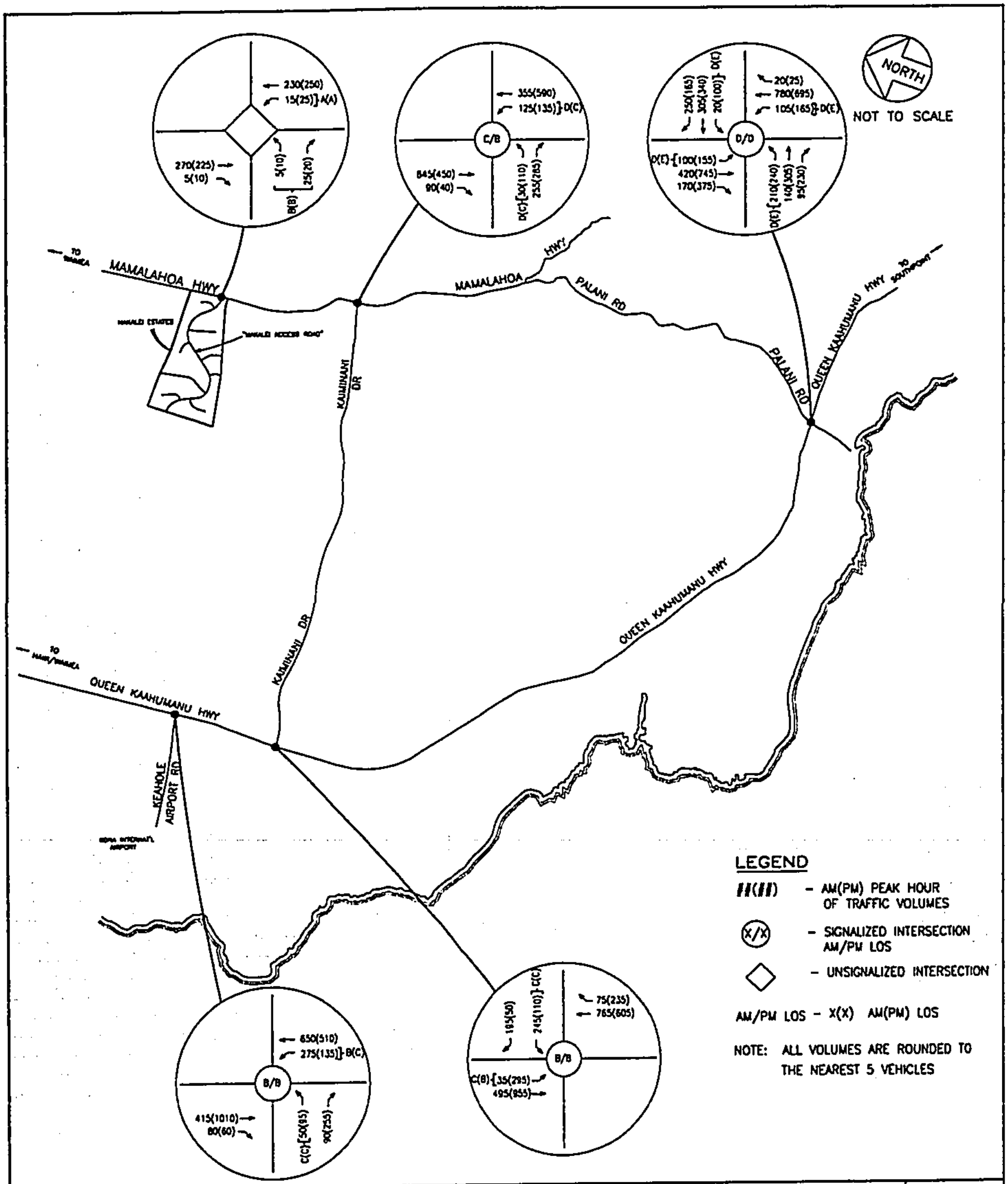
Queen Kaahumanu Highway/Kaiminani Drive

The Queen Kaahumanu Highway southbound left-turn lane will change from LOS B to LOS C during the weekday PM peak hour of traffic.

Figure 7 shows the Base Year 2009 traffic volumes and LOS. The study intersections LOS for Base Year 2009 conditions are summarized in Table 6.



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	BASE YEAR 2007 TRAFFIC VOLUMES AND LEVEL OF SERVICE	5



HILUHILU DEVELOPMENT

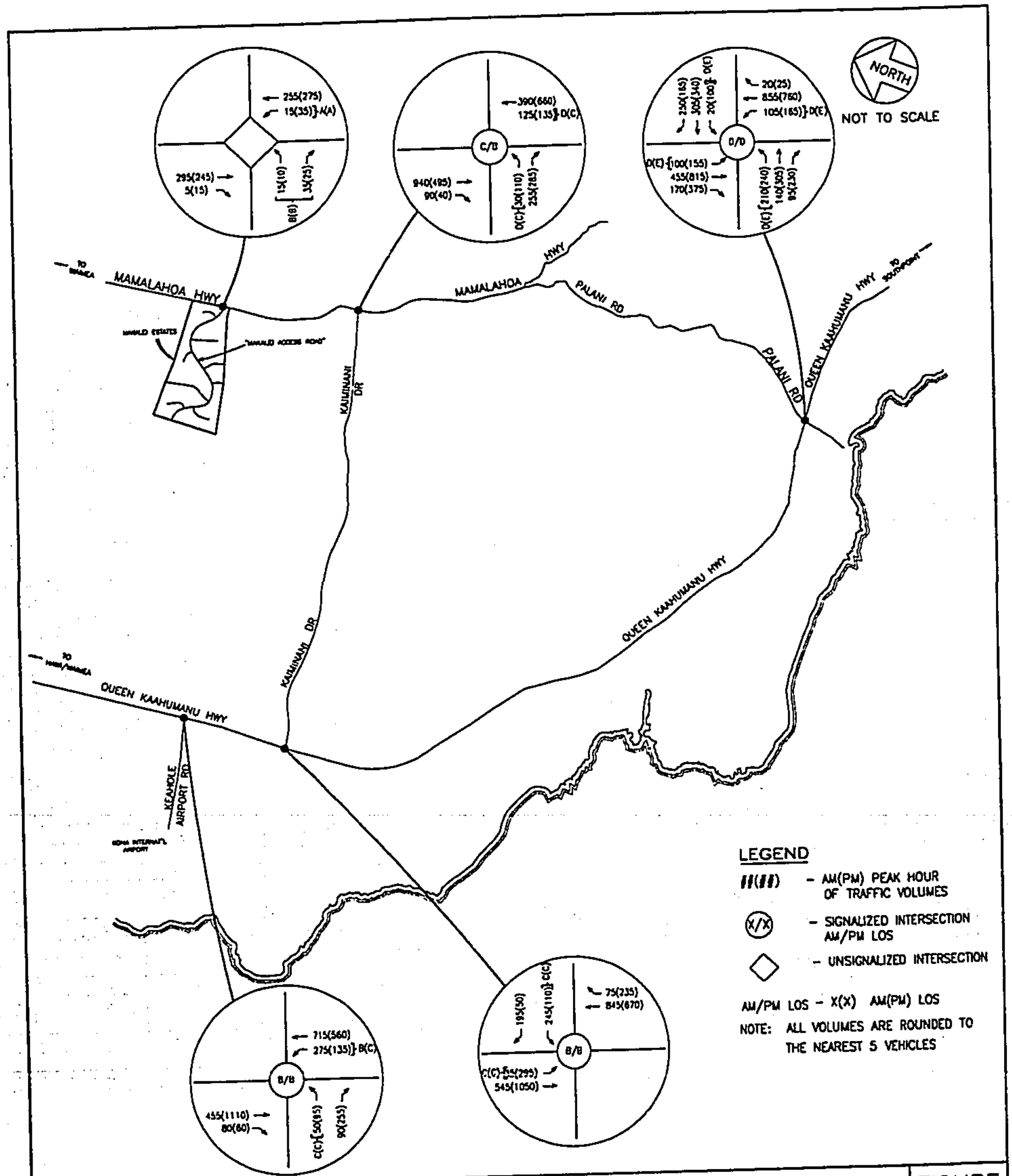
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS HONOLULU, HAWAII

BASE YEAR 2007
WITH MITIGATIVE MEASURES

FIGURE
6

Table 5
Base year 2007 without Traffic Generated by the Project
Level of Service Summary

	Existing Year 2003				Base Year 2007 Without Project-Generated Traffic				Base Year 2007 With Mitigative Measures Without Project			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway												
NB LT	A	7.7	A	7.7	A	8	A	7.9	–	–	–	–
EB LT/RT	A	9.8	A	9.9	B	11.7	B	11.3	–	–	–	–
Kaiminani Drive/Mamalahoa Highway												
NB LT	B	10.6	A	8.7	B	11.8	A	9.1	D	49	C	27.5
NB TH	–	–	–	–	–	–	–	–	A	2	A	5.2
SB RT/TH	–	–	–	–	–	–	–	–	C	24	B	16.4
EB LT	E	42.8	F	69.2	F	73.0	F	163.7	D	53.3	C	27.8
EB RT	E	36.1	C	16.3	F	78.3	C	19.9	D	43.4	B	16.4
Overall	–	–	–	–	–	–	–	–	*C*	*24.7*	*B*	*14.0*
Palani Road/Queen Kaahumanu Highway												
NB LT	E	73.8	F	117.9	D	52.1	E	65.2	–	–	–	–
NB TH	E	59.2	E	57.2	D	40.8	D	43.1	–	–	–	–
NB RT	B	15.0	C	22.1	C	20.7	C	20.8	–	–	–	–
SB LT	E	68.1	F	105.5	D	50.7	E	60.8	–	–	–	–
SB TH	C	26.2	E	65.2	C	31.3	D	46	–	–	–	–
SB RT	free right-turn				–	–	–	–	–	–	–	–
EB LT	E	76.5	F	107.6	D	54.1	E	62.9	–	–	–	–
EB TH	C	29.6	D	51.2	C	24.5	C	34.4	–	–	–	–
EB RT	free right-turn				–	–	–	–	–	–	–	–
WB LT	D	52.6	F	126.5	D	52.6	E	64.2	–	–	–	–
WB TH	E	65.1	F	91.2	D	47.4	E	61.2	–	–	–	–
WB RT	free right-turn				–	–	–	–	–	–	–	–
Overall	*D*	*54.7*	*E*	*77.4*	*D*	*41*	*D*	*49.7*	–	–	–	–
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	C	21.3	C	21.2	B	17.0	B	19.4	–	–	–	–
NB RT	A	2.3	A	6.4	A	2.6	A	8.6	–	–	–	–
SB LT	C	25.5	C	27.1	C	24.4	B	18.8	–	–	–	–
SB TH	A	5.5	A	5.6	A	6.7	A	4.0	–	–	–	–
WB LT	C	31.7	C	29.1	C	20.8	C	26.2	–	–	–	–
WB RT	free right-turn				–	–	–	–	–	–	–	–
Overall	*B*	*17.6*	*B*	*14.4*	*B*	*13.9*	*B*	*11.8*	–	–	–	–
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	19.1	C	30.2	B	16.0	C	24.2	–	–	–	–
NB TH	A	3.7	A	2.6	A	3.5	A	3.3	–	–	–	–
SB TH	B	18.2	C	26.5	B	18.9	B	14.7	–	–	–	–
SB RT	A	7.0	A	2.8	A	8.6	A	3.5	–	–	–	–
EB LT	C	24.8	D	42.7	C	23.8	C	25.3	–	–	–	–
EB RT	free right-turn				–	–	–	–	–	–	–	–
Overall	*B*	*11.9*	*C*	*20.5*	*B*	*11.1*	*B*	*12.4*	–	–	–	–



HILUHILU DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS
HONOLULU, HAWAII

FIGURE 7

BASE YEAR 2009 TRAFFIC VOLUMES AND LEVEL OF SERVICE

Table 6
Base Year 2009 without Traffic Generated by the Project
Level of Service Summary

	Existing Year 2003				Base Year 2007 Without Project-Generated Traffic				Base Year 2009 Without Project-Generated Traffic			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway												
NB LT	A	7.7	A	7.7	A	8	A	7.9	A	7.9	A	7.8
EB LT/RT	A	9.8	A	9.9	B	11.7	B	11.3	B	10.7	B	11
Kaiminani Drive/Mamalahoa Highway												
NB LT	B	10.6	A	8.7	D	49	C	27.5	D	50.6	C	29.3
NB TH	–	–	–	–	A	2	A	5.2	A	1.9	A	5.8
SB RT/TH	–	–	–	–	C	24	B	16.4	C	30.4	B	16.7
EB LT	E	42.8	F	69.2	D	53.3	C	27.8	D	54.6	C	27.8
EB RT	E	36.1	C	16.3	D	43.4	B	16.4	D	47.1	B	17.3
Overall	–	–	–	–	*C*	*24.7*	*B*	*14.0*	*C*	*28.4*	*B*	*14.3*
Palani Road/Queen Kaahumanu Highway												
NB LT	E	73.8	F	117.9	D	52.1	E	65.2	D	52.1	E	65.2
NB TH	E	59.2	E	57.2	D	40.8	D	43.1	D	46.8	D	47.0
NB RT	B	15.0	C	22.1	C	20.7	C	20.8	C	20.7	C	20.8
SB LT	E	68.1	F	105.5	D	50.7	E	60.8	D	50.7	E	60.8
SB TH	C	26.2	E	65.2	C	31.3	D	46	C	31.8	D	52.7
SB RT	free right-turn				–	–	–	–	–	–	–	–
EB LT	E	76.5	F	107.6	D	54.1	E	62.9	D	54.1	E	62.9
EB TH	C	29.6	D	51.2	C	24.5	C	34.4	C	24.5	C	34.6
EB RT	free right-turn				–	–	–	–	–	–	–	–
WB LT	D	52.6	F	126.5	D	52.6	E	64.2	D	52.6	E	64.2
WB TH	E	65.1	F	91.2	D	47.4	E	61.2	D	47.4	E	61.2
WB RT	free right-turn				–	–	–	–	–	–	–	–
Overall	*D*	*54.7*	*E*	*77.4*	*D*	*41*	*D*	*49.7*	*D*	*43.3*	*D*	*52.4*
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	C	21.3	C	21.2	B	17.0	B	19.4	B	17.1	B	19.2
NB RT	A	2.3	A	6.4	A	2.6	A	8.6	A	2.6	A	8
SB LT	C	25.5	C	27.1	C	24.4	B	18.8	C	24.4	C	20.2
SB TH	A	5.5	A	5.6	A	6.7	A	4.0	A	6.4	A	4.2
WB LT	C	31.7	C	29.1	C	20.8	C	26.2	C	22.5	C	26.2
WB RT	free right-turn				–	–	–	–	–	–	–	–
Overall	*B*	*17.6*	*B*	*14.4*	*B*	*13.9*	*B*	*11.8*	*B*	*14.0*	*B*	*11.9*
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	19.1	C	30.2	B	16.0	C	24.2	B	16	C	24.2
NB TH	A	3.7	A	2.6	A	3.5	A	3.3	A	3.6	A	3.3
SB TH	B	18.2	C	26.5	B	18.9	B	14.7	B	19.4	B	14.7
SB RT	A	7.0	A	2.8	A	8.6	A	3.5	A	8.6	A	3.5
EB LT	C	24.8	D	42.7	C	23.8	C	25.3	C	23.8	C	25.3
EB RT	free right-turn				–	–	–	–	–	–	–	–
Overall	*B*	*11.9*	*C*	*20.5*	*B*	*11.1*	*B*	*12.4*	*B*	*11.2*	*B*	*12.2*

G. Base Year 2010 Traffic Operations Without Project-Generated Traffic

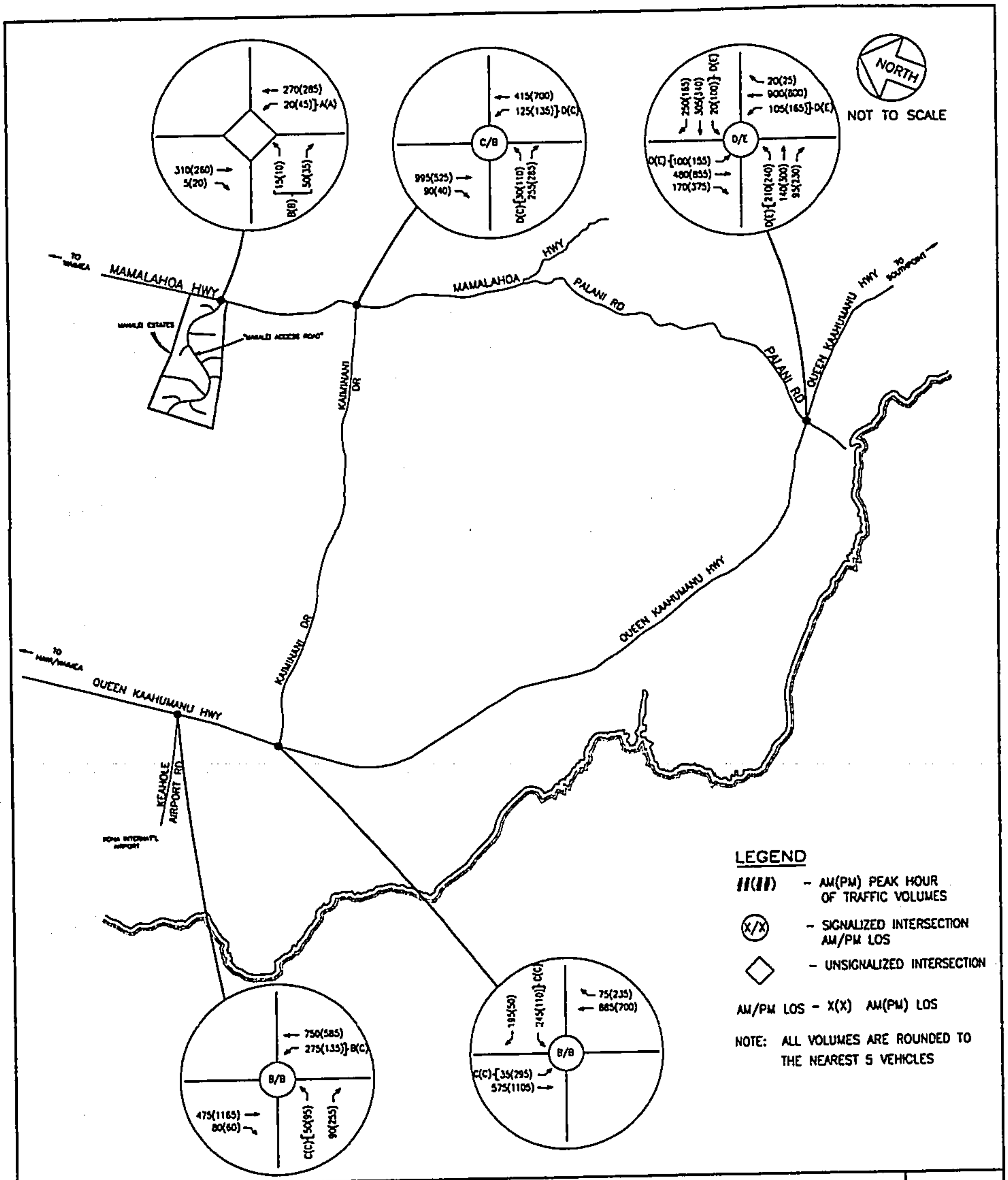
1. Base Year 2010 Traffic Conditions Analysis

Operating condition will generally remain unchanged from Base 2009 conditions except at the following intersection(s):

Queen Kaahumanu Highway/Palani Road

The Queen Kaahumanu Highway southbound through traffic will operate at LOS E instead of LOS D during the weekday PM peak hour of traffic. Overall the intersection will also operate at LOS E instead of LOS D during the weekday PM peak hour of traffic.

Figure 8 shows the Base Year 2010 traffic volumes and LOS. The study intersection LOS for Base Year 2010 conditions are summarized in Table 7.



HILUHILU DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS
HONOLULU, HAWAII

FIGURE 8

BASE YEAR 2010 TRAFFIC VOLUMES AND LEVEL OF SERVICE

Table 7
Base Year 2010 without Traffic Generated by the Project
Level of Service Summary

	Existing Year 2003				Base Year 2007 Without Project-Generated Traffic				Base Year 2009 Without Project-Generated Traffic				Base Year 2010 Without Project-Generated Traffic			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway																
NB LT	A	7.7	A	7.7	A	8	A	7.9	A	7.9	A	7.8	A	8	A	8
EB LT/RT	A	9.8	A	9.9	B	11.7	B	11.3	B	10.7	B	11	B	12.2	B	11.4
Kaiminani Drive/Mamalahoa Highway																
NB LT	B	10.6	A	8.7	D	49	C	27.5	D	50.6	C	29.3	D	52.7	C	27.5
NB TH	--	--	--	--	A	2	A	5.2	A	1.9	A	5.8	A	1.9	A	5.6
SB RT/TH	--	--	--	--	C	24	B	16.4	C	30.4	B	16.7	D	37.1	B	17.8
EB LT	E	42.8	F	69.2	D	53.3	C	27.8	D	54.6	C	27.8	D	54.6	C	29.1
EB RT	E	36.1	C	16.3	D	43.4	B	16.4	D	47.1	B	17.3	D	49.4	B	17.3
Overall	--	--	--	--	*C*	*24.7*	*B*	*14.0*	*C*	*28.4*	*B*	*14.3*	*C*	*32.4*	*B*	*14.4*
Palani Road/Queen Kaahumanu Highway																
NB LT	E	73.8	F	117.9	D	52.1	E	65.2	D	52.1	E	65.2	D	52.1	E	68.1
NB TH	E	59.2	E	57.2	D	40.8	D	43.1	D	46.8	D	47.0	D	48.2	D	50.8
NB RT	B	15.0	C	22.1	C	20.7	C	20.8	C	20.7	C	20.8	C	20.1	C	20.8
SB LT	E	68.1	F	105.5	D	50.7	E	60.8	D	50.7	E	60.8	D	50.7	E	60.8
SB TH	C	26.2	E	65.2	C	31.3	D	46	C	31.8	D	52.7	C	31.3	E	59.3
SB RT	free right-turn				--	--	--	--	--	--	--	--	--	--	--	--
EB LT	E	76.5	F	107.6	D	54.1	E	62.9	D	54.1	E	62.9	D	54.1	E	62.9
EB TH	C	29.6	D	51.2	C	24.5	C	34.4	C	24.5	C	34.6	C	25.2	C	34.6
EB RT	free right-turn				--	--	--	--	--	--	--	--	--	--	--	--
WB LT	D	52.6	F	126.5	D	52.6	E	64.2	D	52.6	E	64.2	D	52.6	E	64.2
WB TH	E	65.1	F	91.2	D	47.4	E	61.2	D	47.4	E	61.2	D	50.8	E	61.2
WB RT	free right-turn				--	--	--	--	--	--	--	--	--	--	--	--
Overall	*D*	*54.7*	*E*	*77.4*	*D*	*41*	*D*	*49.7*	*D*	*43.3*	*D*	*52.4*	*D*	*44.2*	*E*	*55.4*
Kaiminani Drive/Queen Kaahumanu Highway																
NB TH	C	21.3	C	21.2	B	17.0	B	19.4	B	17.1	B	19.2	B	17.8	B	19.8
NB RT	A	2.3	A	6.4	A	2.6	A	8.6	A	2.6	A	8	A	2.6	A	8
SB LT	C	25.5	C	27.1	C	24.4	B	18.8	C	24.4	C	20.2	C	24.4	C	20.2
SB TH	A	5.5	A	5.6	A	6.7	A	4.0	A	6.4	A	4.2	A	6.4	A	4.3
WB LT	C	31.7	C	29.1	C	20.8	C	26.2	C	22.5	C	26.2	C	22.5	C	26.2
WB RT	free right-turn				--	--	--	--	--	--	--	--	--	--	--	--
Overall	*B*	*17.6*	*B*	*14.4*	*B*	*13.9*	*B*	*11.8*	*B*	*14.0*	*B*	*11.9*	*B*	*14.3*	*B*	*12.0*
Keahole Airport Road/Queen Kaahumanu Highway																
NB LT	B	19.1	C	30.2	B	16.0	C	24.2	B	16	C	24.2	B	16.9	C	26.5
NB TH	A	3.7	A	2.6	A	3.5	A	3.3	A	3.6	A	3.3	A	3.6	A	3
SB TH	B	18.2	C	26.5	B	18.9	B	14.7	B	19.4	B	14.7	B	18.6	B	14.6
SB RT	A	7.0	A	2.8	A	8.6	A	3.5	A	8.6	A	3.5	A	8	A	3.2
EB LT	C	24.8	D	42.7	C	23.8	C	25.3	C	23.8	C	25.3	C	23.8	C	27.1
EB RT	free right-turn				--	--	--	--	--	--	--	--	--	--	--	--
Overall	*B*	*11.9*	*C*	*20.5*	*B*	*11.1*	*B*	*12.4*	*B*	*11.2*	*B*	*12.2*	*B*	*11.1*	*B*	*12.3*

IV. FUTURE TRAFFIC PROJECTIONS WITH PROJECT-GENERATED TRAFFIC

The development increments and dates for the Project are based upon the following, in Table 8:

Table 8 **Hiluhilu Land Use**	Phase 1 Year 2007	Phase 2 Year 2009	Phase 3 Year 2010	Total
Single-Family (Dwelling Unit)	215	185	70	470
Multi-Family (Dwelling Unit)	20	60	40	120
Apartment (Dwelling Unit)	25	100	50	175
Senior Housing (Dwelling Unit)	--	80	--	80
Hotel (Rooms)	--	120	--	120
Golf Course (Acres)	180	--	--	180
University Village (Students)	375	250	125	750
Medical Offices (Square Feet)	20,000	40,000	--	60,000
Research and Development (Gross Floor Area, Square Feet)	--	40,000	40,000	80,000
Commercial (Gross Floor Area, Square Feet)	25,000	25,000	30,000	80,000

The development of traffic projections for the Project involves trip generation, trip distribution, and traffic assignment, which were described earlier in this report.

A. Trip Generation

Trip rates contained in the nationally published ITE Trip Generation, 6th Edition, were used to estimate the number of trips generated by the proposed Project.

The Project will generate trips that are internal to the development and to the adjacent University of Hawaii West Hawaii campus. The Project is envisioned as a residential community with recreational amenities, a golf course, and commercial sites that will interact with the development of the adjacent University of Hawaii West Hawaii campus. Information contained in the March 2001, Trip Generation Handbook, published by ITE estimates an approximate internal capture rate of 30 percent for a similar Multi-Use Development. As a conservative estimate, an internal capture rate of approximately 20 percent was used to estimate internal trips.

Table 9 shows the trip generation rates used for the Project. Table 10 shows the incremental trip generation estimate for each phase of the Project.

Table 9
Trip Generation Rates

Land Use (ITE Code)	Units	Daily Trip Rate	AM Peak Hour of Traffic		PM Peak Hour of Traffic	
			Trip Rate	% Enter	Trip Rate	% Enter
Single Family (210)	Dwelling Units	9.57	a	25%	b	64%
Apartment (220)	Dwelling Unit	6.63	c	16%	d	67%
Residential Condominium/Townhouse (230)	Dwelling Unit	5.86	e	17%	f	18%
Elderly Housing-Attached (253)	Dwelling Unit	3.48	0.07	63%	0.10	59%
Hotel (310)	Rooms	8.23	g	61%	h	53%
Golf Course (430)	Acres	5.04	i	74%	j	34%
Junior/Community College (540)	Students	1.54	0.14	91%	0.17	68%
Medical-Dental Office Building (720)	1,000 sq ft GFA	36.13	2.43	80%	3.17	27%
Research and Development Center (760)	1,000 sq ft GFA	8.11	k	83%	l	15%
Shopping Center (820)	1,000 sq ft GLA	42.92	m	61%	n	48%

KEY:

GLA = gross leasable area
GFA = gross floor area
sq ft = square feet

a. T = 0.7*X+9.477
b. T = EXP(0.901*LN(X)+0.527)
c. T = 0.497*X+3.238
d. T = 0.541*X+18.743
e. T = EXP(0.790*LN(X)+0.298)
f. T = EXP(0.827*LN(X)+0.309
g. T = EXP(1.24*LN(X)-1.99
h. T = EXP(1.212*LN(X)-1.763)
i. T = EXP(0.632*LN(X)+0.403)
j. T = 0.126*X+31.301
k. T=EXP(0.875*LN(X)+0.883)
l. T=EXP(0.832*LN(X)+1.060)
m. T = EXP(0.596*LN(X)+2.329)
n. T = EXP(0.66*LN(X)+3.403)

Table 10
Project Land Uses and Trip Generation

Land-Use Designation	No. of Units	Average Daily Trips (vpd)	AM Peak Hour of Traffic Enter (vph)	AM Peak Hour of Traffic Exit (vph)	PM Peak Hour of Traffic Enter (vph)	PM Peak Hour of Traffic Exit (vph)
Phase I						
Single Family Home	215	2,181	42	127	144	81
Apartment	25	284	3	13	21	11
Residential Townhouse	20	184	2	14	12	6
Golf Course	180	907	28	10	18	36
UH West Hawaii	375	1,154	48	5	43	20
Medical Offices	20,000	603	39	10	19	50
Village Commercial	25,000	2,795	43	27	121	131
Subtotal – Phase I	-	8,108	205	206	378	335
Phase II						
Single Family Home	185	1,905	37	111	126	71
Apartment	100	868	8	48	62	30
Residential Townhouse	60	468	6	34	30	16
Senior Housing	80	278	4	2	5	3
Hotel	120	705	31	20	30	27
UH West Hawaii	250	973	32	3	29	14
Medical Offices	40,000	1,421	78	19	35	96
Research and Development	40,000	480	51	10	9	53
Village Commercial	25,000	2,795	43	27	121	131
Subtotal – Phase II	-	9,893	290	274	447	441
Phase III						
Single Family Home	70	747	14	44	50	28
Apartment	50	434	4	24	31	15
Residential Townhouse	40	332	4	24	22	10
UH West Hawaii	125	792	16	2	14	7
Research and Development	40,000	480	51	10	9	53
Village Commercial	30,000	3,143	48	30	136	148
Subtotal – Phase III	-	5,928	137	134	262	261
Total Phases I through III	1520	**23,929**	**632**	**614**	**1,087**	**1037**

vpd = vehicles per day vph = vehicles per hour

B. Trip Distribution and Traffic Assignment

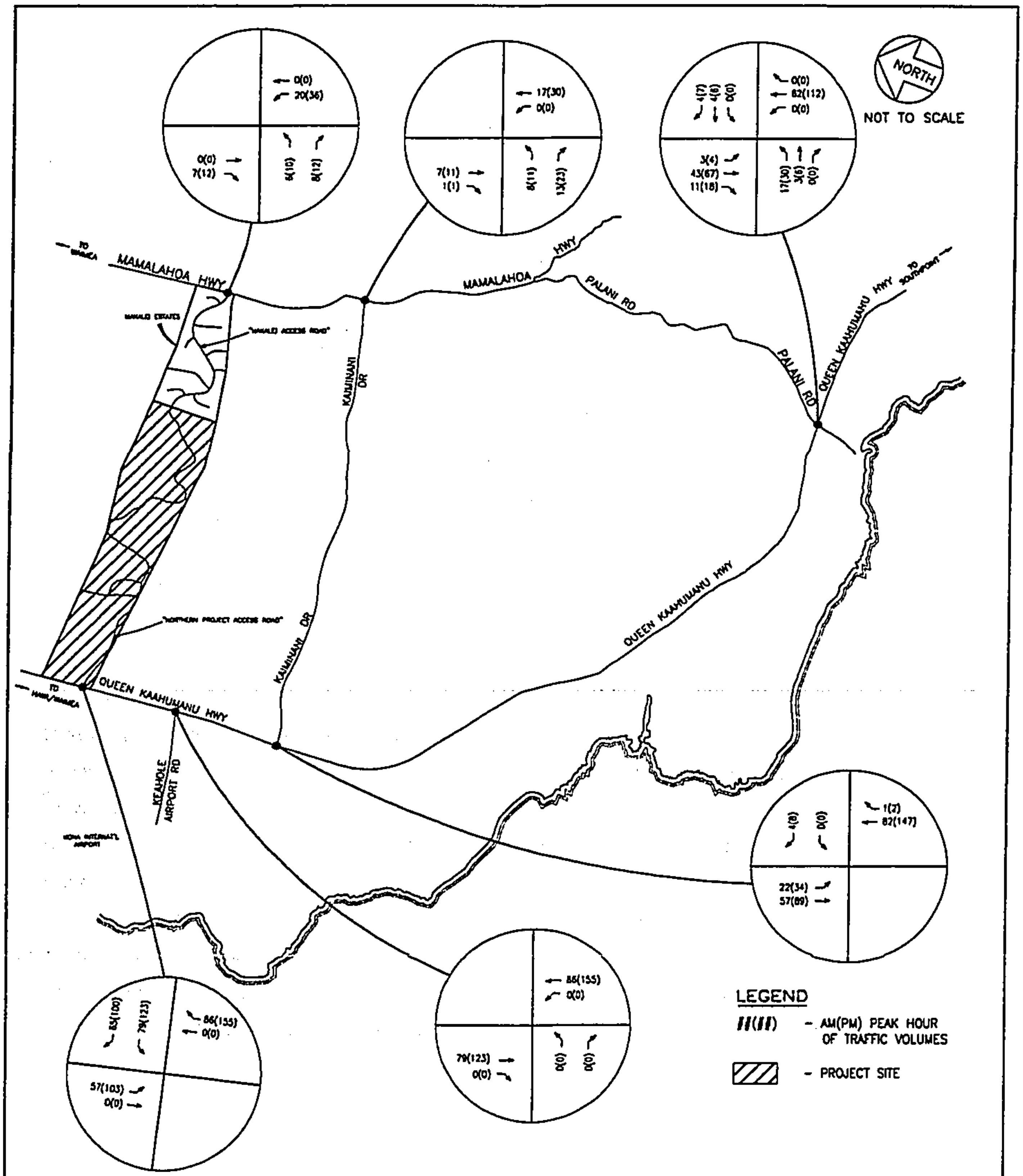
The Project traffic was distributed onto the existing roadway network based on field observations and existing peak hour turning movement volumes. The distribution percentages are shown in Table 11. Figures 9, 10, and 11 show the Project traffic assignment for Phases I through III.

Table 11
Trip Distribution Factors

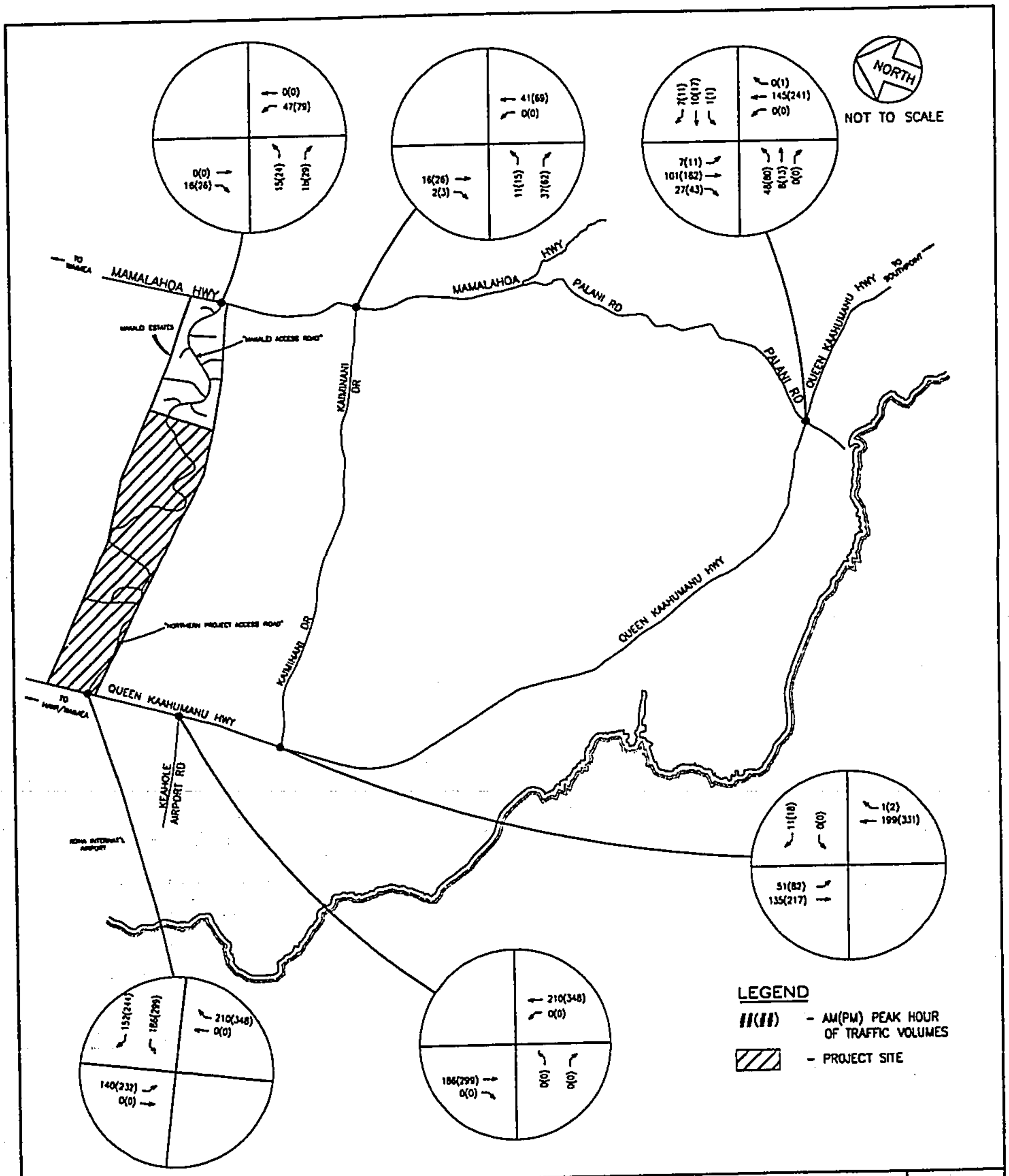
Direction (to/from)	Factor
North of Project Site using Mamalahoa Highway	4%
South of Project Site using Mamalahoa Highway	9%
North of Project Site using Queen Kaahumanu Highway	37%
South of Project Site using Queen Kaahumanu Highway	50%
Total	**100%**

C. Project Roadways and Access

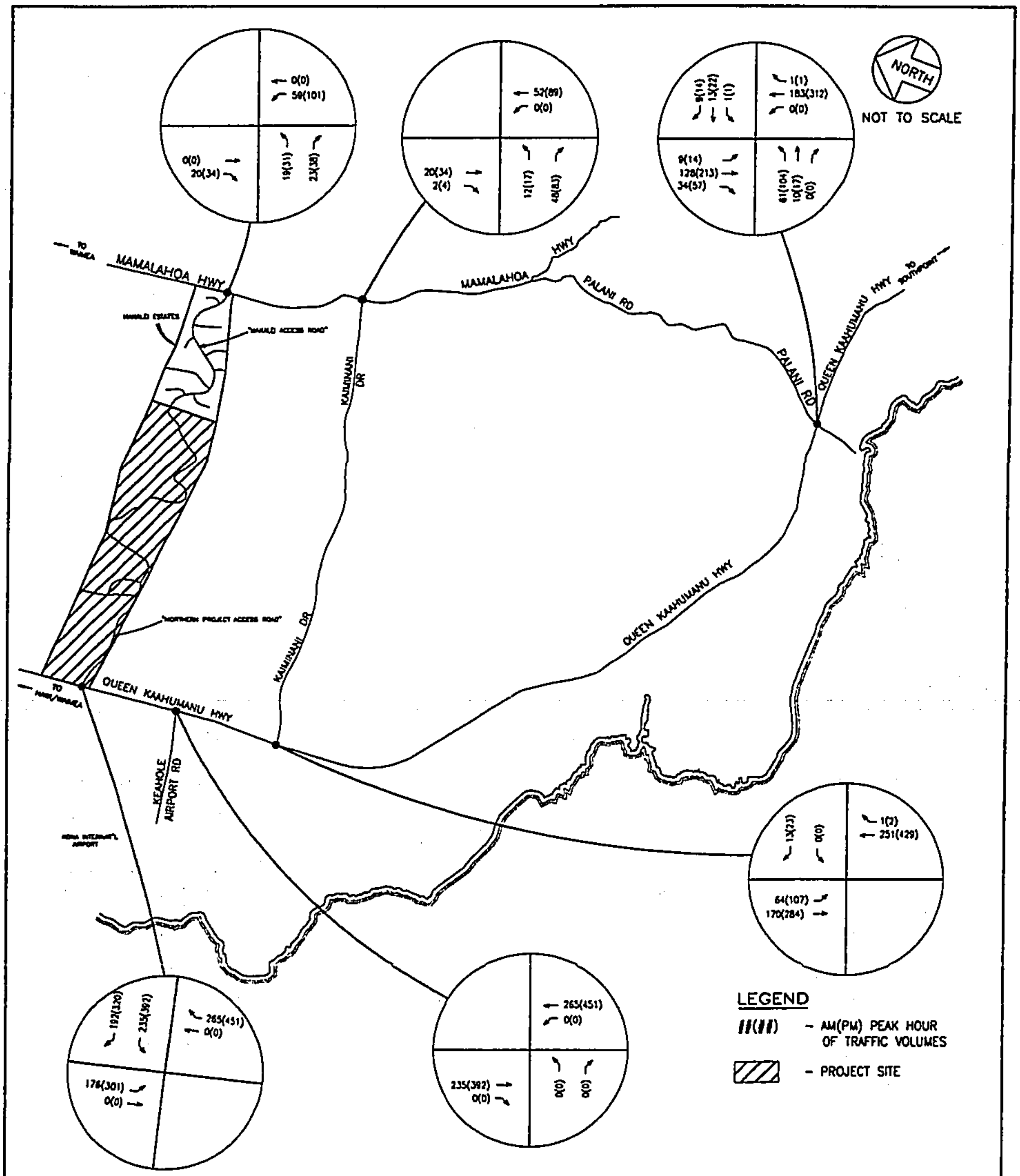
As described earlier in this report, access to the project site is proposed to connect through the existing Makalei Estates roadway ("Makalei Access Road") with one of two alternative connections to Queen Kaahumanu Highway. One access (Northern Project Access Road) would have an alignment to the project site located just north of the existing Queen Kaahumanu Highway/Keahole Airport Road intersection, which will add another intersection on Queen Kaahumanu Highway. The other alternative access (Airport Access Road) would have an alignment to the project site located across Keahole Airport Road at the Queen Kaahumanu Highway/Keahole Airport Road intersection, to form the forth leg of the intersection.



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	PROJECT GENERATED TRAFFIC YEAR 2007 PHASE I	9



HILUHILU DEVELOPMENT	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	PROJECT GENERATED TRAFFIC YEAR 2009 PHASE I AND II	10



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	PROJECT GENERATED TRAFFIC YEAR 2010 PHASE I, II, AND III	11

V. FUTURE TRAFFIC CONDITIONS WITH PROJECT-GENERATED TRAFFIC WITH THE NORTHERN PROJECT ACCESS ROAD

Project traffic was added to their respective base year traffic volumes for each of the three phases of development, as is shown in Figures 12 through 16.

A. Phase I - Year 2007

1. Year 2007 Traffic Condition Analysis

Queen Kaahumanu Highway/Northern Project Access Road

The Queen Kaahumanu Highway/Northern Project Access Road intersection will warrant the installation of a traffic signal system and the following intersection configurations are recommended:

- Northbound approach – one through lane and one exclusive right-turn deceleration lane.
- Southbound approach – one through lane and one exclusive left-turn lane.
- Westbound approach – one shared left-turn and right-turn lane.

With the traffic signal and the above intersection configurations, the intersection will overall operate at LOS B during both weekday AM and PM peak hours of traffic.

Overall intersection or individual intersection traffic movements at all other study intersections will operate at LOS D or better except at the following locations:

Queen Kaahumanu Highway/Palani Road

The Queen Kaahumanu Highway northbound and southbound left-turn traffic will continue to operate at LOS E during the weekday PM peak hour of traffic. The Palani Road eastbound and westbound left-turn traffic will continue to operate at LOS E during the weekday PM peak hour of traffic. The Palani Road westbound through traffic will continue to operate at LOS E during the weekday PM peak hour of traffic. The overall intersection LOS will operate at LOS E instead of LOS D during the weekday PM peak hour of traffic.

The intersection LOS for Phase I of the Project is summarized in Table 12.

B. Phase II - Year 2009

1. Year 2009 Traffic Condition Analysis

Queen Kaahumanu Highway/Northern Project Access Road

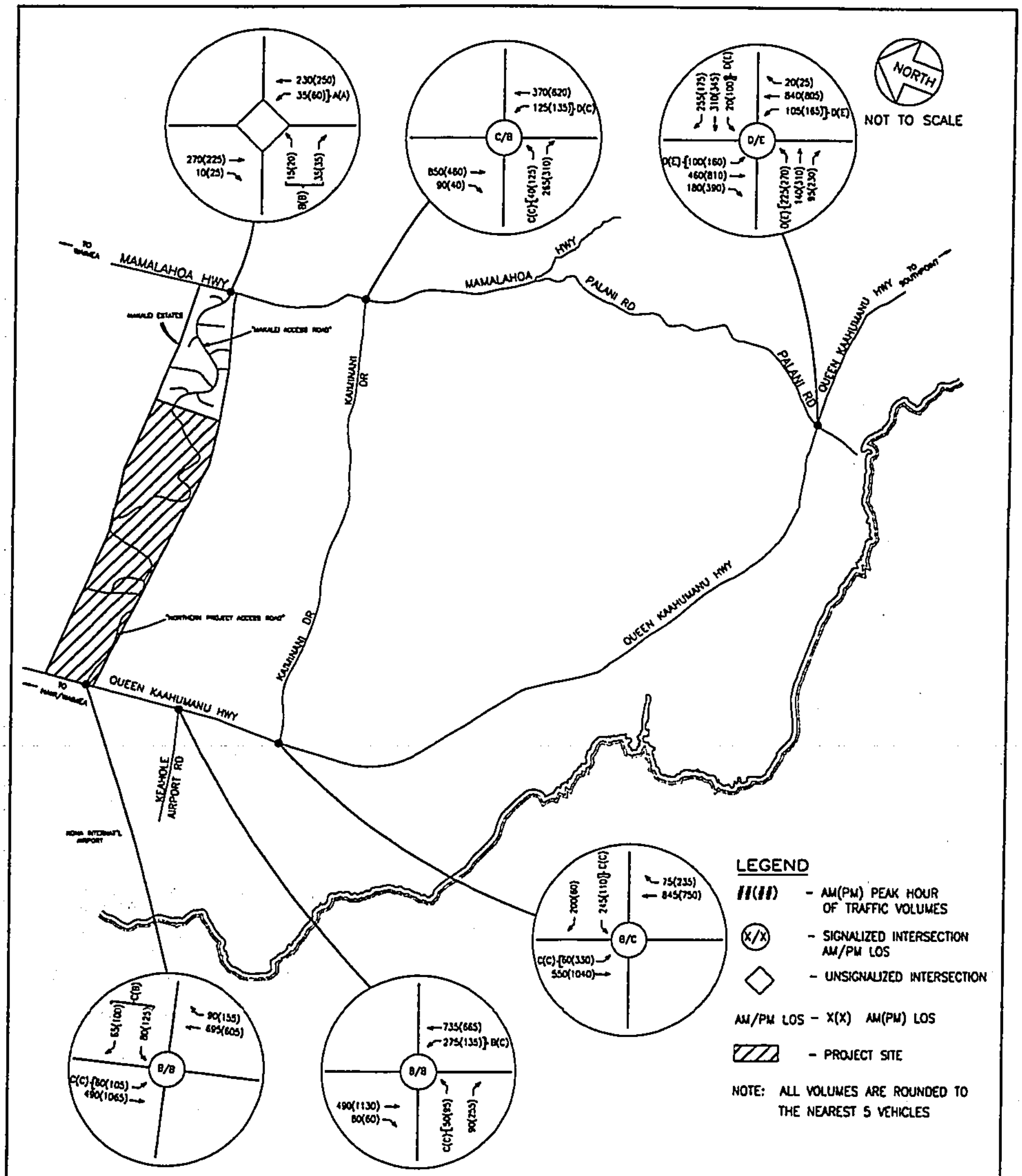
The intersection configuration will be similar as Year 2007 (Phase I) intersection configuration except for the westbound approach. The Northern Project Access Road westbound approach will require separate right-turn and left-turn lanes to accommodate the demand of right-turn and left-turn traffic.

