FINAL ENVIRONMENTAL IMPACT STATEMENT

URBAN EXPANSION STATE LANDS

Keahole To Kailua Region
North Kona, Hawaii

JULY 1993

As Part Of A Petition To:
State Land Use Commission

Prepared For:
Office Of State Planning, State Of Hawaii

Prepared By:
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August 2, 1993

Mr. Brian Choy, Director
Office of Environmental
Quality Control
Central Pacific Plaza
220 S. King Street, 4th Fl.
Honolulu, Hawaii 96813

Dear Mr. Choy:

Subject: LUC Docket No. A92-685/Office of State Planning

At its meeting of July 28, 1993, the Land Use Commission accepted the Final Environmental Impact Statement (FEIS) prepared for the subject docket as filed by Petitioner, for the reclassification of approximately 2,640 acres of land currently in the Agricultural and conservation Districts into the Urban District at Keahole, North Kona, Hawaii.

The Commission's Findings of Fact, Conclusions of Law, and Decision and Order accepting the FEIS will be forwarded to you at a later date under separate cover.

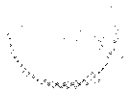
Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

cc: OSP



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C. Botanical Survey (Char & Associates)

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1.0 INTRODUCTION AND SUMMARY

1.1 Intended Use of this Document

This final environmental impact statement ("FEIS") has been prepared in support of a petition by the Office of State Planning ("OSP") (the "Petitioner") to the Hawaii State Land Use Commission (the "Commission") for a land use boundary amendment from the Conservation and Agriculture Districts to the Urban District for approximately 2,640 acres of land in the Keahole to Kailua area of North Kona, Hawaii. The petition is in response to a recommendation made by OSP in the State Land Use District Boundary Review Report (for the island of Hawaii), which identifies the petition area as a "Priority Area for Action," to be reclassified to the Urban District.

This FEIS is intended to comply with Chapter 343, Hawaii Revised Statutes (HRS), and the environmental impact statement (EIS) regulations promulgated by Chapter 200 of Title 11, Department of Health. The purposes of this document are to provide information to public officials and members of the community about the nature of the proposed action; to assess the existing environmental conditions of the property; to evaluate potential impacts of the proposed action and to present mitigating actions for those impacts, if necessary; and, to consider alternatives to the proposed action.

1.2 Project Summary

Landowner:	State of Hawaii Department of Land and Natural Resources Division of Land Management P.O. Box 621 Honolulu, Hawaii 96809 (808) 587-0400
Petitioner/ Applicant:	Office of the Governor Office of State Planning (OSP) P.O. Box 3540 Honolulu, Hawaii 96811-3540 (808) 587-2802 Attention: Mary Lou Kobayashi
Preparers of Final Environmental Impact Statement:	Helber Hastert & Fee, Planners 733 Bishop Street, Suite 2590 Honolulu, Hawaii 96813 (808) 545-2055 Attention: Scott Ezer
Location:	North Kona Judicial District, County of Hawaii Makaula; Haleohiu; Hamanamana; Kalaoa 1st, 2nd, 3rd, 4th, 5th; and Ooma 1st and 2nd ahupua'a, east of the Keahole Airport and approximately seven miles north of Kailua-Kona
Tax Map Key:	Division 3, Zone 7, Section 3: Plat 09, Parcels 5 and 8; Plat 10, Parcel 2 and a Portion of Parcel 33

Approximate Acreage:	2,640 acres
Existing State Land Use District:	Agricultural District Conservation District, General Subzone
County of Hawaii General Plan:	Urban Expansion, Extensive Agriculture
County Zoning:	Unplanned, Open
Existing Uses:	Vacant, Two (2) 69 Kilovolt (kV) transmission lines, 0.5-million gallon County Water Tank
Approving/Accepting Agency:	State Land Use Commission
Request:	State Land Use District Boundary Amendment to Urban District

1.3 Alternatives Considered

Two alternatives to the proposed action were considered: a no-action alternative; and, an agriculture alternative. These alternatives were determined to be undesirable because they would prevent the implementation of existing State of Hawaii and County of Hawaii policies.

1.4 Summary of Probable Impacts and Mitigation Measures

A summary of the probable impacts and mitigation measures for the proposed urbanization of the petition area is presented below. Urbanization of the area is recommended as part of the State Land Use District Boundary Review required by Section 205-18, HRS. The purpose of the boundary review is to allocate sufficient land for future urban growth and also to direct urban growth to appropriate areas. Since the intent is to provide for long-range planning rather than reacting to developer-initiated proposals, specific land uses have not been determined for the area. It should be noted that probable impacts are based on the assumption that the petition area will be used to accommodate "urban expansion," without defining specific uses within the petition area. As discussed in Section 2.5, possible future uses for the petition area would be a mix of urban uses, including but not limited to, housing, parks and open space, commercial, light industrial, roadways and public facilities.

Although this area has been identified as desirable for future urban expansion and is recommended for reclassification under the boundary review, additional studies and the approval of various agencies as to mitigating measures will be required before development of the area can occur, in most cases, prior to zoning or building permit approval. It is proposed that a series of standard conditions shown in Appendix J be attached to any approval granted by the Commission.

This FEIS includes a discussion of alternative development scenarios of the petition area for the purpose of representing order of magnitude development potential for the area (Section 2.5). The scenarios are based on the existing and emerging urban uses within the Keahole to Kailua region. The scenarios provide gross, order of magnitude ranges for

residential units, commercial and light industrial acreages, etc., which provide a basis to determine and assess potential impacts to public facilities and services.

Although the level of analysis only provides order of magnitude impact estimates, the Petitioner believes that measures can be identified at this early stage of planning for the petition area to mitigate future significant impacts. A number of these mitigation measures are embodied in the conditions that the Petitioner proposes be attached to any approval granted by the Commission. These conditions are presented in Appendix J and discussed in Chapters 4, 5, and 6, under appropriate subject headings (Housing, Water Supply, Wastewater, etc). When the conditions recommended are included in the text of the FEIS, they are italicized for easy identification.

Soils/Agricultural Productivity. None of the soils found within the petition area have rated as suitable for agricultural activities by the U.S. Soil Conservation Service, the U.H. Land Study Bureau or the State Department of Agriculture (DOA) (ALISH). In addition, there are no agricultural activities found on the petition area. Therefore, there will be no adverse impacts to existing agricultural operations if the petition area is urbanized. DOA has expressed interest in expanding its existing Keahole Agricultural Park into a portion of the petition area. However, the petitioner feels that more suitable lands are available elsewhere in the region.

Drainage. It is estimated that approximately 1,000 cubic feet per second of additional runoff will be generated by the urbanization of the petition area. This runoff can be precluded from entering downstream properties by installing an on-site system of swales and underground drainage structures coincident with development of the property, which would channel runoff into a system of dry wells and retention basins.

Water Quality. Urbanization of the petition area has the potential to adversely impact water quality (nearshore and groundwater), through storm water runoff, wastewater treatment and disposal, increased potable water demands, and decrease in permeable surfaces providing groundwater recharge. Mitigation measures include requiring an environmental risk assessment if a golf course (or courses) is included in the eventual urbanization of the petition area, and participation in a regional water quality monitoring program by the owner/developer of the petition area.

Historic Resources. A detailed background synthesis of the entire petition area and an inventory survey of the 500-acre university site indicated the presence of a number of historic sites, nine of which are worthy of preservation. Significant portions of the petition area remain unsurveyed. The owner/developer of the petition area will need to conduct inventory surveys for the entire site and work closely with the Department of Land and Natural Resources, State Historic Preservation Division, to ensure adequate protection of historic resources.

Flora/Fauna. The petition area was subjected to botanical and biological field reconnaissance studies by trained biologists. No threatened or endangered species were encountered in the field surveys. A botanical survey indicated the presence of one 'aiea plant, which is a Category 1 Candidate Endangered Species, in the northeastern portion of the petition area, situated within an 'a'a lava flow. Given the limited time spent on the project site and the area covered during field studies, it is possible that there may be a few more trees of 'aiea on the petition area, and, perhaps, uhiuhi, an officially listed endangered species. It will be necessary to conduct more intensive botanical surveys, particularly in the two mixed shrubland vegetation types, where the largest number and diversity of native species occur. If areas with endangered or rare and vulnerable plants are subsequently found, it may be necessary and/or desirable to establish a nature study

park (or parks) around these areas or institute alternate mitigation measures acceptable to State and Federal agencies. The portions of the petition area covered by fountain grass grassland (which is a major part of the site) are not likely to contain endangered or rare and vulnerable species.

Visual Resources. Urbanization of the petition area will irretrievably alter the landscape from its predominantly natural state to one of urban uses. Although existing public views of the petition area are infrequent and transitory, those that are available will be altered. Adverse visual impacts can be mitigated by controlling building heights, the use of prudent site planning methods, and using landscaping to "soften" the appearance of those buildings.

Air Quality. There will be both short- and long-term impacts to air quality associated with the petition area. Short-term impacts will be related to construction activities and exhaust emissions from on-site construction equipment. Long-term impacts will result from increased motor vehicle traffic on nearby roadways. Short-term impacts will be mitigated by adherence with State of Hawaii Air Pollution Control Regulations during construction. Longer-term impacts may be mitigated by the incorporation of transportation systems management (TSM) practices and energy-efficient facilities into the master plan.

Population. The North Kona District has been one of the fastest growing areas in the State of Hawaii, with an average annual growth rate of 6.2 percent since 1980. The reclassification and subsequent development of the petition area will support continued population growth in the region. Based on the three scenarios discussed in Section 2.5, it is estimated urbanization of the petition area could accommodate between 16,254 and 21,339 residents.

Economy/Employment. Short- and long-term job opportunities will be created by: (a) construction activities that result from the reclassification of the petition area; (b) future businesses that might locate to the petition area; and, (c) development of a West Hawaii campus of the University of Hawaii. As such, the economic diversity of the West Hawaii economy will be enhanced, and there will be an increase in property, sales and state income taxes. Based on the three scenarios discussed in Section 2.5, it is estimated that urbanization of the petition area could provide between 18,600 and 33,560 direct, indirect and induced jobs.

Housing. Although specific land uses for the petition area have yet to be determined, it is probable that residential uses will comprise a significant percentage of its acreage, thus contributing to the availability of new housing opportunities in West Hawaii. Based on the three scenarios discussed in Section 2.5, it is estimated that urbanization of the petition are could add between 5,650 and 7,533 dwelling units to the region.

Traffic. Although existing traffic flow on Queen Kaahumanu Highway is at acceptable levels of service (LOS), future left turn movements from Kaimi Nani Drive and the Airport Access Road will reach unacceptable LOS by 1998 unless plans being prepared by the State Department of Transportation for the improvement of Queen Kaahumanu Highway to a four-lane, limited access highway are implemented. Improvements to the highway would ultimately include the construction of interchanges. The Department of Transportation, Airports Division, is beginning preliminary design of a new airport interchange which would also provide primary highway access to the northern portion of the petition area.

Potable Water. Rapid population growth in the North Kona region is taxing existing well sources, storage and transmission systems. The County Department of Water Supply and the State Department of Land and Natural Resources are exploring various alternatives to mitigate this situation, including the development of new sources. The reclassification of the petition area will add to the strain on existing potable water systems. Based on the three scenarios discussed in Section 2.5, it is estimated that urbanization of the petition area could result in a demand for potable water of between 4.6 and 6.6 million gallons per day (mgd). This range is compared to the estimated balance of the sustainable yield of the North Kona Water System of about 7.0 mgd (this reflects other known public and private developments that are anticipated in the region).

Wastewater Disposal. Presently, there is no available municipal wastewater treatment plant (WWTP) that can accommodate wastewater that would be generated by the development of the petition area. The recently adopted Keahole to Kailua Development Plan indicates sewage from this area discharging to a proposed Municipal Treatment Plant No. 2, which will be located approximately two miles north of the Keahole Airport. Based on the three scenarios discussed in Section 2.5, it is estimated that urbanization of the petition area could produce between 2.5 and 3.0 mgd of wastewater.

Electric Power. Hawaii Electric Light Company, Inc. (HELCO) recently announced plans to expand the capacity of the Keahole Generating Plant from 30 megawatts (MW) to 86 MW by 1997. It is likely that electrical demand for the urbanized petition area will exceed 40 mW. It will be necessary to closely monitor growth in the region against available electrical output provided by HELCO.

Police/Fire/Emergency Services. The increase in population attributable to the development of the petition area will increase demand on existing police, fire, and health services within the region. The petitioner will coordinate with State Department of Health and the County departments of Police and Fire, to set aside land, if required, to accommodate additional stations or substations for these services.

Schools. Current planning by the State Department of Education for the North Kona School District does not anticipate any population growth within the petition area. Consequently, the urbanization of the petition area will require the Department of Education to reevaluate its plans to service the Keahole to Kailua region.

Solid Waste Disposal. The existing landfill in West Hawaii (the Kailua Landfill) is expected to close in late 1993, and a new landfill will then be opened at Puu Anahulu. It is anticipated that solid waste generated by the urbanization of the petition area will be handled at the Puu Anahulu Landfill. Based on the three scenarios discussed in Section 2.5, it is estimated that between 48 and 64 tons of solid waste per day could be generated by the urbanization of the petition area.

1.5 Unresolved Issues

This request for a land use boundary amendment from the Conservation and Agriculture Districts to the Urban District is filed in response to recommendations contained in OSP's State Land Use District Boundary Review Report. The purpose of the Boundary Review is to allocate sufficient land for future urban growth and also to direct urban growth to appropriate areas. No specific land uses for the petition area, with the exception of the University, have been determined. In this context, parcel-specific impacts associated with the proposed reclassification cannot be determined. This FEIS has, however, through discussion of development scenarios (Section 2.5), defined order of magnitude

impacts for a broad range of issues (potable water, wastewater, traffic, housing, population, etc.)

Prior to development of the petition area, it will be necessary to conduct detailed investigations of many of the issues covered in this FEIS. As discussed in Section 1.4, the Petitioner is recommending the adoption of numerous conditions to be attached to any approval granted by the Commission as a means to ensure that a detailed discussion of impacts based on parcel-specific land uses occurs prior to the submittal of applications for County zoning. This should be viewed as a means to mitigate any uncertainty about how specific impacts will be addressed.

1.6 Necessary Permits and Approvals

Table 1 lists the State of Hawaii and County of Hawaii permits that will be required prior to development of the petition area. Other permits may be required for specific construction activity.

Table 1: Development Permits and Approvals

Authority	Approval Required
State of Hawaii	
State Land Use Commission	Land Use District Boundary Amendment
Department of Land and Natural Resources	Chapter 6E Review
Commission on Water Resource Management	Well Construction and Pump Installation Permits
Department of Health	Potable Water System Approval
County of Hawaii	
County Council	Rezoning General Plan Amendment
Planning Department	Subdivision Approval
Board of Water Supply	Modified water distribution system approval
Department of Public Works	Building Permits Grading and Stormwater Management Permits

2.0 DESCRIPTION OF PROPOSED ACTION

2.1 Location

The petition area is located on the leeward slopes of Mt. Hualalai, directly east (mauka) of the Keahole Airport area and the Queen Kaahumanu Highway, and seven miles north of Kailua-Kona. The site encompasses portions of the Makaula, Haleohiu, Hamanamana, Kalaoa, Kalaoa-O'oma and O'oma 2nd ahupua'a. The petition area is bounded by the Queen Kaahumanu Highway and the State-owned Keahole Agricultural Park to the west (makai), the privately-owned Kau ahupua'a to the north, the Kona Palisades and Kona Acres subdivisions, along with various State of Hawaii and privately-owned parcels of land to the east, and the privately-owned Kohanaiki ahupua'a to the south (Figure 1).

Kaimi Nani Drive bisects the petition area in an east to west direction, connecting Queen Kaahumanu Highway with Mamalahoa Highway. Vehicular access to the boundaries of the petition area is possible from either Queen Kaahumanu Highway or Kaimi Nani Drive, although there are no improved roads within the petition area. Pedestrian access to the site is possible from Queen Kaahumanu Highway or mauka of the Hawaii Electric Light Company (HELCO) generating plant.

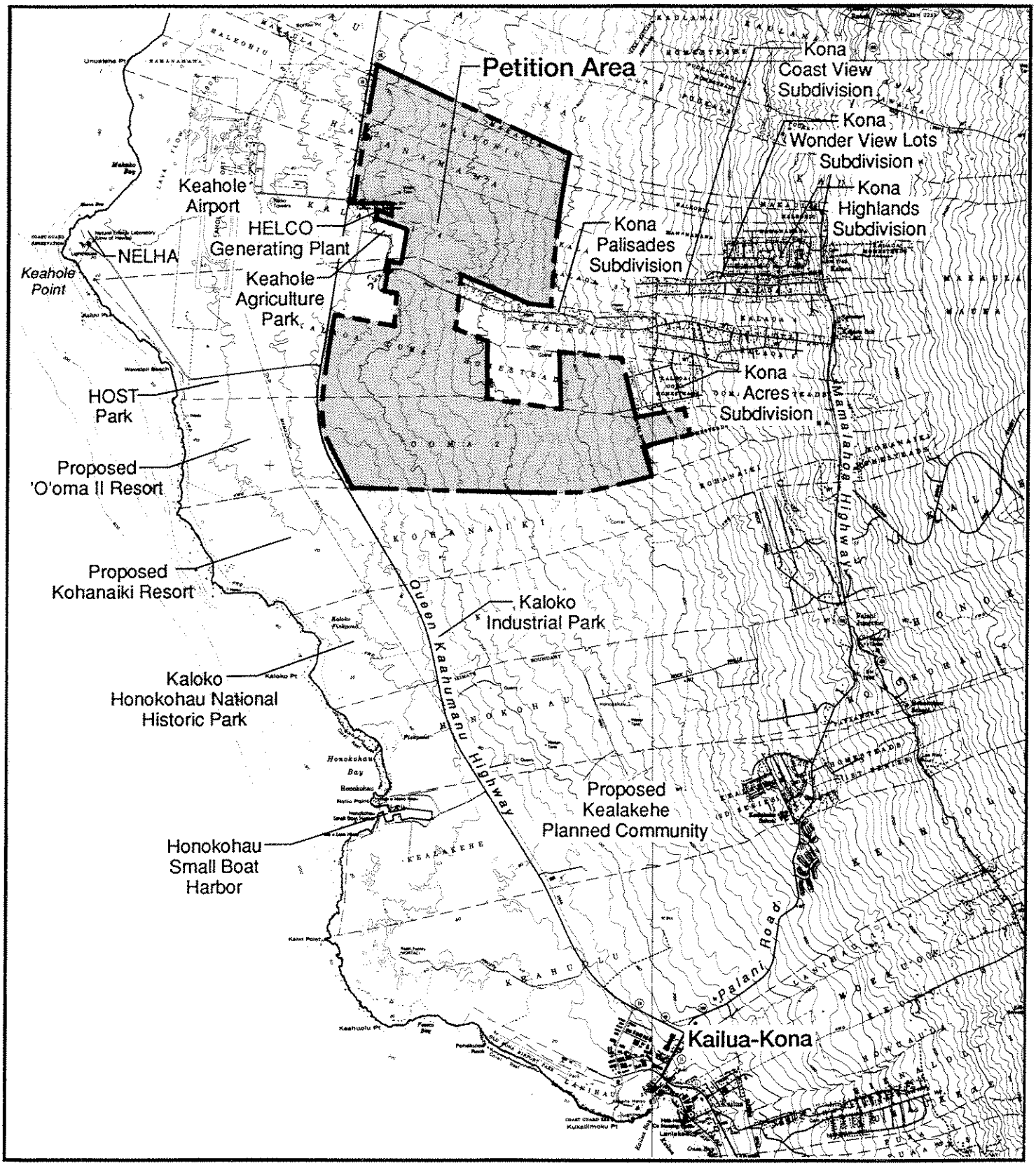
The petition area is comprised of four parcels, referred to for taxation purposes as TMK 7-3-09:05, 7-3-09:08, 7-3-10:02, and 7-3-10: por. 33, (Figure 2). Together, these parcels comprise approximately 2,640 acres. The largest of these parcels (TMK 7-3-10: por. 33) totals approximately 1,570 acres in size (Table 2). The remaining parcels include: TMK 7-3-09:05, a 903.789-acre parcel occupying a large portion of the O'oma 2nd ahupua'a; a rectangular 44.97-acre parcel (TMK 7-3-09:08) occupying a portion of the O'oma 2 ahupua'a; and a 118.6-acre parcel (TMK 7-3-10:02) occupying a portion of the Kalaoa-O'oma ahupua'a.

Table 2: Summary of Tax Parcels

TMK Number	Acreage	
7-3-09:05	903.789	
7-3-09:08	44.97	
7-3-10:02	118.6	
7-3-10:por.33	1,570	(approx)
Total	2,640	(approx)

2.2 Environmental Setting and Existing Land Use

Elevation of the petition area ranges from about 80 feet above mean sea level (msl) at the southwest (makai) corner (near Queen Kaahumanu Highway) to about 840 feet above msl at the southeastern (mauka) boundary of the site (Figure 3). The site's topography is characterized as being moderately sloping with approximately 90 percent of the site having gradients of less than 10 percent. Most of the remaining lands have gradients between 10 to 20 percent. Generally, the flatter lands are concentrated in areas below an elevation of 380 feet msl. Above this elevation, there is a higher frequency of areas with gradients in excess of 10 percent. Within this general setting, localized mounds and depressions, characteristic of lava flows, are present throughout the site.



Regional Location Map

URBAN EXPANSION STATE LANDS

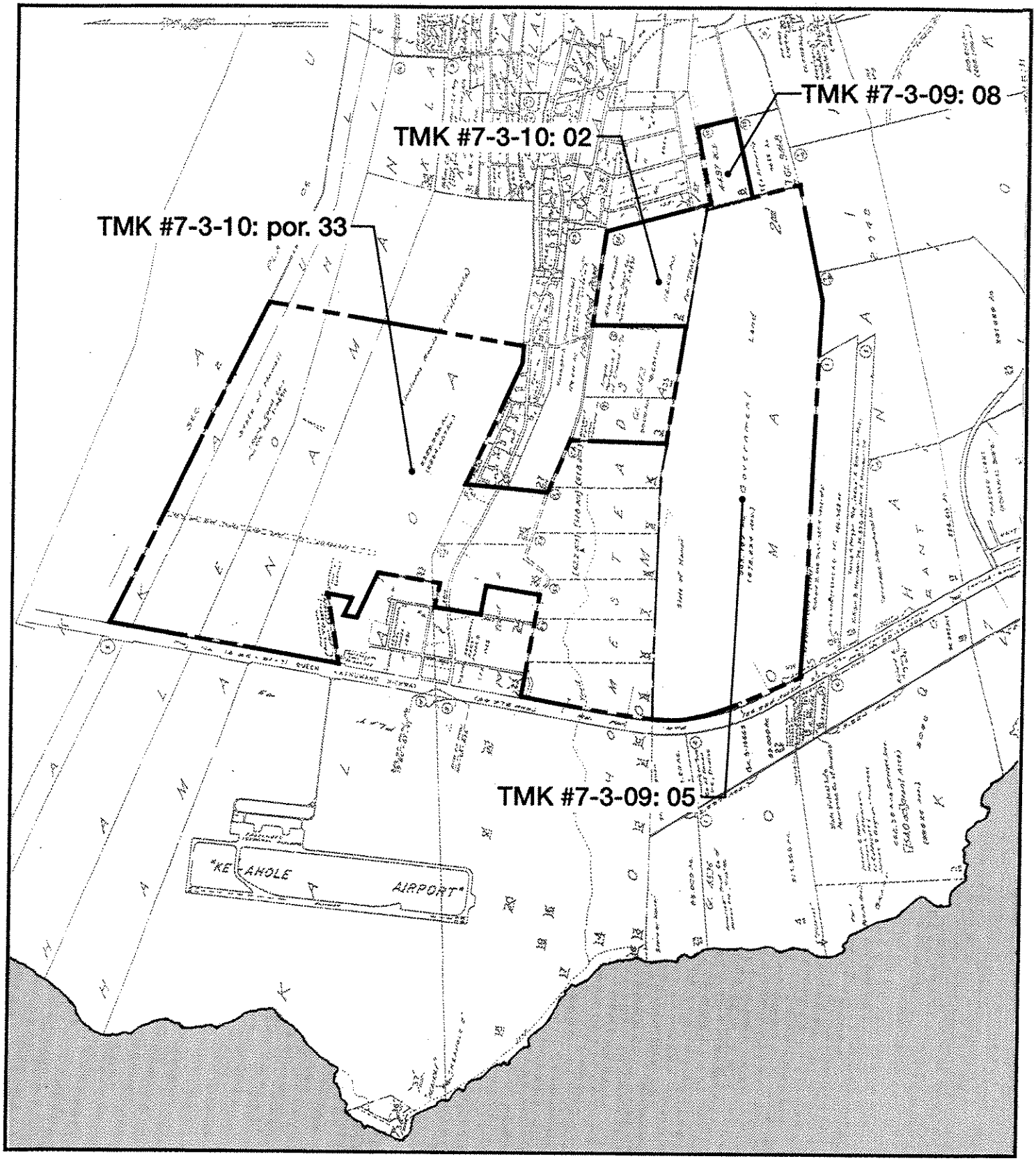
Keahole to Kailua Region

Figure: 1

Feet

0 2500 5000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners



Tax Map

URBAN EXPANSION STATE LANDS

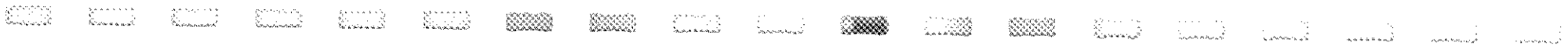
Keahole to Kailua Region

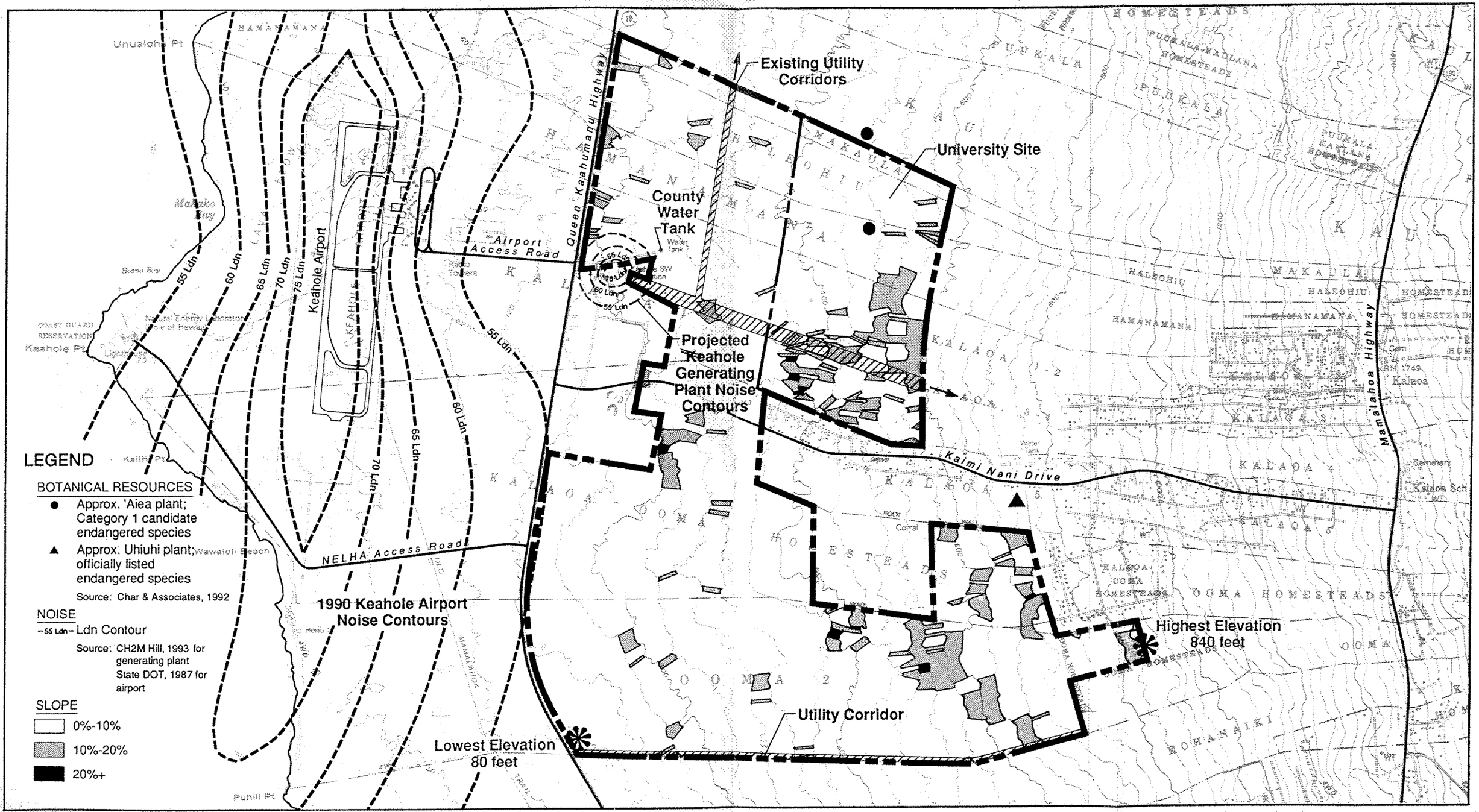
Figure: 2

Feet

0 1500 3000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners





Environmental Constraints
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Figure: 3

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

The County of Hawaii Department of Water Supply maintains a 0.5 million gallon water tank and access road in the northern makai portion of the site. The Hawaii Electric Light Company (HELCO) maintains two 69 kilovolt (kV) transmission line corridors which traverse the northern portion of the petition area in both an east-west and north-south direction. In addition, Nansay Hawaii, Inc. has an easement for another utility corridor on the southern boundary of the petition pending approval from the Department of Land and Natural Resources. Other than these uses, the petition area is vacant and remains in its natural state, with a landscape consisting of prehistoric lava flows covered by sparse vegetation composed of grasses and scattered shrubs and trees.

One Category 1 candidate endangered species, the 'aiea, was identified in the northeastern portion of the petition area, during a botanical survey prepared for the FEIS. A second 'aiea plant is known on the adjacent (north) Kau ahupua'a at about the 480-foot elevation. Also an officially listed endangered species, the uhiuhi, is found on the adjacent Pu'uhonua Estates Subdivision, at about the 720-foot elevation.

There are other land uses which affect the environmental setting of the petition area. These are: the Keahole Generating Station located adjacent to the western (makai) portion of the petition area; and the Keahole Airport, located makai of the petition area across Queen Kaahumanu Highway. Analysis of noise contour lines for existing operations at the airport and projected operations at the generating station show minimal impact to the petition area. Except for a narrow strip of land immediately mauka of Queen Kaahumanu Highway, all of the petition area is outside the 1990 55 Ldn noise contour for the airport (KPMG Peat Marwick, 1987), and only a small portion of the petition area would be within the projected 65 Ldn noise contour for the Keahole Generating Station after a planned expansion from 30 to 86 mW peak capacity (CH2M Hill, December 1992) (Figure 3).

2.3 Regional Description

The project site lies within the North Kona Judicial District, one of nine judicial districts in Hawaii County. The North Kona District lies on the western coast of the island of Hawaii within the larger region known as West Hawaii. Anaeho'omalu Bay marks the district's northern boundary and Kealakekua Bay marks its southern boundary. The inland boundaries are defined by the land masses of Mauna Loa and Hualalai. The North Kona Judicial District includes Census Tracts 215 (Kailua-Kona) and 216 (the remainder).

The primary commercial center of the region is located at Kailua-Kona, the second largest town on the island of Hawaii, with a 1990 population of 9,126 (The State of Hawaii Data Book, 1991). Secondary urban centers are found in the communities of Holualoa, Kainaliu, Keauhou and Kalaoa.

Adjacent Uses

Keahole Generating Station and Substation. The Keahole Agricultural Park abuts a portion of the western end of the petition area mauka of Queen Kaahumanu Highway (Figure 1). The agricultural park is located on State-owned land and was developed by the State of Hawaii, although individual parcels are leased to commercial growers, primarily in the horticultural industry.

HELCO Power Plant. HELCO owns two separate parcels in the immediate vicinity. Immediately adjacent to the petition area is HELCO's generating station located on a 14.998-acre site identified as TMK 7-3-49:36. HELCO also owns a 0.645-acre site adjacent to and makai (west) of Keahole generating station. The smaller parcel is the site of the Keahole substation and is identified as TMK 7-3-49:37. The power plant has an electrical generating capacity of 30 mW. Although HELCO's main site encompasses about 15 acres, all structural improvements are contained within approximately three acres (Lyman, September 1992). A 69 kV transmission line corridor extends from the power plant and divides into two corridors as it extends east from the generating station.

Commercial Radio Antennae. Radio Station KIPA maintains and operates four 90-foot radio transmission towers on a four-acre site (TMK 7-3-49:38) adjacent to the HELCO power plant.

Residential Subdivisions. Two residential subdivisions, Kona Palisades and Kona Acres, abut the eastern boundary of the petition area. Kona Palisades is a 1,358-lot subdivision approved by the County of Hawaii in three phases between 1968 and 1970. Kona Acres is a 312-lot subdivision with one-acre lots, approved by the County of Hawaii in four phases between 1973 and 1978.

Kohanaiki Mauka. Approximately 70 acres of land immediately south of the petition area and adjacent to the Queen Kaahumanu Highway are proposed for a commercial and light industrial subdivision.

Nearby Uses

Keahole Airport. The major existing land use in the area is the State-owned Keahole Airport, located makai of Queen Kaahumanu Highway west of the petition area. The airport, which opened in 1971, is operated by the State Department of Transportation, Airports Division, and provides air transportation service to West Hawaii.

NELHA. Adjacent to the western boundary of the Keahole Airport lies the Natural Energy Laboratory of Hawaii Authority (NELHA), a publicly-funded research facility. NELHA is involved in the research and commercial application of alternative energy systems, aquaculture and related fields, utilizing deep ocean water pumped ashore via offshore pipelines. NELHA consists of the Natural Energy Laboratory of Hawaii and the Hawaii Ocean Science and Technology (HOST) Park.

Residential Subdivisions. In addition to the Kona Palisades and Kona Acres Subdivisions, a number of other, smaller residential subdivisions are located to the east of the petition area. They include the Kona Highlands, Kona Wonder View Lots and Kona Coast View.

Coastal Resorts. There are no existing resorts within seven miles of the petition area, the nearest resort being the Kona Village Resort in North Kona. O'oma II and Kohanaiki are proposed coastal developments located makai of the petition area. O'oma II is a 300-acre multi-use, master planned resort proposed for development by Kahala Capital Corporation. The master plan includes a marine exploratorium, a conference center, a water recreation park, an 18-hole golf course, clubhouse and driving range, a Japanese-style inn, a 550-room hotel, single and multi-family residential uses, a small retail commercial area, and a wastewater treatment plant (WWTP). The Kohanaiki Resort is a 450-acre master planned project proposed for development by Nansay Hawaii, Inc. The master plan includes three hotels totaling

1,500 rooms; an 18-hole golf course and clubhouse, single and multi-family residential uses, an athletic club, child care center, artisan's village, beach club, public park and related public access improvements, resort maintenance facilities including a WWTP, and other resort amenities.

Kaloko-Honokohau National Historical Park. Immediately south of Kohanaiki is the approximately 640-acre Kaloko-Honokohau National Historical Park (NHP) being developed by the U.S. National Park Service.

Honokohau Industrial Park. Mauka of NHP is the 90-acre Honokohau Industrial Park consisting of 194 fee simple, one-acre industrial lots.

Honokohau Small Boat Harbor. Beyond the NHP to the south lies the 245-slip Honokohau Small Boat Harbor operated by the State Department of Transportation, Harbors Division. DOT is planning to expand the harbor to the south the accommodate an additional 300 slips for privately-owned boats.

Kealakehe (makai). South of the Harbor lies the State-owned Kealakehe ahupua'a. The County is now in the process of constructing a regional wastewater treatment plant (WWTP) in the coastal area of Kealakehe, makai of the Queen Kaahumanu Highway . The facility encompasses about 30 acres and has a 20-year design period capacity of 2.8 mgd average flow. Later phases of the new plant will increase capacity to approximately 7.8 mgd for a 40-year design period.

Kealakehe (mauka). Mauka of the Queen Kaahumanu Highway, about two miles south of the project site, lies the proposed Kealakehe Residential Community on approximately 990 acres, being developed by the State Housing Finance and Development Corporation (HFDC). The project includes a major new civic center, up to 5,000 residential units (60 percent in the affordable range), and a public golf course (being developed by Hawaii County). Full build out is expected to occur in approximately 20 years.

2.4 Proposed Action

The Petitioner requests a State Land Use District Boundary amendment to reclassify the petition area from Agricultural and Conservation Districts to the Urban District. Of the total acreage, approximately 1,400± acres in the western (makai) half of the petition area lies within the State Conservation District (General Subzone) and about 1,200± acres lies within the State Agricultural District. The land within the Agricultural District is predominantly in the eastern (mauka) portion of the petition area, although a small portion lies in the western (makai) area, immediately mauka of the existing Keahole Agricultural Park. All of the lands within the petition area are ceded lands.

The petition is based on a recommendation made by OSP as part of the Draft State Land Use District Boundary Review (for the island of Hawaii), which identifies the petition area for urban reclassification as a "Priority Area for Action." This is the highest priority category assigned to land recommended for reclassification. The basis for the reclassification is taken directly from the report:

> "The urbanization of the Kailua to Keahole area consistent with the Keahole to Kailua Development Plan and West Hawaii Regional Plan is supported during the boundary review. Of top priority for State-initiated reclassification are State-owned lands consistent with State plans for the area which will be used to

> develop facilities and allow uses to support the development of the area as the Big Island's Second City. The site of the University of Hawaii's Kona campus is included in these State lands. Reclassification of lands in the K to K area may serve as a catalyst to bring several landowners together to develop infrastructure." (Executive Summary, p. 35)

Approximately 500 acres in the northeastern portion of the petition area is proposed to be developed as the West Hawaii Campus of the University of Hawaii, as indicated in the County's Keahole to Kailua Plan. Other uses for the remainder of the petition area have yet to be defined, although a mix of urban uses is expected, including but not limited to, housing, parks, commercial uses, light industrial uses, roadways, and public facilities. Specific acreages and locations for uses have yet to be determined.

2.5 Urbanization Scenarios

To address the requirements of Chapter 343, HRS, it is necessary to describe the general magnitude of potential impact the implementation of the proposed action would have on the environment. However, the purpose of the Five-Year Boundary Review is to allocate sufficient land for future urban growth and also to direct urban growth to appropriate areas. The intent is to provide for long-range planning by designating areas for future urban growth rather than reacting to landowner-initiated petitions. As such, specific land uses or projects have not been identified for boundary review recommendation areas. A primary difficulty encountered in meeting the requirements of Chapter 343, HRS to provide a discussion of estimated impacts and mitigation is the lack of a specific land use plan for the petition area.

A logical approach to this problem is to create alternative development scenarios based on assumed acreages for various uses which could be expected to be developed within the urbanized petition area. Once acreages have been assigned for the uses, it is then possible to calculate order of magnitude values of demand for specific public services and facilities. An integral component of this approach involves the use of various standards and multipliers to be used in conjunction with the assignment of acreages to each of the land use categories. Impacts related to water, wastewater, population, employment, etc, can be determined through use of accepted multipliers and standards. Appendix A contains a more detailed description of the methods and findings of the scenario analysis.

2.5.1 Land Use Assumptions

To provide a basis for determining possible land uses and land allocation, a survey of eleven recently developed or planned, large-scale master-planned communities was conducted. Projects analyzed included seven from Oahu (Waikele, Royal Kunia, Mililani Mauka, Villages of Kapolei, Ewa Gentry, Waiawa Gentry, and Wahiawa Lands), two from Maui (Maui Lani and Villages of Lai'opua) and two from Hawaii County (Villages of Le'alii and Queen Liliuokalani Trust). The size of the projects ranged from the 577-acre Waikele project to the 1,910-acre Waiawa Gentry development, with the average size at 1,021 acres, approximately half the size of the petition area (not including the 500-acre university site). General land use and allocation characteristics of these planned communities based on the survey are provided in Table 3 below. A summary of the results of this survey showing a detailed breakdown of the land use allocations for each of these projects can be found in Appendix A.

Table 3
Land Use Allocation Survey Results*

Land Use	Range in Allocation (Percent)	Average Allocation (Percent)
Residential	29-75	55
Commercial	0-3	1
Civic	1-10	4
Employment	0-52	6
Light Industrial	0-20	3
Parks	1-4	3
Golf Course	0-26	16
Open Space/Circ.	3-37	11

* See Appendix A for a more detailed description of survey

A general description of the land use categories is provided to assist in understanding the assumptions made during the development of the scenarios. It is important to note that these land uses may not necessarily represent the actual mix of land uses that would be developed within the petition area nor the specific land uses themselves. The uses and allocations do however represent a depth of recent development experience, rooted in market acceptability and financial feasibility, and therefore are suitable for use as a predictive model to determine potential development impacts that would result from the urbanization of the petition area.

*1. **Residential.*** The residential component contains a mix of single- and multi-family dwellings, with an average density of 8.8 dwelling units per acre (d.u./acre) (Average of the eleven master planned projects surveyed). This density reflects the affordable housing requirements imposed by State and County agencies over the past several years. As shown in Table 3, the percent of total project area dedicated to residential uses ranged from 29 to 75 percent, with an average area of development set aside for residential uses of about 55 percent of the gross area.

Residential household population is assumed to be 2.7 persons per dwelling unit. This assumption is based on an analysis of household size in the census tracts within the North Kona District (U.S. Bureau of the Census, 1990 Census, Tape STF-1A).

*2. **Neighborhood Commercial.*** This use is defined as supporting the on-site residential population (i.e., the daily retail and other business needs of the residential community). This category would not include regional-serving retail or office uses commonly associated with regional shopping malls or office parks (these uses would be included under "employment center" uses described below). As shown in Table 3, the percent of the total project area dedicated to neighborhood commercial uses ranged from one to three percent, with the average area set aside for neighborhood commercial of about one percent.

*3. **Civic.*** This land use category includes a range of residential-supporting uses such as police, fire and ambulance stations, day care facilities, churches, schools, etc. The percent of the total project area dedicated to civic uses ranged from one to 10 percent, with the average at about four percent.

*4. **Employment Center.*** The employment center category encompasses all major employment-producing, region-serving land uses, including regional business/commercial centers, business parks and research/technology parks. The percent of the total project area dedicated to employment uses ranged from zero to 52 percent with the average about six percent. The term is not meant to spatially delimit the land use; numerous and diverse centers could be contemplated.

*5. **Light Industrial.*** This land use category would accommodate a wide range of light industrial uses, including warehousing, light manufacturing, etc. It is expected that portions of this category would support activities at Keahole Airport, NELHA and the future university. The petition area is well-suited for this type of use because of its proximity to these major complementary land uses, and an existing transportation network that includes the airport and Queen Kaahumanu Highway. This land use category ranged from zero to 20 percent, averaging about three percent.

*6. **Parks.*** Parks are an important land use element of any plan for urban development. As shown in Table 3, the percent of the total project area dedicated to parks ranged from one to four percent, with the average about three percent. It should be noted that the Hawaii County Park standard of five acres of park per 1,000 population (Glenn Miyao, February 1993) and the Oahu County standard of 350 square feet of park per dwelling, exceed the allocation by almost 100 percent. The difference could be attributable to in lieu payments or conservatism used in estimating park requirements in the source documents.

*7. **Golf Course.*** Nine of the eleven projects surveyed included at least one 18-hole golf course. In addition to providing for increased recreational opportunities, the golf course can accommodate some of the wastewater generated in the region as well as storm runoff. The percent of the total project area dedicated to golf course ranged from zero to 26 percent, with the average at 16 percent. For purposes of this analysis, a golf course is assumed to require 200 acres (two courses would need 400 acres), including club houses and appurtenant facilities. No conclusions are inferred regarding ownership or control of the course(s).

*8. **Open Space/Circulation.*** This land use category includes major streets and other open space uses not classified within the preceding land uses. This could include land left in an undeveloped condition or set aside as habitat preserves or nature parks, although none of the master-planned communities studied provided large areas for this purpose. The percent of the total project area dedicated to open space ranged from three to 37 percent, with the average about eleven percent.

*9. **University.*** The 500-acre university site is the only portion of the petition area set aside for a specific use; the West Hawaii campus of the University of Hawaii. Based on information provided by the University of Hawaii, the campus is expected to accommodate a student population of 5,000. It is expected that about 1,000 of these students will board in on-campus dormitories, and approximately 500 persons would be included as support staff for the university (faculty, administration, maintenance, etc.). This land use element is consistent for all urbanization scenarios.

It should be noted that the survey of the eleven master planned developments indicated an average three percent allocation for light industrial land uses. Yet, all three scenarios have allocated a minimum 14 percent land area for these uses. The location of the petition area is well suited for the attraction of regional levels of light industrial uses, rather than those supportive of resident population within the development. This

is because of the location of the petition area in conjunction with Keahole Airport, Queen Kaahumanu Highway, NELHA and the future university. In combination, these uses will generate demand for light industrial land beyond that accounted for by the future residents of the petition area.

2.5.2 Land Use Scenarios

Three land use scenarios were developed to assist in analyzing potential environmental impacts. The scenarios all contain the land uses described in the previous section with the major difference being the allocations of residential, open space, employment centers, light industrial uses, and golf courses. Scenario I describes a plan with a relatively high open space allocation and a correspondingly low residential allocation (relative to the averages determined in the preceding section). Scenario II describes a plan with a higher residential allocation and a high light industrial allocation. Scenario III looks at a high residential allocation, two golf courses and a medium light industrial component. Each of the scenarios is discussed further below.

Scenario I

Scenario I is presented as the least intensive development scenario. It has the highest percentage of open space (35.2 percent) and the lowest percentage of residential acreage (30 percent or 5,650 homes) of the three scenarios. The high percentage of open space could be attributed to areas designated for extensive archaeological preserves, broader setback corridors along the major powerline easements and internal roadways, or perhaps a broad system of open space areas surrounding residential pockets. The acreage allotted for the neighborhood commercial and employment center uses are assumed to be for support of the resident population within the petition area. The acreage for light industrial uses is assumed to address demand within a more limited geographic area, in closer proximity to the petition area. One golf course is identified. Table 4 summarizes the various land uses for Scenario I.

Table 4
Scenario I Land Use Allocation

Land Use	Percent Allocation	Acres	Residential Units
Residential	**30.0**	642	5,650
Neighborhood Commercial	1.2	26	
Civic	4.2	90	
Employment Center	**3.0**	64	
Light Industrial	14.0	**300**	
Parks	3.0	64	
Golf Course (1)	9.3	**200**	
Open Space/Circulation	35.2	754	
Subtotal	100	2,140	5,650
University		500	
	Total	2,640	5,650

Note: Note: bold-faced numbers established for specific scenario, other numbers based on Table 3 or residual value (i.e., open space/circulation)

Scenario II

Scenario II intensifies the urban character of the petition area by increasing the acreage for residential uses to 35 percent (6,591 homes), and increasing the acreage for light industrial uses to 23 percent, thereby reducing the acreage available for open space/circulation to just under 15 percent. The increase in acreage for light industrial reflects an attempt to capture a larger portion of the regional K to K market. Similar to Scenario I, the neighborhood commercial, civic and park land uses are limited to support the residential population. Table 5 summarizes the various land uses for Scenario II.

Table 5
Scenario II Land Use Allocation

Land Use	Percent Allocation	Acres	Residential Units
Residential	**35.0**	749	6,591
Neighborhood Commercial	1.2	26	
Civic	4.2	90	
Employment Center	9.3	**200**	
Light Industrial	23.0	**500**	
Parks	3.0	64	
Golf Course (1)	9.3	**200**	
Open Space/Circulation	14.5	311	
Subtotal	100	2,140	6,591
University		500	
Total		2,640	6,591

Note: Note: bold-faced numbers established for specific scenario, other numbers based on Table 3 or residual value (i.e., open space/circulation)

Scenario III

Scenario III presents a higher residential allocation (40 percent or 7,533 homes) together with two golf course complexes. With the higher residential and golf course allocation and a continued high allocation for light industrial uses (400 acres), open space/circulation use is reduced nine percent. Employment center uses, neighborhood commercial, civic and parks are set at the minimum residential-support levels. The second golf course might be justified on the basis of need for additional stormwater management control and wastewater reuse. Table 6 summarizes the land uses for Scenario III.

Table 6
Scenario III Land Use Allocation

Land Use	Percent Allocation	Acres	Residential Units
Residential	**40.0**	856	7,533
Neighborhood Commercial	1.2	26	
Civic	4.2	90	
Employment Center	6.1	131	
Light Industrial	18.7	**400**	
Parks	**3.0**	64	
Golf Course (2)	18.7	**400**	
Open Space/Circulation	8.1	174	
Subtotal	100	2,140	7,533
University		500	
	Total	2,640	7,533

Note: Note: bold-faced numbers established for specific scenario, other numbers based on Table 3 or residual value (i.e., open space/circulation)

2.5.3 Limitations of the Scenario Approach

The three scenarios described above are hypothetical although realistically based on actual and planned examples of major planned communities. The scenarios provide what appear to be "accurate" depictions of land uses and unit counts. Because no physical land planning has been conducted, it is premature and erroneous to assume that the petition area will indeed accommodate one or any of the proposed scenarios. Furthermore, there is no way to analyze the spatial/locational impacts of the various land uses without a comprehensive land use plan. It is recognized that a wide range of land use allocations and associated design solutions exist. As suggested in the discussion, site constraints such as archeological remains, transmission line easements, circulation requirements, topographic relief, and other site factors must be taken into account to determine actual land use allocations and achievable densities. Additionally, external constraints such as adequacy of public facilities and services, market support, and financial feasibility factors will all heavily influence the actual land plan.

2.6 Project Phasing

A general discussion of project phasing is provided. It is recognized that project phasing is generally determined as an adjunct to the project master-planning stage, taking into account specific information relating to the land use plan, project costs, market preferences, infrastructure availability, etc. Based on the available information and experience gained from other major urbanization projects, it is possible to draw some general conclusions.

A project of the scale contemplated will take 15 to 30 years to completely build out, assuming master planning is commenced and necessary entitlements and approvals are secured in the near term. More detailed planning and design will establish several major project phases related to major stages of off-site infrastructure development, and market support.

Based on existing site accessibility (principally highway access), it is very possible that initial phases of the project will be within the lower reaches of the site, adjacent to the Queen Kaahumanu Highway with successive phases moving upslope. It is also possible that several phases of the project might be constructed simultaneously (i.e., residential and employment center components being constructed simultaneously under separate development agreements). Current access to the Mamalahoa Highway is constrained to Kaimi Nani Drive, and unless another major mauka-makai connector roadway is built, primary access will continue to be via the Queen Kaahumanu Highway. The timing of the mid-level roadways proposed in the Keahole to Kailua Development Plan (and any new mauka-makai connectors with the Mamalahoa Highway) will influence the timing of subsequent phases of the development within the mauka areas of the site.

The 500-acre West Hawaii campus is a long-range proposal which will also be constructed in major development phases. The initial project phase would require construction of the proposed University Parkway, providing direct access to Queen Kaahumanu Highway. The proposed mid-level roadways will provide additional access to the university when constructed.

3.0 RELATIONSHIP OF THE PROPOSED ACTION TO EXISTING PUBLIC PLANS, POLICIES, AND CONTROLS

This section of the FEIS discusses relevant State and County land use policies and controls which affect the proposed action.

3.1 Hawaii State Plan

The Hawaii State Plan, (Chapter 226, HRS, as amended) establishes a set of guidelines for the long-range development of the State, and provides overall themes, goals, objectives, policies, and priority guidelines. The following describes the purpose of the State Plan:

> "...[it] shall serve as a guide for the future long-range development of the State; identify the goals, objectives, policies, and priorities for the State of Hawaii; provide the basis for determining priorities and allocating limited resources, such as public funds, services, manpower, land, energy, water, and other resources; improve coordination of state and county plans, policies, programs, projects, and regulatory activities; and to establish a system for plan formulation and program coordination to provide for an integration of all major state and county activities." (Chapter 226-1, HRS; Findings and Purpose)

The goals, objectives, policies and guidelines of the Hawaii State Plan are, on occasion, in competition with one another. Because of this, the proposed development supports some of the goals, while is inconsistent with others. The following section analyzes the projects impacts with respect to relevant State Plan goals, objectives, policies, and priority guidelines:

Section 226-5 Objectives and policies for population.

Section 226-5(b)(1) *Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county.*

Section 226-5(b)(2) *Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.*

Section 226-5(b)(3) *Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands.*

Section 226-5(b)(7) *Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.*

Discussion: The urbanization of the petition area would provide additional housing, educational and economic opportunities for the residents of Hawaii County, in conformance with other existing State and County land use policies. Additional potable water will be required for the petition area. The development of these resources will need to be coordinated with the Department of Land and Natural Resources and the County Department of Public Works.

Section 226-6 Objectives and policies for the economy-in general

Section 226-6(a)(1) *Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.*

Section 226-6(a)(2) *A steadily growing and diversified economic base that is not overly dependent of few industries.*

Discussion: The addition of a university to West Hawaii will provide additional job and educational opportunities in a wide diversity of fields. Additional commercial opportunities will be provided to support activities at Keahole Airport, and the Natural Energy Laboratory of Hawaii Authority (NELHA) in addition to the construction activity that will be needed to support the development of new businesses and housing.

Section 226-10 Objectives and policies for the economy-potential growth activities

Section 226-10(b)(3) *Enhance and promote Hawaii's role as a center for international relations, trade, finance, services, technology, education, culture and the arts.*

Section 226-10(b)(5) *Promote Hawaii's geographic, environmental, social and technological advantages to attract new economic activities into the State.*

Section 226-10(b)(7) *Increase research and the development of ocean-related economic activities such as mining, food production and scientific research.*

Discussion: The location of the university site at Keahole can provide support for existing and future ocean-related research and commercialization projects at NELHA, thereby increasing Hawaii's visibility for these programs in general, and West Hawaii's visibility in particular. Educational opportunities will therefore be increased not only for Hawaii's residents, but for others as well.

Section 226-12 Objectives and policies for the physical environment-scenic, natural beauty, and historic resources.

Section 226-12(b)(1) *Promote the preservation and restoration of significant natural and historic resources.*

Section 226-12(b)(4) *Protect those special areas, structures and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage.*

Discussion: Archaeological studies conducted as part of the FEIS will identify significant historic resources within the petition area, so that preservation plans can be implemented to preserve and improve them for interpretive development.

Section 226-13 Objectives and policies for the physical environment--land,air, and water quality.

Section 226-13(b)(2) *Promote the proper management of Hawaii's land and water resources.*

Section 226-13(b)(3) *Promote effective measures to achieve desired quality in Hawaii's surface, ground and coastal waters.*

Discussion: The petitioner is cognizant of the proximity of the petition area to NELHA and the "AA" coastal waters of Keahole and has committed to participation in a regional water quality monitoring program and an effective environmental risk assessment should a golf course be considered for the petition area.

Section 226-15 Objectives and policies for facility systems--solid and liquid wastes.

Section 226-15(b)(1) *Encourage the adequate development of sewerage facilities that complement planned growth.*

Section 226-15(b)(2) *Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.*

Discussion: Planning for the petition area is in its early stages. Therefore provision for adequate wastewater treatment facilities and the development of recycling and solid waste reduction programs can be effectively coordinated with appropriate State and County agencies.

Section 226-16 Objectives and policies for facility systems-water.

Section 226-16(b)(1) *Coordinate development of land use activities with existing and potential water supply.*

Section 226-16(b)(3) *Reclaim and encourage the productive use of runoff water and wastewater discharges.*

Discussion: Analysis of the water resources in the region conducted by the hydrological consultant for the project indicates the potential for water resources to serve an urbanized petition area. These observations are made on the basis of assumptions made concerning recharge, subsurface geology and future domestic needs. Making these resources available to the petition area will require coordination between the petitioner, the Department of Land and Natural Resources and the County Department of Water Supply. In addition, it is hoped that wastewater generated within the petition area can be partially recycled as irrigation water for golf courses and other landscaping needs.

Section 226-17 Objectives and policies for facility systems-transportation.

Section 226-17(b)(6) *Encourage transportation systems that serve to accommodate present and future development needs of communities.*

Discussion: The State Department of Transportation, Highways Division, is presently involved in efforts to plan for the future alignment of the Queen Kaahumanu Highway from Kailua-Kona to Kawaihae. The urbanization of the petition area will need to be included in this planning effort, particularly as it relates to the implementation of the County's Keahole to Kailua Development Plan. Both of these planning efforts are attempts to provide for long-range transportation improvements that will be needed in the region to accommodate anticipated growth.

Section 226-18 Objectives and policies for facility systems--energy/telecommunications

Section 226-18(a)(2) *Increased energy self-sufficiency.*

Section 226-18(c)(3)(C) *Adoption of energy-efficient practices and technologies.*

Discussion: According to the State Energy Functional Plan, the transportation sector is the single largest consumer of energy, accounting for about 60 percent of total oil consumption state-wide. One way to reduce oil dependency is to reduce travel distance between work, home and other transportation destinations. The urbanization of the petition area is consistent with other State and County land use policies that would eventually lead to a concentration of urban services and activities (including employment, housing, retail, schools, recreation) within the Keahole to Kailua region. This concentration of services and activities would allow residents to live in closer proximity to their workplaces and other daily travel destinations in West Hawaii than current patterns of development allow. In this sense, urbanization of the petition area will help to reduce future consumption of oil.

Other opportunities to reduce consumption of fossil fuels are related to construction practices (including the use of reflective building materials and proper building orientation to take advantage of prevailing wind patterns for ventilation) and the use of alternate and renewable sources of energy such as solar water heaters. All of these opportunities must be considered in the context of how they might be implemented. If solar water heaters are included in contractor specifications for building design, these costs are ultimately passed on to the home buyer. While the inclusion of such appliances in construction will result in lower energy consumption, do they add sufficient cost to the overall cost of the house to price some potential home buyers out of the market? The answers to these questions, and the selection of appropriate methods of energy reduction through design, need to be resolved during the final stages of project design.

Section 226-19 Objectives and policies for socio-cultural advancement--housing

Section 226-19(b)(1) *Effectively accommodate the housing needs of Hawaii's people.*

Section 226-19(b)(3) *Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.*

Discussion: Although specific land uses for the petition area have not yet been determined, it is probable that residential uses will be a key component of any development plan. Housing units would then be constructed providing additional housing opportunities for residents of Hawaii County in an area that housing has not kept pace with household formations and that is projected to be an area of future population growth.

Section 226-21 Objectives and policies for socio-cultural advancement-education.

Section 226-21(b)(2) *Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs.*

Section 226-21(b)(5) *Provide higher educational opportunities that enable Hawaii's people to adapt to changing employment demands.*

Discussion: The University of Hawaii Board of Regents recently completed a site selection study to identify a West Hawaii location for as a campus for the University of Hawaii. This study resulted in the selection of a 500-acre portion of the petition area. This campus is intended to serve the residents of West Hawaii and provide them with additional educational services and opportunities.

3.2 State Functional Plans

The Hawaii State Plan directs the appropriate State agencies to prepare functional plans for their respective program areas. The plans set forth "...the policies, statewide guidelines, and priorities within a specific field of activity, when such activity or program is proposed administered, or funded by any agency of the State" (Section 226-2(1), HRS). Each functional plan contains objectives to be achieved and policies to be pursued within the specified areas. "The functional plan shall identify priority issues in the functional area and shall contain objectives, policies, and implementing actions to address those priority issues" (Section 226-55(b)).

Twelve State Functional Plans have been prepared covering the areas of agriculture, transportation, conservation lands, housing, tourism, historic preservation, energy, recreation, education, health, human services and employment. The following section analyzes the proposed reclassification of the petition area with respect to the applicable functional plans.

3.2.1 State Agricultural Functional Plan

The Department of Agriculture coordinated the preparation of the Agricultural Functional Plan. The plan identifies two fundamental objectives to be achieved: (1) continued viability in Hawaii's sugar and pineapple industries; and, (2) continued growth and development of diversified agriculture throughout the State. In addition, four issue areas have been identified, one of which is pertinent to the petition area; Land and Water.

Issue Area: Land and Water
Implementing Action: H(1)(a): Complete agricultural parks projects presently committed, and develop additional projects in accordance with the Ad Hoc Agricultural Park Site Selection Committee.

Implementing Action H(2): Conserve and protect important agricultural lands in accordance with the Hawaii State Constitution.

Discussion: The major focus of this implementing action is to expand the State's agricultural park program. The State Department of Agriculture has commented during the preparation of the FEIS that there is a need for an additional 200 acres of land in the southern portion of the petition area to expand the existing Keahole Agricultural Park. The Petitioner recommends that other State-owned land north of the petition area along Mamalahoa Highway be used for an Agricultural Park because the area is better suited for agricultural activities. Also, because of the poor quality of the soils which underlay the petition area, the proposed reclassification will not remove lands that are currently in agricultural production.

3.2.2 State Housing Functional Plan

The Housing Finance and Development Corporation coordinated the preparation of the this functional plan. The plan includes home ownership, land acquisition for affordable housing development, rental housing, and rental housing for the elderly and other special need groups as issue areas.

Issue Area: Homeownership
Implementing Action A(1)(b): Initiate the development of large scale, master planned residential communities on Oahu, Hawaii, Maui and Kauai which includes opportunities for owner builders.

Discussion: Although specific plans for urbanization of the petition area have not yet been developed, a significant portion of the overall acreage could be devoted to single-family residential use. This will provide more housing opportunities for residents of the Big Island to build homes.

Implementing Action A(2)(b): Form public/private partnerships and/or enter into public/private development agreements to develop affordable housing.

Discussion: The urbanization of the petition area will increase opportunities for public/private partnerships to provide affordable housing.

Issue Area: Land Acquisition for Affordable Housing Development.
Implementing Action E(1)(a): Assess, delineate, and where feasible, acquire, master plan, and develop lands suitable for future residential development.

Discussion: The urbanization of the petition area will provide additional lands suitable for residential development.

Implementing Action E(2)(a): Survey and reserve for future development State and County owned lands which are suitable for housing development.

Discussion: The petition area is owned by the State of Hawaii. The process of reclassification is a direct step toward implementing future housing development.

3.2.3 State Recreation Functional Plan

The preparation of the Recreation Functional Plan was coordinated by the Department of Land and Natural Resources (DLNR) and contains six issue areas, one of which is applicable to the petition area; Mauka, Urban and Other Recreation Opportunities.

Implementing Action IIc(1)b: Provide Additional playing fields and upgrade existing fields for both youth and adult sports leagues.

Discussion: Although specific uses for the petition area have not yet been identified, it is probable that community and neighborhood parks with adequate play fields will be included in the future master plan.

Implementing Action IIC(1)f: Provide opportunities for golf at reasonable cost by planning new municipal courses and by assuring that privately developed courses have provision for play by residents at "kamaaina rates."

Discussion: The three scenarios for urbanization of the petition area discussed in Section 2.6 each include at least one golf course. Although specific uses for the petition area have not yet been identified, it is probable that at least one golf course would be included in the future master plan. Provision for play by residents at "kamaaina rates" can be ensured by providing suitable conditions on the approval of the petition and subsequent county zoning approvals.

3.2.4 State Transportation Functional Plan

The Department of Transportation coordinated the preparation of the Transportation Functional Plan.

Policy I.B.1: Close the gap between where people live and work through decentralization, mixed zoning, and related initiatives.

Implementing Action: Promote the development of homes near jobs.

Discussion: The urbanization of the petition area is consistent with State and County long-range land use policies within the Keahole to Kailua region including the West Hawaii Regional Plan and the Keahole to Kailua Development Plan. These plans project significant urbanization within the K-K corridor, including the petition area. It is envisioned that a mix of housing and job opportunities will be provided for the residents of West Hawaii, allowing them to live and work within the same region.

3.2.5 State Historic Preservation Functional Plan

The State Historic Preservation Plan was coordinated by the Department of Land and Natural Resources and includes issue areas concerning the preservation of historic sites and the collection and preservation of historic records, artifacts and oral histories and perpetuation of traditional skills.

Issue Area: Preservation of Historic Properties
Objective B: Protection of Historic Properties
Policy B.I: Provide timely historic property reviews which are effectively integrated into the land use regulatory system.

Discussion: Two archaeological efforts have been undertaken in conjunction with the petition to reclassify the petition area to the State Urban District: (1) an archaeological assessment study of the entire petition area; and (2) an inventory survey of the 500 acres in the northeast portion of the petition area which has been identified as the future site of the West Hawaii campus for the University of Hawaii.

In addition to providing an intensive ground survey of 11.5 percent of the petition area, the assessment study is intended to be used as a predictive model to anticipate where historic sites may be located within the petition area. The inventory survey has identified all sites found within the 500-acre university site and will be used to develop mitigation and preservation plans for sites worthy of preservation.

3.2.6 State Energy Functional Plan

The State Energy Functional Plan was coordinated by the Energy Division of the Department of Business, Economic Development and Tourism.

Objective A Moderate the growth in energy demand through conservation and energy efficiency
Policy A(2) Stimulate and promote greater energy efficiency and conservation in the transportation sector.
Objective (B) Displace oil and fossil fuels through alternate and renewable energy resources

Discussion: According to the State Energy Functional Plan, the transportation sector is the single largest consumer of energy, accounting for about 60 percent of total oil consumption state-wide. One way to reduce oil dependency is to reduce travel distance between work, home and other transportation destinations. The urbanization of the petition area is consistent with other State and County land use policies that would eventually lead to a concentration of urban services and activities (including employment,

housing, retail, schools, recreation) within the Keahole to Kailua region. This concentration of services and activities would allow residents to live in closer proximity to their workplaces and other daily travel destinations in West Hawaii than current patterns of development allow. In this sense, urbanization of the petition area will help to reduce future consumption of oil.

Other opportunities to reduce consumption of fossil fuels are related to construction practices (including the use of reflective building materials and proper building orientation to take advantage of prevailing wind patterns for ventilation) and the use of alternate and renewable sources of energy such as solar water heaters. All of these opportunities must be considered in the context of how they might be implemented. If solar water heaters are included in contractor specifications for building design, these costs are ultimately passed on to the home buyer. While the inclusion of such appliances in construction will result in lower energy consumption, do they add sufficient cost to the overall cost of the house to price some potential home buyers out of the market? The answers to these questions, and the selection of appropriate methods of energy reduction through design, need to be resolved during the final stages of project design.

3.3 State Land Use Law

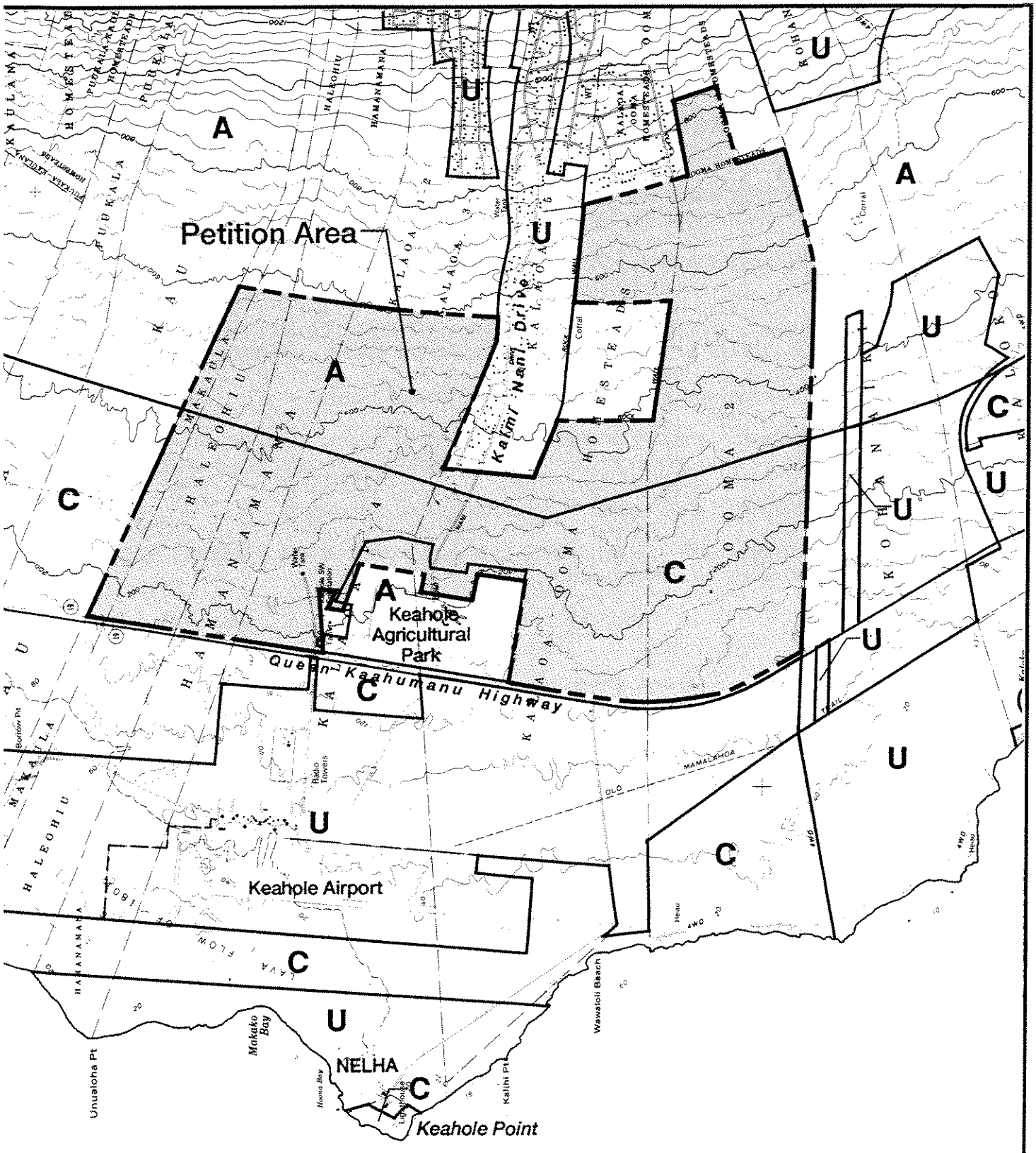
All lands in the State have been classified in one of four land use districts by the State Land Use Commission (LUC), pursuant to Chapter 205, HRS; Urban, Rural, Agricultural and Conservation. Approximately 1,400± acres in the western (makai) half of the petition area lies within the State Conservation District. The remaining 1,200± acres lies within the State Agricultural District (Figure 4). In addition, a 48-acre portion of TMK 7-3-10:33 in the western portion of the site, directly adjacent to the Keahole Agricultural Park, is located within the State Agricultural District. This area was included in a State land use boundary amendment approved by the State Land Use Commission in 1980 to implement the development of the Keahole Agricultural Park (Docket No. 79-458).

The Office of State Planning filed a petition with the Land Use Commission on October 19, 1992 to reclassify the land within the petition area from the Conservation and Agriculture Districts to the Urban District. An EIS preparation notice (EISPN) for the proposed reclassification was published in the OEQC Bulletin on January 8, 1993. The Commission will determine the acceptability of the final EIS and then schedule a hearing on the petition request.

The State Land Use Commission Rules, adopted October 1986, require that an application for a boundary amendment show that it is "reasonable, not violative of Section 205-2[HRS] and consistent with the policies and criteria established pursuant to Sections 205-16, 205-17 and 205A-2, HRS" (Hawaii Land Use Commission Rules, Section 15-15-77). In reviewing petitions for reclassification of district boundaries, the Commission must specifically consider four criteria. The criteria are presented below, in italics, followed by a brief discussion of each criterion.

(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawaii State Plan and relates to the applicable priority guidelines of the Hawaii State Plan and the adopted functional plans;"

Discussion: The proposed reclassification conforms to most applicable goals, objectives, and policies and the guidelines of the State Functional Plans. Because of their competing nature, the project is not consistent with all policy areas.



Existing State Land Use Districts
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Figure: 4

Feet
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Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

(2) The extent to which the proposed reclassification conforms to the applicable district standards."

Discussion: The applicable standards for the Urban District are found in Section 15-15-18 of the Land Use Commission Rules. These are reprinted and discussed below.

In determining the boundaries for the Urban District, the following standards would be used:

(1) It shall include lands characterized by a "city-like" concentration of people, structures, streets, urban level of services and other related land uses;

(2) It shall take into consideration the following specific factors:

A. Proximity to centers of trading and employment facilities except where the development would generate new centers of trading and employment;

B. Substantiation of economic feasibility by the petitioner;

C. Proximity to basic services such as sewers, water, sanitation, schools, parks, and police and fire protection; and

D. Sufficient reserve areas for urban growth in appropriate locations based on a ten-year projection;

(3) It shall include lands with satisfactory topography and drainage and reasonably free from the danger of floods, tsunami and unstable soil conditions and other adverse environmental effects;

(4) In determining urban growth for the next ten years, or in amending the boundary, lands contiguous with existing urban areas shall be given more consideration than non-contiguous lands, and particularly when indicated for future urban use on State or County General Plans;

(5) It may include lands in appropriate locations for new urban concentrations and shall give consideration to areas of urban growth as shown on the State and County General Plans;

(6) It may include lands which do not conform to the standards in paragraphs (1) to (5):

A. When surrounded or adjacent to existing urban development; and

B. Only when such lands represent a minor portion of this District;

(7) It shall not include lands, the urbanization of which will contribute towards scattered spot urban development, necessitating unreasonable investment in public infrastructure or support services;

(8) It may include lands with a general slope of twenty percent or more which do not provide open space amenities or scenic values if the Commission finds that such lands are desirable and suitable for urban purposes and that official design and construction controls are adequate to protect the public's health, welfare and safety, and the public's interests in the aesthetic quality of the landscape.

Discussion: The Office of State Planning has recommended as part of its Five-Year Boundary Review that the petition area is considered a "Priority Area for Action" (Section 3.4). This recommendation is made within the context of other existing State and County land use policies for the petition area and the region as a whole (The Keahole to Kailua Development Plan, The County of Hawaii General Plan, the West Hawaii Regional Plan). The West Hawaii Plan directs future urbanization to the Kailua to Keahole subregional planning area. The County of Hawaii Keahole to Kailua Development Plan designates this area for residential, commercial, industrial and other uses. Thus the petition area is considered part of a region stretching from Kailua-Kona to Keahole that has been identified for urban growth, necessary to accommodate the future population of West Hawaii.

The petition area is located along Queen Kaahumanu Highway, and is in close proximity to Keahole Airport, two regional transportation links. In addition, the petition area is contiguous to existing residential development. Although basic public services are not available to presently serve the petition area, adopted plans, and other plans now being developed, are assuming that urbanization of the petition area will occur, and project future need for public services in the region.

Over 90 percent of the petition area has slopes of less than 20 percent and would therefore be suitable for urban development.

(3) "Impact on Areas of Statewide Concern."

A. Preservation or maintenance of important natural systems or habitats.

Discussion: One 'aiea plant, a Category 1 candidate endangered species, was found within the petition area. This plant will be preserved and adequate buffered areas will be provided.

B. Maintenance of valued cultural, historical, or natural resources.

Discussion: The project archaeologist has conducted two studies within the petition area; an assessment study and an inventory survey. Significant sites have been identified as the result of these studies. However, only a small portion of the petition area has been covered by an inventory survey (just over 10 percent). Those sites that are significant will be preserved. Conditions will be applied to assure that additional studies will be required before further applications are made for county zoning.

C. Maintenance of other natural resources relevant to Hawaii's economy, including, but not limited to, agricultural resources.

Discussion: None of the land within the petition area has been evaluated as suitable for agricultural production. No land will be taken out of agricultural production. However, the Department of Agriculture has expressed its interest in expanding the Keahole Agricultural Park into a portion of the petition area. The petitioner believes there are more suitable State-owned lands in the region for this purpose.

D. Commitment of state funds and resources.

Discussion: As development of the petition area proceeds, it is probable that additional state funds will be needed for infrastructure development. State funds may also be involved in developing the area for specific uses.

E. Provision for employment opportunities and economic development.

Discussion: The proposed development is expected to provide for between 18,600 and 33,560 direct, indirect and induced jobs, based on the analysis of three possible development scenarios for the petition area. These jobs would be in a variety of fields, including education, research, retail, construction and industry.

F. Provision for housing opportunities for all income groups, particularly the low, low-moderate, and gap groups.

Discussion: Although specific land uses for the petition area have not yet been developed, it is probable that residential uses will comprise a significant portion of the urbanized petition area. Within this context, housing opportunities for residents of the County of Hawaii will be increased.

(4) In establishing the boundaries of the districts in each County, the Commission shall give consideration to the General Plan of the County in which the land is located.

Discussion: Except for a small area in the western (makai) portion of the petition area, the County General Plan identifies the petition area for urban expansion.

3.4 Five Year Boundary Review

Section 205-18, HRS, requires the Office of State Planning (OSP) to undertake a review of the classification and districting of all land in the State every five years. Following the reinstatement of the Five-Year Boundary Review by the Legislature in 1985, OSP began a boundary review project in 1991 (OSP, March, 1992).

As stated in the Five-Year Boundary Review Report:

> "The purpose of the Five-Year Boundary Review is: To conduct a statewide, comprehensive, policy-oriented examination of State Land Use District classifications. It provides the Land Use Commission the opportunity to review urbanization proposals from a broad, comprehensive and long-range viewpoint rather than incrementally on a case-by-case basis..." (Executive Summary, p. 1)

The Five-Year Boundary Review process included reviews of the following:

- Hawaii State Plan;
- State Functional Plans;
- County General Plan and County Development and/or Community Plans;
- baseline studies;
- resource mapping through the State's Geographic Information System; and,
- extensive coordination with State, County and Federal agencies and other public and private organizations.

Based on this review effort, OSP published a State Land Use District Boundary Review Hawaii, for the County of Hawaii in May, 1993. The urbanization of the Kailua to

Keahole area, consistent with the West Hawaii Regional Plan the Keahole to Kailua Development Plan is supported by the boundary review. The site of the University of Hawaii's West Hawaii campus is included in these State lands (ibid).

The lands within the petition area have been categorized as a "Priority Area for Action" which charges OSP with the responsibility to initiate petitions for reclassification.

3.5 West Hawaii Regional Plan

In November 1989, OSP published the West Hawaii Regional Plan, a document which is intended to provide policy guidance for the State in order to most effectively meet the region's present and emerging needs. It is also intended to complement the County of Hawaii's General Plan and Community Development Plans. One of the primary assumptions of the plan is the identification of subregional planning areas. Subregional planning areas have been defined "as the areas most probable for future expansion since landowners face similar infrastructure problems."

It is the intent of the West Hawaii Regional Plan that future regional urbanization be concentrated in the Subregional Planning Areas. The petition area is included in a Subregional Planning Area that stretches from Keahole to Kailua. In this respect, the proposed boundary amendment is consistent with the West Hawaii Regional Plan.

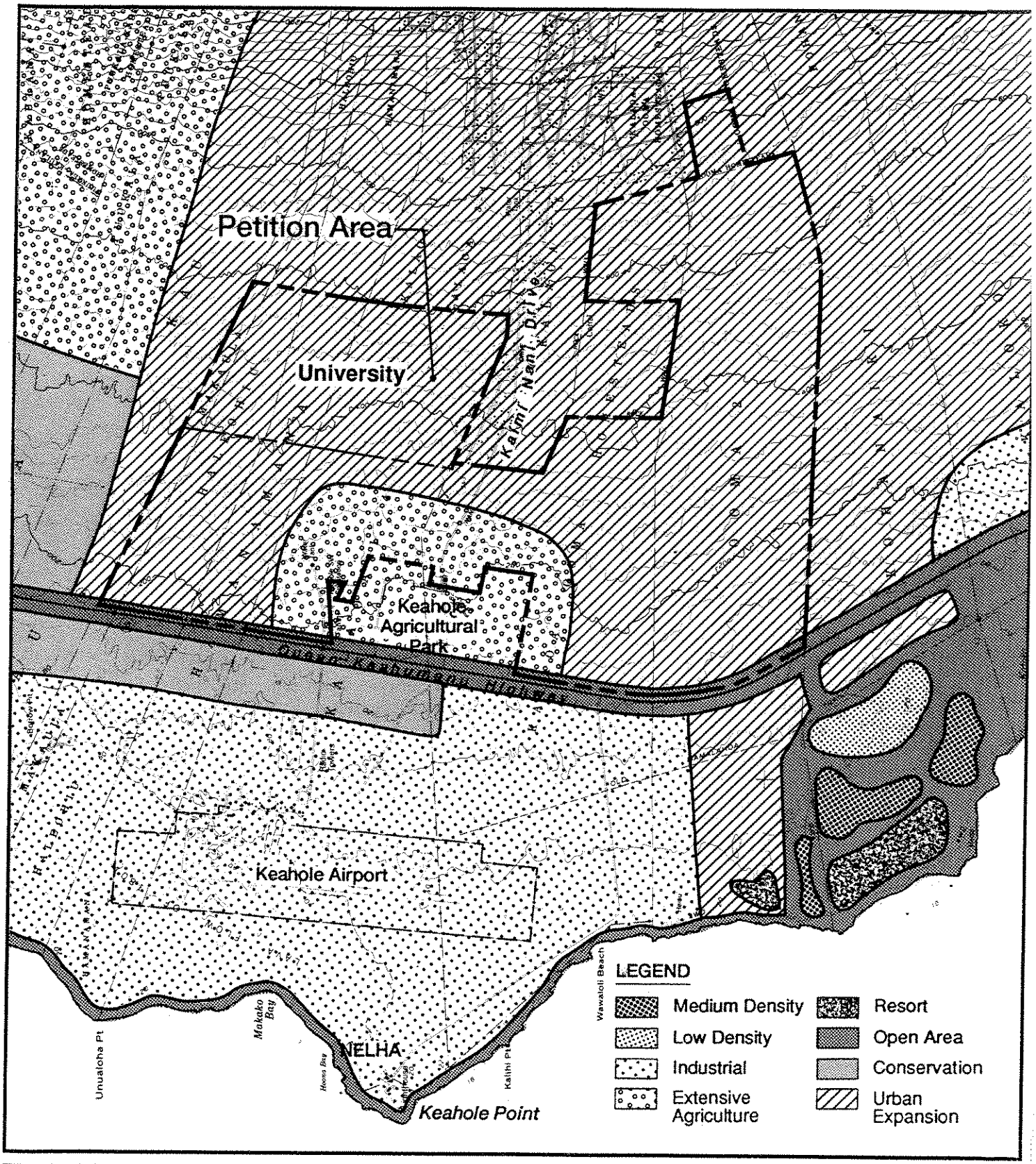
3.6 Hawaii County General Plan

The Hawaii County General Plan (Ordinance No. 89-142, as amended), "is the policy document for the long-range comprehensive development of the island of Hawaii...[it] provides the direction for the future growth of the County. It brings into focus the relationship between residents and their pursuits and institutions, offering policy statements which embody the expressed goals for present and future generations." (General Plan, 1989) The plan contains goals, policies and standards as well as a series of land use maps referred to as General Plan Land Use Pattern Allocation Guide (LUPAG) Maps. The LUPAG maps delineate thirteen different land use categories throughout the county. It is important to note that the LUPAG Map boundaries are not intended to be site-specific and are not intended to be interpreted in the same manner as zoning map boundaries. Except for a portion of the petition area that surrounds the Keahole Agricultural Park that is designated as "Extensive Agricultural", the majority of the petition area is designated as "Urban Expansion" under the County General Plan (Figure 5).

Land uses under the "Extensive Agriculture" designation are limited to "pasturage and large lands". "Urban Expansion Areas" allow "for a mix of high density, medium density, low density, industrial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined." (General Plan, 1989). The urbanization of the petition area is consistent with the urban expansion designation of the General Plan.

3.7 Keahole to Kailua Development Plan

The Keahole to Kailua Development Plan (K-K Plan), adopted by the Hawaii County Council on April 3, 1991 (Resolution No. 296), represents an ongoing effort by the County of Hawaii to prepare for the future urbanization of the region to meet the growing needs of West Hawaii. Although the study was administered and funded by the County of Hawaii, State agencies, community groups and major landowners in the region contributed significantly to the process of developing a preferred plan. In this context,



County General Plan

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Figure: 5

Feet
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Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

the plan provides a land use plan that emphasizes the siting of major infrastructure intended to serve the region.

While the purpose of the land use plan is to provide a framework for the future growth and development of the Keahole to Kailua area, the plan itself is not intended to be used as a master site plan that has fixed all of the major roads and land use locations.

The K-K land use plan identifies a 500-acre "University" site in the northeastern portion of the petition area (Figure 6). The western (makai) portion of the site (generally corresponding to the existing Conservation District) is identified as open space and recreation. The southeastern portion of the petition area is designated as "Residential Expansion" and an "Educational Center" is identified within this parcel. A small portion of the petition area located adjacent to the Keahole Agricultural Park is designated as "Extensive Agricultural Lots". In addition, three north-south roadways (a mid-level arterial, Waena Drive, and Kealakehe Street Extension) and an east-west roadway (University Drive) are identified as extending into the petition area.

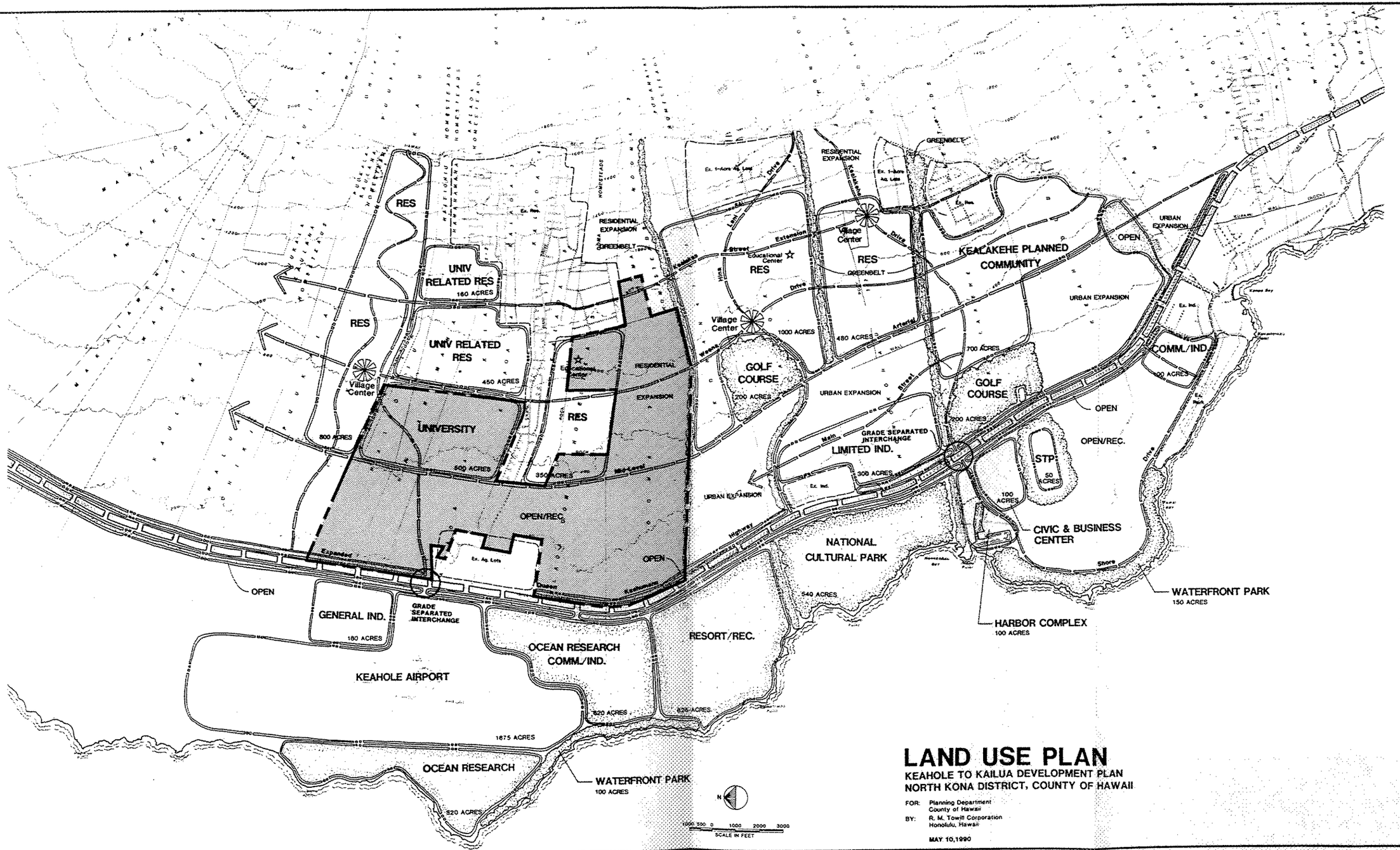
3.8 Hawaii County Zoning

Approximately 1,400± acres, or roughly one-half of the western (makai) portion of the petition area, is zoned "Open" under the existing County zoning. The remaining 1,200± acres in the eastern (mauka) half of the petition area is zoned "Unplanned" (Figure 7). Uses permitted under the "Open" designation include: public parks; the growing of plants which do not impair views; golf course and country clubs if compatible with the stated purpose of adoption; heiaus, historical structures and monuments; existing churches and temples of historical significance; natural features, phenomena, and vistas as tourist attractions; private recreational uses involving no above ground structures except dressing rooms and comfort stations; aquaculture activity; and uses considered directly accessory to the above permitted uses (Zoning Code, County of Hawaii, 1985) Uses permitted within "Unplanned" districts include: one single-family dwelling per building site; agricultural uses and buildings; processing, handling, and sale of agricultural products produced on the premises; home occupations; piggeries and apiaries; hunting and fishing preserves or lodges; aquaculture activity; and buildings and uses normally considered directly accessory to the above permitted uses (ibid).

Changes to the present "Open" and "Unplanned" zoning designations to appropriate urban zoning designations will be required once specific urban uses have been identified.

3.9 Coastal Zone Management/Special Management Area Rules and Regulations

In an effort by the State of Hawaii to preserve and protect the natural resources of the coastal zones, special controls on development along the shoreline have been implemented, as contained in Chapter 205A, Hawaii Revised Statutes (HRS), as amended. The objectives and policies of the Hawaii Coastal Zone Management (CZM) program are included in the Shoreline Protection Act of 1975 (Chapter 205A-2, HRS). All of the island of Hawaii lies within the CZM area except for the forest reserve area. The petition area does not lie within the Special Management Area as defined by the County of Hawaii, and therefore does not require a Special Management Area Use Permit. An analysis of the proposed reclassification in comparison to the objectives and policies of Chapter 205-A, HRS, is provided below as they relate to the urbanization of the petition area. Following each major subarea, a review of the relationship of the proposed action and the specific objective is presented.


RES
UNIV RELATED RES
160 ACRES
UNIV RELATED RES
450 ACRES
Village Center
800 ACRES
UNIVERSITY
900 ACRES
RESIDENTIAL EXPANSION
RES
950 ACRES
OPEN/REC.
Ex. Ag. Lots
OPEN
OPEN
GENERAL IND.
180 ACRES
GRADE SEPARATED INTERCHANGE
KEAHOLE AIRPORT
1675 ACRES
OCEAN RESEARCH COMM./IND.
320 ACRES
OCEAN RESEARCH
320 ACRES
WATERFRONT PARK
100 ACRES
RESORT/REC.
825 ACRES
RESIDENTIAL EXPANSION
GREENBELT
Village Center
1000 ACRES
GOLF COURSE
200 ACRES
Educational Center
RES
480 ACRES
GREENBELT
URBAN EXPANSION
GRADE SEPARATED INTERCHANGE
LIMITED IND.
300 ACRES
KEALAKEHE PLANNED COMMUNITY
OPEN
URBAN EXPANSION
700 ACRES
GOLF COURSE
200 ACRES
OPEN
OPEN/REC.
STP
50 ACRES
100 ACRES
CIVIC & BUSINESS CENTER
NATIONAL CULTURAL PARK
540 ACRES
HARBOR COMPLEX
100 ACRES
WATERFRONT PARK
150 ACRES
URBAN EXPANSION
COMM./IND.
90 ACRES
Ex. Ind.
Ex. Res.
Ex. 1-Acre Ag. Lots
Ex. Ag. Lots
Ex. Ind.
Ex. Res.
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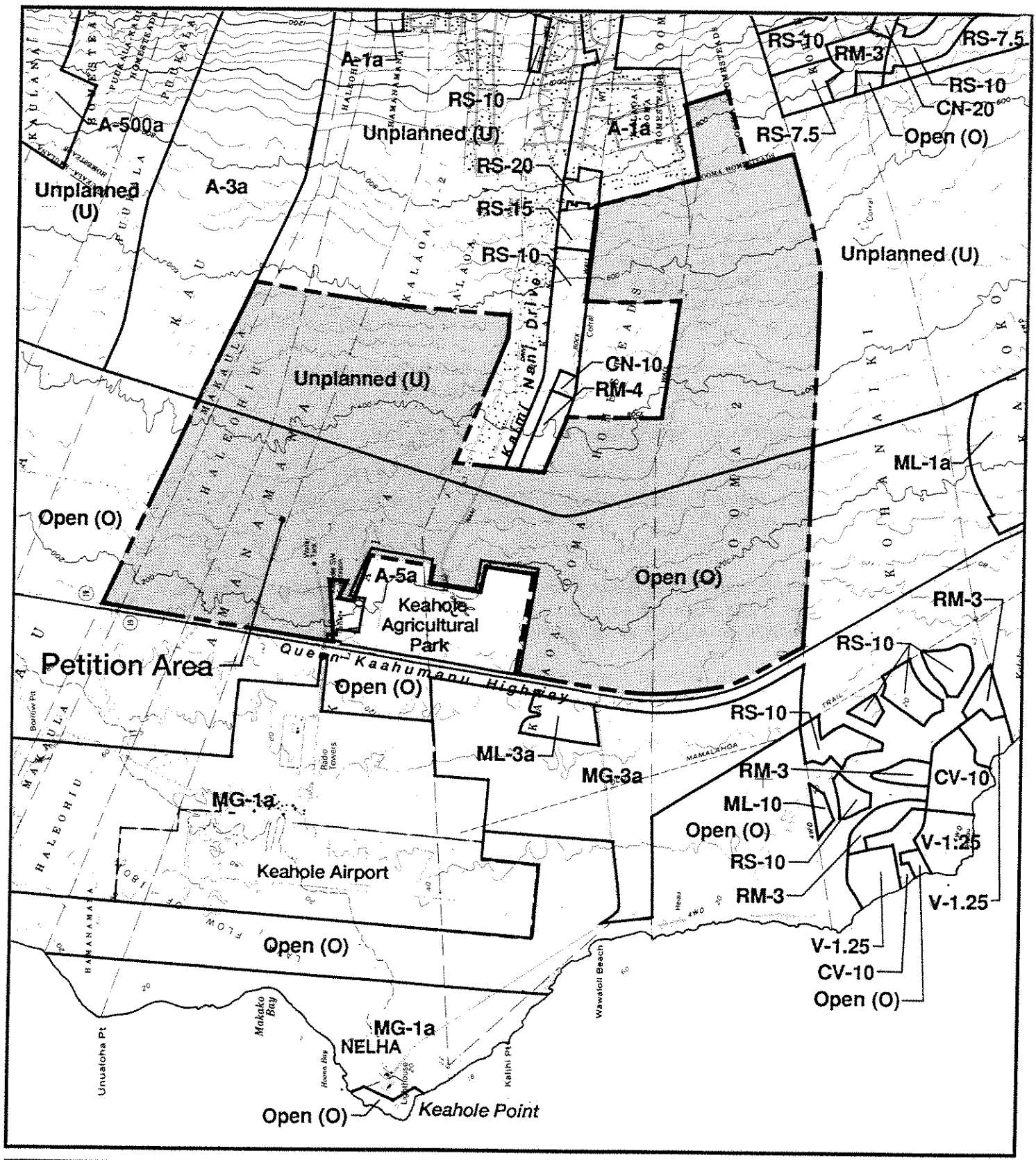


County Zoning

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Figure: 7

Feet

0 1500 3000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

- **Recreational Resources**

Objective:
To provide coastal recreation opportunities accessible to the public.

Policies:
1. *To protect unique coastal recreational resources;*
2. *To replace areas of recreational value as damaged or destroyed by development;*
3. *To provide adequate public access;*
4. *To develop new coastal recreational opportunities;*
5. *To encourage the dedication of coastal areas with recreational value for public use.*

Discussion: The proposed reclassification will not have an adverse impact on coastal resources, nor will it impede existing access to the shoreline.

- **Scenic and Open Space Resources**

Objective:
To protect, preserve and where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:
1. *To insure that new developments are compatible with the visual environment;*
2. *To preserve and maintain shoreline open space and scenic resources;*
3. *To encourage developments which are not coastal dependent to locate inland.*

Discussion: Visual impacts of the proposed action have been described and analyzed in Section 4.13. The proposed reclassification will not adversely affect the quality of coastal scenic and open space resources. Development of the petition area will be visible sporadically from Queen Kaahumanu Highway. Appropriate urban design and landscaping elements will mitigate the appearance of urban development, although the natural openness of the petition area will be lost.

- **Economic Uses**

Objective:
To provide public and private facilities and improvements important to the State's economy in suitable locations.

Policies:
1. *To concentrate coastal dependent development in appropriate areas;*
2. *To insure coastal dependent development, minimize adverse social, visual, and environmental impact;*
3. *To direct location and expansion of developments to existing designated areas.*

Discussion: The urbanization of the petition area is consistent with other existing State and County land use policies: the Keahole to Kailua Development Plan, the County of Hawaii General Plan, and, the West Hawaii Regional Plan.

- **Coastal Hazards**

Objective:
To reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Policies:
1. *To control development in areas subject to coastal hazards;*
2. *To ensure that developments comply with the requirements of the Federal Flood Insurance Program;*
3. *To prevent coastal flooding from inland projects.*

Discussion: The petition area is not affected by tsunami, storm waves, stream flooding, erosion or subsidence.

3.10 Environmental Impact Statements (Chapter 343, HRS)

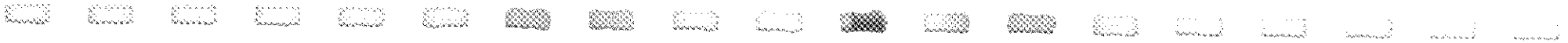
Section 343-5(a)(1) & (2), HRS, notes that the provisions of Chapter 343 apply to any actions proposing reclassification of lands within the Conservation District, or actions involving the use of State lands.

Section 343-5(c), HRS, states that applications proposing actions subject to Chapter 343, HRS "shall prepare an environmental assessment of such proposed action at the earliest practicable time to determine whether an environmental impact statement shall be required."

An environmental assessment (EA) was prepared to fulfill these requirements and on the basis of this EA, the Land Use Commission determined on December 17, 1992 that an environmental impact statement (EIS) was required for the proposed reclassification of the petition area. The EIS preparation notice (EISPN) was published in the OEQC Bulletin on January 8, 1993. The publication of this notice of determination began a 30-day public review period which ended on February 7, 1993.

A list of agencies, organizations and individuals consulted during the preparation of the draft EIS is found in Chapter 10 of this document. Chapter 11 contains reproductions of written comments on the EISPN received by March 15, 1993 and the written responses to the comments. Chapter 12 contains written reproductions of comments received during the pre-assessment consultation.

A notice of the availability of the Draft EIS was published in the April 8, 1993 edition of the OEQC Bulletin, which began a 45-day comment period which ended on May 23, 1993. Chapter 13 contains written reproductions of comments received during the comment period and the written responses to the comments.



4.0 PHYSICAL AND NATURAL ENVIRONMENT

This section describes the physical environment of the petition area, and, where appropriate, the probable impacts of the proposed action and possible measures to mitigate those impacts.

4.1 Easements and Conservation District Use Permits (CDUPs)

A number of easements and Conservation District Use Permits (CDUPs) have been approved which either directly affect or are located adjacent to the petition area. These are listed below in Table 7 and shown on Figure 8.

Table 7
Summary of Easements and CDUPs

Tax Map No.	Identification	Purpose	In Favor Of
7-3-10:por. 33	Utility Easement	Reservoir/Acc. Rd.	DWS
7-3-10:por. 33	Utility Easement "77"	Transmission Line	HELCO
7-3-10:por. 33	Power Line Easement "I"	Transmission Line	HELCO
7-3-10:por. 33	HA-209 (CDUP)	Transmission Line	HELCO
7-3-10:por. 33	HA-487 (CDUP)	Transmission Line	HELCO
7-3-09:05	HA-2397 (CDUP)	Utility Corridor	Nansay Hawaii, Inc.
7-3-49:36	HA-0487 (CDUP)	Elec. Generation Stn.	HELCO
7-3-09:05	Utility Easement	Utility Corridor	Nansay Hawaii, Inc.
7-3-49:37	HA-0209 (CDUP)	Elec. Substation	HELCO
7-3-49:38	HA-1963 (CDUP)	Synchronous Transm.	Big Island Broadcasting Co
7-3-49:38	HA-1963 (CDUP)	Propane Generator	Big Island Broadcasting Co
7-3-10:33	HA-1911 (CDUP)	Elec. Substation	State of Hawaii

Source: Department of Land & Natural Resources, Division of Land Management, August, 1992; Tax Map Key Records
* Pending Approval

The most significant easements/CDUPs affecting the petition area involve the transmission line corridors set aside for HELCO on the northern portion of the petition area. These corridors range between 100 and 300 feet in width, providing a major land use that must be considered in future site planning for this portion of the petition area.

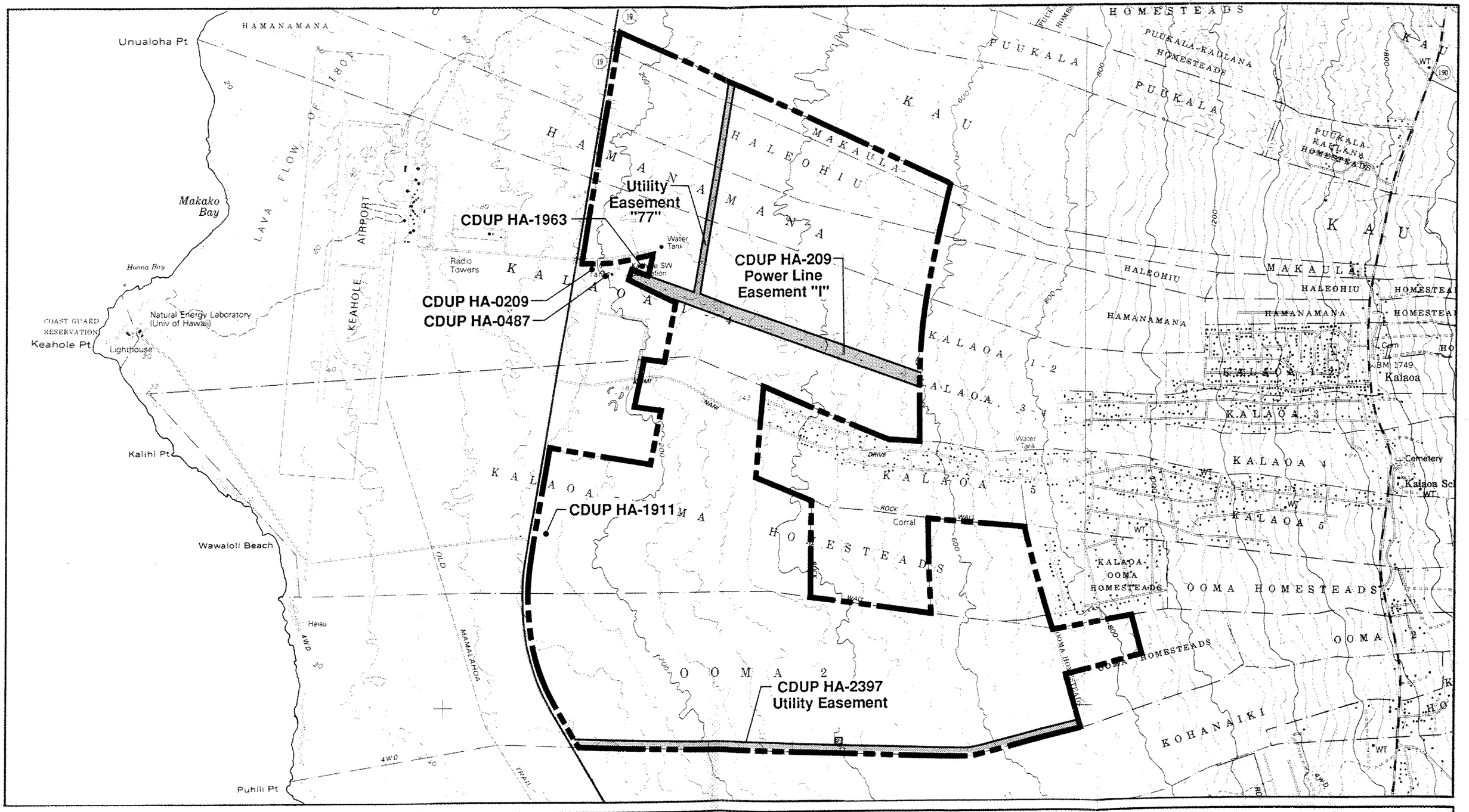
Other CDUPs adjacent to the petition area have allowed the development of HELCO's Keahole Generating Station and electric substation, and the transmitters for the Big Island Broadcasting Company.