With the above improvement, the Northern Project Access Road westbound left-turn traffic will operate at LOS E during the PM peak hour of traffic. The Queen Kaahumanu Highway southbound left-turn traffic will also operate at LOS E during the weekday PM peak hour of traffic. Overall, the intersection will operate at LOS D during the weekday AM peak hour of traffic and at LOS E during the weekday PM peak hour of traffic.

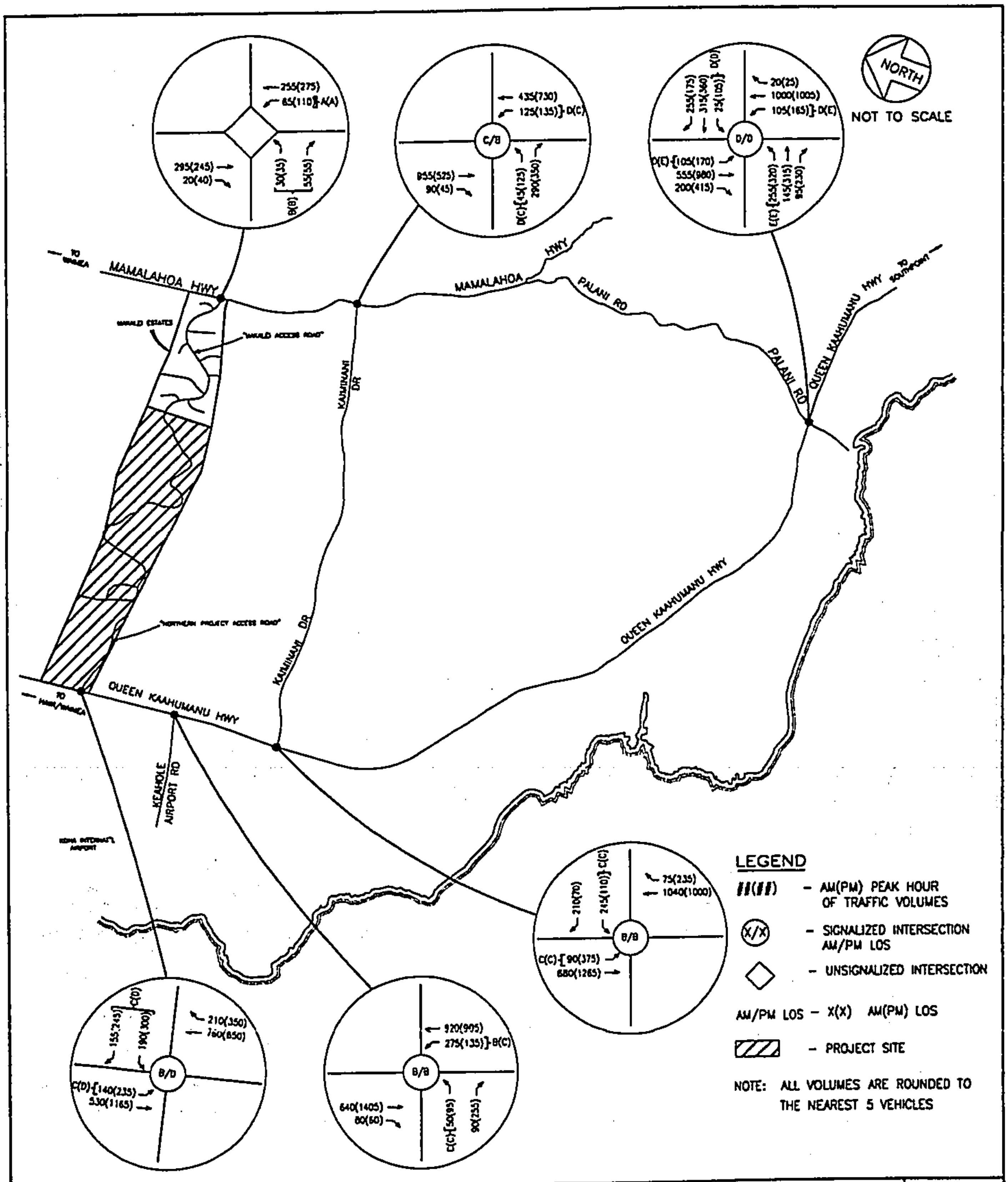
Overall intersection or individual intersection traffic movements at all other study intersections will continue to operate at LOS D or better except at the following intersections:

Mamalahoa Highway/Kaiminani Drive

As a signalized intersection, the Kaiminani Drive eastbound right-turn traffic and left-turn traffic will operate at LOS E instead of LOS D during the weekday AM peak hour of traffic.



HILUHILU DEVELOPMENT	AYA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII FUTURE YEAR 2007 TRAFFIC VOLUMES AND LEVEL OF SERVICE	FIGURE 12

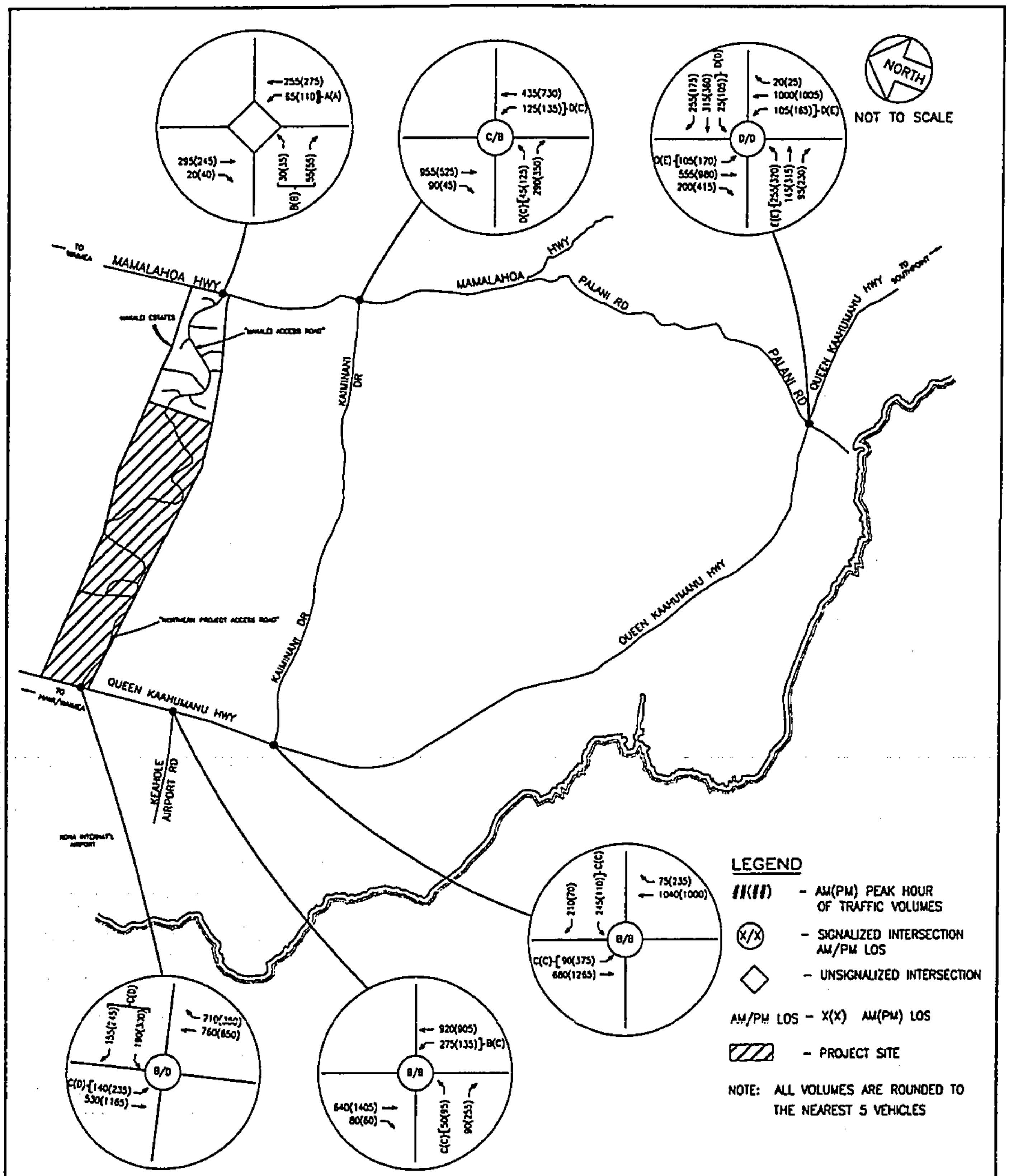


HILUHILU DEVELOPMENT

AYA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS HONOLULU, HAWAII

FUTURE YEAR 2009 TRAFFIC VOLUMES AND LEVEL OF SERVICE

FIGURE 13

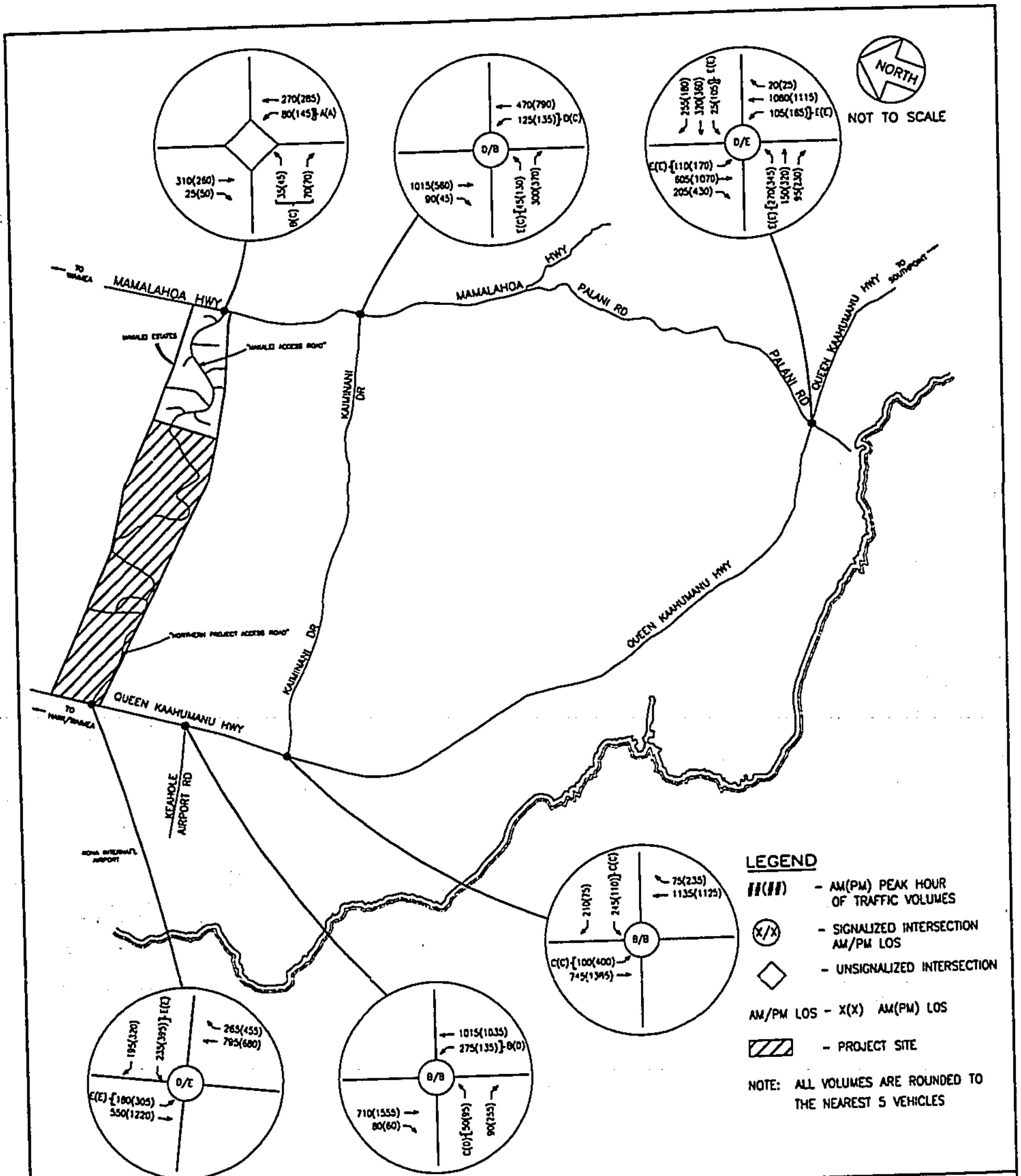


HILUHILU DEVELOPMENT

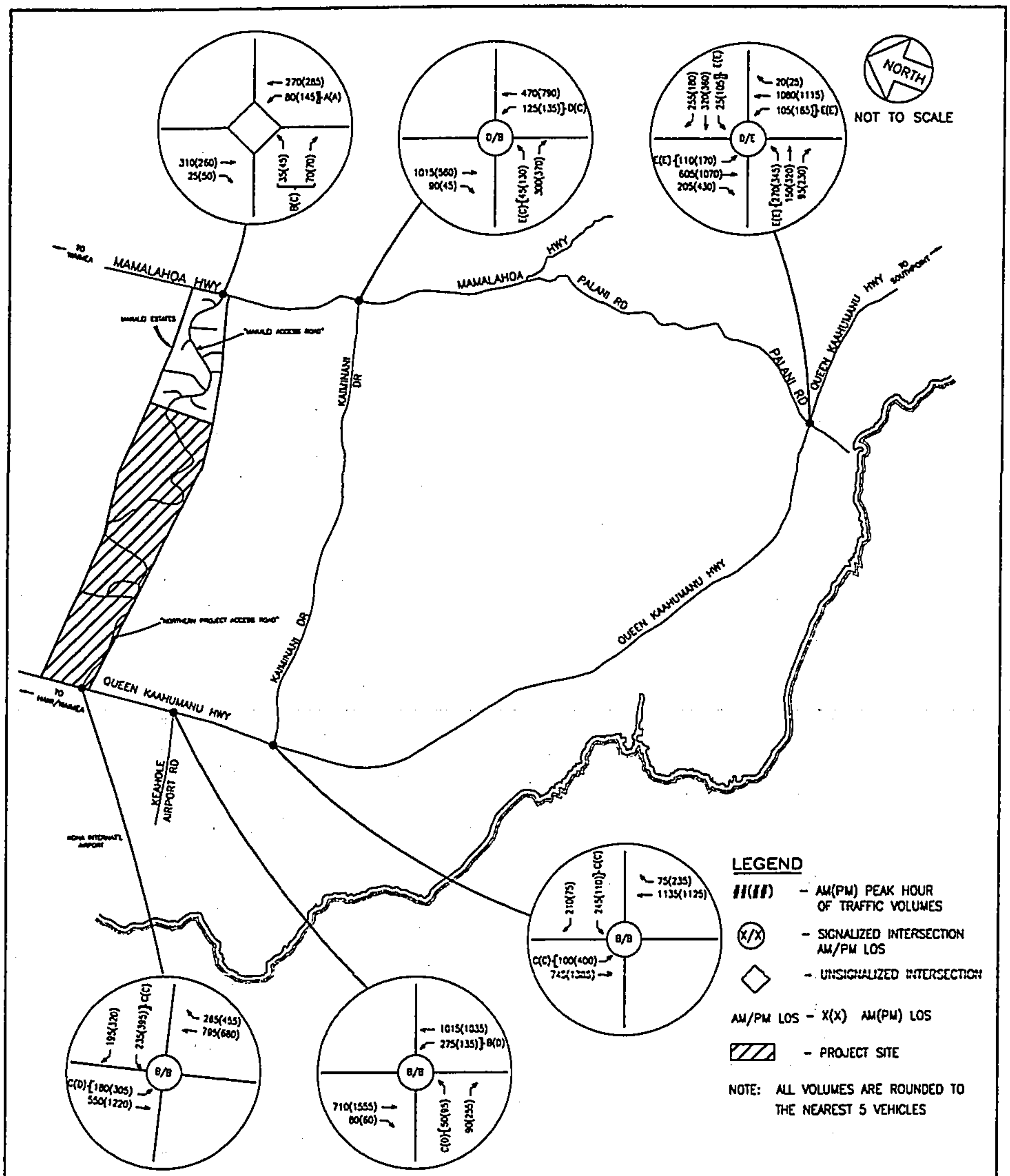
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS,SURVEYORS HONOLULU,HAWAII

FUTURE YEAR 2009
WITH MITIGATIVE MEASURES

FIGURE 14



HILUHILU DEVELOPMENT	AYA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	FUTURE YEAR 2010 TRAFFIC VOLUMES AND LEVEL OF SERVICE	15



HILUHILU DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS HONOLULU, HAWAII

FUTURE YEAR 2010
WITH MITIGATIVE MEASURES

FIGURE
16

Table 12
Future Year 2007 with Phase I Project
with Northern Project Access Road
Level of Service Summary

	Base Year 2007 Without Project-Generated Traffic				Future Year 2007 With Phase I Project			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway								
NB LT	A	8	A	7.9	A	8	A	8
EB LT/RT	B	11.7	B	11.3	B	11.6	B	12.0
Kaiminani Drive/Mamalahoa Highway								
NB LT	D	49	C	27.5	D	46.8	C	27.5
NB TH	A	2	A	5.2	A	2.2	A	5.4
SB RT/TH	C	24	B	16.4	C	33.2	B	16.7
EB LT	D	53.3	C	27.8	C	28.8	C	28.4
EB RT	D	43.4	B	16.4	C	28.1	B	17.1
Overall	*C*	*24.7*	*B*	*14.0*	*C*	*26.7*	*B*	*14.3*
Palani Road/Queen Kaahumanu Highway								
NB LT	D	52.1	E	65.2	D	52.1	E	66.7
NB TH	D	40.8	D	43.1	D	48.9	D	53.4
NB RT	C	20.7	C	20.8	C	21.3	C	20.2
SB LT	D	50.7	E	60.8	D	50.7	E	63.8
SB TH	C	31.3	D	46	C	32.7	D	54.4
SB RT	--	--	--	--	--	--	--	--
EB LT	D	54.1	E	62.9	D	54.2	E	67.0
EB TH	C	24.5	C	34.4	C	23.8	C	30.7
EB RT	--	--	--	--	--	--	--	--
WB LT	D	52.6	E	64.2	D	52.6	E	70.8
WB TH	D	47.4	E	61.2	D	48.2	E	64.0
WB RT	--	--	--	--	--	--	--	--
Overall	*D*	*41*	*D*	*49.7*	*D*	*44.4*	*E*	*55.4*
Kaiminani Drive/Queen Kaahumanu Highway								
NB TH	B	17.0	B	19.4	B	17.1	C	33.7
NB RT	A	2.6	A	8.6	A	2.6	B	10.7
SB LT	C	24.4	B	18.8	C	25.3	C	34.0
SB TH	A	6.7	A	4.0	A	6.4	A	7.8
WB LT	C	20.8	C	26.2	C	22.5	C	34.9
WB RT	--	--	--	--	--	--	--	--
Overall	*B*	*13.9*	*B*	*11.8*	*B*	*14.2*	*C*	*20.7*
Keahole Airport Road/Queen Kaahumanu Highway								
NB LT	B	16.0	C	24.2	B	16.9	C	26.5
NB TH	A	3.5	A	3.3	A	3.6	A	3.2
NB RT	--	--	--	--	--	--	--	--
NB RT/TH	--	--	--	--	--	--	--	--
SB LT	--	--	--	--	--	--	--	--
SB TH	B	18.9	B	14.7	B	19.1	B	14.6
SB RT	A	8.6	A	3.5	A	8	A	3.2
EB LT	C	23.8	C	25.3	C	23.8	C	27.1
EB RT	--	--	--	--	--	--	--	--
EB TH/LT	--	--	--	--	--	--	--	--
WB LT	--	--	--	--	--	--	--	--
WB TH/LT	--	--	--	--	--	--	--	--
WB RT	--	--	--	--	--	--	--	--
Overall	*B*	*11.1*	*B*	*12.4*	*B*	*11.4*	*B*	*11.9*
Northern Project AccessRoad/Queen Kaahumanu Highway								
NB TH	--	--	--	--	B	18.0	B	17.5
NB RT	--	--	--	--	A	201	A	2.5
SB LT	--	--	--	--	D	46.2	C	34.9
SB TH	--	--	--	--	A	5.9	C	29.7
WB RT/LT	--	--	--	--	D	40.5	D	37.3
WB LT	--	--	--	--	--	--	--	--
WB RT	--	--	--	--	--	--	--	--
Overall	--	--	--	--	*B*	*16.4*	*C*	*25.4*

Queen Kaahumanu Highway/Palani Road

The Queen Kaahumanu Highway northbound and southbound left-turn traffic will both operate at LOS F instead of LOS E during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway northbound through traffic will operate at LOS E instead of LOS D during both the weekday AM and PM peak hours of traffic. The Queen Kaahumanu Highway southbound traffic will operate at LOS E instead of LOS D during the weekday PM peak hour of traffic. The Palani Road eastbound left-turn traffic will operate at LOS E instead of LOS D during the weekday AM peak hour of traffic and at LOS F instead of LOS E during the PM peak hour of traffic. The westbound left-turn traffic and through traffic will operate at LOS F instead of LOS E during the weekday PM peak hour of traffic. The overall intersection, however, will operate at LOS E instead of LOS D during both the weekday AM and PM peak hours of traffic.

2. Year 2009 Traffic Mitigation Measures

Queen Kaahumanu Highway/Palani Road

The Palani Road eastbound left-turn traffic is projected to have a demand of approximately 315 vehicles. Two dedicated left-turn lanes are recommended for this approach. With the recommended improvement, individual intersection traffic movements will operate at LOS E or better during the weekday AM and PM peak hours of traffic. The overall intersection will operate at LOS D during both the weekday AM and PM peak hours of traffic.

The results of the intersection analyses for traffic conditions resulting from Phase I and Phase II development are in Table 13.

Table 13
Future Year 2009 with Phase I and Phase II
with Northern Project Access Road
Level of Service Summary

	Base Year 2009 Without Project-Generated Traffic				Future Year 2009 With Phase I and II Project				Future Year 2009 With Phase I and II Project Mitigation Measures			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway												
NB LT	A	7.9	A	7.8	A	8.2	A	8.2	–	–	–	–
EB LT/RT	B	10.7	B	11	B	13.5	B	13	–	–	–	–
Kaiminani Drive/Mamalahoa Highway												
NB LT	D	50.6	C	29.3	D	52.7	C	26.5	–	–	–	–
NB TH	A	1.9	A	5.8	A	2.1	A	5.7	–	–	–	–
SB RT/TH	C	30.4	B	16.7	C	32.8	B	16.3	–	–	–	–
EB LT	D	54.6	C	27.8	D	54.6	C	28.3	–	–	–	–
EB RT	D	47.1	B	17.3	D	54.6	B	18.9	–	–	–	–
Overall	*C*	*28.4*	*B*	*14.3*	*C*	*31.0*	*B*	*14.3*	–	–	–	–
Palani Road/Queen Kaahumanu Highway												
NB LT	D	52.1	E	65.2	F	205.9	F	279.1	D	52.1	E	64.3
NB TH	D	46.8	D	47.0	F	129.5	F	199.3	D	41.3	D	52
NB RT	C	20.7	C	20.8	B	15.5	B	16.9	B	17.2	B	12
SB LT	D	50.7	E	60.8	F	205.69	F	279.1	D	52.1	E	69.3
SB TH	C	31.8	D	52.7	C	31.2	F	128.1	C	28.1	D	46.9
SB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB LT	D	54.1	E	62.9	F	185.9	F	200.3	E	56	E	69.6
EB TH	C	24.5	C	34.6	D	49.2	E	59	C	29	D	48.4
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	D	52.6	E	64.2	F	116.0	F	252.8	D	53.6	D	42.8
WB TH	D	47.4	E	61.2	F	182.7	F	234.9	D	46.2	E	66.5
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*D*	*43.3*	*D*	*52.4*	*F*	*120.3*	*F*	*178.8*	*D*	*40.6*	*D*	*54.2*
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	B	17.1	B	19.2	B	18	C	31.6	–	–	–	–
NB RT	A	2.6	A	8	A	2.3	A	6.5	–	–	–	–
SB LT	C	24.4	C	20.2	C	29.9	C	31.6	–	–	–	–
SB TH	A	6.4	A	4.2	A	6.2	A	4.3	–	–	–	–
WB LT	C	22.5	C	26.2	C	24.7	C	29.7	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*B*	*14.0*	*B*	*11.9*	*B*	*15*	*B*	*18.8*	–	–	–	–
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	16	C	24.2	B	19.3	C	30.2	–	–	–	–
NB TH	A	3.6	A	3.3	A	3.5	A	3.1	–	–	–	–
NB RT	–	–	–	–	–	–	–	–	–	–	–	–
NB RT/TH	–	–	–	–	–	–	–	–	–	–	–	–
SB LT	–	–	–	–	–	–	–	–	–	–	–	–
SB TH	B	19.4	B	14.7	B	17.6	B	16.7	–	–	–	–
SB RT	A	8.6	A	3.5	A	7	A	2.8	–	–	–	–
EB LT	C	23.8	C	25.3	C	24.9	C	31.4	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB TH/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	–	–	–	–	–	–	–	–	–	–	–	–
WB TH/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*B*	*11.2*	*B*	*12.2*	*B*	*11*	*B*	*12.9*	–	–	–	–
Northern Project AccessRoad/Queen Kaahumanu Highway												
NB TH	–	–	–	–	C	33.0	D	45.9	–	–	–	–
NB RT	–	–	–	–	A	3.1	A	7.7	–	–	–	–
SB LT	–	–	–	–	D	37.3	E	71.7	–	–	–	–
SB TH	–	–	–	–	A	5.3	D	48.1	–	–	–	–
WB RT/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	–	–	–	–	C	34.1	E	69.3	–	–	–	–
WB RT	–	–	–	–	B	15.8	C	29.1	–	–	–	–
Overall	–	–	–	–	*B*	*21.5*	*D*	*45.2*	–	–	–	–

C. **Phase III- Year 2010**

1. **Year 2010 Traffic Condition Analysis**

Queen Kaahumanu Highway/Northern Project Access Road

The intersection configuration will remain the same as Year 2009 (Phase II) intersection configuration.

The Queen Kaahumanu Highway northbound through traffic will operate at LOS E during both the weekday AM and PM peak hours of traffic. The Queen Kaahumanu Highway southbound through traffic will operate at LOS E during the weekday PM peak hour of traffic. In addition, the Queen Kaahumanu Highway southbound through traffic will experience over-capacity conditions during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway southbound and the Northern Project Access Road westbound left-turn traffic will operate at LOS E during both the weekday AM and PM peak hours of traffic.

Overall intersection or individual intersection traffic movements at all other intersection will operate at LOS D or better except at the following locations:

Queen Kaahumanu Highway/Palani Road

The Queen Kaahumanu Highway northbound and southbound left-turn traffic will both operate at LOS E instead of LOS D during the weekday AM peak hour of traffic and remain at LOS E during the weekday PM peak hour of traffic. The Queen Kaahumanu Highway northbound through traffic will operate at LOS E instead of LOS D during the PM peak hour of traffic, and the southbound traffic will remain at LOS E during the weekday PM peak hour of traffic. The Palani Road eastbound and westbound left-turn traffic will both operate at LOS E instead of LOS D during the weekday AM peak hour of traffic and remain at LOS E during the weekday PM peak hour of traffic. The Palani Road eastbound through traffic will operate at LOS E instead of LOS C during the weekday PM peak hour of traffic. The Palani Road westbound through traffic will operate at LOS E instead of LOS D during the weekday AM peak hour of traffic and remain at LOS E during the weekday PM peak hour of traffic. Overall, the intersection will remain at LOS D during the weekday AM peak hour of traffic and at LOS E during the weekday PM peak hour of traffic.

2. Year 2010 Mitigative Measures

Queen Kaahumanu Highway/Northern Project Access Road

The widening of Queen Kaahumanu Highway from two lanes to four lanes between Keahole Airport Road and Waimea Road is recommended in the May 1998, Hawaii Long Range Land Transportation Plan. Should the widening be implemented, the Queen Kaahumanu Highway/Northern Project Access Road intersection will improve and operate at overall LOS B during both the AM and PM peak hours of traffic.

The intersection LOS resulting from the Project are summarized in Table 14.

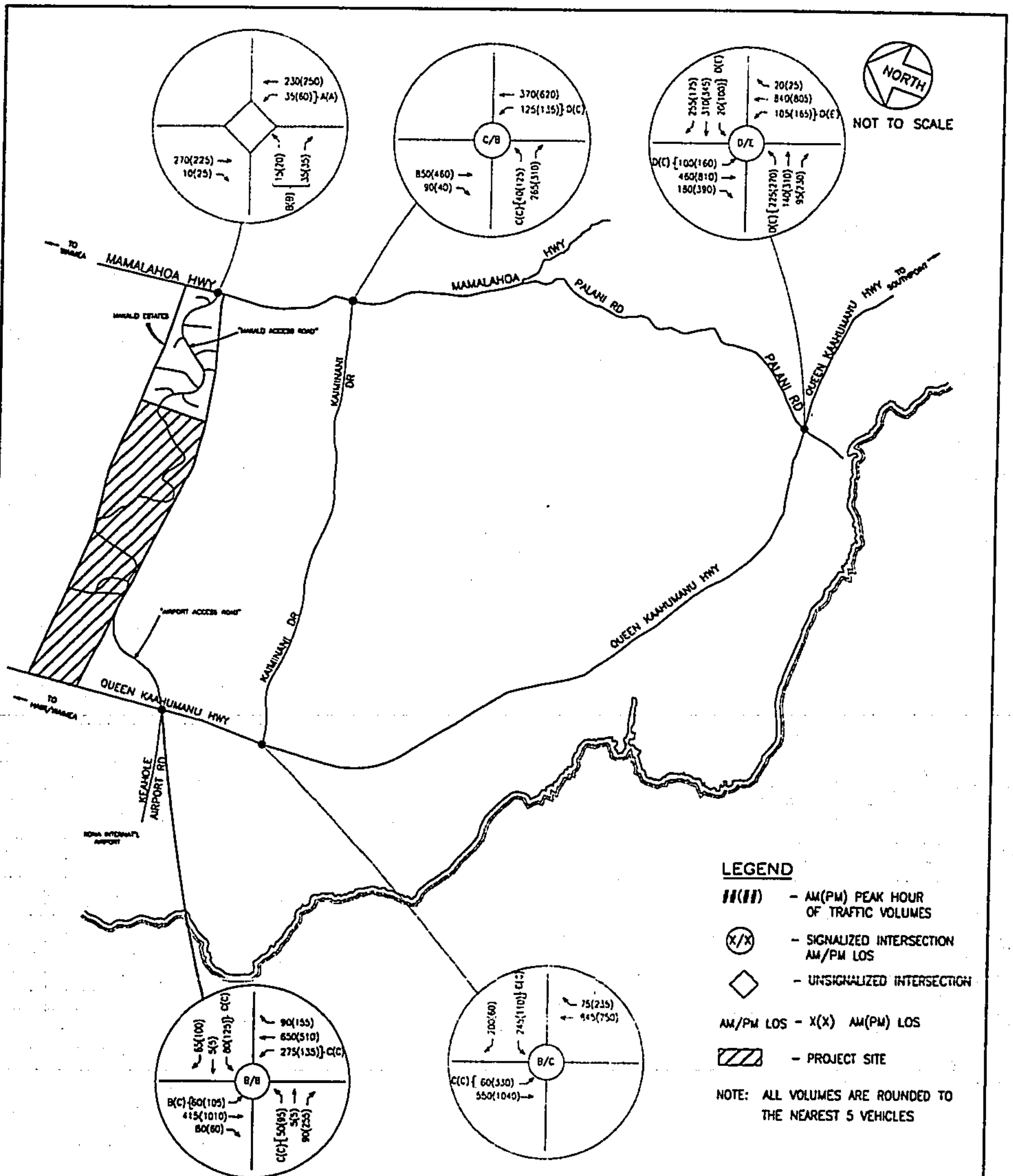
VI. FUTURE TRAFFIC CONDITIONS WITH PROJECT-GENERATED TRAFFIC WITH THE AIRPORT ACCESS ROAD ALTERNATIVE

The Project may construct an alternative access point (Airport Access Road) on to Queen Kaahumanu Highway in lieu of the Northern Project Access Road. The alternative access would construct the fourth leg at the Queen Kaahumanu Highway/Keahole Airport Road intersection.

The intersection analyses for the other study intersection will remain the same no matter which access point on Queen Kaahumanu Highway is chosen. Figures 17 through 19 shows the Project traffic, with addition to their respective base year traffic volumes of the three phases of development and LOS with the Airport Access Road alternative.

Table 14
Future Year 2010 with Phase I, II, and III
with Northern Project Access Road
Level of Service Summary

	Base Year 2010 Without Project-Generated Traffic				Future Year 2010 With Phase I, II, and III Project				Future Year 2010 With Phase I, II, and III Project Mitigative Measures			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway												
NB LT	A	8	A	8	A	8.3	A	8.4	–	–	–	–
EB LT/RT	B	12.2	B	11.4	B	14.7	C	17.6	–	–	–	–
Kaiminani Drive/Mamalahoa Highway												
NB LT	D	52.7	C	27.5	D	52.7	C	26.5	–	–	–	–
NB TH	A	1.9	A	5.6	A	2	A	6.5	–	–	–	–
SB RT/TH	D	37.1	B	17.8	D	41.4	B	18.1	–	–	–	–
EB LT	D	54.6	C	29.1	E	56.2	C	29.1	–	–	–	–
EB RT	D	49.4	B	17.3	E	62.5	C	20.2	–	–	–	–
Overall	*C*	*32.4*	*B*	*14.4*	*D*	*36.4*	*B*	*15.2*	–	–	–	–
Palani Road/Queen Kaahumanu Highway												
NB LT	D	52.1	E	68.1	E	65.6	E	75.2	–	–	–	–
NB TH	D	48.2	D	50.8	D	44.9	E	64.6	–	–	–	–
NB RT	C	20.1	C	20.8	B	19.8	B	15.6	–	–	–	–
SB LT	D	50.7	E	60.8	E	67.1	E	75.2	–	–	–	–
SB TH	C	31.3	E	59.3	C	32.1	E	55.9	–	–	–	–
SB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB LT	D	54.1	E	62.9	E	68.9	E	78.9	–	–	–	–
EB TH	C	25.2	C	34.6	D	36.4	E	56.8	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	D	52.6	E	64.2	E	68.2	E	56.1	–	–	–	–
WB TH	D	50.8	E	61.2	E	58.6	E	71.6	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*D*	*44.2*	*E*	*55.4*	*D*	*47.4*	*E*	*63.8*	–	–	–	–
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	B	17.8	B	19.8	C	20.4	C	34.5	–	–	–	–
NB RT	A	2.6	A	8	A	2.4	A	8.3	–	–	–	–
SB LT	C	24.4	C	20.2	C	29.6	C	34.7	–	–	–	–
SB TH	A	6.4	A	4.3	A	6.0	A	4.4	–	–	–	–
WB LT	C	22.5	C	26.2	C	26.9	C	34.9	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*B*	*14.3*	*B*	*12.0*	*B*	*16.2*	*B*	*19.8*	–	–	–	–
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	16.9	C	26.5	B	19.3	D	43.7	–	–	–	–
NB TH	A	3.6	A	3	A	3.7	A	3.5	–	–	–	–
NB RT	–	–	–	–	–	–	–	–	–	–	–	–
NB RT/TH	–	–	–	–	–	–	–	–	–	–	–	–
SB LT	–	–	–	–	–	–	–	–	–	–	–	–
SB TH	B	18.6	B	14.6	B	18.6	C	20.1	–	–	–	–
SB RT	A	8	A	3.2	A	7	A	3.4	–	–	–	–
EB LT	C	23.8	C	27.1	C	24.9	D	46.3	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB TH/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	–	–	–	–	–	–	–	–	–	–	–	–
WB TH/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*B*	*11.1*	*B*	*12.3*	*B*	*11.3*	*B*	*15.8*	–	–	–	–
Northern Project AccessRoad/Queen Kaahumanu Highway												
NB TH	–	–	–	–	E	56.4	E	67.1	C	25.3	C	32.8
NB RT	–	–	–	–	A	6.5	A	9.0	A	6.6	A	7.6
SB LT	–	–	–	–	E	58.8	E	79.5	C	28.8	D	37.3
SB TH	–	–	–	–	C	32.2	E	79.0	A	7	B	11.6
WB RT/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	–	–	–	–	E	74.0	E	79.3	C	30.4	C	34.3
WB RT	–	–	–	–	C	20.1	C	23.2	A	7.7	A	7
Overall	–	–	–	–	*D*	*41.5*	*E*	*61.9*	B	15.9	B	19.9

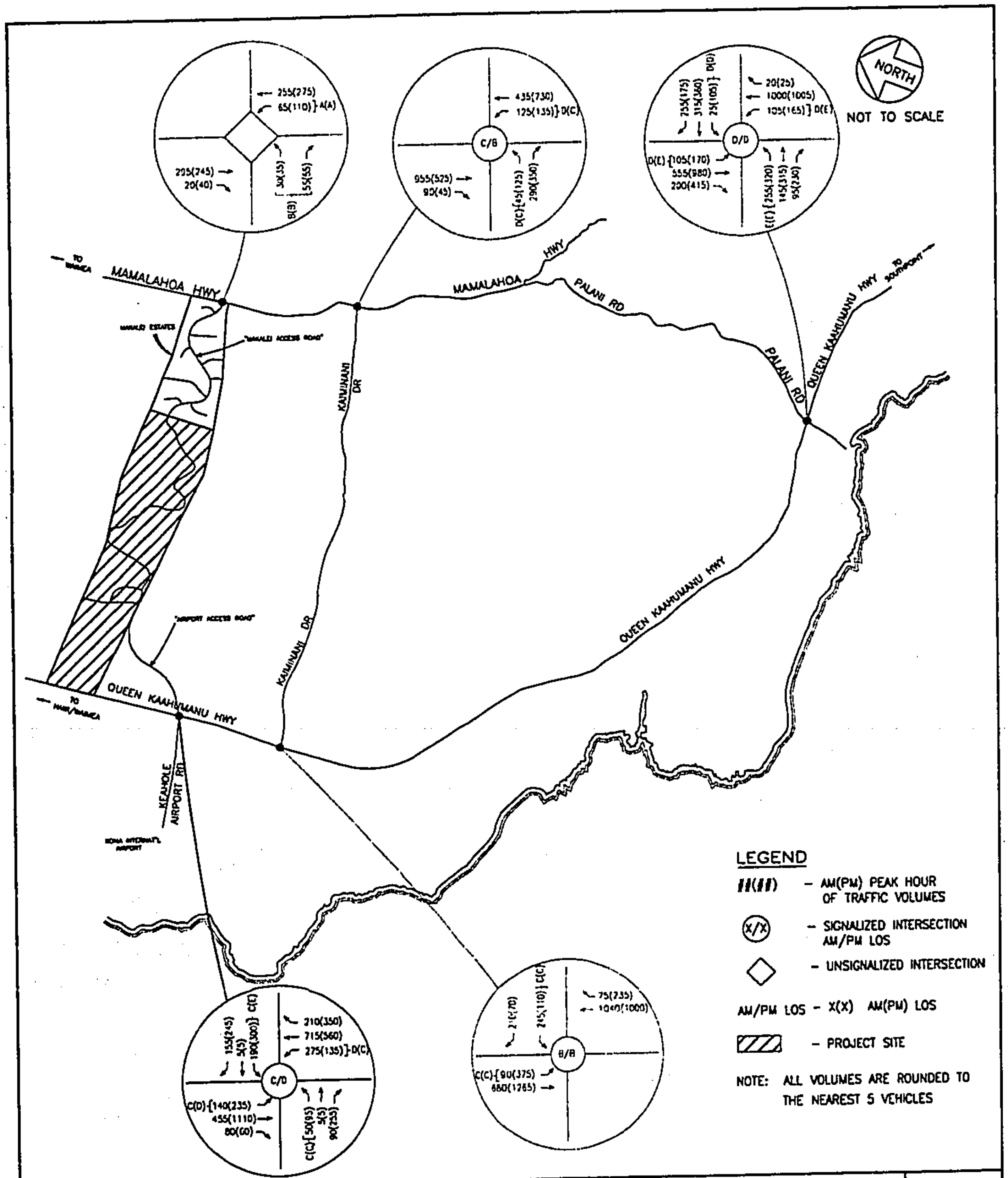


HILUHILU DEVELOPMENT

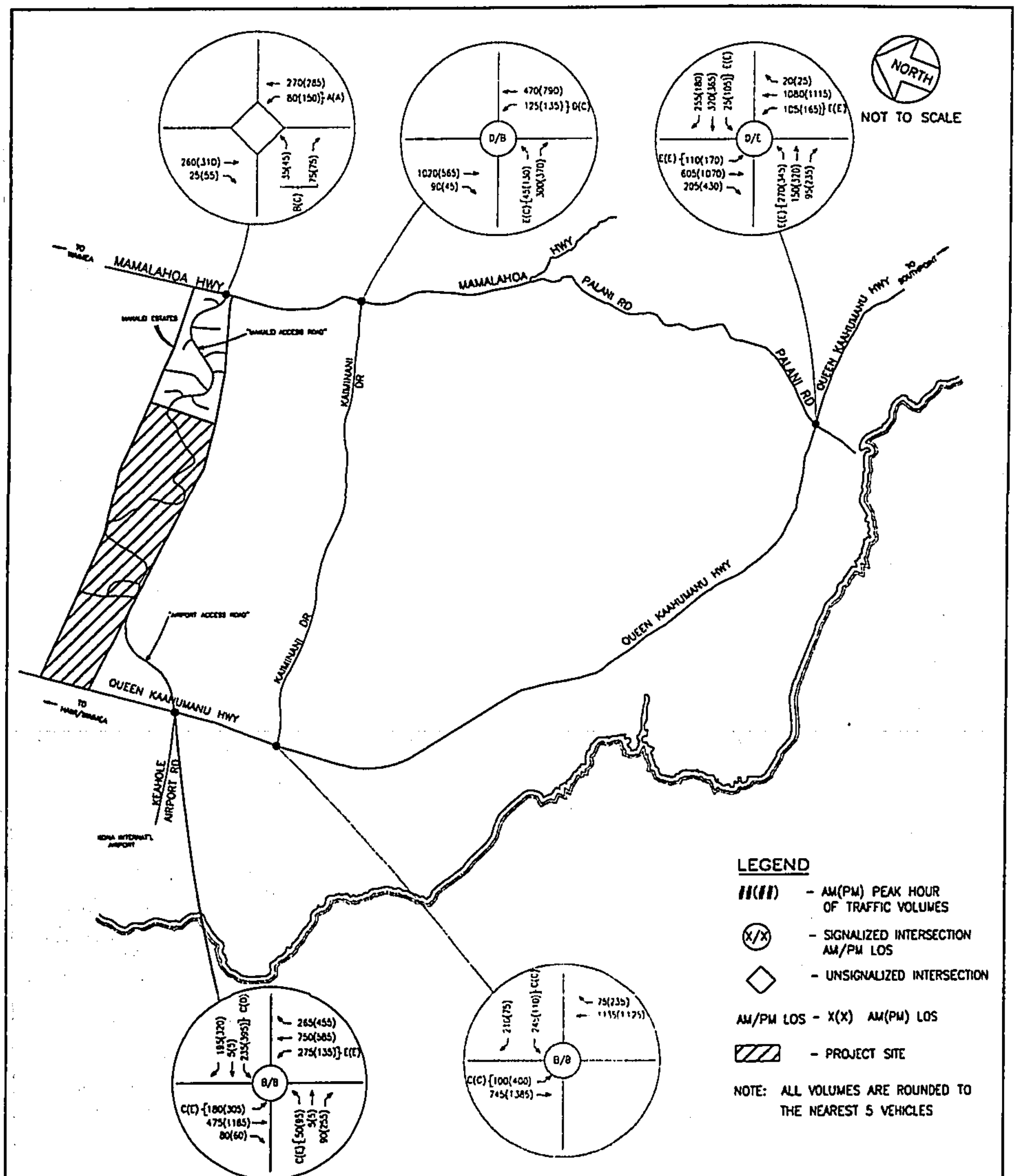
AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS HONOLULU, HAWAII

FUTURE YEAR 2007 ALTERNATIVE PROJECT ACCESS WITH PHASE I

FIGURE 17



HILUHILU DEVELOPMENT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS HONOLULU, HAWAII	FIGURE
	FUTURE YEAR 2009 ALTERNATIVE PROJECT ACCESS WITH PHASE I AND II	18



HILUHILU DEVELOPMENT

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS HONOLULU, HAWAII

FUTURE YEAR 2010 ALTERNATIVE PROJECT ACCESS WITH PHASE I, II, AND III

FIGURE 19

A. **Phase I - Year 2007**

1. **Year 2007 Traffic Condition Analysis**

<u>Queen Kaahumanu Highway/Keahole Airport Road/Airport Access Road</u>

The following intersection configurations are recommended:

- Northbound approach – one exclusive left-turn lane, one through lane, and one shared right/through lane.
- Southbound approach – one exclusive left-turn lane, two through lanes, and one right-turn lane.
- Eastbound approach – one shared through/left-turn lane, and a right-turn lane connecting to a southbound acceleration lane forming a "free" right-turn lane.
- Westbound approach – one right-turn lane and one shared through/left-turn lane.

With the above intersection configurations, individual intersection traffic movements will operate at LOS C or better during the AM and PM peak hour of traffic. Overall, the intersection will operate at LOS B during both the weekday AM and PM peak hours of traffic.

The intersection LOS for traffic conditions resulting from Phase I development with the Airport Access Road alternative is summarized in Table 15.

B. **Phase II - Year 2009**

1. **Year 2009 Traffic Condition Analysis**

<u>Queen Kaahumanu Highway/Keahole Airport Road/Airport Access Road</u>

The intersection configuration will remain the same as Year 2007 (Phase I) intersection configuration.

Overall, the intersection will operate at LOS C during the weekday AM peak hour of traffic and at LOS D during the weekday PM peak hour of traffic.

The intersection LOS resulting from Phase I and Phase II development with the Airport Access Road alternative is summarized in Table 16.