4.2 Climate

Affected Environment

West Hawaii can be characterized as having a semi-tropical climate. The average annual temperature is 75 degrees Fahrenheit (F), with an average high of 83 degrees F, and an average low of 67 degrees F. Average annual precipitation in Kailua-Kona is 25 inches.





Easements & Conservation District Use Permits (CDUPs)

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Figure: 8

Feet 0 1000 2000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

The geographic distribution of precipitation closely resembles the topographic contours: a high rainfall belt lies between the 1,200- and 3,000-foot elevations on the leeward slopes of Hualalai and Mauna Loa, with zones of decreasing annual rainfall at lower elevations near the coast and at higher elevations above the rain-bearing trade wind regime (Figure 9). Normally more rain falls in the area during the summer months.

The North Kona coast is largely sheltered from the predominant trade wind system by the land masses of Mauna Loa, Mauna Kea and Hualalai. The prevailing pattern is on-shore winds in the morning and early afternoon, often collecting in a cloud bank at the higher elevations, then becoming off-shore breezes in the late afternoon and evening. Typical wind velocities range between 3 to 14 knots. Relative humidity is also generally stable year round, with the daily average ranging from 71 to 77 percent.

Probable Impacts

No significant change in the sites macro (or regional) climate is anticipated. Modification of the micro (or site-specific) climate will result from the planting of shade trees and the construction of buildings that channel air flows. Equally important would be changes in people's perceptions of the climate with the addition of landscaped areas.

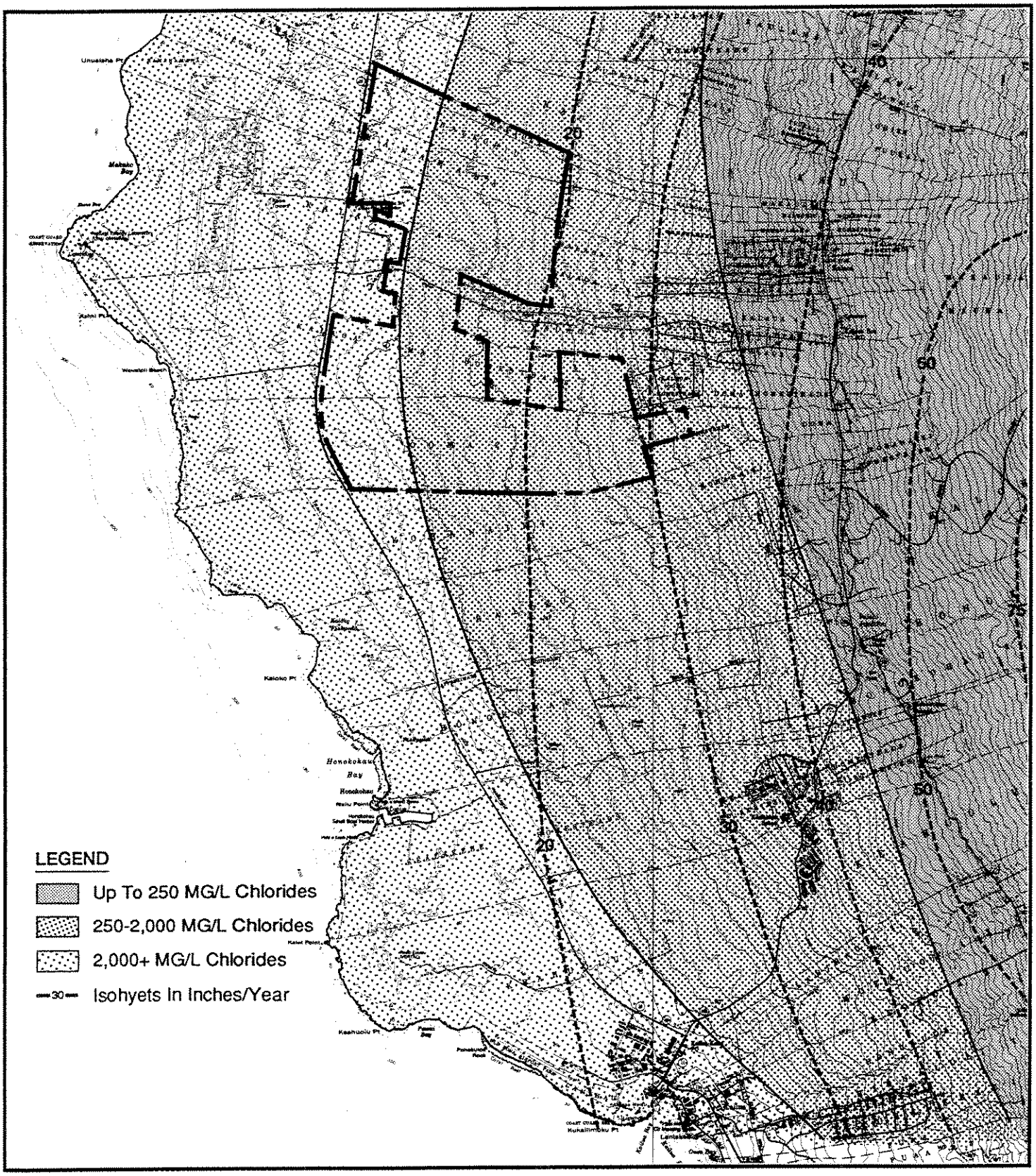
4.3 Geologic and Hydrologic Setting

Affected Environment

The petition area is located on the western slope of Hualalai, a dormant shield-type volcano (elevation 8,271 feet). Hualalai Volcano last erupted in 1801 along its northwest rift zone. An eruption at the 1,500-foot elevation produced lava flows that spread out along the coast as far south as Keahole Airport. The northwest rift zone represents the major geologic structure in the area (Water Resource Associates, 1992).

The western slopes of Hualalai Volcano consist predominantly of alkalic olivine basalt flows that poured out of the northwest rift zone. Some of the flows, however, are gradational to Hawaiite (andesite). The basalt flows are typically thin-bedded, dip 10 to 15 percent and average 4 or 5 feet in thickness on the upper slopes (Macdonald and Abbott, 1970). These flows, however, probably average 10 feet in thickness on the more gentle (2 percent) slopes near the coast. The flows consist of both pahoehoe and a'a types and belong to the prehistoric member (Holocene age) of the Hualalai volcanic series. Hualalai lavas extend as far south as Keauhou, some 7 miles to the south, where they interfinger with lava flows from Mauna Loa Volcano (Water Resource Associates, 1992).

Rainfall on the permeable volcanic slopes above an elevation of approximately 2,000 feet is the principal source of Kona's groundwater resources. Most of the rainfall percolates quickly downward into the ground to become groundwater at depth, due to highly permeable, basaltic lava flows which are mostly unweathered and have little soil cover. Groundwater in the coastal area between Keahole and Kahaluu occurs as a thin, unconfined basal lens of brackish to fresh water floating on salt water in very permeable Hualalai basalt lava flows. This thin basal aquifer is recharged principally by ground water discharging seaward from inland bodies of high-level groundwater over and possibly through, an as yet, undefined hydrogeologic boundary that is located approximately two to four miles inland from the coast (ibid).



Groundwater/Rainfall Map
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Source: Keahole to Kailua Development Plan, County of Hawaii, 1991

Figure: 9

Feet
0 2500 5000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

The presence of the hydrogeologic boundary is thought to have created high-level ground water based upon well data and a geophysical survey conducted in the Palani Junction area. A well drilled by the State of Hawaii at Kalaoa has a head of 238 feet above sea level, while a mile north, a well drilled by Nanasay Hawaii at Kau has a head of only 10 feet. Another well drilled by the County of Hawaii at Honokohau encountered ground water at 109 feet above sea level. High level ground water has been encountered in three other wells located between Honokohau and Waiaha, indicating that high-level ground water probably occurs more or less continuously mauka of Mamalahoa Highway along a 6-mile stretch of North Kona between Kalaoa and Waiaha (ibid).

The inland and lateral extent of this high-level water and the nature of the confining hydrogeologic structure are not well known at this time, although five other wells located south of Kahaluu have discovered high-level ground water as far south as Keei, some 14 miles south of Keahole. The hydrogeologic boundary between the basal water and inland high-level water apparently lies parallel to the coastline, approximately two miles or more inland. However, because different water levels ranging from 40 to 490 feet above sea level have been encountered, high-level ground water probably occurs in separate or partially separate bodies (ibid).

Ground water within the petition area is not suitable for potable water development, as potable wells are generally developed between elevations of 1,500 feet to 1,800 feet (R.M. Towill, 1990). Most of the petition area falls within the 250-2,000 mg/l chlorides category which indicates that portions of these areas may be suited for the development of brackish wells used for irrigation purposes (a level of less than 1,000 mg/l chlorides is generally required for the development of brackish wells, although higher salinity irrigation water could be used for more salt tolerant plants) (Figure 9).

Probable Impacts

The petition area represents a small proportion of the total groundwater recharge area. The area that provides the bulk of land surface which acts to collect rainwater that recharges potable groundwater resources is located mauka of Mamalahoa Highway, on the western slopes of Mt. Hualalai, a considerable distance from the petition area. Urbanization of the petition area will not significantly interrupt the flow of recharge to these groundwater resources. However, urbanization of the petition area will provide additional demand on these resources. These impacts are discussed in greater detail in Section 6.4 (Water Supply) of the FEIS.

The urbanization of the petition area will increase the opportunity for pollutants to enter groundwater via storm runoff or as leachate from materials applied to landscaped areas (fertilizers, pesticides, etc.) Pathways followed by groundwater as it migrates to the ocean are the result of the volcanic origins of the island and its relatively young geologic age, which has created myriad subsurface pathways through porous lava to the ocean. Within the region makai of the petition area, there is particular concern about maintaining the quality of groundwater and the nearshore environment because nearshore waters have been classified "AA" by the State Department of Health (DOH) and because of proximity to the Natural Energy Laboratory of Hawaii Authority (NELHA), which relies on the availability of pristine ocean water.

Mitigation Measures

At the present time, there are several on-going programs makai of the petition area to monitor groundwater and ocean water quality. NELHA, Nansay Hawaii, Inc. (developers at Kohanaiki), and Kahala Capital Corporation (developers at 'O'oma II) are

all involved in water quality monitoring programs, so there is a wealth of available information on existing water quality. The Petitioner recommends that the Land Use Commission attach the following condition to its approval:

The developer of the subject property shall maintain, to the extent required by the State Department of Health, on-site facilities to insure that the nearshore, offshore and deep ocean waters remain in pristine condition. The developer of the subject property shall also participate in a water quality monitoring program with the Natural Energy Laboratory of Hawaii and the Hawaii Ocean and Science Technology Park. This program shall be submitted for review to the State Department of Health.

Also, if the future development of the petition area includes a golf course, an environmental risk assessment should be conducted to analyze possible impacts that might occur as the result of the application of pesticides and fertilizers to the course. In addition the Petitioner recommends that the following condition be attached :

The developer and/or landowner of the subject property shall, to the satisfaction of the State Department of Health, keep wastewater ponds holding effluent for irrigation of golf courses at a sufficient distance from residential areas to prevent odor and insect nuisances.

The developer of the subject property shall also engage the services of a qualified golf course manager to oversee the irrigation of the golf course and application of fertilizers and pesticides to the golf course within the Property and who shall be qualified in the application of fertilizers and pesticides on those areas.

The developer and/or landowner of the subject property shall comply with the State Department of Health's conditions for new golf course developments.

4.4 Topography and Slopes

Affected Environment

Elevation of the petition area ranges from about 80 feet above mean sea level (msl) at the southwest corner (near Queen Kaahumanu Highway) to about 840 feet above msl at the southeastern boundary of the site. The site's topography is characterized as being moderately sloping with approximately 90 percent of the site having gradients of less than 10 percent. Most of the remaining lands have gradients between 10 to 20 percent (Figure 3). Generally, the flatter lands are concentrated in areas below an elevation of 380 feet msl. Above this elevation, there is a higher frequency of areas with gradients in excess of 10 percent. Within this general setting, localized mounds and depressions, characteristic of lava flows, are present throughout the site.

Probable Impacts

Development of the petition area will require a significant amount of site work, including alteration of the existing lava terrain for roadways and building sites.

Mitigation Measures

Once reclassification of the petition area occurs, the next step in the development process will be the preparation of a master plan. To the extent possible, the master plan should

site land uses, including roadways, to minimize grading and reduce the need to large-scale reshaping of the underlying landform.

4.5 Natural Hazards

Affected Environment

Lava Flow Hazard. The petition area is susceptible to potential lava flow from Hualalai, one of the five volcanoes comprising the island of Hawaii and one of the three volcanoes which have been active in historic times. The last active period of eruption for Hualalai occurred in 1801. The northwest volcanic rift zone at about the 1,600-foot elevation (in the vicinity of the Puhi o Pele Cinder Cone, just makai of the Mamalahoa Highway), produced a lava flow which extended to the shoreline just north of Keahole Point. The petition area is within lava flow hazard zone 4, a zone of "medium" threat (the U.S. Geological Survey has identified 9 volcanic flow hazard zones on the island of Hawaii, with "1" being the highest hazard and "9" being the lowest). Zone 4 includes all of Hualalai, where the frequency of eruption is lower than that for Kilauea or Mauna Loa (Wright, et al. 1992).

Volcanic Activity. The U.S. Geological Survey (USGS) has identified "zones of relative risk" associated with volcanic activity on the island of Hawaii. These zones take into account both direct elements of volcanic activity (such as lava flows inundation, rock fragments and gases) and indirect hazards (such as subsidence, surface rupture, earthquakes, and tsunamis). The classification system includes six zones, "A" through "F", with risk increasing from "A" to "F." The petition area is located in the "DE" zone, indicating a relatively low degree of risk from volcanic action (Mullineaux and Peterson, 1974).

Seismicity. The entire island is susceptible to earthquakes originating in fault zones under and adjacent to it. Two fault zones have been identified within the Kona region: the Kealakekua and the Kaloko faults, both located in South Kona and well away from the project site. The Big Island is classified as a Zone 3 area for the purpose of structural design. The classification system is based on a scale of 0 to 4, increasing in level of risk due to seismic occurrence and danger. The Hawaii County Building Code requires that all new structures be designed to resist forces that might be expected in Zone 3 areas.

Probable Impacts

The occurrence of a natural disaster, such as volcanic eruption or earthquake, would pose a risk to life and property within the petition area.

Mitigation Measures

All structures within the petition area should be located, designed, and constructed to conform with local building standards and regulations for potential seismic activity. More extensive geotechnical surveys will be required before detailed site and construction plans can be drawn to ensure adequate stability and structural foundations.

4.6 Soils

Affected Environment

The Soil Survey of the Island of Hawaii, State of Hawaii, prepared by the United States Department of Agriculture Soil Conservation Service (1973), has identified three soil

types on the site: pahoehoe lava, a'a lava, and Punaluu series. Figure 10 shows the distribution of soil types in the petition area. The two predominant soil types are pahoehoe and a'a lava which are scattered throughout the site. Pahoehoe lava is characterized by a billowy, glassy surface that is relatively smooth, although the surface may be rough and broken in some areas, with hummocks and pressure domes. A'a lava flows are characterized by clinkery, hard, glassy pieces piled in tumbling heaps. Both of these soil types have no soil covering. The third type, concentrated in the southeast corner and western portions of the site, is the Punaluu series. In a representative profile, the surface layer is black peat about 4 inches thick, underlain by pahoehoe bedrock. The soil is medium acid. The peat is rapidly permeable. The pahoehoe lava is very slowly permeable although water moves rapidly through the cracks. Runoff is slow and erosion hazard is slight. This soil can be used for pasture.

The Soil Survey indicates that the property is not suited for agricultural use. The two lava types listed above have a Capacity Class Rating of VIIIs, defined as soil and land forms whose limitations preclude the cultivation of commercial plants. The Punaluu series soils have a rating of VIIs, indicating the soils and landforms have limitations that make them unsuitable for agricultural cultivation and limit their use to largely pasture, range, woodland, or wildlife.

The University of Hawaii Land Study Bureau's Detailed Land Classification-Island of Hawaii classifies the land forms into groupings similar to those mentioned above, and classifies the entire project area as "E", or very poorly suited for agricultural productivity (Figure 11).

None of the land within the petition area has been identified as Important Agricultural Land under the State ALISH system (Agricultural Land of Importance to the State of Hawaii).

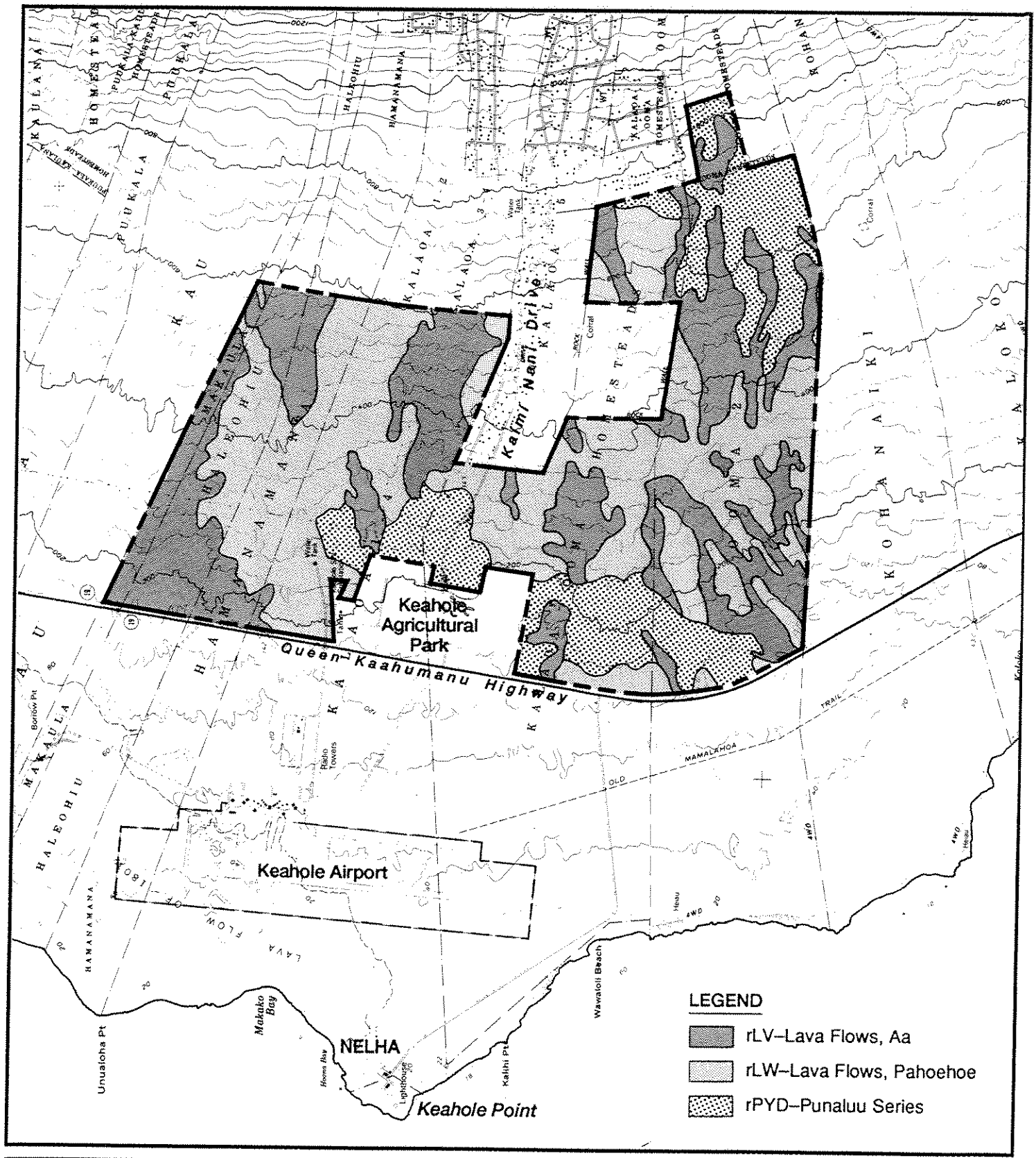
Short-term Impacts. Construction activity will take place on moderately-sloped surfaces dominated by pahoehoe lava flows, which could present difficulties as a foundation material in comparison to a'a lava, which is more easily crushed and shaped by conventional bulldozers. Periodically during the grading and construction phases, loose lava particles and fill material will be exposed to wind and water erosion.

Long-term Impacts. Most of the property is covered by lava with little, if any soil cover. Development of the property will not reduce the inventory of agriculturally significant lands. On the other hand, lack of sufficient soil cover will require soil to be imported for all landscaped areas. The amount of imported soil material needed has not been determined and will vary according to the acreage devoted to plant materials requiring a soil base.

Mitigation Measures

The most important mitigative technique is the choice of grading scheme and its relationship to the existing topography. Planned conformity between site design and the natural topography will minimize the amount of reshaping and filling needed.

To provide adequate on-site drainage, the complete elimination of mass grading would not be possible. Erosion control techniques called for by State and County agencies should be used where appropriate to minimize soil loss, although soil loss is not expected to be a problem because of regional climate and the limited amount of existing soil cover.



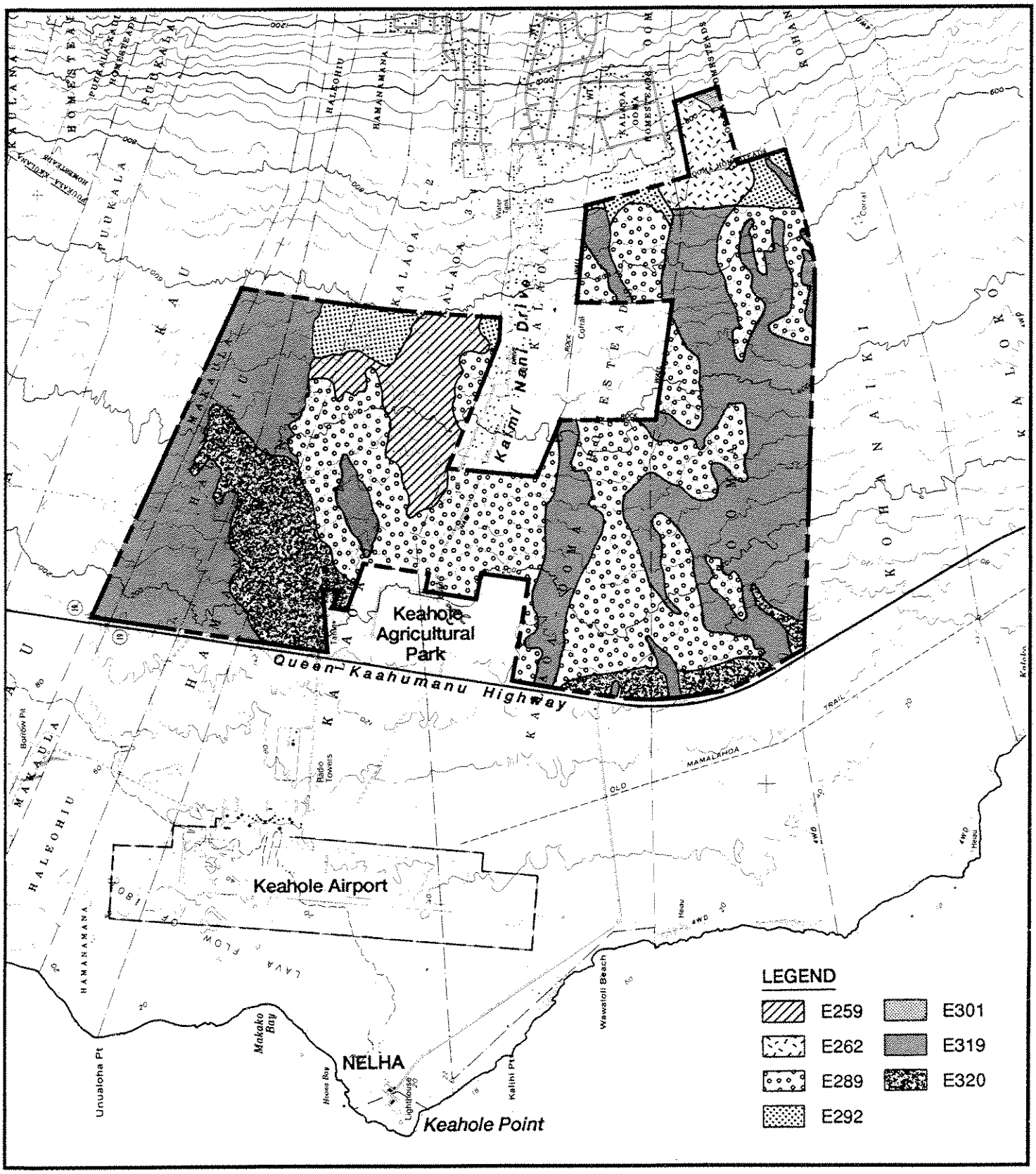
U.S. Soil Conservation Service Soils Map
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Source: U.S. Soil Conservation Service, 1973

Figure: 10

Feet
0 1500 3000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners



U.H. Land Study Bureau Soils Map
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Source: University of Hawaii Land Study Bureau, 1965

Figure: 11

Feet
0 1500 3000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

4.7 Agriculture

Affected Environment

As discussed in Section 4.6, the soils of the petition area are dominated by pahoehoe and a'a lava flows. Punaluu Series soils comprise a third soil type found on the petition area. Each of these soils types have been categorized as not suited for agriculture use by the U.S. Soil Conservation Service and the University of Hawaii Land Study Bureau. In addition, none of the petition area is identified as Important Agricultural Land under the State ALISH system.

Despite the lack of soils suitable for agricultural production, the State Department of Agriculture (DOA) has developed the Keahole Agriculture Park, which is situated adjacent to the western portion of the petition area. The agricultural park consists of 34 parcels which average about five acres in size, and are leased to farmers by the DOA. The parcels that are in production grow mostly ornamental flowers or landscape plants. During the preparation of the FEIS, DOA has maintained its intent to expand the Keahole Agriculture Park. DOA has requested that 200 acres of the petition area, immediately south of the existing agricultural park, be set aside for expansion of the park.

Probable Impacts

Currently, there are no agricultural activities within the petition area. As such, the urbanization of the petition area will not remove any agricultural land from production. However, reclassification of the petition area to the Urban District would foreclose the opportunity to expand the Keahole Agriculture Park.

The DOA has also expressed concern about the potential incompatibility of urban uses immediately adjacent to and surrounding the agricultural park on three sides.

Mitigation Measures

As a measure to protect the interests of existing farming operations at the Keahole Agriculture Park, the Petitioner recommends that the Land Use Commission attach the following condition to its approval:

The developer and/or landowner of the petition area shall notify all prospective buyers/lessees of the urbanized petition area about the provisions of the Hawaii Right-to-Farm Act, Chapter 165, HRS, which limits the circumstances under which pre-existing farming activities may be deemed a nuisance. They should also be notified about the potential noise, odor and dust pollution that could result from activities at the agricultural park.

Future planning for the urbanized petition area should be sensitive to the compatibility of uses surrounding the agricultural park. The issue of proximal compatibility would be addressed once specific land uses have been determined for the petition area. For example, light industrial uses or golf course fairways might offer compatible transitional uses.

Regarding the potential loss of opportunity to expand the Keahole Agriculture Park within the petition area, the Petitioner recommends that expansion should be encouraged on other State-owned parcels north of the petition area, along Mamalahoa Highway.

4.8 Drainage and Flooding

Affected Environment

The existing drainage area affecting the petition area covers (both on-site and off-site), approximately 8,336 acres (13.1 square miles), extending from the undeveloped Makaula-O'oma Mauka Tract to Queen Kaahumanu Highway. Existing developments in the vicinity have no continuous underground drainage system. Instead, the asphalt concrete roads have side swales with periodic CRM ditch structures and connecting drain pipes, which direct runoff ultimately to open areas which facilitate the rapid percolation of storm water runoff (M&E Pacific, 1992, Appendix B).

In the vicinity of Queen Kaahumanu Highway, drainage runoff can flow under the highway through a series of 14 corrugated metal pipe culverts, ranging in size from 30 to 96 inches, fronting the petition area (ibid).

The existing off-site peak runoff is about 3,500 cubic feet per second (cfs) and the existing on-site peak runoff is 2,300 cfs (Figure 12).

Probable Impacts

Based on general assumptions about future development of the water shed and the petition area, it is estimated that an additional 1,000 cfs of peak discharge will be added to the on-site peak discharge (an increase of 43 per cent).

Mitigation Measures

Additional runoff can be precluded from entering into downstream properties by installing a system of swales and underground drainage structures which would channel the runoff into a system of dry wells (ibid).

The use of unlined channels, wherever possible, would allow infiltration of runoff into the porous lava rock and thus minimize flows at discharge points. In addition, areas could be left in open space (including golf course areas) for drainage infiltration into the ground. The developer and/or landowner should be required to fund the design and construction of drainage improvements required as a result of the development of the petition area to the satisfaction of the appropriate State and County of Hawaii agencies.

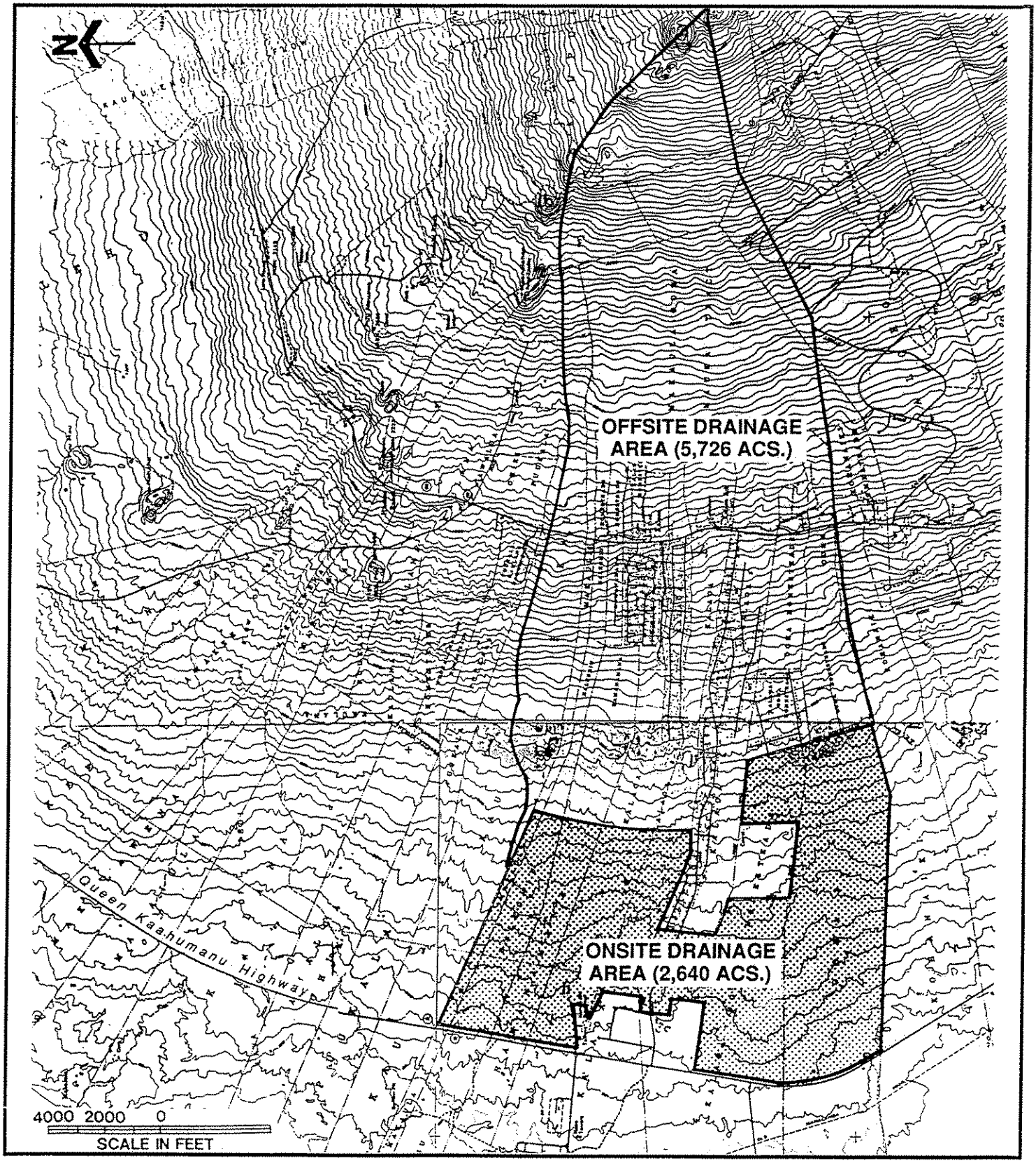
In addition, the Petitioner recommends that the Land Use Commission attach the following condition to its approval:

The developer and/or landowner of the petition area shall fund the design and construction of drainage improvements required as a result of the development of the petition area to the satisfaction of the appropriate State and County agencies.

4.9 Noise

Affected Environment

The petition area is currently exposed to relatively low noise levels and is not adversely affected by aircraft operations at the Keahole Airport, according to the master plan adopted by the State Department of Transportation (DOT), Airports Division for the Keahole Airport. The petition area lies outside the 55 Ldn noise contour line paralleling the makai border of the Kalaoa-O'oma ahupua'a and Queen Kaahumanu Highway



Existing Drainage Area

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Source: M&E Pacific, Inc.

Figure: 12

4000 2000 0

SCALE IN FEET

Prepared for: Office of State Planning, State of Hawaii

Prepared by: Helber Hastert & Fee, Planners

(KPMG Peat Marwick, November, 1987) (Figure 3). This noise level was recently validated with the measurement of aircraft noise at about 50 Ldn in the vicinity of HELCO's Keahole Generating Station (CH2M Hill, 1992).

The other source of noise in the vicinity of the petition area is the existing Keahole Generating Station, which is adjacent to the northwestern portion of the petition area. Noise contours for the existing facilities of the Keahole Generating Station assume that the station is operating with the combustion turbine on-line for approximately 17 to 18 hours per day, and the six diesel generators each operating approximately 5 to 6 hours per day. The highest noise level which currently affects the petition area, is approximately 62 Ldn (CH2M Hill, 1992). The area influenced by this noise contour is limited to an area of less than one acre. These noise levels have been determined to be compatible with commercial, office, and industrial uses (Darby & Associates, 1990). Within about 800 feet of the HELCO property line, the noise contour level drops to approximately 57 Ldn (CH2M Hill, 1992).

Probable Impacts

Construction Noise. Development of the petition area will involve grubbing, grading and the construction of infrastructure and buildings. The various construction phases of a development project can generate significant amounts of noise. Actual noise levels will depend on the methods of construction employed during each stage of the process. Earthmoving equipment such as bulldozers and diesel powered trucks will probably be the loudest equipment used during construction.

Traffic Noise. It is also probable that noise generated by vehicular traffic along Queen Kaahumanu Highway and Kaimi Nani Drive will increase, both from construction vehicles and subsequently from vehicle trips by residents, employees and visitors to the urbanized petition area. The degree to which traffic noise increases as a result of vehicular trips associated with the urbanization of the petition area cannot be projected because specific uses for the petition area have not yet been determined.

Cumulative Impacts

The noise impacts associated with the expansion of the Keahole Generating Station can only be marginally attributable to the urbanization of the petition area. However, the expansion of the generating station will increase noise impacts in the area immediately surrounding the station. With the exception of a small area (about 0.5 acres) north of the generating station, noise levels measured at the HELCO property line will be below the 70 Ldn Noise Contour. Approximately eight acres of the petition area will be exposed to sound levels in excess of 60 Ldn (Figure 3).

Mitigation Measures

It is recommended that any future developer be responsible for implementing appropriate sound attenuation measures, if found necessary, to bring noise levels down to levels acceptable to the State Department of Health and the State Department of Transportation for those portions of the petition area affected by Highway noise. Such attenuation measures could include setbacks from Queen Kaahumanu Highway, landscape buffers and sound attenuating construction materials.

It is also recommended that only land uses compatible with anticipated noise levels attributable to the expansion of the Keahole Generating Station be located in those areas affected by the increase in noise from the generating station.

In addition, the Petitioner recommends that the Land Use Commission attach the following condition to its approval:

No residential or condominium units be constructed within areas exposed to noise levels of 60 Ldn or greater. It is also recommended that the developer/landowner grant an avigation and noise easement to the State of Hawaii in a form prescribed by the State Department of Transportation on any portion of the petition area exceeding 55 Ldn, attributable to Keahole Airport operations.

If any residential properties are assisted under programs administered by the Department of Housing and Urban Development (HUD), they must comply with 24 CFR Part 51 Subpart B: Noise Abatement and Control.

4.10 Flora

Char & Associates conducted a botanical survey of the petition area in August and September 1992. The results of this survey are summarized below and the full report is attached to the FEIS as Appendix C.

Affected Environment

The vegetation on the project site varies from grassland with low, scattered shrubs on the lower elevations to open and closed shrublands on the upper elevation portions of the site. Native, dry, lowland shrubs and trees are found throughout the site but are more numerous on 'a'a lava flows; they are a major component of the open and closed shrublands on the property. In this region, 'a'a flows generally tend to support a greater number of native plant species including several rare and endangered elements. Thus, these areas were more intensively surveyed than the pahoehoe, fountain grass dominated portions of the petition area.

Three vegetative types are recognized on the petition area: (1) fountain grass grassland; (2) open mixed shrubland; and (3) closed mixed shrubland. The distribution of these vegetation types is influenced by environmental factors such as substrate type and rainfall gradient. The fountain grass grassland encompasses about 0 percent of the site and occurs on the lower elevation portions of the petition area, largely on pahoehoe lava flows. Open mixed shrubland occurs on 'a'a lava flows from about the 400-foot elevation contour upwards, while closed mixed shrubland is found from about the 640-foot elevation, generally on more weathered pahoehoe and 'a'a substrates.

1. Fountain Grass Grassland

The general physiognomy of this vegetation type is of low tufts of grass with scattered shrubs and, occasionally, a few trees. Fountain grass (Pennisetum setaceum), a perennial species, from one to four feet tall, and native to northern Africa, is the dominant plant cover. On some rocky outcroppings, pili grass (Heteropogon contortus) and Natal redtop grass (Rhynchelytrum repens) may become locally common. Native lowland shrubs scattered throughout the grassland include 'uhaloa (Waltheria indica), the native caper or maiapilo (Capparis sandwichiana), 'ilima (Sida fallax), and a'ali'i (Dodonaea viscosa). Shrubs of noni (Morinda citrifolia), a plant of very early Polynesian introduction, is also occasional in this vegetation type. Introduced or alien shrubs include koa-haole or ekoa

(Leucaena leucocephala), Christmas berry (Schinus terebinthifolius), klu (Acacia farnesiana), indigo (Indigorfera sufruticosa), and pluchea (Pluchea symphytifolia). The shrubs are generally of low stature, from one to six feet tall. A few trees of kiawe (Prosopis pallida) are found in some swale areas, adjacent to the highway, on the southern half of the site.

The amount of plant cover within this vegetation type is variable. Along the lower elevation portions of the site, closer to the Queen Kaahumanu Highway, the plant cover may be 30 to 50 percent; this portion of the site receives the least amount of rainfall. Along the "wetter" mauka limits of the grasssland, plant cover becomes dense, about 80 to 90 percent, and shrubs become more numerous.

2. Open Mixed Shrubland

This vegetation type occurs at about the 400-foot elevation of the petition area. Shrub cover is open, that is less than 60 percent of total ground area. The shrubs are from 6 to 15 feet tall and the trees are from 15 to 25 feet tall. The shrub cover is a mix of native and introduced species, with the native species locally abundant in certain areas.

Native woody components common in this vegetation type are lama (Diospyros sandwicensis), alahe'e (Canthium odoratum), kolomona (Senna gaudichaudii), naio, mamane (Sophora chrysophylla), a'ali'i and maiapilo. A few scattered trees of 'ohi'a 'ohe (Erythrina sandwicensis) are occasionally encountered. Somewhat dense tangles of huehue vines (Cocculus tribolus) are frequently found, usually sprawling over low shrubs and on the ground.

Introduced or alien shrubs which are common components in the open mixed shrubland are Christmas berry and koa-haole. Trees of silk oak (Grevillea robusta), a native of Queensland, Australia, are scattered throughout this vegetation type. On the southern half of the petition area, near a rock wall, is a grove of large, old mango trees (Mangifera indica)

The rough, clinkery 'a'a flow areas in this vegetation type are often dominated by a lama-alahe'e-naio association Other native shrubs and trees are also more frequent on these 'a'a flows. One plant of 'aiea (Nothocestrum breviflorum), a Category 1 candidate endangered species, is found on the 'a'a flow on the northern half of the property (Figure 3). Only one tree was identified during the survey. This species is known to inhabit dry to mesic forest areas, and will reach 15 to 25 feet in height. It has fragrant yellowish-green flowers and is endemic to the Island of Hawaii.

3. Closed Mixed Shrubland

In this vegetation type, the shrub cover becomes closed, greater than 60 percent, often with Christmas berry forming dense thickets, 12 to 18 feet tall. Trees also become more numerous, sometimes forming small stands. Some native woody elements common in the open mixed shrubland become uncommon to rare here.

On areas with 'a'a and rocky pahoehoe outcroppings or knolls, native trees and shrubs such as lama, alahe'e, and mamane are common. The rocks are often covered by a thin layer of moss, due to the somewhat greater rainfall on this portion of the project site. In some places, there may be a dense undergrowth of air plant (Kalanchoe pinnata). A few small stands of kukui (Aleurites moluccana), 20 to 30 feet tall are also found.

In the closed mixed shrubland, 'ohe trees (Reynoldsia sandwicensis) become occasional, while silk oak becomes common to locally abundant, often forming small stands of trees. Among the native elements which become uncommon to rare in the closed shrubland are Bidens micrantha ssp. ctenophylla, kolomona, naio, and a'ali'i.

Probable Impacts

Prior to conducting field studies, Char & Associates undertook a literature search to prepare a list of threatened and endangered, as well as rare and vulnerable plants, which might occur on the petition area. Based on this literature search, an officially listed endangered species, the uhiuhi (Caesalpinia kavaiensis) is found on the adjacent Pu'uhonua Estates Subdivision, at about the 720-foot elevation. In addition a Category 1 candidate endangered species, the 'aiea (Nothocestrum breviflorum) is found on the adjacent (north) Kau ahupua'a at about the 480-foot elevation (Figure 3).

Two other species, Bidens micrantha ssp ctenophylla, and the hala pepe (Pleomele hawaiiensis), are known in the general area. Bidens micrantha ssp. ctenophylla occurs scattered throughout the petition area in the two shrubland vegetation types. On some of the 'a'a outcroppings on the southern half of the property, it is locally common, occurring in large numbers.

Given the limited time spent on the project site and the area covered during field studies, it is possible that there may be a few more trees of 'aiea on the petition area, and, perhaps, uhiuhi. The closed mixed shrubland may also harbor endangered or rare species because the vegetation is dense and visibility is limited.

If these areas are not surveyed at a more intensive level, the identification of existing plants that are endangered (listed, candidate, proposed) will not occur. Urbanization could then inadvertently destroy some of these plants.

Mitigation Measures

Prior to development of the petition area, it will be necessary to conduct more intensive botanical surveys, particularly in the two mixed shrubland vegetation types, where the largest number and diversity of native species occur. The Petitioner recommends that the Land Use Commission attach the following condition to its approval:

The developer and/or landowner of the subject property shall conduct more intensive botanical surveys. The Developer and/or landowner shall prepare and agree to execute a mitigation plan which meets the requirements of the Department of Land and Natural Resources prior to the developer and/or landowner applying for county building permits if county rezoning is not required. The Department of Land and Natural Resources must approve the plan and a copy of the approved plan must be submitted to the Land Use Commission prior to the developer and/or landowner applying for county zoning or prior to the developer and/or landowner applying for county building permits if county rezoning is not required.

If areas with endangered or rare and vulnerable plants are found, it may be necessary and/or desirable to establish a nature study park (or parks) around these areas as has

already been proposed for the State Housing and Finance Development Corporation's Villages of La'i'opua (formerly known as the Kealakehe Planned Community).

Landscaping with native plants already found on the petition area and surrounding areas is another mitigation measure which should be considered. Suitable native material include 'ohe, Bidens, uhiuhi, mamane, kolomona, alahe'e, wiliwili, 'ulei, maiapilo, etc. These natives are attractive and are adapted to the local environmental conditions, thus requiring less water and little soil, if any.

4.11 Fauna

Phillip Bruner conducted an avifauna and feral mammal survey of the petition area in September and October 1992. The results of this survey are summarized below and the full report is attached to the FEIS as Appendix D.

Affected Environment

No endemic (native) birds were observed on the survey. The only species which potentially could occur in petition area are the Short-eared Owl or Pueo (Asio flammeus sandwichensis) and the endangered Hawaiian Hawk or 'Io (Buteo solitarius). These two birds forage in open grasslands as well as forests and agricultural fields.

The only migratory species recorded on the survey was the Pacific Golden Plover (Pluvialis fulva). A total of 14 plover were counted on the survey. Open patches in the grassland and lava flows at lower elevations provide usable habitat for this species.

Because of the absence of wetlands and the accessibility of predators to the petition area, no waterbirds or seabirds were found in the petition area.

Seventeen (17) species of exotic birds were recorded during the field survey. Some of the more abundant species included the Rock Dove (Columba livia), the Zebra Dove (Geopelia striata), the Warbling Silverbill (Lonchura malabarica), the Japanese White-eye (Zosterops japonicus) and the Nutmeg Mannikin (Lonchura punctulata).

A total of six Small Indian Mongoose (Herpestes auropunctatus) were observed. Skeletal remains of feral goats were noted in several lava tubes. Neither live goats nor fresh scats were found. Pig tracks were seen and residents whose lands adjoin the eastern forested sections of the petition area reported that pigs were common in the area.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinereus) are relatively limited, but the species does occur on the island of Hawaii. Three evenings were devoted to searching for this species, with no sightings.

Probable Impacts

No particularly special or unique birds, including threatened or endangered species, was discovered in the petition area during the survey. Dry grasslands, open lava flows and mixed exotic and native second growth dry forest habitats are abundant at this elevation in West Hawaii. Consequently, it is anticipated that the urbanization of the petition area will not have any adverse impacts to avifauna or feral mammals.

4.12 Historic Resources

The Petitioner has worked closely with the Department of Land and Natural Resources, Historic Preservation Division ("DLNR-SHPD"), in preparing a scope of work to provide adequate information about the historic resources within the petition area and to meet Chapter 343, HRS requirements. A memorandum from Don Hibbard, State Historic Preservation Administrator, to Harold Masumoto, Director of the Office of State Planning documenting the scope of work is attached as Appendix E. In summary, it directs the Petitioner to conduct a background synthesis for the petition area, which would include prior archaeological and historical and some new historical work. The synthesis survey would indicate areas which have undergone archaeological survey, noting which surveys were adequate. It would also predict site patterns in unsurveyed portions of the petition area.

Based on this memorandum, the project archaeologist, Paul H. Rosendahl, Ph.D., Inc. (PHRI), prepared the archaeological assessment study for the petition area. The complete assessment study is attached as Appendix F, and is summarized below. As required, PHRI also conducted an inventory survey for the 500-acre university site located in the northeastern section of the petition area. The complete inventory survey is attached as Appendix G, and is also summarized below.

Affected Environment

Figure 13 shows all historic sites that have been identified within the petition area, including work done prior to the preparation of the FEIS. A summary of findings of the interim inventory survey and the assessment study, including a brief discussion of sites identified during the two studies, follows.

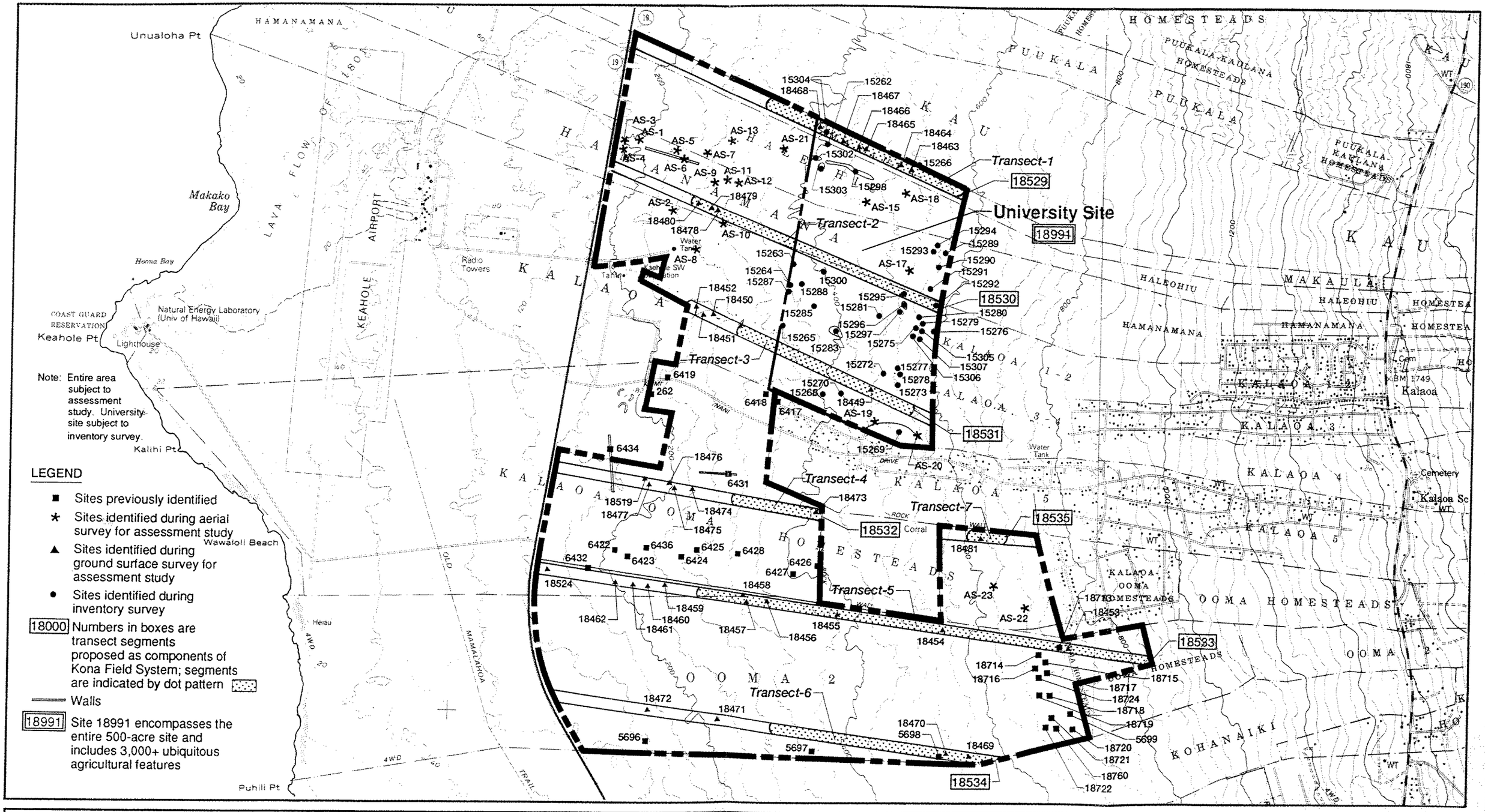
Archaeological Assessment Study

The basic purpose of the assessment study was to enable predictions concerning the probable nature and distribution of archaeological resources within the petition area. The study was completed as a synthesis of literature review, aerial reconnaissance and a partial intensive ground surface survey of portions of the petition area (about 11.5 percent of the petition area).

Background research indicates that 39 previous archaeological investigations have been conducted within the "study area" (the archaeological assessment study area is bounded by the Land of Kau to the north, Mamalahoa Highway to the east, the Land of Kohana-iki to the south and the Pacific Ocean to the west; the study area is to be differentiated from the petition area). Most of the archaeological sites in the study area have been found close to the coast between the coastline and the 20-foot elevation. This is not surprising, considering the availability of the rich marine resources and the ruggedness of the surrounding terrain. Site density drops off between the 20- to 40-foot contours, but this area was still moderately occupied and was no doubt associated with the adjacent coastal strip.

Inland from the coastal strip, to somewhere near the 400-foot elevation, site density remains generally low. This area is typically covered by weathered and unvegetated pahoehoe and 'a'a lava flows, and is situated below the agricultural uplands, the primary resource procurement zones, so a lack of substantial evidence of occupation is to be expected.





Historic Sites

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Source: PHRI, Inc., 1993

Figure: 13

Feet 0 1000 2000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

In the uplands, between the 400-foot contour and Mamalahoa Highway, remnants of agriculture have been recorded; e.g., rock mounds, modified outcrops and terraces. Whether these represent isolated agricultural plots, or are part of a larger system such as the Kona Field System, has not yet been determined. One of the problems with determining the extent of these agricultural features is that few archaeological investigations have been conducted in these areas; only 14 studies have been conducted above the 400-foot contour within the study area.

1. Chronological framework. The establishment of a chronological framework was a primary goal for the assessment study, because it would provide a context in which to view general settlement patterns. Based on the analysis contained in the assessment study, there is ample evidence to support the prehistoric use of North Kona, with a general sequence of early occupation of favorable coastal areas followed by later expansion into more marginal zones and upland areas. Initial occupation of the northern end of North Kona occurred at Anaeho'omalu about AD 900. As the population increased, it probably expanded to certain more favorable areas in the northern end of North Kona such as Kiholo, Kukio and Kaupulehu. It was not until much later, about AD 1400 - 1600, that settlement of the coastal areas at Kohana-iki and 'O'oma 2nd and expansion into upland agricultural areas (including the petition area) occurred.

2. Settlement Patterns. If the underlying structure of the ahupua'a system is based on the exploitation of different environmental zones, then a closer examination of these zones should allow predictions to be made about the type of activities that occurred within each zone. Several researchers have attempted to clarify the extent and nature of the use of the various zones, including Rosendahl, Davis and Cordy. Each of these researchers have developed models of settlement patterns. Although these models vary in detail, they describe similar findings, identifying three zones within the study area: the Coastal Zone; the Barren Zone; and, the Upland Zone.

The Coastal Zone. The Coastal Zone generally consists of barren, rocky shorelines, isolated bays with coralline beach formations, inland ponds, brackish basal water, fresh water springs and strand vegetation occurring in limited soil deposits. It has been variously described as running from the shoreline to approximately the 20- or 30-foot contour. It was thought to have supported limited permanent habitations and features which include trails, caves, enclosures, platforms, pools, cairns, C-shaped structures and pavings.

The Barren Zone. The Barren Zone begins at about the 20- to 30-foot contour and extends upland to about the 425-foot contour. It is characterized by bare, non-disintegrated lavas, arid conditions, limited dry scrub vegetation, with little or no soil development. The use of this zone appears to have been associated with mauka-makai pedestrian travel, with sites that consist mainly of trails, a few C-shaped structures and caves near the trails, and cairns that may have been associated with the trails. With some exceptions, habitation sites contained only shallow deposits and appeared to be temporary in nature.

The Upland Zone. The Upland Zone starts at about the 425-foot contour and continues mauka. This zone consists of moderate soil development and adequate rainfall. There were indications that this was the lower margin of an upland agricultural system including house enclosures, stone platforms, high-stacked ahu, stone walls and the numerous stone mounds suggesting that the local crop was largely sweet potato.

The petition area does not contain any portion of the Coastal Zone, but does contain portions of the Barren and Upland Zones. It was anticipated that the Barren Zone would extend from the Queen Kaahumanu Highway along the western (makai) boundary of the petition area (about 80- to 120-foot elevation), inland to approximately the 400-foot elevation. The Upland Zone was expected to begin at approximately the 450-foot contour and continue inland to the easternmost edge of the petition area (about the 840-foot elevation) and beyond.

Given the distribution of sites encountered within the study area during other surveys at the same elevations, it was expected that the Upland Zone portion of the project area would exhibit a nearly continuous distribution of sites and features related to agriculture, and possibly, temporary habitation.

The data from the assessment survey make several important contributions to the study of prehistoric development in the North Kona area. First, the report provides a synthesis and refinement of previous settlement pattern models for the North Kona area and presents a new single model. A test of this model against dat from previously unsurveyed areas indicated a high degree of correspondence between the predicted distribution patterns and the field data. Second the report provides an updated and accurate database of site and feature information from the study area. Third, the combination of the survey coverage map and the general significance assessments and recommended treatments provided for the newly identified sites, offer valuable guidelines for future work within the project area and the larger study area.

Sites identified during the ground surface survey were not recorded to inventory level; none of the archaeological remains identified was mapped or extensively recorded, and no subsurface testing was undertaken. The significance of the archaeological remains were, however, tentatively assessed in terms of federal and state criteria.

Of the 42 sites that were newly identified during the ground surface survey, all were tentatively assessed as significant for information value. In addition, seven sites (Sites 18449, 18453, 18458, 18467, 18469, 18470, and 18473) were considered excellent examples of site types. These same seven sites were also tentatively assessed as significant for cultural value. Further data collection is tentatively recommended for all 42 newly identified sites.

Preservation with interpretive development is tentatively recommended for Sites 18449, 18453, 18458, 18469 and 18470, and preservation "as is" is tentatively recommended for Sites 18467 and 18473.

For the sites with apparent cultural significance, it is possible that further examination will result in a final recommendation of either preservation "as is", or preservation with interpretive development.

Archaeological Inventory Survey

The archaeological inventory survey was conducted by PHRI in December 1992 and January 1993 and covered 500 acres in the northeast corner of the petition area identified as the site for the future West Hawaii campus of the University of Hawaii. The inventory survey is summarized below and attached as Appendix G.

This portion of the petition area has previously been the subject of a reconnaissance survey by Davis (1977) and an archaeological assessment by Henry and Graves (1993),

which is discussed above. Neither of these projects met the inventory level standards of DLNR-SHPD, as they did not provide complete coverage of the area.

During the inventory survey, 43 sites consisting of 388+ features were identified within the 500-acre university site. The approximate locations of these sites are shown in Figure 13. The sites consist of both single and multiple components, and their physical condition ranges from poor to good. Formal feature types noted include modified outcrop, C-shape, enclosure, terrace, platform, alignment, steppingstone, trail, cairn, mound, cupboard, modified lava tube, utilized lava tube, wall, pahoehoe excavation, hearth, modified depression, stacked rock, filled crack, petroglyph, pavement, cleared area, ash concentration and midden scatter. Functional feature types present include temporary and longer-duration habitation, refuge, agriculture, possible burial, ceremonial, indeterminate, recreation, quarry, transportation, marker, and other (including storage, water catchment, and lamp holder).

As part of the inventory survey, four subsurface test units, totaling 3.7 square meters, were excavated at three sites (15269, 15276, and 15292) and placing four trowel tests at Site 15276. Based on these subsurface test units some general observations can be made in the areas of age determinations, portable artifacts, and ecofactual remains.

Age Determinations. The results of the age determination analysis span 463 years, extending from AD 1487 to the present (AD = 1950). Based on this analysis, initial occupation of the project area occurred during the prehistoric period, possibly beginning as early as AD 1487.

Portable Artifacts. In general, the artifact assemblage encountered during the current investigation suggests that a fairly narrow range of prehistoric activities was carried out within the project area. Eating was indicated by picks found and woodworking, such as carving of figurines or manufacturing canoes, are suggested by the discovery of and adze fragment and coral abrader, although the abrader may have been used for a variety of abrading tasks.

Ecofactual Remains. The results of the ecofactual analysis indicate that subsistence patterns in the project area included the collection and consumption of a small variety of shell fish, ranging from several taxa of marine gastropods to bivalves and sea urchins. In general, the marine invertebrates included in the assemblage are common inhabitants of the shorelines, shallow-water areas, solution benches and fringing reefs of the windward islands of the Hawaiian chain and would have been easily accessible to local populations.

General significance assessments and recommended general treatments. Sites identified during the archaeological assessment study were not recorded to inventory level. The results developed by PHRI are meant to serve as a baseline study for future archaeological studies within the petition area. The significance of archaeological remains within the petition area were, however, tentatively assessed in terms of federal and state criteria.

Based on this analysis, all 42 sites identified during the ground survey were assessed as significant for information value. In addition, seven sites (Sites 18449, 18453, 18458, 18467, 18469, 18470, and 18473) were considered excellent examples of the site types. Seven sites were tentatively assessed as significant for cultural value. These were sites 18449 (trail), 18453 (house platform), 18458 (trail), 18467 (refuge cave), 18469 (trail), 18470 (complex containing petroglyphs), and 18473 (complex containing a burial tube and petroglyphs). Further data collection is tentatively recommended for all 42 newly identified sites. Preservation with interpretive development is tentatively recommended

for Sites 18449, 18454, 18458, 18469, and 18470, and preservation "as is" is recommended for Sites 18467 and 18473.

For all sites with apparent cultural significance, it is possible that further examination will result in a final recommendation of either preservation "as is", or preservation with interpretive development. Tentative significance assessments and recommended general treatments for all newly identified sites and features are summarized in Table 8.

Table 8
Summary of Tentative General Significance Assessments and Recommended General Treatments

SIHP[1] Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
18450	+	-	-	-	+	-	-	-
18451	+	-	-	-	+	-	-	-
18452	+	-	-	-	+	-	-	-
18454	+	-	-	-	+	-	-	-
18455	+	-	-	-	+	-	-	-
18456	+	-	-	-	+	-	-	-
18457	+	-	-	-	+	-	-	-
18459	+	-	-	-	+	-	-	-
18460	+	-	-	-	+	-	-	-
18461	+	-	-	-	+	-	-	-
18462	+	-	-	-	+	-	-	-
18463	+	-	-	-	+	-	-	-
18464	+	-	-	-	+	-	-	-
18465	+	-	-	-	+	-	-	-
18466	+	-	-	-	+	-	-	-
18468	+	-	-	-	+	-	-	-
18471	+	-	-	-	+	-	-	-
18472	+	-	-	-	+	-	-	-
18474	+	-	-	-	+	-	-	-
18475	+	-	-	-	+	-	-	-
18476	+	-	-	-	+	-	-	-
18477	+	-	-	-	+	-	-	-
18478	+	-	-	-	+	-	-	-
18479	+	-	-	-	+	-	-	-
18480	+	-	-	-	+	-	-	-
18481	+	-	-	-	+	-	-	-
18519	+	-	-	-	+	-	-	-
18524	+	-	-	-	+	-	-	-
18529	+	-	-	-	+	-	-	-
18530	+	-	-	-	+	-	-	-
18531	+	-	-	-	+	-	-	-
18532	+	-	-	-	+	-	-	-
18533	+	-	-	-	+	-	-	-
18534	+	-	-	-	+	-	-	-
18535	+	-	-	-	+	-	-	-
Sub Total	**35**	**0**	**0**	**0**	**35**	**0**	**0**	**0**
18449	+	-	+	+	+	-	+	-
18458	+	-	+	+	+	-	+	-
18469	+	-	+	+	+	-	+	-
18470	+	-	+	+	+	-	+	-
Sub Total	**4**	**0**	**4**	**4**	**4**	**0**	**4**	**0**
18467	+	-	+	+	+	-	-	+
18473	+	-	+	+	+	-	-	+
Sub Total	**2**	**0**	**2**	**2**	**2**	**0**	**0**	**2**
18453	+	-	+	+	+	-	+	-
Sub Total	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**0**
Total	**42**	**0**	**7**	**7**	**42**	**0**	**5**	**2**

Table 8
Summary of Tentative General Significance Assessments and Recommended General Treatments (continued)

[1] *State inventory of historic places number*

General Significance Categories:

A — *Important for information content, further data collection necessary (CRM value mode assessment = scientific research value)*

X — *Important for information content, no further data collection necessary (CRM value mode assessment = scientific research value)*

B — *Excellent example of site type at local, regional, island, state, or national level (CRM value mode assessment = interpretive value)*

C — *Culturally significant (CRM value mode assessment = cultural value)*

Recommended General Treatments:

FDC — *Further data collection necessary (further survey and testing, and possibly subsequent data recovery/mitigation excavations)*

NFW — *No further work of any kind necessary; sufficient data collected, archaeological clearance recommended; no preservation potential (possible inclusion into landscaping suggested for consideration)*

PID — *Preservation with some level of interpretive development recommended (including appropriate related data recovery work) and*

PAI — *Preservation "as is," with no further work (and possible inclusion into landscaping), or minimal further data collection necessary*

Source: Paul H. Rosendahl, Ph.D., Inc, July 1993

Based on federal and state criteria, 34 of the 43 sites identified during the inventory survey are assessed as significant solely for information content. Nineteen of the 34 sites require no further work. These 19 sites lack cultural deposits and portable remains; data collected from them during the survey is considered sufficient. Preservation of the sites is not essential, although some sites could be considered for inclusion into development landscaping. Fifteen of the 34 sites are recommended for further data collection.

Three of the nine remaining sites are assessed as significant for information content and provisionally for cultural value, and are recommended for further data collection and possible preservation "as is." Of the three sites, two (Sites 15276 and 15295) will require more detailed recording as well as burial testing. The remaining site (Site 15292), also a potential burial, was not tested because it may be outside the petition area. This site should be accurately located prior to further data collection.

Three sites are assessed as significant for information content and as excellent examples of site types. Further data collection and preservation with interpretive development are recommended for these sites.

Two sites are evaluated as significant for information content and as excellent example of site types, and are recommended for preservation with some level of interpretive development. No further archaeological work is recommended at present. The sites have been mapped, described, photographed, and their locations have been plotted. Neither of the sites contain cultural deposits suitable for excavation.

The final site is evaluated as significant for information content and as culturally significant due to the presence of four known human burials (Site 15298). Preservation "as is" as well as further data collection is recommended. A summary of general significance assessments and general treatments is show in Table 9.

Table 9
Summary of General Significance Assessments and Recommended General Treatments

SIHP[1] Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
15263	-	+	-	-	-	+	-	-
15264	-	+	-	-	-	+	-	-
15265	-	+	-	-	-	+	-	-
15266	-	+	-	-	-	+	-	-
15272	-	+	-	-	-	+	-	-
15273	-	+	-	-	-	+	-	-
15275	-	+	-	-	-	+	-	-
15279	-	+	-	-	-	+	-	-
15280	-	+	-	-	-	+	-	-
15287	-	+	-	-	-	+	-	-
15288	-	+	-	-	-	+	-	-
15289	-	+	-	-	-	+	-	-
15294	-	+	-	-	-	+	-	-
15299	-	+	-	-	-	+	-	-
15303	-	+	-	-	-	+	-	-
15305	-	+	-	-	-	+	-	-
15306	-	+	-	-	-	+	-	-
15307	-	+	-	-	-	+	-	-
18891	-	+	-	-	-	+	-	-
Subtotal:	0	19	0	0	0	19	0	0
15262	+	-	-	-	+	-	-	-
15268	+	-	-	-	+	-	-	-
15269	+	-	-	-	+	-	-	-
15270	+	-	-	-	+	-	-	-
15277	+	-	-	-	+	-	-	-
15278	+	-	-	-	+	-	-	-
15282	+	-	-	-	+	-	-	-
15283	+	-	-	-	+	-	-	-
15284	+	-	-	-	+	-	-	-
15286	+	-	-	-	+	-	-	-
15290	+	-	-	-	+	-	-	-
15291	+	-	-	-	+	-	-	-
15293	+	-	-	-	+	-	-	-
15297	+	-	-	-	+	-	-	-
15300	+	-	-	-	+	-	-	-
Subtotal:	15	0	0	0	15	0	0	0
15276	+	-	-	*	+	-	-	*
15292	+	-	-	*	+	-	-	*
15295	+	-	-	*	+	-	-	*
Subtotal:	3	0	0	3	3	0	0	3

Table 9
Summary of General Significance Assessments and Recommended General Treatments (continued)

SIHP[1] Site Number	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
15285	+	-	+	-	+	-	+	-
15296	+	-	+	-	+	-	+	-
15302	+	-	+	-	+	-	+	-
Subtotal:	3	0	3	0	3	0	3	0
15281	-	+	+	-	-	+	+	-
15304	-	+	+	-	-	+	+	-
Subtotal:	0	2	2	0	0	2	2	0
15298	+	-	-	+	+	-	-	+
Subtotal:	1	0	0	1	1	0	0	1
Total:	22	21	5	4	22	21	5	4

[1] ***State inventory of historic places number***

* ***Provisional assessment pending results of further data collection***

General Significance Categories:

A *Important for information content, further data collection necessary (CRM value mode assessment = scientific research value)*

X *Important for information content, no further data collection necessary (CRM value mode assessment = scientific research value)*

B *Excellent example of site type at local, regional, island, state, or national level (CRM value mode assessment = interpretive value)* *C=Culturally significant (CRM value mode assessment = cultural value)*

Recommended General Treatments:

FDC *Further data collection necessary (further survey and testing, and possibly subsequent data recovery/mitigation excavations)*

NFW *No further work of any kind necessary; sufficient data collected, archaeological clearance recommended; no preservation potential (possible inclusion into landscaping suggested for consideration)*

PID *Preservation with some level of interpretive development recommended (including appropriate related data recovery work) and*

PAI *Preservation "as is," with no further work (and possible inclusion into landscaping), or minimal further data collection necessary*

Source: Paul H. Rosendahl, Ph.D., Inc., July 1993

Probable Impacts

Because only 500 acres of the approximate 2,640-acre petition area have been subjected to an inventory survey, and because site plans for the petition area have not yet been determined, it is difficult to assess the full impact of the reclassification of the petition area on historic resources.

Both the assessment study and the inventory survey report have identified numerous sites within the petition area which indicate the area was frequented by early Hawaiians for a

wide variety of uses including habitation, agriculture, ceremonial and transportation. Identified sites are scattered throughout the petition area, although their density seems to be greater at higher elevations. Some sites that have been recommended for preservation "as is" or for preservation with interpretive development are located at lower elevations.

It is clear as a result of the assessment study, that many more sites would be predicted within the petition area that have not yet been identified. Reclassification of the petition area and its subsequent development could threaten such sites unless adequate measures are taken to identify all sites within the petition area and to preserve those sites worthy of protection after identification.

Mitigation Measures

As described above, only the 500-acre portion of the petition area identified as the university has been the subject of an inventory survey. Just over ten percent (11.5) of the petition area has been subjected to an intensive ground surface survey conducted as part of the assessment study (some portions of the intensive ground survey were also covered by the inventory survey). For these reasons, it will be necessary to complete an inventory survey for the entire petition area prior to the initiation of any future development.

The DLNR-SHPD is cognizant of this requirement, and suggested in its memorandum of July 27, 1992 that as a condition to any approved petition:

> "1. Each prospective future developer shall have an archaeological inventory survey conducted by a professional archaeologist prior to submitting an application to the County of Hawaii for rezoning. The findings of this survey shall be submitted to the State's Historic Preservation Division in report format for adequacy review. This Division must verify that the survey report is acceptable, must approve significance evaluations, and must approve mitigation commitments for significant historic sites.
>
> 2. If significant historic sites are present, then each prospective future developer shall agree to develop and execute a detailed historic preservation mitigation plan -- prior to any ground altering construction in the area. The State's Historic Preservation Division must approve this plan, and that Division must verify, in writing to the Land Use Commission that the plan has been successfully executed."

Some of the sites that have been identified are burials or potential burials. PHRI has recommended preservation "as is" is for all burials identified in the petition area. If disinterments are necessary, the procedures of Chapter 6E, Hawaii Revised Statutes, as amended, shall be followed. DLNR-SHPD would be notified and would contact the Big Island Burial Council. Future developers, the DLNR and the Big Island Burial Council would then work out a burial treatment plan.

4.13 Visual Resources

Affected Environment

The existing visual character of the petition area can be described from two perspectives; the first includes visual resources accessible from public viewpoints outside of the petition area, the second includes visual resources which can be experienced from within the

petition area. The accompanying Figure 14 summarizes the major visual resources described below.

Major Public Viewpoints (off-site)

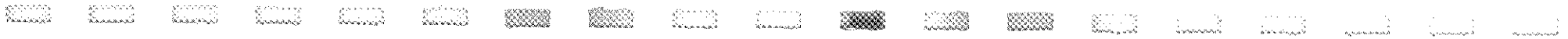
Three public viewpoints have been identified: (1) mauka views of the petition area along Queen Kaahumanu Highway, (2) makai views from Mamalahoa Highway, and (3) mauka views from Keahole Airport. The most significant views of the site are those experienced from Keahole Airport and along Queen Kaahumanu Highway. Views of the petition area from Mamalahoa Highway are transitory at best, lasting less than a second, occurring during breaks in vegetation at streets and private driveways.

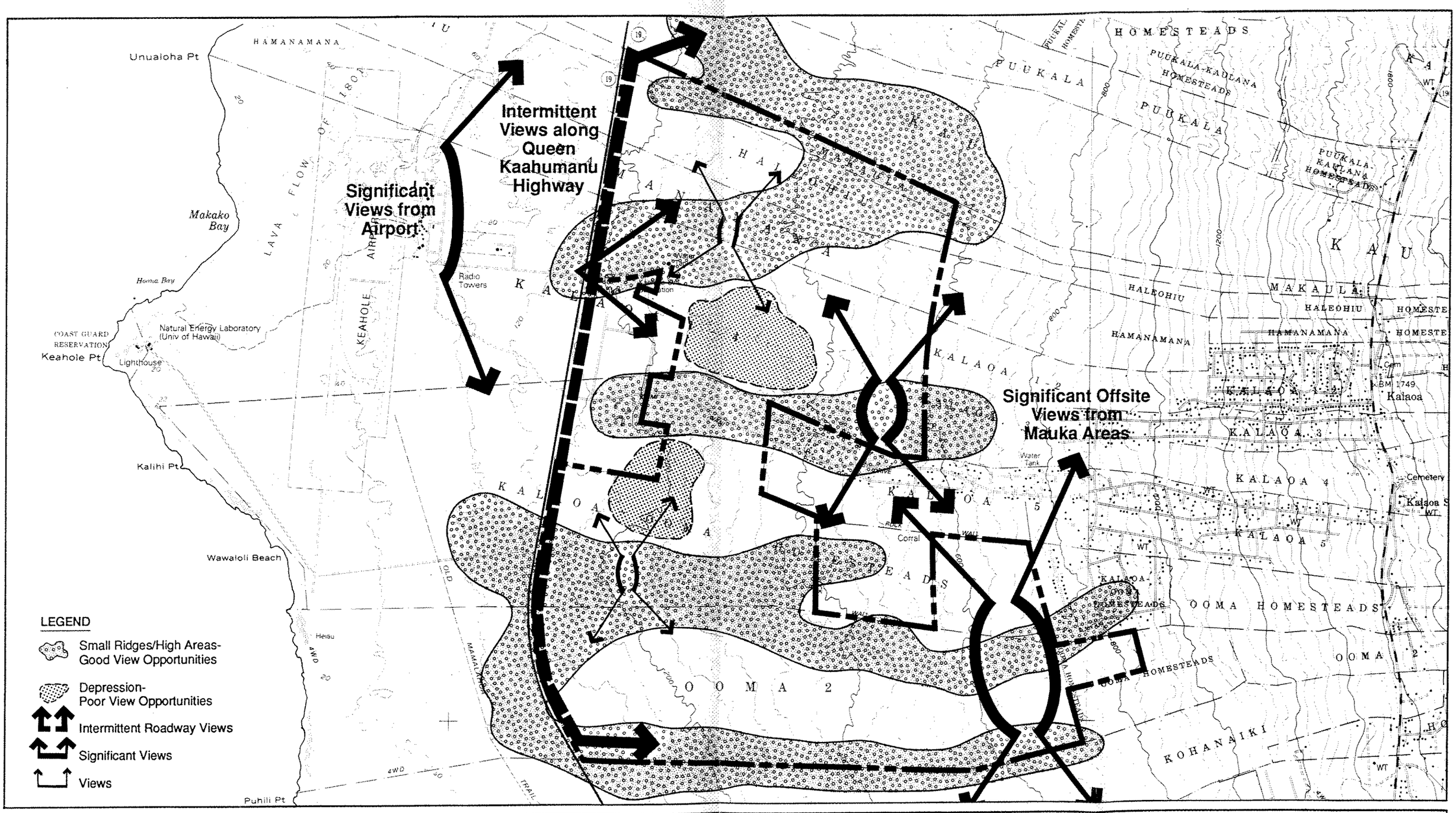
The most expansive views of the site can be experienced from Keahole Airport and the Keahole Airport Access Road. On a clear day, a view of the western slope of Hualalai (including the petition area and development within the vicinity of Mamalahoa Highway and Kaimi Nani Drive) can be experienced from the airport and from Keahole Airport Access Road (driving mauka toward the petition area). Because of the site's proximity and visibility from Keahole Airport (the gateway to West Hawaii), special attention must be given to the type of development and the identification of appropriate mitigation measures within the petition area to minimize adverse visual impacts to the existing viewshed. Figure 14 depicts the orientation of these views and those described below.

Views of the site from Queen Kaahumanu Highway are limited by: (1) existing topographical features and land uses which restrict continuous views and permit only intermittent views of the property, and, (2) the contrast between sparsely vegetated lava fields and the Pacific Ocean which tends to draw one's attention towards the makai viewshed. Nevertheless, although limited, views of the petition area from points along Queen Kaahumanu Highway are available and described below.

Beginning at Honokohau Harbor and proceeding in a northerly direction along Queen Kaahumanu Highway, views of the site are impeded by the natural topography, berms, and existing vegetation mauka of the highway. At a point approximately 2.0 miles north of Honokohau Harbor, mauka views are present from the roadway. However, views of the site are blocked by a lava ridge which runs along the edge of the southern boundary of the petition area. Once past this ridge, there are intermittent views of the site in areas where the highway is at grade with the topography mauka of the roadway. The best views of the site occur from a point approximately 3.3 miles north of the harbor to a point approximately 5.5 miles north of the harbor. As is characteristic of most of the mauka views along Queen Kaahumanu Highway, views along this 2.2 mile section of the highway are also interrupted by berms and vegetation mauka of the highway. In addition, the HELCO power plant and Keahole Agricultural Park visually impede views of the site from Queen Kaahumanu Highway.

Travelling in a southerly direction along Queen Kaahumanu Highway, intermittent views of the site are present from 0.2 miles to 2.5 miles from the Keahole airport. Again, the Keahole Agricultural Park, HELCO power plant, berms and natural topographic features serve as major impediments to views of the petition area.





Visual Resources

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Figure: 14

Feet 0 1000 2000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

Views from Within the Site

Hualalai (mauka) and the Pacific Ocean (makai) serve as the two major view objects which are visible from within the petition area. These two geographic features serve as major elements in the composition of a mauka/makai viewshed experienced from within the petition area. The expansiveness of views within these viewsheds is determined by one's location within the petition area. The most expansive views can be experienced from the steeper, higher elevations, most notably at areas above the 500-foot elevation. At elevations below 450 feet in the northern portion of the petition area, makai views are somewhat restricted by the HELCO power plant, the 0.5-million gallon water tank, and the Keahole Agricultural Park. In addition, localized ridges, outcroppings and depressions play a major role in affecting the quality of views at lower elevations throughout the site. These ridges and depression are identified in Figure 14.

Probable Impacts

Future urbanization of the petition area will alter the landscape from its predominantly natural state to one of urban uses, thereby reducing irretrievably, the natural open space in the region. Although existing public views of the petition area are infrequent and transitory, those that are available will be altered.

In addition, the development of the petition area will provide new residents, workers and visitors with views of the West Hawaii coastal region and mauka views of Mt. Hualalai.

Cumulative Impacts

As discussed in Section 4.8, HELCO is planning to expand the capacity of the Keahole Generating Station from 30 mW to 86 mW. As a result, the physical plant at the generating station will be significantly increased, including the construction of a 104-foot emission exhaust stack (Thompson, February, 1993). The visual impacts of the emission stack are not attributable to the urbanization of the petition area. The proposed stack will, however, adversely affect views from within the petition area.

Mitigation Measures

Adverse visual impacts can be mitigated by adopting prudent site planning criteria (low building heights, appropriate roof materials, generous setback and building bulk standards) and landscape design standards to provide adequate buffers and screening.

4.14 Air Quality

Affected Environment

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. Within the region of the project area, the presence of Mauna Kea and Hualalai affect local wind patterns, and hence local air quality (B.D. Neal & Associates, 1990).

Present air quality in the petition area is mostly affected by air pollutants from natural, industrial, agricultural and or/vehicular sources. Natural sources of air pollution which may affect the area but cannot be quantified accurately, include the ocean (sea spray), plants (aero-allergens), wind blown dust and volcanoes. Of these natural sources of pollution, volcanoes are the most significant. This is especially so since the latest eruption phase of the Kilauea volcano, which began in 1983. Emissions from this

eruption can be seen in the form of volcanic haze (vog) which persistently hangs over the area (ibid).

The major industrial sources of air pollution in the vicinity include the Keahole Generating Station and the Kailua Landfill, operated by the County of Hawaii. Emissions from the landfill consist mainly of fugitive dust from heavy equipment operations, smoke and noxious fumes from underground fires, which has been the subject of numerous complaints from people residing and working nearby. Because the petition area is situated so far away from the landfill, it is not expected to be adversely impacted by emissions from the landfill (ibid).

HELCO has operated an air quality monitoring station approximately 0.8 miles southeast of Keahole Generating Station. Based on the results of this monitoring, existing ambient air quality within the vicinity of the generating station meets both State of Hawaii and Federal air quality standards (CH2M Hill, 1992).

Queen Kaahumanu Highway, which borders the petition area on the west, is the region's major arterial roadway, and as a result, contributes exhaust from motor vehicles traversing Queen Kaahumanu Highway. It is likely that elevated concentrations of exhaust are confined to limited areas near intersections where and when traffic congestion occurs during poor dispersion conditions (B.D. Neal & Associates, 1990).

Probable Impacts

Impacts to air quality as the result of the proposed project can be differentiated between short-term and long-term impacts.

Short-term Impacts. Short-term direct and indirect impacts on air quality could potentially occur due to construction. There are two potential types of air pollution emissions which could directly result in short-term air quality impacts during construction: (1) fugitive dust from vehicle movement and site excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there could also be short-term impacts from slow-moving construction equipment traveling to and from the project site and from a temporary increase in local traffic caused by commuting construction workers.

Long-term Impacts. After construction is completed, use of the petition area will result in increased motor vehicle traffic on nearby roadways, potentially causing long-term impacts on ambient air quality in the project vicinity. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides, and those burning leaded gasoline contribute lead to the atmosphere. As older vehicles continue to disappear from the numbers of those currently operating on the state's roadways, lead emissions are approaching zero. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state (B.D. Neal & Associates, 1990).

Power Generating Emissions. Some long-term impacts on air-quality could potentially occur due to indirect emissions from power generating facilities supplying the petition area with electricity.

Cumulative Impacts

As discussed in Section 4.8, HELCO is planning to expand the Keahole Generating Station from its present capacity 30 mW to 86 mW. As part of the analysis for the expansion of generating station, EPA guideline dispersion models were used to calculate

maximum concentrations of combustion pollutants that would potentially occur. Modelling analysis predicted the maximum ground level concentrations for nitrogen oxide, sulfur dioxide and particulate matter less than 10 microns in diameter for the proposed expansion project and existing diesel and combustion turbine units at Keahole (CH2M Hill, 1992).

The maximum predicted concentrations were added to the maximum background concentrations and compared with the most stringent state and federal ambient air quality standards. According to the modelling results, no national or state ambient air quality standards would be exceeded as the result of the proposed expansion of the generating station (ibid).

Mitigation Measures

Construction-Related Emissions. Strict compliance with State of Hawaii Air Pollution Control Regulations regarding establishment of a regular dust-watering program and covering of dirt-hauling trucks will be required to effectively mitigate fugitive dust emissions from construction activities. Twice-daily watering is estimated to reduce dust emissions by up to 50 percent. Use of wind screens and/or limiting the area that is disturbed at any given time may be required in sensitive or dust-prone areas.

Long-term Impacts. Appropriate traffic engineering and systems management solutions within the region should avoid/mitigate traffic congestion, and thereby reduce or eliminate areas subject to vehicle-related impacts to ambient air quality. This is particularly important in anticipation of continued elimination of older vehicles which burn leaded gasoline.

Power Generating Emissions. The incorporation of alternative energy devices and conservation measures into the master planning for the petition area can help reduce dependence on fossil fuels, thereby reducing these emissions.

Urbanization of the petition area could add up to about 40 mW of electrical demand to the utility network or about 0 percent of the total expansion of the Keahole Generating Station. Nevertheless, the expansion will be subject to rigorous review by the State Department of Health (DOH) and must meet state and federal clean air requirements. Mitigation measures will be determined by the DOH during the permitting process and may include limitations on the allowable size of the facility, emission control technology requirements, or specification of fuel properties (ibid).

In addition, the Petitioner recommends that the Land Use Commission attach the following condition to its approval: *that the developer/landowner of the petition area be required to participate in an air quality monitoring program as specified by the State Department of Health.*



5.0 SOCIOECONOMIC FACTORS

5.1 Housing

Affected Environment

Although new housing construction in Hawaii County reached high levels in the late 1980's, up significantly from the early part of the decade, it did not keep pace with the growth of population and households, particularly in North Kona. Housing units for residents (total inventory, less visitor units) increased in North Kona from 7,540 in 1980 to 9,990 in 1990, a growth rate of 3.1 percent per year. During the same period, population increased at an annual rate of 6.2 percent, while the number of households increased at a rate of 7.1 per cent (State of Hawaii Data Book, 1987, 1991; 1980 Census of Population and Housing, 1990 Census of Population and Housing). Table 10 shows the trend in the numbers of housing units in North Kona and the County of Hawaii.

Table 10
Housing Units in North Kona and Hawaii County
1970-1990

	North Kona	Hawaii County
1970	2,485	19,957
1980	7,540	34,792
1990	9,990	48,253

Source: The State of Hawaii Data Book, 1991 and U.S Census Bureau file tape STF-1A

These statistics indicate that there has been a significant tightening of the housing market in the West Hawaii Region, as housing starts have not kept pace with rates of population increase and household formation. These conclusions are supported by the Final EIS prepared for the Kealakehe Planned Community, an affordable housing project sponsored by the State Housing Finance and Development Corporation (HFDC). The FEIS reported sharp increases in population, but a much lower rate of housing construction, which has led to a severely limited housing supply in West Hawaii, evidenced by higher housing prices, construction costs and rental prices (Belt Collins & Associates, July 1990).

In partial response to the perceived demand for affordable housing in the region, HFDC is planning the construction of about 4,100 affordable housing units at Kealakehe, approximately three miles south of the petition area (ibid). In addition, development on land owned by the Queen Liliuokalani Trust could add about 2,700 dwelling units as part of their proposed development at Keahuolu, near Kailua-Kona (Belt Collins and Associates, October 1990).

Probable Impacts

Although specific land uses for the petition area have not been determined, it is probable that residential uses will comprise a significant percentage of its acreage. The percentage of gross land set aside for residential uses ranged between 30 and 40 percent of the petition area (minus the 500-acre University site) as discussed in Section 2.5. These

percentages translate into gross acreages ranging from 642 to 856 acres, providing between 5,650 to 7,533 dwelling units at 8.8 du/acre. In this respect, the proposed reclassification could positively affect the provision of needed housing for residents of West Hawaii. Table 11 shows the distribution of possible dwelling units that might be built within the land use programs for each of the three scenarios.

Table 11
Possible Dwelling Units Attributable to the Petition Area

	Acreage	Dwelling Units*
Scenario I	642	5,650
Scenario II	749	6,591
Scenario III	856	7,533

* A mix of single- and multi-family dwellings; average density of 8.8 dwelling units/acre

Mitigation Measures

The Petitioner recommends that the Land Use Commission attach the following condition to its approval regarding the provision of affordable housing: *"the developer and/or the landowner of the petition area shall provide affordable housing opportunities for low, low-moderate, and gap-group income residents of the County of Hawaii to the satisfaction of the State Housing Finance and Development Corporation in accordance with the Affordable Housing Guidelines adopted by the HFDC, effective July 1, 1992, as periodically amended. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as may be mutually agreeable between the developer and/or landowner of the petition area and the HFDC. Agreement by the HFDC on the provision of affordable housing should be obtained prior to the developer and/or landowner applying for county rezoning."*

5.2 Population

Resident Population. The resident population of North Kona was estimated at 13,748 in 1980. From 1970 to 1980, the resident population for the area increased at an annual rate of 18.5 percent per year, or nearly quadruple the 4.5 percent rate for the county as a whole. Since 1980, resident population growth on the island has been more gradual and continues to be most rapid in the North Kona and South Kohala districts, with the resident population of North Kona reaching 22,284 in 1990 (Table 4). Between 1980 and 1990, the population grew 6.5 percent per year in North Kona compared to about 2.4 percent for the island as a whole.

The Hawaii County General Plan projects population in the North Kona District to a 2005 population of between 43,250 and 64,500 residents, depending on various economic scenarios. This represents an increase of between 21,000 (94%) and 42,000 (189%) residents from 1990 levels and a continuation of the relatively rapid rate of growth experienced in North Kona during the previous two decades.

Table 12
Population Growth
in North Kona and Hawaii County, 1907 - 2005

	North Kona	County of Hawaii
1970	4,832	63,468
1980	13,748	92,053
1990	22,284	120,317
2005*	43,250-64,500	173,000-258,000

* Hawaii County General Plan Projection

Source: The State of Hawaii Data Book, 1987, 1991, Hawaii County General Plan

Probable Impacts

Section 2.5 of the DEIS discusses three possible scenarios to predict order of magnitude impacts that might result from the urbanization of the petition area, including residential population. Assuming an average household size of 2.7 for a mix of single-family and multi-family dwellings, it is anticipated that the petition area could accommodate a range of resident population between about 16,254 and 21,339 (including about 1,000 students that would board in dormitories at the university campus) at ultimate build out, (circa 2010-2025. Table 13 shows the possible range of resident population based on the three scenarios discussed in Section 2.5.

Table 13
Possible Resident Population Attributed to the Petition Area

Scenario	Acres (Residential)	Dwelling Units*	Resident Population**
I	642	6,420	16,254
II	749	7,490	18,796
III	856	8,560	21,339

* assumes average 8.8 dwelling units/acre

** assumes 2.7 persons per household plus 1,000 students living in university dorms

A comparison of the ranges for anticipated population increase projected by the County General Plan for 2005 and the three scenarios (between (2010 and 2025) shows that the urbanization of the petition area would account for anywhere from 39 to 102 percent of the General Plan projection (this percentage will vary when comparing the lowest population estimate for the petition area against the highest Hawaii County population projection, and the highest population estimate for the petition area against the lowest Hawaii County population projection and is overstated as the projection horizons of the development exceed the General Plan population by 5 to 20 years).).

The urbanization of the petition area will provide jobs and housing for the residents of West Hawaii and for others who desire to migrate to the island or region. Within the context of population projections contained in the County of Hawaii General Plan, the

provision of housing and jobs will serve to support projected population increases including in-migration. Therefore, urbanization of the petition area would tend to support population growth for the area.

Cumulative Impacts

In addition to the proposed reclassification of the petition area, there are two other major residential developments proposed between Keahole and Kailua: the HFDC project at Kealakehe; and Queen Liliuokalani Trust development at Keahuolu. These projects are currently planned to add 4,100 and 2,700 dwelling units, respectively, to the regional housing stock in the next 20 years, thereby accommodating a combined resident population of about 18,000 people. Collectively, the three projects could readily absorb all the population projected for the North Kona District through the year 2005.

5.3 Economy/Employment

Affected Environment

Economy. Through the early years of Statehood, diversified agriculture formed the economic base of the region. However, the importance of diversified agriculture to the region has been eclipsed by the growth of the visitor industry and associated service related jobs. In 1950, 52 percent of the employed persons of Kona listed farm laborer, farm manager or farmer as their primary occupation. By 1980, only 8.2 percent of the labor force held agriculturally related jobs (Kona Regional Plan, 1983). Today, tourism is the primary economic activity of the North Kona District, supplanting agriculture as the number one revenue generating activity. In 1970, there were approximately 1,750 visitor accommodation units in the Kona area, representing 50 percent of the Big Island visitor units. By 1980, the Kona area supported a total of 3,774 visitor units, increasing by an average growth rate of 7 percent per year. Currently, there are approximately 4,990 transient units available in the Kona area, comprising well over half of the island's total inventory.

Other local service industries, such as retailing, real estate and financial services, have benefited from the income introduced by the expanding visitor industry. Consistent with the changing economic base and growing population of the North Kona District, new service industries are expanding to meet added demands for their services.

Employment. Between 1970 and 1980 the number of people employed in the North Kona District rose from 1,925 to 7,100, an increase of 268 percent (Table 14). This is attributed to the rise of resort and tourist-related centers of employment which provided new job opportunities. This compares with a county-wide increase from 25,180 to 38,150 during the same period, an increase of about 51 percent, substantially less than that for North Kona. Between 1980 and 1990 the number of people employed in North Kona rose from 7,100 to 10,700, an increase of about 51 percent. Although this increase is less dramatic than during the previous decade, it still represents a healthy increase in the number of persons employed. By comparison, the county as a whole experienced an increase in the number of persons employed from 38,150 to 59,200, an increase of 55 percent (State of Hawaii Data Book, 1987, 1991).

Assuming job growth follows the projected General Plan population growth for the North Kona District (population projected to increase between 94% and 189% by 2005), the District could absorb between 10,000 and 20,200 new jobs by 2005.

Table 14
Employment Growth
in North Kona and Hawaii County, 1970 -1990

	North Kona	Hawaii County
1970	1,925	25,180
1980	7,100	38,150
1990	10,700	59,200

Source: The State of Hawaii Data Book, 1987, 1991

The County of Hawaii averaged an unemployment rate of 3.8 percent during 1990, which increased to an average of 7.1 percent for the first 6 months of 1992. This compares to a statewide average of 2.8 percent during 1990 and 4.0 percent for the first 6 months of 1992. The North Kona District unemployment rate for the two periods was 2.9 percent and 5.2 percent, respectively, indicating a general worsening of the statewide economy, paralleling national trends which were evident beginning in the early part of 1991. Table 15 compares unemployment trends in North Kona, Hawaii County and the State of Hawaii since 1980.

Table 15
Unemployment Trends; 1980-1992
North Kona, Hawaii County and the State of Hawaii

Area	1980	1985	1990	1992*
State of Hawaii	4.9%	5.6%	2.8%	4.0%
Hawaii County	6.2%	8.5%	3.8%	7.1%
North Kona	4.8%	5.5%	2.9%	5.2%

* Average figures for the first 6 months of 1992

Source: State Department of Labor and Industrial Relations, September, 1992

Anticipated Impacts

The urbanization and development of the petition area will generate short-term employment during the construction period. In addition, long-term employment opportunities will be created, especially if some of the land uses identified in the Keahole to Kailua Development Plan are implemented, such as the West Hawaii campus of the University of Hawaii. Not only will such action improve the economic diversification of the West Hawaii economy, but it will also generate increased property, sales and income taxes.

Table 16
Possible Direct Employment Attributed to the Petition Area

Land Use	Scenario I	Scenario II	Scenario III
Residential	282	330	377
Nbhd Comml	1,104	1,104	1,104
Civic	1,798	1,798	1,798
Empl. Center	2,568	8,000	5,222
Light Ind.	3,000	5,000	4,000
Parks	11	11	11
Golf Course	40	40	80
University	500	500	500
Total Employment	9,303	16,783	13,092

Source: Helber Hastert & Fee, Planners (appendix A)

Based on the three scenarios discussed in Section 2.5, urbanization of the petition area is expected to provide between 9,303 and 16,782 long-term direct jobs as indicated in Table 16 at full build-out between 2010 and 2025. The range in number of projected jobs is a function of the land area devoted to specific land uses.

Direct employment provided by the project will stimulate indirect and induced jobs. Indirect jobs are create by goods and services needed to support project operations. Induced jobs are created when workers in direct jobs spend their money to buy goods and services. Indirect employment and induced jobs are created throughout the economy and not just in the particular direct job classification or region. Actual indirect and induced job components can be analyzed using the state's input-output model applied to each of the projected job classifications.

Assuming an overall indirect and induced multiplier of 1.0 (for each direct job there will be 1.0 indirect and induced jobs created). Total direct, indirect and induced jobs could range from 18,600 to 33,560. As would be expected, the highest number of jobs are associated with Scenario II, which has the largest acreage devoted to the employment center and light industrial land uses. This reflects the assumption that Scenario II will capture a broader regional market for these land uses than the other two scenarios. Table 16 shows the breakdown of anticipated jobs for each scenario.

Indirect and induced jobs are created throughout the economy, both functionally and spatially. Also, it should be noted that the jobs represent an ultimate year projection (between 2010 and 2025).

5.4 Social Impacts

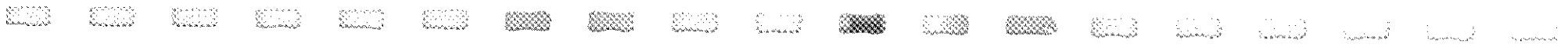
Affected Environment

Based on the discussion in Sections 5.1, 5.2 and 5.3, it is apparent that the North Kona Region is expected to absorb additional increases in resident population in the coming years. These quantitative observations are consistent with existing trends in population growth and job creation in North Kona. The trends are also consistent with County and State land use policies (see Chapter 3) which identify the Keahole to Kailua region as the focus of future urban growth in West Hawaii.

Anticipated Impacts

A number of factors will determine the social impacts associated with the urbanization of the petition area. These include: the rate of growth in the region; the ability of infrastructure construction to keep pace with growth; and the demographic characteristics of new in-migrants. Accelerated growth rates could heighten social impacts as residents perceptions of urban problems such as overcrowding, traffic congestion, competition for recreational resources, and crime increase. In turn, these factors are related to the ability of State and County government to provide necessary public services to keep pace with population increases. These public services include; roadways, wastewater treatment, potable water, fire protection, schools, libraries, health care, etc.

The question remains as to where these in-migrants will come from. It is probable that they will come from a number of locations, including East Hawaii, other Hawaiian islands, Pacific Islands, and the continental Untied States. The degree to which the cultural values and lifestyles of the in-migrants differ from those of existing West Hawaii residents will determine, in great part, the extent of social impacts. While the exact composition of the in-migrant workers cannot be predicted at present, it may, however, be safely predicted that the projected growth levels imply some types of very major shifts in the Big Island's population composition in the coming years (Community Resources, Inc., July, 1990)



6.0 INFRASTRUCTURE AND PUBLIC FACILITIES

6.1 Traffic

A traffic assessment for the petition area was prepared by the traffic engineering firm The Traffic Management Consultant (TMC), to determine the probable impacts the reclassification of the petition area will have on the region's traffic. Because specific uses for the petition area have not yet been determined, this assessment does not attempt to predict specific traffic impacts such as trip generation and traffic movement attributable to the development of the petition area. Instead, a general discussion of existing traffic conditions is followed by an analysis of probable future conditions. Future conditions are presented in a context of anticipated growth in the region and governmental plans for improvements to transportation corridors that are presently serving or planned to serve the region. The complete assessment is attached as Appendix H and is summarized below.

Affected Environment

Existing Circulation Network. Queen Kaahumanu Highway is the primary arterial highway in the region. This two-lane, Class I State Highway is a limited access highway within a 300-foot right-of-way (fronting the petition area), with a posted speed limit of 55 miles per hour. Dedicated in 1975, the highway extends 38 miles to connect the towns of Kawaihae and Kailua-Kona and provides a vital transportation link between the growing coastal resort areas of South Kohala, Keahole Airport and Kailua-Kona (TMC July, 1991). Exclusive left turn and right turn lanes are provided on Queen Kaahumanu Highway at key intersections, such as at Keahole Airport Road and Kaimi Nani Drive. Left turn median storage lanes and right turn acceleration lanes are also provided at these intersections. These intersections are currently unsignalized (TMC, 1993).

Mamalahoa Highway was the main road between Kailua-Kona and Waimea prior to the opening of Queen Kaahumanu Highway in 1975. It still provides a major transportation link between Hilo and Kailua-Kona (via Waimea or directly when travelled in conjunction with the Saddle Road). The highway extends around most of the Big Island. Kaimi Nani Drive intersects Queen Kaahumanu Highway, about 0.5 miles south of Keahole Airport Road. The mauka portions of Kaimi Nani Drive provide access to the residential subdivisions mauka of the petition area. Until the recent construction of Hina Lani Drive, which is located about 3.2 miles south of the Keahole Airport Road intersection, the only connection between the two arterials was Kaimi Nani Drive (ibid).

Existing Peak Hour Traffic. The AM peak hour of traffic in the area adjacent to the petition area occurs between 6:45 AM and 7:45 AM. The intersection of Keahole Airport Access Road and Queen Kaahumanu Highway operates at acceptable Levels of Service (LOS) during the AM peak hour of traffic (LOS is a quantitative and qualitative assessment of traffic operations, defined by LOS A through LOS F, with LOS A being the best operating condition and LOS F being the worst operating condition.). The left turn movement from Kaimi Nani Drive to southbound Queen Kaahumanu Highway operates at LOS "D" during this time. The remaining traffic movements at the intersection of Queen Kaahumanu Highway and Kaimi Nani Drive operate at acceptable LOS (ibid).

The PM peak hour of traffic occurs between 4:00 PM and 5:00 PM. The left turn movement from Keahole Airport Access Road to northbound Queen Kaahumanu Highway operates at LOS D during the PM peak hour of traffic. The left turn movement from Kaimi Nani Drive to southbound Queen Kaahumanu Highway operates at LOS D during

the PM peak hour of traffic. The remaining traffic movements at the intersection of Keahole Airport Access Road and Queen Kaahumanu Highway operate at satisfactory LOS (ibid).

Cumulative Impacts

The Keahole to Kailua corridor is in the midst of significant changes, and is planned to be the focus of continued growth during the next 20 years. In addition to the petition area, developments are planned or underway at the Queen Liliuokalani Trust lands at Keahuolu, the State-owned tract at Kealakehe, the Nansay-owned land at Kohanaiki, the Kahala Capital-owned property at 'O'oma 2nd, the Natural Energy Laboratory of Hawaii Authority, and the expansion of the Keahole Airport.

Each of these developments have been the subject of separate traffic impact analysis reports over the last few years, each projecting additional vehicle trips for Queen Kaahumanu Highway. Variously, these reports recommend specific improvements to Queen Kaahumanu Highway to accommodate the additional traffic. These improvements include traffic signalization and fully channelized intersections.

In recognition of the rapid changes within the region, several transportation studies have either been completed or are underway by State and County agencies to plan for necessary circulation improvements to accommodate growth. These include the Keahole to Kailua Development Plan, the Queen Kaahumanu Highway Master Plan and the Island of Highway Long Range Highway Plan.