Table 15
Future Year 2007 with Phase I Project
with Airport Access Road Alternative
Level of Service Summary

	Base Year 2007 Without Project-Generated Traffic				Future Year 2007 With Phase I Project				Future Year 2007 With Airport Access Road Alternative			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway												
NB LT	A	8	A	7.9	A	8	A	8	--	--	--	--
EB LT/RT	B	11.7	B	11.3	B	11.6	B	12.0	--	--	--	--
Kaiminani Drive/Mamalahoa Highway												
NB LT	D	49	C	27.5	D	46.8	C	27.5	--	--	--	--
NB TH	A	2	A	5.2	A	2.2	A	5.4	--	--	--	--
SB RT/TH	C	24	B	16.4	C	33.2	B	16.7	--	--	--	--
EB LT	D	53.3	C	27.8	C	28.8	C	28.4	--	--	--	--
EB RT	D	43.4	B	16.4	C	28.1	B	17.1	--	--	--	--
Overall	*C*	*24.7*	*B*	*14.0*	*C*	*26.7*	*B*	*14.3*	--	--	--	--
Palani Road/Queen Kaahumanu Highway												
NB LT	D	52.1	E	65.2	D	52.1	E	66.7	--	--	--	--
NB TH	D	40.8	D	43.1	D	48.9	D	53.4	--	--	--	--
NB RT	C	20.7	C	20.8	C	21.3	C	20.2	--	--	--	--
SB LT	D	50.7	E	60.8	D	50.7	E	63.8	--	--	--	--
SB TH	C	31.3	D	46	C	32.7	D	54.4	--	--	--	--
SB RT	--	--	--	--	--	--	--	--	--	--	--	--
EB LT	D	54.1	E	62.9	D	54.2	E	67.0	--	--	--	--
EB TH	C	24.5	C	34.4	C	23.8	C	30.7	--	--	--	--
EB RT	--	--	--	--	--	--	--	--	--	--	--	--
WB LT	D	52.6	E	64.2	D	52.6	E	70.8	--	--	--	--
WB TH	D	47.4	E	61.2	D	48.2	E	64.0	--	--	--	--
WB RT	--	--	--	--	--	--	--	--	--	--	--	--
Overall	*D*	*41*	*D*	*49.7*	*D*	*44.4*	*E*	*55.4*	--	--	--	--
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	B	17.0	B	19.4	B	17.1	C	33.7	--	--	--	--
NB RT	A	2.6	A	8.6	A	2.6	B	10.7	--	--	--	--
SB LT	C	24.4	B	18.8	C	25.3	C	34.0	--	--	--	--
SB TH	A	6.7	A	4.0	A	6.4	A	7.8	--	--	--	--
WB LT	C	20.8	C	26.2	C	22.5	C	34.9	--	--	--	--
WB RT	--	--	--	--	--	--	--	--	--	--	--	--
Overall	*B*	*13.9*	*B*	*11.8*	*B*	*14.2*	*C*	*20.7*	--	--	--	--
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	16.0	C	24.2	B	16.9	C	26.5	C	22.6	C	26.5
NB TH	A	3.5	A	3.3	A	3.6	A	3.2	--	--	--	--
NB RT	--	--	--	--	--	--	--	--	--	--	--	--
NB RT/TH	--	--	--	--	--	--	--	--	B	19.5	B	14.2
SB LT	--	--	--	--	--	--	--	--	B	16.9	C	24.4
SB TH	B	18.9	B	14.7	B	19.1	B	14.6	B	15.5	B	19
SB RT	A	8.6	A	3.5	A	8	A	3.2	B	14.3	B	11.4
EB LT	C	23.8	C	25.3	C	23.8	C	27.1	--	--	--	--
EB RT	--	--	--	--	--	--	--	--	--	--	--	--
EB TH/LT	--	--	--	--	--	--	--	--	C	23.8	C	22.7
WB LT	--	--	--	--	--	--	--	--	--	--	--	--
WB TH/LT	--	--	--	--	--	--	--	--	C	25.3	C	24.4
WB RT	--	--	--	--	--	--	--	--	A	7.9	B	10.5
Overall	*B*	*11.1*	*B*	*12.4*	*B*	*11.4*	*B*	*11.9*	*B*	*18.7*	*B*	*18.2*
Northern Project AccessRoad/Queen Kaahumanu Highway												
NB TH	--	--	--	--	B	18.0	B	17.5	--	--	--	--
NB RT	--	--	--	--	A	201	A	2.5	--	--	--	--
SB LT	--	--	--	--	D	46.2	C	34.9	--	--	--	--
SB TH	--	--	--	--	A	5.9	C	29.7	--	--	--	--
WB RT/LT	--	--	--	--	D	40.5	D	37.3	--	--	--	--
WB LT	--	--	--	--	--	--	--	--	--	--	--	--
WB RT	--	--	--	--	--	--	--	--	--	--	--	--
Overall	--	--	--	--	*B*	*16.4*	*C*	*25.4*	--	--	--	--

Table 16
Future Year 2009 with Phase I and Phase II
with Airport Access Road Alternative
Level of Service Summary

	Base Year 2009				Future Year 2009 With Phase I and II Project and Recommended Improvements				Future Year 2009 Witih Aiport Access Alternative			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
Project Access/Mamalahoa												
NB LT	A	7.9	A	7.8	A	8.2	A	8.2	–	–	–	–
EB LT/RT	B	10.7	B	11	B	13.5	B	13	–	–	–	–
Kaiminani Drive/Mamalahoa Highway (signalized from Year 2007)												
NB LT	D	50.6	C	29.3	D	52.7	C	26.5	–	–	–	–
NB TH	A	1.9	A	5.8	A	2.1	A	5.7	–	–	–	–
SB RT/TH	C	30.4	B	16.7	C	32.8	B	16.3	–	–	–	–
EB LT	D	54.6	C	27.8	D	54.6	C	28.3	–	–	–	–
EB RT	D	47.1	B	17.3	D	54.6	B	18.9	–	–	–	–
Overall	*C*	*28.4*	*B*	*14.3*	*C*	*31.0*	*B*	*14.3*	–	–	–	–
Palani Road/Queen Kaahumanu Highway												
NB LT	D	52.1	E	65.2	D	52.1	E	64.3	–	–	–	–
NB TH	D	46.8	D	47.0	D	41.3	D	52	–	–	–	–
NB RT	C	20.7	C	20.8	B	17.2	B	12	–	–	–	–
SB LT	D	50.7	E	60.8	D	52.1	E	69.3	–	–	–	–
SB TH	C	31.8	D	52.7	C	28.1	D	46.9	–	–	–	–
SB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB LT	D	54.1	E	62.9	E	56	E	69.6	–	–	–	–
EB TH	C	24.5	C	34.6	C	29	D	48.4	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	D	52.6	E	64.2	D	53.6	D	42.8	–	–	–	–
WB TH	D	47.4	E	61.2	D	46.2	E	66.5	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*D*	*43.3*	*D*	*52.4*	*D*	*40.6*	*D*	*54.2*	–	–	–	–
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	B	17.1	B	19.2	B	18	C	31.6	–	–	–	–
NB RT	A	2.6	A	8	A	2.3	A	6.5	–	–	–	–
SB LT	C	24.4	C	20.2	C	29.9	C	31.6	–	–	–	–
SB TH	A	6.4	A	4.2	A	6.2	A	4.3	–	–	–	–
WB LT	C	22.5	C	26.2	C	24.7	C	29.7	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*B*	*14.0*	*B*	*11.9*	*B*	*15*	*B*	*18.8*	–	–	–	–
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	16	C	24.2	B	19.3	C	30.2	D	36	C	30.9
NB TH	A	3.6	A	3.3	A	3.5	A	3.1	–	–	–	–
NB RT	–	–	–	–	–	–	–	–	–	–	–	–
NB RT/TH	–	–	–	–	–	–	–	–	C	34.7	C	31.3
SB LT	–	–	–	–	–	–	–	–	C	22.7	D	50.4
SB TH	B	19.4	B	14.7	B	17.6	B	16.7	B	17.7	D	50.3
SB RT	A	8.6	A	3.5	A	7	A	2.8	B	15.9	B	17.7
EB LT	C	23.8	C	25.3	C	24.9	C	31.4	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB TH/LT	–	–	–	–	–	–	–	–	C	20.8	C	29.8
WB LT	–	–	–	–	–	–	–	–	–	–	–	–
WB TH/LT	–	–	–	–	–	–	–	–	C	32.4	E	58.6
WB RT	–	–	–	–	–	–	–	–	A	8.4	B	11.1
Overall	*B*	*11.2*	*B*	*12.2*	*B*	*11*	*B*	*12.9*	*C*	*27.7*	*D*	*40.3*
Project Access/Queen Kaahumanu Highway												
NB TH	–	–	–	–	C	33.0	D	45.9	–	–	–	–
NB RT	–	–	–	–	A	3.1	A	7.7	–	–	–	–
SB LT	–	–	–	–	D	37.3	E	71.7	–	–	–	–
SB TH	–	–	–	–	A	5.3	D	48.1	–	–	–	–
WB RT/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	–	–	–	–	C	34.1	E	69.3	–	–	–	–
WB RT	–	–	–	–	B	15.8	C	29.1	–	–	–	–
Overall	–	–	–	–	*B*	*21.5*	*D*	*45.2*	–	–	–	–

C. Phase III- Year 2010

1. Year 2010 Traffic Condition Analysis

Queen Kaahumanu Highway/Keahole Airport Road/Airport Access Road

The intersection configuration will be similar as Year 2009 (Phase II) intersection configuration except for the northbound and westbound approach. The following improvements to the northbound and westbound approach lane configurations are recommended:

- Northbound approach – one exclusive left-turn lane, two through lanes, and one exclusive right-turn lane.
- Westbound approach – one right-turn lane, one shared through/left-turn lane and one exclusive left-turn lane.

With the above improvements to the intersection, individual traffic movements will operate at LOS E or better during the weekday AM and PM peak hour of traffic. Overall, the intersection will operate at LOS C during the weekday AM peak hour of traffic and at LOS D during the PM peak hour of traffic.

The intersection LOS from Phase I to Phase III development with the Airport Access Road alternative is summarized in Table 17.

VII. CONCLUSIONS

A. Future Conditions without the Project

- Installation of a traffic signal system at the Mamalahoa Highway/Kaiminani Drive will most likely be warranted by Year 2007.
- Queen Kaahumanu Highway will operate at near capacity conditions for future base years without the Project. Roadway improvements such as widening Queen Kaahumanu Highway between Henry Street and Keahole Airport Road need to be considered to serve the future travel demands on Queen Kaahumanu Highway even without the Project. Without the widening or other roadway improvements, Queen Kaahumanu Highway and its intersection with Keahole Airport Road and Kaiminani Street will experience at capacity conditions without the Project. In addition, Queen Kaahumanu Highway at its intersection with Palani Road will experience over-capacity conditions without the Project.

Table 17
Future Year 2010 with Phase I, II, and III Project
with Airport Access Road Alternative
Level of Service Summary

	Base Year 2010 Without Project-Generated Traffic				Future Year 2010 With Phase I and II Project and Recommended Improvements				Future Year 2010 With Airport Access Road Alternative			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)
"Makalei Access Road"/Mamalahoa Highway												
NB LT	A	8	A	8	A	8.3	A	8.4	–	–	–	–
EB LT/RT	B	12.2	B	11.4	B	14.7	C	17.6	–	–	–	–
Kaiminani Drive/Mamalahoa Highway												
NB LT	D	52.7	C	27.5	D	52.7	C	26.5	–	–	–	–
NB TH	A	1.9	A	5.6	A	2	A	6.5	–	–	–	–
SB RT/TH	D	37.1	B	17.8	D	41.4	B	18.1	–	–	–	–
EB LT	D	54.6	C	29.1	E	56.2	C	29.1	–	–	–	–
EB RT	D	49.4	B	17.3	E	62.5	C	20.2	–	–	–	–
Overall	*C*	*32.4*	*B*	*14.4*	*D*	*36.4*	*B*	*15.2*	–	–	–	–
Palani Road/Queen Kaahumanu Highway												
NB LT	D	52.1	E	68.1	E	65.6	E	75.2	–	–	–	–
NB TH	D	48.2	D	50.8	D	44.9	E	64.6	–	–	–	–
NB RT	C	20.1	C	20.8	B	19.8	B	15.6	–	–	–	–
SB LT	D	50.7	E	60.8	E	67.1	E	75.2	–	–	–	–
SB TH	C	31.3	E	59.3	C	32.1	E	55.9	–	–	–	–
SB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB LT	D	54.1	E	62.9	E	68.9	E	78.9	–	–	–	–
EB TH	C	25.2	C	34.6	D	36.4	E	56.8	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	D	52.6	E	64.2	E	68.2	E	56.1	–	–	–	–
WB TH	D	50.8	E	61.2	E	58.6	E	71.6	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*D*	*44.2*	*E*	*55.4*	*D*	*47.4*	*E*	*63.8*	–	–	–	–
Kaiminani Drive/Queen Kaahumanu Highway												
NB TH	B	17.8	B	19.8	C	20.4	C	34.5	–	–	–	–
NB RT	A	2.6	A	8	A	2.4	A	8.3	–	–	–	–
SB LT	C	24.4	C	20.2	C	29.6	C	34.7	–	–	–	–
SB TH	A	6.4	A	4.3	A	6.0	A	4.4	–	–	–	–
WB LT	C	22.5	C	26.2	C	26.9	C	34.9	–	–	–	–
WB RT	–	–	–	–	–	–	–	–	–	–	–	–
Overall	*B*	*14.3*	*B*	*12.0*	*B*	*16.2*	*B*	*19.8*	–	–	–	–
Keahole Airport Road/Queen Kaahumanu Highway												
NB LT	B	16.9	C	26.5	B	19.3	D	43.7	E	59.8	E	70.7
NB TH	A	3.6	A	3	A	3.7	A	3.5	D	39.8	D	41.7
NB RT	–	–	–	–	–	–	–	–	A	9.5	B	17.4
NB RT/TH	–	–	–	–	–	–	–	–	–	–	–	–
SB LT	–	–	–	–	–	–	–	–	C	26.1	E	66.7
SB TH	B	18.6	B	14.6	B	18.6	C	20.1	C	20.9	E	55.9
SB RT	A	8	A	3.2	A	7	A	3.4	B	18.2	C	24.6
EB LT	C	23.8	C	27.1	C	24.9	D	46.3	–	–	–	–
EB RT	–	–	–	–	–	–	–	–	–	–	–	–
EB TH/LT	–	–	–	–	–	–	–	–	C	31.2	E	64.3
WB LT	–	–	–	–	–	–	–	–	C	23.5	D	38.4
WB TH/LT	–	–	–	–	–	–	–	–	C	23.7	D	38.7
WB RT	–	–	–	–	–	–	–	–	D	42.6	E	60.6
Overall	*B*	*11.1*	*B*	*12.3*	*B*	*11.3*	*B*	*15.8*	*C*	*32.1*	*D*	*48.2*
Northern Project AccessRoad/Queen Kaahumanu Highway												
NB TH	–	–	–	–	C	25.3	C	32.8	–	–	–	–
NB RT	–	–	–	–	A	6.6	A	7.6	–	–	–	–
SB LT	–	–	–	–	C	28.8	D	37.3	–	–	–	–
SB TH	–	–	–	–	A	7	B	11.6	–	–	–	–
WB RT/LT	–	–	–	–	–	–	–	–	–	–	–	–
WB LT	–	–	–	–	C	30.4	C	34.3	–	–	–	–
WB RT	–	–	–	–	A	7.7	A	7	–	–	–	–
Overall	–	–	–	–	*B*	*15.9*	*B*	*19.9*	–	–	–	–

B. Future Year Conditions with the Project

1. General

- The Palani Road eastbound left-turn traffic will require a double left-turn lane by Year 2009 with the Project to accommodate the future left-turn traffic demand.

2. With Northern Project Access Road

- The projected traffic volumes at the Queen Kaahumanu Highway/Northern Project Access Road will most likely warrant installation of a traffic signal system by Year 2007.
- The Queen Kaahumanu Highway northbound approach at the Northern Project Access Road will require one through lane and an exclusive right-turn lane by Year 2007.
- The Queen Kaahumanu Highway southbound approach at the Northern Project Access Road will require one through lane and an exclusive left-turn lane by Year 2007.
- The Northern Project Access Road westbound approach will require a single lane approach serving both the right-turn and left-turn traffic by Year 2007.
- The Northern Project Access Road westbound approach will require an exclusive right-turn lane and an exclusive left-turn lane by Year 2009.
- Queen Kaahumanu Highway would need to be widened from two-lanes to four-lanes between Keahole Airport Road and Northern Project Access Road by Year 2010 to alleviate over-capacity conditions at the Northern Project Access Road intersection.

3. With Airport Access Road Alternative

- If the Airport Access Road were to be pursued, the developer would need to resolve land acquisition issues to construct the portion of the alternative access road.

- The Queen Kaahumanu Highway/Keahole Airport Road intersection and would require signal phasing modification to accommodate the additional forth leg at the Queen Kaahumanu Highway/Keahole Airport Road/Airport Access Road intersection.
- The Queen Kaahumanu Highway northbound approach will require one exclusive left-turn lane, one through lane, and one shared right-turn/through lane by Year 2007.
- The Queen Kaahumanu Highway southbound approach will require one exclusive left-turn lane, one through lane, and one exclusive right-turn lane by Year 2007.
- The Keahole Airport Road eastbound approach will remain the same as its existing condition for Years 2007, 2009, and 2010.
- The Airport Access Road westbound approach will require one exclusive right-turn lane, and one shared through/left-turn lane by Year 2007.
- The Airport Access Road westbound approach will require one exclusive right-turn lane, and one shared through/left-turn lane and one exclusive left-turn lane by Year 2010.

VIII. RECOMMENDATIONS

A. Future Conditions without the Project

- Widen Queen Kaahumanu Highway to four-lanes between Henry Street and Keahole Airport Road to relieve the projected traffic demand at the study intersections even without the Project. Near capacity conditions are exhibited today and are projected for future conditions without the Project.
- Monitor vehicular traffic volumes at the Mamalahoa Highway/Kaiminani Drive intersection, and install a traffic signal system when warranted.

B. Future Conditions with the Project

1. General

- Construct a double left-turn lane at the Palani Road eastbound approach at its intersection with Queen Kaahumanu Highway by Year 2009.

2. With Northern Project Access Road

- Widen Queen Kaahumanu Highway to four lanes between the Keahole Airport Road and the Northern Project Access Road by Year 2010.

<u>Queen Kaahumanu Highway/Northern Project Access Road intersection</u>

- Install a traffic signal system at the Queen Kaahumanu Highway/Northern Project Access Road intersection by Year 2007 when warranted.
- Provide an exclusive left-turn lane for the Queen Kaahumanu Highway southbound approach by the first Project occupancy.
- Provide a right-turn deceleration lane for the Queen Kaahumanu Highway northbound approach by the first Project occupancy.
- Provide a single lane approach for the Northern Project Access Road eastbound approach by the first Project occupancy.
- Provide an exclusive right-turn lane and a separate left-turn lane for the Northern Project Access Road by Year 2009.

3. With Airport Access Road Alternative

- Modify the traffic signal system at the Queen Kaahumanu Highway/Keahole Airport Road for the Airport Access Road intersection.
- Provide an exclusive left-turn lane for the Queen Kaahumanu Highway southbound approach by the first Project occupancy.

- Provide an exclusive right-turn lane and a shared through/left-turn lane for the Airport Access Road approach by the first Project occupancy.
- Provide an exclusive right-turn lane, a shared through/left-turn lane, and an exclusive left-turn lane for the Airport Access Road approach by Year 2010.
- Provide a northbound right-turn deceleration lane for the Queen Kaahumanu Highway approach by Year 2010.

REFERENCES

1. Fredric R. Harris, Inc., Hawaii Long Range Land Transportation Plan, 1998.

2. Institute of Transportation Engineers, Trip Generation - 6th Edition, 1997.

3. State of Hawaii, Department of Transportation, Highways Division, Planning Branch, Traffic Count Data.

4. State of Hawaii, Department of Transportation, Highways Division, Planning Branch, Traffic Summary – Island of Hawaii 2002.

5. Transportation Research Board, Highway Capacity Manual – HCM 2000, Special Report 209, 2000.

6. U.S. Department of Transportation, Federal Highway Administration, MUTCD 2000 – Manual on Uniform Traffic Control Devices – Millennium Edition, December 2000, amended June 2001.

Appendix F
Air Quality

DRAFT

AIR QUALITY STUDY

FOR THE PROPOSED

HILUHILU PROJECT

KAU, NORTH KONA, HAWAII

Prepared for:

Roger Harris Planning

July 2003

B.D. NEAL & ASSOCIATES

*Applied Meteorology * Air Quality * Computer Science*

P.O. BOX 1808 * KAILUA-KONA, HAWAII 96745 * TELEPHONE (808) 329-1627 * FAX (808) 331-8428

EMAIL: bdneal@kona.net

CONTENTS

FIGURES

TABLES

TABLES (cont.)

Table

1.0 SUMMARY

Hiluhilu Development Company, LLC is proposing to develop the Hiluhilu Project on 725 acres of predominantly vacant land located in the North Kona District on the island of Hawaii. The proposed project will consist of a 120-unit hotel, 765 single-family homes, an 18-hole golf course, 220,000 square feet of commercial and office space, and other related facilities. Development of the project is expected to be completed and fully occupied by 2010. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are more stringent than the comparable national standards except for those pertaining to sulfur dioxide and particulate matter.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its near coastal situation and by nearby mountains. Winds are predominantly light and variable, although kona storms generate occasional strong winds from the south or southwest during winter. Temperatures in the project area are generally very consistent and moderate with average daily temperatures ranging from about 65°F to

85°F. The extreme minimum temperature recorded at the nearby Old Kona Airport is 47°F, while the extreme maximum temperature is 93°F. Average annual rainfall in the area amounts to about 25 inches with each month typically contributing about 2 inches.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. The limited air quality data that are available for the area from the Department of Health indicate that (despite the vog) concentrations are well within state and national air quality standards.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at intersections in the project vicinity and to predict future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are probably well within both the state and the national ambient air quality standards. In the year 2010 without the project, carbon monoxide concentrations were predicted to decrease despite the expected increase in ambient traffic volumes. This is because older vehicles that emit more air pollution will be retired during the intervening years. With the project in the year 2010, carbon monoxide concentrations were estimated to increase by about 20 to 30 percent in the project area compared to the without project case, but concentrations would still likely remain equal to or lower than the existing levels. Implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but based on the estimated demand levels and emission rates involved, any significant impacts are unlikely. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts and conserve the island's resources.

2.0 INTRODUCTION

Hiluhilu Development Company, LLC is proposing to develop the Hiluhilu Project on approximately 725 acres of land in the North Kona District on the island of Hawaii (see Figure 1 for project location). The proposed development is a master planned community that includes a 120-unit hotel, 765 single-family residential units, elderly housing, an 18-hole golf course and clubhouse, 80,000 square feet of research and development area, 80,000 square feet of commercial space, 60,000 square feet of medical facilities, a mixture of classrooms and teaching labs, and other associated facilities. The site of the proposed development is approximately 1.5 miles north of Kona International Airport along the mauka side of Queen Kaahumanu Highway. The project site is bordered by Queen Kaahumanu Highway on the west, Makalei Estates on the east, and the future University of Hawaii West Hawaii Campus to the south. Presently, the majority of the project site is vacant land. Construction of the project is expected to be completed in three phases with full development and occupancy by 2010.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate impacts either by the project or on the project are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit, and the state 1-hour limit for ozone is more than two times as stringent as the national 1-hour standard. The U.S. Environmental Protection Agency (EPA) is currently working on a plan to phase out the national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and at this time, it is expected that the new standards for particulate will be implemented by 2005. To date, the Hawaii Department of Health has not updated the state particulate standards.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The site of the proposed project is located near the midpoint of the western coast of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach some areas to the lee. Due to wind shadow effects caused by the terrain, winds in the project area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds that move downslope and out to sea. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location results in a larger temperature profile compared to windward locations at the same elevation. At the Old Kona Airport, located a few miles south of the project site, average daily minimum and maximum temperatures are 67°F and 83°F, respectively [1]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the project site are very similar.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kona area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the mountainous interior of the island. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is wetter than might be expected for a leeward location. This is due to the persistent onshore and upslope movement of marine air caused by both eddie and seabreeze or mountain slope effects. Some of the rainfall occurs during summer afternoons and evenings as a result of this onshore and upslope movement of moisture-laden marine air, and some occurs in conjunction with winter storms. At the Old Kona Airport, average annual rainfall amounts to about 25 inches with each month registering about 2 inches [1]. Rainfall at the project site is probably somewhat lower than this amount.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Hawaii for calendar year 1993. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources.

It should be noted that Hawaii Island is unique from the other islands in the state in terms of the natural volcanic air pollution emissions that occur. Volcanic emissions periodically plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Although emissions from Kilauea are vented on the other side of a mountain barrier more than 50 miles east of the project site, the prevailing wind patterns eventually carry some of the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area.

The major industrial source of air pollution in the project vicinity is Hawaii Electric Light Company's Keahole Power Plant, which is located about 1.5 miles to the south. Air pollution emissions from Keahole Power Plant consist mostly of sulfur dioxide and oxides of nitrogen.

Queen Kaahumanu Highway, which borders the project site on the makai side, is the region's major arterial roadway. Downslope winds during the morning will tend to carry emissions from motor vehicles traversing this roadway away from the project area, while afternoon onshore winds will carry emissions toward the project.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very limited data are available for Hawaii Island, and even less data are available for the Kona area specifically. During 1997, the Department of Health established an air quality monitoring site in the Kealakekua area (approximately 20 miles south of the project site) for measuring particulate matter and sulfur dioxide, but only data for calendar years 1999, 2000 and 2001 have been published to date for this site. As indicated in Table 3, measurements of sulfur dioxide concentrations at this location during the 1999-2001 monitoring period were consistently low with annual average concentrations of 6 to 8 $\mu g/m^3$, which represents about 10 percent of the state and national standard. The highest annual second-highest 3-hour and 24-hour concentrations (which are most relevant to the standards) for these three years were 49 and 20 $\mu g/m^3$, respectively; these are less than 5 percent of the applicable standards. No exceedances of the state/national 3-hour and 24-hour AAQS for sulfur dioxide were recorded. The annual average particulate concentration for 1999 was 15 $\mu g/m^3$, which equates to about 30 percent of the state/national standard. The second-highest 24-hour concentration of particulate matter, 27 $\mu g/m^3$, is about 18 percent of the state/national standard, and there were no violations of the state/national AAQS during the 1999 monitoring period. Monitoring of particulate matter was discontinued at this site during June 2000.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the state. Ozone concentrations, on the other hand, have been found to exceed the state standard at times at Sand Island on Oahu. Carbon monoxide air pollution typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project sites, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 30 to 40 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, three scenarios were selected for the carbon monoxide modeling study: (1) year 2003 with present conditions, (2) year 2010 without the project, and (3) year 2010 with the project. Year 2010 is when full development and occupancy is expected to be achieved. To begin the modeling study of the three scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, the four key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Queen Kaahumanu Highway at Palani Road;
- Queen Kaahumanu Highway at Kaiminani Drive;
- Queen Kaahumanu Highway at Keahole Airport Road;
- Queen Kaahumanu Highway at the northern project access road.

The traffic impact assessment report for the project [4] describes the projected future traffic conditions and laneage configurations of these intersections in detail.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 45.0% light-duty gasoline-powered automobiles, 42.3% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.3% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6 based on assumed free-flow vehicle speeds corresponding to the posted speed limits (25 to 45 mph depending on location).

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.5 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.5 ppm to all predicted concentrations for 2003. Although increased traffic is expected to occur within the project area within the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 summarizes the results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 2003 with existing traffic, year 2010 without the project and year 2010 with the project. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2003) case was 5.9 mg/m^3. This was projected to occur during the morning peak traffic hour near the intersection of Queen Kaahumanu Highway and Palani Road. Concentrations at other locations and times studied were 5.1 mg/m^3 or lower. All predicted worst-case 1-hour concentrations for the 2003 scenario were well within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2010 without the proposed project, the predicted worst-case concentrations decreased by about 15 to 25 percent compared to the existing case. This was due to the decrease in emissions that is expected to occur over the next several years, which is the result of older motor vehicles being retired. For the 2010 without project scenario, the highest worst-case 1-hour concentration was again predicted to occur during the morning at the intersection of Queen Kaahumanu Highway and Palani Road. A value of 5.1 mg/m^3 was predicted to occur at this location. Peak-hour worst-case values at the other locations and times studied for the 2010 without project scenario ranged between 2.4 and 3.7 mg/m^3. All projected worst-case concentrations for this scenario remained within the state and national standards.

Predicted 1-hour worst-case concentrations for the 2010 with project scenario were about 20 to 30 percent higher compared to the 2010 without project case but still lower than or not significantly different from the existing scenario. Similar to the other scenarios studied, the highest worst-case concentration was predicted to occur during the morning at the intersection of Queen Kaahumanu Highway and Palani Road. The highest concentration at this location and time was 5.5 mg/m^3. The highest concentrations at other locations and times studied ranged between 3.2 and 5.2 mg/m^3. All predicted worst-case 1-hour concentrations for the 2010 with project scenario were well within both the national and the state AAQS.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2003 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the three locations studied ranged from 2.2 mg/m^3 both at Queen Kaahumanu Highway at Keahole Airport Road and at Kaiminani Drive to 3.0 mg/m^3 at Queen Kaahumanu Highway at Palani Road. The estimated worst-case concentrations were within both the state standard of 5 mg/m^3 and the national limit of 10 mg/m^3.

For the year 2010 without project scenario, worst-case concentrations ranged between 1.6 and 2.5 mg/m^3, with the highest concentration at the Queen Kaahumanu Highway and Palani Road intersection. Concentrations at all three locations studied decreased by about 20 percent compared to the existing case. All predicted concentrations were within the standards.

For the 2010 with project scenario, worst-case concentrations increased by about 15 to 30 percent compared to the without project case, but the predicted concentrations were still lower than or equal to the estimated existing values. Concentrations ranged from 2.0 mg/m^3 at Queen Kaahumanu Highway at Keahole Airport Road to 2.8 mg/m^3 at Queen Kaahumanu Highway at Palani Road. All predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The peak electrical demand of the project when fully developed is expected to reach about 1.5 Mw [12]. Assuming the average demand is approximately one-half the peak demand, the annual electrical demand of the project will reach approximately 7 million kilowatt-hours. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from geothermal energy, wind power or other sources. In order to meet the electrical power needs of the proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 6 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at local power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 2. The estimated indirect emissions from project electrical demand amount to less than 1 percent of the present air pollution emissions occurring on Hawaii Island even if all power is assumed to be derived from oil.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 2000 tons per year [12]. Currently, all solid waste on the island is buried at solid waste landfills. Thus, assuming this continues to be the method for solid waste disposal, the only associated air pollution emissions that will occur will be from trucking the waste to the landfill and burying it. These emissions should be relatively minor.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After the proposed project is completed, any long-term impacts on air quality in the project area due to emissions from project-related motor vehicle traffic should be small. Worst-case concentrations of carbon monoxide should remain within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of waste materials generated by the project will likely be small based on the relatively small magnitudes of these emissions. Nevertheless, indirect emissions from project electrical demand could likely be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; providing movable, controlled openings for ventilation at opportune times; and possibly installing automated room occupancy sensors. Solid waste related air pollution could likely be reduced somewhat by the promotion of conservation and recycling programs within the proposed development. This could reduce solid waste volumes, which would in turn reduce any related air pollution emissions proportionately.

REFERENCES

1. "Climatic Summary of the United States, Supplement for 1951 through 1960, Hawaii and Pacific", U.S. Department of Commerce, Weather Bureau, Washington, D.C., 1965.

2. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1995.

3. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

4. Austin, Tsutsumi & Associates, Inc., Traffic Impact Report, Hiluhilu Project, Draft, July 10, 2003.

5. User's Guide to MOBILE6.0, Mobile Source Emission Factor Model, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, Michigan, January 2002.

6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

7. User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, U.S. Environmental Protection Agency, November 1992.

8. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.

9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

10. Guideline for Modeling Carbon Monoxide from Roadway Intersections, U.S. Environmental Protection Agency, EPA-454/R-92-005, November 1992.

11. Annual Summaries, Hawaii Air Quality Data, 1997-2001, State of Hawaii Department of Health.

12. Personal communication, Roger Harris, Roger Harris Planning, to Barry D. Neal, B.D. Neal & Associates, July 23, 2003.

Figure 1 - Project Location

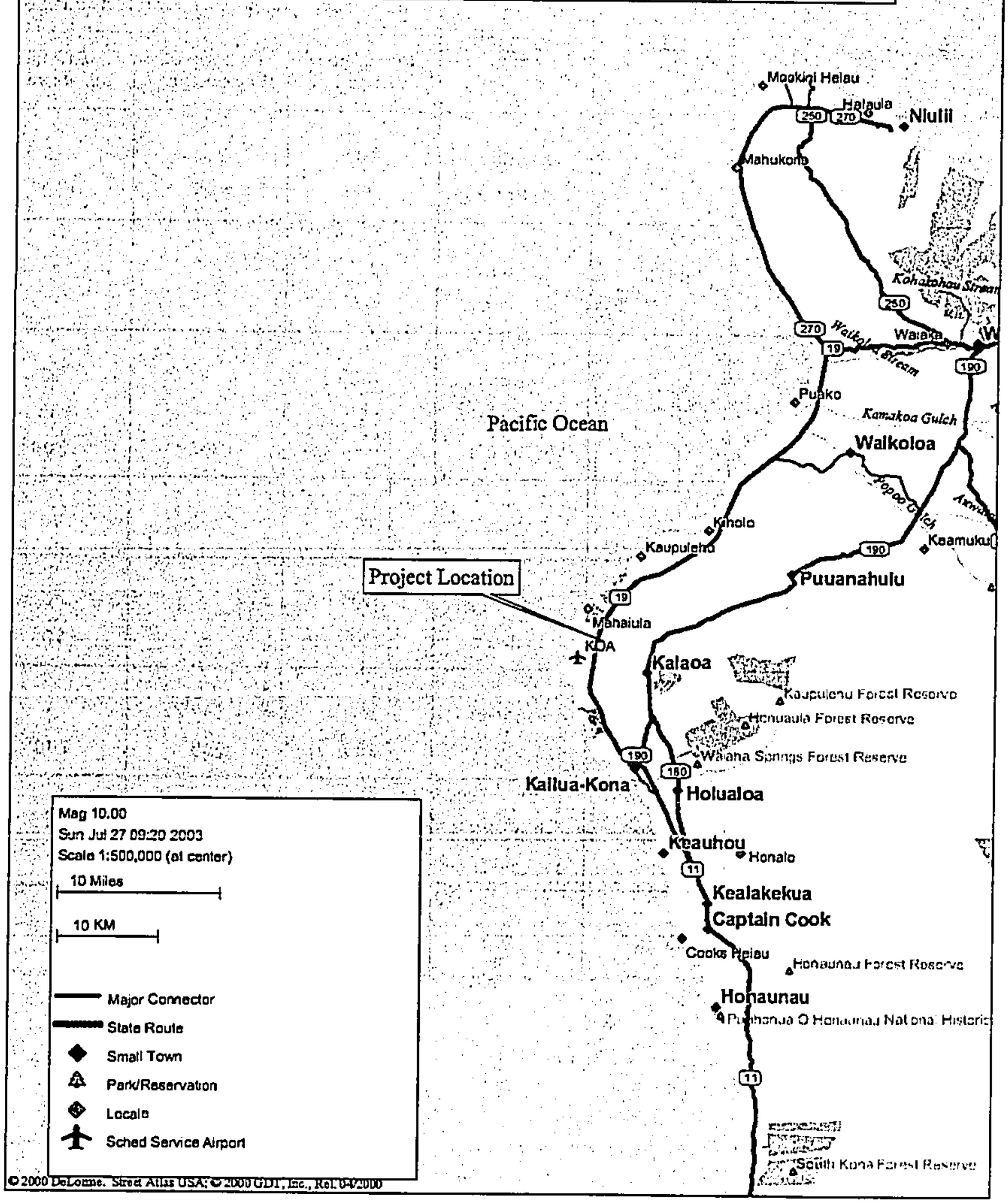


Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	μg/m³	Annual 24 Hours	50[a] 150[b]	50[a] 150[b]	50 150[c]
Particulate Matter (<2.5 microns)	μg/m³	Annual 24 Hours	15[a] 65[d]	15[a] 65[d]	- -
Sulfur Dioxide	μg/m³	Annual 24 Hours 3 Hours	80 365[c] -	- - 1300[c]	80 365[c] 1300[c]
Nitrogen Dioxide	μg/m³	Annual	100	100	70
Carbon Monoxide	mg/m³	8 Hours 1 Hour	10[c] 40[c]	- -	5[c] 10[c]
Ozone	μg/m³	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	- 100[c]
Lead	μg/m³	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	μg/m³	1 Hour	-	-	35[c]

[a] Three-year average of annual arithmetic mean.

[b] 99th percentile value averaged over three years.

[c] Not to be exceeded more than once per year.

[d] 98th percentile value averaged over three years.

[e] Three-year average of fourth-highest daily 8-hour maximum.

[f] Standard is attained when the expected number of exceedances is less than or equal to 1.

Note: Standards for particulate matter (<2.5 microns) and for 8-hour ozone have not yet been implemented.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF HAWAII, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST HILUHILU PROJECT

Parameter / Location	1999	2000	2001
Sulfur Dioxide / Kealakekua, Kona			
Period of Sampling (months)	12	12	12
3-Hour Averaging Period:			
No. of Samples	2859	2897	2869
Highest Concentration (μg/m^3)	60	50	3
2nd Highest Concentration (μg/m^3)	43	49	37
No. of State AAQS Exceedances	0	0	0
24-Hour Averaging Period:			
No. of Samples	360	365	360
Highest Concentration (μg/m^3)	18	25	22
2nd Highest Concentration (μg/m^3)	18	16	20
No. of State AAQS Exceedances	0	0	0
Annual Average Concentration (μg/m^3)	6	6	8
Particulate (PM-10) / Kealakekua, Kona			
Period of Sampling (months)	12	6	-
24-Hour Averaging Period:			
No. of Samples	47	17	-
Highest Concentration (μg/m^3)	28	23	-
2nd Highest Concentration (μg/m^3)	27	23	-
No. of State AAQS Exceedances	0	0	-
Annual Average Concentration (μg/m^3)	15	18	-

Source: State of Hawaii Department of Health, "Annual Summary, Hawaii Air Quality Data, 1999, 2000 and 2001"

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR HILUHILU PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario					
	2003/Present		2010/Without Project		2010/With Project	
	AM	PM	AM	PM	AM	PM
Queen Kaahumanu Highway at Northern Project Access Road	-	-	-	-	5.2	3.7
Queen Kaahumanu Highway at Keahole Airport Road	4.4	3.1	3.2	2.4	4.0	3.2
Queen Kaahumanu Highway at Kaiminani Drive	4.5	3.7	3.4	3.0	4.4	3.4
Queen Kaahumanu Highway at Palani Road	5.9	5.1	5.1	3.7	5.5	4.5

Hawaii State AAQS: 10
National AAQS: 40

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR HILUHILU PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario		
	2003/Present	2010/Without Project	2010/With Project
Queen Kaahumanu Highway at Northern Project Access Road	-	-	2.6
Queen Kaahumanu Highway at Keahole Airport Road	2.2	1.6	2.0
Queen Kaahumanu Highway at Kaiminani Drive	2.2	1.7	2.2
Queen Kaahumanu Highway at Palani Road	3.0	2.5	2.8

Hawaii State AAQS: 5
National AAQS: 10

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM HILUHILU PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	2
Sulfur Dioxide	18
Carbon Monoxide	2
Volatile Organics	<1
Nitrogen Oxides	8

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes peak electrical demand of 1.5 Mw and that the average electrical demand is one-half the peak demand, resulting in 7 million kw-hrs per year of electrical power use. Estimated emission rates assume low-sulfur oil used to generate power.

Appendix G

Acoustic Study For The Proposed
Hiluhilu Development, North Kona,
Hawai'i

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Hiluhilu Project in North Kona, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. Figure 1 depicts the location of the project site. The future traffic noise levels along the primary access roadways to the project were calculated for the year 2010.

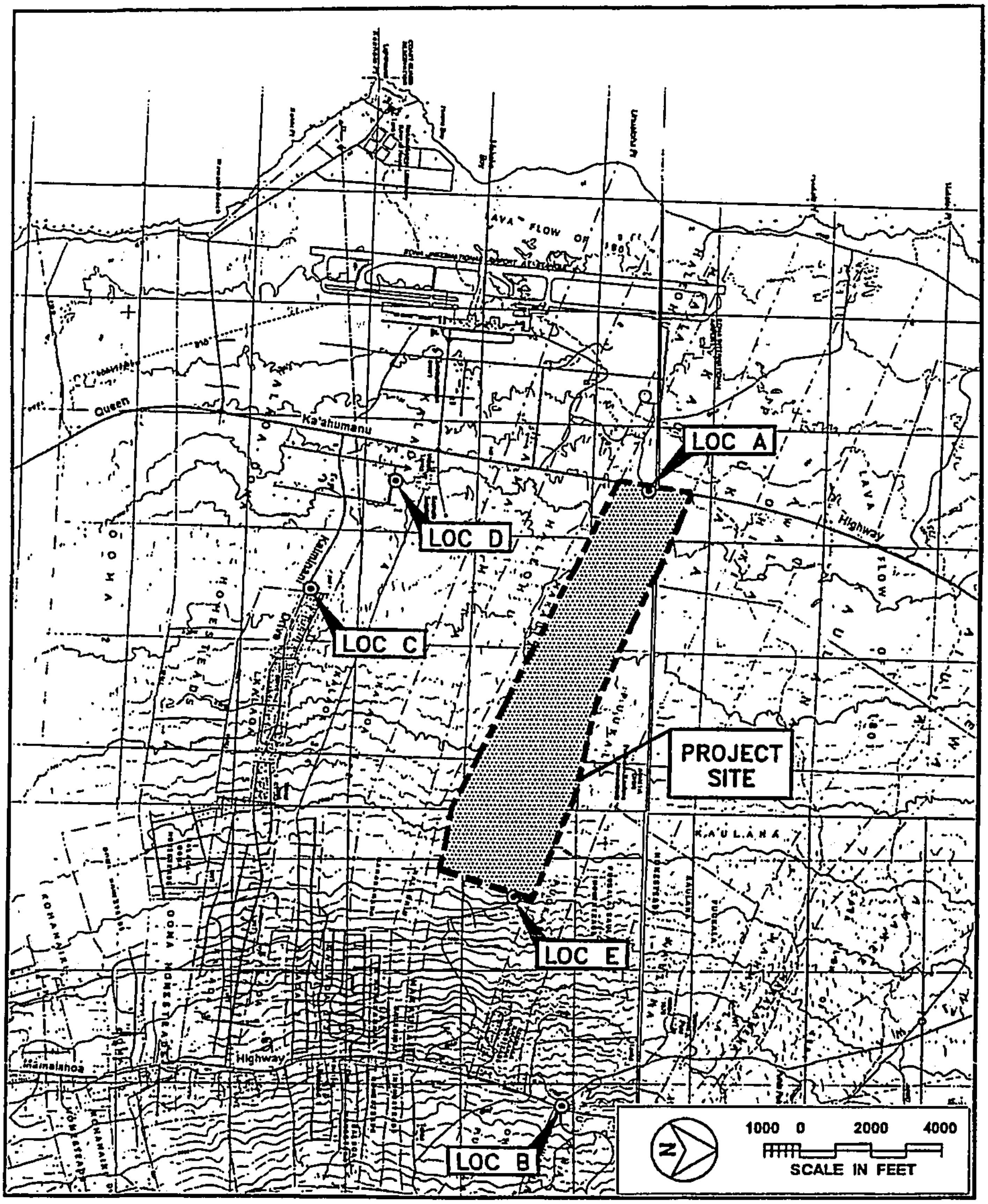
Along the existing Queen Kaahumanu Highway, traffic noise levels are expected to increase by 2.6 to 3.5 DNL between CY 2003 and CY 2010 as a result of both project and non-project traffic. Along Mamalahoa Highway, traffic noise levels are predicted to increase by 1.7 to 2.8 DNL. Traffic noise increases due to project traffic are predicted to range from 0.4 to 1.6 DNL which is within the range of the noise increases caused by non-project traffic on these two roadways. These increases in traffic noise levels associated with project traffic range from the insignificant to the moderately significant. Fortunately, the larger and more significant increases in traffic noise levels are expected to occur along Queen Kaahumanu Highway, where the lands along the highway Rights-of-Way are generally undeveloped.

Based on previously published FAR Part 150 aircraft noise contours for Kona International Airport, the project site is located outside of the existing and forecasted 55 DNL noise contours, and is considered to be acceptable for the development of noise sensitive uses as planned. Noise contours for CY 2010 and CY 2020, which were developed during the last Master Plan and FAR Part 150 Study updates for Kona International Airport, confirm that the project site is outside of the airport noise contours, and special aircraft noise attenuation measures are not required over the project area. The implementation of the airport noise disclosure provisions of Act 208 is not considered to be necessary over the entire project area because the existing and forecasted 55 DNL noise contours are not expected to encompass noise sensitive developments within the project area.

Project residents should not be impacted by traffic noise from Queen Kaahumanu or Mamalahoa Highways since adequate setback distances have been provided from the highways.

Noise impacts from the nearby Keahole Generating Station are not expected to occur due to the large distances between the station and the project site. In addition, sound attenuation measures have been recently incorporated into the station's generating equipment, which have reduced plant noise levels to inaudible levels.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce



LOCATIONS OF PROJECT SITE AND NOISE MEASUREMENT SITES	FIGURE 1

construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed Hiluhilu Project in North Kona on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine the future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from noise resulting from fixed and rotary wing aircraft operations at nearby Kona International Airport at Keahole, from the nearby Keahole Generating Station, and from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (DNL or Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted sound levels as read on a standard Sound Level Meter. The maximum A-Weighted sound level occurring while a noise source such as a heavy truck or aircraft is moving past a listener (i.e., the maximum sound level from a "single event") is referred to as the "Lmax value". The mathematical product (or integral) of the instantaneous sound level times the duration of the event is known as the "Sound Exposure Level", or Lse, which is analogous to the energy of the time-varying sound levels associated with a single event.

The DNL values represent the average noise during a typical day of the year. DNL exposure levels of 55 or less are typical of quiet rural or suburban areas. DNL exposure levels of 55 to 65 are typical of urbanized areas with medium to high levels of activity and street traffic. DNL exposure levels above 65 are representative of densely developed urban areas and areas fronting high volume roadways.

By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. Because of the averaging used, DNL values in urbanized areas typically range between 50 and 75 DNL. In comparison, the typical range of intermittent noise events may have maximum Sound Level Meter readings between 75 and 105 dBA. A more complete list of noise descriptors is provided in Appendix B to this report. In Appendix B, the Ldn descriptor symbol is used in place of the DNL descriptor symbol.

Table 1, extracted from Reference 1, categorizes the various DNL levels of outdoor noise exposure with severity classifications. Table 2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Figure 2, extracted from Reference 2, presents suggested land use compatibility guidelines for residential and nonresidential land uses. A general consensus among federal agencies has developed whereby residential housing development is considered acceptable in areas where exterior noise does not exceed 65 DNL. This value of 65 DNL is used as a federal regulatory threshold for determining the necessity for special noise abatement measures when applications for federal funding assistance are made.