Keahole to Kailua Development Plan (K-K Plan). The K-K Plan was prepared by R.M. Towill Corporation for the County of Hawaii Department of Planning in 1991. The roadway plan proposed in the K-K Plan envisions three north-south collector/arterial roadways pass through the petition area (Figure 7). The lowest elevation roadway (about 400-foot contour) to pass through the petition area is a mid-level arterial (the "Mid-Level Arterial") which would roughly parallel Queen Kaahumanu Highway and connect to Palani Road to the south and extend out beyond the petition area to the north. This arterial is presently planned as a four-lane roadway with a 120-foot right-of-way. Waena Drive passes through the petition area at about the 800-foot elevation and is presently planned as a four-lane, undivided roadway with an 80-foot right-of-way. A third north-south roadway, Kealakehe Street Extension, passes through the east portion of the petition area at about the 1,000-foot elevation.

The K-K Plan also shows a mauka-makai roadway (University Drive) intersecting with Queen Kaahumanu Highway at Keahole Airport Access Road to provide access to the northern portion of the petition area, including the university site.

Queen Kaahumanu Highway Master Plan. The Queen Kaahumanu Highway Master Plan is a two-phased effort that is expected to result in a long-range plan for the entire highway corridor between Kailua-Kona and Kawaihae. This project is on-going at this writing.

The first phase of the master plan is expected to include plans to widen the two-lane highway to a four-lane, divided highway. Completion of Phase I improvements is expected in 1996. Subsequent phases would include extending the four-lane widening to Kawaihae, upgrading the highway to a controlled-access freeway, and the construction of grade separated interchanges and a frontage road system to replace at-grade access along the highway.

The frontage road system would provide access to properties between interchange locations. The collector-distributor road system, between Queen Kaahumanu Highway and Mamalahoa Highway, would include the major north-south county roadways, such as the Mid-Level Arterial and Waena Drive, and the major mauka-makai roadways, such as University Drive.

In addition to interchanges planned at the Keahole Airport Access Road (University Drive) and the Kealakehe Interchange, other potential interchanges could include the recently completed Hina Lani Drive (adjacent to the Kaloko Light Industrial subdivision) and near the proposed developments at 'O'oma 2nd and Kohanaiki. The latter interchange could provide access to the southern portion of the petition area.

Island of Hawaii Long Range Highway Plan. In May 1991, Parsons Brinckerhoff, Quade and Douglas, Inc., completed a study for the State Department of Transportation (DOT) and the County of Hawaii, Island of Hawaii Long Range Highway Plan (HLRHP). The HLRHP estimates that the Year 2010 average daily traffic on Queen Kaahumanu Highway would increase to 32,900 vehicles per day between Keahole and Kealakehe. This represents a 9.2 percent annual increase over 1992 conditions. In the HLRHP, the improvement of Queen Kaahumanu Highway, between Keahole Airport and Palani road is rated as the highest priority for the island of Hawaii.

The HLRHP is being updated at this writing and is expected to be completed by the end of 1993. The updated highway plan would evaluate regional needs, based on statewide population and employment forecasts and the development projects approved since a 1988 land use forecast that was used for HLRHP. These recent projects are expected to include the State HFDC housing project at Kealakehe, the development of the Queen Liliuokalani Trust Lands and the petition area.

Petition Area Accessibility. It is assumed that access to the northern portion of the petition area would be provided at the proposed Airport Access Road/University Drive Interchange, via the proposed University Drive. Due to the distance between the southern portion of the petition area and the proposed Kealakehe interchange, an additional interchange near 'O'oma 2nd/Kohanaiki could provide needed access to the southern portion of the petition area. However, interchange locations have not been determined by DOT yet. If an interchange is not provided in this area, then access could be provided by a frontage road along Queen Kaahumanu Highway, and the Mid-Level Arterial, Waena Road, and Kealakehe Street Extension, as identified in the K-K Plan.

Kaimi Nani Drive provides only limited potential for access between the petition area and Queen Kaahumanu Highway. Because of its proximity to the Airport Access Road, it is unlikely an interchange would be located at Kaimi Nani Drive.

The proposed University Drive is an extension of Keahole Airport Access Road at the proposed Airport interchange, from Queen Kaahumanu Highway to Mamalahoa Highway. University Drive would provide access to the northern portion of the petition area, including the University site. Maximum allowable road grades for collector roads may be difficult to maintain as a result of the steep terrain near Mamalahoa Highway.

The proposed Mid-level Arterial, Waena Drive and Kealakehe Street Extension are expected to provide access between the petition area and the Kealakehe area. These north-south roadways are expected to carry traffic with origins and destinations in neighboring communities. However, regional access is expected to be provided by Queen Kaahumanu Highway.

Future Highway Needs. All the studies that were reviewed by TMC concur that traffic demand on Queen Kaahumanu Highway would exceed the existing two-lane capacity before the Year 2000, with or without urbanization of the petition area. Several issues relative to the petition area need to be addressed by ongoing and future studies:

- Number and location of interchanges proposed on Queen Kaahumanu Highway, within the vicinity of the petition area;
- Configuration and operation of the frontage road system along Queen Kaahumanu Highway in the vicinity of the petition area;
- Implementation schedule of the proposed north-south arterial/collector roadways; and,
- Traffic impacts and access requirements, based upon a development plan for the petition area.

Mitigation Measures

The Petitioner recommends that the Land Use Commission attach the following condition to its approval: *that the developer and/or landowner shall prepare a Traffic Impact Analysis Report (TIAR) prior to applying for County zoning. The developer and/or landowner shall also participate in the funding and construction of local and regional transportation improvements and programs including dedication of rights-of-way as determined by the State Department of Transportation and the County of Hawaii Department of Public Works. Agreement by the State Department of Transportation on the level of funding and participation shall be obtained prior to the developer and/or landowner applying for County zoning.*

It is further recommended that the developer and/or landowner shall monitor traffic attributable to the petition area at on-site and off-site locations and shall undertake subsequent mitigative measures that may be reasonably required, which should be coordinated with and approved by the Department of Transportation.

It is also recommended that the developer and/or the landowner shall appoint a permanent transportation manager whose function is the formulation, use, and continuation of alternative transportation opportunities that would optimize the use of existing and proposed transportation systems. In the alternative, the developer, the developer and/or the landowner may participate in a regional program for transportation management with other developers and/or landowners. This program shall address the transportation opportunities that would optimize the use of existing and proposed transportation systems. Either option would continue to be in effect unless otherwise directed by the State DOT. The program for either option shall be reviewed by the DOT prior to implementation. The transportation manager or developer and/or landowner should also conduct periodic evaluations of the program's effectiveness and shall make reports of these evaluations available to the DOT for review.

6.2 Keahole Airport

Affected Environment

Keahole Airport is situated to the west (makai) of the petition area and consists of a modern terminal complex and a single runway 150 feet wide and 6,500 feet long. Aircraft generally approach the runway from a northerly direction and take off in a southerly direction. An update of the 1971 Keahole Master Plan was initiated by the State Department of Transportation (DOT), Airports Division in 1986 and culminated in the acceptance of an EIS for the Keahole Airport Master Plan in December 1988.

The current master plan identifies the type and extent of aviation facilities needed at Keahole Airport through the year 2005. Included in the recommendations for the master plan is the extension of the runway from 6,500 feet to 11,000 feet to accommodate international arrivals.

Probable Impacts

The development of the petition area will generate additional air passenger and freight traffic through the Keahole Airport, although increases attributable to its development would not necessitate expansion of airport facilities. The aggregate demand on airport facilities from West Hawaii developments are anticipated to require future terminal expansion and lengthening of the runway to accommodate fully-loaded wide-bodied aircraft, consistent with the Airport Master Plan.

6.3 Harbors

Affected Environment

Three principal harbors provide service to West Hawaii; Kawaihae Harbor, Honokohau Small Boat Harbor, and Kailua Bay. Kawaihae Harbor is the only State commercial harbor in West Hawaii and has a basin area of nearly 50 acres. It is located approximately 25 miles north of the proposed project. Developed in 1959, the harbor has a 40-foot deep entrance channel and a 35-foot deep harbor basin with an area of about 53 acres. In 1986, Kawaihae Harbor handled a total of 451 vessels (excluding domestic fishing craft). Of this total, 173 (38 per cent) were self-propelled vessels, and 95 per cent of these were tugboats or towboats. In that same year, the harbor handled over 592,000 short tons of cargo. Cargo handled includes building materials, consumer goods, large equipment, and machinery, as well as provisions and supplies for the resort facilities in South Kohala and North Kona.

There are two projects that have recently improved the operating capability of Kawaihae Harbor. The first project, extended the existing pier from a length of about 620 feet to about 1,220 feet. The second project, made several landside improvements to the harbor facilities, including; paving existing container yards, improving the existing electrical system and improving the access roads to the harbor.

The Honokohau Small Boat Harbor is the major pleasure-craft, commercial and charter fishing anchorage in West Hawaii. The harbor is located approximately three miles south of the project site. Currently, the man-made harbor can accommodate a total of about 245 boats. All available slips are filled with a waiting list of interested parties. The long-range master plan for the facility calls for a total of 455 slips to be developed on the 65.5-acre harbor site.

Kailua Pier, within Kailua Bay serves as a recreational resource for visitor-related activities associated with Kailua Village. In addition to charter fishing boats, the harbor provides facilities for sunset dinner cruise boats, daytime tours, the Atlantis submarine tour service, parasails and other ocean-related recreational activities. The Bay also provides off-shore docking for interisland cruise ships.

Probable Impacts

It is probable that increases in cargo handling at Kawaihae Harbor and the use of ocean recreational activities offered at the Honokohau and Kailua-Kona Harbors generated by the urbanization of the petition area will result in additional job opportunities and increased demand for recreational boat slips.

6.4 Water Supply

Affected Environment

Water Resource Associates prepared an overview of water resources in the North Kona Region. Its report is summarized below and attached as a technical appendix (Appendix I).

North Kona Water System. Potable water use in the Keahole-Kahaluu area of North Kona is provided by the County of Hawaii Department of Water Supply (DWS) from its North Kona Water System (NKWS). The Kahaluu Well Field and Water Development Shaft are the primary sources of supply for the NKWS. Water is transported from the Kahaluu sources through two major pipelines: one along Mamalahoa Highway to Kalaoa and another along Kuakini and Queen Kaahumanu Highways to Keahole Airport. The Mamalahoa route includes 12- and 8-inch diameter pipelines and the Kuakini/Queen Kaahumanu route, which starts at the Kahaluu shaft, includes a 24-inch diameter pipeline that reduces to 20 inches 3.5 mile south of Kailua-Kona, to 16 inches at Kailua-Kona, and finally to 12 inches between Honokohau Harbor and Keahole Airport.

Only two new well sources have been added to the water system since the development of the shaft in 1975. In 1983, the State of Hawaii drilled the Holualoa Well (No. 3657-01) which was placed into production in 1986 to help meet the growing water demand in the area. In 1990, the State drilled the Kalaoa Mauka Well (No. 4358-01) and unexpectedly discovered a high-level ground water source. This well was added to the NKWS in 1992, with the overall system reaching a total pump capacity of 13.2 million gallons per day (mgd). Table 17 shows how pump capacity is allocated within the NKWS.

Total pumpage from the Kahaluu sources has increased steadily from 4.5 mgd in 1980 to 7.5 mgd in 1990. The total system pumpage for the 1990-1991 fiscal year reached 8.342 mgd as shown in Table 1.

Water Budget. A key component in any discussion of water resources is an understanding of how much water might be available for source development. Such an understanding is based on the concepts of ground water recharge and sustainable yield. Calculations relevant to ground water recharge and sustainable yield are used to compute a water budget for an aquifer system, based upon reasonable and logical assumptions of geology and hydrology. The water budget method is based on average ground water conditions and can be expressed as the net amount of rainfall that percolates deep enough below the ground to escape evapotranspiration and is calculated from the following equation:

Recharge = Rainfall - Evapotranspiration - Runoff

Table 17
Average Water Use and Pump Capacity
North Kona Water System

Source	1990-1991 Average Water Use (mgd)	Pump Capacity (mgd)
Kahaluu Well A	0.773	1.00
Kahaluu Well B	0.759	1.00
Kahaluu Well C	0.611	1.00
Kahaluu Well D	0.713	1.00
Kahaluu Shaft	4.868	8.00
Holualoa Well (No. 365-01)	0.618	0.72
Kalaoa Mauka Well (No. 4358-01)		0.50
Total	**8.342***	**13.22**

* Does not include Kalaoa Mauka Well which was not placed in service until 1992

Source: Water Resource Associates; November 1992

Based on Water Resource Associate's calculations, the estimated ground water recharge in the 10-mile stretch of North Kona between Kalaoa and Kahaluu is 53 mgd. Only a fraction of the estimated ground water recharge can be developed on a sustained, long-term basis. This fractional amount is called the sustainable yield of an aquifer. Sustainable yield is the amount of ground water that can be developed without adversely affecting the long-term ability of a basal aquifer to produce acceptable quality water from existing and new sources. The sustainable yield of a basal aquifer is always less than its recharge.

The concept of sustainable yield for basal aquifers, however, is not completely applicable to the high level aquifers of North Kona because they are not threatened by salt water intrusion (see Section 4.2, Geologic and Hydrologic Setting). Assuming that the utility of any downgradient basal aquifer is not a factor, the sustainable yield of a high-level aquifer would be equal to its ground water recharge, rather than a fraction of the aquifer. On the other hand, if a usable downgradient basal aquifer exists and its utility must be protected, the sustainable yield of a particular coastal sector must take into account both the high-level and downgradient basal aquifers.

In any case, optimum development of North Kona's ground water resources would consist of development of the high-level aquifers. Based upon experience with aquifer performance in Honolulu and Pearl Harbor, Water Resource Associates estimates the sustainable yield of the 10-mile stretch North Kona between Kalaoa and Kahaluu to be 40 mgd.

Anticipated Impacts

Future Water Demand Outside the Petition Area. The estimated future water needs of the County's North Kona Water System is 24.8 mgd. This estimate includes water needs

for resort facilities south of Keahole and 7.0 mgd for future State projects Water Resource Associates, December 1992). With a current water use of 8.3 mgd for the North Kona Water System (Table 1), a total of 33.1 mgd is the projected demand for 2010. Given an estimated sustainable yield of 40 mgd in the Kalaoa-Kahaluu area, there is approximately 7.0 mgd of potentially exploitable potable resource.

Future Water Demand For the Petition Area. As discussed in Section 2.5, three development scenarios were employed to estimate order of magnitude impacts associated with the urbanization of the petition area. Based on these scenarios, it is estimated that the petition area could generate a demand for between 5.15 and 7.11 mgd of potable water. Table 18 shows the estimated water demand for various land uses within each scenario.

Table 18
Possible Potable Average Water Demand Attributed to the Petition Area

Land Use	Scenario I (mgd)	Scenario II (mgd)	Scenario III (mgd)
Residential	2.26	2.64	3.01
Nbhd Comml	0.11	0.11	0.11
Civic	0.36	0.36	0.36
Empl. Center	0.34	1.05	0.68
Light Ind.	1.31	2.18	1.74
Parks	0.26	0.26	0.26
Golf Course	0.02	0.02	0.02
University	0.50	0.50	0.50
Total Demand	5.15	7.11	6.69

Source: Helber Hastert & Fee, Planners (Appendix A)

Subtracting the 0.5 mgd attributable to the University site (which is already included in the 24.8 mgd estimated as the future potable water need for the North Kona Water System), the estimated demand for potable water as a result of urbanization of the petition area ranges from about 4.6 mgd to 6.6 mgd. If these figures are compared to the estimated remaining water budget for the North Kona Water System established by Water Resource Associates of 7.0 mgd, there could be between 0.4 mgd and 2.3 mgd of developable potable resources available for other users if all estimated demand attributable to the petition area is assigned.

It is important to qualify these estimates by underscoring they are only estimates of future water demand based on the three development scenarios and do not necessarily reflect actual future patterns of development within the petition area. They do, nevertheless, provide an order of magnitude estimate for future demand.

Mitigation Measures

Because the municipal water system cannot currently provide adequate potable water for the development of the petition area, the Petitioner must work closely with other State agencies and the County of Hawaii to identify new sources of potable water.

If potable wells are to be developed, possible sites for these wells are likely to be chosen from areas along the Mamalahoa Highway corridor, between the Kau and Kealakehe ahupua'a. Alternative sites south of Keauhou might also be developed and integrated with the County system.

In addition to new sources, significant improvements to the existing County transmission system will be required to support the urbanization of the petition area as well as other projects planned in the region. The Keahole to Kailua Development Plan (K to K Plan) identifies five planned corridors to transmit water from the water resource development zone along the Mamalahoa Highway corridor to makai areas. In addition to potential costs associated with source development, the petitioner may be required to participate in the construction of the transmission system from the source to the project site. The petitioner intends to work closely with the County Department of Water Supply (DWS) to coordinate the construction of new source, storage and transmission facilities. Fire flow for the project will also need to be included in the water system design.

6.5 Wastewater Disposal

Affected Environment

Two methods of liquid waste disposal are used in the Kona area: private cesspool and wastewater treatment plants (both municipal and private). The primary method of domestic sewage treatment and disposal continues to involve the use of private cesspools. This disposal method is becoming increasingly problematic due to the permeability of the underlying lava substrate and the propensity of wastes to seep through the strata causing contamination of potable ground water sources and adjacent coastal waters. The State Department of Health (DOH) will no longer approve the use of cesspools for domestic sewage treatment. Minimum DOH requirements now include the installation of septic tanks and leaching fields.

The Kailua Municipal Sewerage System is one of five municipal sewage systems operated by the County of Hawaii. Built in the mid-1960's, the collection system includes 14,000 feet of sewer lines, six sewage pump stations and a wastewater treatment plant (WWTP) located in the Kailua Village Industrial Area. The system is presently operating near capacity (1.4 mgd). The WWTP utilizes an activated sludge/step aeration treatment process and produces secondary treated effluent for irrigation use at a nearby County park and dried sewage sludge which is disposed of in a landfill. The existing Keahole Airport system, located about one-mile north of the project site, consists of an extended aeration, prefabricated treatment plant, with a capacity of 0.04 mgd, servicing the airport complex.

A new 2.8 mgd municipal WWTP is under construction at Kealakehe on State-owned land adjacent to the southern boundary of the Honokohau Small Boat Harbor. The facility includes land irrigation as the primary method of waste disposal. The new system will incorporate the existing collection system of the Kailua-Kona Sewerage System and would expand service in the Kailua-Kona area and northward to approximately Honokohau. Final alignment and configurations for new areas to be sewered have not been developed. However, the facility will not have the capacity to accommodate the wastewater from the development of the petition area.

Probable Impacts

As stated above, there is presently no available municipal WWTP that can accommodate wastewater that will be generated by the development of petition area. The recently adopted Keahole to Kailua Development Plan indicates sewage from this area discharging

to a proposed Municipal Treatment Plant No. 2, which will be located approximately two miles north of Keahole Airport. The plan anticipates this plant will be in service by the year 2005.

Based on the use of the three scenarios discussed in Section 2.5, Table 19 shows the range of anticipated wastewater flows for the urbanized petition area.

Table 19
Possible Design Average Wastewater Flows Attributed to the Petition Area

Land Use	Scenario I (mgd)	Scenario II (mgd)	Scenario III (mgd)
Residential	1.30	1.51	1.73
Nbhd Comml	0.02	0.02	0.02
Civic	0.19	0.19	0.19
Empl. Center	0.04	0.12	0.08
Light Ind.	0.45	0.75	0.60
Parks	0.26	0.26	0.26
Golf Course	0.02	0.02	0.02
University	0.19	0.19	0.19
Total Demand	2.45	3.05	3.07

Source: Helber Hastert & Fee, Planners

Assuming that adequate wastewater treatment facilities can be constructed to service the petition area, it will then be necessary to dispose of the treated effluent. Portions of the effluent could be used as irrigation for any golf course(s) that are constructed within the petition area. The use of sewage effluent as an irrigation source has been studied extensively in Hawaii, and it has been demonstrated that secondary-treated wastewater can be used successfully for irrigation and concurrently for aquifer recharge. It has also been demonstrated that natural grassed systems act as a living surface filter and a subsurface trickling filter, outperforming secondary treatment in improving water quality under certain conditions. However, although the recharge water quality is acceptable, the applied effluent often contains human enteric viruses, even after chlorination. This could be a problem for off-site drift when effluent is applied as a spray (Environmental and Turf Services, Inc., 1991).

The use of effluent for irrigation will not absorb all the wastewater generated by the petition area, even if two golf courses are constructed (assuming that each course could use as much as 1.0 mgd of irrigation, there would still be a need to dispose of about between about 0.5 and 1.0 mgd of effluent per day). Other disposal methods, such as underground injection, would be needed for the balance of the wastewater not used for irrigation.

Mitigation Measures

The Petitioner recommends that the Land Use Commission attach the following condition to its approval: *that the developer and/or landowner of the petition area shall participate in the funding and construction of adequate wastewater transmission and disposal*

facilities, on a pro-rata basis, as determined by the State Department of Health and the County Department of Public Works.

It is also recommended that if wastewater is to be used as an irrigation source, that treatment be elevated to adopt California's 2 NTU standard for the use of effluent water in turf irrigation ("NTU" is an acronym for "nominal turbidity unit", a measure of the turbidity or cloudiness of a solution). Adoption of this strict pre-chlorination clarity standard would mean that effluent would be classified as Class B; suitable for human contact.

It is further recommended that in the event effluent is used to irrigate any golf course, the developer and/or landowner be required to follow the most recent Department of Health Guidelines applicable to all new golf course development.

6.6 Electrical Power and Communication

Affected Environment

Electrical Power. Electrical service to the petition area, as well as the entire island is provided by Hawaii Electric Light Company (HELCO). Present information from HELCO indicates their island-wide electrical generating capacity is 174.5 megawatts (mW), with a peak demand of approximately 140 mW (Tanigawa, September 23, 1992). HELCO's Keahole generating plant, located adjacent to the western portion of the petition area, has a current generating capacity of 30 mW.

In an effort to keep up with island-wide, as well as regional electrical demand, HELCO is initiating an expansion of the Keahole generating plant to 86 mW. HELCO proposes to incrementally expand the generating plant in three phases (1994, 1996 and 1997) to add 20 mW, 20 mW and 16 mW, respectively during each of the three expansion phases (Lee, September 17, 1992). As of the writing of the DEIS, HELCO has filed a DEIS for the plant expansion, dated December 1992 (the Department of Land and Natural Resources (DLNR) is the accepting authority for the EIS).

In addition to the expansion of the Keahole generation station, HELCO is also planning two new transmission lines that will have a terminus at the Keahole switching station. The first will be a 69 kV transmission line between Keahole Kailua-Kona. The second will either be a 69 kV or 138 kV transmission line between the Keahole switching station and the Keamuku station to the north. Separate EISs will be prepared by HELCO for each of the transmission line projects (ibid). As of the writing of the DEIS, HELCO has filed an environmental assessment, with the DLNR as the accepting agency, indicating that a full EIS will be required for the southern corridor. It is possible that one or both corridors would pass through portions of the petition area, depending on the final transmission line selected.

In addition, there are two existing transmission corridors within the petition area. One runs north-south, roughly 1/2-mile mauka of Queen Kaahumanu Highway, and the second runs east-west, the entire length of the petition area (Section 2.2). The Department of Health has raised concerns about the potential health hazards that could be caused by electromagnetic fields (EMF) in the vicinity of these transmission lines (Lewin, February 25, 1993)

Telephone. Hawaiian Telephone Company (HTCo) serves the petition area from their Kailua-Kona Electronic Common Control (ECC) facilities with trunk cables supported on the HELCO 69 kV poles mauka of Queen Kaahumanu Highway. There are no significant

spares in the trunking cables to support new major developments, in accordance with PUC directives.

Cable Television. Sun Cablevision is licensed to provide cable television service in the Kona-Kohala region. There are presently no cable lines servicing the petition area. The closest cabled areas are Kailua-Kona to the south and the Kona Palisades subdivision to the east.

Probable Impacts

Electrical Power. It is likely that urbanization of the petition area would result in an increase of at least 40 mW in electrical demand. This represents about 70 percent of the capacity of the proposed expansion of the Keahole Generating Station. It is probable that urbanization of the petition area will require additional capacity beyond that currently planned at the Keahole Generating Station. Since development of the petition area would extend beyond the year 2010 (planning horizon for Keahole Generating Plant upgrade), there is time to plan for the addition of generating capacity in the region.

Telephone. Based on general assumptions made about the acreage involved in the proposed boundary amendment, Hawaiian Telephone would need to add a remote switching office to accommodate development of the petition area. The remote switching office will require approximately 12,000 square feet of land area, to be located in the approximate center of the petition area. It would also be necessary to have the switching office within 2,640 feet of any planned HELCO substation (Mabuni, September 24, 1992).

Cable Television. It will be necessary to provide additional service to the petition area.

Mitigation Measures

The developer and/or landowner should work closely with HELCO to monitor the capacity of electrical production in the region to ensure that there is adequate supply for future development of the petition area.

Once specific land uses for the petition area have been identified, the developer and/or landowner should work closely with HELCO to identify any potential health hazards that might be present as the result of proximity to the transmission lines now found within the petition area. The identification of potential health hazards should be done prior to any application for County zoning.

Energy-saving measures will be incorporated, as much as feasible, into the development's site planning, landscaping, building design, and mechanical systems and equipment. The developer will use the Model Energy Code, developed under the auspices of the Department of Business, Economic Development and Tourism, as a guide for the development of the petition area. The Model Energy Code is a building energy efficiency standard for the State of Hawaii, and includes a set of requirements for the energy-efficient design of buildings and building systems.

Development of the petition area will also seek to incorporate strategies for energy efficient architectural design as identified in the 1990 AIA/DBED study entitled "Hawaiian Design, Strategies for Energy Efficient Architecture." These design strategies include orientation and building form; solar control; daylighting; natural ventilation; landscaping; building systems and material selection; and equipment efficiency. The

petitioner recognizes the importance of incorporating energy saving design to encourage cost effective energy efficiency.

6.7 Police, Fire and Emergency Services

Affected Environment

Police Protection. Police protection for the region is provided by the Hawaii County Police Department operating from its new regional headquarters in Kealakehe, about two miles south of the petition area. The area served by the Kealakehe Station extends from Manuka State Park in South Kona to Anaeho'omalu Bay in North Kona. Substations are also maintained in Captain Cook and Kailua-Kona.

Fire Protection. The Hawaii County Fire Department provides fire protection services to Big Island residents. Fire stations within the region are located at Captain Cook, Kailua-Kona and South Kona. A volunteer station is located at Waikoloa. The Kailua-Kona station is the closest in to the petition area, located on Palani Road above the Queen Kaahumanu intersection, about eight miles from the petition area (approximate response time of ten (10) minutes).

The Hawaii Insurance Rating Bureau assigns Public Protection Classification numbers according to risk analysis in their Fire Protection Manual. The lowest rating in the Kailua-Kona area is a Class 6. This means that property is within 1,000 feet of a fire hydrant and within five road miles of a responding fire department station. The petition area is rated as a Class 10, which means that fire protection facilities are not considered adequate for recognition by the bureau (Ayala, June 1991).

Emergency Ambulance. Emergency ambulance service is administered by the Emergency Services Branch of the Department of Health (DOH), with primary responsibility for the provision of emergency service given to the County of Hawaii Fire Department under contract to DOH. Advanced life support ambulance units are located at the Kailua-Kona Fire Station (one unit), the Captain Cook Fire Station (one unit) the Mauna Lani Fire Station (one unit) and Waimea Fire Station (two units) (Nishimura, September 23, 1992).

Probable Impacts

The increase in population attributable to the development of the petition area will increase demand on existing police, fire and emergency facilities within the region.

Mitigation Measures

Urbanization of the petition area will require the provision of additional police, fire and emergency services in the region. It is recommended that the Petitioner coordinate with the State Department of Health, and the County Departments of Police and Fire, to set aside land, if required, to accommodate additional stations or substations for these services.

6.8 Schools and Libraries

Affected Environment

Schools. The North Kona District is serviced by three public schools. The only public high school serving the region, Konawaena, is located in Captain Cook, about 19 miles

south of the petition area. As the population of North Kona has increased in recent years, so has the enrollment in North and South Kona schools. As shown in Table 6, the enrollment in the public schools of North and South Kona have increased their collective enrollments by about 1,448 students (35 percent) since 1984, with North Kona alone experiencing an increase of 944 students (43 percent). The public schools in West Hawaii are characterized as overcrowded and the Department of Education has plans to add a high school and an elementary school at Kealakehe to complement the proposed HFDC development at Kealakehe. Currently there are no school sites planned in the petition area, although land areas for such use have been accommodated in the analysis of alternative scenarios (Toguchi, September 10, 1992).

Table 20
Enrollment Trends; North and South Kona Schools

District	School	Location	Grades	1984 Enrollment	1992 Enrollment
North Kona	Kealakehe School	Kailua-Kona	K-8	1,244	1,855
	Kahakai School	Kailua-Kona	K-6	440	711
	Holualoa	Holualoa	K-6	321	383
South Kona	Konawaena Elem.	Kailua-Kona	K-6	613	735
	Konawaena Interm and High	Kailua-Kona	7-12	1,439	1,821
Total				4,057	5,505

Source: Department Of Education, September 1992

Libraries. The North Kona region is currently served by three public libraries located in Kailua-Kona, Holualoa, and, Kealakekua.

Probable Impacts

Current facilities planning projections for the Department of Education do not include additional population increases within the petition area. Although a high school is being planned in Kealakehe to serve the residential community being planned by HFDC, additional enrollment impact associated with the urbanization of the petition area will require new facilities (ibid). Because land uses for the petition area have not yet been determined, it is difficult to predict the level of additional services that would be required at this time.

Mitigation Measures

It is recommended by the Petitioner that the Land Use Commission attach the following condition to its approval: *that the landowner and/or developer of the petition area should contribute to the development, funding and/or construction of school facilities, on a pro-rata basis, as determined by and to the satisfaction of the Department of Education*

(DOE). Agreement by DOE on the level of funding and participation shall be obtained prior to the developer and/or landowner applying for county zoning.

6.9 Recreation Facilities

Affected Environment

The General Plan for Hawaii County describes the recreation facilities of North Kona as "generally inadequate." Some of the existing recreation facilities in the district have been variously described as having "limited area", "too small for team sports", "no restroom facilities", "inadequate parking", and "overcrowded." This assessment of the region's recreation facility was supported by the Keahole to Kailua Development Plan, which stated "the area lacks adequate parks and outdoor recreation facilities."

In addition, the Kona Palisades Estates Community Association has indicated that they have been working with State and County officials to establish a community park within the petition area (Matsuyama, September 23, 1992). The location of this proposed park is also within the area identified by the State Department of Agriculture for expansion of the Keahole Agricultural Park.

Probable Impacts

The urbanization of the petition area can serve the growing resident population of the North Kona District and their recreational needs. An increase in population will likewise increase the stress on a public recreation system that is already determined to be inadequate.

Mitigation Measures

It is recommended that the developer and/or landowner coordinate the provision of adequate recreational facilities with the County Department of Parks and Recreation.

6.10 Solid Waste Disposal

Affected Environment

The County operates 28 solid waste transfer station chutes at 21 locations around the island, including a transfer station at Kailua. Refuse collected at these stations is transferred to one of two landfill sites on the Big Island: Hilo or Kailua-Kona (Kealakehe). Refuse collected by private contractors cannot be deposited at the refuse transfer stations; instead it must be trucked to a landfill site. Hazardous wastes and sludge are not accepted at any of the County's landfills.

In 1990, approximately 108 tons per day of solid waste were generated in North and South Kona. In 1991, it was estimated that 6.0 pounds of solid waste was generated per capita per day on the Big Island (Kuba, February 1993).

Governor Waihee recently signed into law the Solid Waste Management Act (Act 324, Session Laws of Hawaii, 1991), which mandates a 25 percent decrease in solid waste generation by the year 1995 and a 50 percent reduction in solid waste generation by the year 2000. Each county is required to prepare a Waste Management Plan to realize these reductions. At this time, the County of Hawaii has not developed a waste management plan, although a draft plan is currently under review.

The Kailua Landfill, which presently serves the North and South Kona solid waste district, is expected to close in late 1993 (ibid). The Kailua Landfill will be replaced by a new landfill at Puu Anahulu, south of Waikoloa. It is probable that the Kealakehe site would then be converted to a transfer station. Refuse from the petition area would be accepted by the proposed municipal landfill at Puu Anahulu.

Probable Impacts

Based on the three scenarios discussed in Section 2.5, it is estimated that between 48 and 64 tons of solid waste could be generated each day as a result of urbanization of the petition area. This assumes that there will be no change in the per capita generation of solid waste. If there is a reduction in this value via reuse, recovery and recycling, the total amount of solid waste generated by the urbanization of the petition area may be less.

Mitigation Measures

The anticipated closure of the Kealakehe Landfill offers an opportunity to develop an additional transfer station on the landfill site. This transfer station could serve the petition area, thereby providing a more convenient and efficient means for solid waste disposal within the region.

The Department of Health has recommended that secondary resources be incorporated in the development of the petition area, such as compost and crushed glass.

The Petitioner recommends that the Land Use Commission attache the following condition to its approval: *that the developer and/or landowner of the petition area should cooperate with the State Department of Health and the County of Hawaii Department of Public Works to conform to the program goals and objectives of the Integrated Solid Waste Management Act, Chapter 342G, HRS, and the County's approved integrated solid waste management plans in accordance with a schedule and timeframe satisfactory to the Department of Health.*

6.11 Civil Defense Services

Affected Environment

The petition area is not affected by flood hazard and is within lava flow hazard zone 4, a zone of medium threat.

Probable Impacts

Should a natural disaster affect the petition area after it has been urbanized, the added population and urban improvements would add to the responsibilities of the various civil defense agencies.

Mitigation Measures

It is recommended by the Petitioner that the Land Use Commission attach the following condition to its approval: *that the developer and/or landowner of the subject property should fund and construct adequate civil defense measures as determined by the County and State Civil Defense agencies.*

The State Department of Defense has indicated that three civil defense sirens would be needed for the petition area (Price, January 25, 1993)

6.12 Health Care Facilities

Affected Environment

There are presently four state hospitals and a private medical center on the island of Hawaii which serve the residents of West Hawaii. The State Department of Health administers the Kona Hospital, the Hilo Hospital and the Honokaa Hospital. The Kona Hospital is an 82-bed acute care facility, which is the closest facility to the project site. The Hilo Hospital is a much larger acute care facility, with 276 beds. Patients from West Hawaii are accommodated at the Hilo Hospital when there is either a shortage of beds at Kona or a need for a medical specialty not available at Kona that is available in Hilo. In addition there is a long-term 50-bed facility planned in Honokaa to replace an existing 30-bed acute facility that has outlived its structural usefulness. A fourth state facility, the Kohala Hospital, a 26-bed acute care facility, serves the residents of the Kohala area (Kam, Department of Health, June 1991).

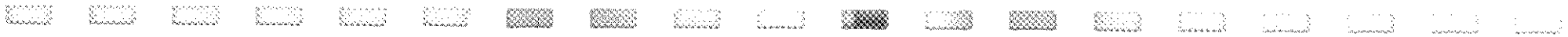
A planned community general facility is to be located in Waimea. This 50-bed facility will be designed as an acute-care facility, and will be constructed with matching State and private funding. When completed, the hospital will be privately run and will be the only facility offering acute care services in North Hawaii. There are no other facilities presently planned to serve the West Hawaii area.

Probable Impacts

The increase in resident population that is probable as a result of the urbanization of the petition area will place additional demands on health care services in the region.

Mitigation Measures

The developer and/or landowner of the petition area should coordinate development activities with the State Department of Health to provide it with as much lead time as possible to plan for expanded health care facilities in the region.



CHAPTER 7 ALTERNATIVES TO THE PROPOSED ACTION

7.1 Introduction

Two alternatives to the proposed action are considered below: (1) a no-action alternative; and, (2) an agriculture alternative.

7.2 No Action Alternative

This alternative would preclude development of the petition area, and thus a benefit of this alternative would be the retention of the site in its natural state for an undetermined period of time.

The no action alternative suggests that the Petitioner will postpone the urbanization of the petition area. Other benefits associated with this alternative relate to the economic "savings" incurred from the deferment of development expenses, including on- and off-site infrastructure, and the retention of the petition area in its undeveloped condition.

Detriments for the no-action alternative are many:

- the Petitioner would be prevented from implementing State and County land use policies, which are to urbanize the petition area;
- housing opportunities would be reduced, as less land would be available for development of residential uses;
- job opportunities and tax revenues would also be reduced.

7.3 Agriculture Alternative

The agriculture alternative would allow a fuller development of agricultural uses within the petition area. Such an alternative would provide additional opportunities for diversified agriculture, although substantial investment in the provision of infrastructure, including roads, water lines and electricity, (albeit at lower levels than urbanization of the petition area) would be required. This alternative assumes there is significant pent-up demand for additional agricultural land that is marginally productive, at best.

A recent analysis of diversified agriculture in Hawaii indicates that ample prime agricultural land will be available to easily accommodate the statewide requirements of diversified agriculture (Decision Analysts Hawaii, Inc., January, 1993). This conclusion is based on four findings:

- a vast amount of prime agricultural land and water is available statewide, having been freed from sugar and pineapple production in recent years;
- it is very possible that additional sugarcane acreage and water will be freed, given the existence of unprofitable sugar operations;
- some, if not most, of the sugar operations would make their lands available for profitable replacement crops to the extent that such crops exist; and in contrast,
- land requirements for diversified agriculture are surprisingly modest.

In this context, there is sufficient land available for diversified agriculture without including the petition area.

The agriculture alternative has the same detriments as the no action alternative.

7.4 Analysis and Conclusion

Current State and County of Hawaii land use policies directed at urbanizing the Kailua to Keahole corridor, and the associated demands for affordable housing and economic development indicate that the only feasible alternative to the Petitioner is the urbanization of the petition area. Therefore, the no-action alternative and the agriculture alternative have been rejected. In the case of the agriculture alternative, it is problematic whether there is sufficient demand for marginally productive land to warrant additional investment for the construction of infrastructure to support a considerable expansion of agricultural activities in this location. This is especially true in light of the recent closure of the Hamakua Sugar Company and the availability of large tracts of agriculturally productive land that is already serviced by adequate infrastructure.

CHAPTER 8 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17(k)) requires the "identification of unavoidable impacts and the extent to which the action makes the use of non-renewable resources during the phases of the action, or irreversibly curtails the range of potential uses of the environment.

Reclassification of the petition area will eventually lead to its urbanization and the irretrievable commitment of natural and fiscal resources to its development. This will include the loss of existing open space that is primarily in an unaltered condition and the spending of public funds to construct the infrastructure necessary to support new development, including roads, water sources and transmission lines, sewer lines, and wastewater treatment facilities. In addition, fossil fuels will be expended in support of construction activities, the manufacture of construction materials and the on-going needs of the residential and commercial activities that would be part of the urbanized petition area.

The commitment of using these resources, however, should be evaluated in light of recurring benefits to the residents of the region, the County, and the State alternative of taking no action.

The overall reclassification will remove 1,400 acres± from the State Conservation District and 1,200± acres from the State Agriculture District. Construction of buildings and other man-made improvements will narrow the range of future non-urban uses for this acreage, although no land that is currently productive will be taken out of the agricultural inventory.

Impacts to historic sites will be mitigated in accordance to mitigation plans by the State Historic Preservation Division. Impacts to rare, threatened and/or endangered plants will be mitigated by establishing appropriate buffer zones.

CHAPTER 9 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17(j)) requires a brief discussion of the "extent to which the proposed action involves tradeoffs between short-term losses and long-term losses or vice-versa, and a discussion of the extent to which the proposed action forecloses future options, narrows the range of beneficial uses of the environment, or poses long-term risks to health or safety..."

Analyses of various on-site environmental features have found the petition area to be well endowed with physical attributes that are desirable both as possible urban uses and continued preservation of historic and botanical resources. These include the gently-sloping nature of the petition area, which makes future development feasible, the expansive mauka and makai views which will provide visual amenities to future development and the location of the petition area in a region that has been identified by State and County land use plans as policies to be the center of future development within the larger West Hawaii Region.

Studies have indicated that the proposed reclassification is generally compatible with the existing natural environment. Specific recommendations to mitigate any adverse impacts will be more clearly defined during future master planning for the petition area and would be implemented in the construction and operation phases of the proposed development.

During the analysis of potential impacts associated with the reclassification of the petition area, including studies prepared for the DEIS, existing and future water resources within the North Kona Water System have been described. Depending on the mix of uses that may be developed within the petition area, it is possible that water sources for the North Kona Water System could approach their sustainable yield, if all other planned projects, both public and private, are developed. otherwise, if the urbanization of the petition area occurs, little environmental degradation is expected to occur nor would it pose a significant risk to the health and safety of residents or visitors in the resort area or vicinity.

As the property develops, its productivity in terms of generating tax revenues will increase. Employment and housing opportunities generated within the petition area will have benefits that ripple through the regional economy. Income from property, personal and excise taxes are expected to offset expenses associated with expanded public services to meet the needs of population growth anticipated by the County General Plan.

Throughout this DEIS, it has been pointed out that specific land uses for the petition area have not yet been identified. Nevertheless, based on a discussion of three possible development scenarios in Section 2.5, a broad range of potential impacts have been identified and discussed. Where the potential for adverse environmental impacts related to the project have been identified, measures to mitigate the undesirable consequences of development have been proposed. With the possible exception of diversified agriculture (primarily horticulture), the property is unsuitable for certain alternative land uses in which productivity is measured by the value of their cultivated or extracted products.

10 CONSULTED PARTIES AND PARTICIPANTS IN THE DEIS PREPARATION PROCESS

10.1 Participants in the Draft EIS Preparation Process

The draft EIS was prepared for the Office of State Planning by Helber Hastert and Fee, Planners. The following list identifies individuals and organizations who were involved in the preparation of the DEIS and their respective contributions.

Helber Hastert & Fee, Planners

Thomas A. Fee, AICP, (Principal-in-charge)
Scott Ezer (Project Manager and Principal Author)

Technical Consultants

Phillip L. Bruner (Avifauna and Mammals)
Paul H. Rosendahl, Inc. (Archaeology)
Water Resource Associates (Hydrology)
Char and Associates (Botany)
M&E Pacific, Inc. (Drainage)
The Traffic Management Consultant (Traffic Engineering)

10.2 Parties Consulted During the Preparation of the Draft EIS

An EIS Preparation Notice (EISPN) was published in the OEQC Bulletin for the proposed boundary amendment on January 8, 1993, following a determination by the State Land Use Commission that the boundary amendment may have a significant effect on the environment. The publication of the EISPN began a 30-day public review period which ended on February 8, 1993. A copy of the EISPN was mailed to 45 agencies, organizations, and individuals listed below. The list contains parties believed to have an interest in the proposed boundary amendment.

By March 23, 1993, a total of 20 agencies, organizations or individuals provided written comments on the EISPN. The parties who responded to the EISPN are identified by an asterisk (*) and their respective comments are reproduced in Chapter 11.

Federal Agencies

Department of the Interior
- Fish and Wildlife Service
- National Park Service
- Geological Survey and Water Resources Division

* Department of Housing and Urban Development, Community Planning and Development Division
Department of Agriculture, Soil Conservation Service
* Department of the Army, U.S. Army Engineer District, Honolulu
U.S. Department of Commerce, National Marine Fisheries Service-Honolulu Laboratory
* Federal Aviation Administration, Airports District Office

State Agencies

Office of Environmental Quality Control
* Department of Business, Economic Development and Tourism
* Energy Division
* Land Use Commission
* Department of Education
State Librarian
Department of Accounting and General Services
* Department of Agriculture
* Department of Health
Environmental Management Division
* Board of Land and Natural Resources
* Department of Transportation
* Housing Finance and Development Corporation
University of Hawaii
Environmental Center
Water Resources Research Center
Administration (Manoa)
* Department of Defense
* Department of Hawaiian Home Lands
* Office of Hawaiian Affairs
Natural Energy Laboratory of Hawaii Authority
Department of Land and Natural Resources
* State Historic Preservation Division

University of Hawaii at Hilo, Chancellor's Office

County of Hawaii Agencies

Honorable Steven Yamashiro, Mayor
Department of Parks and Recreation
Department of Research and Development
* Department of Water Supply
* Fire Department
Planning Department
* Police Department

Public Utilities

* GTE Hawaiian Telephone Company, Inc.
Hawaii Electric Light Co.

Community Organizations/ Interest Groups

American Lung Association
Keahole Ag Park Community Association
Keahole Point Association
Kalaoa Community Park Citizens Committee
Kona Palisades Community Association
CH2M Hill

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCE

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

RECEIVED
JAN 12
HELBER HASTERT & FEE PLANNERS

January 8, 1993

Mr. Scott Ezer
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

LOG NO: 7217
DOC NO: 9301RC11

Dear Mr. Ezer:

SUBJECT: **State LUC Petition -- Keahole to Kailua Region: EIS Prep Notice**
Multiple, North Kona, Hawaii

Thank you for your letter of January 7, 1993, submitting this document. As you note on pages 23-24, PHRI will be doing a detailed synthesis of settlement patterns for the area and will also be conducting an inventory survey for 500 acres of the project area. We will await the submittal of those documents for our review.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

RC:sty

Helber Hastert
Planners

February 22, 1993

Mr. Don Hibbard, Administrator
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 8, 1993.

As pointed out in the environmental assessment, Paul H. Rosendahl, Ph.D., Inc., (PHRI), has conducted a detailed synthesis of settlement patterns in the area and an inventory survey for 500 acres of the petition area. You should already have received an advance copy of the synthesis study, prior to the publication of the draft EIS. We have also requested that PHRI send you a copy of the interim report for the inventory survey, prior to the publication of the draft EIS.

Both documents will be summarized in the draft EIS and attached as technical appendices. We look forward to your comments on both documents.

Also, we are aware that an archaeological inventory survey will be required for all portions of the petition area not covered by an inventory survey prior to the developer/landowner applying for zone change at the county level.

Sincerely,

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PBH Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545-2055
Facsimile: 808 545-2050

US Department
of Transportation
**Federal Aviation
Administration**

AIRPORTS DISTRICT OFFICE
BOX 50244
HONOLULU, HI 96850-0001
Telephone: (808) 541-1243
Fax: (808) 541-3462

January 14, 1993

Mr. Scott Ezer
Helber Hastert & Fee
733 Bishop Street, #2590
Honolulu, Hawaii 96813

HELBER HASTERT & FEE
PLANNERS

Dear Mr. Ezer:

We have reviewed the Environmental Impact Statement Preparation Notice (EISPN) Urban Expansion State Land Keahole to Kailua Region transmitted January 7, 1993.

We have no comments on the EISPN, but note that the State Department of Transportation, Airports Division, has submitted a Grant Application for funding to update the Keahole Airport Master Plan and Noise Compatibility Study.

Sincerely,

David J. Welhouse
Airport Engineer/Planner

Henry A. Sumida
Airports District Office Manager

Helber Hastert
Planners

February 22, 1993

Mr. David J. Welhouse, Airport Engineer/Planner
U.S. Department of Transportation
Federal Aviation Administration
Airports District Office
Box 50244
Honolulu, Hawaii 96850-0001

Dear Mr. Welhouse:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 14, 1993.

We note that you have no comments on the EISPN. We also note your comment that the State Department of Transportation, Airports Division has submitted a grant application for funding to update the Keahole Airport Master Plan and Noise Compatibility Study. We will monitor the progress of these studies so that any changes to existing information can be incorporated into the planning process for the petition area at the earliest time possible.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PBI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545-2055
Facsimile: 808 545 2050

Stephen K. Yamashiro
Mayor

Victor V. Vierra
Chief of Police

Francis C. DeMorales
Deputy Chief of Police

Police Department

County of Hawaii • 349 Kapiolani Street • Hilo, Hawaii 96720-3998 • (808) 961-2244 • Fax (808) 961-2702

January 15, 1993

Mr. Scott Ezer
Associate
Helbert Hastert & Fee
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

RE: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
URBAN EXPANSION STATE LANDS
KEAHOLE TO KAILUA REGION

We foresee an increase in traffic and calls for services should the application be granted.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

TJH:sk

cc: Kona Police

Helbert Hastert
Planners

February 22, 1993

Mr. Victor V. Vierra, Chief of Police
County of Hawaii
Police Department
349 Kapiolani Street
Hilo, Hawaii, 96720-3998

Dear Chief Vierra:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 15, 1993.

We note that you foresee an increase in traffic and calls for service should the petition for reclassification be granted. The Traffic Management Consultant is conducting a traffic assessment for the proposed reclassification. This report will include a general discussion of traffic patterns and Department of Transportation plans to address the expectation of increased traffic as result of urbanization. This report will be summarized in the draft EIS and included in its entirety as a technical appendix.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

OFFICE OF THE SUPERINTENDENT

RECEIVED
JAN 28
HELBER HASTERT & FEE

January 20, 1993

Mr. Scott Ezer, Associate
Helber Hastert, and Fee Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

SUBJECT: Environmental Impact Statement Prep Notice (EISPN)
Urban Expansion State Lands
Keahole to Kailua Region, Island of Hawaii

The Department of Education (DOE) has reviewed the subject EISPN and has the following comments to add to those in our letter dated September 10, 1992:

1) On pages 4 and 38, the statement is the reclassification, "will require new public education facilities, as yet unplanned, or a change in school service areas." The option of changing school service areas is not viable in the North Konawaena schools since all are operating beyond capacity. We recommend that the last portion of the sentence be deleted.

2) It is the intention of the DOE to request that any school sites needed within the reclassification area be donated to the State of Hawaii.

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

3) We must reemphasize the need to be informed of planned developments since they are the basis for enrollment projections and the need for additional educational facilities.

All of the comments in the September 10, 1992, letter are still valid.

Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga
A. Garson

Helber Hastert
Planners

February 22, 1993

Mr. Charles T. Toguchi, Superintendent
State of Hawaii
Department of Education
P.O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 20, 1993.

We note that the option of changing school service areas is not viable in the North Konawaena schools since all are operating beyond capacity. Accordingly, the last portion of the sentence you referenced will be deleted.

We also note that the Department of Education intends to request that any school sites needed within the reclassification area be donated to the State of Hawaii. As more specific planning occurs for the petition area, future land area needed for additional school sites will be coordinated with the Department of Education. We hope to keep your department informed as more specific plans are developed, since these plans form the basis for enrollment projections and the need for additional educational facilities.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

January 20, 1993

RECEIVED
JAN 21 19[illegible]
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer, Associate
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: Environmental Assessment: Urban Expansion State Lands, Keahole to Kailua Region, North Kona, Hawaii

Thank you for allowing our review of the subject assessment dated November, 1992, for approximately 2,640 acres of land in the Keahole area of the Big Island.

We have no additional comments other than the concerns expressed in our letter of September 18, 1992.

Should there be any questions, please call Mr. Ben Henderson of our Planning Office at 586-3838

Warmest aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:BH:jc

2547L.2

Helber Hastert
Planners

February 22, 1993

Ms. Hoaliku Drake, Chairman
Hawaiian Homes Commission
State of Hawaii
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

Dear Ms. Drake:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 20, 1993. We note that you have no additional comments other than those expressed in your letter of September 18, 1992, which we received during the early consultation process.

The Office of State Planning (OSP) believes the proposed urban expansion implements long-range planning proposals that will provide development opportunities in the region for many years. This planning effort is consistent with existing adopted State and County planning documents, including the Hawaii County General Plan, the Keahole to Kailua Development Plan, and the West Hawaii Regional Plan. It is understood that a coordinated effort by the State and County of Hawaii, as well as private landowners will be required to provide needed improvements and services for the entire region.

OSP also believes HFDC's Kealakehe project and this request are mutually supportive. Because the Kealakehe project is further along in the planning process, OSP does not believe the two projects will be competing for capital improvement funds.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee | 733 Bishop Street, Suite 2590 | Telephone: 808 545 2055
Grosvenor Center, PRI Tower | Honolulu, Hawaii 96813 | Facsimile: 808 545 2050

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

January 22, 1993

Planning Division

RECEIVED
JAN 26

Mr. Scott Ezer, Associate
Helber Hastert Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice for the Urban Expansion State Lands for Keahole to Kailua, Hawaii. We have no additional comments to offer from those presented in our previous letter dated September 21, 1992.

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

Helber Hastert
Planners

February 22, 1993

Mr. Kisuk Cheung, P.E.,
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 22, 1993.

We note that you have no additional comments to offer from those presented in your previous letter dated September 21, 1992, which we received during the early consultation process. Those comments indicated that a Department of the Army permit will not be required for any work within the petition area and that the petition area is located in the "Zone X-unshaded" area (areas determined to be outside the 500-year flood plain) according to FEMA's Flood Insurance Rate Maps.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

PHONE (808) 734-2161

January 25, 1993

RECEIVED
JAN 26
HELBER HASTERT & FEE
PLANNERS

TO: Mr. Scott Ezer
Helber Hastert & Fee, Planners

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense

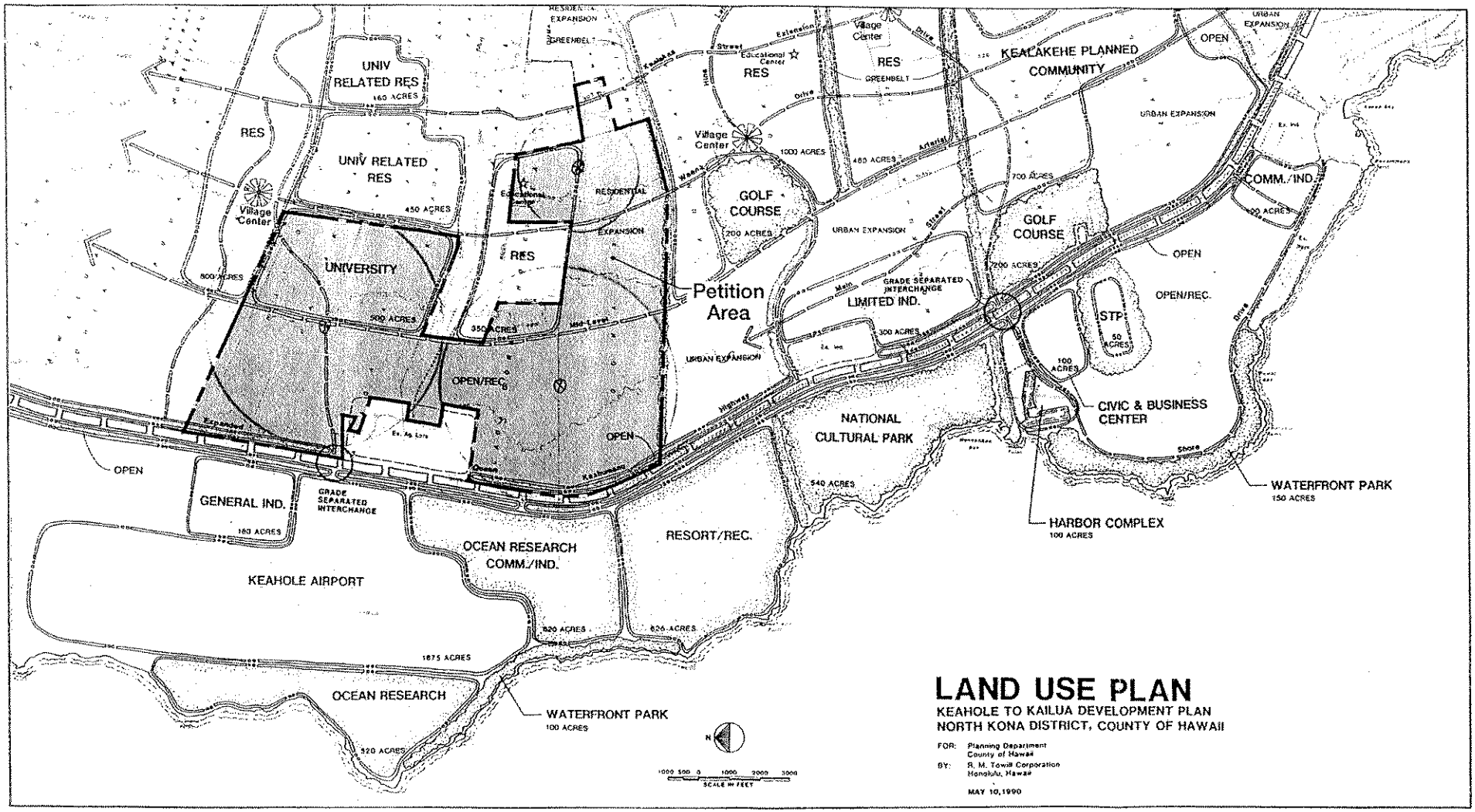
SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN), ENVIRONMENTAL ASSESSMENT (EA); URBAN EXPANSION STATE LANDS, KEAHOLE TO KAILUA REGION

We appreciate this opportunity to comment on the EA for Urban Expansion State Lands, Keahole to Kailua Region, North Kona, Hawaii, Hawaii. Project area TMK: 3-07-09: 05 and 08; 3-07-10: 02 and por. 33.

While we do not have negative comments specifically directed at this EA, we do have a proposal that entails that the developer install two (2) each 121 Db and one (1) each 115 Db solar powered sirens in the project area. The proposed 121 Db sirens require a 250 feet radius buffer zone from any residential building. The 115 Db siren requires a 100-foot radius buffer zone from any residential building. The locations for the sirens are shown on figure 12, "LAND USE PLAN." Just as parks, schools, fire hydrants, underground/overhead utilities and sidewalks are planned as integral parts of subdivisions and industrial areas, so must emergency warning systems be planned for the safety of communities.

Our State Civil Defense planners and technicians are available to discuss this further if there is a requirement. Please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

Enc.



Keahole to Kailua Development Plan

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Source: Keahole to Kailua Development Plan, County of Hawaii, 1991

Figure: 12

Feet 0 1500 3000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

Helber Hastert
Planners

February 22, 1993

Mr. Roy C. Price, Sr., Vice Director of Civil Defense
State of Hawaii
Department of Civil Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Mr. Price:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 25, 1993.

We note that you propose the installation of two (2) 121 decibel (Db) and one (1) 115 dB solar powered sirens in the petition area. We also note that the 121 dB sirens require a 250-foot buffer zone from any residential building and that the 115 dB siren requires a 100-foot buffer zone. We appreciate your early recognition of these requirements so that they can be more easily integrated into the future plans for the area.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PBH Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

Stephen Yamashiro
Mayor
Nelson M. Tsuji
Fire Chief

Fire Department

County of Hawaii • 466 Kinoole Street • Hilo, Hawaii 96720-2983 • (808) 961-8297 • Fax (808) 961-6920

January 25, 1993

RECEIVED
28
HELBER HASTERT & FEE
PLANNERS

Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Attention: Scott Ezer

Gentlemen:

Subject: Environmental Impact Statement Preparation Notice
Urban Expansion State Lands
Keahole to Kailua Region

We have reviewed the above-referenced environmental assessment and recommend the projection of a possible site for a fire station in this area for appropriate response times.

Thank you for giving us the opportunity to submit our comments.

Sincerely,

NELSON M. TSUJI
Fire Chief

NMT/mo

Helber Hastert
Planners

February 22, 1993

Mr. Nelson M. Tsuji, Fire Chief
County of Hawaii
Fire Department
466 Kinoole Street
Hilo, Hawaii 96720-2983

Dear Chief Tsuji:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 25, 1993.

We note your comment and recommendation concerning the projection of a possible site for a fire station in this area to maintain appropriate response times.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer,
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6916

January 25, 1993

RECEIVED

Mr. Scott Ezer
Helber Hastert & Fee, Planners
733 Bishop Street
Suite 2590
Honolulu, HI 96813

ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
AGRICULTURAL/CONSERVATION TO URBAN
TAX MAP KEY 7-3-09:5 AND 8, 7-3-10:2 AND 7-3-10:33 (POR.)

We have reviewed the subject assessment.

Please refer to our letter of November 4, 1992 to the Office of State Planning for our comments and requirements. A copy of which is attached.

H. William Sewake
Manager

WA

Attach.

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969 1421 • FAX (808) 969 6996

November 4, 1992

Office of State Planning
ATTENTION: MS. MARY LOW KOBAYASHI
P.O. Box 3540
Honolulu, HI 96811-3540

STATE LAND USE BOUNDARY AMENDMENT
AGRICULTURAL/CONSERVATION TO URBAN (2,589 ACRES)
TAX MAP KEY 7-3-09:5 AND 8, 7-3-10:2, AND 7-3-10:33 (POR.)

We have reviewed the subject petition.

General information regarding potable drinking water is sufficiently explained in Section 3.3.1, pages 33 and 34 of the environmental assessment. With the understanding that the State continue to pursue water system development either individually or jointly with other public or private groups, we have no objections to the petition.

H. William Sewake
Manager

QA

cc - State of Hawaii Department of the Attorney General - Attention: Rick J. Eichor, Esq.
Ann Ogata-Deal, Esq.

State of Hawaii Land Use Commission
Planning Department

... Water brings progress...

Helber Hastert
Planners

February 22, 1993

Mr. H. William Sewake, Manager
County of Hawaii
Department of Water Supply
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Kealohe to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 25, 1993.

We note that you refer to comments made in your letter of November 4, 1992 which was submitted during the early consultation process. These comments offer that the general information supplied is sufficiently explained in the environmental assessment for the above project and that you have no objection to the petition.

For your information, Water Resource Associates has since completed a groundwater resource report relative to the petition. This report will be summarized in the draft EIS and attached as a technical appendix.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PBH Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

IN REPLY REFER TO:
93:PPE/347

January 26, 1993

RECEIVED
JAN 28
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helber Hastert & Fee Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Re: Environmental Impact Statement Preparation Notice for Urban Expansion of State Lands in the Keahole to Kailua Region

Upon review of the subject EISPN, it appears that it will be necessary to coordinate the master planning of the urban expansion area with the alignment of the electrical transmission lines to mitigate any potential electromagnetic field impacts.

Thank you for the opportunity to comment.

Sincerely,

JOSEPH K. CONANT
Executive Director

Helber Hastert
Planners

February 22, 1993

Mr. Joseph K. Conant, Executive Director
State of Hawaii
Department of Budget and Finance
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

Dear Mr. Conant:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated January 26, 1993.

We note your comment concerning the future alignment of electrical transmission lines that will be necessary to increase transmission capabilities for Hawaii Electric Light Company (HELCO). We are aware of HELCO's need for additional transmission lines corridors and recognize that planning for these corridors is in an early planning stage. We believe that because specific land uses and their locations have not yet been identified for the petition area, it will be possible to accommodate any transmission corridors that will need to cross the petition area.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

GTE Hawaiian Tel

Beyond the call

GTE Hawaiian Telephone Company Incorporated
P.O. Box 4249 · Hilo, HI 96720 · (808) 935-9411

February 2, 1993

Reply to:
ABY-3
Honolulu, HI



Mr. Scott Ezer
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 25900
Honolulu, Hawaii 96813

Subject: **Review for:**
Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands
Keahole to Kailua Region

Dear Mr. Ezer:

Thank you for the opportunity to provide additional comments on the subject project.

At this time, we do not have any additional comments than those stated in our **September 28, 1992** letter to your office.

If you have further questions, please give me a call at 834-6221 or Gordon Yadao at 933-6488.

Winslow Tanabe
Operations Manager
OSP Engineering

WIT/bu

c: G. Yadao

Helber Hastert
Planners

February 22, 1993

Mr. Winslow Tanabe, Operations Manager
OSP Engineering
GTE Hawaiian Telephone Company Incorporated
P.O. Box 4249
Hilo, Hawaii 96720

Dear Mr. Tanabe:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated February 2, 1993.

We note that you have no additional comments for EISPN other than those stated in a letter of September 28, 1992, which you submitted as part of the early assessment process. Your comments at that time indicated that Hawaiian Telephone Company would have to establish an Electronic Serving Area for the petition area, which would require approximately 12,000 square feet of land for a remote switching office. You further indicated that the remote switching office should be approximately 2,640 feet from any planned HELCO substation.

You also noted that portions of the petition area north of the Keahole Agricultural Park are located out of the existing telephone rate base area, and associated aid-to-construction costs will need to be calculated once the plans for the area are finalized.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PBT Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.5013

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

February 8, 1993

RECEIVED
15
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helber Hastert & Fee, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: Environmental Impact Statement Preparation
Notice (EISPN), Urban Expansion State Lands
Keahole to Kailua Region

Since the proposal is to reclassify State lands in the Keahole to Kailua region without specifying uses for the petition area, the standard conditions as discussed with the Office of State Planning should be imposed. Of particular importance is the condition requiring the submittal of a Traffic Impact Analysis Report to our department and the provision for transportation improvements.

On Page 33, the second paragraph should be revised to reflect completion of the two projects at Kawaihae Harbor. Another project, a joint Federal/State effort to develop a 90-craft small boat harbor, is underway and will be located adjacent and to the south of Kawaihae Harbor. This project is being implemented by the Department of Land and Natural Resources, Boating and Ocean Recreation Division. Recreation vessels moored in the commercial harbor will be relocated to the new boat harbor.

Thank you for this opportunity to provide comments.

Sincerely,

Rex D. Johnson
Director of Transportation

Helber Hastert
Planners

February 22, 1993

Mr. Rex Johnson, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated February 8, 1993.

We note your recommendation that since the proposal for reclassification has not specified land uses for the petition area, the standard traffic conditions discussed with the Office of State Planning should be imposed as a condition of reclassification. The draft EIS will include this language in the discussion of mitigating measures.

We also note that two projects discussed on page 33 of the EISPN have been completed. The draft EIS will reflect this change in status to these projects. In addition, we appreciate the information regarding the development of a 90-craft small boat harbor underway adjacent and south of Kawaihae Harbor, which is being implemented by the Department of Land and Natural Resources, Boating and Ocean Recreation Division. This information will also be incorporated into the draft EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAII 96813-5249
PHONE (808) 586-3777
FAX (808) 586-3799

February 8, 1993

RECEIVED
- 9
HELBER HASTERT & FEE
PLANNERS

Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawai'i 96813
Attention: Scott Ezer

RE: Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands, Keahole to Kailua Region

Dear Mr. Ezer:

We have received a copy of the above-referenced Environmental Impact Statement Preparation Notice. Thank you for the opportunity to provide comment at this preliminary level. We suggest that the following concerns be addressed in the project EIS.

1. Inclusion of a plan which describes the cultural, historical and archaeological resources and identifies ways in which these sites can be protected, preserved and interpreted for the benefit of the community.

2. A discussion of how the utility needs for the new urban area can be met, considering the current electric power crisis.

3. A discussion of traffic patterns and Department of Transportation plans to address the expectation of increased traffic as a result of urbanization.

4. A discussion of the ability to increased meet the demand for potable water as a result of urbanization.

If you have any questions, please contact Lynn J. Lee in our Land and Natural Resources Division at 586-3777.

Sincerely,

Richard K. Paglinawan
Administrator

cc: Clayton Hee
Chair, Board of Trustees

Helber Hastert
Planners

February 22, 1993

Mr. Richard K. Paglinawan, Administrator
State of Hawaii
Office of Hawaiian Affairs
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813-5249

Dear Mr. Paglinawan:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated February 8, 1993. We have responded to your comments in the order they appear in your letter:

1. Paul H. Rosendahl, Ph.D., Inc. (PHRI) has conducted two archaeological studies relating to the above project. The first, an archaeological assessment study, covers the entire 2,640 acres which are the subject of the petition for boundary amendment before the Land Use Commission. This study provides a synthesis of archaeological background research, including review and evaluation of readily available archaeological reports and records, archaeological and historical literature, historic documents and records, and cartographic sources relevant to the overall project area.

   It also includes aerial reconnaissance and a limited ground surface survey of the area. The intent of this study, as approved by the Department of Land and Natural Resources, Historic Preservation Division, is to enable predictions concerning the probable nature and distribution of archaeological resources within the overall project area.

   The second study, an inventory survey, covers 500 acres in the northeastern portion of the petition area that have been identified as the future site of the West Hawaii campus of the University of Hawaii.

   Both studies will be summarized in the draft EIS and will be included in their entirety as technical appendices.

2. The draft EIS will contain a discussion of how utility needs for the new urban area can be met.

3. The Traffic Management Consultant (project traffic engineer) is conducting a traffic assessment for the proposed reclassification. This report will include a general discussion of traffic patterns and Department of Transportation plans to address the expectation of increased traffic as result of urbanization. This report will be summarized in the draft EIS and included in its entirety as a technical appendix.

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Helber Hastert
Planners

Mr. Richard K. Paglinawan
February 22, 1993
Page 2

4. Water Resource Associates (project hydrologist) has conducted a survey of existing and future groundwater resources and demand for the North Kona Water System, which serves petition area. This survey will be summarized in the draft EIS and included in its entirety as a technical appendix.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

2-9-93

Dear Helber, Hastert & Fee,

Please include me on your mailing list for a copy of the Draft and Final Environmental Impact Statements (when they are available) for OSP's "Keahole to Kailua Region Urban Expansion of State Lands," North Kona.

Mahalo,
Deborah L. Chang
P.O. Box 3226
Lihue, Hi. 96766-6226

Helber Hastert
Planners

February 22, 1993

Ms. Deborah L. Chang
P.O. Box 3226
Lihue, Hawaii 96766-6226

Dear Ms. Chang:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated February 9, 1993.

In response to your request, we will include you on our mailing list for the Draft and Final environmental impact statements. We look forward to your review and comment on these documents.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

BOARD OF LAND AND NATURAL RESOURCES
DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:SKK

FILE NO.: 93-376
DOC. NO.: 2217

FEB 11 1993

RECEIVED
FEB 15 1993
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helbert, Hastert and Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the Expansion of Urban Lands - Keahole to Kailua Region

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the submitted EISPN and have the following comments.

Our Department's Division of Forestry and Wildlife comments that under Section 3.1.14 Flora and Fauna, there is mention that one Category 1 Candidate Endangered plant, the 'aiea (Mthocestrum breviflorum) was found on the property. The Environmental Impact Statement (EIS) should include mitigative actions to preserve this tree.

Also, under Section 3.1.15 Historic Resources, historic trails, if any, should be investigated along with other historical and archaeological sites.

In addition, as stated in the EISPN, sufficient potable water for the project is not available within the petition area, and supplemental supplies will need to be imported. The Commission on Water Resource Management understands that the petitioners' water consultant will address the water supply problem in detail in the EIS.

Our Department's Historic Site Section has already responded in a separate letter.

Thank you for your cooperation in this matter. Please feel free to contact Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

JOHN P. KEPPELER, II
Acting Chairperson

Helber Hastert
Planners

February 22, 1993

Mr. John P. Keppeler, II, Acting Chairperson
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Keppeler:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to our EISPN for the above project by letter dated February 11, 1993.

You note the identification of one Category 1 Candidate Endangered plant, the 'aiea (Nothocestrum breviflorum) within the petition area and the need to include mitigative actions to preserve this tree. The draft EIS will discuss how to preserve this tree, in addition to other plants that might not have bee identified during the botanical survey conducted by Char & Associates.

Regarding historic resources, the petitioner (the State Office of State Planning) and the project archaeologist (Paul H. Rosendahl, Ph.D., Inc. [PHRI]) have worked closely with your Division of Historic Preservation on the scopes of archaeological work needed for this request. As a result, two archaeological studies relating to the above project have been conducted. The first, an archaeological assessment study, covers the entire 2,640 acres which are the subject of the petition for boundary amendment before the Land Use Commission. This study provides a synthesis of archaeological background research, including review and evaluation of readily available archaeological reports and records, archaeological and historical literature, historic documents and records, and cartographic sources relevant to the overall project area.

It also includes aerial reconnaissance and a limited ground surface survey of the area. The intent of this study, as approved by the Department of Land and Natural Resources, Historic Preservation Division, is to enable predictions concerning the probable nature and distribution of archaeological resources within the overall project area.

The second study, an inventory survey, covers 500 acres in the northeastern portion of the petition area that have been identified as the future site of the West Hawaii campus of the University of Hawaii.

Both studies will be summarized in the draft EIS and will be included in their entirety as technical appendices.

Regarding water supply, Water Resource Associates (project hydrologist) has conducted a survey of existing and future groundwater resources and demand for the North Kona

Helber Hastert & Fee
Grosvenor Center, PBI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Water System, which serves the petition area. This survey will be summarized in the draft EIS and included in its entirety as a technical appendix.

We will respond under separate cover to the responses submitted by the Division of Historic Preservation.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

JOHN WAIHEE
Governor

PDOA:605

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

YUKIO KITAGAWA
Chairperson, Board of Agriculture

ILIMA A. PIANAIA
Deputy to the Chairperson

FAX: 973-9613

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96823-2159

January 13, 1993

RECEIVED
JAN 15
PLANNING DEPT & FEE

Mr. Scott Ezer
Helber, Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands
Keahole to Kailua Region

The Department of Agriculture has reviewed the subject EIS Preparation Notice, which was published on January 8, 1993, and will accompany the Office of State Planning's petition for land use district boundary amendment.

We appreciate the fact that our letter of September 16, 1992, is included in Appendix A of the EISPN (Comments Received During EA Consultation). However, we are concerned that none of the contents or recommendations in our letter appear to be reflected in the body of the EISPN.

We would like to note that the statements on pages 2 and 18, that there will be no adverse impact of the urbanization on agricultural activities, are not entirely correct. Urbanization of the 200-acre area directly south of the Keahole Agricultural Park would adversely affect the plans of this Department to further develop and expand the agricultural park, as pointed out in our letter of September 16, 1992. The Keahole Ag Park Community Association (letter of September 22, 1992) is concerned about the incompatibility of urban uses surrounding the agricultural park, where pesticide spraying may take place and where water supply quality and pressure are already a concern. Finally, the Kona Palisades Estates Community Association (letter of September 22, 1992) has proposed a recreational park in the area which we had previously designated for agricultural park expansion. This conflict is also not addressed in the EISPN.

Thank you for the opportunity to comment. This Department reiterates, however, its request that the 200-acre agricultural park expansion area (shown in the map attached to our September 16 comments) be reclassified from Conservation to Agricultural rather than Urban District.

Sincerely,

Yukio Kitagawa

YUKIO KITAGAWA, Chairperson
Board of Agriculture

c: Office of State Planning
Land Use Commission
Dept. of Land & Natural Resources
County of Hawaii Planning Dept.

Helber Hastert
Planners

March 12, 1993

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to the EISPN for the above project by letter dated January 13, 1993.

We note that your department has expressed its intent to expand the Keahole Agricultural Park to include 200 acres of land directly south of the existing agricultural park. This 200 acres is situated within the petition area that the Office of State Planning (OSP) is seeking to reclassify to the State Urban District. The draft environmental impact statement (DEIS) will reflect DOA's request to include the 200 acres in the ag park expansion.

Please be advised that OSP continues to recommend that expansion of agricultural uses should be encouraged in other State-owned parcels further north of the petition area along Mamalahoa Highway, rather than adjacent to the existing ag park.

Also, the DEIS will reflect concerns that have been expressed regarding the potential incompatibility of the agricultural park and urban uses that could be developed subsequent to reclassification of the petition area. These concerns include pesticide spraying, water supply, noise and odor. Future planning for specific uses within the petition area will need to be sensitive to the existing Keahole Agricultural Park.

We also note that the Kona Palisades Estates Community Association has proposed a recreational park in the area your department had previously designated for agricultural park expansion. A brief discussion of this proposal will be included in the DEIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Office of State Planning
Land Use Commission
Department of Land and Natural Resources
County of Hawaii Planning Department

Helber Hastert & Fee | 733 Bishop Street, Suite 2590 | Telephone: 808 545-2055
Grosvenor Center, PRI Tower | Honolulu, Hawaii 96813 | Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR OF HAWAII

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:

February 25, 1993

92-327/epo

Mr. Scott Ezer
Helber Hastert & Fee, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

HELBER HASTERT & FEE
PLANNERS

Dear Mr. Ezer:

Subject: Environmental Impact Statement Preparation Notice (EISPN) and
Environmental Assessment (EA)
Urban Expansion State Lands
Keahole to Kailua Region

Thank you for allowing us to review and comment on the subject document. Besides our comments found in our September 30, 1992 letter to you (see Appendix A), we have the following additional comments to offer:

Air Quality

We would like to see more discussion in the Environmental Impact Statement (EIS) regarding the effects of air emissions from the adjacent HELCO power plant on future residents of the area. The same applies to gaseous emissions from the Kailua landfill. We have serious concerns that residential development, business, and recreational facilities will be developed in close proximity to the landfill before effective closure measures are implemented. Simply closing the landfill will not alleviate our concerns. We also have concerns and would like to see more discussion on the electro-magnetic fields from the 69KV transmission line and the four radio transmitters.

Solid Waste

This Environmental Assessment discusses the current disposal options, as well as the Integrated Solid Waste Management Plan for the State of Hawaii. The DEA discusses the waste diversion goals established in the Plan, but the discussion focuses on disposal options for the waste, rather than diversion practices.

Since the land for this urban expansion is state-owned, this office strongly suggests the subsequent Environmental Impact Statement must include further investigation of waste diversion activities, such as the development and implementation of a waste minimization plan for each project to reduce the volumes of waste generated.

The Environmental Impact Statement should also discuss the possibilities for incorporating secondary resources in the design and development of the urban area. Compost is a valuable soil amendment for landscaping purposes, and crushed glass may be used for road paving purposes. Chapter 264-8.5, Hawaii Revised Statutes, requires all state and county highway roadway contracts and improvements to utilize glassphalt for pavement construction when crushed glass is available at a cost equal to or lower than aggregate.

If you should have any questions on this matter, please call Ms. Carrie McCabe of the Office of Solid Waste Management at 586-4243.

Groundwater

The existing groundwater in the subject area may not be of potable water quality, however, this water can be put to many uses, especially agricultural development. Therefore, consideration should be given to protect the existing groundwater. If you should have any questions in this matter, please contact Mr. Bill Wong of the Safe Drinking Water Branch at 586-4258.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

c: Office of Solid Waste Management
Clean Air Branch
Hawaii District Health Office (H. Matsuura)

Helber Hastert
Planners

March 12, 1993

Mr. John C. Lewin, M.D., Director
Department of Health
State of Hawaii
P.O. Box 338

Dear Dr. Lewin:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to the EISPN for the above project by letter dated February 25, 1993. We respond to your comments in the order they appear in your letter.

Air Quality. The draft EIS (DEIS) will contain more information related to the effects of air emissions from the adjacent HELCO power plant. As you are aware, HELCO is in the process of preparing an environmental impact statement for the expansion of the Keahole Generating Plant from 30 megawatts (mW) to 86 mW. In the draft EIS for this expansion (dated December 1992) it is acknowledged that the Department of Health (DOH) must grant approvals for the expansion. It is further acknowledged that DOH may impose limitations on the size of the facility, emission control technology requirements, or specification of fuel properties. The Office of State Planning (OSP) believes these issues will be discussed at great length as these two projects continue through the approval process.

Regarding the proximity of the petition area to the Kealakehe landfill, we note that the distance from the petition area to the landfill ranges from 3 to 6 miles. Recent work by air quality consultant B.D. Neal and Associates indicates that this distance should provide an adequate buffer between the landfill and the petition area. In addition, the dominant wind pattern in the region is mauka-makai, further reducing any potential impact to the petition area from the landfill.

We should also note that the landfill is expected to close near the end of 1993. We recognize that it is probable the landfill will continue to burn for some time even after its closure. However, the proposed boundary amendment does not include the identification of specific land uses. Consequently, it will be some time before any development occurs there.

We also recognize the potential for impacts associated with electro-magnetic fields. Currently there are two electric transmission line corridors within the petition area; one runs north-south, roughly 1/2-mile mauka of Queen Kaahumanu Highway, and the second runs east-west, the entire length of the petition area. Before any application is made to the County of Hawaii for a change in zoning, it will be necessary to complete an in-depth analysis of the potential effects of these transmission lines when specific land uses are identified. OSP believes this issue can be adequately addressed prior to application for County zoning.

Helber Hastert & Fee
Grosvenor Center, PBN Tower
733 Bishop Street, Suite 2290
Honolulu, Hawaii 96813
Telephone: 808 545 2055
Facsimile: 808 545 2050

Helber Hastert
Planners

Mr. John C. Lewin, M.D.
March 12, 1993
Page 2

Solid Waste. As we mentioned earlier, specific land uses for the petition area have not yet been determined. Once these uses are identified, it will be possible to develop a solid waste management and minimization plan. OSP is recommending that any approval granted by the State Land Use Commission be conditioned to require that the developer and/or landowner of the petition area cooperate with the State Department of Health and the County of Hawaii Department of Public Works to conform to the program goals and objectives of the Integrated Solid Waste Management Act, Chapter 342G, HRS, and the County's approved integrated solid waste management plans in accordance with a schedule and timeframe satisfactory to the Department of Health.

Groundwater. We recognize the potential impacts to groundwater that might result from the urbanization of the petition area. OSP is recommending that the developer and/or landowner of the petition area should be required to participate in a regional water quality monitoring program. OSP is also recommending that if a golf course is developed within the petition area, that an environmental risk assessment be undertaken to ensure that adequate precautions are taken to protect groundwater quality and that all guidelines established by DOH governing new golf course development be followed.

Sincerely,

HELBER HASTERT and FEE, Planners,

Scott Ezer
Associate

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Honolulu Office
Seven Waterfront Plaza, Suite 500
500 Ala Moana Boulevard
Honolulu, HI 96813

FEB 08 1993

RECEIVED
10
HELBER HASTERT & FEE PLANNERS

Mr. Scott Ezer
Helber Hastert & Fee, Planners
Grovsnor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Ezer:

Thank you for the opportunity to comment on the proposed development of 2,640 acres in Kona, Hawaii that will provide for 500 acres for the West Hawaii Campus of the University of Hawaii and a land use mix of housing, parks, commercial uses, light industrial uses and public facilities. We understand that a specific allocation in terms of acreage and numbers of housing units and other uses has not been determined at this time.

The following comments are submitted that would apply to HUD-assisted housing projects for your consideration.

1. Historic Preservation: Review and analysis of historic properties must comply with Section 106 of the National Historic Preservation Act of 1966, as amended.

2. Noise: Residential properties that are assisted under programs administered by the Department of Housing and Urban Development (HUD) must comply with 24 CFR Part 51 Subpart B: Noise Abatement and Control.

   It appears that the vehicular traffic, projected to twenty years, along Queen Kaahumanu Highway may exceed 65 Ldn noise levels based on the current level of service at the intersection with the road to Keahole Airport. Also the combined levels of aircraft operations and the expansion of the HELCO power plant should be calculated for the total projected noise level to determine if mitigation measures are required.

3. Air quality: Levels of sulphur dioxide and Total Suspended Particulates emitted by the existing and proposed expansion of the existing power plant should be evaluated for consistency with the State and Federal Air Quality Standards.

If you have any questions on this matter, you may call Frank Johnson, Community Planning and Development Division, at 541-1327.

Very sincerely yours,

Patty A. Nicholas
Director
Community Planning and
Development Division

March 12, 1993

Ms. Patty A. Nicholas, Director
U.S. Department of Housing and Urban Development
Honolulu Office
Community Planning and Development Division
Seven Waterfront Plaza, Suite 500
500 Ala Moana
Honolulu, Hawaii 96813

Dear Ms. Nicholas:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to the EISPN for the above project by letter dated February 22, 1993. We have addressed your comments in the order they appear in your letter.

1. **Historic Preservation.** Review and ananlysis of histoirc sites within the petition area will comply with all applicable State of Hawaii and federal criteria for historic preservation.

2. **Noise.** We recognize that federally assisted housing programs must comply with 24 CFR Part 51 Subpart B: Noise Abatement and Control. At this time, specific land uses and their locations have not yet been determined for the petition area. The draft environmental impact statement (DEIS) will address anticipated noise impacts associated with Queen Kaahumanu Highway. Specific impacts to land uses close to the highway can be addressed once master planning for the petition area has been completed. This issue can be addressed when the landowner/developer applies for changes to county zoning designations.

   At the present time, all portions of the petition area are situated outside the 1990 55 Ldn noise contour associated with aircraft operations at the Keahole Airport. Airport noise and the noise impacts of the Keahole Generating Station will be discussed in the DEIS.

3. **Air Quality.** Air quality impacts associated with the Keahole Generating Station will be discussed in the DEIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

Helber Hastert & Fee
Grosvenor Center, PBT Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545 2055
Facsimile: 808 545 2050

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

January 25, 1993

RECEIVED
FEB - 1 1993
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer, Associate
Helber Hastert & Fee, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Mr. Ezer:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Environmental Impact Statement Preparation Notice and Environmental Assessment for the Urban Expansion of State Lands, Keahole to Kailua Region.

The comments were provided by our Energy Division and the Land Use Commission. Questions regarding these comments may be directed to Maurice H. Kaya, Energy Program Administrator, at 587-3812 or Esther Ueda, LUC Executive Officer, at 587-3826.

Thank you for the opportunity to comment.

Sincerely,

Mufi Hannemann

Enclosures

cc: OSP
OEQC

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

January 25, 1993

SUBJECT: Environmental Impact Statement Preparation Notice and Environmental Assessment (EA) for the Urban Expansion of State Lands, Keahole to Kailua Region

Energy Division has reviewed the subject EA and offers the following comments:

1. Without more specific details of the development scenarios for this area, it is not possible at this time to assess the cumulative impacts of the proposed developments. As discussed in more detail below, we suggest that the draft EIS consider and report on these cumulative effects, together with other proposed development projects in the region, such as Hawaiian Electric Light Company's (HELCO) planned expansion of the Keahole Generating Station and HELCO's planned construction of two new transmission lines between Keahole Switching Station and the Kailua Switching Station, and between Keahole and the Keamuku Station, respectively. An assessment of the impacts of HELCO's planned projects can be drawn from their respective EIS's and comments from the public and consulted parties.

2. The EA generally describes visual impacts of the planned development to irretrievably reduce the naturally open space of the region. It goes on to state that "Adverse visual impacts will be mitigated by adopting prudent site planning criteria . . . " However, HELCO's Keahole expansion project, if completed, will include construction of a 190 foot exhaust stack, which will result in adverse visual impacts within a two mile radius of the site. The extent to which such a impact can be mitigated is questionable.

3. Long-term impacts on air quality are projected to occur from electric generating facilities providing the project with power. The EA goes on to state that alternative energy devices and conservation measures can help reduce fossil fuel dependency and reduce emissions. We concur. It is, therefore, suggested that a more detailed description of specific mitigation measures be provided. For example, the enclosed documents relating to the Hawaii Model Energy Code, including a final draft impact analysis of the code should be used to support the more detailed analysis of mitigation measures that could be employed. Further, we recommend that HELCO be consulted to determine in more detail what demand-side management and alternate

energy supply-side programs have been and are being planned within the framework of their integrated resource planning activities.

4. The EA presumes that "The proposed expansion of the Keahole Generating Plant should provide adequate capacity for electric demand within the region . . . " We believe the following points militate against this presumption:

   a. HELCO has not yet submitted its integrated resource plan to the Public Utilities Commission for approval;

   b. HELCO's proposed expansion project at Keahole is inconsistent with State and County energy plans to increase energy self-sufficiency by improving the efficiency by which energy is produced, transmitted and used, together with aggressive diversification of energy supply resources away from the use of oil, especially for electricity generation; and

   c. Given the island of Hawaii's relatively long-lived recent history of power capacity shortages and attendant rolling blackouts, the EA's presumption that power will be available may be overly optimistic.

Thank you for the opportunity to provide these comments.

Enclosures

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

January 19, 1993

Mr. Scott Ezer
Helber, Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: Environmental Impact Statement Preparation Notice (EISPN) and Environmental Assessment (EA) for the Urban Expansion of State Lands, Keahole to Kailua Region

We have reviewed the subject EA transmitted with your letter of January 7, 1993 and have the following comments:

1) It appears that the EA is missing Figures 3, 5, 9, and 12 which are referenced in the text.

2) Inasmuch as specific uses have not been identified, we suggest that any discussion of impacts and mitigative measures within the development scenarios be based on a regional perspective, addressing cumulative impacts to infrastructure, visual and air quality, the socio-economic environment, and so forth from the proposed urban expansion, as well as from existing and proposed developments in the region. The draft EIS should also include a discussion on the interrelationship and compatibility of the expansion with the other developments, including the Department of Agriculture's plan to expand the Keahole Agricultural Park, as well as with neighboring undeveloped areas in the region.

3) The draft EIS should include a development timetable if possible so that potential impacts can be evaluated on a temporal basis with other on-going or proposed developments.

4) The draft EIS should include a projected list of necessary approvals required for the urban expansion from governmental agencies and other groups having jurisdiction.

5) We suggest that the draft EIS include a map showing any easements and Conservation District Use Permits issued immediately outside of the petition area.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

cc: OSP
OEQC
DBEDT

March 12, 1993

Mr. Mufi Hanneman, Director
Department of Business, Economic Development & Tourism
State of Hawaii
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Hanneman:

Environmental Impact Statement Preparation Notice (EISPN)
Urban Expansion State Lands-Keahole to Kailua Region

Thank you for responding to the EISPN for the above project by letter dated January 25, 1993, which included comments from your Energy Division and the Land Use Commission. Our responses are separated by origin of comment.

Energy Division

1. As discussed in the EISPN, the draft environmental impact statement (DEIS) will contain scenarios for possible development of the petition area so that order of magnitude impacts can be estimated on various public services. Included in the discussion of cumulative impacts will be Hawaii Electric Light Company's (HELCO) plans in the region.

2. We recognize that HELCO's plans to expand the Keahole Generating Station include a tall exhaust stack which will cause significant visual impacts. We also recognize that the exhaust stack will be visible from within portions of the petition area and that it will be difficult to mitigate such visual impacts.. However, it is the responsibility of HELCO, not the Office of State Planning (OSP), to discuss the possible mitigation of visual impacts of the exhaust stack.

3. Specific uses for the petition area have yet to be determined. At this point, OSP believes it is premature to discuss detailed measures to reduce fossil fuel dependency. The development of specific mitigation measures, in conjunction with the Energy Division, to reduce fossil fuel dependency can occur once uses for the petition area have been identified.

4. We recognize the power capacity problems that have plagued HELCO and the Big Island in the recent past. In part, HELCO's plans to expand the Keahole Generating Station are intended to reduce these problems. Urbanization of the petition area is expected to occur over a 15- to 25-year period, so that demand for public services, including electricity will be phased over several years. One of the purposes of the EIS process is to identify long-term impacts that might be associated with development actions. There is no doubt that many agencies at the State and County level, as well as private developers, will need to work closely in the next few years in order to solve the problems associated with power delivery within Hawaii County. The Office of State Planning is committed to helping solve these problems.

Helber Hastert & Fee | 733 Bishop Street, Suite 2590 | Telephone: 808 545 2055
Grosvenor Center, PBT Tower | Honolulu, Hawaii 96813 | Facsimile: 808 545 2050

Land Use Commission

1. We are enclosing copies of Figures 3, 5, 9 and 12 which are missing from the Commission's copy of the EA.

2. As discussed in the EA, development scenarios will be included in the DEIS to facilitate the discussion of probable impacts associated with urbanization of the petition area. We should note that these scenarios are only for the purpose of anticipating impacts and should not be construed to assign specific land uses to the urbanization of the petition area.

   This discussion will include cumulative impacts, including the Department of Agriculture's plans to expand the Keahole Agricultural Park.

3. The DEIS will include a discussion of possible phasing for the urbanization of the petition area.

4. The DEIS will include a projected list of necessary governmental approvals required for the urban expansion of the petition area.

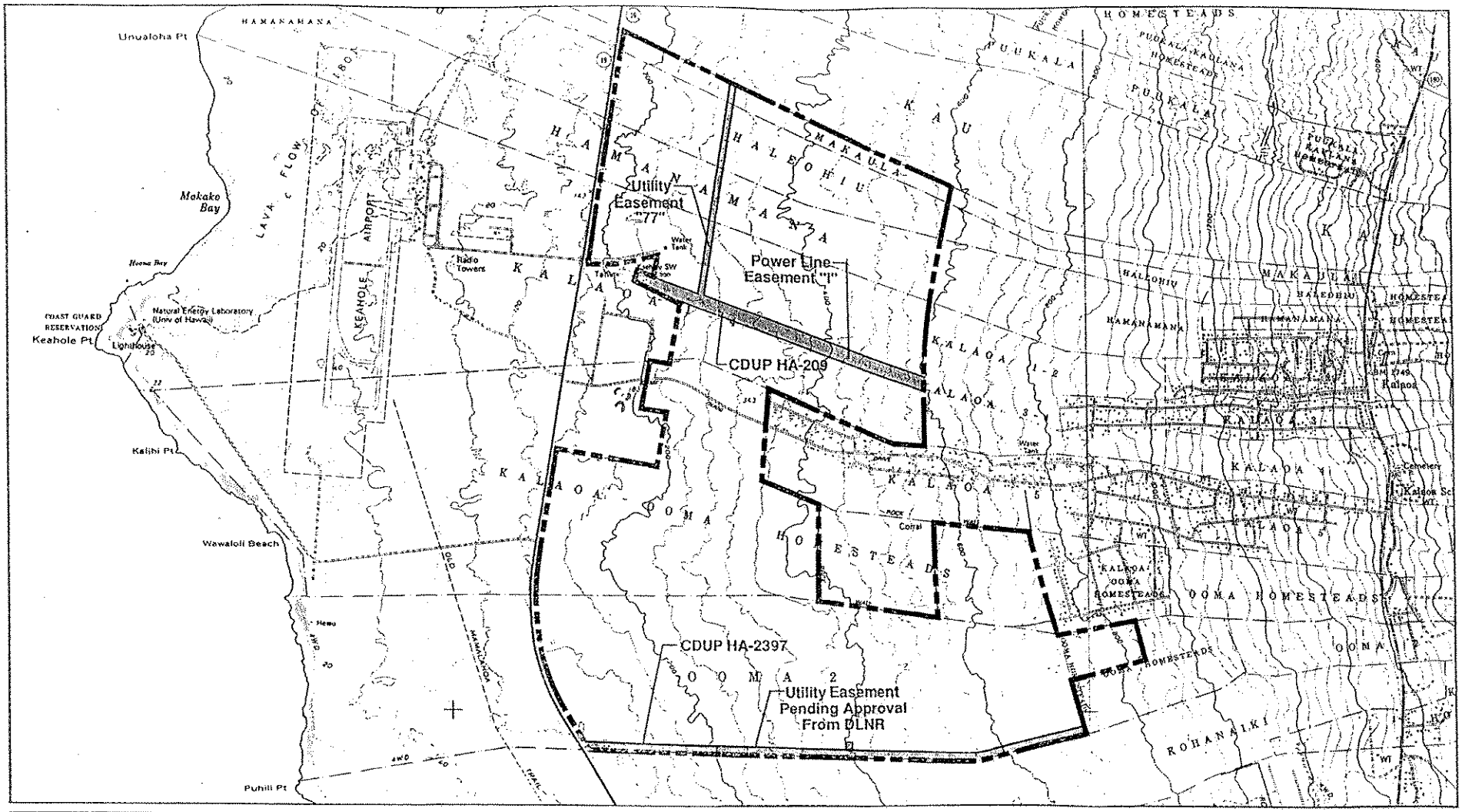
5. The DEIS will include a map showing any easements and Conservation District Use Permits issued immediately outside the petition area.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Office of State Planning
Land Use Commission
Office of Environmental Quality Control



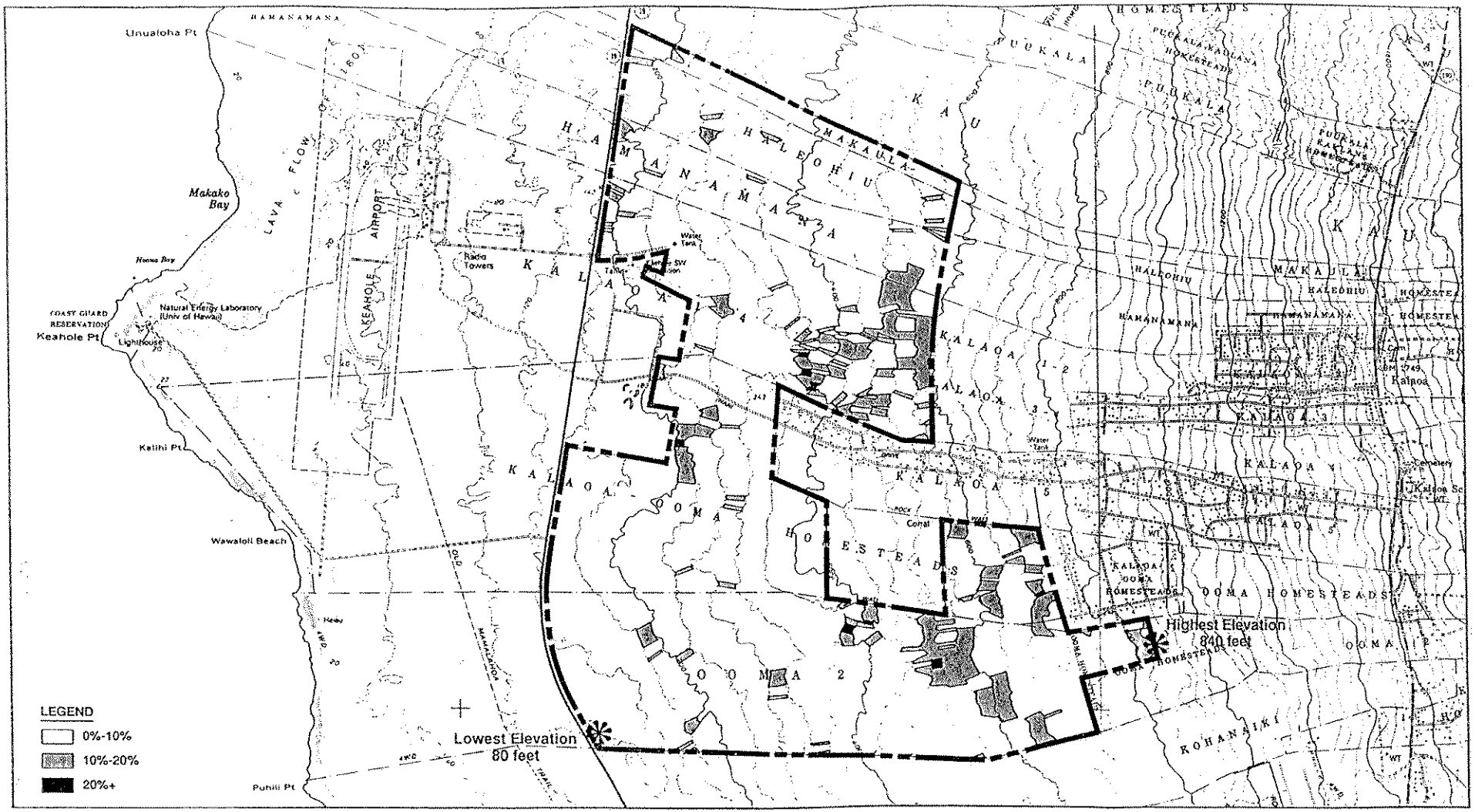
Easements & Conservation District Use Permits (CDUPs)
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Figure: 3

Feet
0 1000 2000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

14

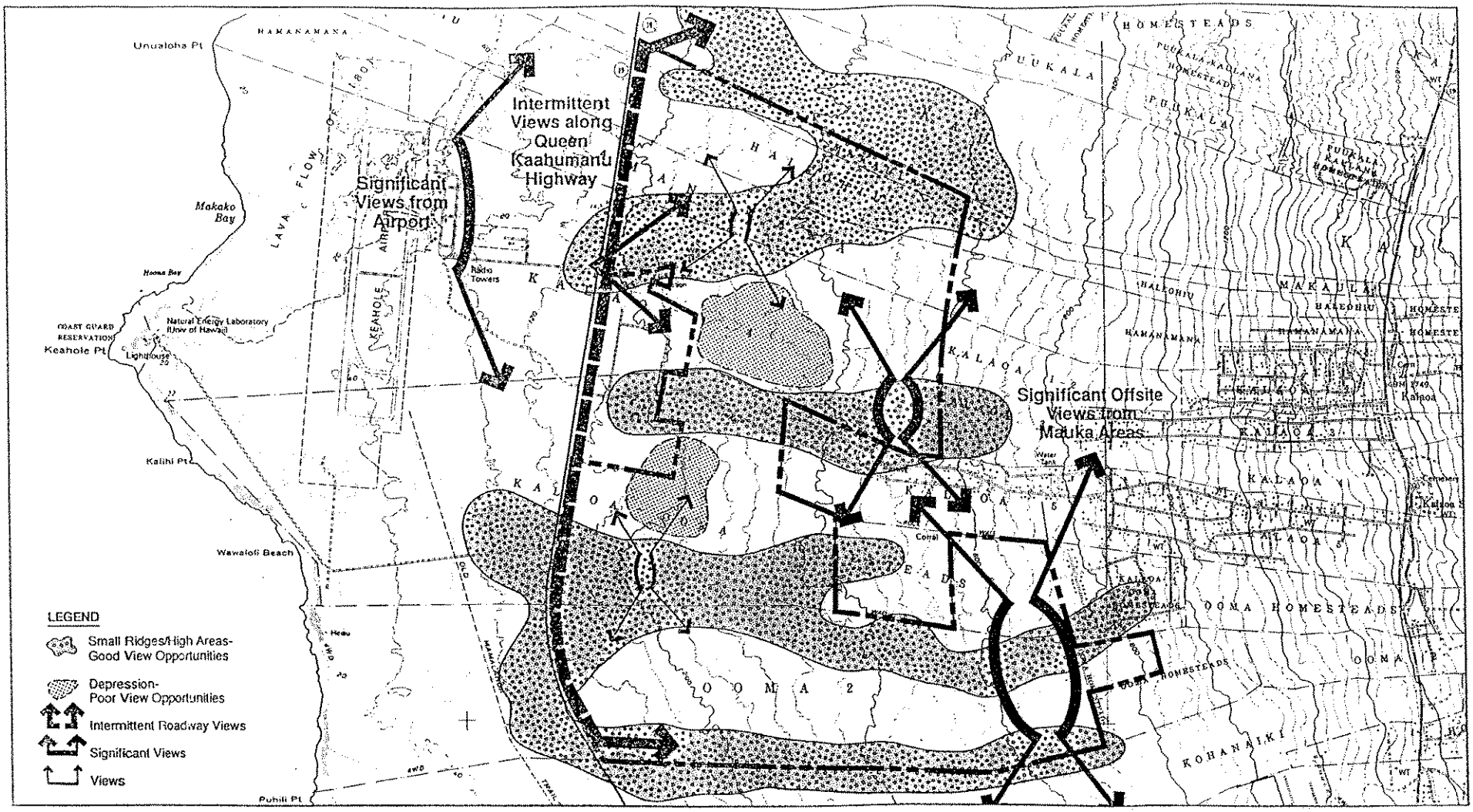


Slope Analysis
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Figure: 5

Feet
0 1000 2000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

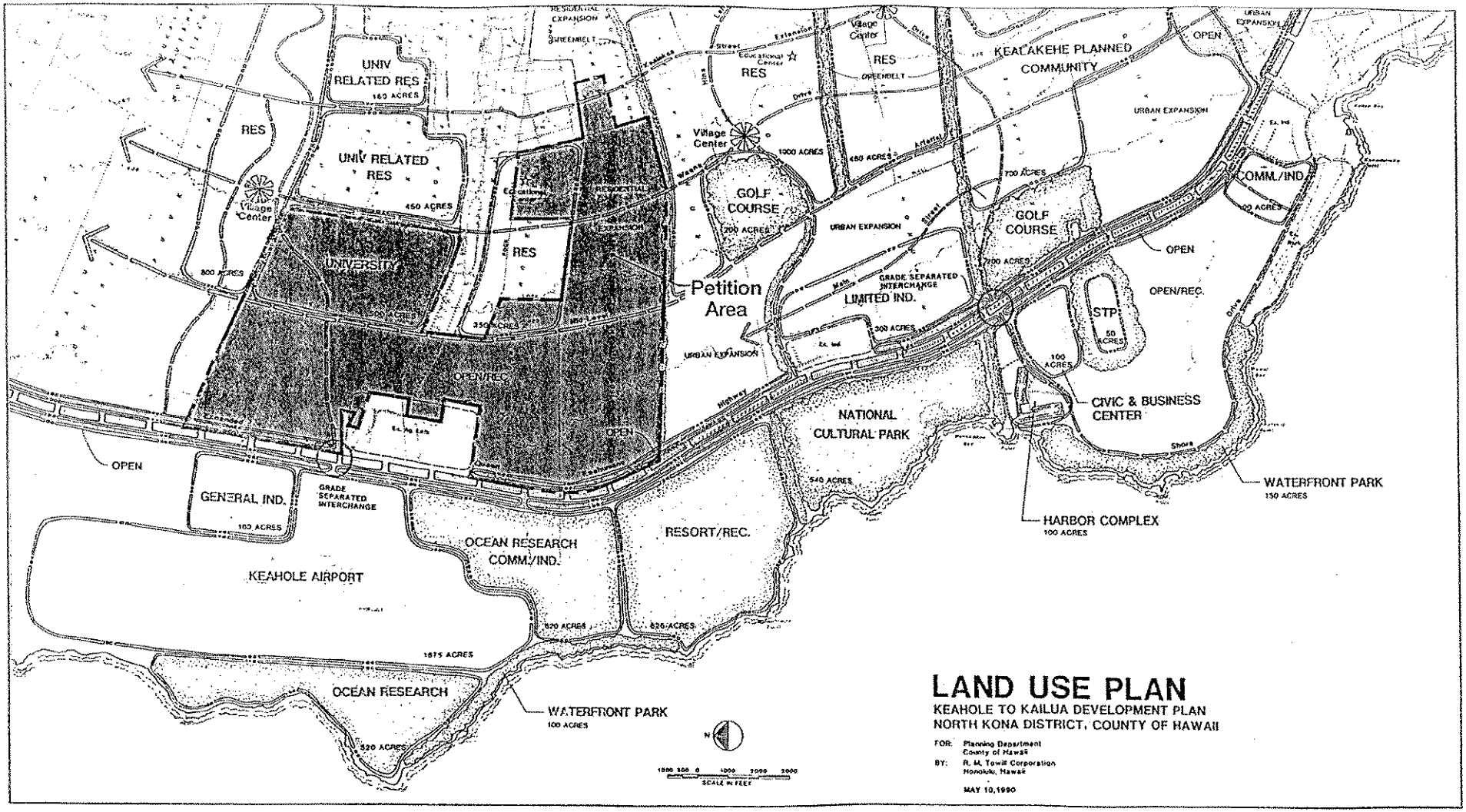


Visual Resources
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Figure: 9

Feet
0 1000 2000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners



Keahole to Kailua Development Plan

URBAN EXPANSION STATE LANDS

Keahole to Kailua Region

Source: Keahole to Kailua Development Plan, County of Hawaii, 1991

Figure: 12

Feet 0 1500 3000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

Lorraine R. Inouye
Mayor

Daniel Ayala
Fire Chief

Harding Fragas, Jr.
Deputy Fire Chief

Fire Department

County of Hawaii • 466 Kinoole Street • Hilo, Hawaii 96720-2983 • (808) 961-8297 • Fax (808) 961-6920

September 9, 1992

Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Scott Ezer

Gentlemen:

Subject: State Land Use Boundary Amendment
& Environmental Assessment Consultation
Urban Expansion State Lands
Keahole to Kailua Region

We have no comments on the above-referenced petition at this time.