As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

TABLE 2

EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

EFFECTS[1] / DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS	Hearing Loss	Speech Interference		Annoyance[2]	Average Community Reaction[4]	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	%Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

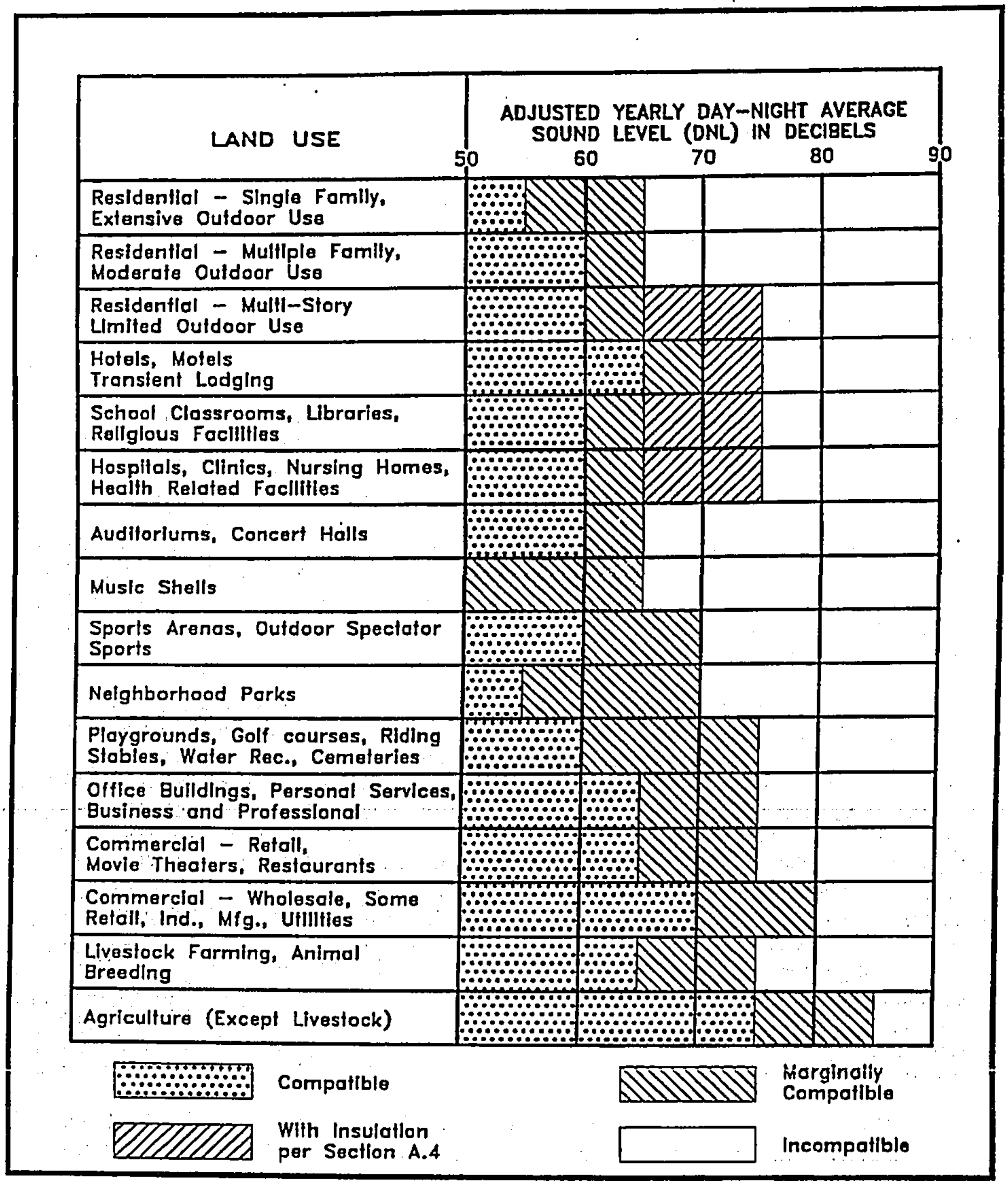
1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

2. Depends on attitudes and other factors.

3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.



LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY-NIGHT AVERAGE SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
(Source: American National Standards Institute S12.9-1998/Part 5)

FIGURE 2

roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 DNL lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL or lower is considered acceptable. These federal agencies include the Federal Aviation Administration (FAA), Department of Defense (DOD); Federal Housing Administration, Housing and Urban Development (FHA/HUD), and Veterans Administration (VA). This standard is applied nationally (see Reference 3), including Hawaii.

Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise (see Reference 4). For typical, naturally ventilated structures in Hawaii, an exterior noise level of 55 DNL results in an interior level of approximately 45 DNL, which is considered to be the "Unconditionally Acceptable" (or "Near-Zero Risk") level of interior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For aircraft noise, the Hawaii State Department of Transportation, Airports Division (HDOTA), has recommended that 60 DNL be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. Table 3 summarizes the recommendations for compatible land uses at various levels of aircraft noise. For those noise sensitive land uses which are exposed to aircraft noise greater than 55 DNL, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. Reference 5 requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation (FAR) Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150). The most recent FAR Part 150 noise contours for Kona International Airport at Keahole were completed in 1996 and reflect conditions through 2001. Additional airport noise contours for 2010 and 2020 were developed by the HDOTA for information purposes only during the 1996 to 1997 time frame.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

In the State of Hawaii, the State Department of Health (DOH) regulates noise from on-site activities. State DOH noise regulations are expressed in maximum

TABLE 3

HAWAII STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS (DNL)

TYPE OF LAND USE	**** Yearly Day-Night Average Sound Level ****					
	< 60	60-65	65-70	70-75	75-80	80-85
RESIDENTIAL						
Low density residential, resorts, and hotels (outdoor facil.)	Y(a)	N(b)	N	N	N	N
Low density apartment with moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings with limited outdoor use	Y	N(b)	N(b)	N	N	N
PUBLIC USE						
Schools, day-care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and office buildings serving the general public	Y	Y	Y(d)	Y(d)	N	N
Transportation and Parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL AND GOVERNMENT USE						
Offices - government, business, and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale and retail - building materials, hardware and heavy equipment	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, tours, lei stands, ticket offices, etc.	Y	Y	Y(d)	Y(d)	N	N
Retail, restaurants, shopping centers, financial institutions, etc.	Y	Y	Y(d)	Y(d)	N	N
Power plants, sewage treatment plants, and base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios without outdoor sets, broadcasting, production facilities, etc.	Y(c)	Y(c)	N	N	N	N
MANUFACTURING, PRODUCTION, AND STORAGE						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc.	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc.	Y	Y	N	N	N	N
Professional/resort sport facilities, locations of media events, etc.	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Numbers in parentheses refer to notes.

KEY TO TABLE 3:

Y(Yes) = Land Use and related structures compatible without restrictions.
N(No) = Land Use and related structures are not compatible and should be prohibited.

TABLE 3 (CONTINUED)

HAWAII STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS (DNL)

NOTES FOR TABLE 3:

(a) A noise level of 60 DNL does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 DNL planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk level of 55 DNL and the significant risk level of 65 DNL.

(b) Where the community determines that these uses must be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 DNL or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor to indoor NLR, and will not eliminate outdoor noise problems.

(c) Because the DNL noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior DNL exposure level.

(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(e) Residential buildings require NLR. Residential buildings should not be located where noise is greater than 65 DNL.

(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

allowable property line noise limits rather than DNL (see Reference 6). The noise limits apply on all islands of the State, including Oahu. Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for preservation/residential, apartment/commercial, and agricultural/industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

Because the proposed project site is located on lands designated for single family and multifamily residential, and commercial uses, various DOH noise limits would be applicable along the lot boundary lines or receptor locations for any stationary machinery, or equipment related to commercial or construction activities. These property line limits are 60 dBA and 50 dBA during the daytime and nighttime periods, respectively, for commercial lots or receptors. For multifamily or apartment use, the State DOH limits are also 60 dBA and 50 dBA during the daytime and nighttime periods, respectively. For single family residential and public facility uses, the State DOH limits are 55 dBA and 45 dBA during the daytime and nighttime periods, respectively. These noise limits cannot be exceeded for more than 2 minutes in any 20-minute time period under the State DOH noise regulations. The State DOH noise regulations do not apply to aircraft or motor vehicles.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and background ambient noise levels were measured at five locations in the project environs to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development: Queen Kaahumanu Highway and Mamalahoa Highway; and for determining the existing background ambient noise levels in the project area.

The locations of the measurement sites are shown in Figure 1. Noise measurements were performed during July 2003. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in Table 4. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 8). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and loose soil propagation loss factor. The traffic assignments for the project (Reference 9) and Hawaii State Department of Transportation counts on Queen Kaahumanu Highway (Reference 10) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were equal to the 24-hour DNL along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour DNL of traffic noise on Queen Kaahumanu Highway (see Figure 3).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic turning movements (Reference 9). The forecasted increases in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.

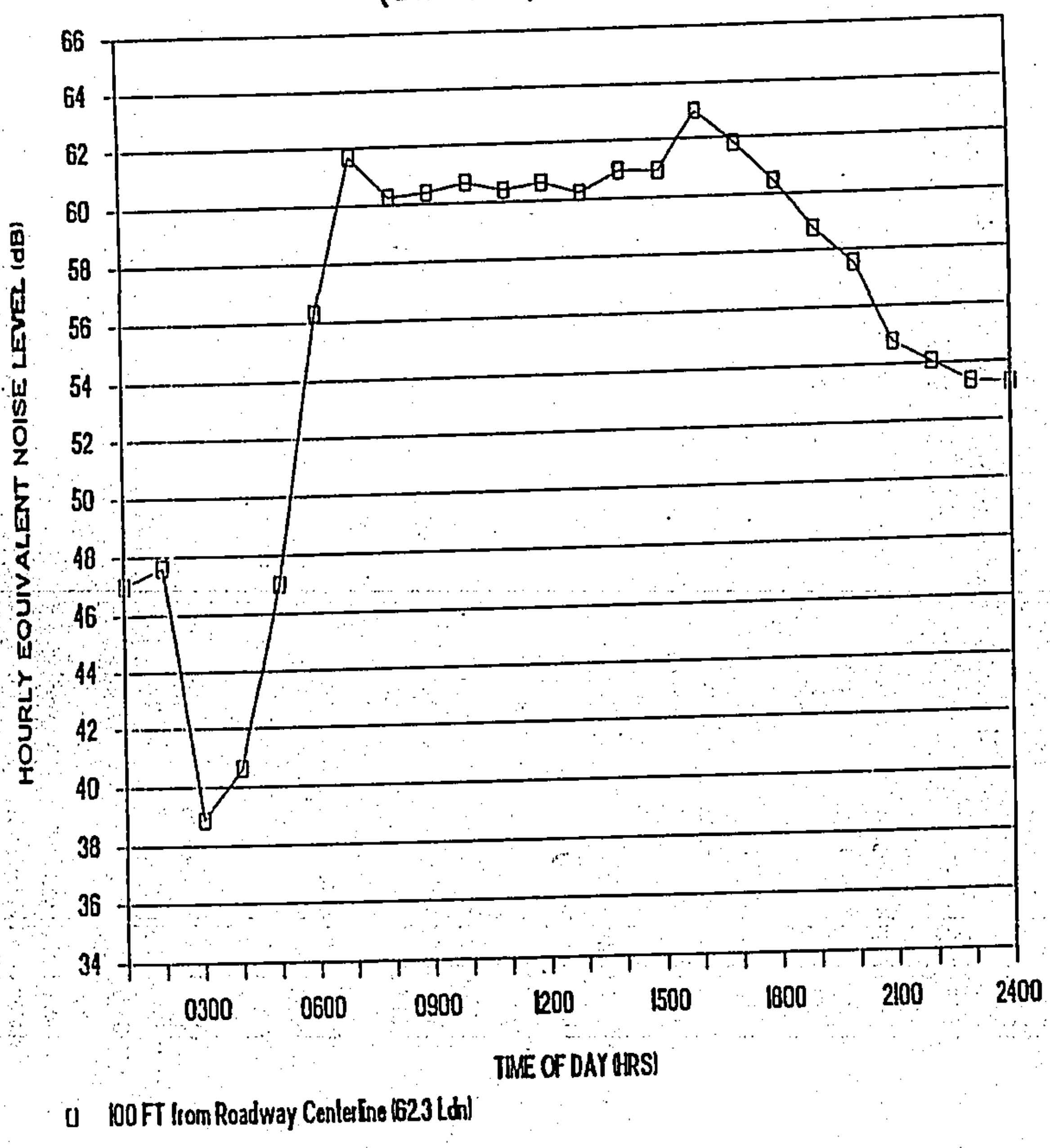
The relationships of the aircraft flight tracks and noise contours for Kona International Airport to the project site and its proposed land uses were examined to determine if potential noise impacts were possible at the project site. The locations of the airport noise contours for 2001, 2010, and 2020 were compared with the location of the project site, and risks of noise impacts were evaluated. The need for special aircraft noise attenuation measures or disclosures of aircraft noise level at the project site was determined by comparing the locations of the 2001 FAR Part 150 airport noise contours with the location of the project site.

TABLE 4
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	Hourly Traffic Volume M.TRUCK	Hourly Traffic Volume H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A	90 FT from centerline of Q. Kaahumanu Hwy. (7/01/03)	0716 TO 0816	65	846	26	49	68.5	68.8
A	90 FT from centerline of Q. Kaahumanu Hwy. (7/01/03)	1546 TO 1646	65	1,296	24	20	68.6	68.9
B	66 FT from centerline of Mamalahoa Hwy. (7/01/03)	0841 TO 0940	45	223	9	11	64.1	65.4
B	66 FT from centerline of Mamalahoa Hwy. (7/01/03)	1500 TO 1530	45	288	6	10	65.7	65.8
C	50 FT from centerline of Kaiminani Dr. (7/01/03)	1000 TO 1100	35	294	8	1	61.7	61.8
D	400 FT from Puklawa St. on Kupaloke St. (7/01/03)	1427 TO 1443	N/A	N/A	N/A	N/A	54.2	N/A
E	At west end of Makalei Estates Subdivision Road (7/02/03)	0856 TO 0956	N/A	N/A	N/A	N/A	32.9	N/A

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY AT KEAHOLE AIRPORT ROAD TOWARD KAWAIHAE (Sta. 8-P, 5/9-10/88)



CHAPTER V. EXISTING NOISE ENVIRONMENT

Traffic Noise. The existing traffic noise levels in the project environs vary from levels of approximately 70 DNL along the makai (west) property boundary, to less than 45 DNL at the mauka (east) property boundary and interior locations of the project site. Traffic noise levels along Queen Kaahumanu Highway are less than 70 DNL at 90 FT or greater setback distances from the highway centerline. Traffic noise levels along Mamalahoa Highway are less than 66 DNL at 66 FT or greater setback distances from the highway centerline. At the east boundary of the project which adjoins the Makalei Estates subdivision, existing background ambient noise levels are very low and less than 45 DNL.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in Table 5. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 65 and 75 DNL contours were also calculated as shown in Table 6. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of Table 6, it was concluded that the existing 65 DNL traffic noise contour is located approximately 175 FT from the centerline of Queen Kaahumanu Highway, and approximately 102 FT from the centerline of Mamalahoa Highway in the immediate vicinity of the project site.

Existing traffic noise levels at the interior portions of the project site are low (less than 45 DNL) due to their large setback distances from the two highways at the east and west ends of the project area. At these interior locations on the project site, aircraft noise and the natural sounds of birds and winds in foliage are the dominant noise sources. A discussion of existing aircraft noise levels on the project site is provided in the following section. Between aircraft noise events, background ambient noise levels drop to a range of 25 to 45 dB. During calm wind periods, background ambient noise levels decrease to levels less than 40 dB. The minimum background ambient noise levels at these interior locations are controlled by distant traffic and wind noise.

Aircraft Noise. Aircraft noise sources in the project environs are associated with fixed and rotary wing aircraft operations at Kona International Airport at Keahole. Figures 4 through 6 depict aircraft flight tracks in the project environs during CY 2003, which were similar to those reported in Reference 7. Occasionally, depending on weather, visibility, or air traffic conditions, helicopter and light, fixed wing aircraft may cross over the western boundary of project site as indicated by the departure and arrival tracks shown in Figures 4 and 5, respectively. The noisier jet aircraft flight tracks typically remain west of the project site and are aligned with Kona International Airport's single runway. However, large overseas jet aircraft may occasionally overfly the center

TABLE 5

EXISTING (CY 2003) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Entrance Rd.	45	386	366	10	10	68.5	65.2	59.1
Mamalahoa Hwy. - South of Entrance Rd.	45	398	378	10	10	68.6	65.2	59.2
Mamalahoa Hwy. - North of Kaiminani Dr.	45	980	930	25	25	72.5	69.2	63.1
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,247	1,185	31	31	73.5	70.2	64.1
Q. Kaahumanu Hwy. - N. of Entrance Rd.	65	1,387	1,317	35	35	73.8	70.4	63.7
Q. Kaahumanu Hwy. - S. of Entrance Rd.	65	1,387	1,317	35	35	73.8	70.4	63.7
Q. Kaahumanu Hwy. - N. of Airport Rd.	65	1,387	1,317	35	35	73.8	70.4	63.7
Q. Kaahumanu Hwy. - S. of Airport Rd.	65	1,622	1,540	41	41	74.6	71.1	64.4
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	65	1,614	1,534	40	40	74.5	71.1	64.4
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	65	1,611	1,531	40	40	74.5	70.0	64.3
Kaiminani Dr. - East of Q. Kaahumanu Hwy	35	681	661	17	3	65.3	61.9	55.9
Kaiminani Dr. - West of Mamalahoa Hwy.	35	565	548	14	3	64.5	61.2	55.2
Entrance Rd. - West of Mamalahoa Hwy.	35	30	29	1	0	51.4	48.4	42.1
Entrance Rd. - East of Q. Kaahumanu Hwy	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

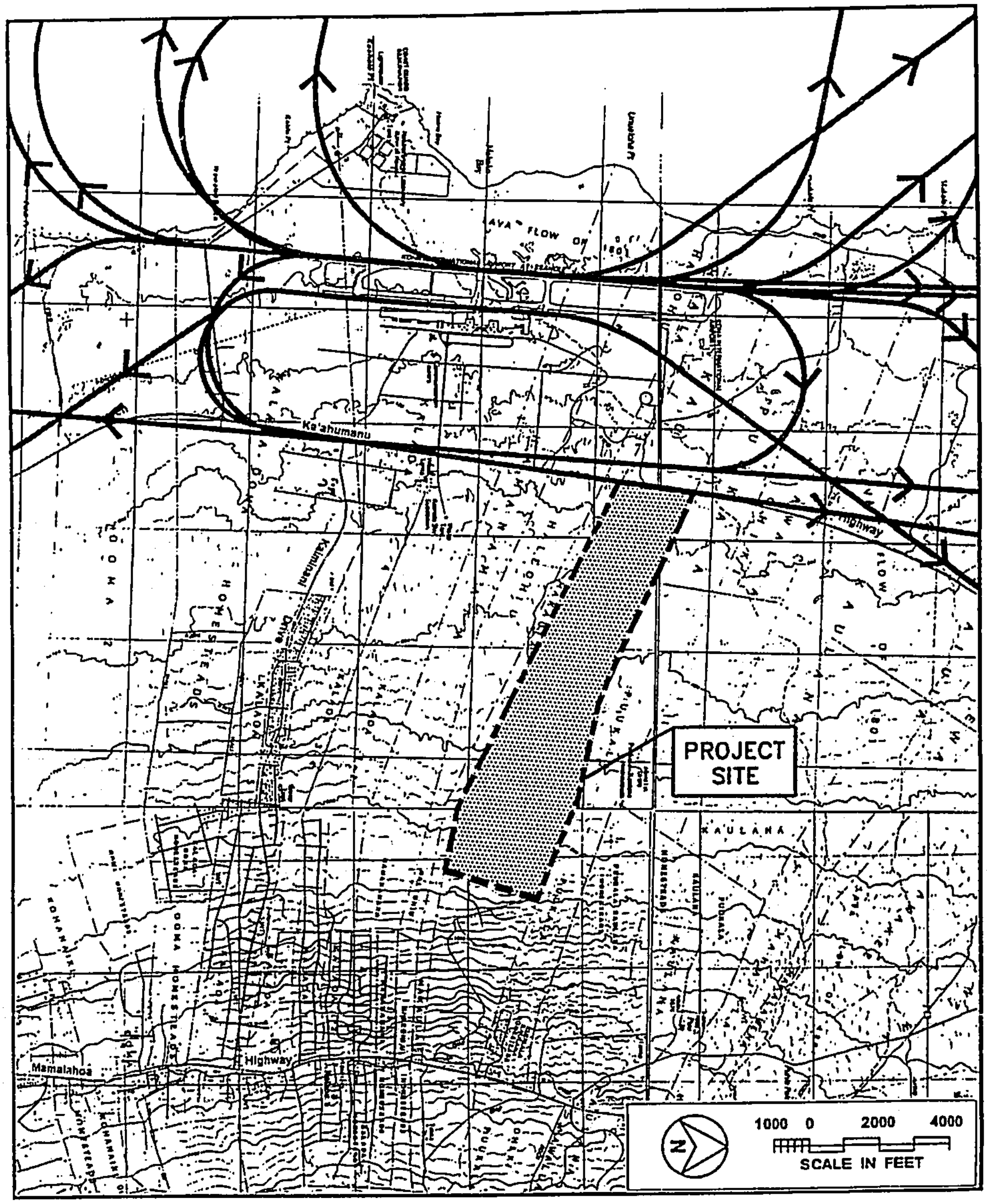
TABLE 6

YEAR 2003 AND 2010 DISTANCES TO 65 AND 75 DNL CONTOURS (PM PEAK HOUR)

STREET SECTION	65 DNL SETBACK (FT) CY 2003	65 DNL SETBACK (FT) CY 2010	75 DNL SETBACK (FT) CY 2003	75 DNL SETBACK (FT) CY 2010
Mamalahoa Hwy. - North of Entrance Rd.	102	129	13	20
Mamalahoa Hwy. - South of Entrance Rd.	102	141	14	23
Mamalahoa Hwy. - North of Kaiminani Dr.	161	200	30	44
Mamalahoa Hwy. - South of Kaiminani Dr.	181	219	36	52
Q. Kaahumanu Hwy. - N. of Entrance Rd.	175	229	39	67
Q. Kaahumanu Hwy. - S. of Entrance Rd.	175	236	39	71
Q. Kaahumanu Hwy. - N. of Airport Rd.	175	236	39	71
Q. Kaahumanu Hwy. - S. of Airport Rd.	188	246	46	77
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	188	246	45	77
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	184	241	46	74
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	70	77	7	8
Kaiminani Dr. - West of Mamalahoa Hwy.	64	70	6	6
Entrance Rd. - West of Mamalahoa Hwy.	16	47	0	4
Entrance Rd. - East of Q. Kaahumanu Hwy.	N/A	104	N/A	13

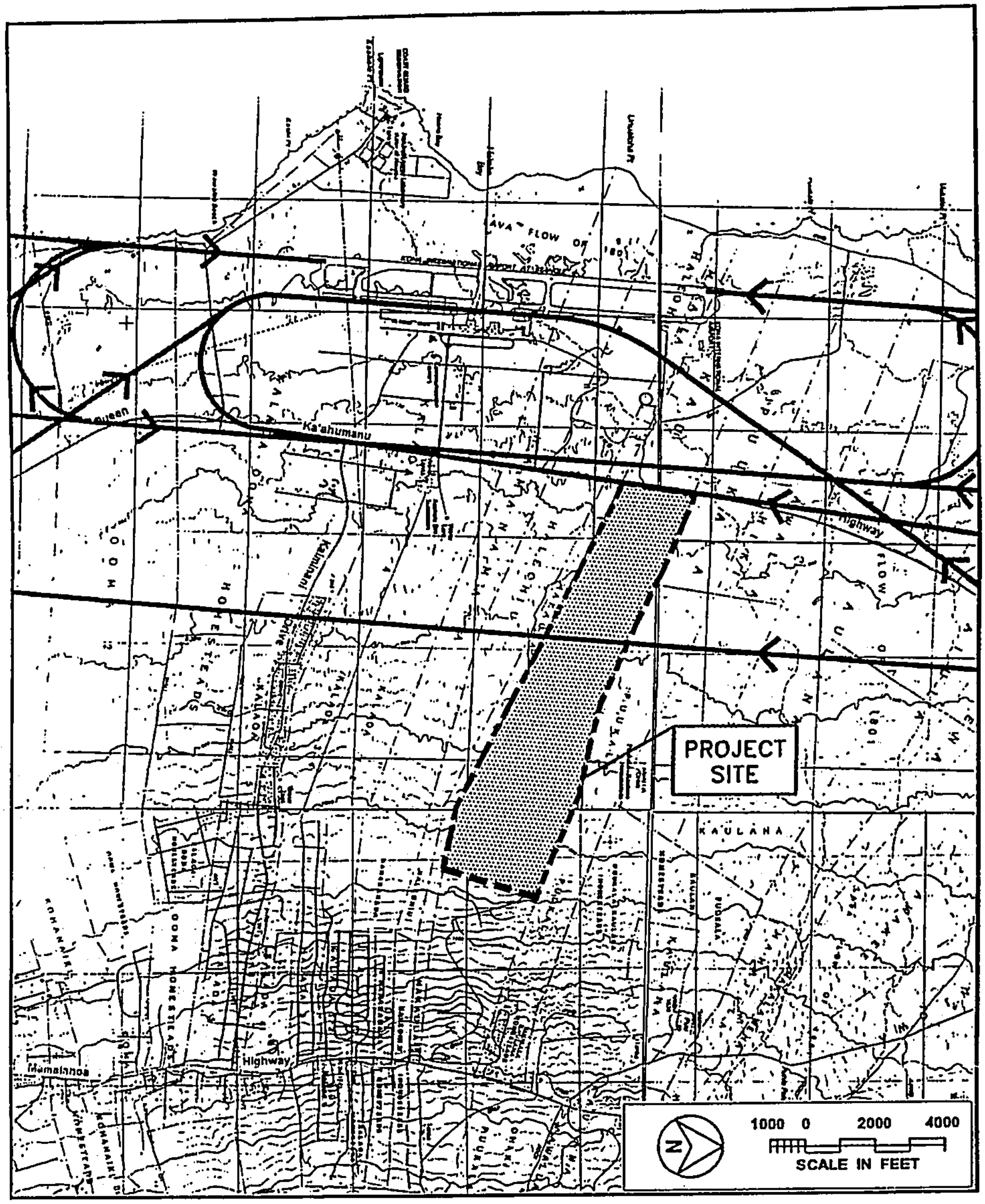
Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 5 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.

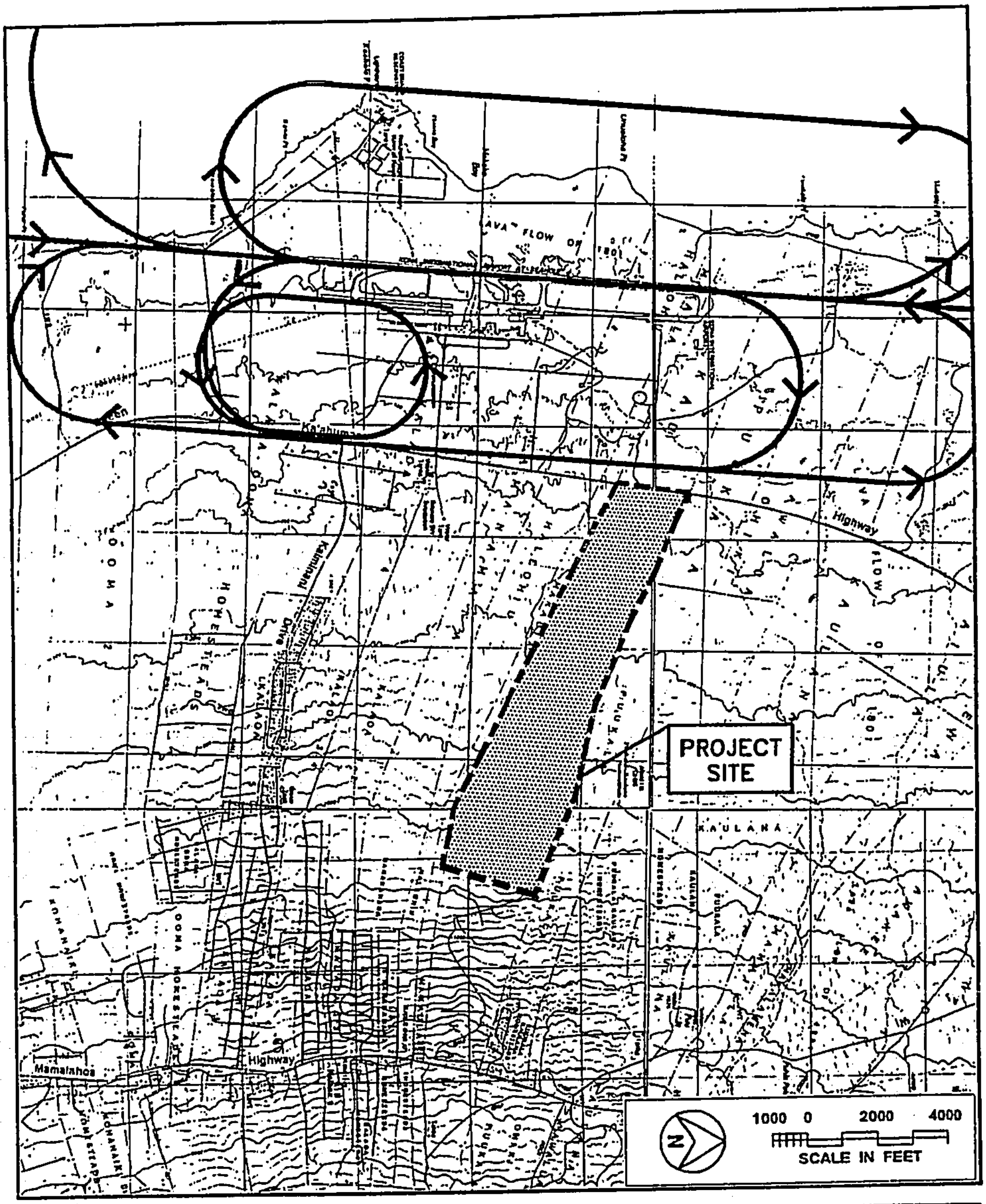


LOCATIONS OF EXISTING AVERAGE AIRCRAFT DEPARTURE FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 4



LOCATIONS OF EXISTING AVERAGE AIRCRAFT ARRIVAL FLIGHT TRACKS IN PROJECT ENVIRONS	FIGURE 5



LOCATIONS OF EXISTING AVERAGE AIRCRAFT TRAINING FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 6

of the project site where shown in Figure 5 when landing using a right hand turn during north flow pattern conditions (Runway 35 in use). This approach to the airport is used due to the presence of other aircraft traffic approaching the airport from the west.

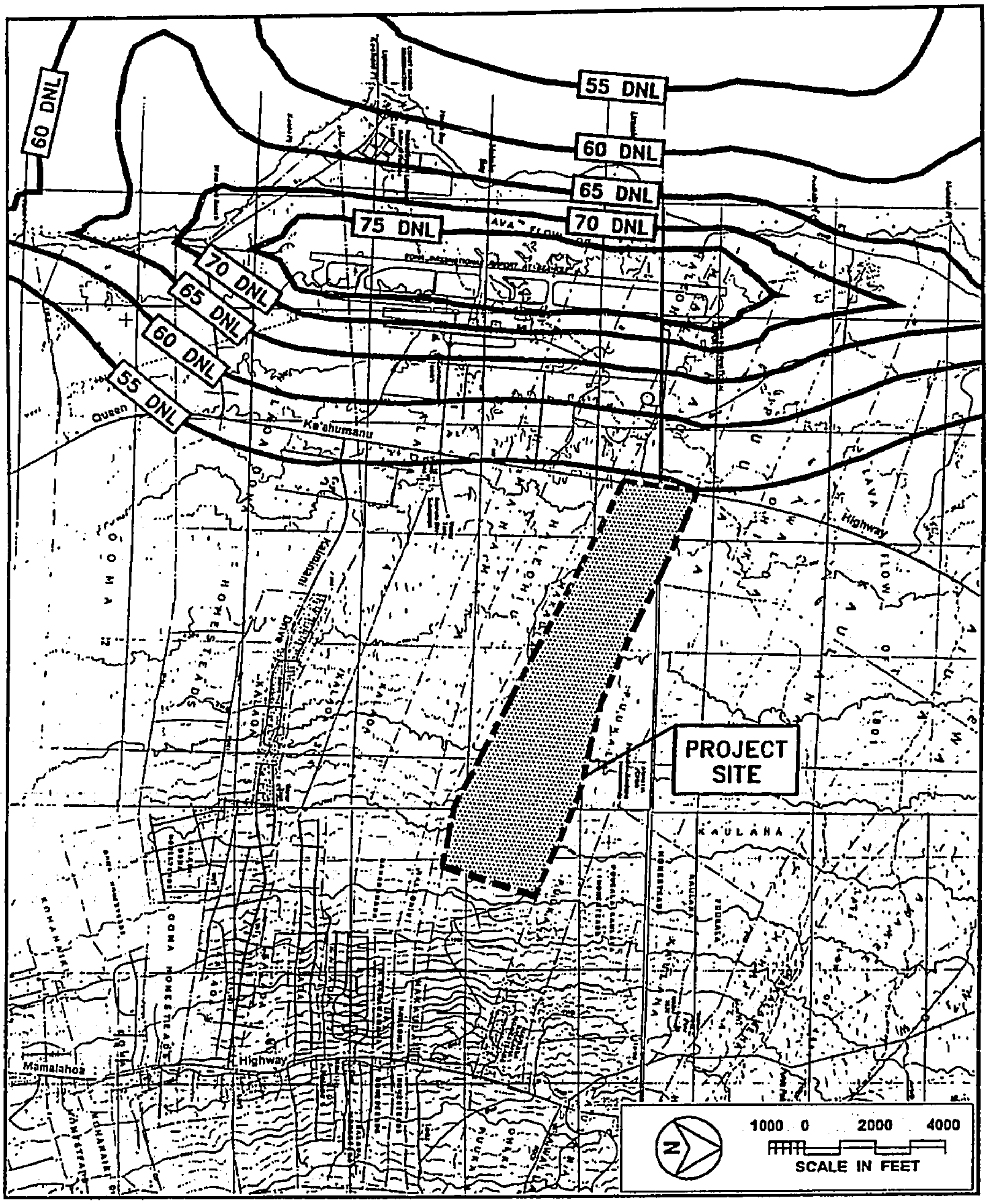
Figure 7 depicts the locations of the 55 through 75 DNL aircraft noise contours during the CY 2001 period. These noise contours were obtained from the Kona International Airport FAR Part 150 report (Reference 7). From Figure 7, aircraft noise levels over the project site are below 55 DNL, and as such, are considered to be in the "Minimal Exposure, Unconditionally Acceptable" category for the planned land uses on the project site.

The highest, single event, aircraft noise levels over the project site will occur during north wind conditions when aircraft land from the south and depart toward the north using the airport's Runway 35. Typical maximum noise levels from the noisier B-737(200) jet aircraft are expected to range from 75 to 80 dB. The newer, and quieter B-717(200) jet aircraft are typically quieter, and less than 75 dB. Noise levels from helicopters, fixed wing air taxi, and general aviation aircraft are generally less than 70 dB. Higher noise levels of helicopter and light fixed wing aircraft which exceed 70 dB are also possible during flyovers over the project site.

Based on the most current information on aircraft noise levels operations at Kona International Airport, the location of the existing 55 DNL contour is estimated to be west of the project site as shown in Figure 7. The location of the existing 60 DNL contour is estimated to be approximately 2,000 FT west of the project site. Based on these FAR Part 150 noise contours for Kona International Airport and their relationship to the project site, it was concluded that the 60 DNL aircraft noise contour is located outside the project site, with at least 5 DNL of margin for increased contour expansion. The 55 DNL aircraft noise contour also does not cross through the project site, and has a smaller 1 DNL of margin for increased contour expansion. Based on these airport noise contours in the project environs, it was concluded that special aircraft noise mitigation measures are not required, and existing aircraft noise levels do not place special development constraints on the project site.

<u>Generating Station Noise</u>. A possible noise source in the project environs is the Keahole Generating Station, which is operated by Hawaii Electric Light Company, Inc. (HELCO). The location of the generating station is approximately 5,000 FT south of the project site as shown in Figure 1. Six 2.5 megawatt diesel generators and one 14 megawatt combustion turbine generator operate at the generating station. The combustion turbine unit was installed with a silencer package to minimize its noise emissions, and the diesel generators were also silenced with exhaust mufflers.

Predicted worst case noise level from the generating station with all six diesel sets and combustion turbine unit on-line is approximately 38 dBA at the project's south boundary line. This worst case level of noise is considered to be very low, and should not cause adverse noise impacts at the project site.



LOCATIONS OF CY 2001 AIRCRAFT NOISE CONTOURS FROM FAR PART 150 REPORT

FIGURE 7

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 9 for CY 2010 with and without the proposed project. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in Table 7 for the PM peak hour of traffic. As indicated in Table 8, by CY 2010 and following complete project build-out, traffic noise levels on Queen Kaahumanu Highway in the areas fronting the project are predicted to increase by 2.6 to 2.9 DNL. Along Mamalahoa Highway, traffic noise levels are predicted to increase by 2.0 to 2.8 DNL. South of the project, and along Kaiminani Drive, traffic noise levels are predicted to increase by 0.7 to 0.8 DNL. This range of increases in traffic noise levels from 0.7 to 2.9 DNL is considered to be low to moderate, and reflects the growth in forecasted project and non-project traffic in the project environs by CY 2010.

Table 6 summarizes the predicted increases in the future setback distances to the 65 and 75 DNL traffic noise contour lines along the roadways in the project environs and attributable to both project plus non-project traffic in CY 2010. The setback distances in Table 6 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in Table 6, the setback distances to the 65 DNL contour are predicted to range from 229 to 246 FT from the centerline of Queen Kaahumanu Highway following project build-out in CY 2010. Along Mamalahoa Highway, setback distances to the 65 DNL contour are predicted to range from 129 to 219 FT from the centerline of Mamalahoa Highway. Along Kaiminani Drive and the project's future East/West connector road, setback distances to the 65 DNL contour are expected to range from 47 to 104 FT.

Table 8 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2010, and as measured by the Leq or DNL descriptor systems. As indicated in Table 8, the increases in traffic noise along Queen Kaahumanu Highway due to project traffic are slightly greater than those resulting from non-project traffic. Along Mamalahoa Highway, project traffic noise contributions are expected to be less than non-project traffic noise contributions by CY 2010. Along Kaiminani Drive, project traffic is expected to increase traffic noise levels above those associated with non-project traffic by 0.7 DNL. The largest increases in traffic noise levels attributable to project traffic are expected to occur along the project's entrance roads at Queen Kaahumanu Highway and Mamalahoa Highway. Overall, the increases in noise levels associated with project traffic are expected to be manageable along Queen Kaahumanu and Mamalahoa Highways, and are expected to be similar to those associated with non-project traffic.

Aircraft Noise. The aircraft noise contours in the project environs for the CY 2010 and 2020 periods were developed during the most recent Master Plan and FAR

TABLE 7

FUTURE (CY 2010) TRAFFIC VOLUMES AND NOISE LEVELS
ALONG VARIOUS ROADWAY SECTIONS
(PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) *********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - North of Entrance Rd.	45	626	594	16	16	70.6	67.2	61.2
Mamalahoa Hwy. - South of Entrance Rd.	45	747	709	19	19	71.3	68.0	62.0
Mamalahoa Hwy. - North of Kaiminani Dr.	45	1,514	1,438	38	38	74.4	71.0	65.0
Mamalahoa Hwy. - South of Kaiminani Dr.	45	1,843	1,751	46	46	75.2	71.9	65.8
Q. Kaahumanu Hwy. - N. of Entrance Rd.	65	2,512	2,386	63	63	76.5	73.0	66.3
Q. Kaahumanu Hwy. - S. of Entrance Rd.	65	2,734	2,598	68	68	76.8	73.3	66.6
Q. Kaahumanu Hwy. - N. of Airport Rd.	65	2,734	2,598	68	68	76.8	73.3	66.6
Q. Kaahumanu Hwy. - S. of Airport Rd.	65	2,969	2,821	74	74	77.2	73.7	67.0
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	65	2,980	2,830	75	75	77.2	73.7	67.0
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	65	2,849	2,707	71	71	77.0	73.5	66.8
Kaiminani Dr. - East of Q. Kaahumanu Hwy	35	813	789	20	4	66.1	62.7	56.7
Kaiminani Dr. - West of Mamalahoa Hwy.	35	669	649	17	3	65.2	61.9	55.8
Entrance Rd. - West of Mamalahoa Hwy.	35	303	293	8	2	62.0	58.6	52.7
Entrance Rd. - East of Q. Kaahumanu Hwy	35	1,464	1,420	37	7	68.6	65.3	59.3

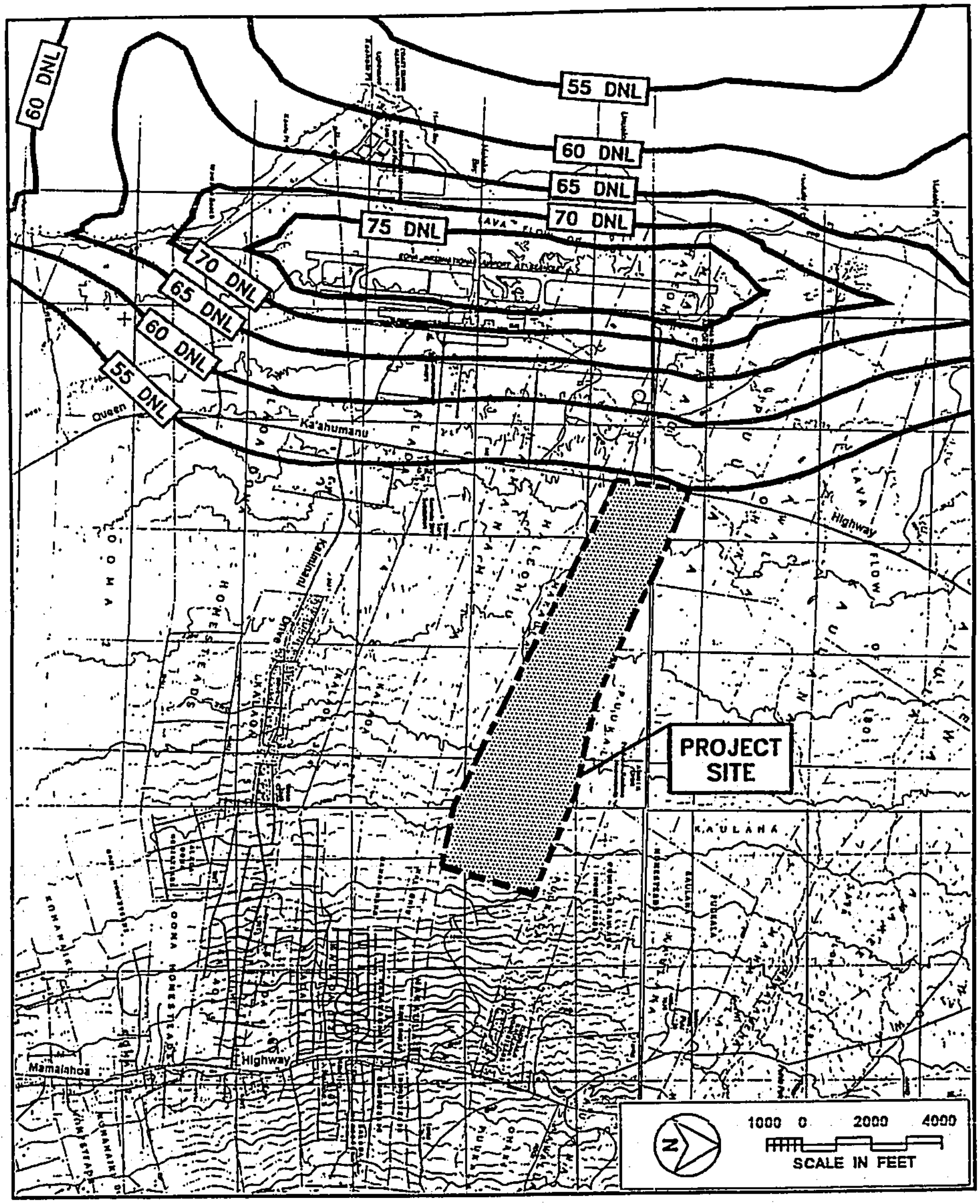
TABLE 8

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2010) (PM PEAK HOUR)

STREET SECTION	NOISE LEVEL (DB) NON-PROJECT TRAFFIC	INCREASE DUE TO PROJECT TRAFFIC
Mamalahoa Hwy. - North of Entrance Rd.	1.5	0.5
Mamalahoa Hwy. - South of Entrance Rd.	1.9	0.9
Mamalahoa Hwy. - North of Kaiminani Dr.	1.4	0.4
Mamalahoa Hwy. - South of Kaiminani Dr.	1.2	0.5
Q. Kaahumanu Hwy. - N. of Entrance Rd.	1.3	1.3
Q. Kaahumanu Hwy. - S. of Entrance Rd.	1.3	1.6
Q. Kaahumanu Hwy. - N. of Airport Rd.	1.3	1.6
Q. Kaahumanu Hwy. - S. of Airport Rd.	1.2	1.4
Q. Kaahumanu Hwy. - N. of Kaiminani Dr.	1.2	1.4
Q. Kaahumanu Hwy. - S. of Kaiminani Dr.	2.3	1.2
Kaiminani Dr. - East of Q. Kaahumanu Hwy.	0.1	0.7
Kaiminani Dr. - West of Mamalahoa Hwy.	0.0	0.7
Entrance Rd. - West of Mamalahoa Hwy.	4.7	5.5
Entrance Rd. - East of Q. Kaahumanu Hwy.	0.0	65.3

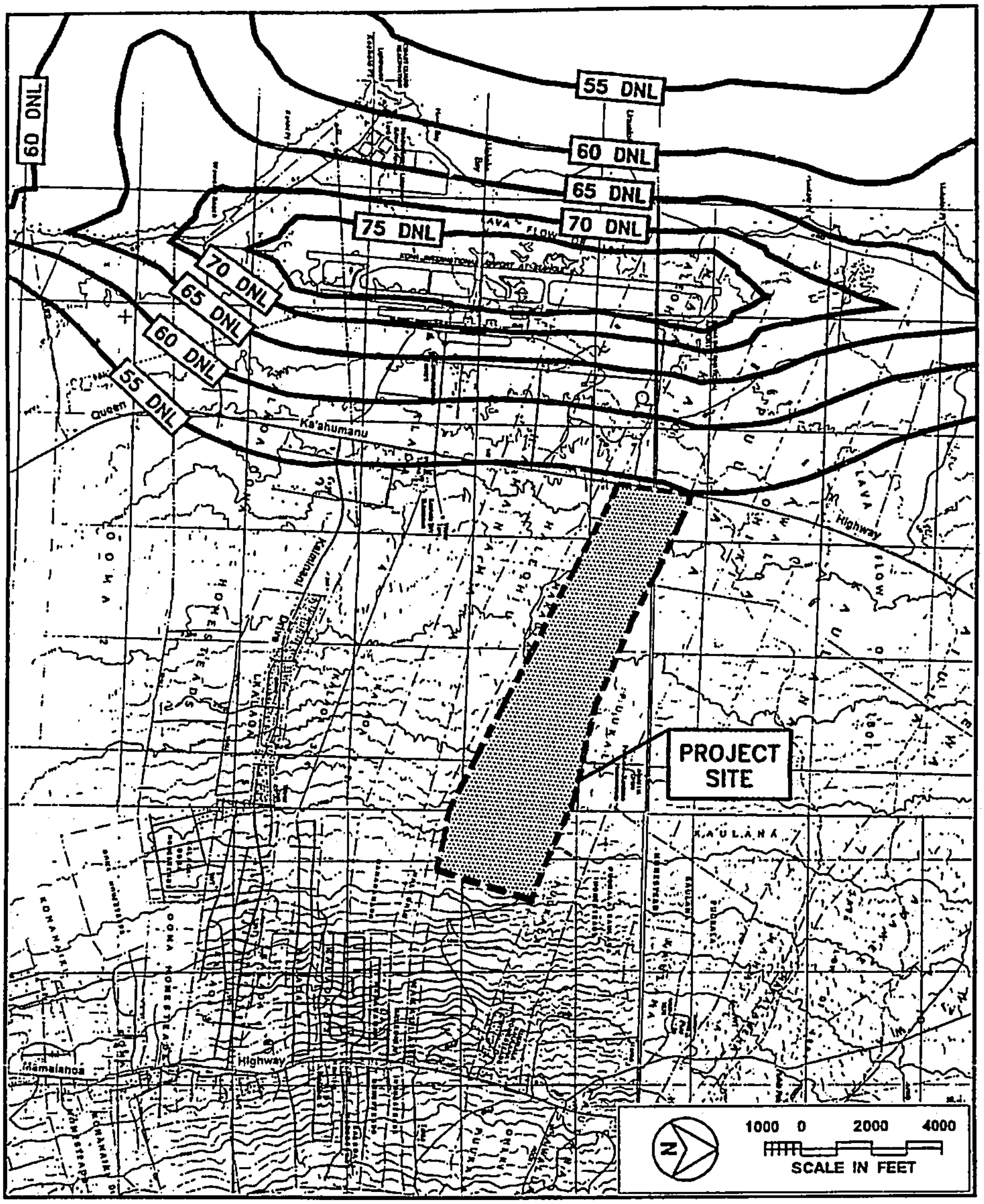
Part 150 Study Updates for Kona International Airport at Keahole. These airport noise contours are shown in Figures 8 and 9. These noise contours may overstate the forecasted aircraft noise levels since they do not include the 100 percent replacement of the noisier DC-9(50) aircraft by the quieter B-717(200) aircraft by Hawaiian Airlines. Nevertheless, the forecasted 2010 and 2020 airport noise contours are expected to remain outside the project area. Based on the relationships of the project site to the forecasted airport noise contours shown in Figures 8 and 9, it was concluded that risks of adverse noise impacts from aircraft noise should be minimal at the project site.

The available forecasts for aircraft noise over the project site indicate that the 55 and 60 DNL contours will not extend into the project site by CY 2010 or 2020 (see Figures 8 and 9). Therefore, unless significant changes occur in the operational activity and forecasts for Kona International Airport at Keahole, the project site is expected to remain outside the 55 and 60 DNL aircraft noise contours through the CY 2020 time period.



LOCATIONS OF CY 2010 AIRCRAFT NOISE CONTOURS (KONA INTERNATIONAL AIRPORT)

FIGURE 8



LOCATIONS OF CY 2020 AIRCRAFT NOISE CONTOURS (KONA INTERNATIONAL AIRPORT)

FIGURE 9

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise. The increases in traffic noise levels attributable to the project from the present to CY 2010 are predicted to range from 1.2 to 1.6 DNL along Queen Kaahumanu Highway, where traffic noise levels are expected to be above 65 DNL along the highway Right-of-Way. These increases in traffic noise levels along Queen Kaahumanu Highway which are attributable to the project are considered to be in the moderate category, and are only slightly higher than the traffic noise increases expected as a result of non-project traffic. In addition, the lands along the highway Right-of-Way are generally vacant in the project environs. For these reasons, traffic noise impacts along Queen Kaahumanu Highway and resulting from project traffic are not considered to be serious. However, setback distances to the 65 DNL contour are expected to increase as a result of both project and non-project traffic.

Relatively small increases (less than 1.0 DNL) in traffic noise levels along the north sections of Mamalahoa Highway are expected to occur as a result of the proposed project. By CY 2010, project traffic is expected to increase traffic noise levels along the north sections of Mamalahoa Highway by approximately 0.5 DNL. This level of increase is not considered significant, and traffic noise impacts resulting from project traffic along these sections of the highway are not expected to occur.

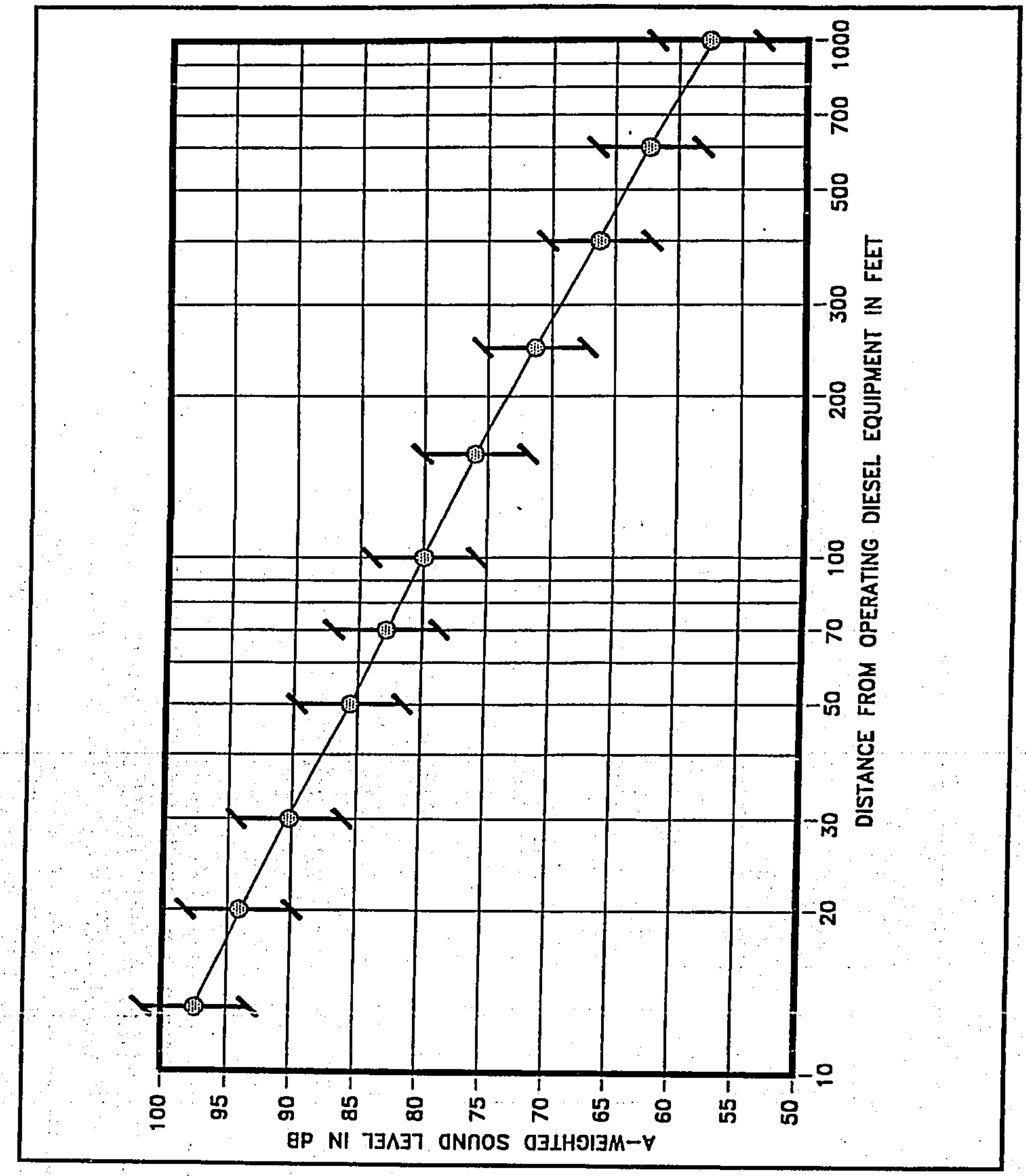
Along the south sections of Mamalahoa Highway, potential noise impacts from project and non-project traffic are possible, both in respect to existing and planned noise sensitive receptors along these roadways. Existing and future residences which are located along the sections of Mamalahoa Highway south of the project's entrance road may be impacted by the future traffic noise along the highway if their setback distances from the highway centerline are less than 141 FT. Because traffic noise along public roadways such as Mamalahoa Highway are generated by non-project as well as project traffic, mitigation of offsite traffic noise impacts are generally performed by individual property owners along the roadways' Rights-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Where adequate setbacks beyond the 65 DNL noise contour are not available, the construction of 6 FT high sound walls is generally effective for attenuating traffic noise at single story structures, or at the ground floors of multistory structures. Whenever mitigation of traffic noise at the upper floors are required, the use of closure and air conditioning, or the use of sound attenuating windows are the more appropriate sound attenuation measures. Along Mamalahoa Highway, the homes are generally well below the highway grade due to the sloped terrain, and for this reason, 6 FT high sound attenuation walls which are located along the west highway Right-of-Way should be effective for traffic noise mitigation.

Aircraft Noise. Based on currently available existing and forecasted aircraft noise contours over the project site, special aircraft noise attenuation measures are not considered mandatory on the project site. The implementation of the airport noise disclosure provisions of Act 208 is not required because the existing and forecasted 55 DNL noise contours do not enter into the project area.

Combined Traffic and Aircraft Noise. When applying for FHA/HUD financial assistance on residential developments, sound attenuation measures are normally required if total exterior noise levels exceed 65 DNL. Traffic noise levels may exceed 65 DNL along the highway corridors and major thoroughfares which service the project. If the traffic noise level equals 65 DNL and the aircraft noise level equals 60 DNL at a project dwelling, the total noise level will be 66 DNL, which exceeds the FHA/HUD standard of 65 DNL. However, existing and forecasted aircraft noise levels over the project site should not exceed 55 DNL. Under these more favorable conditions with aircraft noise levels less than 55 DNL, combined traffic and aircraft noise levels should not exceed 65 DNL when traffic noise levels are less than 65 DNL. Where traffic noise levels exceed 65 DNL, the combined noise levels will be identical to the traffic noise levels and will not be dependent upon the levels of aircraft noise, as long as aircraft noise levels remain at least 10 DNL units below the traffic noise levels.

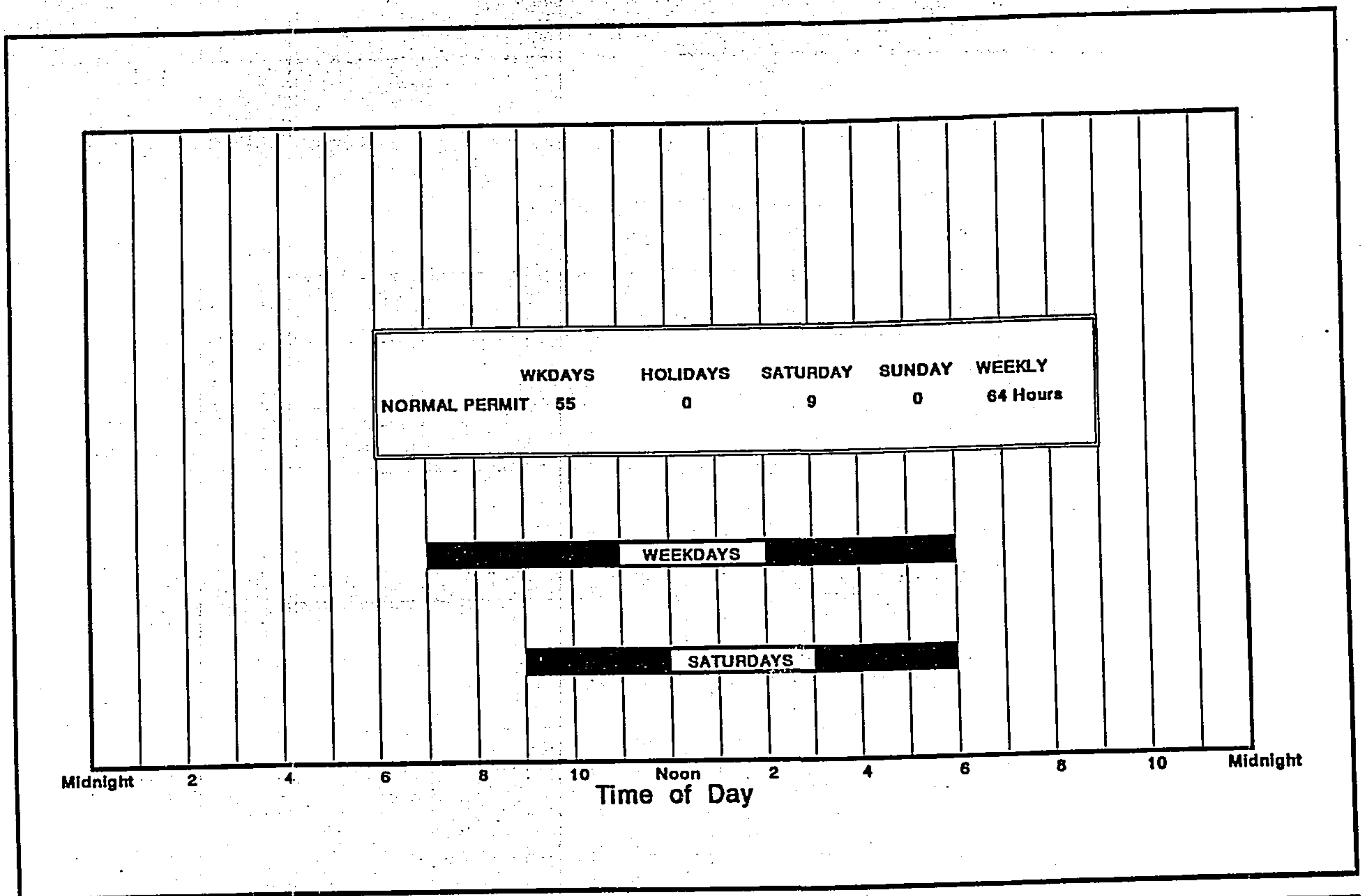
Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 10. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing residences along the project entrance road near the eastern end of the project site. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Hawaii (Reference 6), is another noise mitigation measure which can be applied to this project. Figure 11 depicts the normally permitted hours of construction for normal construction noise as well as the curfew periods for construction noise. Noisy construction activities are not allowed on on Sundays and holidays under the DOH permit procedures.



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 10



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

FIGURE 11

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74- 004; March 1974.

(5) "Mandatory Seller Disclosures in Real Estate Transactions;" Chapter 508D, Hawaii Revised Statutes; July 1, 1996.

(6) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(7) "FAR Part 150 Noise Compatibility Program Report; Kona International Airport At Keahole" State Department of Transportation, Airports Division; December 1997.

(8) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.1 User's Guide (Addendum) of March 2003.

(9) Existing and Future Turning Movements for Hiluhilu Development Project; Austin, Tsutumi & Associates, Inc.; May 14 and June 26, 2003.

(10) 24-Hour Traffic Counts, Station 8-P, Queen Kaahumanu Highway at Keahole Airport Road; State Department of Transportation; June 3, 2002.

Appendix H

Lands of Kau- (North Kona)
Soil Report

Lands of Kau- (North Kona)
Soil Report

By Yusuf N. Tamimi, Ph.D.
(Professor Emeritus of Soil Science)
University of Hawaii at Manoa

Lands of Kau is located immediately above the Kona-Keahole Air Port and extends in a makai-mauka pattern starting at about 200 foot elevation to just below Makalei Estates Subdivision, at an elevation of nearly 1000 feet. The area is composed of about 725 acres of vacant land. This report is based on first hand on-site visits by this investigator on three separate times; twice traversing it from makai to mauka and once from mauka to makai. Observations on several locations along and radiating from a "field road" were recorded, describing the soils, their depth and apparent properties, nature of the terrain, slope, elevation and existing vegetation. Photographs were also taken for documentation. Several sources of information on soils classification, (Soil Survey, Island of Hawaii) land use studies, and report on Agricultural Lands of Importance in the State of Hawaii (ALISH), were also consulted.

Based on soil types, rainfall patterns and the associated plant species, this parcel of the Lands of Kau can be broadly divided into three distinct sections: A. Upper Area, B. Middle Area, and C. Lower Area

A. Upper Area:

This area appears to have been previously cleared. According to the Soil Survey of Island of Hawaii by Sato et al (1973), the upper area is dominated by Punaluu soil series (extremely rocky peat [rPYD] 6-20% slope) with pockets of Kaimu soil series (extremely stony peat [rKED] 6-20% slope) and Pahoehoe land with some weathered volcanic ash and organic residues, which accumulated in low spots. Pockets of lava flows of A'a [rLV] are also observed in this area.

Apparently, the rainfall is sufficient to support the existing biomass, which consists of few tree species, shrubs and some grasses (See picture No.1). This includes ohia, silk oak, mamane, Christmas berry, koa haole, noni, ilima, fountain grass and other unidentified species.

Picture No. 1

Representative area of Section A (Upper Area) of Lands of Kau

Part of this section can be utilized as seasonal pasture with very low animal carrying capacity, (possibly 20 acres/head.). If it is to be developed into productive pasture, it requires establishing fences, developing a reliable and adequate source of water as well as constructing internal roads and livestock watering system and improving the grazing forage species. These investments may not be financially rewarding due to the expected high cost of land renovation as well as the marginal production capabilities of such land due to the very shallow soil and the seasonality of rainfall.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY

SEE FRAME(S)

IMMEDIATELY FOLLOWING

Apparently, the rainfall is sufficient to support the existing biomass, which consists of few tree species, shrubs and some grasses (See picture No.1). This includes ohia, silk oak, mamane, Christmas berry, koa haole, noni, ilima, fountain grass and other unidentified species.

Picture No. 1

Representative area of Section A (Upper Area) of Lands of Kau

Part of this section can be utilized as seasonal pasture with very low animal carrying capacity, (possibly 20 acres/head.). If it is to be developed into productive pasture, it requires establishing fences, developing a reliable and adequate source of water as well as constructing internal roads and livestock watering system and improving the grazing forage species. These investments may not be financially rewarding due to the expected high cost of land renovation as well as the marginal production capabilities of such land due to the very shallow soil and the seasonality of rainfall.

B. Middle Area:

This middle portion, which appears to receive lower rainfall, is dominated by Pahoehoe lava flows [rLW] and Punaluu soil series [rPYD] with pockets of A' a Lava flows [rLV]. The terrain is very rough and inhospitable (Sea picture No.2). A'a lava flows with jagged and clinker rocks with very sharp edges make it dangerous to traverse. The biomass in this section is much less than the upper area. Very few scrubby ohia trees, some cactus, noni, koa haole, fountain grass and few shrubs are found here.

Picture No.2

Representative area of Section B (Middle Area) of Lands of Kau

this section unsuitable for any traditional farming.

C. Lower Area:

As we move down the slope rainfall seems to decrease and the A'a [rLV] and Pahoehoe [rLW] flows dominate the "soil" picture. In this section the rock formations are very rugged, jagged and hard to traverse. Rocky gulches and bare small rocky hills are common to this section. The diversity of plant species here is extremely limited. This may be due to the insufficient rainfall as well as the absence of fine soil material and organic residue, which can store moisture, essential for sustaining plant growth. Most of this section is void of vegetation, but where it exists, fountain grass, few rattlebox, some scrubby koa haole and very few ohia trees are found (Sea picture No. 3)

Picture No. 3

Representative area of Section C (Lower Area) of Lands of Kau

Similar to the above Section B, the lack of soil, the rough and un-even terrain and the low rainfall render this section also unfit for any traditional farming.

General Land Use Classifications:

Two published reports on land use for the State of Hawaii were utilized in this report. One by the University of Hawaii Land Study Bureau: *Detailed Lands Classification – Island of Hawaii (L.S. Bulletin No. 6)* and the other by the

Department of Agriculture of the State of Hawaii: *Agricultural Lands of Importance in the State of Hawaii (ALISH),* [See Appendixes 2 and 3]. According to the Land Study Bureau (Maps No. 1, 5 and 11 not attached) the agricultural productivity rating of this parcel of the Lands of Kau (1000 ft. elevation and lower) was designated as class E, which is a classification given to land with very poor productivity, (see description of classes in Appendix 2). As for the ALISH report, practically all of the land in this parcel was designated to have no agricultural importance. [See ALISH relevant maps and photos in Appendix 3]. Detailed maps in the ALISH report consist of lands of agricultural importance, while maps of several sections, which were classified to have no agricultural significance, were not published in the report (assumingly, to save on expenses). All of the Lands of Kau below the 1000-foot elevation fell in this category, so the attached detailed ALISH map includes only a small section of the land below 1000-foot elevation (see maps in Appendix 3).

Conclusion:

Results of the investigation of the suitability (or lack of it) of the Lands of Kau for agricultural use revealed the following:

1. There is no adequate soil in all of the area, and there is a complete absence of cultivable land in all portions of this parcel.
2. Rainfall appears to be marginal at the upper area and very inadequate to sustain agriculture in the middle and lower sections.
3. The dominantly rocky nature of this area makes it nearly impossible to develop into an economically viable agricultural land without huge investments to provide adequate and reliable water resources and a functional water distribution system as well as complete reshaping of

the landmass, and establishment of suitable roads. The expected high cost of developing such amenities and the uncertainties of profitable returns on such investment may preclude such considerations.

4. Since 1989 when the present owners purchased this land parcel, no agricultural activities were attempted, possibly due to the expected economic futility of such an effort.
5. It is apparent that since this land parcel, as is, appears to have no economic agricultural production capabilities, removing it from its classification as Agricultural Land will have no effect on the agricultural industry of the State of Hawaii.

Appendix -1

References:

1) Soil Survey of Island of Hawaii, State of Hawaii, 1973

By H.H. Sato, W. Ikeda, P. Paeth, R. Smythe, and M. Takahiro, Jr.

United States Department of Agriculture, Soil Conservation Service. In Cooperation with the University of Hawaii Agriculture Experiment Station

Soil Series found on site

From Sato et. al.

Symbol:	Description (soil series)
rLV :	A'a lava flows
rLW:	Pahoehoe lava flows
rPYD:	Punaluu, Extremely rocky peat (6-20 % slope) Well-drained organic soil over A'a lava. It occurs on elevations 0-1000 ft. Mean annual rainfall from 40-60 inches. General vegetation includes guava, guinea grass, and lantana, Christmas berry, not suitable for cultivation. (Sato et. Al. page 48)
rKED:	Kaimu, extremely stony peat (6-20 % slope) Well-drained organic soils over Pahoehoe lava. Elevation range from sea level to 1000 ft. Mean annual rainfall: 60-90 inches.. Vegetation includes koa haole, Christmas berry, guinea grass, natal redtop, sand burr. Used for pasture. (Sato et. Al.Page 22)

Appendix - 2

2) Detailed Land Classification – Island of Hawaii, 1965:

By: H. L. Baker, T. Sahara, T. M. Ryan, Jr., E. T Murabayashi, Jr., A. Y. Ching, Jr., F. N. Fujimura, Jr., and I. Kuwahara, Jr.,

Land Study Bureau, University of Hawaii, Honolulu, Hawaii

L. S. Bulletin No. 6, November 1965

Agricultural Land Suitability Classes:

This is based on agricultural productivity ratings (page 45):

A. Very Good

B. Good

C. Fair

D. Poor

E. Very Poor

Appendix - 3

3) Agricultural Lands of Importance in the State of Hawaii (ALISH) –Island of Hawaii (1977)

Department of Agriculture,

State of Hawaii

The ALISH report characterized the Agricultural lands in the State of Hawaii according to their importance as follows:

Prime Agricultural Land:

Land, which has the soil quality, growing season and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming.

Unique Agricultural Land:

Land that has the special combination of soil quality, location, growing season, and moisture supply and is used to produce sustained high quality and or high yields of specific crop.

Other Important Agricultural Land:

Land other than Prime or Unique Agricultural Land that is also having Statewide or local importance for agricultural use.

Existing Urban Development:

Land, which has been developed for urban type use.

U. S. Government:

Land which is currently under the jurisdiction of the U. S. Government.

All other lands that are mapped different than above are considered to be of no importance for agriculture.

Appendix – 3

ALISH

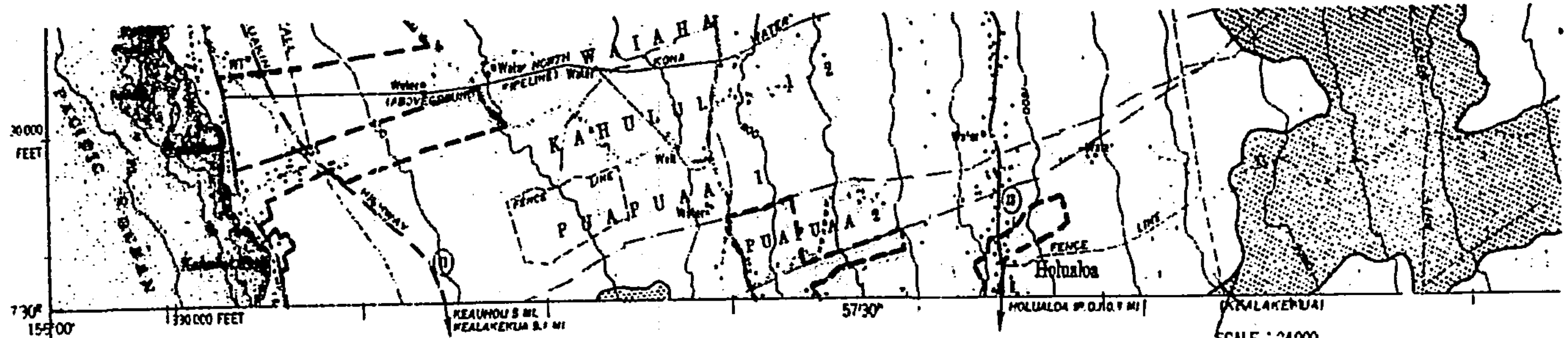
AGRICULTURAL LANDS OF IMPORTANCE TO THE STATE OF HAWAII (REVISED)

Department of Agriculture
State of Hawaii
November, 1977

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 45

To Dr. Tamimi	From Earl
Co.	Co. DOA
Dept.	Phone # 9739466
Fax # 9593101	Fax # 9739467

Appendix-3



SCALE 1:24000

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES IN FEET—DATUM IS MEAN LOWER LOW WATER

APPROXIMATE MEAN DECLINATION, 1959

NOTE:
Base Map taken from photo copy of the published U S Department of Interior Geological Survey Quadrangle Map.

Polyconic projection. Old Hawaiian datum
10,000-foot grid based on Hawaiian coordinate system, zone I
1000-meter Universal Transverse Mercator grid ticks, zone 5

LEGEND:

PRIME AGRICULTURAL LAND - Land which has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods.

UNIQUE AGRICULTURAL LAND - Land that has the special combination of soil quality, location, growing season, moisture supply, and is used to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods.

OTHER IMPORTANT AGRICULTURAL LAND - Land other than Prime or Unique Agricultural Land that is also of statewide or local importance for agricultural use.

EXISTING URBAN DEVELOPMENT - Land which has been developed for urban type use.

U.S. GOVERNMENT Land which is currently under the jurisdiction of the U.S. Government.

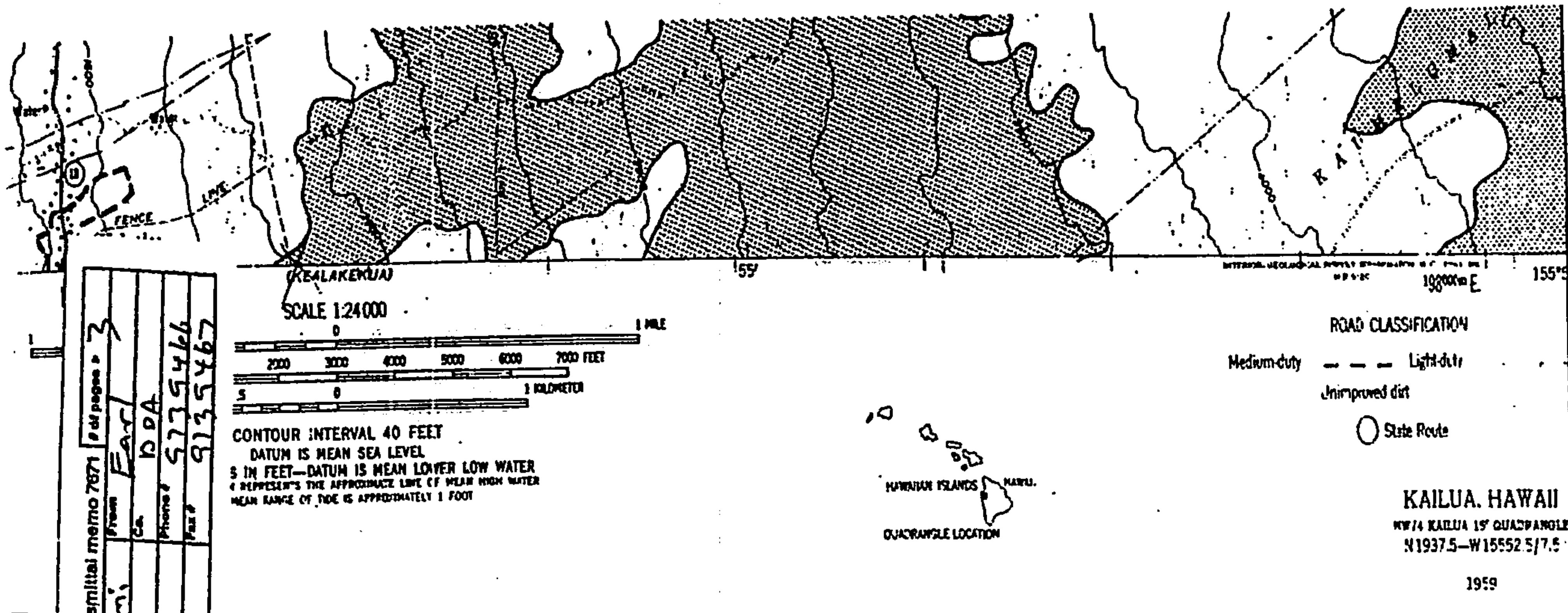
DEPARTMENT O
STATE (

AGRICULTURAL LAN
TO THE STA

ISLAND

11

Appendix-3



Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 3
To Dr. Tamimi | From Earl
Co. | Co. DOA
Dept. | Phone # 5735466
Fax # 9553101 | Fax # 9735467

12

DEPARTMENT OF AGRICULTURE
STATE OF HAWAII

AGRICULTURAL LANDS OF IMPORTANCE TO THE STATE OF HAWAII

ISLAND OF HAWAII

NOTE:

Prepared with the assistance of the Soil Conservation Service, United States Department of Agriculture, and the College of Tropical Agriculture, University of Hawaii.

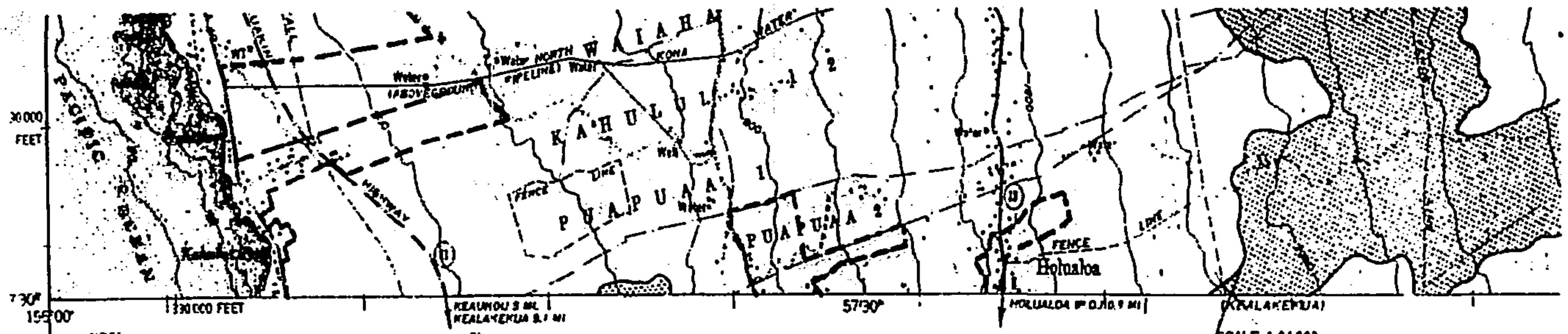
JANUARY, 1977

SHEET: H-7

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

Appendix-3



SCALE 1:24000

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES IN FEET—DATUM IS MEAN LOWER LOW WATER

NOTE:
Base Map taken from photo copy of the published U S Department of Interior Geological Survey Quadrangle Map

Polyconic projection. Old Hawaiian datum
10,000-foot grid based, on Hawaiian coordinate system, zone 1
1000-meter Universal Transverse Mercator grid ticks, zone 5

APPROXIMATE MEAN DECLINATION, 1959

LEGEND:

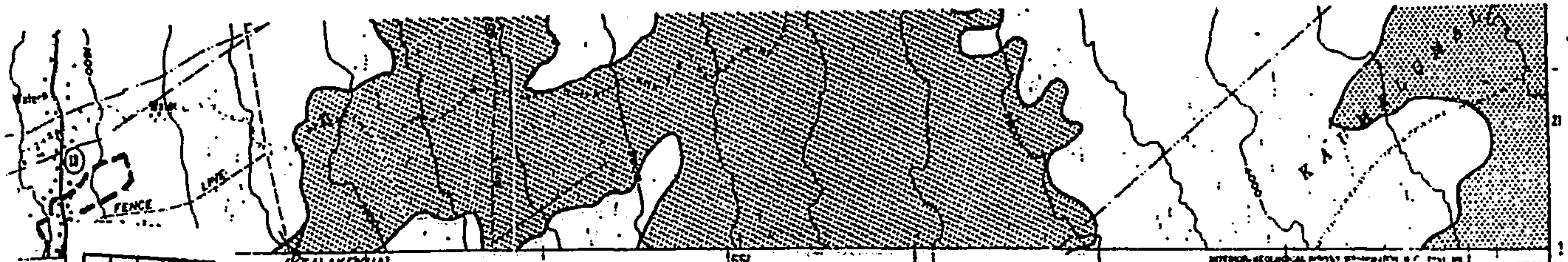
- PRIME AGRICULTURAL LAND – Land which has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods.
- UNIQUE AGRICULTURAL LAND – Land that has the special combination of soil quality, location, growing season, moisture supply, and is used to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods.
- OTHER IMPORTANT AGRICULTURAL LAND – Land other than Prime or Unique Agricultural Land that is also of statewide or local importance for agricultural use.
- EXISTING URBAN DEVELOPMENT – Land which has been developed for urban type use.
- U.S. GOVERNMENT Land which is currently under the jurisdiction of the U.S. Government.

DEPARTMENT O
STATE (

AGRICULTURAL LAN
TO THE STA

ISLAND

Appendix-3



SCALE 1:24000

0 — 1 MILE
2000 3000 4000 5000 6000 7000 FEET
.5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

Medium-duty — — — Light-duty
Unimproved dirt
State Route

KAILUA, HAWAII
NW/4 KAILUA 15' QUADRANGLE
N1937.5—W15552.5/7.5

1959

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 3

To	Dr. Tamimi	From	Earl
Co.		Co.	DOA
Dept.		Phone #	5739466
Fax #	9553101	Fax #	9135467

DEPARTMENT OF AGRICULTURE
STATE OF HAWAII

AGRICULTURAL LANDS OF IMPORTANCE TO THE STATE OF HAWAII

ISLAND OF HAWAII

NOTE:

Prepared with the assistance of the Soil Conservation Service, United States Department of Agriculture, and the College of Tropical Agriculture, University of Hawaii.

JANUARY, 1977

SHEET: H-7

Appendix-3

PREFACE

Nationally, land use management has become a great concern, especially regarding land resources that do or can contribute to our food and fiber needs. The degree of this concern is perhaps best expressed by the efforts of the United States Department of Agriculture's Soil Conservation Service to classify and identify our nation's best farmlands in the interest of preserving these land resources.

Hawaii, having taken the lead in public land use policy with the passage of the nation's first state land use law in 1961, shares this concern and has, as a matter of public policy, worked toward the preservation and development of our agricultural resources. Agricultural Lands of Importance to the State of Hawaii represents further progress in this effort. Adopted by the State Board of Agriculture, this system of identifying agriculturally important lands is intended to provide our decision makers with a valuable tool for use in agricultural preservation, planning and development.

Many thanks go to those who assisted in this project.

John Farias, Jr.
Chairman, Board of Agriculture
State of Hawaii

AGRICULTURAL LANDS OF IMPORTANCE TO THE STATE OF HAWAII

Introduction

In October, 1975, the Soil Conservation Service (SCS) of the United States Department of Agriculture adopted a program to identify the extent and location of the nation's best lands available for the production of food, feed, fiber, forage, and oilseed crops. One of the reasons for such a program was stated as follows:

> "Land use decision makers at all levels need a system for identifying, classifying, inventorying, and mapping those lands with highest (agricultural) production potential."[1]

The adoption of this program and the requirement that it be conducted in cooperation with other interested agencies at the national, state, and local levels of government provided the State of Hawaii with the opportunity to classify all its lands from an agricultural perspective, and be the first state in the nation to do so.

A classification system and criteria for classification were developed by an ad hoc committee comprised of representatives from the Soil Conservation Service, the University of Hawaii's College of Tropical Agriculture, the State Rural Development Committee, the State of Hawaii Departments of Agriculture, Planning and Economic Development, and Land and Natural Resources.

The classification system and criteria developed by the committee was adopted by the Board of Agriculture, State of Hawaii, on January 28, 1977. It delineates those lands of the State which are of agricultural importance and, within this delineation, categorizes agricultural lands according to specific criteria.

The three major categories of agricultural land have been plotted on standard USGS quad maps at a scale of 1:24000 for the entire State of Hawaii. The maps are available for reference use at local county Soil Conservation Service offices.

1 Recommendations on Prime Lands, U. S. Department of Agriculture, July 1975

Appendix-3

The Classification System

The classification system for identification of agriculturally important lands in the State of Hawaii provides for the:

1. Establishment of classes of agricultural lands primarily, but not exclusively, on the basis of soil characteristics;
2. Establishment of criteria for classification of lands; and
3. Identification of lands which meet the criteria for the respective classes.

Three classes of agriculturally important lands were established for the State of Hawaii with the intent of facilitating the SCS effort to inventory prime farmlands nationally and adapting the classification to the types of agricultural activity in Hawaii. These classes and their corresponding SCS (national) equivalents are:

HAWAII CLASSIFICATION SYSTEM	SCS CLASSIFICATION SYSTEM
Prime Agricultural Land	Prime Farmland
Unique Agricultural Land	Unique Farmland
Other Important Agricultural Land	Additional Farmland of Statewide & Local Importance

The criteria for classification of PRIME AGRICULTURAL LAND are identical to the criteria established by SCS for national application. The criteria for UNIQUE AGRICULTURAL LAND and OTHER IMPORTANT AGRICULTURAL LAND were established cooperatively by the Soil Conservation Service in Hawaii, the College of Tropical Agriculture, and the State Department of Agriculture.

Land considered for classification may or may not currently be in agricultural use, or may be in an agricultural use other than that which its classification may indicate as its agricultural capability. An example of the latter situation is land currently being used for grazing but which meets the criteria for Prime Agricultural Land. Lands not considered for classification as agricultural lands of importance to the State of Hawaii are:

1. Developed urban land over 10 acres;
2. Natural or artificial enclosed bodies of water over 10 acres;
3. Forest reserves;
4. Public use (parks and historic sites) lands;
5. Lands with slopes in excess of 35%; and
6. Military installations, except undeveloped areas over 10 acres.

The classification of agriculturally important lands does not in itself constitute a designation of any area to a specific land use. The classification should, however, provide decision makers with an awareness of the long-term implications of various land use options for production of food, feed, forage, and fiber crops in Hawaii.

Over time new areas may be developed for agricultural uses, other areas may be converted to irreversible non-agricultural uses, and new knowledge may be gained regarding soil interpretations. These and other developments will necessitate the periodic review and revision of the classification system and lands identified for the various classes.

The Criteria for Classification

PRIME AGRICULTURAL LAND

PRIME AGRICULTURAL LAND is land best suited for the production of food, feed, forage, and fiber crops. The land has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

PRIME AGRICULTURAL LAND meets the following criteria:

1. The soils have an adequate moisture supply. Included are:
   a. Soils having aquic or udic moisture regimes.[2] These soils commonly are in humid or subhumid climates that have well distributed rainfall or have enough rain in the summer that the amount of stored moisture plus rainfall is approximately equal to or exceeds the amount of potential evapotranspiration. Water moves through the soil at some time in most years.
   b. Soils having xeric or ustic moisture regimes and in which the available water capacity is great enough to provide adequate moisture for the commonly grown crops in 7 or more years out of 10.
   c. Soils having aridic or torric moisture regimes and the area has a developed irrigation water supply that is dependable and of adequate quality. Also included are soils having xeric or ustic moisture regimes in which the available water capacity is limited but the area has a developed irrigation water supply that is dependable and of adequate quality.
   d. Soils having sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone if the root zone is less than 40 inches deep, to produce the commonly grown crops in 7 or more out of 10 years.

   A dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown.

2 For definitions of moisture regimes see Soil Taxonomy, Agricultural Handbook 436, December 1975.

Appendix-3

2. The soils have a soil temperature regime that is isomesic, isothermic, or isohyperthermic. These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 47°F (8°C); and the difference between the mean summer and mean winter temperature differ by less than 90°F (5°C).

3. The soils have a pH between 4.5[3] and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep. This range of pH is favorable for growing a wide variety of crops without adding large amounts of amendments.

4. The soils have no water table or a water table that is maintained at a sufficient depth during the cropping season to allow crops common to the area to be grown.

5. The soils can be managed so that in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15.

6. The soils are not flooded frequently during the growing season (less often than once in 2 years).

7. The soils have a product of K (erodibility factor) x percent slope of less than 2.0. That is, soils having a serious erosion hazard are not included.

8. The soils have a permeability rate of at least 0.06 inches (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual soil temperature at a depth of 20 inches is less than 57°F (14°C). Permeability rate is not a limiting factor if the mean annual soil temperature is 57°F (14°C) or higher.

9. Less than 10 percent of the surface layer in these soils consists of rock fragments coarser than 3 inches (7.6 cm). These soils present no particular difficulty in cultivating with large equipment.

10. Must not be thixotropic and have isomesic temperature regime.

UNIQUE AGRICULTURAL LAND

UNIQUE AGRICULTURAL LAND is land other than PRIME AGRICULTURAL LAND and is used for the production of specific high-value food crops. The land has the special combination of soil quality, growing season, temperature, humidity, sunlight, air drainage, elevation, aspect, moisture supply, or other conditions, such as nearness to market, that favor the production of a specific crop of high quality and/or high yield when the land is treated and managed according to modern farming methods. In Hawaii, some examples of such crops are coffee, taro, rice, watercress and non-irrigated pineapple.

Land that qualifies as PRIME AGRICULTURAL LAND and is used for a specific high-value crop is classified as PRIME AGRICULTURAL LAND rather than as UNIQUE AGRICULTURAL LAND.

OTHER IMPORTANT AGRICULTURAL LAND

OTHER IMPORTANT AGRICULTURAL LAND is land other than PRIME or UNIQUE AGRICULTURAL LAND that is of state-wide or local importance for the production of food, feed, fiber, and forage crops. The lands in this classification are important to agriculture in Hawaii yet they exhibit properties, such as seasonal wetness, erodibility, limited rooting zone, slope, flooding, or droughtiness, that exclude them from the PRIME or UNIQUE AGRICULTURAL LAND classifications. Two examples are lands which do not have an adequate moisture supply to qualify as PRIME AGRICULTURAL LAND and lands which have similar characteristics and properties as UNIQUE AGRICULTURAL LAND except that the land is not currently in use for the production of a "unique" crop. These lands can be farmed satisfactorily by applying greater inputs of fertilizer and other soil amendments, drainage improvement, erosion control practices, flood protection and produce fair to good crop yields when managed properly.

Other criteria which may qualify lands as OTHER IMPORTANT AGRICULTURAL LAND are:

1. The land has slopes less than 20%, is presently in crop or has cropping potential, and is not classified as PRIME or UNIQUE AGRICULTURAL LAND. The soils have a moisture supply which is adequate for the commonly grown crop.

2. The land has slopes less than 35%, is presently used for grazing or has grazing potential, and is not classified as PRIME or UNIQUE AGRICULTURAL LAND. The soils have:
   a. An aquic, udic, xeric, or ustic moisture regime in which the available water capacity is sufficient to produce fair to good yields of adapted forage.
   b. Less than 10% rock outcrops and coarse fragments coarser than 3 inches (7.6 cm) in the surface layer.

3. The soils are thin organic soils underlain by aa lava (typic tropofolists) having aquic, udic, xeric, or ustic moisture regimes and isohyperthermic (greater than 72° F) or isothermic (59°-72° F) soil temperature regimes.

[3] Soils which have a pH of less than 4.5 in surface soil because of use of fertilizers are excluded.