Sincerely,

DANIEL AYALA
Fire Chief

DA/mo

RECEIVED
SEP 10 '92
HELBER HASTERT & FEE
PLANNERS

Helber Hastert
Planners

November 3, 1992

Mr. Daniel Ayala, Fire Chief
County of Hawaii
466 Kinoole Street
Hilo, Hawaii 96720-2983

Dear Chief Ayala:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your dated September 9, 1992 which offered no comments during the early assessment consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PBT Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545 2055
Facsimile: 808 545 2050

JOHN WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

OFFICE OF THE SUPERINTENDENT

September 10, 1992

Mr. Scott Ezer, Associate
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

RECEIVED
SEP 13
HELBER HASTERT & FEE
PLANNERS

Dear Mr. Ezer:

SUBJECT: State Land Use Boundary Amendment and
Environmental Assessment (EA) Consultation
Urban Expansion State Lands
Keahole to Kailua Region - North Kona,
Island of Hawaii

The Department of Education is greatly interested in the development plan of the subject area and proposed "urban expansion". Both the State's West Hawaii Regional Plan and the County of Hawaii's Keahole to Kailua Development Plan project future urbanization and residential expansion. As you are aware, residential development is inevitably followed closely by enrollment impact on schools.

The Keahole to Kailua area of Hawaii is already highly impacted and all schools in the area - Kealakehe Elementary, Kealakehe Intermediate, and Konawaena High Schools are overcrowded. In order to plan properly for the future, we require information regarding the number of proposed units and projected timelines of the developments to make enrollment projections. The projections can then be translated into the need for new schools or school buildings on existing campuses. It is imperative that we receive information as early as possible.

There are currently no school sites proposed in the subject area and the only additional elementary school site is within the State development at the Villages of La'i'opua, Kealakehe. The elementary school site should be developed in the next six to ten years depending on the rate of development of La'i'opua. A high school is being planned in Kealakehe but additional enrollment impact will require planning additional facilities or a change in school service areas.

Please be advised that any elementary school site requires eight usable acres if located next to a park or twelve acres if no park is available. An intermediate school site requires 12 to 18 usable acres depending on the availability of an adjacent park.

We request that the Department of Education be consulted throughout the development of the proposed area in order to be able to plan facilities in a timely manner.

Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga
A. Garson

Helber Hastert
Planners

November 3, 1992

Mr. Charles Toguchi, Superintendent
Department of Education
P.O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 10, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PBR Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545 2055
Facsimile: 808 545 2050

JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

RECEIVED
SEP 14 1992
HELBER HASTERT & FEE
PLANNERS

September 10, 1992

Mr. Scott Ezer
HELBER HASTERT & FEE, PLANNERS
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Ezer:

SUBJECT: STATE LAND USE BOUNDARY AMENDMENT AND ENVIRONMENTAL ASSESSMENT CONSULTATION URBAN EXPANSION STATE LANDS KEAHOLE TO KAILUA REGION

Thank you for allowing us to comment on the proposed petition to amend the Conservation and Agriculture Land Use District Boundaries for portions of State-owned lands in the Keahole to Kailua region at North Kona, County of Hawaii.

We have no comments to offer at this time.

Sincerely,

Brian J. J. Choy
Director

BC/ab

Helbert Hastert
Planners

November 3, 1992

Mr. Brian Choy, Director
Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter dated September 14, 1992 which offered no comments during the early assessment consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, OSP

Helbert Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545 2055
Facsimile: 808 545 2050

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

RECEIVED
SEP 15
HELBER HASTERT & FEE
PLANNERS

September 10, 1992

Mr. Scott Ezer
Helbert Haster & Fee, Planners
Suite 2590, Grosvenor Center
733 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: State Land Use Boundary Amendment and Environmental Assessment Consultation for Urban Expansion of State Lands, Keahole to Kailua Region

We have reviewed the map transmitted with your letter of August 27, 1992 and have the following comments.

1) We confirm that the proposed petition area is designated within the State Land Use Agricultural and Conservation Districts.

2) It appears that the intent is to exclude the State's Keahole Agricultural Park, which was reclassified from the Conservation District to the Agricultural District under Docket No. 79-458/DPED for agricultural uses from the petition area; however, as shown on the map, the petition area actually includes portions of the Park on the mauka side. We suggest that further clarification of the Park's boundaries be obtained from our office prior to the formulation of the environmental assessment.

3) The map does not indicate the approximately 70.376 acres reclassified by the Commission from the Agricultural and Conservation District to the Urban District under Docket No. A91-665/Kamaaina 8, A Hawaii General Partnership. This rectangular urban parcel is situated adjacent to the southern boundary of the petition area, mauka of Queen Kaahumanu Highway, and is identified as TMK No.: 7-3-09: 15.

We have no further comments to offer at this time. Thank you for the opportunity to comment on this matter.

If you have any questions, please call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:th

Helber Hastert
Planners

November 3, 1992

Ms. Esther Ueda, Executive Officer
Land Use Commission
State Of Hawaii
Department of Business, Economic Development
& Tourism
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

Thank you for submitting comments during the early assessment consultation process for the above project by letter dated September 10, 1992.

We note that you suggested that further clarification of the Keahole Agricultural Park's boundaries be obtained and that any maps depicting the State Land Use Boundaries for the region should include approximately 70.376 acres that were recently reclassified by the Land Use Commission from the Agricultural and Conservation Districts to the Urban District (Docket No. A91-665).

This information has been verified and corrections have been made to the appropriate exhibits in the environmental assessment and petition for land use boundary amendment for the proposed reclassification.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi

Helber Hastert & Fee
Grosvenor Center, PRII Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Lorraine R. Inouye
Mayor

Victor V. Vierra
Chief of Police

Francis C. DeMorales
Deputy Chief of Police

Police Department

County of Hawaii • 349 Kapiolani Street • Hilo, Hawaii 96720-3998 • (808) 961-2244 • Fax (808) 961-2702

September 11, 1992

Mr. Scott Ezer
Associate
Helbert Hastert & Fee
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

RECEIVED
SEP 17

Dear Mr. Ezer:

RE: STATE LAND USE BOUNDARY AMENDMENT AND
ENVIRONMENTAL ASSESSMENT CONSULTATION
URBAN EXPANSION STATE LANDS
KEAHOLE TO KAILUA REGION

The ingress and egress to the site should be properly addressed due to the heavy traffic on Queen Kaahumanu Highway.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

WP:sk

cc: Kona Police

Helbert Hastert
Planners

November 3, 1992

Mr. Victor V. Vierra, Chief of Police
County of Hawaii
349 Kapiolani Street
Hilo, Hawaii 96720-3998

Dear Chief Vierra:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

Thank you for submitting comments during the early assessment consultation process for the above project by letter dated September 11, 1992.

We note your comment concerning ingress and egress to the site. A traffic engineer will be preparing a traffic impact assessment survey which will be discussed in the forthcoming draft environmental impact statement (DEIS).

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi
Esther Ueda

Helbert Hastert & Fee
Grosvenor Center, PBT Tower

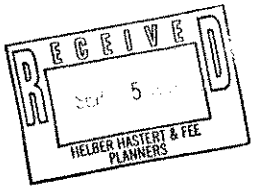
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545-2055
Facsimile: 808 545-2050

U.S. Department
of Transportation
**Federal Aviation
Administration**

AIRPORTS DISTRICT OFFICE
BOX 50244
HONOLULU, HI 96850-0001
Telephone: (808) 541-1243
Fax: (808) 541-3462

September 14, 1992



Mr. Scott Ezer, Associate
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

We have received your September 1, 1992 letter regarding a State Land Use Boundary Amendment and Environmental Assessment Consultation, Urban Expansion State Lands, Keahole to Kailua Region.

We have no comments on the proposed amendment, but we request a copy of the Draft EA for our review. Also, we suggest you contact the State Department of Transportation, Airports Division.

Sincerely,

David J. Welhouse

David J. Welhouse
Airport Engineer/Planner

Henry A. Sumida
Airports District Office Manager

Helber Hastert
Planners

November 3, 1992

Mr. David Welhouse
Airport Engineer/Planner
U.S. Department of Transportation
Federal Aviation Administration
Airports District Office
Box 50244
Honolulu, Hawaii 96850-0001

Dear Mr. Welhouse:

**State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region**

We acknowledge receipt of your letter of September 14, 1992 which offered no comments during the early assessment consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,589 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR OF HAWAII

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

September 14, 1992

RECEIVED
SEP 16
HELBER HASTERT & FEE PLANNERS

LOG NO: 6268
DOC NO: 3527c

Mr. Scott Ezer, Associate
Helber Hastert & Fee Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

SUBJECT: State LUC Boundary Petition -- Keahole to Kailua Region
Multiple, North Kona, Hawaii

Thank you for your letter of September 1, 1992, asking for input, to aid your EA preparation.

Our concern is with historic preservation matters. We advised the Office of State Planning (OSP) on the needs for this petition -- basically the preparation of a detailed background synthesis of settlement patterns (based on archival and archaeological data), to enable prediction of sites in the area. The OSP scope of work for the historic preservation concerns requires consultation with our office and our review of the background report. Thus, at this time, we have no further comments. We will expect to be contacted by your consulting archaeological firm as they are doing the work, and we will then await reviewing the report.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

RC:sty

cc: OCEA (File 93-150)

Helber Hastert
Planners

November 3, 1992

Mr. Don Hibbard, Administrator
State Historic Preservation Division
Department of Land and Natural Resources
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 14, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
Governor

YUKIO KITAGAWA
Chairperson, Board of Agriculture

ILIMA A. PILANAIA
Deputy to the Chairperson

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

FAX: 973-9613

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96823-2159

September 16, 1992

RECEIVED
SEP 21 1992
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: **State Land Use Boundary Amendment and Environmental Assessment Urban Expansion State Lands Keahole to Kailua Region**

This responds to your request of August 27, 1992, for comments to be used in the formulation of an environmental assessment for the proposed land use district boundary amendment petition to be submitted by the Office of State Planning (OSP) for State-owned lands in North Kona.

As we have informed the OSP on January 10 and July 1, 1992, during the Five-Year Boundary Review, the Department of Agriculture is contemplating the expansion of the Keahole Agricultural Park by about 200 acres immediately to the south and/or east of the existing facility. The lands in question are portions of TMK: 7-3-10: 33 and 7-3-09: 05. This area (hatch-marked on the attached map) should be reclassified from Conservation to Agricultural rather than Urban District.

The possibility of linking the Keahole Agricultural Park with an adjacent university complex (i.e., a West Hawaii University of Hawaii campus) could result in an exciting and mutually beneficial relationship. However, surrounding the agricultural park on three sides by Urban District lands intended to support the development of a "second city" for West Hawaii would adversely affect the existing farm operations due to proximity of incompatible urban uses. Urbanization of these immediately surrounding lands would also unnecessarily constrain the future expansion of the 34-lot park, for which there were, at last count, 123 expressions of interest by farmers seeking additional lots at that location.

We had informed the County of Hawaii Planning Department on November 18, 1988, prior to the 1989 General Plan amendments which designated the area for "urban expansion," that we were considering expanding the Keahole Agricultural Park to the south and/or east of the existing facility. OSP's West Hawaii Regional Plan (November, 1989; page 25) also

mentions the potential for expanding the agricultural park to the south on State-owned lands. Therefore, urbanization of the approximately 200-acre area shown on the attached map is contrary to previously expressed intentions to develop the site for agricultural use.

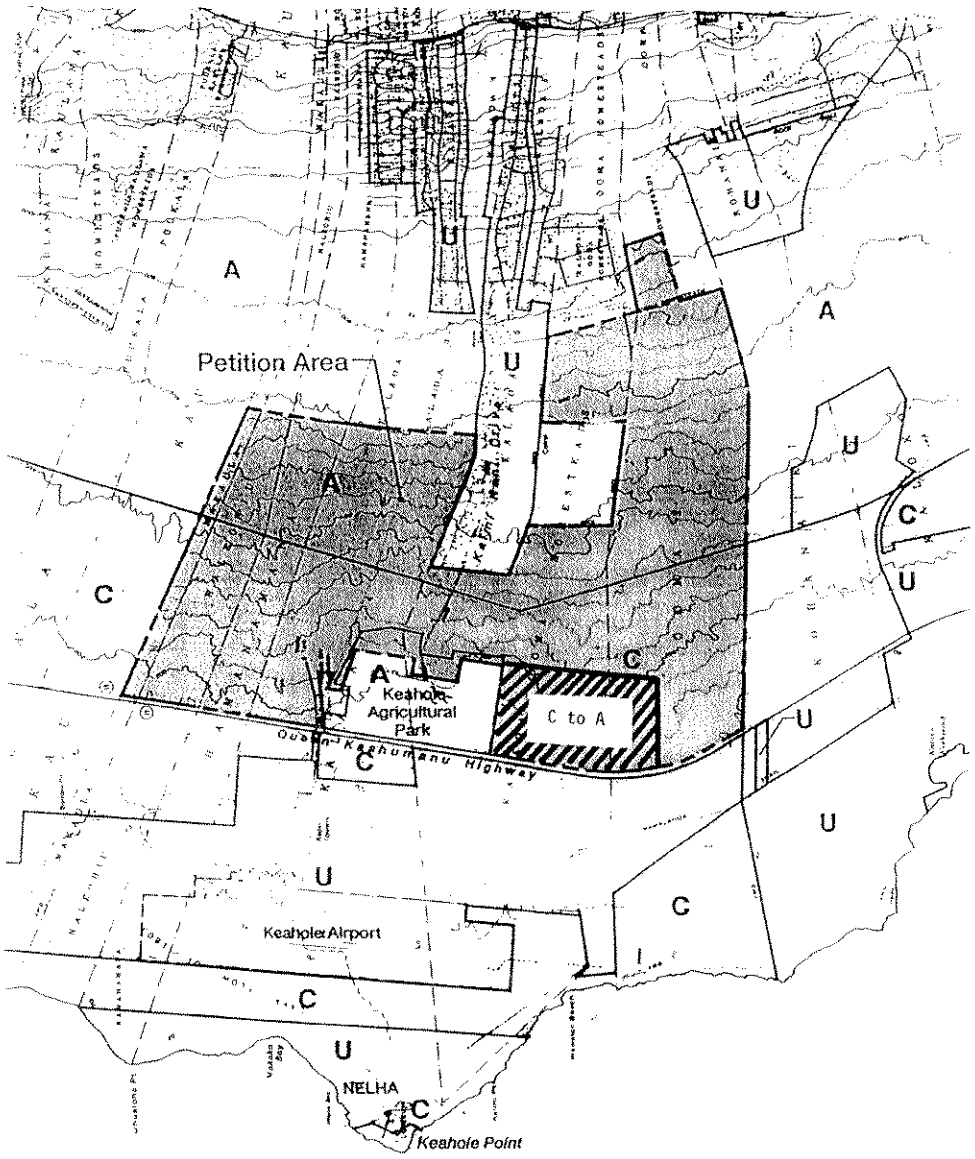
The Department of Agriculture requests that in preparing the boundary amendment petition and environmental assessment for the North Kona lands, the aforementioned 200-acre area be reclassified from Conservation to Agricultural District for the expansion of the Keahole Agricultural Park. Questions on this matter may be directed to Dr. Paul J. Schwind, Planning Program Administrator, at 973-9469.

Sincerely,

Yukio Kitagawa
YUKIO KITAGAWA, Chairperson
Board of Agriculture

Attachment

c: Office of State Planning



Helber Hastert
Planners

November 3, 1992

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 16, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi
Esther Ueda

Helber Hastert & Fee
Grosvenor Center, PBI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545 2055
Facsimile 808 545 2050

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-1

RECEIVED
SEP 18 1992
HELBER HASTERT & FEE PLANNERS

Warren H. W. Lee, P.E.
President

September 17, 1992

Helber Hastert& Fee, Planners
Attention: Scott Ezer
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Gentlemen:

Subject: State Land Use Boundary Amendment and Environmental Assessment Consultation for the Urban Expansion of State Lands in the Keahole-Kailua Region

Hawaii Electric Light Company, Inc. (HELCO) owns two separate parcels in the immediate vicinity of the State lands proposed for redesignation to the State's Urban District. Immediately adjacent to the State lands is HELCO's Keahole generating station located on a 14.998-acre site that is identified as Tax Map Key parcel 7-3-49:36. HELCO also owns a 0.645-acre site adjacent to and makai (west) of Keahole generating station. The smaller parcel is the site of the Keahole substation and is identified as Tax Map Key parcel 7-3-49:37.

As an adjoining property owner, HELCO has an interest in the proposed redesignation of the State lands to the State Urban District.

HELCO COMMENTS

HELCO supports that State's proposal to redesign the State-owned lands.

HELCO may desire to acquire additional State owned lands to the north and east of the Keahole generating station. The potential acquisition may accommodate future expansion of the station and contribute to the buffer zone between the station and surrounding uses. HELCO will look forward to discussing this with the State.

SUMMARY OF HELCO'S EXISTING KEAHOLE GENERATING STATION FACILITIES AND PROPOSED EXPANSION

HELCO is initiating an environmental impact statement for the expansion of the Keahole generating plant within the existing parcels. The proposed expansion would increase the plant generating capacity from 30 megawatts (MW) to 86 MW. The proposed expansion is as follows:

* Phase One: The addition of one 20 MW, simple-cycle combustion turbine for 1994 commercial operation.

* Phase Two: The addition of a second 20 MW, simple cycle combustion turbine for 1996 commercial operation.

* Phase Three: The conversion of the two simple-cycle combustion turbine units by adding two heat recovery steam boilers and a steam turbine for 1997 commercial operation. This will result in an additional 16 MW of generation output.

Together, these components will constitute a 56 MW dual-train, combined cycle unit. In addition to the new generating facilities, HELCO proposes to add control houses, an office, a warehouse and shop, expansion of the existing transmission switching station, fuel oil storage tanks, an exhaust stack, an air-cooled condenser, water supply wells, treatment facilities, and a reinjection well. A battery storage facility is also being considered. The proposed additions are designed to improve system voltage, provide additional capacity to meet projected demand for electric service, develop generating capacity near the area of demand, replace older generating facilities and increase overall system reliability. The new generating facilities will use No. 2 diesel fuel.

In addition to the expansion of Keahole generation station, HELCO is also planning two new transmission lines that will have a terminus point at the Keahole switching station. The first will be a 69 KV transmission line between the Keahole switching station and the Kailua substation. The second will be either a 69 KV or 138 KV transmission line between the Keamuku and the Keahole switching stations. Separate environmental impact statements will be prepared for each of the transmission line projects. The proposed transmission lines will meet projected demand for electric service and increase overall system reliability.

We trust that this information will assist you in preparing the environmental impact statement for the State Land Use Boundary amendment for the redesignation of state-owned lands to the Urban Expansion of state lands in the Keahole-Kailua region.

The environmental reports for the HELCO project are being prepared by CH2M Hill. Inquiries should be directed to Mr. Al Lono Lyman or Ms. Karen Stabenow at 943-1133.

If you have any questions concerning the existing facility or planned expansion, please contact Clyde Nagata, Manager of Engineering at 969-0321.

Sincerely,

Warren H. W. Lee
President

cc: Al Lono Lyman

Helber Hastert
Planners

November 3, 1992

Mr. Warren H.W. Lee, President
Hawaii Electric Light Company, Inc.
P.O. Box 1027
Hilo, Hawaii 96721-1027

Dear Mr. Lee:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 17, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC
Al Lyman, CH2M Hill

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR

RUSSEL S. NAGATA
COMPTROLLER

ROBERT P. TAKUSHI
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
DIVISION OF PUBLIC WORKS
P. O. BOX 119, HONOLULU, HAWAII 96810

LETTER NO. (P)1800.2

SEP 17 1992

RECEIVED
SEP 21 1992
HELBER HASTERT & FEE
PLANNERS

Helber, Hastert and Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Mr. Scott Ezer

Gentlemen:

Subject: Urban Expansion State Lands
Keahole to Kailua
North Kona, Hawaii
Land Use District Boundaries

Thank you for the opportunity to comment on the subject petition area. We have no comments to offer at this time.

Should there be any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

GORDON MATSUOKA
State Public Works Engineer

RY:jk

Helber Hastert
Planners

November 3, 1992

Mr. Gordon Matsuoka
State Public Works Engineer
Department of Accounting and General Services
Division of Public Works
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Matsuoka:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 17, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PBT Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

September 18, 1992

RECEIVED
SEP 21 1992
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer, Associate
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: State Land Use Boundary Amendment and Environmental Assessment Consultation: Urban Expansion State Lands, Keahole to Kailua Region

The number of acres that are proposed for redistricting to Urban should be clearly indicated on maps for the subject application. It appears to be in excess of 5,000 acres.

Among the concerns that should be addressed is the need for more urban lands in that particular location and the impacts of the reclassification on existing undeveloped urban district lands in that region.

The assessment should indicate how the government's participation will provide incentives and support for private sector projects, or produce much needed improvements and services which the private sector cannot or is unwilling to provide.

The dilution of limited capital improvement funds, and their possible diversion from the Kealakehe project area should be evaluated.

Thank you for the opportunity to comment.

Warmest aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:BH:jc

2547L.1

Helber Hastert
Planners

November 3, 1992

Ms. Hoaliku Drake, Chairman
Hawaiian Homes Commission
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

Dear Ms. Drake:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 16, 1992 for the early consultation process for the above project.

We note your comment concerning the acreage for the propose urban expansion. We have rechecked land area for the proposed urban expansion and believe the total land area is approximately 2,589 acres.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRU Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

SEP 18 1992

IN REPLY REFER TO:

HWY-PS
2.3749

RECEIVED
SEP 22
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helber, Hastert & Fee
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

State Land Use Boundary Amendment and Environmental Assessment Consultation; Urban Expansion State Lands; Keahole to Kailua Region

Thank you for your letter of August 27, 1992, requesting our comments concerning the subject petition area.

We have the following comments:

1. We intend to have the Queen Kaahumanu Highway serve as a high speed, limited-access highway for the region and will allow access to the highway only at major interchanges. All other roadways will have to access onto frontage roads on both sides of the highway, which will then carry traffic to and from the interchanges.

2. As an interim measure, the developer shall provide a fully channelized intersection with deceleration, acceleration, and turning lanes at its temporary access to Queen Kaahumanu Highway and any other related roadway improvements at no cost to the State. The proposed channelized intersection should also provide a left-turn median acceleration lane for traffic exiting the development.

3. We will allow the installation of traffic signals at the development's access to Queen Kaahumanu Highway, when warranted, together with a lowering of speed limits in the vicinity of the intersection.

4. The project should be fully coordinated with adjacent existing and proposed developments especially for the development of a frontage road system.

   The interchange servicing the area will be at the Keahole Airport. Please coordinate your access requirements and design with our Airports Division.

5. The developer shall commit to participating in regional highway improvements as determined by the Department of Transportation.

6. Construction plans for work within the State highway right-of-way must be submitted for our review and approval.

7. Any habitable area within the existing and forecasted 60 Ldn and greater aircraft noise contours will be designed and constructed with the necessary sound attenuation features to mitigate any adverse effects.

   Further, the applicant will waive all claims from the State for additional sound attenuation treatment resulting from significant changes in aircraft/airport operations and noise for areas within the existing and forecasted 60 Ldn and greater noise contours.

8. A noise and avigation easement satisfactory to the State Airports Division should be provided that will run with the land ownership.

We appreciate this opportunity to provide comments.

Sincerely,

For Rex D. Johnson
Director of Transportation

Helber Hastert
Planners

November 3,1992

Mr. Rex D. Johnson, Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 18, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PBH Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545 2055
Facsimile 808 545 2050

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

September 21, 1992

Planning Division

RECEIVED
SEP 23 1992
HELBER HASTERT & FEE
PLANNERS

Helber Hastert & Fee, Planners
Attention: Mr. Scott Ezer
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Sir/Madam:

Thank you for the opportunity to review and comment on the State Land Use Boundary Amendment petition for portions of State-owned lands in the Keahole to Kailua region of North Kona, County of Hawaii. The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. The proposed amendment does not involve any work in waters of the United States; therefore, a DA permit is not required.

b. According to the enclosed Federal Emergency Management Agency's Flood Insurance Rate Map Index Panel 155166 0001 1900 dated July 1990, the proposed site is located in Zone X-unshaded (areas determined to be outside the 500-year flood plain).

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

Enclosure

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

HAWAII COUNTY,
HAWAII
(UNINCORPORATED AREAS)

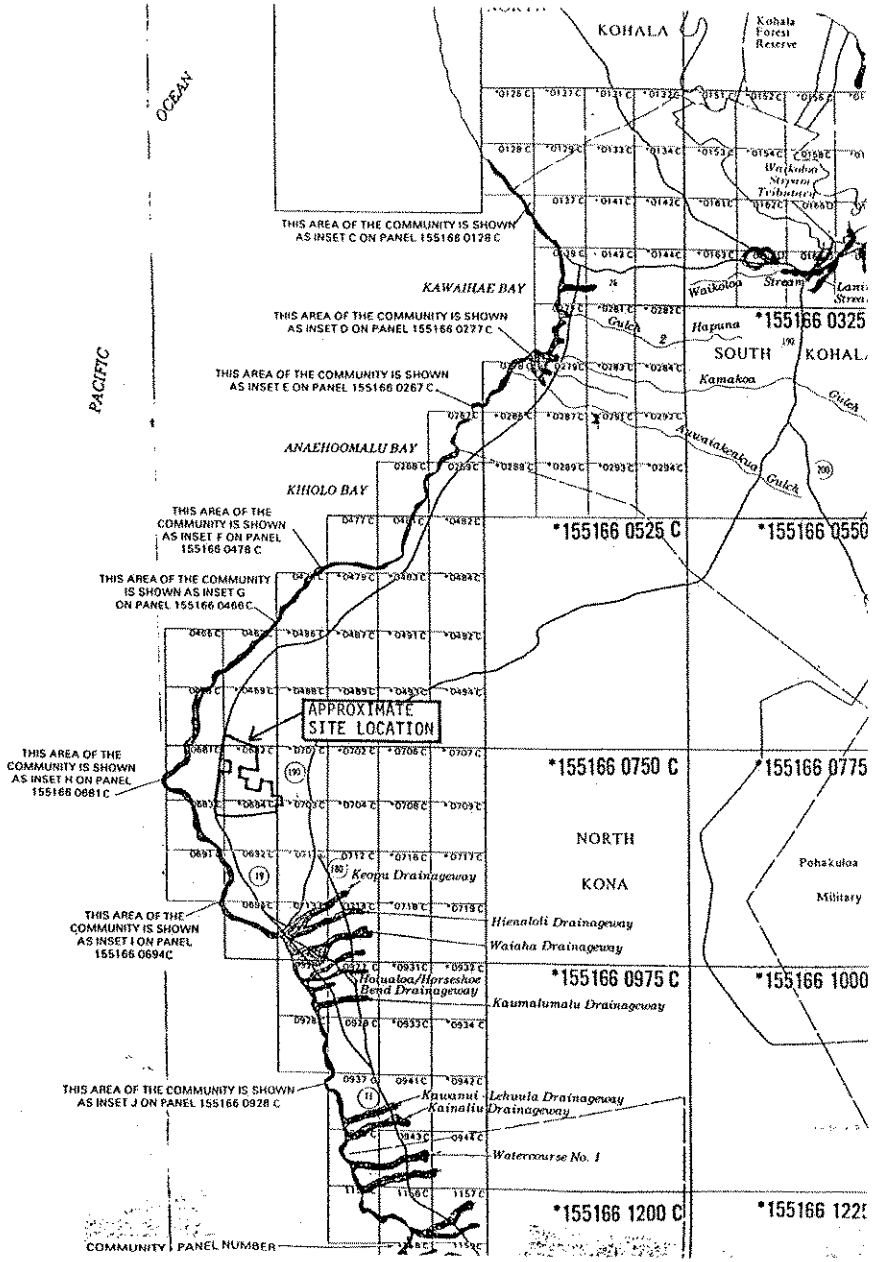
MAP INDEX
and
STREET INDEX

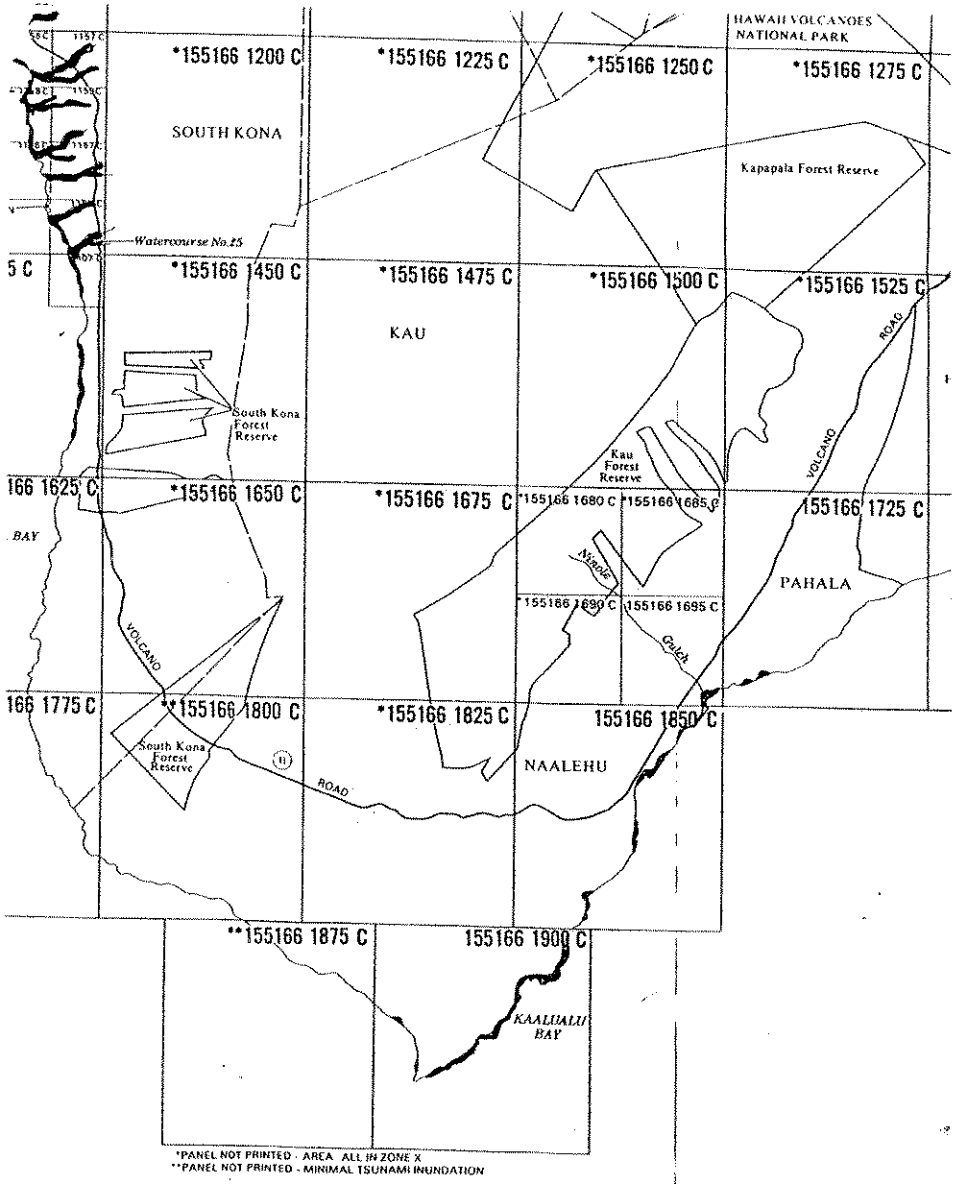
PANELS PRINTED: 50, 100, 125, 128, 137, 139, 143, 162, 164, 166, 167, 168, 169, 200, 205, 225, 267, 268, 269, 277, 278, 279, 466, 467, 468, 477, 478, 481, 681, 683, 691, 692, 694, 712, 713, 714, 860, 870, 880, 885, 890, 925, 926, 927, 928, 929, 937, 939, 941, 943, 944, 1152, 1156, 1157, 1158, 1159, 1166, 1167, 1169, 1400, 1407, 1425, 1600, 1695, 1725, 1850, 1900

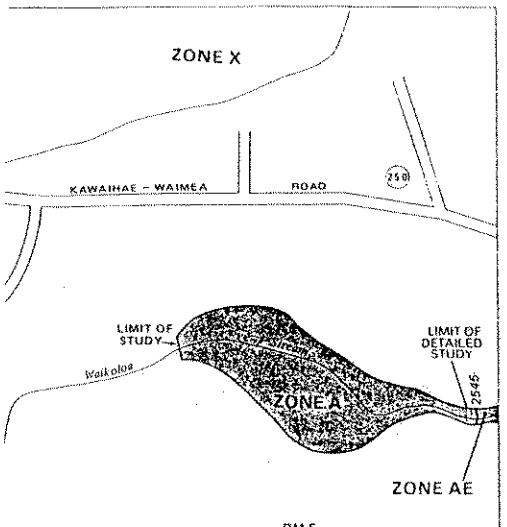
COMMUNITY-PANEL NUMBERS
155166 0001 - 1900

MAP REVISED:
3 NEW PANELS JULY 16, 1990

Federal Emergency Management Agency







LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- ZONE A — No base flood elevations determined.
- ZONE AE — Base flood elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE A99 — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- ZONE V — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- ZONE X — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- ZONE X — Areas determined to be outside 500-year flood plain.
- ZONE D — Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*

RM7 X — Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Coastal base flood elevations apply only landward of the shoreline.

Elevations reference marks are described in the Flood Insurance Study Report.

Helber Hastert
Planners

November 3, 1992

Mr. Kisuk Cheung, P.E.
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

Thank you for submitting comments during the early assessment consultation process for the above project by letter dated September 21, 1992.

We note your comments that the proposed urban expansion does not require a Department of the Army Permit and the subject site is located in Zone X-unshaded (areas determined to be outside the 500-year flood plain).

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PBT Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

SEP-22-92 TUE 10:31 NELH P.01

NELH — HOSTPARK
Natural Energy Laboratory of Hawaii — Hawaii Ocean Science and Technology Park

September 21, 1992

Mr. Scott Ezer
HELBER, HASTERT & FEE, PLANNERS
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

TO: SCOTT EZER NO. OF PAGES: 1
DEPT: FAX #:( ) 545-2050
FROM: CLARE HACHMUTH CO: NELHA
FAX #:( ) PHONE:( )
aSeeTac Fax Memo DMFX14

Dear Mr. Ezer:

SUBJECT: State Land Use Boundary Amendment and Environmental Assessment Consultation Urban Expansion State Lands, Keahole to Kailua Region

The Natural Energy Laboratory of Hawaii Authority depends on the high quality of the groundwater, coastal and offshore water for the continued operation of the projects and businesses located at Keahole Point. These tenants use groundwater and/or ocean water to culture various marine species or to perform alternate energy and related research.

Development mauka of the facility has the potential of causing an impact on the groundwater prior to the flow of the water under the NELHA property. An extensive water quality monitoring program has been established to verify the ground water quality and to forewarn of any impending degradation of the the coastal water. Several new developments mauka of NELHA have already agreed to participate in this monitoring program by either installing wells or contributing toward the operation of the program.

Please address the potential for groundwater contamination, efforts to prevent contamination and monitoring procedures to be developed for any future development in the area. Include in the discussion any requirements for hookup to regional sewage treatment plants or controls on types of sewage treatment that will be allowed.

Thank you for the opportunity to comment on the proposed action.

Sincerely,

Clare Hachmuth
Executive Director

Helber Hastert
Planners

November 3, 1992

Ms. Clare Hachmuth, Executive Director
Natural Energy Laboratory of Hawaii Authority
P.O. Box 1740
Kailua-Kona, Hawaii 96745

Dear Ms. Hachmuth:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 21, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, OSP

Helber Hastert & Fee
Grosvenor Center, PBT Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545 2055
Facsimile: 808 545 2050

Gay W. Glover, President
Keahole Ag Park Commumnity Association
C/O GLover Orchids Inc.
73-4392 Pukiawe St.
Kailua-Kona, HI 96740
Phone 326-2077
Fax 329-1259

RECEIVED
SEP 25 1992
HELBER HASTERT & FEE PLANNERS

Helber Hastert & Fee
733 Bishop Street, Siute 2590
Honolulu, HI 96713

Sept. 22, 1992

Dear Scott Ezer,

Thank you for your letter yo Mr. Yip in regards to State Land Use Boundary Amendment and Environmental Assessment Consultation, Urban Expansion State Lands, Keahole to Kailua Region.

It is of great concern to us what happens to the area surrounding the Agricultural Park. We have concerns with the compatibility of farming and urban areas.

Specifically, some members of our association have expressed concern that pesticide spraying may be objectionable to our new neighbors and have asked that suitable buffer zones be included in your plans. Others have expressed concern about the adequacy of infrastructure, particularly water supply quality and preasure, and traffic impacts.

We would like to be involved in the environmental impact assessment process. We have not had enough time to consult with all the farmers, but we would like to have some more information before we conclude our comments.

Thank you for this opportunity.

Sincerely,

Gay Glover
President

Helber Hastert
Planners

November 3, 1992

Ms. Gay Glover, President
Keahole Ag Park Community Association
c/o Glover Orchids Inc.
73-4392 Pukiawe Street
Kailua-Kona, Hawaii 96740

Dear Ms. Glover:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 25, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Kona Palisades Estates Community Association

Post Office Box 2223 Kailua-Kona, Hawaii 96745-2223

Helber Haster & Free
Grosvenor Center, PRI Tower
733 Bishop Street #2590
Honolulu, Hi. 96813
September 22, 1992

RECEIVED
SEP 23 1992
HELBER HASTERT & FEE PLANNERS

Dear Mr. Scott Ezer:

Thank you! for the opportunity to respond to the State's Boundary Amendment Petition.

We, the citizen's of the Kalaoa Park Citizens Committee have been in existence for over (3) three years and was created through a request by Senator Malama Salomon to the Kona Palisadas Community Association.

Following the adoption of the Senator's proposal by the Association's Board of Dirctors. A committee was formed to organize residents of the broader Kalaoa area. The organizing effort was very successful and we have received the full endorsement and cooperation from Grovernor John Waihee, Mayor Lorraine Inouye and Chairman Bill Paty. We are presently working with Geln Toguchi of the DLNR to secure a "right of entry" for the proposed site. (Location of the proposed site identified or enclosed map.)

The citizen's committee has the following concerns regarding the State's Boundary Proposal.

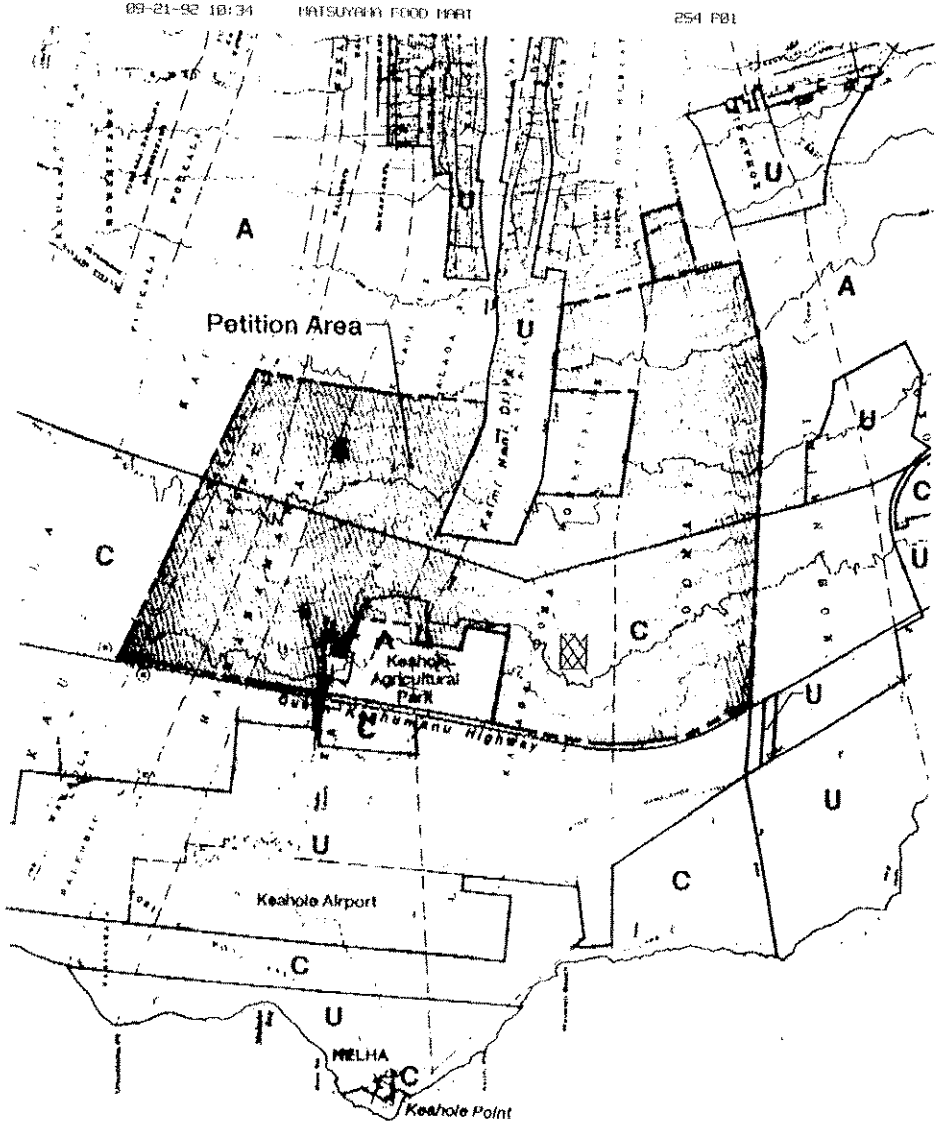
1- The State's Proposal does not preempt or delay the community's Park effort.
2- In achieving the community's first concern, a concerted effort toward cooperation be established between OSP, DLNR, COUNTY PARKS and the COMMUNITY.

Judging from our initial conversation, OSP Urban Initiative would seem to give strong support to the community's effort toward securing greater recreational opportunities for this area. However, our major concern is that the State's effort may complicate our effort by adding yet another level of overview bureaucracy regulation and policies which we must address. Please! keep me informed of any new development.

Mahalo!

Burk Matsuyama
Chairman of Kalaoa Park Committee

cc: Glen Toguchi, DLNR.
Senator Malama Solomon
Representetive Mike O'kieffe
Charmaine Kamaka, County of HI.



Helber Hastert
Planners

November 3, 1992

Mr. Burk Matsuyama, Chairman
Kalaoa Park Committee
Kona Palisades Estates Community Association
P.O. Box 2223
Kailua-Kona, Hawaii 96745-2223

Dear Mr. Matsuyama:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 23, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Senator Malama Solomon
Representative Mike O'Kieffe
Mary Lou Kobayashi, OSP
Esther Ueda, LUC
Glen Toguchi, DLNR
Charmaine Kamaka, DPR

Helber Hastert & Fee
Grosvenor Center, PBT Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

IN REPLY REFER TO:
92:PPE/4754jt

September 25, 1992

RECEIVED
SEP 0 1992
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Re: State Land Use Boundary Amendment and Environmental Assessment for Urban Expansion State Lands in the Keahole to Kailua Region

Thank you for the opportunity to provide comments on the subject project.

While we have no comments to offer at this time, we would appreciate information on the conceptual development plan and land use summary for the site as it becomes available.

Sincerely,

JOSEPH K. CONANT
Executive Director

Helber Hastert
Planners

November 3, 1992

Mr. Joseph K. Conant, Executive Director
Housing Finance and Development Corporation
State of Hawaii
Department of Budget and Finance
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

Dear Mr. Conant:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter dated September 25, 1992 which offered no comments during the early assessment consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545 2055
Facsimile 808 545 2050

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

September 25, 1992

RECEIVED
OCT - 2 1992
HELBER HASTERT & FEE PLANNERS

Mr. Scott Ezer
Associate
Helbert Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

Subject: State Land Use Boundary Amendment and Environmental Assessment
Consultation Urban Expansion State Lands Keahole to Kailua Region

The staff of the U. S. Geological Survey, Water Resources Division, has reviewed the subject Environmental assessment and we have no comments to offer at this time.

Thank you for allowing us to review this assessment.

Sincerely,

William Meyer
District Chief

Helber Hastert
Planners

November 3, 1992

Mr. William Meyer, District Chief
United States Department of the Interior
Geological Survey
Water Resources Division
677 Ala Moana Blvd. Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter dated September 25, 1992 which offered no comments during the early assessment consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Lorraine R. Inouye
Mayor
Charmaine L. Kamaka
Director
Alan R. Parker
Deputy Director

Department of Parks and Recreation

County of Hawaii • 25 Aupuni Street, Room 210 • Hilo, Hawaii 96720 • (808) 961-8311

September 28, 1992

RECEIVED
OCT - 1 1992
HELBER HASTERT & FEE
PLANNERS

Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attn: Scott Ezer

Subject: Urban Expansion of State Lands-Keahole to Kailua Region

Dear Mr. Ezer:

Thank you for informing us of the State's intent to seek urban designation for about 2,500 acres of land mauka of the Queen Kaahumanu Highway, between and including portions of the 'O'oma 2 and Makaula ahupua'as.

We have a right-of-entry request pending before the Board of Land and Natural Resources for site selection and planning of a community park to serve the Kalaoa residential area. We do not foresee this request being adversely affected by the State seeking urban designation for the area.

Thank you again for the opportunity to review and provide input on the request.

Sincerely,

Charmaine Kamaka
Director

Helber Hastert
Planners

November 3, 1992

Ms. Charmaine Kamaka, Director
Department of Parks and Recreation
County of Hawaii
25 Aupuni Street, Room 210
Hilo, Hawaii 96720

Dear Ms. Kamaka:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

Thank you for submitting comments during the early assessment consultation process for the above project by letter dated September 28, 1992.

For your information, OSP has filed a petition for a land use boundary amendment with the State Land Use Commission (LUC) for the above project together with an environmental assessment (EA) of the proposed action. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

GTE Hawaiian Tel

GTE Hawaiian Telephone Company Incorporated
P.O. Box 2200 · Honolulu, HI 96841 · (808) 546-4511

Beyond the call

September 28, 1992

Reply To
ABY-3
Honolulu, HI

RECEIVED
SEP 29 1992
HELBER HASTERT & FEE
PLANNERS

Mr. Scott Ezer
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Ezer:

State Land Use Boundary Amendment
and
Environmental Assessment consultation
Urban Expansion State Lands
Keahole to Kailua Region

Based on our review of the proposed petition area, we have the following comments:

1. HTC has telephone facilities which run along the Queen Kaahumanu and Mamalahoa Highways.

2. It is anticipated that HTC will have to establish an Electronic Serving Area for the Petition area. Therefore, HTC would require a plot of land of approximately 80'x150' to establish a remote switching office situated tentatively in the middle of the Petition area. It should also be approximately 2,640 feet from any planned HELCO substation.

3. A portion of the Petition area mauka of Queen Kaahumanu past the Keahole Agricultural Park towards Waikoloa is out of the existing telephone rate base area, and associated aid-to-construction costs will need to be calculated once the plans for the area are finalized.

Please call me at 834-6221 if you have any further questions.

Winslow I. Tanabe
Operations Manager -
OSP Engineering

WIT/mh2855

c: L. Hartshorn
G. Yadao

Helber Hastert
Planners

November 3, 1992

Mr. Winslow I. Tanabe
Operations Manager
OSP ENgineering
Hawaiian Telephone Company Incorporated
P.O. Box 2200
Honolulu, Hawaii 96841

Dear Mr. Tanabe:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter dated September 28, 1992 for the early assessment consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, OSP

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR OF HAWAII

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

RECEIVED
6

In reply, please refer to:

September 30, 1992

92-327/epo

Mr. Scott Ezer
Associate, Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

RECEIVED
OCT - 6 1992
HELBER HASTERT & FEE
PLANNERS

Dear Mr. Ezer:

Subject: State Land Use Boundary Amendment and
Environmental Assessment (EA) Consultation
Urban Expansion State Lands
Keahole to Kailua-Kona Region

Thank you for allowing us to review and comment on the subject boundary amendments. We have the following comments to offer:

Water Pollution

For any construction activity that may result in the discharge of storm water to waters of the State, and involves the clearing, grading and excavation of five (5) acres or more of total planned development, a National Pollutant Discharge Elimination System (NPDES) storm water permit is required from the Department of Health (DOH). An NPDES permit is required for any discharge to waters of the State including: construction runoff, dewatering activities, hydrotesting water from new water lines or storage tanks, groundwater remediations sites, and cooling water discharges from air conditioning units. The permit application should be submitted to the Director at least 90 days prior to the commencement of construction.

If you should have any questions on this matter, please contact Mr. Denis Lau of the Clean Water Branch at 586-4309.

Wastewater

We have reviewed the document on the subject project submitted by your office. The project area comprises approximately 2,500 acres mauka of Queen Kaahumanu Highway, between and including portions of the 'O'oma 2 and Makaula ahupua'as. We have determined that the subject expansion is located within the service area of the proposed sewage treatment plant No. 2, which is to be constructed 2.5 miles north of Keahole Airport. As the area will be sewered in the future, we have no objections to the proposed "urban expansion" provided that all the projects in the area are connected to the public sewers. The developer should work closely with the County to assure the availability of treatment capacity and adequacy for these projects. Non- availability of treatment capacity will not be an acceptable justification for use of any private treatment works.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290.