Appendix 3

Ad Hoc Committee Membership

Dr. Harold L. Baker, Agricultural Economist, College of Tropical Agriculture, and former Director, Land Study Bureau, University of Hawaii

Dr. Haruyoshi Ikawa, Associate Soil Scientist, College of Tropical Agriculture, University of Hawaii

Blaine Bradshaw, Community Development Specialist, Cooperative Extension Service, College of Tropical Agriculture, University of Hawaii and Executive Secretary, State Rural Development Committee

Oran F. Bailey, Former State Soil Scientist (Hawaii), Soil Conservation Service, United States Department of Agriculture

Richard Huff, State Soil Scientist (Hawaii), Soil Conservation Service, United States Department of Agriculture

Harry Sato, Soil Specialist, Soil Conservation Service, United States Department of Agriculture

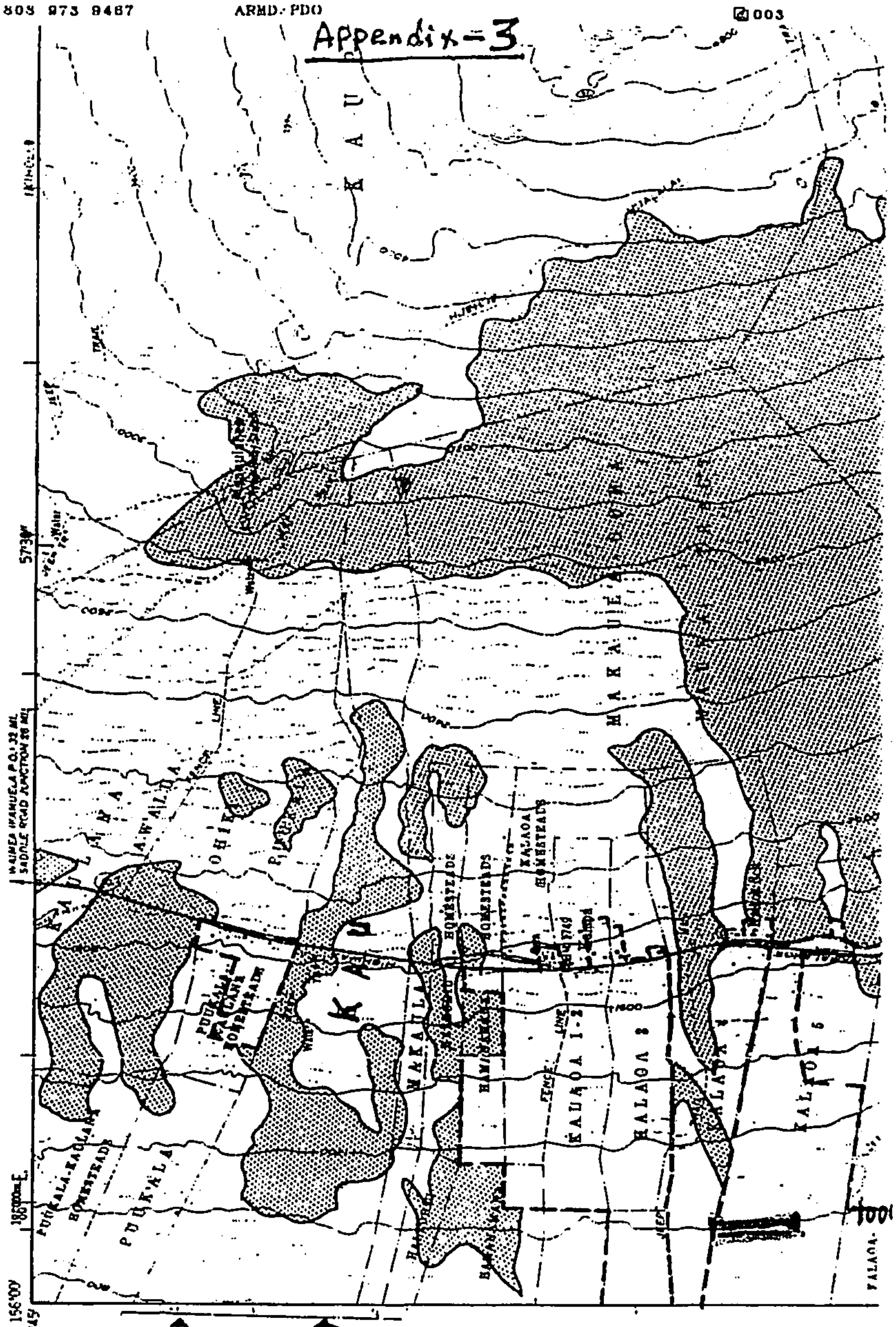
Tatsuo Fujimoto, Chief, Land Use Division, Department of Planning and Economic Development, State of Hawaii

Robert Merriam, Resource Management Forester, Division of Forestry, Department of Land and Natural Resources, State of Hawaii

Robert K. Miura, Agricultural Analyst, Planning and Development Office, Department of Agriculture, State of Hawaii

Appendix-3

ALISH



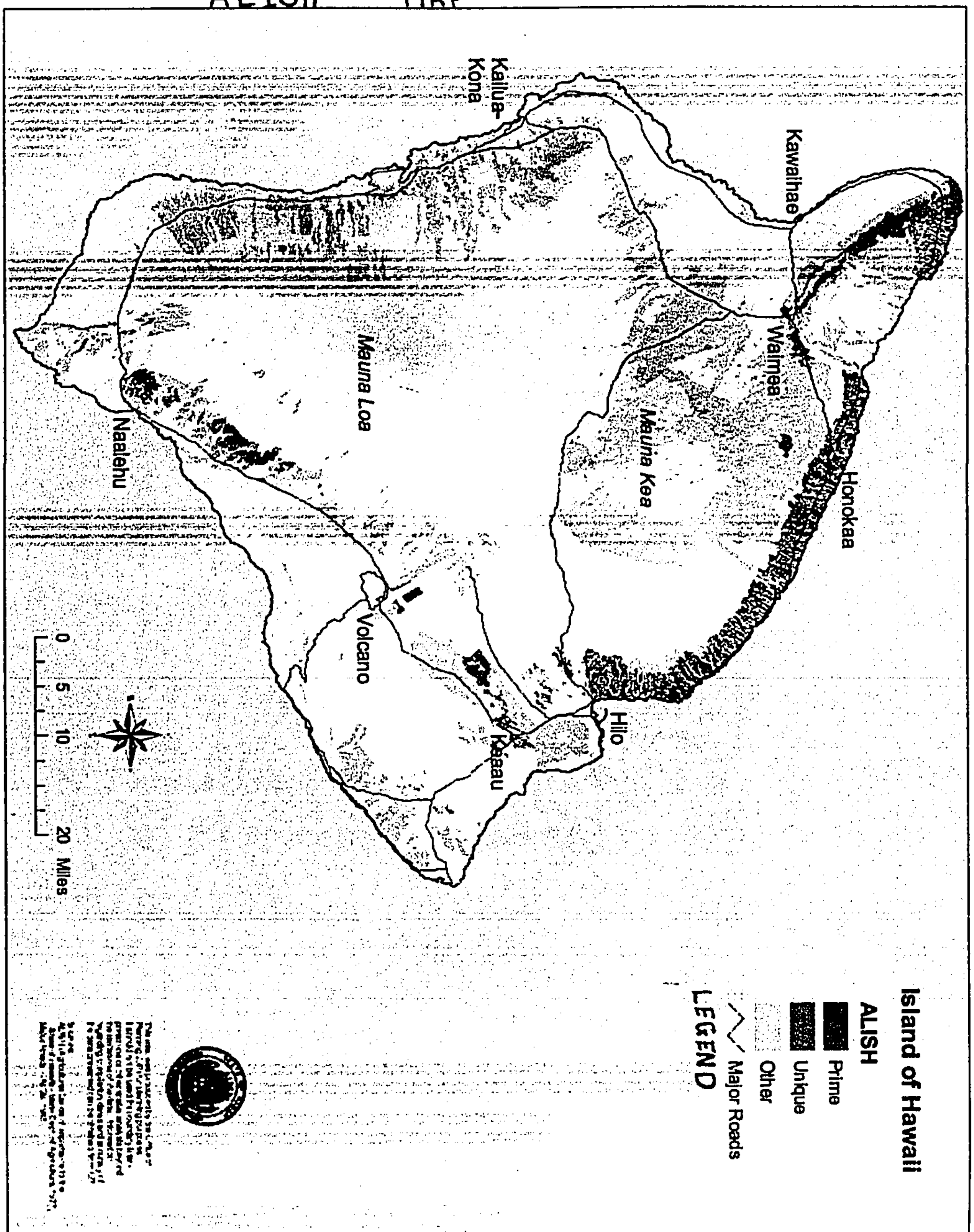
TMK 7-2-5-1 is the Ahupua'a of Kau

7-2-05:01

-MK//

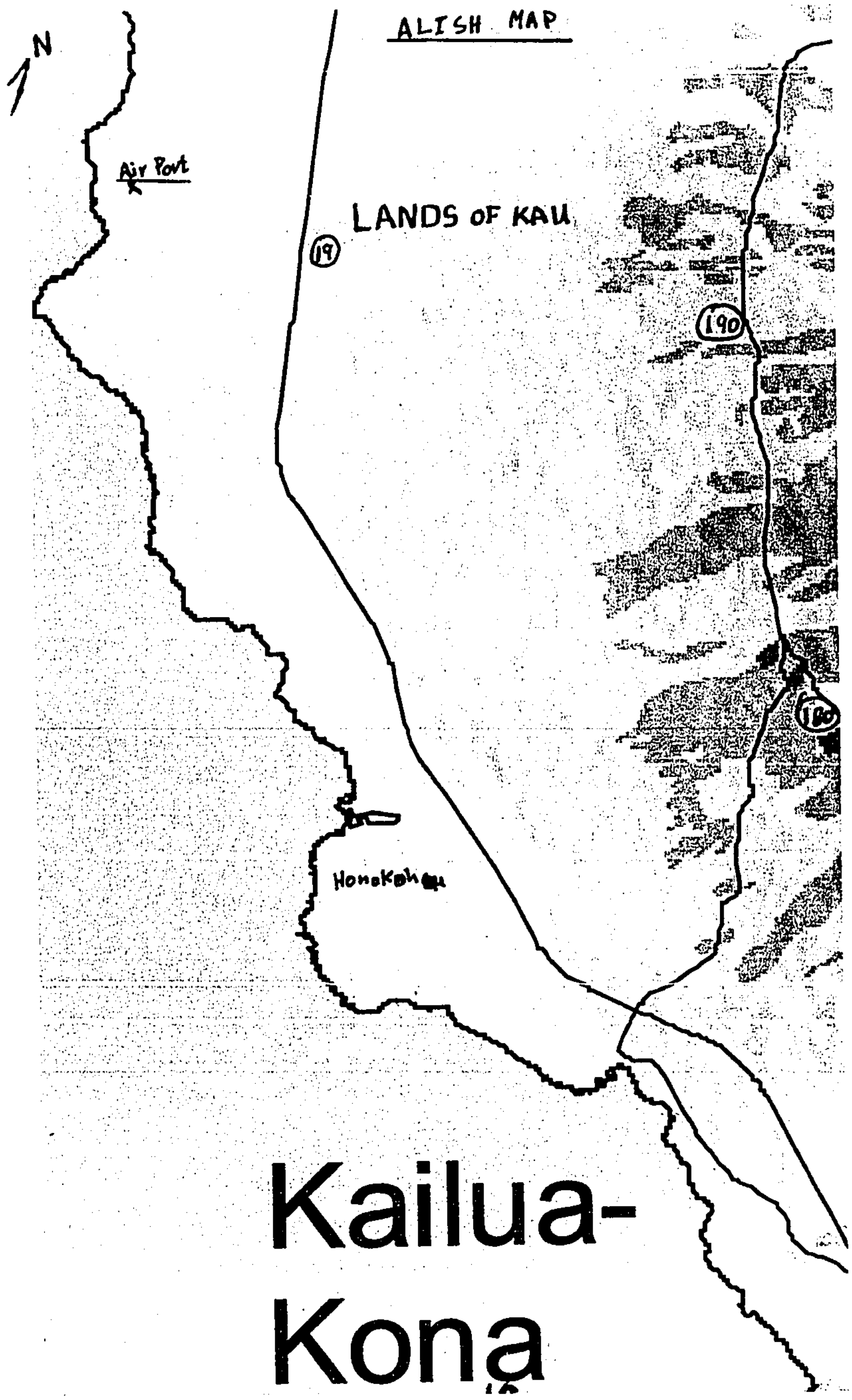
Appendix- 3

ALISH MAP



Appendix-5

ALISH MAP



Appendix - 4

Some vegetation found in the investigated area:

Common Name	Scientific Name
Cactus	Opuntia ficus-indica
Christmas berry	Schinus terebinthifolius
Fountain grass	Pennisitum setaceum
Ilima	Sida fallax
koa haole	Leucaena leucocephala
Mamane	Sophora chrisophylla
Noni.	Morinda citrifolia
Ohia	Metrosideros polymorpha
Rattlebox	Crotalaria mucronata
Silk oak	Gravillea robusta

Appendix I

Market Evaluation of Hiluhilu Project
and University Village Development
Opportunities

KNOWLEDGE BASED CONSULTING GROUP

19 Holly Ave.
Larkspur, CA 94939
(415) 924-6577
clivej@sbcglobal.net

Market Evaluation of Hiluhilu Project and University Village Development Opportunities

Prepared for

Hiluhilu Development Company

Prepared by

Knowledge Based Consulting Group, in association with THK Associates

July 2003

SECTION I
INTRODUCTION

Knowledge Based Consulting Group (KBCG) and THK Associates were retained by Hiluhilu Development to prepare an analysis of residential and commercial development opportunities associated with its proposed golf course community and University Village project on the island of Hawaii. The scope of work included

- Prepare a market analysis for residential and commercial land uses at the Hiluhilu Development site.
- Recommend real estate development programming and marketing guidelines as well as modifications to the concept plan that could increase market value and acceptance.
- Consider the inclusion of a University of Hawaii magnet campus on adjacent property and how it would augment the Hiluhilu Development program.
- Estimate the economic impact of the project

Following this Introduction, Section II presents an overview of Hawaii real estate trends. Section III presents the market analysis, while Section IV provides a summary of the consumer response to the University Village concept. Section V summarizes expected product absorption and pricing recommendations.

KBCG and THK appreciate the opportunity to present these findings and recommendations.

SECTION II

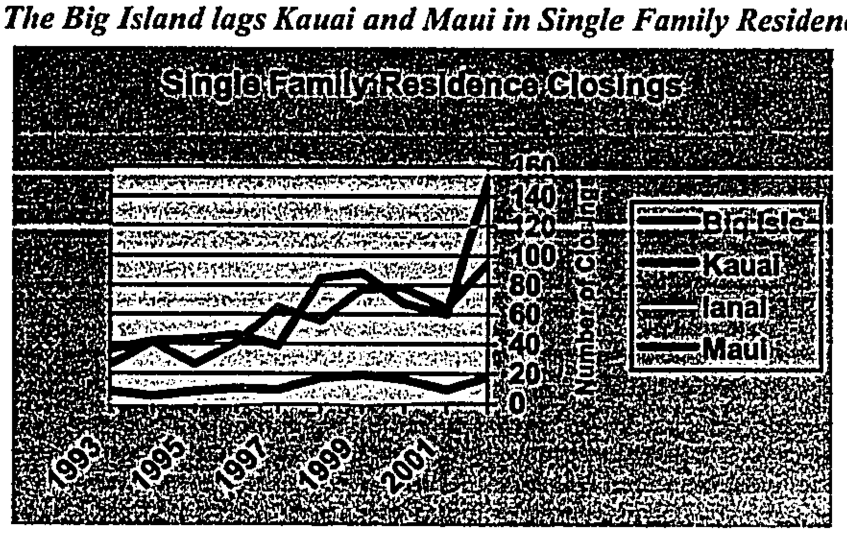
MARKET OVERVIEW, REAL ESTATE TRENDS IN HAWAII MASTER PLANNED COMMUNITIES

Since the focus of this research is to understand the market opportunities for a new master planned community on the Big Island, KBCG reviewed both long and short term real estate trends for master planned communities on the Big Island and the rest of Hawaii. For the Big Island, these communities included Hokulia, Hualalai, Keauhou, Kukio, Mauna Kea, Mauna Lani, and Waikoloa. Importantly, by nearly every measure, the Big Island has seen good growth in its real estate activity in recent years, however it has been losing market share to Maui and Kauai over the past two years.

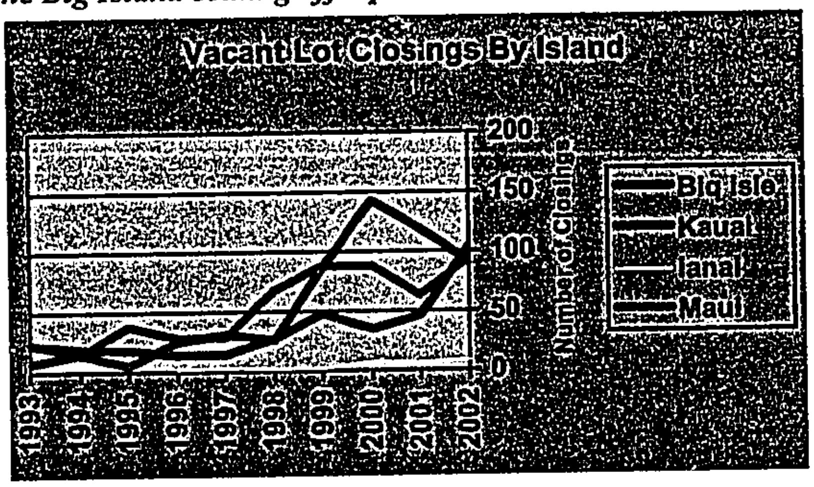
REAL ESTATE CLOSINGS

The Big Island is #3 in overall real estate closings, behind Maui and Kauai. Since 1999, there have been about 300 closings per year in the Big Island master planned communities.

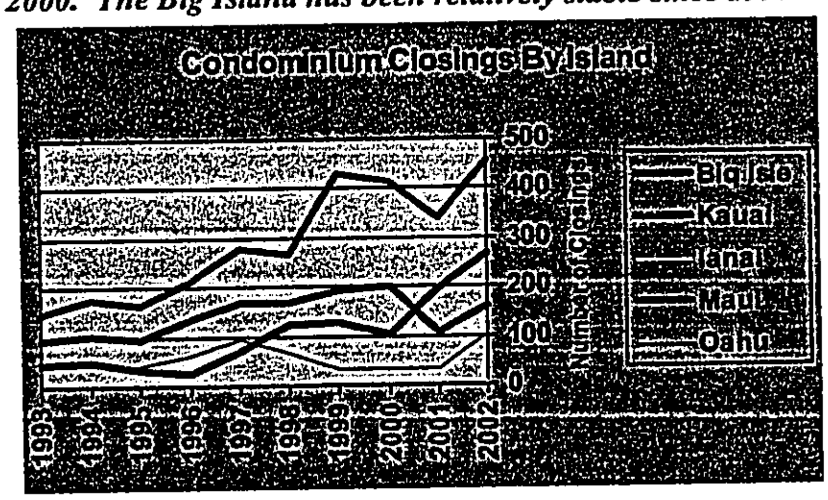
The Big Island lags Kauai and Maui in Single Family Residence Closings



For vacant lots, Kauai, Maui, and Big Island closings were essentially the same in 2002, with the Big Island coming off a peak in 2000.



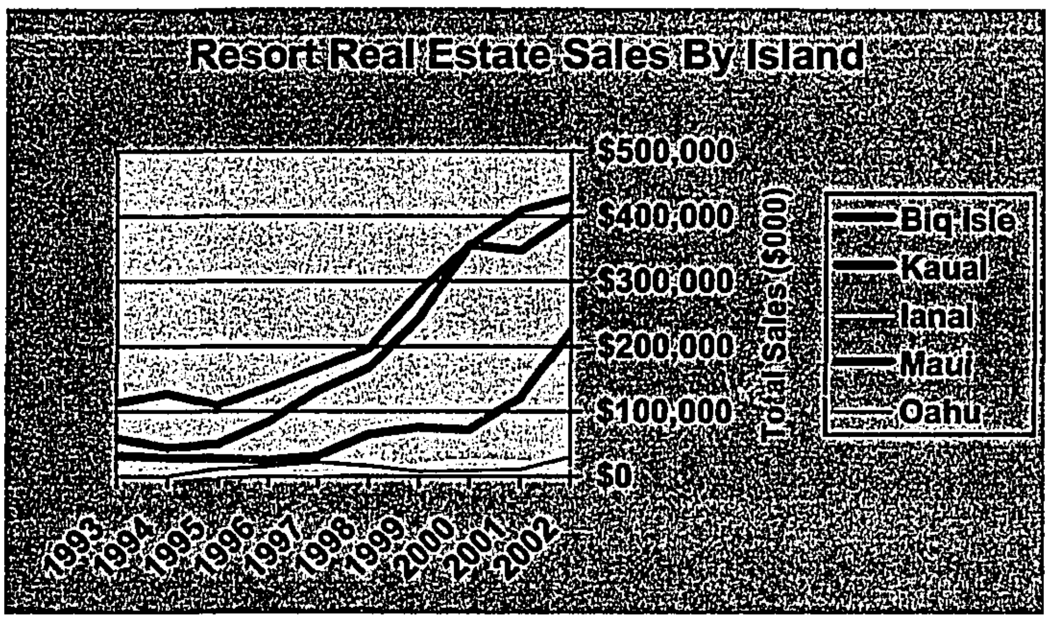
Maui continues to lead in condominium closings, but Kauai has shown healthy gains since 2000. The Big Island has been relatively stable since 1997



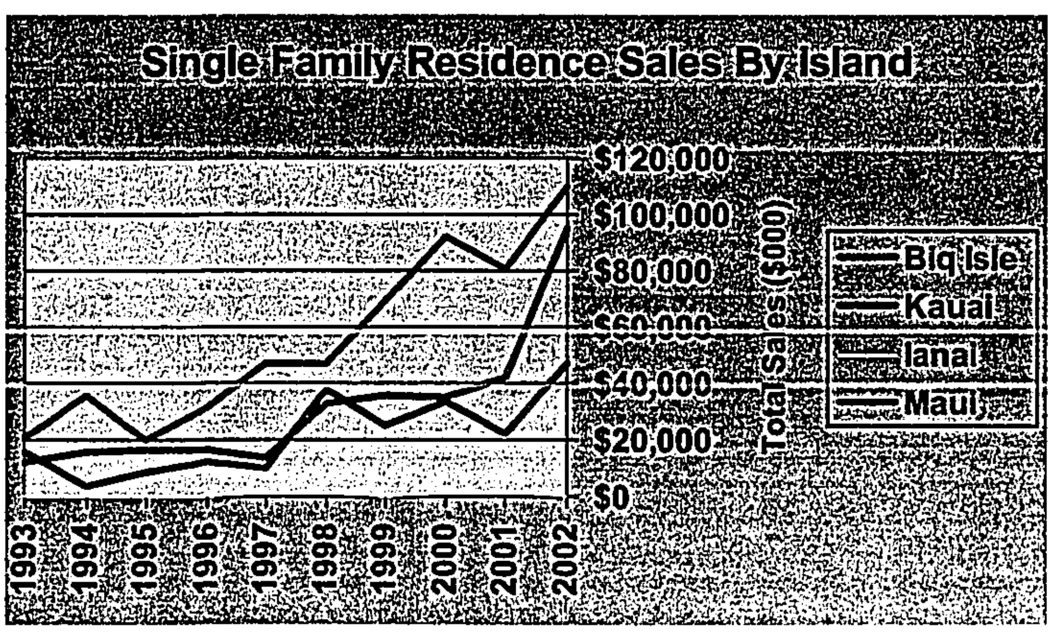
REAL ESTATE SALES VOLUME

For the first time, in 2002 total real estate sales exceeded $1 billion for the selected master planned communities.

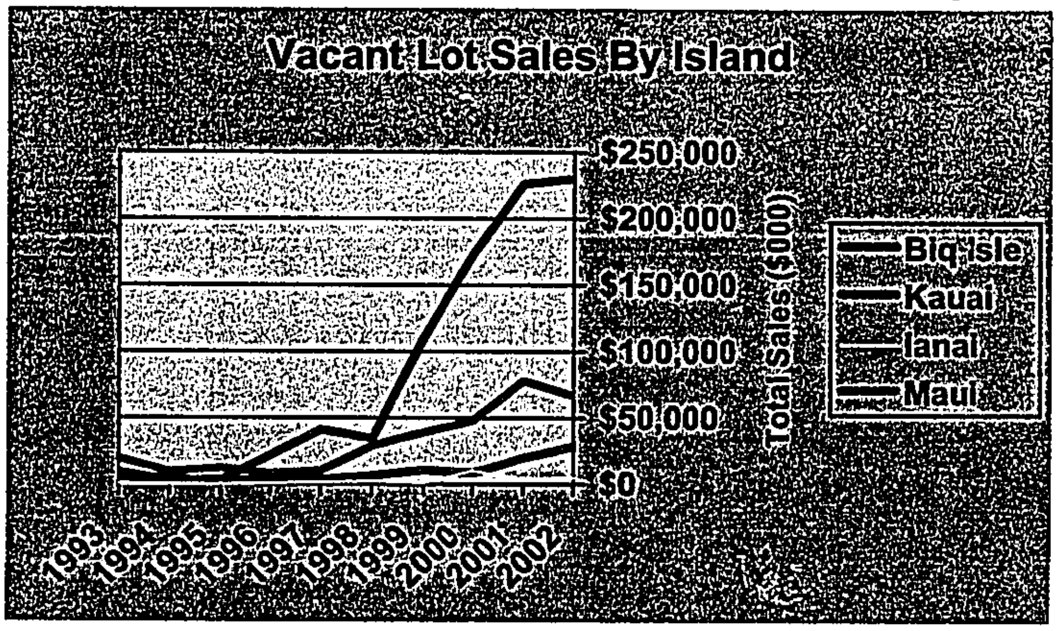
The Big Island and Maui are relatively equal in overall master planned community real estate sales.



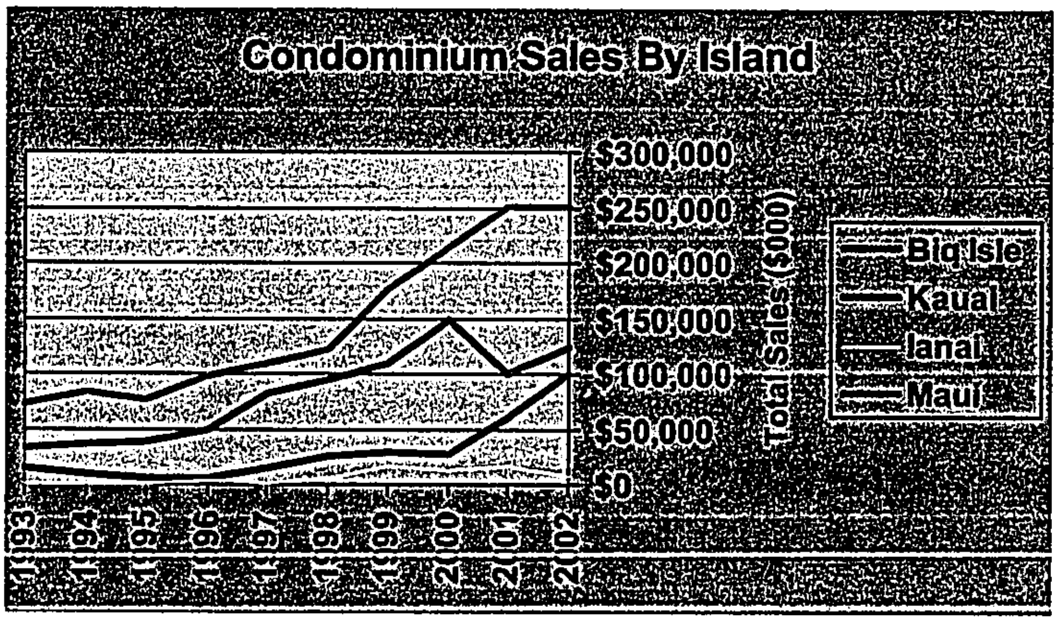
The Big Island is #3 in single family sales volume in master planned communities, averaging about $25 million to $40 million in annual sales volume.



The Big Island is by far the leader in vacant lot sales volume at master planned communities.

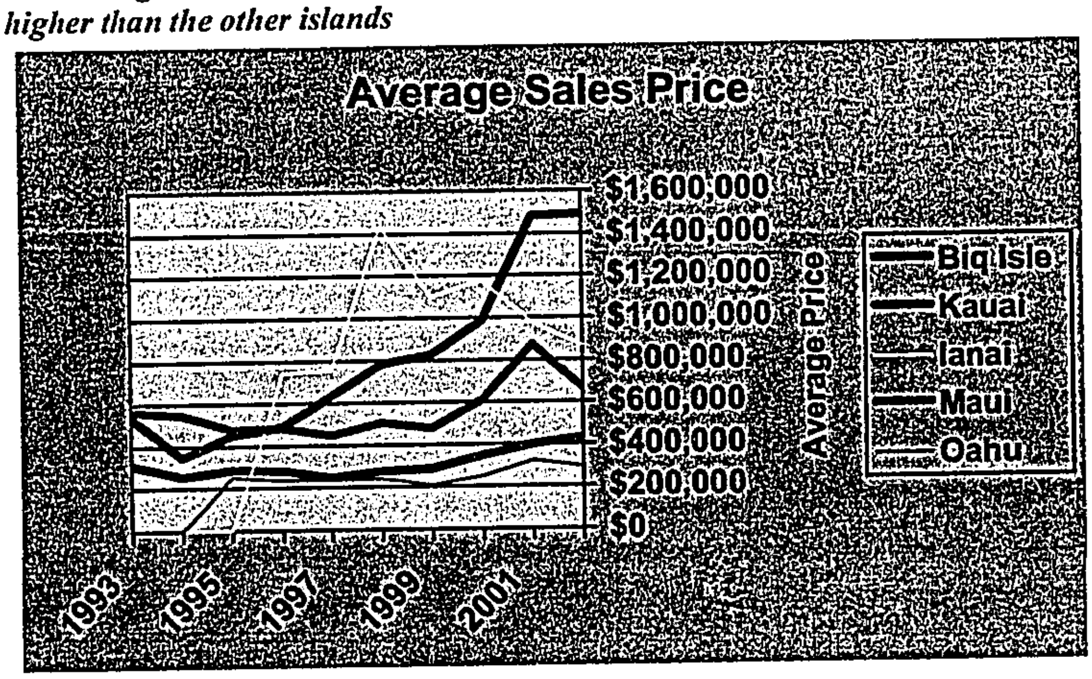


Maui is the leader in condominium sales volume.

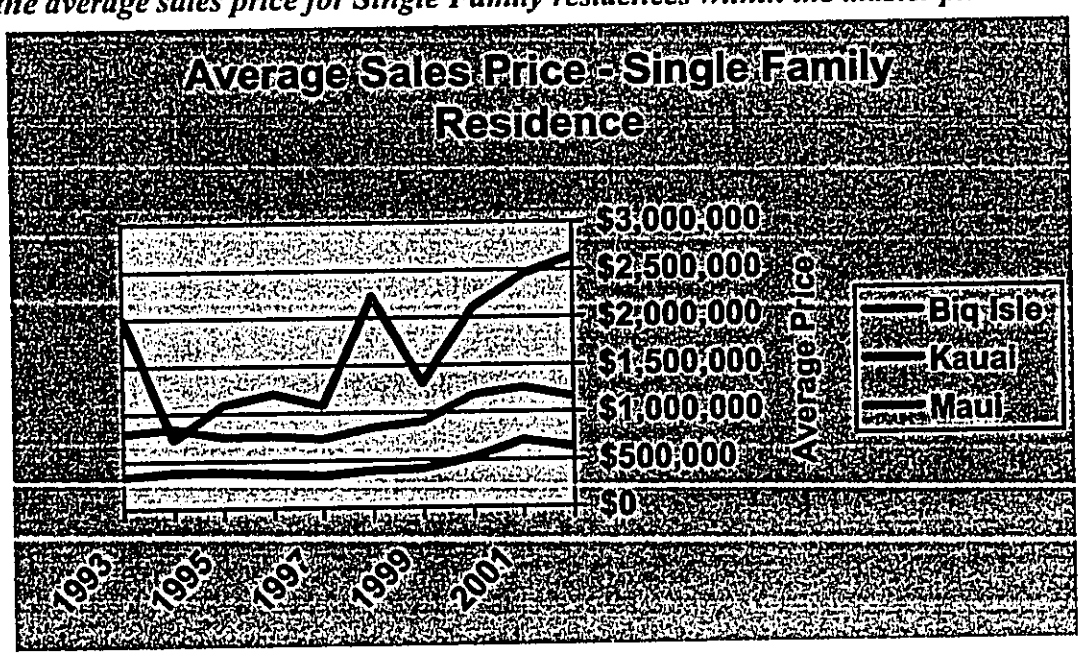


Average Prices

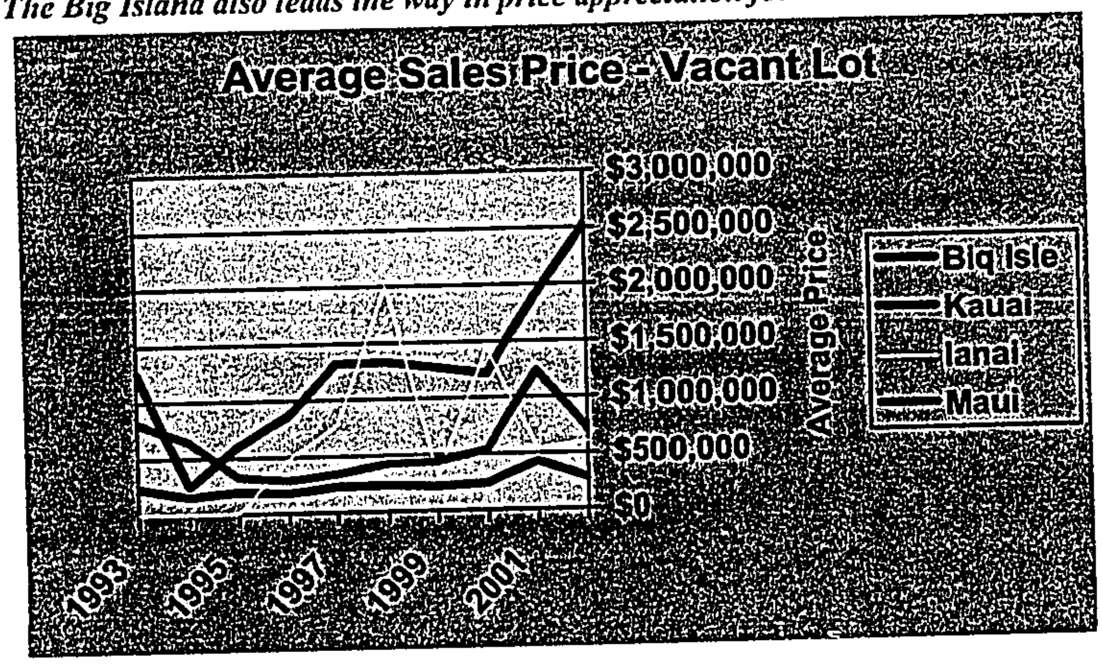
The average real estate values at Big Island master planned communities are substantially higher than the other islands



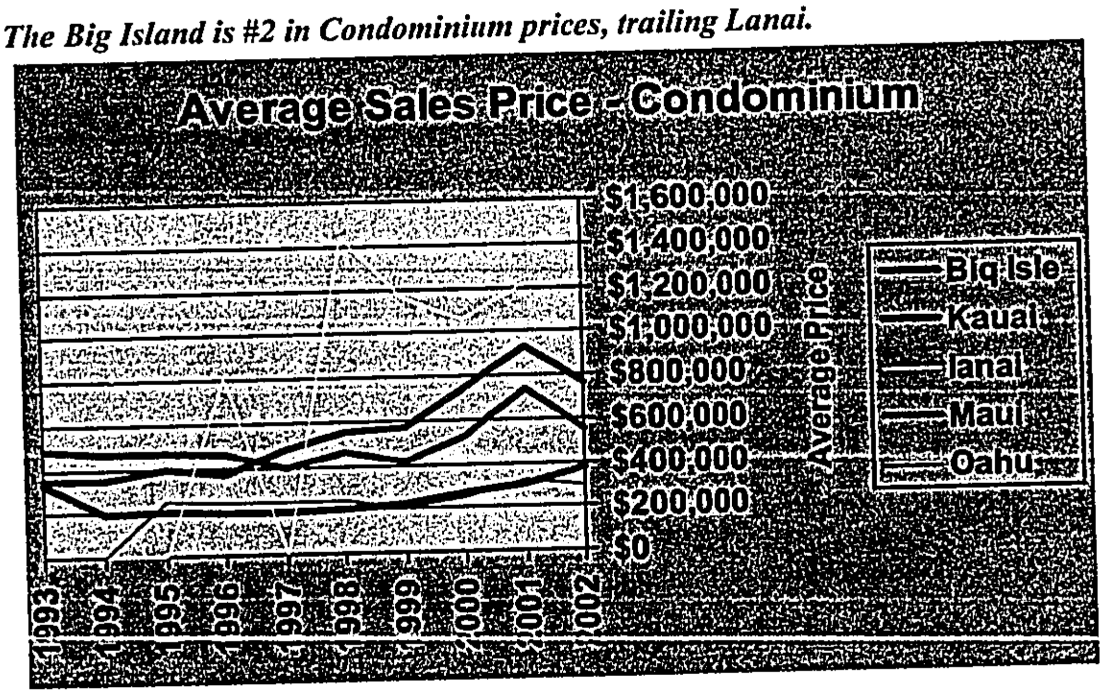
Ever since the opening of Hualalai in 1997, the Big Island has shown a dramatic increase in the average sales price for Single Family residences within the master planned communities.



The Big Island also leads the way in price appreciation for vacant lots

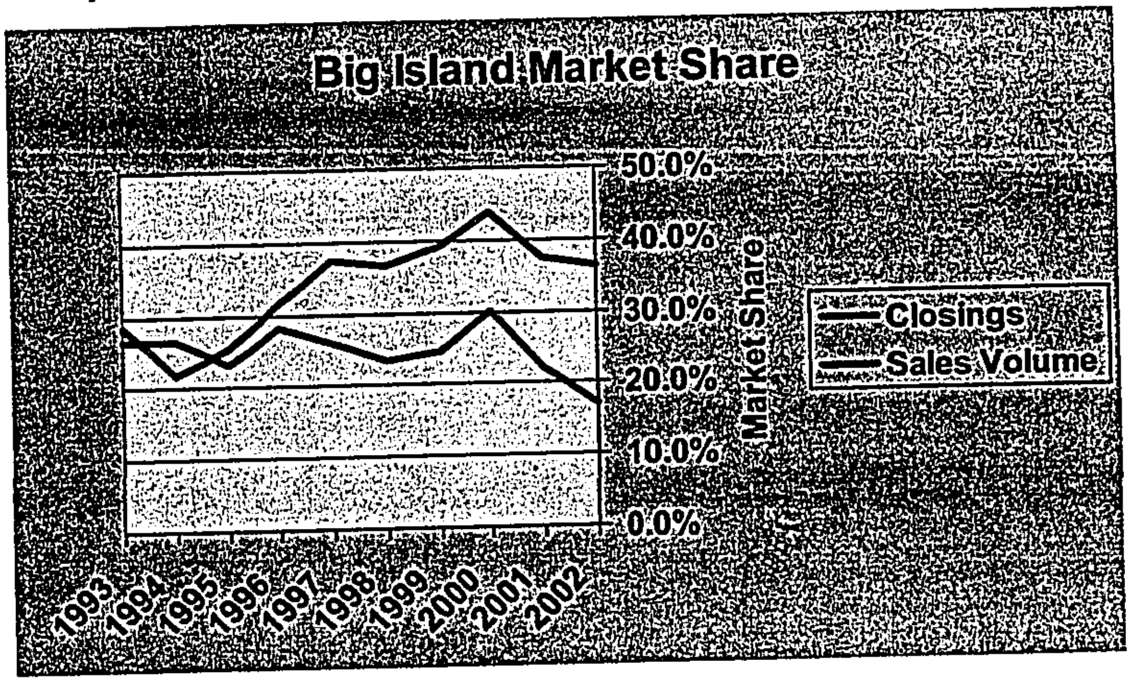


The Big Island is #2 in Condominium prices, trailing Lanai.

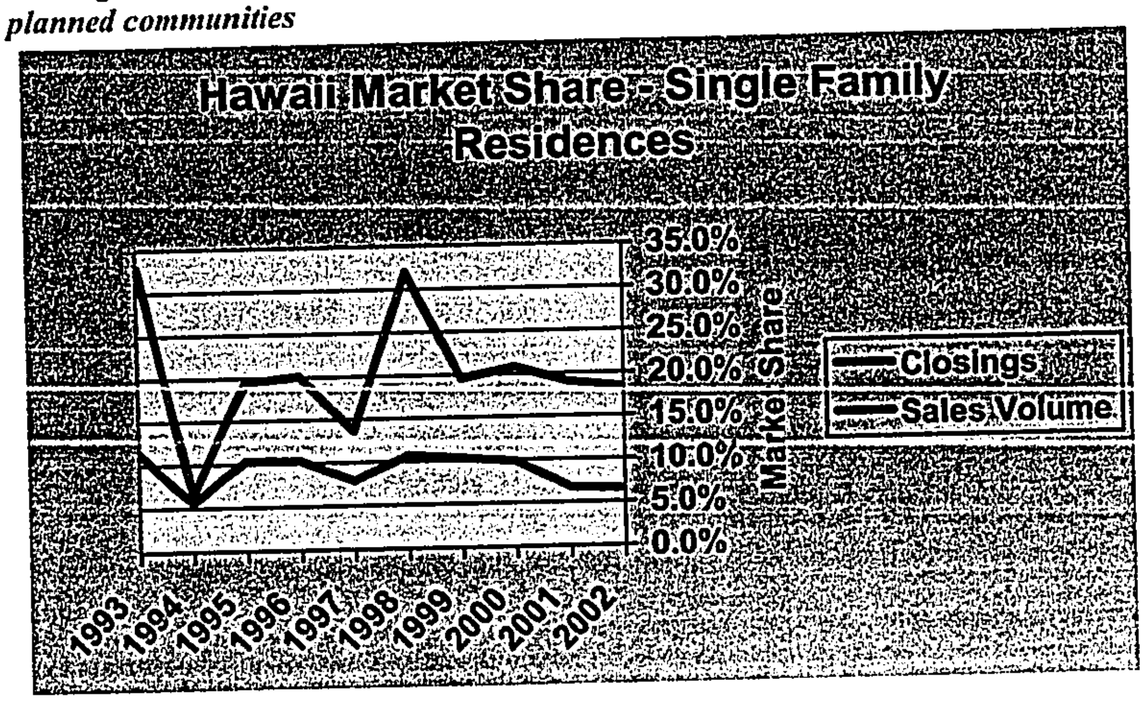


MARKET SHARE

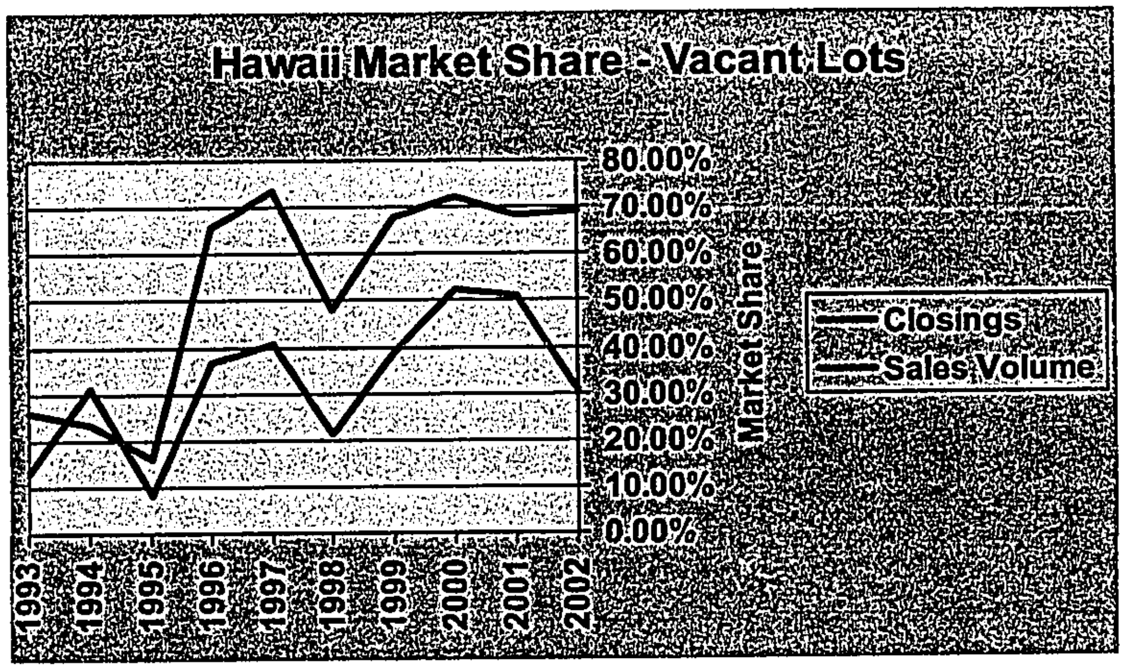
The Big Island has seen a decline in market share for real estate closings and sales volume at master planned communities over the past two years



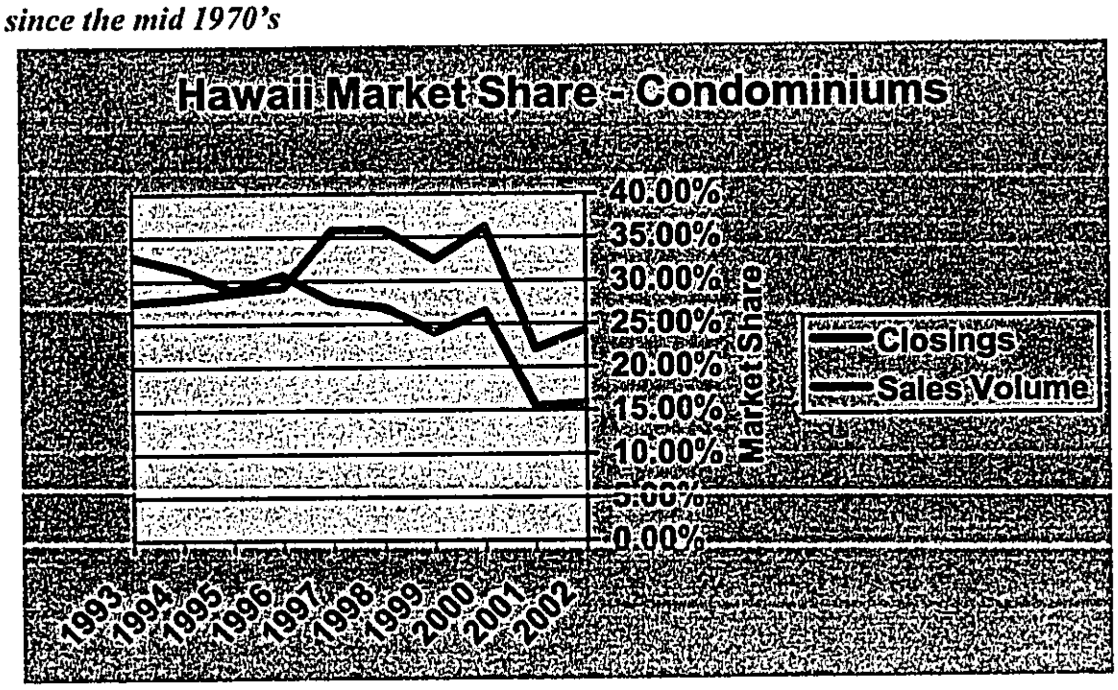
The Big Island represents less than 10% of the closings for single family residences in master planned communities



Since 1996, Hawaii has generally dominated market share in terms of vacant lot closings and sales volume.



Hawaii's share of the condominium market has decreased for both sales volume and closings since the mid 1970's



The supporting data for the above charts and performance for each master planned community is shown in the following table.

Summary of Master Planned Resort Real Estate Activity, 2000 - 2002

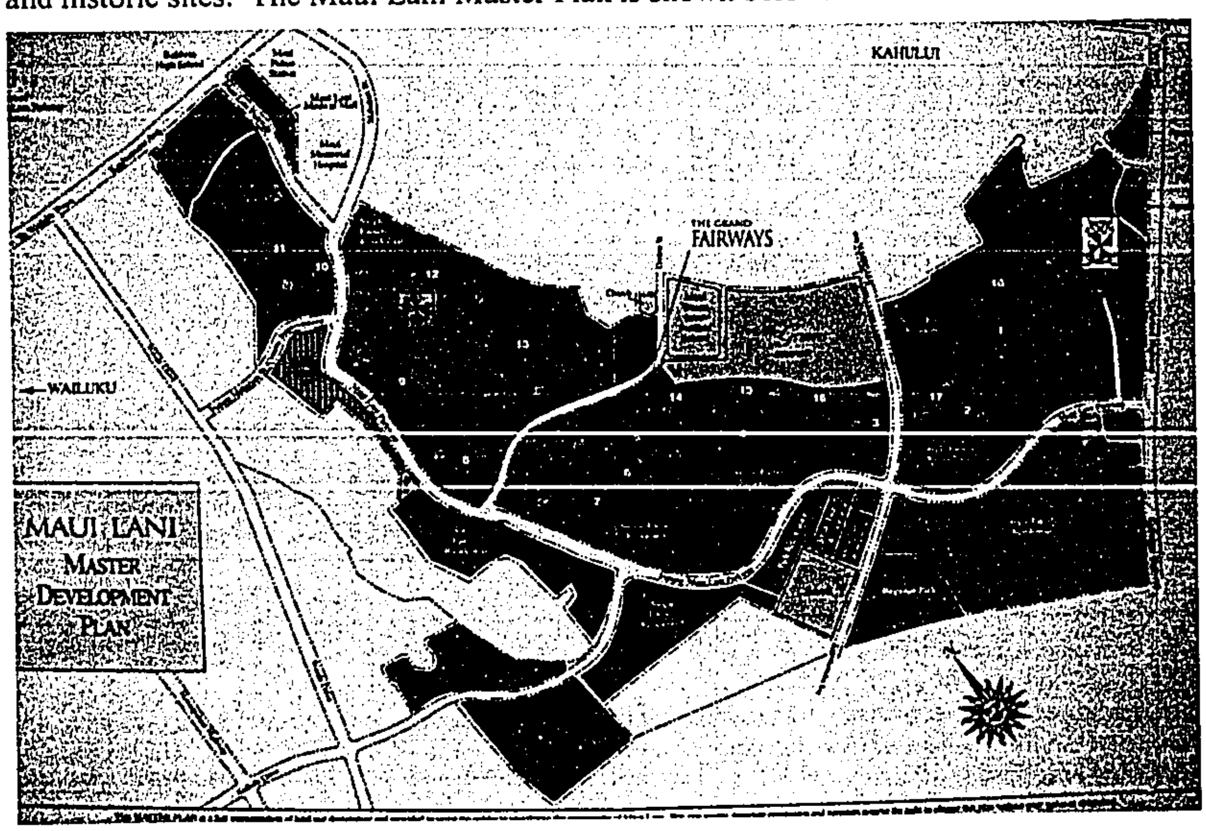
	Closings			Average Price			Total Sales ($000)		
	2000	2001	2002	2000	2001	2002	2000	2001	2002
Residences									
Big Island									
Hualalai	2	1	1	$ 1,570,318	$ 8,425,000	$ 3,575,000	$ 3,141	$ 8,425	$ 3,575
Keauhou	7	4	6	$ 1,032,323	$ 1,475,000	$ 859,833	$ 7,226	$ 5,900	$ 5,159
Mauna Kea	6	2	6	$ 3,231,667	$ 3,740,000	$ 2,609,000	$ 19,390	$ 7,480	$ 15,654
Mauna Lani	1	2	5	$ 4,000,000	$ 3,560,000	$ 4,620,000	$ 4,000	$ 7,120	$ 23,100
	16	9	18	$ 2,109,806	$ 3,213,889	$ 2,638,222	$ 33,757	$ 28,925	$ 47,488
Kauai									
Poipu	29	23	46	$ 623,837	$ 856,483	$ 660,598	$ 18,091	$ 19,699	$ 30,388
Princeville	38	37	105	$ 453,290	$ 600,195	$ 614,620	$ 17,225	$ 22,207	$ 64,535
	67	60	151	$ 527,109	$ 698,439	$ 628,627	$ 35,316	$ 41,906	$ 94,923
Lanai	1	2		$ 735,000	$ 612,500		$ 735	$ 1,225	$ -
Maui									
Kapalua	13	6	2	$ 2,018,462	$ 1,588,467	$ 2,362,500	$ 26,240	$ 9,531	$ 4,725
Wailea	48	44	59	$ 1,004,677	$ 1,235,402	$ 1,160,155	$ 48,224	$ 54,358	$ 68,449
Kaanapali	17	14	34	$ 1,038,941	$ 1,190,214	$ 1,084,559	$ 17,662	$ 16,663	$ 36,875
	78	64	95	$ 1,181,109	$ 1,258,617	$ 1,158,412	$ 92,126	$ 80,551	$ 110,049
Total	*162*	*135*	*264*	*$ 999,597*	*$ 1,130,428*	*$ 956,287*	*$ 161,935*	*$ 152,608*	*$ 252,460*
Vacant Lots									
Big Island									
Hualalai	15	10	18	$ 1,957,333	$ 2,710,000	$ 2,530,833	$ 29,360	$ 27,100	$ 45,555
Keauhou	16	7	12	$ 182,375	$ 263,429	$ 476,617	$ 2,918	$ 1,844	$ 5,719
Mauna Kea	13	10	12	$ 2,600,000	$ 1,473,900	$ 930,854	$ 33,800	$ 14,739	$ 11,170
Mauna Lani	39	3	11	$ 1,690,000	$ 854,167	$ 3,551,409	$ 65,910	$ 2,563	$ 39,065
Hokulia	60	68	19	$ 689,145	$ 841,604	$ 1,338,664	$ 41,349	$ 57,229	$ 25,435
Kukio		14	19		$ 8,562,016	$ 5,434,737	$ -	$ 119,868	$ 103,260
North Kona		7			$ 216,857		$ -	$ 1,518	$ -
	143	119	91	$ 1,212,145	$ 1,889,587	$ 2,529,723	$ 173,337	$ 224,861	$ 230,205
Kauai									
Poipu	9	8	24	$ 371,111	$ 833,139	$ 326,993	$ 3,340	$ 6,665	$ 7,848
Princeville	26	38	80	$ 194,250	$ 345,605	$ 257,724	$ 5,051	$ 13,133	$ 20,618
	35	46	104	$ 239,729	$ 430,394	$ 273,709	$ 8,390	$ 19,798	$ 28,466
Lanai	7	6	8	$ 1,447,857	$ 535,000	$ 599,063	$ 10,135	$ 3,210	$ 4,793
Maui									
Kapalua	17	22	27	$ 1,208,500	$ 1,105,227	$ 864,722	$ 20,545	$ 24,315	$ 23,347
Wailea	57	35	27	$ 354,889	$ 1,315,970	$ 890,325	$ 20,229	$ 46,059	$ 24,039
Kaanapali	14	6	40	$ 507,964	$ 1,211,667	$ 481,345	$ 7,111	$ 7,270	$ 19,254
	88	63	94	$ 544,144	$ 1,232,444	$ 708,937	$ 47,885	$ 77,644	$ 66,640
Total	*273*	*234*	*297*	*$ 878,194*	*$ 1,391,081*	*$ 1,111,458*	*$ 239,747*	*$ 325,513*	*$ 330,103*
Condos									
Big Island									
Hualalai	41	17	11	$ 1,993,293	$ 2,067,839	$ 2,647,273	$ 81,725	$ 35,153	$ 29,120
Keauhou	94	44	47	$ 296,693	$ 393,626	$ 408,144	$ 27,889	$ 17,320	$ 19,183
Mauna Kea	3	16	20	$ 1,540,000	$ 841,893	$ 865,260	$ 4,620	$ 13,470	$ 17,305
Mauna Lani	28	9	39	$ 814,464	$ 999,444	$ 1,019,404	$ 22,805	$ 8,995	$ 39,757
Waikoloa	31	21	44	$ 391,516	$ 396,447	$ 407,891	$ 12,137	$ 8,325	$ 17,947
	197	107	161	$ 757,239	$ 778,163	$ 765,913	$ 149,176	$ 83,263	$ 123,312
Kauai									
Poipu	48	91	102	$ 264,119	$ 322,857	$ 381,300	$ 12,678	$ 29,380	$ 38,893
Princeville	53	105	161	$ 275,702	$ 278,420	$ 375,928	$ 14,612	$ 29,234	$ 60,524
	101	196	263	$ 270,197	$ 299,051	$ 378,011	$ 27,290	$ 58,614	$ 99,417
Lanai	12	14	6	$ 1,056,367	$ 1,215,954	$ 1,208,333	$ 12,676	$ 17,023	$ 7,250
Maui									
Kapalua	69	73	55	$ 592,609	$ 1,174,425	$ 792,579	$ 40,890	$ 85,733	$ 43,592
Wailea	220	104	128	$ 586,654	$ 686,424	$ 668,275	$ 129,064	$ 71,388	$ 85,539
Kaanapali	123	164	273	$ 366,080	$ 573,128	$ 455,832	$ 45,028	$ 93,993	$ 124,442
	412	341	456	$ 521,800	$ 736,405	$ 556,082	$ 214,982	$ 251,114	$ 253,573
Total	*722*	*658*	*886*	*$ 559,729*	*$ 623,123*	*$ 545,770*	*$ 404,124*	*$ 410,015*	*$ 483,552*
Total	1,157	1,027	1,447	$ 696,461	$ 864,786	$ 736,776	$ 805,806	$ 888,136	$ 1,066,115

On balance, the Hawaii real estate market has increased in earnest over the past three years. This upsurge in demand combined with Hawaii's painstaking review and approval process has led to very strong interest in the relatively few development parcels available within master planned communities. For the Big Island, there has been a decrease in market share as average prices increased. The Hiluhilu project, with more moderate prices should help recapture market share and improve the affordability of new single-family residences and attached housing within a master planed community setting.

Maui Lani, Maui

In addition to the master planned communities included above, the recent market success of the Maui Lani project near Wailuku on Maui is a good example of new housing being built to meet local demand. It speaks well for the probable support for an integrated community of commercial and residential uses such as proposed for the Hiluhilu development site and is described below:

Maui Lani is a 1,000-acre master planned community that was started in the 1970s by Alexander & Baldwin Inc. Honolulu developer Bill Mills and other local interests acquired the project in 1994 and in 1996, the first model homes were opened for sale. When completed, it will contain more than 3,000 homes on 1,000 acres that will include 8 different neighborhoods, a large regional park, shopping, schools, churches, a medical complex, The Dunes golf course, clubhouse with restaurant and a driving range. Located in central Maui, Maui Lani is convenient to shopping, the Wailuku business district, the airport, established schools, Maui's attractions, and historic sites. The Maui Lani Master Plan is shown below:



To date, two increments at Maui Lani, the Greens and the Grand Fairways, have been completed and sold out. Resales are already occurring in both developments. The average re-sale price for single-family homes in the Greens subdivision, now three years old, is running around $360,000. Three years ago such a property could have been purchased for around $185,000. Reportedly, 90% to 95% of the buyers are Maui residents and Maui Lani sales have been averaging about 100 units per year. The 6,841-yard Dunes at Maui Lani golf course is ranked as one of the top 2 courses on Maui

Current subdivisions include Grand Fairways North and The Island. Grand Fairways North consists of 80 Lots, ranging from 7,000 to 13,000 square feet. They have mountain and golf course views. Three builders, Betsill Brothers, 3D Builders and Webb Construction, offer semi-custom homes. At The Island, lots were initially offered for sale in late 2001 and early 2002. Perimeter lots sold for $195,000 to $210,000, while interior lots sold for $150,000 to $165,000. Entry level and first time move up developer Schuler Homes purchased a portion of the Island's interior lots. Their typical product is a 2,000 +/- SF homes (4 bedroom, 2 ½ bath) that sells from $365,000 to $425,000.Buyers receive 1-year free membership to the Dunes Player Club and Maui Arts and Cultural Center's Ilima Club.

SECTION III

MARKET DEMAND FOR HILUHILU DEVELOPMENT PROJECT

The potential for new residential development is subject to a variety of pressures including interest rates, inflation, social, political and other economic influences. The detailed market and demographic analysis projected the overall growth in population and household formations, which will create the aggregate demand for new housing construction. Historical trends in new housing construction were also examined to show how past construction trends have coincided with population and demographic changes and economic conditions.

Based upon the historical performance of the Hawaii County housing market, and upon the projected growth in new household formations, the demand for new residential construction can be segmented by tenure and type of unit. This will allow the market potentials for specific types of residential construction to be examined. The key components of residential construction demand during the next decade include new housing units to meet demands of new population growth and household formations, construction to meet the demands of the existing households in the area who desire to upgrade or downgrade into new ownership units, and construction to replace units lost through demolition and conversion. The following table summarizes the net change in housing unit demand expected during the next decade in the Hawaii County area.

THK projects new household formations will average 1,370 per year during the projection period 2002-2012 which will produce a demand for the construction of 1,451 dwelling units annually when adjusted for vacancies and demolitions. Single-family detached construction of 1,180 units annually during the next decade will account for approximately 81.4% of total construction in the Hawaii County area. Townhome and condominium construction will average 90 units annually, or 6.1 % of the total market followed by rental apartment construction with 180 units annually, or 12.3% of total construction.

PROJECTED PERMANENT RESIDENTIAL DEMAND IN HAWAII COUNTY

				Ownership Units			
Year	Households	Annual Change	Annual Housing Unit Demand	Total	Detached	Attached	Rental
2003	59,375	1,250	1,304	1,141	1,061	80	163
2004	60,625	1,283	1,338	1,171	1,089	82	167
2005	61,908	1,316	1,373	1,201	1,117	84	172
2006	63,224	1,351	1,409	1,233	1,147	86	176
2007	64,575	1,386	1,446	1,265	1,176	89	181
2008	65,961	1,423	1,484	1,299	1,208	91	186
2009	67,384	1,460	1,523	1,332	1,239	93	190
2010	68,844	1,498	1,562	1,367	1,271	96	195
2011	70,342	1,537	1,603	1,403	1,305	98	200
2012	71,879	1,576	1,644	1,438	1338	101	205
Average Annual Demand (2002-2012)	1,370		1,451	1,269	1,180	89	181

TOTAL PROJECTED RESIDENTIAL DEMAND IN THE HAWAII COUNTY AREA

Based upon the annual housing unit demand forecast above, THK estimated the demand for seasonal/second homes in the Hawaii County area. With the addition of seasonal home demand, the total housing unit demand will grow at an average of 1,533 units per year for the next decade. The second home market comprises 5.4% of the total Hawaii County housing unit demand. This demand is segregated between detached single-family (80%) and attached single-family (20%). Single-family detached construction of 1,242 units annually during 2002-2012 accounts for about 81% of total construction in the Hawaii County area. Condominiums and townhome construction will average 109 units annually, or 7% of the total market followed by rental apartment construction with 181 units annually, or 12% of total construction.

PROJECTED TOTAL RESIDENTIAL DEMAND IN HAWAII COUNTY

				Ownership Units			
Year	Permanent Household Unit Demand	Seasonal/ Second Home Demand	Total Housing Unit Demand	Total	Detached	Attached	Rental
2002	1271	73	1344	1185	1089	96	159
2003	1,304	75	1,378	1,215	1,117	99	163
2004	1,338	76	1,415	1,247	1,146	101	167
2005	1,373	78	1,451	1,279	1,176	104	172
2006	1,409	80	1,489	1,313	1,207	106	176
2007	1,446	82	1,528	1,347	1,238	109	181
2008	1,484	84	1,569	1,383	1,271	112	186
2009	1,523	87	*1609*	1,419	1,304	115	190
2010	1,562	89	1651	1,456	1,338	118	195
2011	1,603	91	1,694	1,494	*1373*	121	200
2012	1,644	93	1,737	1,531	1,407	124	205
Average Annual Demand (2001-2011)	1,451	83	1533	1,352	1,242	109	181

PROJECTED SINGLE-FAMILY LOT DEMAND IN THE HAWAII COUNTY AREA

Based on the demand for single-family detached units forecasted for the next decade in, THK is able to project the number of additional lots that will be in demand during the same timeframe. THK estimates this demand will grow from 54 lots in 2002 to 70 lots in 2012, an annual average of 62 additional lots. Combined with the units demanded, it results in the total demand for units and lots to increase from 1,144 to 1,478 in 2012, an annual average of 1,305 units and lots over the next decade.

Projected Single Family Lot Demand in Hawaii County, 2002-2012

Year	Total Single Family Unit Demand	Additional Lot Demand	Unit and Lot Demand
2002	1,089	54	1,144
2003	1,117	56	1,173
2004	1,146	57	1,204
2005	1,176	59	1,235
2006	1,207	60	1,267
2007	1,238	62	1,300
2008	1,271	64	1,335
2009	1,304	65	1,369
2010	1,338	67	1,405
2011	1,373	69	1,441
2012	1,407	70	1,478
Average Annual Demand (2002 - 2012)	1,242	62	1,305

TOTAL PROJECTED RESIDENTIAL DEMAND IN THE PRIMARY TRADE AREA

Based on the projected household unit demand for the next decade, THK is able to estimate the demand for seasonal/second homes. In the year 2002, THK estimates the demand to be 64 seasonal units and increase to 83 seasonal units by 2012. This increases the construction of detached single-family to an average of 719 units annually over the next decade. Townhome and condominium construction will average 84 units annually while rental apartment demand will average 104 units annually.

PROJECTED PERMANENT RESIDENTIAL DEMAND IN HAWAII COUNTY

Year	Permanent Household Unit Demand	Seasonal/ Second Home Demand	Annual Housing Unit Demand	Ownership Units Total	Ownership Units Detached	Ownership Units Attached	Rental
2002	727	64	792	701	627	73	91
2003	747	66	813	720	644	75	93
2004	767	68	835	739	662	77	96
2005	788	69	857	759	679	79	98
2006	809	71	880	779	698	81	101
2007	831	73	904	800	716	84	104
2008	854	75	928	822	736	86	107
2009	877	77	953	844	756	88	110
2010	900	79	979	866	776	91	113
2011	925	81	1,005	890	797	93	116
2012	948	83	1,031	912	817	95	119
Average Annual Demand (2002-2012)	834	73	907	803	719	84	104

PROJECTED SINGLE-FAMILY DEMAND IN THE PRIMARY TRADE AREA

Based on the demand for single-family detached units forecasted for the next decade, THK projected the number of lots that will be in demand during the same timeframe. THK estimates this demand will grow from 31 additional lots in 2002 to 41 lots in 2012, an annual average of 36 additional lots. In addition to the units demanded, it results in the total demand for units and lots to increase from 659 to 858 in 2012, an average of 755 units and lots over the coming decade.

Projected Single Family Lot Demand in the Primary Trade Area, 2002-20

Year	Total Single Family Unit Demand	Additional Lot Demand	Unit and Lot Demand
2002	627	31	659
2003	644	32	676
2004	662	33	695
2005	679	34	713
2006	698	35	733
2007	716	36	752
2008	736	37	773
2009	756	38	793
2010	776	39	815
2011	797	40	837
2012	817	41	858
Average Annual Demand (2002-2012)	719	36	755

To better quantify the demand for new residential units in the primary trade area, THK breaks down the trade area's existing households by income range and then converts those income ranges to home purchasing capacity and monthly rental capacity. Home purchasing capacity is calculated using estimated monthly payments (principle, interest, taxes and insurance) based on a 30-year fixed rate mortgage with a 8.0% interest rate and a 20% down payment In determining monthly rental capacity it's assumed – as available statistics indicate – that households that rent spend, on average, 25% of their gross income on housing. Households that own their homes typically allot 28%-32% of their income to mortgage payments. It should be noted that no allowances have been made to account for the greater purchasing capacity that may be derived from adjustable rate mortgages (ARMs) or other alternative financing mechanisms. For that reason, home purchasing capacity estimates are likely conservative.

The median household income in the Hiluhilu Development primary trade area is currently approximately $53,158. This suggests that the median permanent household in the trade area can afford a $181,100 home. However, new home sales suggest that buyers are spending a greater percentage of their incomes on housing and that residents with significantly higher incomes are purchasing new products. Many of these buyers are new to the Island and do not comprise the current median income. Therefore, appropriate adjustments have been made to the demand by price range. In terms of second home purchasing capacity, adjustments were made based on pricing of existing and new product aimed at this market and on similar analyses performed by THK in regionally and conceptually competitive markets.

In the following table, the demand for residential units in the Hiluhilu Development trade area is projected by price range. It shows the demand distribution for the annual average of 755 single-family detached units projected by THK to be demanded in the primary trade area. Approximately 65.0% of the projected single-family demand in the primary trade area will be for lots priced over $100,000. Almost 50% of the seasonal single-family demand is for lots priced over $225,000.

Annual Average Lot/ Unit Demand by Price Range in the Hiluhilu Development Primary Trade Area

Unit Price Range	Lot Price Range	Permanent Households	Percent	2nd Home/ Seasonal Residents	Percent	Additional Lots	Percent	Total	Percent
Detached Single Family									
Under $250,000	Under $100,000	255	38.6%	0	0.0%	0	0.0%	255	33.8%
$250,000 - $349,999	$100,000 $124,999	212	32.1%	3	5.0%	2	5.0%	216	28.7%
$350,000 - $449,999	$125,000 $159,999	78	11.8%	4	7.5%	3	7.5%	85	11.3%
$450,000 - $549,999	$160,000 $189,999	50	7.5%	6	10.0%	4	10.0%	59	7.8%
$550,000 - $649,999	$190,000 $224,999	26	4.0%	18	30.0%	11	30.0%	55	7.3%
$650,000 +	$225,000 +	40	6.0%	28	47.5%	17	47.5%	84	11.2%
Total		660	100.0%	59	100.0%	36	100.0%	755	100.0%
Unit Price Range									
Condominiums and Townhomes									
Under $250,000		44	63.2%	4	25.0%			47	56.5%
$250,000 $350,000		12	16.8%	4	30.0%			16	19.1%
$350,000 +		14	20.0%	7	45.0%			20	24.4%
Total		69	100.0%	15	100.0%			84	100.0%
Unit Rental Rates									
Rental Multi-Family									
Under $600		26	24.5%						
$600 - $750		18	16.8%						
$750 +		61	58.7%						
Total		104	100.0%						

Source: U.S. Bureau of the Census and THK Associates, Inc.

Mobile/Manufactured Homes		
Under $200	2	12.5%
$200 - $239	5	30.0%
$240 - $279	5	35.0%
$280 +	3	22.5%
Total	15	100.0%

Source: U.S. Bureau of the Census and THK Associates, Inc.

Active Residential Projects on the Kona-Kohala Coast

Residential activity on the Big Island has remained fairly robust, even in the aftermath of the September 11th tragedy. A review and analysis of permit activity and sales activity for the period of September 2001 through August 2002 shows greater volume and some appreciation of pricing. The north Kona district, in particular, had by far the greatest activity on the Island. Figures for the 12-month period show 532 single-family sales at an average price of $368,000. Just over 300 condominiums sold for an average price of $222,000. The south Kohala district registered 197 single-family sales at an average price of $413,000. Pricing per square foot generally ranged from $150 to $250 depending upon location and views.

RESIDENTIAL DEVELOPMENT POTENTIALS AT THE HILUHILU DEVELOPMENT SITE

The success of residential development at the Hiluhilu Development site depends on a number of factors: location, physical suitability of the site for development, and the overall market conditions for residential sales. Physically, the site appears well suited for residential development and should lend itself to an interesting layout, particularly once the planned golf course is completed.

THK's projected capture rates for housing units at the Hiluhilu Development site are shown below. The demand by price range and unit type in the primary trade area was projected earlier based upon the projected income and demographic characteristics of the population in the region. The capture rates for the subject site show the share of each market segment that the subject property is expected to capture.

The important elements to evaluate when determining capture rates are the prestige of the community and the quality and character of the immediate area. The capture rates shown reflect the differences in the quality of the location and, the reputation, planning and amenities of competitive developments. These capture rates were determined based upon the geographic attributes of the subject site and those of competitive projects, as well as the' number of competitors in a given price range within the immediate market area.

Based on the competitive review of other projects, the location of the site, its planned amenities, and its access to regional employment, retail, and recreation centers, THK believes that the Hiluhilu Development site will be able to capture either a generic capture rate or a higher than generic capture rate of the single-family detached market. In order to determine capture rates, THK reviewed the number of existing competitors and determined those that will still be marketing product during the Hiluhilu development period. THK then allowed for new project and resale competition and estimated a "fair" share capture rate, adjusted for the site.

An average annual demand of 500 units priced over $250,000 over the next 11 years is expected in the trade area. Given the site's proposed golf course and overall community plan, THK has programmed product in five ranges over $250,000. It is also assumed that the lots will be relatively large (THK has programmed a 10,000-42,500 square foot range). That said, it is estimated that the site could capture approximately eight units per year in the $350,000 to $450,000 price range, nine per year in the $450,000-$550,000 price range, and nine units per year priced over $650,000. This suggests an average lot size of 20,200 square feet and an average annual absorption of 31 acres.

Projected Single Family Detached Demand and Acreage Absorption at the Hiluhilu Development Site

Home Prices	Under $349,999	$350,000 $449,999	$450,000 $549,999	$550,000 $649,999	$650,000 & Above		
Lot Prices:	Under $124,999	$125,000 $159,999	$160,000 $189,999	$190,000 $224,999	$225,000 & Above	Annual Total	Cumulative Total
Annual Average Demand in the Primary Trade Area:	216	85	59	55	84	500	
Number of Competitors:	18	12	8	6	10		
Generic Capture Rate:	5.3%	7.7%	11.1%	14.3%	9.1%		
Site Capture Rate:	5.3%	9.6%	15.0%	19.9%	10.9%	9.7%	
Annual Absorption (Units)							
2002			Planning				
2003	10	7	8	10	8	43	43
2004	10	8	8	10	8	45	88
2005	11	8	8	10	9	46	134
2006	11	8	9	11	9	47	181
2007	11	8	9	11	9	48	229
2008	12	8	9	11	9	50	279
2009	12	9	9	11	10	51	330
2010	12	9	10	12	10	52	382
2011	13	9	10	12	10	54	436
Total	102	73	80	98	83	436	
Annual Average	11	8	9	11	9	48	
Average Lot Size (SF)	10,000	12,500	15,000	21,000	42,500	20,200	
Average Net Density	3.5	2.5	2.0	1.5	0.7	1.5	
Net Acres (Annual Average)	3.3	3.3	4.4	7.2	13.2	31	
Net Acres	29.3	29.4	39.8	65.2	118.4	282.0	

Source: THK Associates, Inc.

Attached and Multi-Family Units

THK has also examined the condominium/townhome component of the development program. Including these units accelerates the project's build-out and opens it up to the sizeable market segments that prefer such product. Moreover, given the market's demographics and the project's location, some sort of townhome/condominium concept will likely draw strong demand.

The following table shows the projected demand for attached ownership units and demonstrates that the site could absorb 20 townhome/condominium units on approximately 2.7 acres annually through 2011. Approximately 35% of those units should be priced over $350,000.

Projected Townhome/ Condominium Demand and Acreage Absorption at the Hiluhilu Development Site

Home Prices:	Under $250,000	$250,000 $350,000	$350,000 & Above	Annual Total	Cumulative Total
Annual Average Demand in the Primary Trade Area:	47	16	20	84	
Number of Competitors	5	4	3		
Generic Capture Rate	16.7%	20.0%	25.0%		
Site Capture Rate:	16.7%	30.0%	37.5%	24.3%	
Annual Absorption (Units)					
2002		PLANNING			0
2003	7	4	7	18	18
2004	7	4	7	19	37
2005	7	5	7	19	56
2006	8	5	7	20	76
2007	8	5	8	20	96
2008	8	5	8	21	117
2009	8	5	8	21	139
2010	9	5	8	22	161
2011	9	5	8	23	183
Total	71	43	69	183	
Annual Average	8	5	8	20	
Average Net Density	12	9	5	7.5	
Net Acres (Annual Average)	0.7	0.5	1.5	2.7	
Net Acres	5.9	4.8	13.8	24.5	

Source: THK Associates, Inc.

The Hiluhilu development would also include apartment sites, and an average absorption of about 20 units per year is projected.

Projected Rental/ Multi-Family Demand and Acreage Absorption at the Hiluhilu Development Site

Rent Ranges:	Under $600	$600 $750	$750 & Above	Annual Total	Cumulative Total
Annual Average Demand in the Primary Trade Area:	26	18	61	104	
Number of Competitors:	5	4	4		
Generic Capture Rate:	16.7%	20.0%	20.0%	18.9%	
Site Capture Rate:	16.7%	20.0%	20.0%	18.9%	
Annual Absorption (Units)					
2002			Planning		
2003	4	3	11	18	18
2004	4	3	11	18	36
2005	4	3	12	19	55
2006	4	3	12	19	75
2007	4	3	12	20	95
2008	4	4	13	20	115
2009	4	4	13	21	136
2010	5	4	13	22	158
2011	5	4	14	22	180
Total	38	32	110	180	
Annual Average	4	4	12	20	
Average Net Density	15.0	12.0	8.0	9.5	
Net Acres (Annual Average)	0.3	0.3	1.5	2.1	
Net Acres	2.6	2.6	13.7	18.9	

Source: THK Associates, Inc.

COMMERCIAL MARKET ANALYSIS

A major component of the Hiluhilu Development plan is to incorporate an urban *core* component into the overall plan as a tie-in to and in conjunction with the development plans at the adjacent University of Hawaii. A community college and specialized medical and educational facilities are being considered along the university facilities and student and faculty housing. A rezoning of the Hiluhilu Development parcel from agriculture to urban, with the support of the university, would help facilitate the expansion plans and expedite the development of this urban core where the two sites converge. County road development plans call for an arterial road to possibly be extended through the proposed core area. In this urban core area, a need would also arise for the development of some retail, office, and research and development/ flex space to be built to serve both the residential community and the educational/medical components. THK has analyzed the overall demand for each of these uses in the Hiluhilu Development trade area as well as at the site. Based on projected annual job growth in the trade area, THK can estimate job growth by sector to project additional space requirements for retail, office, and research and development space over the next ten years. Retail job growth is projected to average 203 annually through 2012. At 350 square feet needed per employee, an additional 700,000 square feet of retail space will be required in the primary trade area. THK estimates a site capture of 15% of this space, meaning 106,000 square feet of retail space will be demanded at the Hiluhilu Development site. With coverage of 22% and a speculative factor of 50%, the Hiluhilu Development site can support 17 acres of retail development. Following the same methodology, the office and research and development/flex markets yield] 6 acres and 13 acres of space respectively. The following table details the breakdown of the commercial space demand.

Hiluhilu Development Office, Retail, and R & D Demand Analysis

Projected Annual Trade Area Employment Growth, 2002-2012	810
Annual Retail Job Growth (25%)	203
Annual Office Job Growth (35%)	284
Annual R & D/Flex Space Job Growth (15%)	122

Use	Annual Job Growth	Square Footage Required x 10 yrs./1	Site Capture/2	Acreage Required/3	Total Acreage Required/4
Demand for Retail Space at Subject Site	203	708,750	106,313	11	17
Demand for Office Space at Subject Site	284	652,050	163,013	13	16
Demand for R&D/Flex Space at Subject Site	122	486,000	160,380	11	13

1\Space per Employee : Retail = 350, Office = 230, R &D = 400
2\Site is estimated to capture : Retail = 15%, Office = 25%, R & D = 33%
3\ F.A. R. : Retail = 22%. Office = 28%, R & D = 35%
4\ Speculative Factor: Retail = 50%, Office = 20%, R & D = 20%

Source: THK Associates, Inc.

SECTION IV

MARKET SUPPORT FOR UNIVERSITY VILLAGE AT HILUHILU DEVELOPMENT

A distinguishing element of the Hiluhilu Development project is the opportunity to plan its real estate program in conjunction with the adjacent University of Hawaii site. This site consists of some 500 acres and has been designated as the future West Hawaii campus for both UH and Community College purposes. Hiluhilu development intends to assist UH in establishing this campus as quickly as possible and to integrate initial University functions and buildings within a University Village in the Hiluhilu community. To help plan the Hiluhilu project and understand how the University Village would augment its market support, we conducted a market research program with current Big Island residents, non-resident property owners, and visitors. The purpose of the research was to understand the general level of community support for the University Village concept as well as their interest in attending University or community college programs, patronizing associated businesses and services, and/ or having a residence in this type of community.

This research was conducted with a sample of Big Island residents and visitors covering the following market segments:

- Big Island Residents
  - Property Owners
  - Renters
- Mainland Residents
  - Big Island Property Owners
  - Visitors

Responses were made by returning a questionnaire in an enclosed stamped envelope or by fax to KBCG. A charitable donation to one of three Hawaiian charities was provided as an incentive to respondents. A copy of the questionnaire is provided in Appendix A.

FINDINGS

We received 121 responses to the survey, for a response rate of 17%, which is quite good considering the extensiveness of the questions and the nature of the financial and real estate information that was being requested. The following is a top line summary of certain key questions as an indicator of Big Island resident and property owner reaction to the Hiluhilu Development project.

RESPONDENT CHARACTERISTICS

Residency

The respondents include a nearly equal mix of permanent residents (50%) and seasonal residents and visitors (50%). The seasonal residents spend an average of 76 days in Hawaii each year. This provides them sufficient time to have substantial involvement in the educational programs and cultural events that could take place at the University Village at Hiluhilu Development.

A large majority (86%) of the respondents were homeowners who already own property in Hawaii. A majority currently reside or own property in the Kona area, but there is also good representation from the Kohala Coast master planned communities.

Demographics

The respondents represented a well-educated group (80% with college degrees) with moderate to upper incomes. Most are over 40 years of age, and there was a relatively equal distribution of male and female respondents

REACTION TO UNIVERSITY VILLAGE CONCEPT

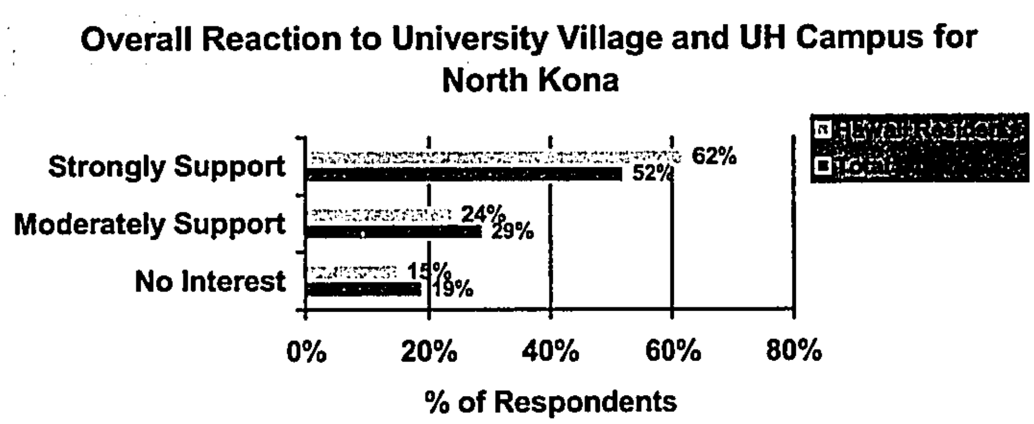
As part of the market research, respondents were asked to indicate their level of interest in the University Village at Hiluhilu Development concept and the types of programs that might be included. For reference, the University Village at Hiluhilu Development project was described as follows:

University Village Description

This market research will be used to design a new University Village community north and east of the Kona airport and adjacent to the designated site for the University of Hawaii and Community College West Hawaii campus. The intent of the developer is to assist the UH in establishing this campus as soon as possible. The University Village is intended to be oriented around a community college environment including classrooms and teaching labs. The village attributes will be achieved by integrating residences, shops and restaurants, an inn with conference center, and performing arts and cultural facilities. It will be pedestrian friendly. Other compatible uses that are being considered for areas outside the Village include residences, a Health and Wellness campus, assisted living facility, and research related incubator space. There may also be a golf course that serves as the home course for the University golf team as well as a training ground for a golf management curriculum.

Overall Reaction:

Over 80 % of the total respondents, and 86% of the permanent resident respondents support the University Village at Hiluhilu Development in North Kona.



Desired UH and Community College Magnet Programs

We also asked a series of questions about whether respondents would be interested in the specific types of community college and UH class subjects that might be offered as well as how they and their family might become personally involved. The opportunities were described as possible magnet programs that are being considered as appropriate to the market and the site. These included:

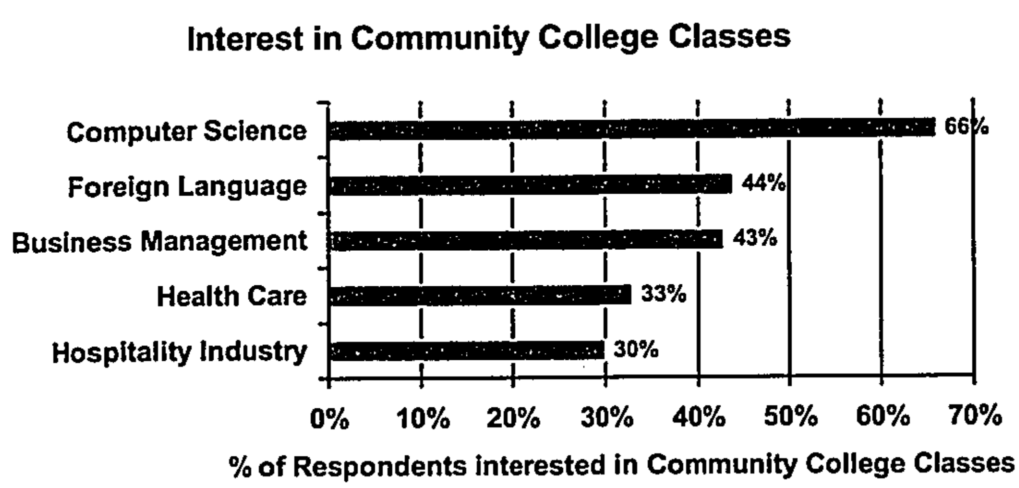
- **Targeted UH and Community College Subjects and Training Programs** that relate specifically to the strength, character, and resources of the Big Island and the needs of the community.
- **International programs** Kona is an excellent location for safety conscious parents sending their students overseas. Courses useful to these students include English as a second language, business, and technology. There is no English as a second language program currently in Kona. A variety of student housing types would need to be provided.
- **Short Course Magnets.** This program seeks to attract high profile visiting professors, businessmen, public figures, performers and other experts to present focused short courses (2 weeks to two months) at the Kona campus. This program is designed to appeal to full time and seasonal residents as well as mainland and international "self improvement" travelers. Successful models for this approach include Kellogg College in Oxford and the curriculum approach of Colorado College.

There is a strong level of interest in these magnet programs and the respondents provided thoughtful customer input to help guide the development as shown below:

Targeted Community College Classes

Approximately 78% of the respondents interested in the University Village at Hiluhilu Development concept indicated an interest in one or more of a suggested set of community college classes, programs and activities. The types of suggested programs were based upon earlier assessments of community needs conducted by the community college.

The greatest level of interest is in computer sciences with 2/3 of the respondents interested in Community College classes selecting this subject.



In addition to the identified class types, respondents offered suggestions of additional subjects they would like to see included in the class offerings. These suggestions covered the following subjects:

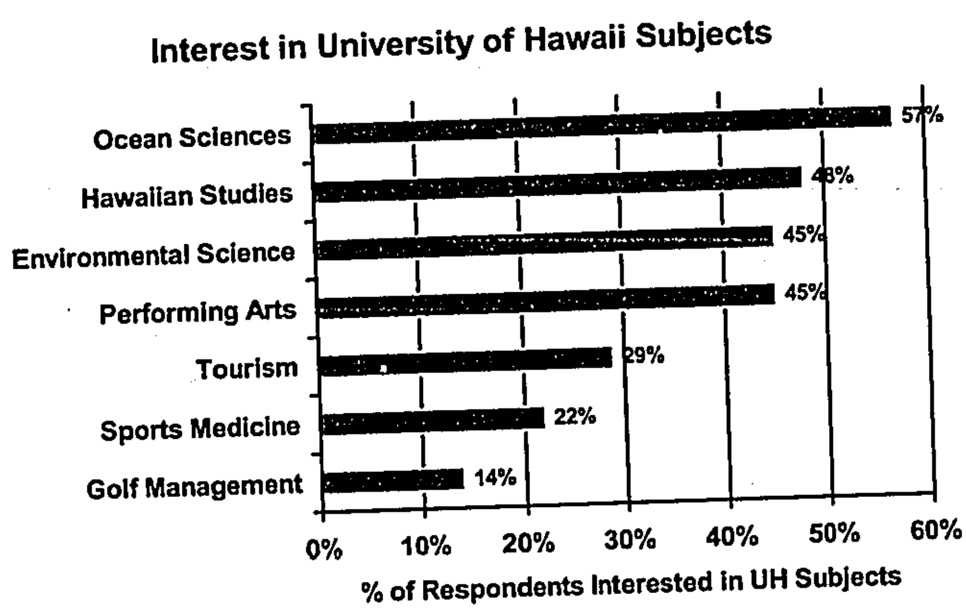
> Accounting, Architecture, Art, Bio Tech, Bridge, Cooking, Construction Management, Criminal Science, Design, Economics, Education, Environment, Hawaiian Culture, History, Landscaping, Land Planning, Liberal Arts, Medical & Alternative Health, Work W/ Disabled, Ocean Sciences, Performing Arts, Political Science, Public Administration, Science, Senior Interest, Writing

Quite obviously there is a wide breadth of educational interests within the community that could be potentially served at the West Hawaii campus.

Targeted University of Hawaii Subjects

Approximately 74% of the respondents interested in the University Village at Hiluhilu Development concept indicated an interest in one or more of a suggested set of 7 University of Hawaii subjects that could be provided at the West Hawaii campus. It was noted in the survey questionnaire that it is the intent of the project that the programs that may be offered at the West Hawaii campus will not unduly duplicate or compete with programs already offered at UH-Hilo.

The subject with the most interest is Ocean Sciences, followed closely by Hawaiian Studies, Environmental Science, and the Performing Arts.



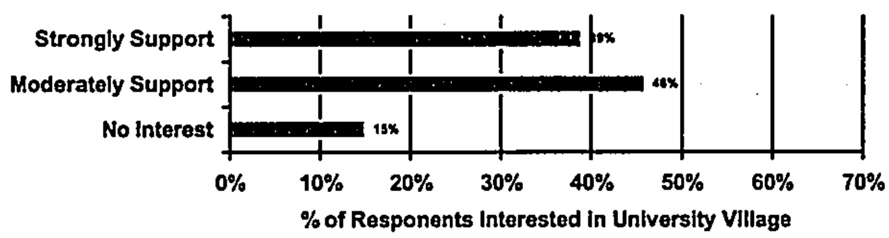
In addition to the identified subjects, respondents offered suggestions of other UH courses they would like to see included. These suggestions covered the following subjects:

> Astronomy, Astrophysics, Child Development, Comparative Religion, Culinary Arts, Education, Engineering, Foreign Language, Flight Training, Medical, Sea Agriculture, Tennis

International Magnet Program.

As shown below, 85% of the persons interested in the University Village by Hiluhilu Development support including the International Magnet Program.

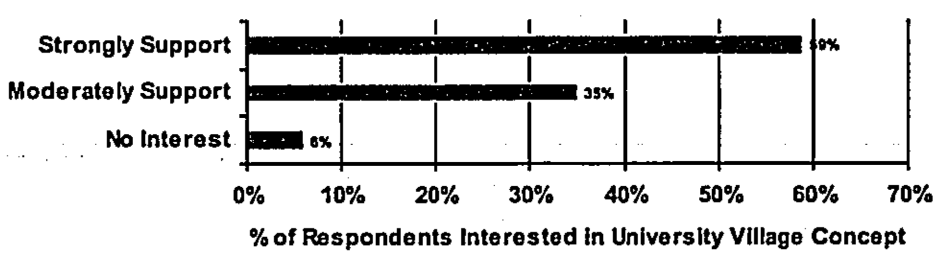
Support for International Magnet Program



Short Course Magnet Program

This program was overwhelmingly endorsed. Approximately 95% of the persons interested in the University Village development indicated support, and 60% strongly support this idea.

Suport for Short Course Magnet Program

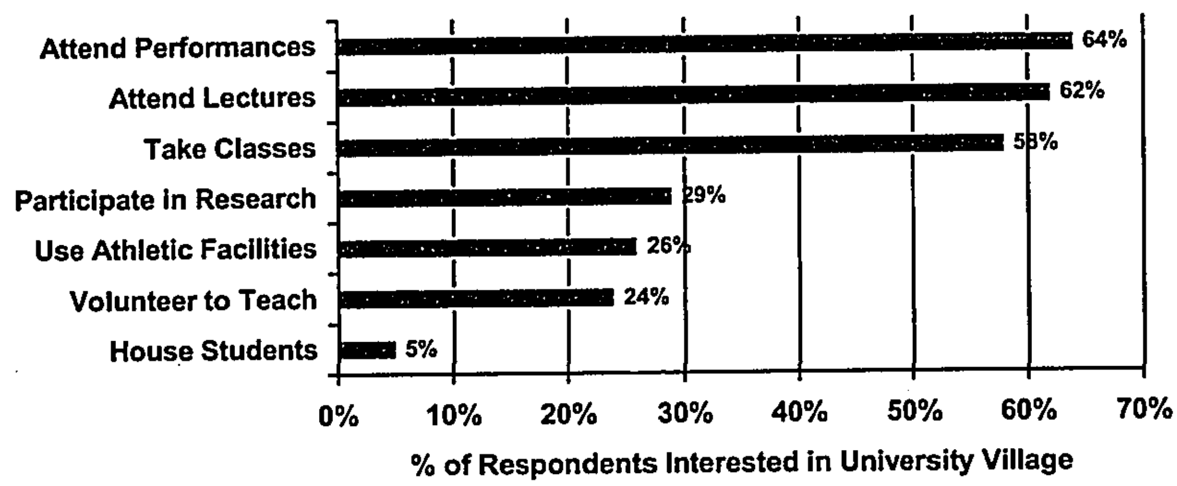


The Short Course Magnet program was equally popular with permanent and seasonal residents,

Usage of University Village Resources and Programs

Given this high level of interest, it follows that the respondents intend to participate in a variety of activities and programs available within the University Village and UH campus.

Expected Participation in University Village and UH Programs



The most highly anticipated usage is to attend performances, followed closely by attending lectures or classes.

INTEREST IN UNIVERSITY VILLAGE REAL ESTATE

Following up on the University Village concept, we asked for respondent reactions to a mix of proposed real estate lot sales and residences types. The University Village real estate products at Hiluhilu Development were described follows:

"In addition to just participating in University or Community College activities, the University Village project will also offer opportunities to live in what promises to be a unique and stimulating environment. We would appreciate your response to the following proposed types of residences that could be included.

> **Ocean View Estate Lots.** These 1-acre lots will front on the golf course and have good ocean views.
>
> **Ocean View Lots.** These 15,000 square foot lots will have ocean views and golf frontage.
>
> **Golf View Lots.** These 12,000 square foot lots will have golf and mountain views.
>
> **Patio Homes.** These two bedroom/ two bath homes would be located in the Village proper and have moderate views
>
> **Townhomes and Condominiums.** These 2 and 3 bedroom units will also be located in the Village and have moderate views.

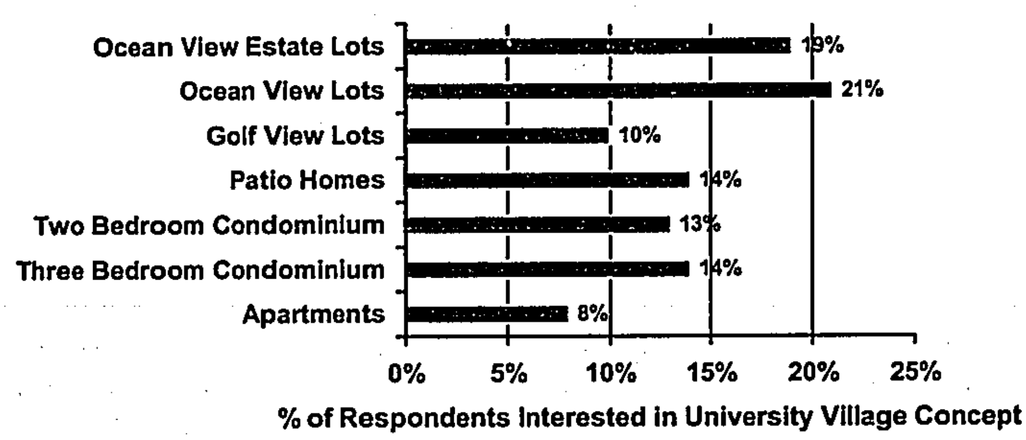
Apartments. The Village Center will also include a mix of apartments for both students and residents."

Approximately 45% of the respondents were interested in at least one form of real estate in the Hiluhilu Development project. By market source, the most interested were current permanent residents of the Big Island, with the majority (51%) expressing interest in real estate at University Village. For non-residents, the level of interest in University Village real estate was still high at 38%.

By Product Type

The highest level of interest was in the ocean view lots followed by the patio homes and the two and three bedroom condominiums. The market driven product mix as indicated by the survey responses would be as follows:

Indicated Distribution of Real Estate Products

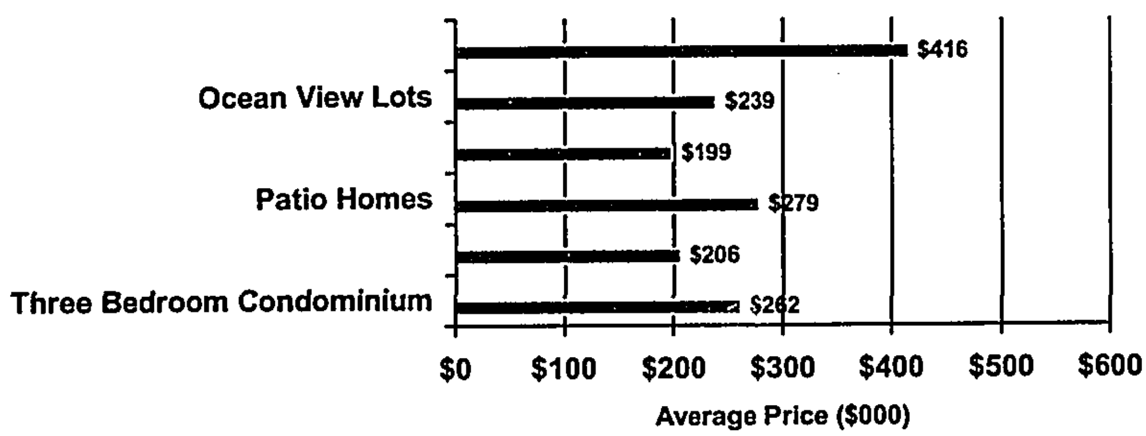


The University Village program (excluding student housing) is substantially consistent with these responses.

Expected Prices

The average expected lot prices range from $416,000 for an ocean view estate lot to around $199,000 for a golf view lot. The average expected price for built product ranges from $279,000 for the patio homes to $206,000 for a two-bedroom condominium in the village.

Expected Prices for Real Estate Products ($000)



Since averages can be misleading, we examined the distribution of expected prices for each product type. These results are presented below

Ocean View Estate Lots

The pricing strategy for University Village is to target the upper middle part of the market (from 33% level to 90% level of expected prices). Ocean View Estate lots should have an entry-level price at around $325,000 with premium product reaching prices of around $500,000.

Ocean View Lots

The entry point for the Ocean View lots is in the $200,000 to $250,000 range, with reasonable product demand up to $400,000

Golf View Lots

Expected prices for the golf view lots have a relatively wide distribution. The entry-level price would be around $125,000 and reach the high $200s for premium sites.

Patio Homes

Entry prices for the patio homes should be in the $200,000 to $250,000 range. Prices could reach up to $400,000 for premium locations.

Two Bedroom Townhomes and Condominiums

Prices for the two bedroom condominiums should lead with a product at around $200,000 with premium units reaching prices of $325.000.

Three Bedroom Townhomes and Condominiums

The three bedroom condominiums should lead with a product at around $250,000, with premium units reaching $375,000.

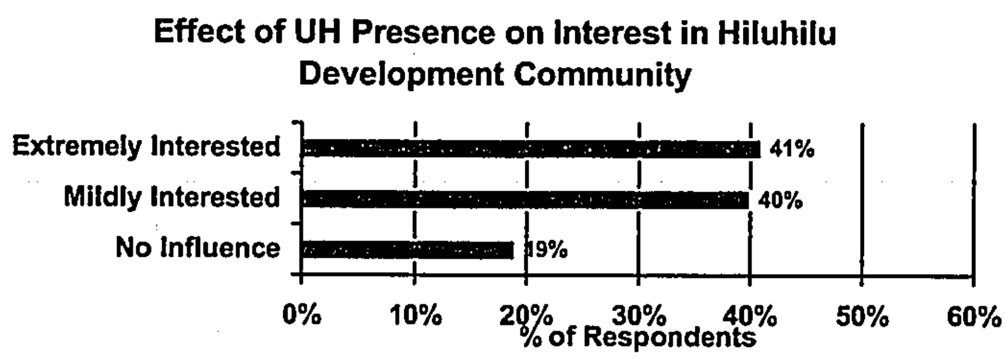
Apartments

Apartments appeal almost exclusively to permanent residents of the Big Island and are not interesting to Mainland visitors or second home owners. Additionally, they appeal primarily to existing renters rather than homeowners. In our subsample of permanent residents, we had relatively few renters who responded to the survey. Of those that did, 70% were interested in apartment living at University Village.

IMPACT OF UNIVERSITY OF HAWAII CAMPUS ON INTEREST IN HILUHILU DEVELOPMENT COMMUNITY

To specifically test the effect of the University of Hawaii relationship to interest in the Hiluhilu Development community, we asked: "How does the presence of an adjacent University of Hawaii and Community College campus affect your interest in this community?"

Over 80% of the respondents are interested in the University Village community – and 41% are extremely interested because of the University of Hawaii connection.



The survey research confirms that the University Village at the Hiluhilu Development project should achieve strong community acceptance and achieve premium real estate values.

SECTION V

RECOMMENDED DEVELOPMENT PROGRAM, PRICING AND REAL ESTATE ABSORPTION PATTERNS AT HILUHILU DEVELOPMENT

The proposed program for the Hiluhilu Development University Village project reflects the market findings of THK and KBCG as well as project team planning inputs, discussions with University of Hawaii (UH) administrators, and a review of the UH Master Plan for the West Hawaii Campus. It is subject to revision and confirmation based upon further discussions with UH; County and Community input; land planning, urban design, engineering and traffic considerations; market refinement from ongoing consumer research; financial analysis; construction considerations; and numerous other influences.

Product Mix

There is strong market support for a mix of moderately priced residential products within the University Village community setting at Hiluhilu Development. Based upon the analysis of general market support and the strong consumer response to the University Village concept, the development program includes a mix of lots, patio homes, townhomes, apartments, and senior housing targeted to meet the needs of local and seasonal residents. The village commercial program includes classroom and cultural facilities, village shopping, and a University related inn/conference center along with student and faculty housing. Outside the village center, space has been allocated for a medical campus, research and development activities, and future community commercial

Hiluhilu Development Plan

	Total	Percent of Total
Residential (units)		
Ocean View Estates	70	11.9%
Ocean View Lots	200	33.9%
Golf View Lots	120	20.3%
Patio Homes	80	13.6%
Two Bedroom Condos	60	10.2%
Three Bedroom Condos	60	10.2%
Subtotal	590	
Apartments/ (Land Sale)	100	
International Student Housing (Land Sale)	75	
University Village Inn (Land Sale)	120	
Senior Housing	80	
Total Units	965	
Commercial (acres)	-	
University Leases	6.0	
Village Commercial	8.0	
Medical, R&D, & Community Commercial	-	
Medical Campus (Land Sale)	10.0	
R&D (Land Sale)	50.0	
Community Commercial (Land Sale)	20.0	
Golf Course	180.0	
Open Space, Parking, and Preservation	152.8	
Total Kau Acreage	700.0	

Pricing

The proposed unit prices for the Hiluhilu Development cover a wide range reflecting market ability to pay and the perceived value of the community amenities inherent in the University Village project.

PRICING RECOMMENDATIONS FOR REAL ESTATE PRODUCTS AT HILUHILU DEVELOPMENT UNIVERSITY VILLAGE

	Recommended Average Prices	Average Unit Size	Recommended Price
Residential Real Estate - Lots	Sale Price	(Sq. Ft.)	Per Square Foot
Ocean View Estate Lots	$400,000	40,000	$10.00
Ocean View Lots	$300,000	15,000	$20.00
Golf View Lots	$200,000	12,000	$16.67
Residential Real Estate - Built Product			
Patio Homes	$350,000	1,800	$194
Two Bedroom Condominiums	$275,000	1,300	$212
Three Bedroom Condominiums	$350,000	1,600	$219
Village Real Estate - Leased	Annual Lease Rate/SF	Space (SF)	
UH Classroom and Lab Space	$12	60,000	
Village Retail	$24	80,000	
Village Real Estate - Land sales ($/unit)	Sales Price ($/ unit)	Units	
Apartments	$35,000	100 units	
International Student Housing	$25,000	75 units	
University Village Inn	$40,000	120 rooms	
Senior Housing	$30,000	80 units	
Other Commercial	Sales Price ($/acre)	Acres	
Medical Campus	$400,000	10	
R&D	$250,000	50	
Community Commercial	$700,000	20	
Golf Memberships	Per Member		
Entrance Fee	$30,000		

REAL ESTATE ABSORPTION

The project is anticipated to commence construction in 2004 with basic infrastructure and golf course development. Initial real estate sales will begin in 2005 and include ocean view estates and ocean view lots along or near the golf course. Housing and commercial space in the University Village will be available for occupancy one to two years later. The estimated buildout period for the project is 6 years.

SUMMARY ABSORPTION SCHEDULE AT HILUHILU DEVELOPMENT

	2003	2004	2005	2006	2007	2008	2009	2010	Total
Residential (units)									
Ocean View Estates			30	20	20				70
Ocean View Lots			20	30	35	35	40	40	200
Golf View Lots				20	20	20	30	30	120
Patio Homes				20	20	20	20		80
Two Bedroom Condos					10	20	10	20	60
Three Bedroom Condos					10	20	10	20	60
Subtotal	-	-	50	90	115	115	110	110	590
Apartments/ (Land Sale)					100				100
International Student Housing (Land Sale)					75				75
University Village Inn (Land Sale)					120				120
Senior Housing						80			80
Total Units	-	-	50	90	410	195	110	110	965
Residential (acres)									-
Ocean View Estates	-	-	30.0	20.0	20.0	-	-	-	70.0
Ocean View Lots	-	-	10.0	15.0	17.5	17.5	20.0	20.0	100.0
Golf View Lots	-	-	-	7.7	7.7	7.7	11.5	11.5	46.2
Patio Homes	-	-	-	4.0	4.0	4.0	4.0	-	16.0
Two Bedroom Condos	-	-	-	-	1.3	2.5	1.3	2.5	7.5
Three Bedroom Condos	-	-	-	-	1.3	2.5	1.3	2.5	7.5
Subtotal	-	-	40.0	46.7	51.7	34.2	38.0	36.5	247.2
Apartments/ (Land Sale)	-	-	-	-	8.0	-	-	-	8.0
International Student Housing (Land Sale)	-	-	-	-	5.0	-	-	-	5.0
University Village Inn (Land Sale)	-	-	-	-	8.0	-	-	-	8.0
Senior Housing	-	-	-	-	-	5.0	-	-	5.0
Total Acres for Housing	-	-	40.0	46.7	72.7	39.2	38.0	36.5	273.2
Commercial (acres)									-
University Leases	-	-	-	3.0	-	-	-	3.0	6.0
Village Commercial	-	-	-	2.0	-	2.0	-	4.0	8.0
Medical, R&D, & Community Commercial									-
Medical Campus (Land Sale)				10.0					10.0
R&D (Land Sale)					20.0			30.0	50.0
Community Commercial (Land Sale)							20.0		20.0
Golf Course		180.0							180.0
Open Space, Parking, and Preservation									152.8
Total Kau Acreage									700.0

Appendix J

Groundwater Resources of Kau,
North Kona, Hawaii

Groundwater Resources of Kau, North Kona, Hawaii

A Water Study for Hiluhilu Development, LLC

June 2003

Waimea Water Services, Inc.
PO Box 326
Kamuela, HI 96743

Groundwater Resources of Kau, North Kona, Hawaii

Groundwater Occurrence

The groundwater resources beneath the land of Kau (between Mamalahoa and Queen Kaahumanu Highways) consist of a basal lens. In theory, fresh water floats on salt water in a ratio of 1:40 where, for every 1 foot of fresh water head above sea level, there are 40 feet of fresh water below sea level. This ratio becomes highly modified where the recharge varies seasonally and there is a strong tidal influence.

Fresh water is found in the basal lens near Mamalahoa Highway at elevation 1800' (wells 4458-01,02), where the water level stands at + 7'. As evidenced by a well on State land (well # 4360-01) in map 1 near the Kona Palisades subdivision, the lens becomes brackish (total chlorides at 580 mg/L) at elevation 680' with a head of +3.2'.

At elevation 1800' above Mamalahoa Highway, well # 4358-01 struck a high level aquifer with the water level standing at elevation + 238' above sea level. Pumping tests at the time of construction indicate a draw down of nearly 100 feet with a salinity of 10 mg/L. The well is presently in DWS service with a pumping rate of 300 gpm.

Although speculative, the high level aquifers seem to be most likely to be related to a fault system rather than dikes found within the rift zone of Hualalai. The high level aquifers along Mamalahoa to the south are all closely associated with coastal slumping (Moore, et al , 1989- Prodigious Submarine Landslides on the Hawaiian Ridge).

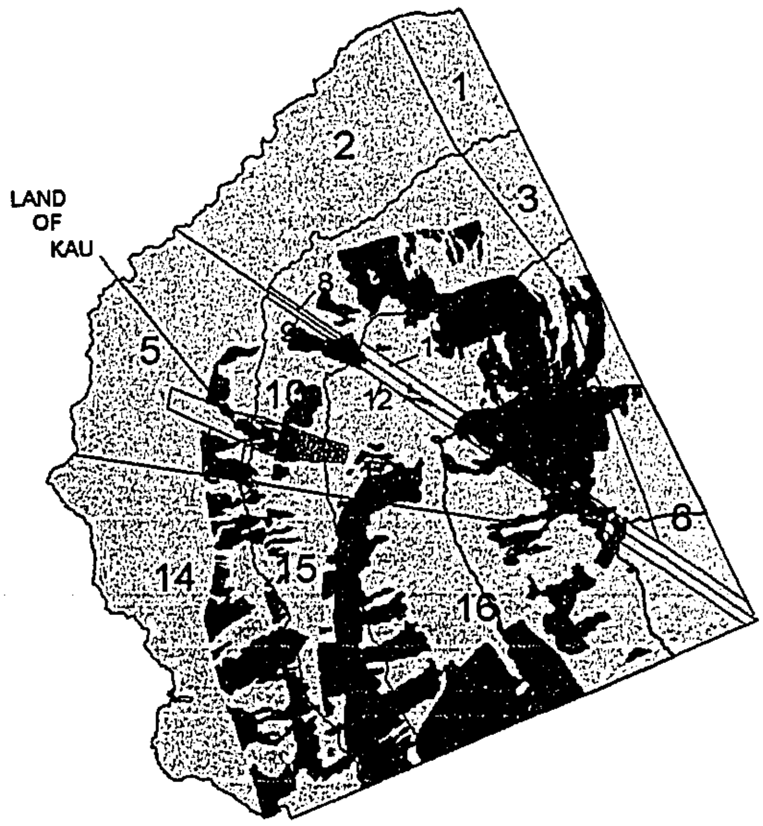
There is no information to suggest that high-level water will occur within the project area.

In 1999, Hiluhilu Development LLC obtained permits to drill three brackish wells at elevation 900' on the land of Kau. The wells were intended to supply brackish water to a proposed golf course. The permits have since lapsed pending changes in development plans. Appendix A contains the complete report of the original description of the groundwater available to the subject wells.

In addition to the occurrence of the groundwater, the recharge to the aquifer has not been systematically evaluated until recently. The following description and analysis is the most current review of the available estimate.

Recharge estimates

The land of Kau lies within the boundaries of a recently completed study (March 2003 by Waimea Water Services, Inc,) entitled " Groundwater Resources of North Hualalai" prepared for the Kamehameha Schools. The study paid particular attention to computing a detailed hydrologic budget where, recharge to the underlying aquifer systems was estimated. These recharge estimates are summarized in Figure 1 below.



Average Recharge With Fog

Zone	Recharge (Mgal/year)	Recharge (MGD)
1	173	.474
2	770	2.109
3	248	.678
4	1316	3.606
5	1416	3.880
6	430	1.178
7	1912	5.238
8	28	.077
9	26	.071
10	615	1.685
11	243	.666
12	255	.699
13	898	2.460
14	2563	7.022
15	1392	3.814
16	2753	7.542
	TOTAL	41.199

Zone boundary
Fog area boundary
0 inches/yr
>0 and ≤ 10 inches/yr
>10 and ≤ 25 inches/yr
> 25 inches/yr

Figure 1 (modified from WWS 2003)

The same methodology (see Appendix B) was applied to the preparation of recharge estimates for the land in the immediate vicinity of the project. Estimates were prepared assuming that there was no fog drip input to the precipitation and one where fog drip is included. These techniques allow for a worst-case recharge where no fog drip predominates. Importantly, either estimate is based on long-term data and incorporates short-term weather changes within the long-term data averages.

The most conservative estimates (no fog) are shown in **Figure 2** where fog drip is included in the estimates in **Figure 3.**

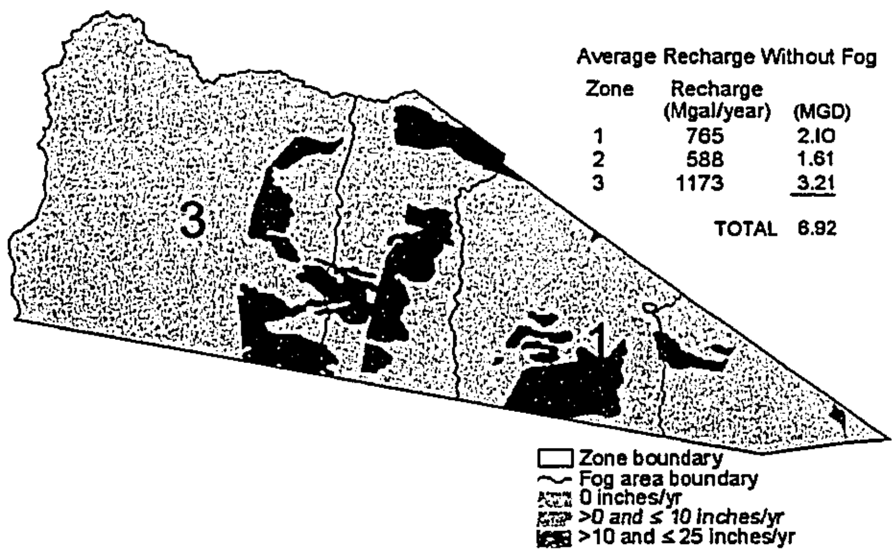


Figure 2

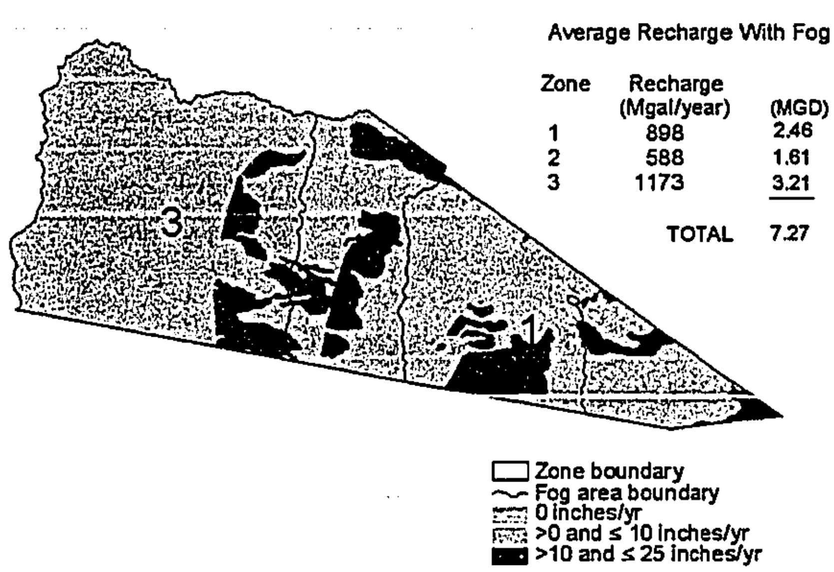


Figure 3

As noted, the most conservative estimate concludes that the groundwater recharge in units 1 and 2 of the study area (above elevation 900 feet) results in about **4 mgd** of groundwater flow within the sub area.

Sustainable Yield

Sustainable yield is defined as that amount of groundwater that can be pumped on a sustained basis. The original estimates by Yuen and Associates, Inc., in 1992 (State Water Resource protection Plan), are more general for the region and are based upon estimates of flow from assumed transmissivity and slope of the water table.

The aquifer sector (Keauhou), which includes the project area, extends from Kua Bay (at Kukio) and Keauhou to the south, and has an estimated sustainable yield of **38 mgd**. The majority of the groundwater flow in the Keauhou sector occurs from Kailua-Kona to Keauhou.

Assuming, however, the flow to the shore is uniformly distributed, the 38 mgd would result is a sustainable yield of about **2 mgd/mile** of shoreline. The width of the project study area is about 4 miles, which would imply that the sustainable yield would be about **8 mgd** for the recharge sub area. Based on the recharge estimates, this would be an excessive estimate of sustainable yield.

A more reasonable estimate might assume that the recharge for the total study sub area includes fog drip and that about **60%** of the **7 mgd** or **4.2 mgd** recharge would be a more defensible estimate of sustainable yield.

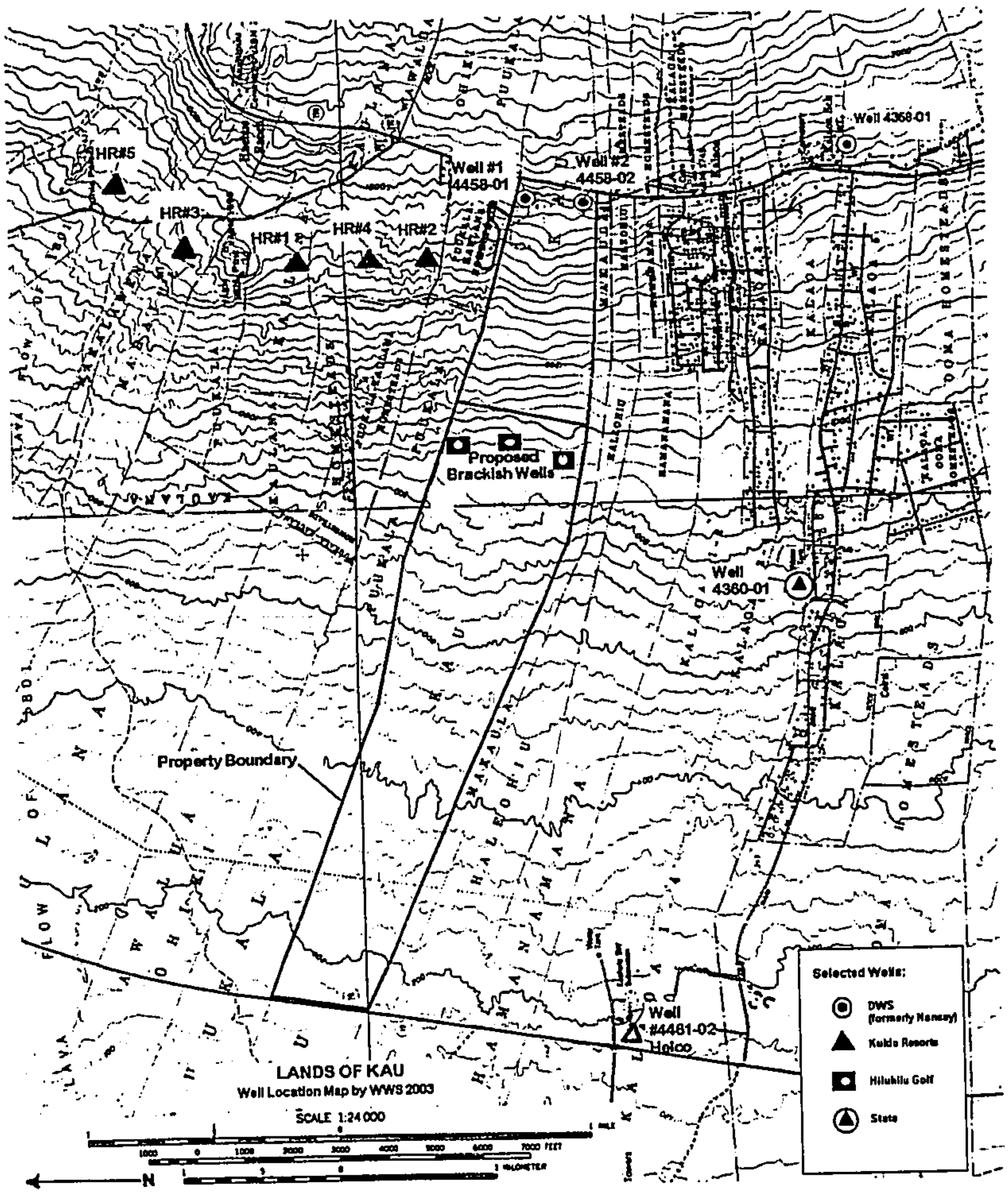
Others (ILum 1991) have estimated the groundwater recharge as high as **7.5 mgd / mile** of shoreline versus a sustainable yield of **4.5 mgd/mile** sustainable yield for the Kahaluu area. This appears to be an unrealistic estimate for the land of Kau when compared with the project estimate of slightly more than **1 mgd/mile** estimated from the hydrologic budget results.

The US Geological Survey, under contract with the National Park Service at Kaloko-Honokohau National Historic park, prepared a computor model synthesis of groundwater resources in 1999 (WRIR 99-4070). This study estimated the groundwater flow at **3 mgd/mile.** No estimates of sustainable yield were provided.

From the above information, the most conservative estimate of sustainable yield for the land of Kau and immediate vicinity is about best estimated at about **1mgd/mile of aquifer width.**

Water Development

Belt Collins and Associates, Inc, (Walter Billingsley- personal communication) estimates that the potable water demand for the project when completed will be approximately 1.21 mgd average day demand. This would include the normal lot uses for irrigation of yards as well as domestic activities as well as those uses for the UH facilities. These uses are expected to generate about .85 mgd of wastewater. The main potable supply will be provided from wells #4458-01& 02.



The proposed golf course will require a supply of about .8 to 1 mgd of irrigation supply when matured. It is intended that the golf course supply will come from brackish wells drilled on site as originally proposed and permitted. New permits will be needed. These wells are shown on the map as " proposed brackish wells".

The combined estimated pump age from the Huehue Ranch wells is to be exported to Kukio (1.3 mgd) and mauka to Makalei Country Club (.6 mgd). About .5 mgd of the 1.3 mgd exported to Kukio will be from the HR # 5 well which pumps from the high-level rift zone aquifer outside the recharge sub area. This leaves a combined pumpage of 1.2 mgd to be pumped from the sub area.

The original planned potable production from wells #4458-01 and # 4458-02 is 2 mgd, of which 1.21 mgd is the potable water to the project.

Assuming the golf demand is 1 mgd, the total to be pumped from the recharge sub area will be as follows:

Wells 4458-01,02	1.21 mgd
HR Wells	1.20 mgd
Brackish	1.00 mgd
Total Pumpage	3.41 mgd

On build out and occupancy, it is anticipated that reclaimed wastewater will be used to irrigate the golf course along the brackish water. This would reduce the pumpage accordingly and possibly reduce it to as low as 2.61 mgd.

Based on the estimates of recharge, sustainable yield and the reclamation of wastewater, it appears that there are adequate water resources in the recharge sub area to support the planned project.

In addition to the obvious supply benefit of recycled wastewater, the application of nutrients to the golf course will consume them. In particular, phosphorus, which is notably absent in Hawaiian soils, will largely be consumed by the turf grass, along with nitrogen. As such, there will be a reduction in the need for the application of supplemental fertilizers

Storm Runoff

The general solution to local drainage in Hawaii County has been to construct dry wells, which redirect any manmade runoff into the ground. The sporadic nature of the rainfall rarely, if ever, results in long-term pollution.

The area is underlain by very fresh, young and permeable lavas from the Hualalai volcano. The lands makai of the project are covered with the youngest of the eruptive series of 1801, which contain numerous lava tubes. The result is a very high horizontal transmissivity in the aquifer as reflected in tidal fluctuation in the water table. Any brief pollution events, which might enter the aquifer, are attenuated as they approach the shore. Even if pollution should be in evidence in moments of time, there will be no persistent pollution if the source is periodic.

Even a long term pollution is likely masked and unidentifiable as the groundwater flow approaches the shoreline.

There are no streams or drainage ways in the area and any manmade runoff should be directed underground as it is presently part of the existing recharge and should not be lost to the system.

There are indications, according to data produced during the 1999 USGS Kaloko- Honokohau study, that there may be some manmade influence as inferred by the detection of phenols in the shallow wells makai of the Kaloko Industrial Park (Water Resources Investigation Report 99-4070).

There are a number of potential sources of phenols, however, there is no conclusive evidence as to source.

Regardless, there are no bodies of water in the vicinity of the Kau project which might be negatively influenced by the project including the underlying brackish lens.

APPENDIX I

Brackish Source Report 1999

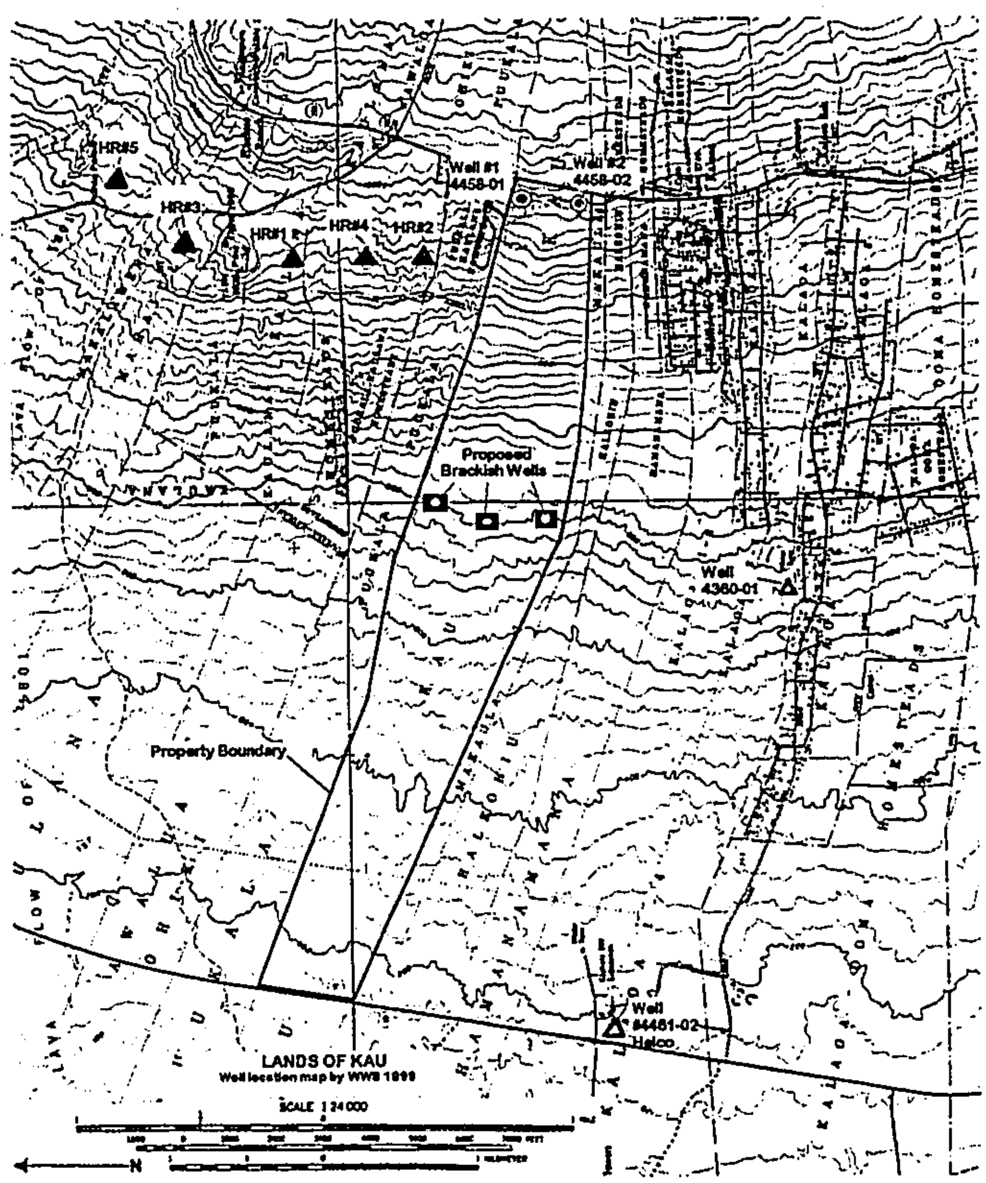
Brackish Water Sources
for
the Lands of Kau, Kona

For Due Diligence, May 15,1999

Introduction

The purpose of this report is to review and evaluate the existing information regarding the water resources on the subject parcel and to more clearly define the opportunity to develop a brackish water supply.

There are presently two wells (4458-01 & 02) situated along the east (Mamalahoa Highway) boundary of the parcel. These wells are intended as a drinking water source and are to be turned over to the County Department of Water Supply.



According to Water Resource Associates (WRA) undated report entitled "Water Resources and Supply for Lands of Kau, North Kona, Hawaii", Wells 1& 2 were each intended to produce 0.8 mgd (million gallons per day). The wells were to be pumped at a rate of 1000 gpm (gallons per minute) for 16 hours per day.

For this analysis, the buyer is estimating that water for about 81 homes at the top of the property will be needed. An additional potable water source will be required for a golf course clubhouse and about 20 surrounding upscale homes. The total potable water requirement is expected to be 343 water units or about .205 mgd.

For this review, based on the experience of the Hualalai Golf course, it is estimated that about 1 mgd of irrigation water will be required for the golf course during grow in. If the soil is adequately prepared, the golf course should not require more than 0.8 mgd, assuming that about 100 acres are under irrigation.

Nearby Potable Wells

As indicated on the well location map, there are a series of potable wells to the north of the Kau Wells I & 2. These wells make up the Huehue Ranch well field. Well 1 is designed to pump at a rate of 350 gpm while Wells 2,3,4, & 5 are designed to pump at a rate of 500 gpm each. All are intended to be pumped for a 16-hour day and the expected production will average 2.0 mgd, the sustainable yield as estimated by Waimea Water Services in 1991.

The salinity in the Kau Wells is about 35 mg/L chlorides in comparison to a salinity of 150 mg/L in HR #2. Recent (April 1999) water levels in Kau#1 and HR#1 were 9.38' and 7.73' respectively.

The Huehue wells are spaced out over a distance of about 1.5 miles or a sustainable yield of about **1.33 mgd/mile** of aquifer width. By contrast, the Kau wells are expected to have a sustainable yield of 1.6 mgd in 0.4 miles or **4 mgd/mile** of aquifer width.

Nearby Brackish Wells

Well # 4360-01 was drilled as an exploration well by the state in 1968. The well was pumped at a rate of 150 gpm and the salinity rose from 600 mg/L chlorides to 740 gpm. The **water level** in April of 1999 stood at an elevation of **+1.99'** above mean sea level. Since the well (located at elevation 681') has never been in production the long-term salinity during pumping is unknown and difficult to predict.

A test well, #4461-02, was constructed in 1993 at the HELCO power plant at elevation 210'. The **water level** was reported to stand a **+1.0'** above sea level. When tested at 500 gpm, the salinity was 5,900 mg/L chlorides. According to the records, the well was drilled to a depth of 253' (elevation - 43').

Proposed Brackish Wells

As part of the original well development plan, proposed by WRA in about 1991, two brackish wells, pumping at 500 gpm each, would produce 1.0 mgd for golf course irrigation. The pumping salinity projected by WRA was expected to be from 600 to 700 mg/L.

Based upon the field evidence and, the assumption that all of the potable well are placed into production as planned, maintaining a salinity of 600 to 700 mg/L chlorides seems highly unlikely, especially with only 2 wells. It is recommend that 3 wells, located at elevation 800', be used to produce the needed irrigation supply (see location map)

Water level measurements made through the years at the state well # 4461-01 indicate that the level ranges from about + 2' to +3'. The water level gradient between the state well and the HELCO well is about 0.75'**/mile.** Between the state well and Kau well # 1, the slope is **4.8'/mile.** The change in slope may indicate an, as yet undefined, groundwater flow boundary between the potable Kau wells and the proposed brackish wells.

Very dense and frequently very thick (up to 300' or more) trachyte lava flows have been encountered during drilling on the slopes of Hualalai. According to the geologic log of Kau well #2 contained in the WRA report, there is a trachyte flow located between the elevations of + 510' and +240'. Assuming that the present land slope (666'/ mile) can be projected at depth, this trachyte flow would be found at elevation – 1000' at the 800' proposed well sites.

The geologic formations penetrated in the upper 800' of Kau # 2 are generally very permeable except for a several very dense AA flows. In particular, a 40' thick, dense AA is located between a depth of 760' and 800' (see attached geologic log). The proposed wells are to be located at about elevation 800' and should penetrate permeable rock, however, this is not certain. The state exploration well penetrated dense lava at sea level and would have difficulty producing at a rate of 500 gpm.

It is recommended that the proposed golf course be carefully designed to minimize water consumption and be planted with salt tolerant grass. Further that the first well be drilled (or at least a pilot bore) be drilled in the pre-planning phase of project development to establish both yield and water quality.

It is expected that as the mauka wells begin to pump heavily, there will be a rise in salinity in the brackish resources, even at the 800' elevation. More detailed investigations, such as recording of water level fluctuations should be pursued upon purchasing the property and prior to any additional water development.

As planned, the purchase of, and supplement with, potable water may be necessary to maintain water quality of the golf course.

Additionally, it is recommended that at least three wells of 500 gpm be used as the source of irrigation water to supply the estimated 0.8 to 1.0 mgd. These wells should be pumped within the HELCO off peak power period from 9:00 PM to 7:00 AM. This represents a rate of about 50% below the on – demand power schedule. By using the off – peak schedule, a usage of about 800,000 gallons per day will cost about $345 per day or $0.43/1000 gallons.

The estimated cost for a completed 800' well, including the well, pump, controls and necessary pipes and valves, is $500,000 per well or about $1.5 million for a well field containing 3 wells.

In conclusion, from 0.8 to 1.0 mgd of brackish irrigation water can be developed within the Land of Kau. The development process should be conservative and recognize the risks to both yield and quality as discussed above. There remain a number of unanswered questions which can only be answered via actual field monitoring and pumping.

APPENDIX II

Hydrologic (water)Budget

Kau Sub-area Water Budget

There are three basic methods of estimating the reliability of groundwater resource supplies commonly applied in Hawaii as follows:

1. Sustainable Yield- These estimates have been calculated based on water table gradient estimates where data is scarce. Where water is extensively developed (Oahu), the sustainable yields have been refined through the use of actual pumpage and water quality data.
2. Gound water modelling- The models are based upon a series of aquifer assumptions and coefficients. Such models create recharge, storage flow and pumpage projections. The model can be used to define the sustainable yield estimate
3. Hydrologic (water) budget – The estimates are based upon long - term rainfall, stream runoff evaporation, transpiration of plants and soil storage balances. The product represents the estimate of recharge to the underlying ground water resources. A sustainable yield of the aquifer can then be estimated using percentages developed in similar conditions where pumpage is occurring.

Estimates of sustainable yield, using method 1 and method 2, have previously been prepared for the North Kona district. Accordingly, it was determined that a hydrologic budget should be prepared to provide a cross check to previous estimates. The following paragraphs describe the methodologies used in the budget process.

GIS Model

The water budget was calculated using a Geographic Information System (GIS) that links the location or spatial distribution of each component of the water budget with the attributes of each component such as monthly median rainfall value or soil type. The GIS model is a model of the environment with real-world coordinates. As such, it is a powerful analytical tool to discover spatial interrelationships among the model components as well as to analyze the validity of the model results.

Water Budget

Ground water is replenished by the infiltration of rainfall that percolates through the root zone in the soil to bedrock. Groundwater recharge can be estimated by a water accounting model similar to that developed by Thornthwaite (1948) and Thornthwaite and Mather (1955) that balances input of rainfall and fog drip with output of runoff, evapotranspiration, groundwater recharge, and the change in soil-moisture storage expressed by:

Eq 1. $$G = P + F - R - ET - \Delta SS$$

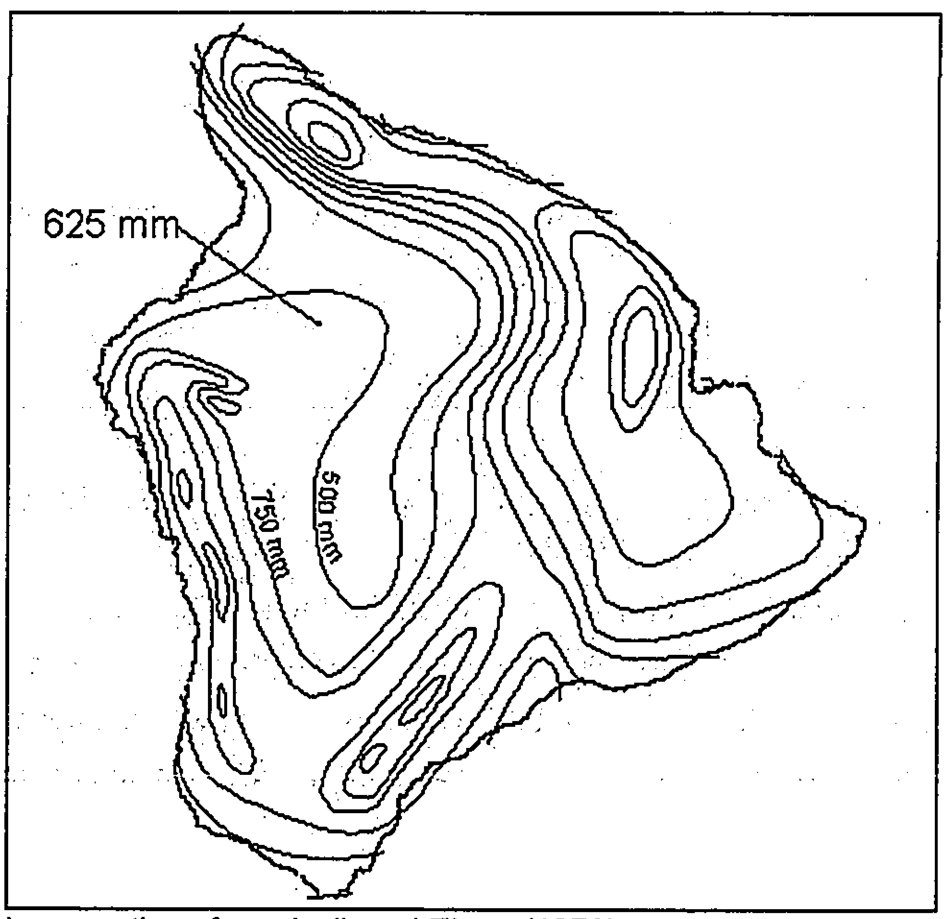
Where: G = groundwater recharge,
F = fog drip,
P = rainfall,
R = direct runoff,
ET = evapotranspiration, and
ΔSS = change in soil-moisture storage.

In this water-budget model direct runoff and fog drip are calculated separately as a percentage of rainfall. Thus, the model calculates groundwater recharge, evapotranspiration and the change in soil-moisture storage in the budgeting process.

Rainfall

The project area is within the strong convergence zone where the Kona area rainfall maximum occurs. This area has a pronounced sea-breeze that develops by way of the tradewind shelter provided by Mauna Loa and Hualalai and high afternoon surface temperatures on the west-facing slopes. The convergence zone occurs where the tradewind flow that is diverted around the high volcanoes collides with the strong sea breeze moving upslope.

The twelve monthly median rainfall maps (Giambelluca and others, 1986) were digitized for use in the GIS model. The maps depict the changing rainfall distribution across the island through the months. Digitizing is a process where each rainfall isohyet, line of equal rainfall, on the map is traced electronically. These lines are projected into a real-world coordinate system in the GIS model creating twelve layers, one for each month. The rainfall value applied to the area between the isohyets is the average value of the two bounding isohyets. The average annual rainfall in the Kau sub area is 23 Mgal/d.



Regression equations from Juvik and Ekern (1978) transects were used to estimate the fog component of the water budget in the project area. A fog contribution area was conservatively set between 3600 ft and the upper reaches of the project area at 5000 feet. For the winter months, October through March, fog was calculated relative to rainfall using:

Eq.2 Fog (mm) = 2.563 + 0.165 x Rainfall (mm) r = 0.903

For the summer months, April through September the following equation was used:

Eq.3 Fog (mm) = 2.098 + 0.341 x Rainfall (mm) r = 0.507

The average fog component calculated by this method is 1 Mgal/d. These equations were developed from a small sample during a collection period that had large synoptic storms. Further investigations to measure fog drip within the project area are necessary to better define this component of the water budget. Because fog drip is poorly known, the water budget was calculated with and without a fog component.

Runoff

Direct runoff from the project area was assumed to be zero as there is no runoff discharge to the ocean. Any surface flow that occasionally occurs, is estimated to infiltrate locally, and thus the volume of water remains in the water budget either as ground-water recharge or as evapotranspiration.

Evapotranspiration and Soil Attributes

Evapotranspiration (ET) is the quantity of water evaporated from water and soil surfaces and transpired by plants. ET can be measured by evaporimeters or lysimeters, or calculated mathematically from various climatic data, none of which are available in the project area. However, ET can be estimated from soil and pan evaporation data.

Pan evaporation measurements are a common way to assess plant water use, and the potential or maximum ET is frequently estimated as a factor of pan evaporation. Ekern and Chang (1985) created a map of the mean annual pan evaporation for the island of Hawaii that was digitized for the GIS water-budget model. The value assigned for the area between the lines of equal pan evaporation is the average value of the two bounding lines. Monthly pan evaporation values were calculated from each month's mean monthly to mean annual ratio, at the Lalamilo station, applied to the mean annual distribution.

The soil attributes of available water capacity (the amount of water held in the soil available to plant roots between field capacity and wilting point) and the root depth determine the maximum soil moisture storage for each soil type. This volume of water in soil storage sets the limit to how much ET can occur from that soil type in any given month. Depending on the monthly input of rainfall and fog drip, the volume of water in soil storage changes. Thus, the actual ET monthly values fluctuate limited by the maximum pan evaporation value and the volume of water held in soil storage.

With a fog component, ET in the Kau sub-area was estimated to be 16.6 Mgal/d and without fog, ET was estimated to be 16 Mgal/d.

Groundwater Recharge

Using equation 1 above, with a fog component, recharge in the Kau sub-area was calculated to be 7.3 Mgal/d, and without fog, recharge was 6.9 Mgal/.

References

Ekern, P.C. and Chang, J.H., 1985, Pan evaporation: State of Hawaii, 1894-1983: State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development, Report R74,
171 p.

Giambelluca, T.W., Nullet, M.A., and Schroeder, T.A., 1986, Rainfall atlas of Hawaii: State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development, Report R76,
267 p.

Juvik, James O and Ekern, Paul C., 1978, A Climatology of Mountain Fog on Mauna Loa, Hawaii Island, WWRC Tech. Rept. No. 118, 63 p.

Thornthwaite, C.W., 1948, An approach toward a rational classification of climate: Geographical Review, v. 38, no. 1, p. 55-94.

Thornthwaite, C.W., and Mather, J.R., 1955, The water balance: Publications in Climatology, v. 8, no. 1, p. 1-104.