Solid Waste

Reclassification of the State lands to an urban district will allow for residential development in the Keahole to Kailua region. The EA or Environmental Impact Statement (EIS) for such an amendment must address the impacts upon the infrastructure that such a change in use would create. The Office of Solid Waste Management requests that the EA or EIS address the impacts of construction and daily activity in this new urban area on solid waste management infrastructure.

Construction and development of a residential community will significantly increase the volumes of solid waste currently handled in the Keahole to Kailua-Kona region. Construction debris, greenwaste from landscaping efforts, and municipal solid waste will be continually generated at the urban area. The increased treatment and handling needs of the waste should be addressed, planned and financed. The time to incorporate many cost- and resource-saving strategies for the community is during the planning and design phase. The DOH believes that urban expansion should be allowed at this site only if the state and county solid waste reduction goals are incorporated into the planning of the urban area, and if a commitment to waste reduction is made. We suggest the inclusion of the following integrated solid waste management strategies in the design and construction of the residential areas:

* Use of secondary resources (recycled materials) whenever feasible in the construction and design of the community (i.e., use of recycled concrete, crushed glass in asphalt for road paving, and the use of compost as a soil amendment for landscaping);

* Development of a greenwaste diversion plan where residents and maintenance staff may compost their greenwaste; and

* Inclusion of sufficient central collection areas for recyclable materials.

If you should have any questions on this matter, please call Mr. John Harder of the Office of Solid Waste Management at 586-4240.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

c: Clean Water Branch
Wastewater Branch
Office of Solid Waste Management

Helber Hastert
Planners

November 3, 1992

Dr. John C. Lewin, M.D.
Director of Health
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

We acknowledge receipt of your letter of September 30, 1992 for the early consultation process for the above project.

For your information, the Office of State Planning (OSP) has filed a petition for a land use boundary amendment for approximately 2,600 acres with the State Land Use Commission (LUC) for reclassification from the Agricultural and Conservation Districts to the Urban District. In support of the petition an environmental assessment (EA) was also filed with the LUC. We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. Once the LUC has determined that an EIS is required and an EIS Preparation Notice (EISPN) has been published in the OEQC Bulletin, we will send you a copy of the EA for your review and comment during the 30-day consultation period for the EISPN.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi,OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545 2055
Facsimile 808 545 2050

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:KCK

File No: 93-150
DOC. ID: 1530

OCT 6 1992

RECEIVED
OCT - 7 1992
HELBER HASTERT & FEE PLANNERS

Mr. Scott Ezer, Associate
Helber Hastert & Fee Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

SUBJECT: State LUC Boundary Petition -- Keahole to Kailua Region
Multiple, North Kona, Hawaii

Thank you again for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Our Department's main concern is with historic preservation matters. We have already advised the Office of State Planning (OSP) on the needs for this petition -- basically the preparation of a detailed background synthesis of settlement patterns (based on archival and archaeological data), to enable prediction of sites in the area. The OSP scope of work for the historic preservation concerns requires consultation with our Historic Preservation Division Office and our review of the background report. Thus, at this time, we have no further comments. The Division will, however, expect to be contacted by your consulting archaeological firm as they are doing the work, the Division will then await reviewing the report.

The Department's Division of Land Management indicates that they wholeheartedly support the proposed boundary amendment.

Thank you for your cooperation in this matter. Please feel free to call me or Sam Lemmo, at 587-0377, should you have any questions.

Very truly yours,

John P. Keppeler II

for WILLIAM W. PATY

cc: Hawaii Land Agent

Helber Hastert
Planners

November 3, 1992

Mr. William W. Paty, Chairperson
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

State Land Use Boundary Amendment and Environmental Assessment
Urban Expansion State Lands
Keahole to Kailua Region

Thank you for submitting comments during the early assessment consultation process for the Environmental Assessment for the above project by letter dated October 6, 1992.

We note your comment that the Department's main concern is with historic preservation matters. We also note your previous communication with the Office of State Planning (OSP) concerning the level of effort required to adequately address these matters. As you know, Paul H. Rosendahl, Inc (PHRI) will be conducting the detailed background synthesis of settlement patterns to enable prediction of sites in the area as well as an inventory survey on 500 acres of the petition area planned to serve as the West Hawaii campus for the University of Hawaii.

For your information, OSP has filed a petition for a land use boundary amendment with the State Land Use Commission (LUC) to reclassify approximately 2,600 acres from the Agriculture and Conservation Districts to the Urban District. You are listed as a party to the petition and were served the petition (including the environmental assessment supporting the petition) by hand delivery on October 19.

We anticipate that the LUC will determine that an environmental impact statement (EIS) is required for the petition. We also anticipate that the 30-day consultation period for the environmental assessment may commence on December 8, 1992 and end on January 7, 1993.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Mary Lou Kobayashi, OSP
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545 2055
Facsimile: 808 545 2050

13 CONSULTED PARTIES AND PARTICIPANTS IN THE FEIS PREPARATION PROCESS

13.1 Participants in the Draft EIS Preparation Process

The final EIS was prepared for the Office of State Planning by Helber Hastert and Fee, Planners. The following list identifies individuals and organizations who were involved in the preparation of the FEIS and their respective contributions.

Helber Hastert & Fee, Planners

Thomas A. Fee, AICP, (Principal-in-charge)
Scott Ezer (Project Manager and Principal Author)

Technical Consultants

Phillip L. Bruner (Avifauna and Mammals)
Paul H. Rosendahl, Inc. (Archaeology)
Water Resource Associates (Hydrology)
Char and Associates (Botany)
M&E Pacific, Inc. (Drainage)
The Traffic Management Consultant (Traffic Engineering)

13.2 Parties Consulted During the Preparation of the Final EIS

Notice of the Draft EIS was published in the April 8, 1993 edition of the OEQC Bulletin. Copies of the DEIS were distributed to 6 agencies, organizations, and libraries. The deadline for comments was May 23, 1993. A total of 23 written comments were received by June 11, 1993. The agencies, organizations and individuals who responded are identified below. Both comments and petitioner responses are reprinted on the following pages.

Federal Agencies

Department of the Navy, Commander, Naval Station Pearl Harbor
Department of the Army, U.S. Army Engineer District
Department of the Interior, Geological Survey
Federal Aviation Administration
Department of Housing and Urban Development

State Agencies

Department of Land and Natural Resources
Department of Land Natural Resources, Historic Preservation Division
Department of Business, Economic Development and Tourism, Land Use Commission
Department of Business, Economic Development and Tourism, Energy Division
Department of Accounting and General Services
Housing Finance and Development Corporation
Department of Transportation
Department of Health
Department of Education
Department of Defense
Office of Environmental Quality Control

Department of Agriculture
Department of Hawaiian Home Lands

University of Hawaii

Environmental Center

County of Hawaii

Fire Department
Police Department

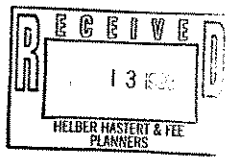
Other Agencies, Organizations and Individuals

William R. Glover
CH2M Hill

U.S. Department
of Transportation
**Federal Aviation
Administration**

AIRPORTS DISTRICT OFFICE
BOX 50244
HONOLULU, HI 96850-0001
Telephone: (808) 541-1243
Fax: (808) 541-3462

April 12, 1993



Mr. Scott Ezer
Helber Hastert & Fee
733 Bishop Street, #2590
Honolulu, Hawaii 96813

Dear Mr. Ezer:

We have reviewed the Draft Environmental Impact Statement Urban Expansion State Lands Keahole to Kailua Region received April 9, 1993.

We have no comments on the DEIS, but note that the State Department of Transportation, Airports Division, has received a Grant to fund the Keahole Airport Master Plan and Noise Compatibility Study update.

Sincerely,

David J. Welhouse

David J. Welhouse
Airport Engineer/Planner

Henry A. Sumida
Airports District Office Manager

Helber Hastert
Planners

May 4, 1993

Mr. David J. Welhouse
Airport Engineer/Planner
U.S. Department of Transportation.
Federal Aviation Administration
Airports District Office
Box 50244
Honolulu, Hawaii 96850-0001

Dear Mr. Welhouse:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 12, 1993 concerning the above project and note that you have no additional comments. We appreciate the information concerning the future update to the Keahole Airport Master Plan and Noise Compatibility Study.

Thank you for reviewing the draft environmental impact statement.

HELBER HASTERT & FEE, Planners

Scott Ezer

Scott Ezer
Senior Associate

cc: Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission

Helber Hastert & Fee
Grosvenor Center, PBI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

United States Department of the Interior

TAKE PRIDE IN AMERICA

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

April 9, 1993

RECEIVED
APR 15 1993
HELBER HASTERT & FEE PLANNERS

Ms. Esther Ueda
State Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Urban Expansion State Lands Keahole to Kailua Region, Draft Environmental Impact Statement (DEIS), North Kona, Hawaii

We are in receipt of the subject DEIS. We regret that due to prior commitments, we are unable to review the DEIS by the May 23rd deadline.

We are returning the DEIS to your office for your future use.

Sincerely,

William Meyer
District Chief

Enclosures

cc: Ms. Mary Lou Kobayashi
Office of State Planning
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Mr. Scott Ezer
Helber Hastert & Fee Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Helber Hastert
Planners

May 4, 1993

Mr. William Meyer
District Chief
United States Department of the Interior
Geological Survey
Water Resources Division
6 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 9, 1993 concerning the above project and note that you will be unable to review the draft environmental impact statement by the May 23rd deadline.

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

April 19, 1993

RECEIVED
2 1 1993
HELBER HASTERT & FEE
PLANNERS

Ms. Esther Ueda
State Land Use Commission
Old Federal Building
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Draft Environmental Impact Statement
Urban Expansion State Lands, Keahole
to Kailua Region, North Kona, Hawaii

Thank you for allowing our review of the subject draft environmental impact statement dated March 1993, for reclassifying approximately 2,640 acres of land in the Keahole area of the Big Island into the Urban District.

We have no additional comments other than the concerns expressed in our letter of September 18, 1992.

Should there be any questions, please call Mr. Ben Henderson of our Planning Office at 586-3838

Warmest aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:BH:jc

cc: Office of Environmental Quality Control
Ms. Mary Lou Kobayashi, Office of State Planning
✓Mr. Scott Ezer, Helber Hastert & Fee, Planners

2547L.2

Helber Hastert
Planners

May 4, 1993

Ms. Hoaliku L. Drake
Chairman
Hawaiian Homes Commission
State of Hawaii
Department of Hawaiian Home Lands
P.O. Box 189
Honolulu, Hawaii 96805

Dear Ms. Drake:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 19, 1993 concerning the above project and note that you have no additional comments.

Thank you for reviewing the draft environmental impact statement.

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission
Office of Environmental Quality Control

Helber Hastert & Fee
Grosvenor Center, PBR Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Stephen K. Yamashiro
Mayor

Nelson M. Tsuji
Fire Chief

County of Hawaii
FIRE DEPARTMENT

466 Kinoole Street • Hilo, Hawaii 96720-2983
(808) 961-8297 • Fax (808) 961-6920

April 23, 1993

RECEIVED
APR 26 1993
HELBER HASTERT & FEE
PLANNERS

State Land Use Commission
Old Federal Building, Room 104
335 Merchant Street
Honolulu, HI 96813

Attention: Esther Ueda

Gentlemen:

Subject: Urban Expansion State Lands
Keahole to Kailua Region
North Kona, Hawaii
TMK: 7-3-09:05; 7-3-09:08; 7-3-10:02; 7-3-10:por 33

We do not have any additional comments to those stated in our letter of January 25, 1993.

Sincerely,

NELSON M. TSUJI
Fire Chief

NMT/mo

cc: Office of State Planning
Helber Hastert & Fee, Planners

Helber Hastert
Planners

May 4, 1993

Mr. Nelson M. Tsuji
Fire Chief
County of Hawaii
Fire Department
466 Kinoole Street
Hilo, Hawaii 9620-2983

Dear Chief Tsuji:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 23, 1993 concerning the above project and note that you have no additional comments.

Thank you for reviewing the draft environmental impact statement.

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning
Esther Ueda, State Land Use Commission

Helber Hastert & Fee
Grosvenor Center, PBT Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

William R. Glover

CERTIFIED PUBLIC ACCOUNTANT
74-5588 PAWAI PLACE BUILDING "N"
KAILUA KONA, HAWAII 96740
808 329 8809

RECEIVED
APR 26 1993
OFFICE OF STATE PLANNING

39578

April 22, 1993

Office of the Governor
Office of State Planning
Attn: Mary Lou Kobayashi
P. O. Box 3540
Honolulu, HI 96811-3540

Re: Urban Expansion State Lands, Draft Environmental Impact Statement

Dear Ms. Kobayashi,

I am the leaseholder from the State of Hawaii of a lot in Keahole Ag Park, which is completely surrounded by the proposed expansion, (see enclosed map) although not a part of it. I was not provided with a copy of the Draft EIS and hereby request a copy. You may wish to consider providing copies to all leasees since we are all directly impacted by the proposed expansion.

In addition, I have had extensive experience with clients engaged in City Planning.

I would like to comment on the Draft EIS as follows:

First, the area clearly needs the urban designation and replanning with urban uses considered.

Second, for many reasons agricultural uses are incompatible with a surrounding urban area and inadequate attention has been paid to mitigating the impact of the proposed expansion on neighbors by "boundary buffer zones". I support the concept of having a golf course or other green area serve as a buffer to industrial areas.

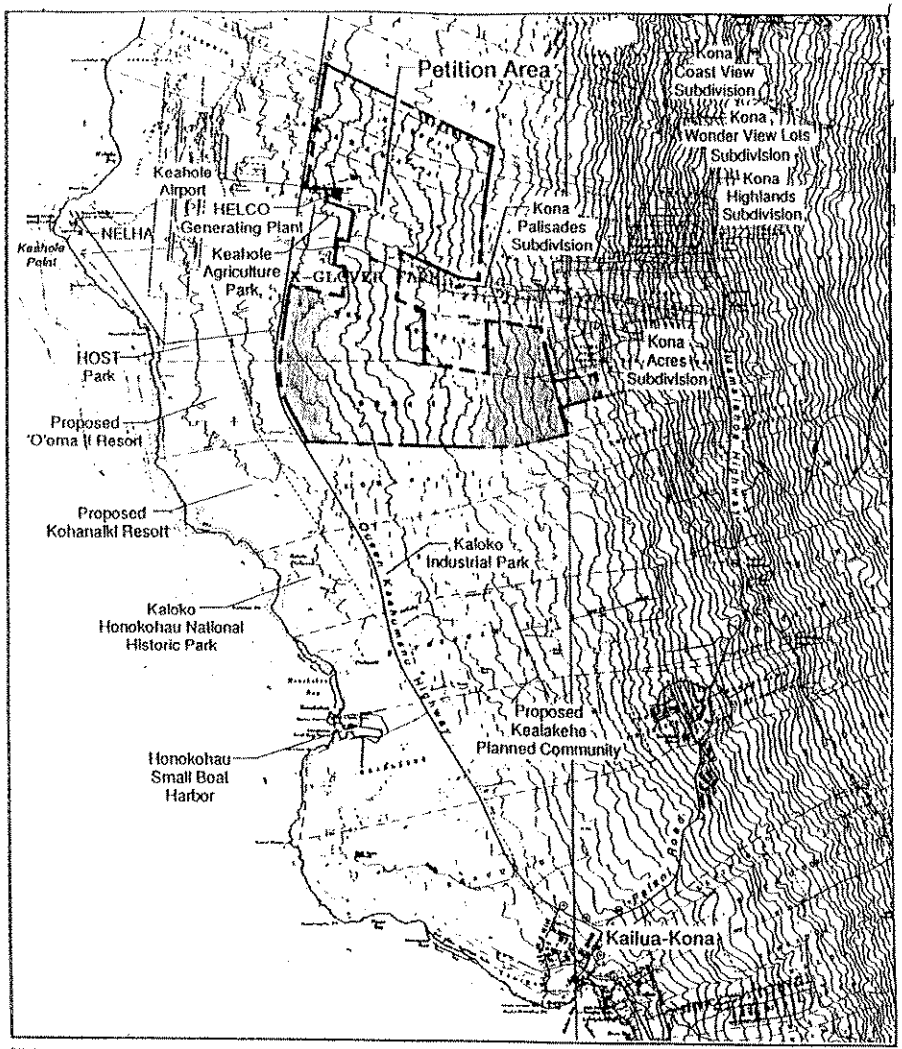
However in my opinion, sound planning should also encompass consideration of a phase out of the ag park and reclassification of Keahole Ag Park to Urban. As stated on page 1-3 under "Soils/Agricultural Productivity", none of the soils in the area are suitable for agricultural activities, and OSP feels that more suitable lands are available elsewhere in the region. If this is true for all adjoining areas, it is equally true for the existing Keahole Ag park. The state could relocate existing leasees, buy them out, or sell them the fee.

The DEIS does not adequately address the hows of this land being developed for urban use nor does it disclose the states plans for development. West Hawaii has virtually no lands available for fee purchase and development by owner managed business resulting in a low equity base for small businesses. Job creation would be substantially enhanced by the state offering fee simple commercial parcels for sale. This could also be a source of significant state revenue for many years to come if the state were to offer mortgage loans. On the other hand, state leases often inhibit capital investment by being overly restrictive in their terms.

I would appreciate being included in further mailings regarding this matter.

Sincerely,

William Glover



Regional Location Map
URBAN EXPANSION STATE LANDS
Keahole to Kailua Region

Figure: 1

Feet
0 2500 5000

Prepared for: Office of State Planning, State of Hawaii
Prepared by: Helber Hastert & Fee, Planners

Helber Hastert
Planners

June 4, 1993

Mr. William R. Glover
74-5588 Pawai Place Building "N"
Kailua-Kona, Hawaii 96740

Dear Mr. Glover:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated April 22, 1993. We will respond to your comments in the order they appear in your letter

Boundary Buffer Zones. We note your support of having a golf course serve as a buffer between agricultural uses and urban uses.

Relocation of Keahole Agricultural Park. We also note your suggestion that the Keahole Agricultural Park be relocated to more suitable lands elsewhere in the region. The Office of State Planning (OSP) recognizes the need to expand agricultural opportunities in West Hawaii and has consistently supported additional lands be set aside on State-owned property for agricultural parks north of the petition area. While there may be concerns associated with the compatibility of existing agricultural uses and future urban uses, OSP supports the continued use of the Keahole Agricultural Park.

Future Development Plans for the Petition Area. You raise a question concerning how the petition area will be developed and what type of use agreements will be offered to future businesses located in the petition area. At this time, OSP has not adopted an overall approach for the development of the petition area. The request that is now pending before the State Land Use Commission implements recommendations to urbanize the petition contained in the Five-Year Boundary Review Report prepared by OSP. The intent is to provide urban lands for future urban growth in West Hawaii, consistent with other existing land use policies contained in the County's General Plan and Keahole to Kailua Development Plan, and the State's West Hawaii Regional Plan.

OSP appreciates your suggestion to offer fee simple commercial parcels for sale to enhance job creation. This suggestion will be considered when OSP evaluates future land use plans for the petition area.

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

Helber Hastert
Planners

Mr. William R. Glover
June 4, 1993
Page 2

Thank you for reviewing the DIES. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda, LUC
Office of State Planning

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

April 23, 1993

RECEIVED
27 1993
HELBER HASTERT & FEE PLANNERS

Planning Division

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for Urban Expansion, Keahole to Kailua Region, North Kona, Hawaii. We have no additional comments to offer beyond those provided in our previous letters dated September 21, 1992 and January 22, 1993.

Sincerely,

ORIGINAL SIGNED

Kisuk Cheung, P.E.
Director of Engineering

Copies Furnished:

Mr. Scott Ezer, Associate
Helber Hastert Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Ms. Mary Lou Kobayashi
Office of State Planning
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Helber Hastert
Planners

May 4, 1993

Mr. Kisuk Cheung, P.E.,
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 23, 1993 concerning the above project and note that you have no additional comments.

Thank you for reviewing the draft environmental impact statement.

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission

Helber Hastert & Fee
Grosvenor Center, PBR Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:
11010
Ser N42/1585

28 APR 1993

RECEIVED
MAY - 1 1993
HELBER HASTERT & FEE PLANNERS

Ms. Esther Ueda
State Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

URBAN EXPANSION STATE LANDS
KEAHOLE TO KAILUA REGION

We have reviewed the subject Draft Environmental Impact Statement (DEIS) and have no comments to offer. We will retain one copy for our records and return the other copy to the Office of Environmental Quality Control.

Thank you for the opportunity to review the draft.

Sincerely,

W. K. Liu
Facilities Engineer
By direction of
the Commander

Encl:
(1) Draft Environmental Impact Statement

Copy to:
Ms. Mary Lou Kobayashi (w/o encl)
Office of State Planning
P. O. Box 3540
Honolulu, Hawaii 96811-3540

Mr. Scott Ezer (w/o encl)
Helber Hastert & Fee, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

State of Hawaii
Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawaii 96813

Helber Hastert
Planners

May 4, 1993

Mr. W.K. Liu
Facilities Engineer
Department of the Navy
Commander
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Liu:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 28, 1993 concerning the above project and note that you have no additional comments.

Thank you for reviewing the draft environmental impact statement.

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission
Office of Environmental Quality Control

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
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Stephen K. Yamashiro
Mayor

Victor V. Vierra
Chief of Police

Francis C. DeMorales
Deputy Chief of Police

County of Hawaii

POLICE DEPARTMENT

349 Kapiolani Street · Hilo, Hawaii 96720-3998
(808) 935-3311 · Fax (808) 961-2702

RECEIVED
- 1 1993
HELBER HASTERT & FEE
PLANNERS

April 28, 1993

State Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Attention: Ms. Esther Ueda

Dear Sir:

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
URBAN EXPANSION STATE LANDS
KEAHOLE TO KAILUA REGION, NORTH KONA, HAWAII
TMK: 7-3-09:05; 7-3-09:08; 7-3-10:02; 7-3-10:POR 33

We will defer comments until we review the updated report on the future highway needs. This report, assessed by the Island of Hawaii Long Range Highway Plan, should be completed by the end of 1993.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

JD:sk

cc: State Office of Environmental Quality Control
Mary Lou Kobayashi, Office of State Planning
Scott Ezer, Helber Hastert & Fee, Planners
Kona Police

Helber Hastert
Planners

May 4, 1993

Mr. Victor V. Vierra, Chief of Police
County of Hawaii
Police Department
349 Kapiolani Street
Hilo, Hawaii, 96720-3998

Dear Chief Vierra:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the Draft Environmental Impact Statement (DEIS) for the above project by letter dated April 28, 1993.

We note that you intend to defer further comment on the project until the Island of Hawaii Long Range Highway Plan is updated.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: State Office of Environmental Quality Control
Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission

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Grosvenor Center, PBN Tower
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Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

OFFICE OF THE SUPERINTENDENT

April 22, 1993

Ms. Esther Ueda
State Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Draft Environmental Impact Statement
Urban Expansion State Lands
Keahole to Kailua Region
North Kona, Hawaii

We have reviewed the subject DEIS and have the following comments:

1) Regarding Section 226-21, page 3-4 of the document. There is no discussion of Department of Education (DOE) concerns regarding the severe enrollment impact which will occur where residential developments occur within the expansion area. Schools are operating beyond capacity and will need additional classrooms to accommodate the projected increase in student population resulting from the urban expansion.

2) Our comments on the January 20, 1993, response to the EIS prep notice are still valid.

MAY 4 10 04 AM '93
LAND USE COMMISSION
STATE OF HAWAII

3) The mitigation measures proposed on pages 6-14 regarding the need for facilities and a proposed condition for State Land Use Commission approval are highly endorsed by the DOE.

Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga, Assistant Superintendent
A. Garson, Hawaii District Office
M. Kobayashi, Office of State Planning
S. Ezer, Helber Hastert & Fee, Planners

Helber Hastert
Planners

June 4, 1993

Mr. Charles Toguchi, Superintendent
Department of Education
P.O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated April 22, 1993. We will respond to your comments in the order they appear in your letter

Hawaii State Plan. You note that on page 3-4 of the DEIS there is no discussion of the Department of Education's (DOE) concerns regarding severe enrollment impact which will occur where residential developments occur within the petition area. Section 226-21(b)(2) of the Hawaii State Plan specifically indicates a policy of the State plan shall be to "ensure the provision of adequate and accessible services and facilities that are designed to meet individual and community needs. Section 6.8 of the DEIS acknowledges that current facilities planning for DOE does not include additional population increases within the petition area. This section has been modified to indicate your agency's concern about enrollment impacts associated with the urbanization of the petition area.

Comments on EISPN. We acknowledge that your comments to the EISPN dated January 20, 1993 are still valid. We believe your comments have been incorporated into the DEIS.

Mitigation measures. We note your endorsement of the proposed mitigation measures on page 6-14 of the DEIS.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning
Esther Ueda

Helber Hastert & Fee
Grosvenor Center, PBR Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545 2055
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DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

Energy Planning & Policy Group, 700 Bishop Street, Suite 1900, Honolulu, Hawaii 96813 PHONE: (808) 587-3836 FAX: (808) 587-3839

April 23, 1993

RECEIVED
MAY - 5 1993
HELBER HASTERT & FEE PLANNERS

APR 23 3 01 PM '93
LAND USE COMMISSION
STATE OF HAWAII

MEMORANDUM

TO: Esther Ueda, Executive Officer
State Land Use Commission

FROM: Maurice H. Kaya

SUBJECT: Draft Environmental Impact Statement (DEIS) Urban Expansion of State Lands, Keahole to Kailua Region

Energy Division has reviewed the subject DEIS and offers the following comments:

1. Chapter 3, Relationship of The Proposed Action to Existing Public Plans, Policies, and Controls, makes reference to goals, objectives, policies and guidelines of the Hawaii State Plan, Chapter 226, Hawaii Revised Statutes (HRS), which are relevant to the proposed expansion. However, this Chapter fails to relate the proposed expansion to Section 226-18, HRS, Objectives and Policies for Facility Systems – Energy/Telecommunications. We believe that this section of the State Plan should be reexamined to include a discussion of the relevant parts of this section to the proposed action. Should the drafters require Energy Division's interpretation of which sections apply, we would be pleased to supply this information.

   Likewise, Section 3.2, State Functional Plans, identifies the functional plans which relate to the proposed expansion. Again, however, a discussion of the Energy Functional Plan's relevance to the proposed action has been omitted. Our offer to assist the drafters extends to this section as well.

2. Section 4.14, Air Quality, page 4-31, states: "Based on the results of this [air quality] monitoring, existing ambient air quality within the vicinity of the generation station exceed both State of Hawaii and Federal air quality standards (CH2M Hill, 1992) (emphasis added)." Then, on the next page the DEIS states: "Some long-term impacts on air-quality could potentially occur due to indirect emissions from power generating facilities supplying the petition area with electricity." And, the report goes on: "According to the modeling results, no national or ambient air quality standards would be exceeded as the result of the proposed expansion of the generating station (ibid)."

   These statements appear to be in conflict. Also, if the existing ambient air quality within the vicinity of the Keahole generating station now exceeds air quality standard, the proposed expansion of the plant to nearly three times its current capacity will obviously create more emissions. Even with the best available control technology, this expansion will substantially increase the risk of long-term impacts on air quality within the proposed expansion area.

3. Page 4-33, Power Generating Emissions, states that: "Only a small portion of the power generated at the expanded generating plant would be attributable to the urbanized petition area. It should also be noted that urbanization of the petitioned area, cannot solely be responsible for the need to increase power generation within the region."

   Yet, page 6-12, Probable Impacts on Electric Power, estimates "That urbanization of the petition area would result in an increase of at least 40 MW in electrical demand." It goes on to state: "It is probable that the urbanization of the petition area would require additional capacity beyond that currently planned at the Keahole Generating Station."

   The discussion of the required additional power generation capacity is inconsistent between Chapters 4 & 6. We concur with the estimated 40 MW of increased demand as the result of the proposed urbanization, and recommend that Chapter 4 be revised to reflect this substantial impact.

4. After reading the DEIS, we are left with the impression that there is a substantial dependence being placed on the expansion of the Keahole Generating Station to provide the additional generating capacity that the proposed expansion would require. We note for the drafters' consideration that the Public Utilities Commission's (PUC) Integrated Resource Planning (IRP) process is currently underway for HELCO and Hawaii's other energy utilities. This process will require that all additional generation facilities be planned for within the IRP framework. Accordingly, HELCO's planned expansion of HELCO's Keahole Generating Station will actually come to fruition only if it is consistant with their approved IRP.

5. Finally, in the consultant's March 12, 1993, response to our earlier comments on the Environmental Impact Statement Preparation Notice (EISPN), it was stated that "At this point, OSP believes it is premature to discuss detailed measures to reduce fossil fuel dependency." It goes on to state that: "Urbanization of the petition area is expected to occur over a 15- to 25- year period, so that demand for public services, including electricity will be phased over several years."

We note for the drafters' consideration that the PUC's IRP planning horizon is 20 years, within which specific supply- and demand-side resources/technologies are planned for development over this 20-year time period. Further, the typical utility-scale fossil fuel generating station's life expectancy is approximately 30 years.

Therefore, we make two points:

- We disagree that it is "premature to discuss detailed measures to reduce fossil fuel dependency." And, we again urge more detailed descriptions of efficiency and alternate energy measures that should be considered over the phased urbanization of the petition area; and

- Given the apparent reliance on the expansion of the Keahole Generating Station to support the development of the petition area, we recommend that Chapter 8, Irreversible and Irretrievable Commitments of Resources, be revised to include language that will reflect the commitment to this expected expansion of a fossil fuel plant with the attendant increased risk of marine and on-shore oil spills and the greater risks of economic dislocations as a result of the price and supply volatility of petroleum in the world market.

Thank you for the opportunity to provide these comments.

Helber Hastert
Planners

May 28, 1993

Mr. Maurice H. Kaya
Energy Division
700 Bishop Street, Suite 1900
Honolulu, Hawaii 96813

Dear Mr. Kaya:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by memorandum dated April 23, 1993. We will respond to your comments in the order they appear in your memorandum.

1. State Plan/State Functional Plans. Chapter 3 of the Final EIS will be updated to include discussion of the new provisions indicated in your letter.

2. Air Quality. We note that you question the consistency of the use of the term "exceeds air quality" in reference to existing air quality in the vicinity of the Keahole Generating Station (page 4-31). The paragraph you reference in your memorandum will be amended in the following manner (language to be deleted is bracketed, language to be added is underscored): "Based on the results of this monitoring, existing ambient air quality within the vicinity of the generating station [exceed] meets both State of Hawaii and Federal air quality standards."

3. Electric Power Requirements. You point out that statements in Chapters 4 and 6 concerning the relationship between anticipated electricity demands resulting from the urbanized petition area and the ability of the expanded Keahole Generating Station to deliver adequate power seem to be in conflict. We concur with your analysis. The proposed expansion of the Keahole Generating Station will add about 56 megawatts (mW) of capacity to the station. It is estimated that the urbanization of the petition area could add up to about 40 mW of electrical demand to the utility network, or about 70 percent of the total expansion of the Keahole Generating Station. The FEIS will be amended to reflect your comment.

4. Keahole Generating Station Expansion. We agree that there is substantial reliance being placed on the expansion of the generating capability of Hawaii Electric Light Company's (HELCO) facilities to provide electricity for future development within the petition area. We assert that growth will take place in the West Hawaii region with or without the urbanization of the petition area. Currently, HELCO intends to provide additional capacity for West Hawaii by expanding the Keahole Generating Station. We acknowledge the requirement for additional generation facilities needs to be consistent with the Public Utilities Commission's Integrated Resource Planning (IRP) process, including the proposed expansion of the Keahole Generating Station.

5. Fossil Fuel Dependency. You urge that the EIS contain more detailed descriptions of efficiency and alternate energy measures that should be considered over the phased urbanization of the petition area. In response to paragraph #1, above, we suggested the use of solar water heaters, appropriate building materials, and efficient building design and orientation to help reduce energy use. We will update this section to include

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references to the standard set forth in the Hawaii Model Energy Code and design strategies identified in the 1990 AIA/DBED study entitled "Hawaiian Design Strategies for Energy Efficient Architecture." The Office of State Planning is in support of these approaches, but still believes that such measures should be considered during future planning for the petition area. The selection of specific measures will depend on the mix of uses and their locations within the petition area, the economics of alternate energy technology and the ability to deliver these service to the petition area.

You also suggest that Chapter 8, Irreversible and Irretrievable Commitments of Resources, be revised to include language that will reflect the commitment to the expected expansion of a fossil fuel plant (Keahole Generating Station), with the attendant increased risk of marine and on-shore oil spills and the greater risks of economic dislocations as a result of the price and supply volatility of petroleum in the world market. Chapter 8 already recognizes that "fossil fuels will be expended in support of ...the ongoing needs of the residential and commercial activities that would be part of the urbanized petition area."

It should be noted that transporting crude oil to produce electricity in Hawaii always has an inherent risk of an oil-spill. When viewed within the context of the overall energy requirements for the entire State, the added crude oil that would be needed for the petition area is minimal. As for the risk of economic dislocation that could result from the price and supply volatility of petroleum in the world market, we point out that the urbanization is intended to accommodate projected growth. Therefore, the need for additional energy production on the Big Island will occur with or without the urbanization of the petition area.

Any solution to a state-wide reduction in the reliance on imported oil as an energy source must be predicated on broad-based efforts in the areas of conservation and alternative resource development.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning
Esther Ueda

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Honolulu Office
Seven Waterfront Plaza, Suite 500
500 Ala Moana Boulevard
Honolulu, HI 96813

HELBER HASTERT & FEE
PLANNERS
MAY - 5 1993
RECEIVED

APR 30 1993

Ms. Ester Ueda
State Land Use Commission
Room 104, Old Federal Building
355 Merchant Street
Honolulu, HI 96813

APR 23 2 09 PM '93
LAND USE COMMISSION
STATE OF HAWAII

Dear Ms. Ueda:

This responds to your request for comments on the Draft Environmental Impact Statement (EIS) prepared for the Urban Expansion State Lands Keahole to Kailua Region, dated March 1993.

We have reviewed those parts of the Draft EIS where we had expressed concern, in our letter to Scott Ezer, Helber Hastert & Fee, Planners, dated February 8, 1993, on the Environmental Assessment, dated November 1992. We found that the concerns raised in our letter were adequately addressed, and that we do not have any further comments.

We appreciate the opportunity to comment on this proposed development, and find that we do not need to receive a copy of the Final EIS.

Very sincerely yours,

Frank L Johns
for Patty A. Nicholas
Director
Community Planning and
Development Division

Helber Hastert
Planners

May 28,1993

Ms. Patty A. Nicholas, Director
U.S. Department of Housing and Urban Development
Honolulu Office
Community Planning and Development Division
Seven Waterfront Plaza, Suite 500
500 Ala Moana
Honolulu, Hawaii 96813

Dear Ms. Nicholas:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 30, 1993 concerning the above project and note that you have no additional comments.

Thank you for reviewing the draft environmental impact statement. A copy of your letter and this response will be appended to the Final EIS.

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning
Esther Ueda, State Land Use Commission

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
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Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

RECEIVED
8 1993
HELBER HASTERT & FEE PLANNERS

May 7, 1993

Ms. Mary Lou Kobayashi
Office of State Planning
P. O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Ms. Kobayashi:

Subject: LUC Docket No. A92-685/Office of State Planning Draft Environmental Impact Statement (DEIS) for the Urban Expansion of State Lands, Keahole to Kailua Region, North Kona, Hawaii

We have reviewed the DEIS for the subject docket and have the following comments:

1) What was the basis for choosing the particular 11 master-planned developments for determining potential development impacts? Were older, more established communities considered, such as Mililani, Hawaii Kai, and Village Park which could provide actual data on wastewater generation, etc. and impacts to infrastructure?

2) Please clarify how the residential and light industrial land use percent allocations for each of the three development scenarios were developed from the data provided in the master-planned communities. Also, please clarify the rationale for using three scenarios.

3) Based on the scenarios and their projected populations, please clarify why a traffic impact assessment using similar standards as those used in projecting wastewater and domestic water demand (without specific uses identified) was not prepared. (It appears that the number of dwelling units, trip generation models, and per capita ownership data based on the scenarios could be used to generate a range of traffic impacts.)

4) Please clarify the specific assumptions and criteria used for the evaluation of the drainage impacts and solid waste generation projections from the project. Cumulative impacts of drainage, wastewater, and solid waste generation upon the environment from existing and proposed neighboring developments should be addressed.

5) There is no discussion on the social impacts of the project beyond the quantitative housing, population, and employment impacts upon the surrounding community. We suggest the Final EIS include an evaluation of qualitative impacts such as social conflict with surrounding residents and businesses, intra-project social impacts, and so forth.

6) According to Appendix A, Table 4 of the DEIS, the multipliers on direct employment are based on a review of recent EIS's. We suggest the Final EIS include a discussion on the projects on which these EIS's are based. Also, with respect to Table 4 and Table 18 on page 6-8, it appears that the projection for "domestic water" (potable water) demand does not include non-potable water uses. Please provide the data for the demand of non-potable water.

7) The project phasing provided does not allow for adequate analysis of the project's impacts through time. We suggest the Final EIS include a more detailed timetable for each proposed land use component for the project.

8) If possible, the Final EIS should include more detailed land use plan maps for all three development scenarios. The generalized land use plan (Figure 6) contained in the DEIS makes it difficult to assess impacts of the proposed land uses outlined in the scenarios.

9) On page 4-11 of Chapter 4, it is mentioned that "...Petitioner recommends that expansion (of the Keahole Agricultural Park) shall be encouraged on other State-owned parcels north of the petition area, along Mamalahoa Highway." Please identify the location of these parcels.

We have no further comments to offer at this time. We appreciate the opportunity to comment on this matter.

Should you have any further concerns or questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

cc: ✓Scott Ezer

Helber Hastert
Planners

June 2, 1993

Ms. Esther Ueda, Executive Officer
Land Use Commission
State Of Hawaii
Department of Business, Economic Development
& Tourism
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

LUC Docket No. A92-685
Draft Environmental Impact Statement
Urban Expansion of State Lands, Keaholé to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 7, 1993. We will respond to your comments in the order they appear in your letter.

As a general comment, we reiterate that the DEIS has been prepared as a supporting document for a boundary petition to implement recommendations included as part of the Office of State Planning's five-year State Land Use District Boundary Review, required by Section 205-18, Hawaii Revised Statutes (HRS). As you know, the purpose of the boundary review was to allocate sufficient land for future urban growth and also to direct urban growth to appropriate areas. Since the intent is to provide long-range planning rather than reacting to developer-initiated proposals, specific land uses have not been determined for the petition area. Probable impacts, therefore, are based on the assumption that the petition area will be used to accommodate "urban expansion," without defining specific uses within the petition area.

1. Basis for selecting master planned community comparables and historical data on infrastructure impacts. The eleven communities selected for determining potential development impacts were chosen to provide a basis for assigning gross acreages for land uses that might be included in the future development of the petition area. The eleven projects represent relatively new, large-scale master planned communities and a mix of uses with densities acceptable in today's market place. Fairly consistent EIS-level information was also available for each of the projects.

These projects were not selected to provide specific data on impacts to infrastructure. Wastewater flows and potable water demands were determined using published design standards which was determined to be a more conservative method of estimating demands.

2. Basis for determining residential and industrial allocations and why three scenarios were used. The survey of master planned communities indicated a land use allocation range for residential and light industrial acreages of between 29 to 75 percent

Helber Hastert & Fee | 733 Bishop Street, Suite 2590 | Telephone 808 545-2055
Grosvenor Center, PBH Tower | Honolulu, Hawaii 96813 | Facsimile 808 545-2050

and 0 to 20 percent, respectively. This compares with a residential range of 30 to 40 percent and a light industrial range of 14 to 23 percent used in the land use scenarios. In general terms, based on locational characteristics of the site and planned residential growth in the region, it was determined that light industrial uses would receive a higher allocation than the norm indicated in the master planned community survey, offset, in part, by a lower residential allocation.

Three scenarios were chosen to allow for a range of land use allocations to be evaluated. Less than three scenarios would significantly reduce the reliability of the estimate, while more than three would not significantly increase the reliability of the estimate.

3. Traffic Impact Assessment. Transportation planning for the Keahole to Kailua region is currently focused on the need for improvements to Queen Kaahumanu Highway. As discussed in Section 6.1 of the DEIS, in recognition of the rapid changes within the region, several transportation studies have either been completed or are underway by State and County agencies to plan for necessary vehicular circulation improvements to accommodate growth. These include the Keahole to Kailua Development Plan, the Queen Kaahumanu Highway Master Plan and the Island of Highway Long Range Master Plan. In addition to these government studies, other traffic impact reports have been prepared for various other private developments in the region.

All of the studies reviewed by the Traffic Management Consultant (TMC), the project traffic consultant, concur that traffic demand on Queen Kaahumanu Highway would exceed the existing two-lane capacity of Queen Kaahumanu Highway by the year 2000.

Because of the unknown nature of future urban land uses for the petition area, a general discussion of existing traffic conditions and future plans for the Queen Kaahumanu corridor were determined to be appropriate for this DEIS. This was confirmed by the State Department of Transportation (DOT) Highways Division which found the proposed approach acceptable. The Office of State Planning (OSP) is aware of the need to provide more detailed traffic analysis for the petition area which is why it is recommending that future development approvals at the County level be preceded by traffic impact analysis reports, as specific land uses are identified for future land use approval requests. Such a recommendation is included in the discussion of mitigation measures for the traffic impacts.

Traffic impact assessments are also used to identify mitigating measures which should be imposed to alleviate the impacts of the development. In this context, OSP has recommended that a number of conditions be required as part of any approval of the boundary petition, including: participaton in the funding and construction of local and regional transportation improvments and programs as required by DOT; monitoring traffic attributable to the petition area at on-site and off-site locations; appointing a permanent transportation manager whose function is the formulation, use, and continuation of alternative transportation opportunities that would optimize the use of existing and proposed transportation systems; or, participation in a regional program for transportation management with other developers and/or landowners.

4. Criteria for drainage and solid waste calculations. Evaluation of the drainage impacts associated with the proposed urbanization of the petition area was conducted by the project civil engineer (M&E Pacific, Inc.). The evaluation was based on an analysis of the total cumulative drainage area affecting the petition area (both on- and off-site) which included general assumptions about impervious surfaces that might result from typical development of the petition area.

Analysis of potential impacts associated with solid waste generation were based on discussions with staff members at the County of Hawaii Department of Public Works, including the identification of a per capita per day solid waste generation rate (about 6.0 lbs per capita per day).

As far as cumulative impacts are concerned, development within the region would significantly add to demand on public services, including wastewater treatment and solid waste. The Keahole to Kailua Development Plan identifies the need for an additional wastewater treatment facility for the region. No engineering or planning work has been done for such a facility other than the recognition of its future need. The size of any wastewater treatment facility serving the region must be designed to meet future demand, unless some private systems are allowed to accommodate some of the demand. In any event, detailed analysis of alternative treated wastewater discharge methods must occur. While some treated wastewater could be used for irrigation, it is possible that other treated wastewater might need to be discharged in other ways, possibly by underground injection.

Given that marine waters fronting this coastline have been designated 'AA' by the State Department of Health and the potential for treated wastewater to adversely affect water quality, it is important that continued marine and ground water monitoring be an integral part of all future development. Such a recommendation is endorsed by OSP and has been included as a mitigation measure in the DEIS.

Likewise, other proposed development in the region will increase surface water runoff. It is anticipated that most of this runoff could be channeled to areas where rapid percolation could occur through porous lavas. Again, marine and ground water monitoring as proposed in the DEIS will be important to assess changes.

5. Qualitative Social Impacts. The final EIS will be revised to include a discussion of qualitative social impacts such as those mentioned in your letter.

6. Employment multipliers and non-potable water use. Appendix A will be revised to include a discussion of the referenced projects. As far as non-potable water demand is concerned, the major user of non-potable water would be any golf course that is developed within the petition area. Based on the irrigation needs of other golf courses in the area, it is estimated that each course would require between 0.5 and 1.0 million gallons of non-potable irrigation water per day. The exact volume of irrigation water requirement would be a function of the type of turf grass used in the course and the acreage of the course that is planted in turf.

Maximum demand produced by two golf courses would be about 2.0 million gallons of irrigation water per day. The minimum estimated wastewater effluent generated from the developed petition area is estimated at 2.45 million gallons per day which represents more effluent than two golf courses could use in one day. Therefore, the analysis indicates a sufficient project-generated non-potable water supply.

7. Project Phasing. Section 2.6 of the DEIS generally describes how the project would be phased given present access conditions. The determination of the phasing of specific land uses without an overall master plan would be highly speculative at this time. The actual timing of the land uses and supporting infrastructure would be determined in the County land use approval process.

8. Detailed land use plans. The exercise to identify order of magnitude impacts for the petition area should be viewed as an estimate which we believe to be an accurate representation of the range of anticipated impacts. Quantitative estimates for such public services as potable water and wastewater are not location-specific, but are a function of the density of the particular use. Other impacts, especially those related to botanical and archaeological resources are location-specific and these resource areas have been identified with appropriate accuracy.

9. Agricultural park expansion. There are State-owned lands north of the petition area which are possible sites. However, a specific site has not yet been selected.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning

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(P)1326.3

... 13 1993

State Land Use Commission
Old Federal Building, Room 104
335 Merchant Street
Honolulu, Hawaii

Attention: Ms. Esther Ueda

Gentlemen:

Subject: Urban Expansion State Lands
Keahole to Kailua Region
Draft Environmental Impact Statement

We have reviewed the subject document and have the following comments to make:

1. DAGS has retained the consulting firm of Design, Planning, and Development, Inc. to prepare a Site Selection/EIS project for a proposed Kona Civic Center.

2. One of the five sites proposed for the Kona Civic Center is located in the Ooma 2 site that is included in the subject DEIS.

3. The Kona Civic Center site will require approximately 30 acres.

If there are any questions regarding the above matter, please have your staff call Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

GORDON MATSUOKA
State Public Works Engineer

RY:jk
cc: Office of State Planning
/Helber, Hastert, & Fee, Planners
OEQC

Helber Hastert
Planners

May 28, 1993

Mr. Gordon Matsuoka
State Public Works Engineer
Department of Accounting and General Services
Division of Public Works
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Matsuoka:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 13, 1993. We have reviewed your comments and offer the following responses.

We note that the O'oma 2nd ahupua'a, mauka of Queen Kaahumanu Highway, is one of five alternate sites being considered by your department for the proposed Kona Civic Center. The discussion of impacts included in the DEIS is based on an analysis of three possible development scenarios for the petition area. Each of the development scenarios includes 90 acres for "civic" uses.

This land use category includes a range of residential-supporting uses such as police, fire and ambulance stations, daycare facilities, churches, schools, etc. While civic-type uses were contemplated as part of the probable overall development plan for the petition area, the Office of State Planning (OSP) has not specifically considered siting the Kona Civic Center in the petition area. OSP intends to work closely with your department during the site selection process, and encourages DAGS and its consultant, Design, Planning, and Development, Inc., to contact Judith Henry to discuss the Kona Civic Center project.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda
Office of State Planning

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
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JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

May 18, 1993

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Ms. Esther Ueda, Executive Officer
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Draft Environmental Impact Statement for the Keahole to Kailua - Urban Expansion of State Lands, North Kona, Hawaii

Thank you for the opportunity to review the subject document. We do not have any comments to offer.

Sincerely,

Brian J. J. Choy
Director

BC:jt

c: Office of State Planning
Helber Hastert and Fee, Planners

Helber Hastert
Planners

May 28, 1993

Mr. Brian J.J. Choy, Director
Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

We acknowledge receipt of your letter dated April 30, 1993 concerning the above project and note that you have no additional comments.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Associate

cc: Office of State Planning
Esther Ueda

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JOHN WAIHEE
Governor

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State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

May 17, 1993

YUKIO KITAGAWA
Chairperson, Board of Agriculture

ILIMA A. PHANAIA
Deputy to the Chairperson

FAX: 973-9613

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96823-2159

COPY

TO: Ms. Esther Ueda, Executive Officer
State Land Use Commission

FROM: Yukio Kitagawa, Chairperson
Board of Agriculture

SUBJECT Draft Environmental Impact Statement (DEIS) for
Urban Expansion State Lands - Keahole to Kailua Region
Agricultural and Conservation to Urban
TMK: 7-3-09: 5, 8; 7-3-10: 2, por. 33
North Kona, Hawaii
Area: 2,640 Acres (about 1,200 acres in the
Agricultural District and 1,400 acres in the
Conservation District)

The Department of Agriculture (DOA) has reviewed the Draft EIS and offers the following comments.

The State is seeking to induce urban development of the subject area as the Big Island's "Second City." Among the uses proposed for the area is the West Hawaii Campus of the University of Hawaii. Total project build-out is expected to take 15 to 30 years.

In the midst of the subject proposal is the 34-lot, 179-acre Keahole Agricultural Park. Since 1988, we have stated that it is our intention to expand the existing facility by approximately 200 acres on its southern and/or eastern boundaries.

Consonance with the West Hawaii Regional Plan

The Office of State Planning's (OSP) West Hawaii Regional Plan recognizes the potential for expanding the Keahole Agricultural Park (page 25). Thus, contrary to the first paragraph on page 3-12 (Section 3.5) of the DEIS, the subject boundary amendment is not entirely consistent with the Regional Plan.

Demand for Agricultural Park lots at Keahole

In our letter to the petitioner's consultant (DEIS, page 12-9), we stated there were 123 expressions of interest by farmers

seeking additional lots at the Keahole location. As of April, 1993, there are an additional 13 interested farmers, for a total of 136. The demand for agricultural park lots is therefore considerable, and is not "problematic" as stated on page 7-2 of the DEIS.

Cost of expanding the Keahole Agricultural Park versus developing a new Agricultural Park along the Mamalahoa Highway

The petitioner's proposed mitigation measure to the foreclosure of any expansion of the Keahole Agricultural Park is to recommend that future agricultural park development in the area take place on other State-owned parcels north of the subject area, along the Mamalahoa Highway (DEIS, page 4-11). The petitioner should state specifically where State agricultural parks could be developed and compare the cost of developing the infrastructure (especially water source and distribution) for a new agricultural park versus the expansion of the Keahole Agricultural Park. There is no County water service along Mamalahoa Highway past the Kona Ocean View Properties subdivision. We are confident that the 200-acre expansion of the Keahole Agricultural Park can be done at far less expense than developing a new agricultural park along the Mamalahoa Highway.

DOA's commitment to water development

The DOA is party to a multi-agency memorandum of understanding (dated January 23, 1993) for the North Kona Water Master Plan which includes the development of new sources of potable water. We are committed to provide $3,658,000 in return for a share of the water - 540,000 gallons per day earmarked for the expansion of the Keahole Agricultural Park. Our share is not transferable out of the joint agency water service area. In this regard, the petitioner's amendment request is not consistent with the North Kona Water Master Plan; the petitioner is not a party to the multi-agency memorandum of understanding.

Buffer zone around the Keahole Agricultural Park

To reduce the likelihood of nuisance complaints, the Keahole Ag Park Community Association requested in their letter of September 22, 1992, (DEIS, page 12-20) that suitable buffer zones be incorporated into plans for the area immediately surrounding the Park. The DEIS suggests that light industrial uses or golf course fairways may serve as "transitional" land uses.

The DEIS mentions that developers and/or landowners will be responsible for informing affected buyers/lessees of the subject area about the provisions of Chapter 165 (Hawaii Right-to-Farm-Act). While Chapter 165 protects farmers from nuisance complaints, our preference is that conflicts between agricultural and nonagricultural uses be avoided before it gets to the complaint stage. Where conflicts do occur, the encroaching use and not the existing farm businesses should bear the full cost of implementing mitigating measures.

Agricultural alternative to the proposed action

The DEIS must separate the issue of expanding the Keahole Agricultural Park from the discussion on the "agricultural alternative" use of the entire subject area (DEIS, page 7-1). As noted earlier, there clearly is a demand for agricultural lots in the Keahole area and the expansion of the area will quite likely be more economic than developing another site. Furthermore, the Keahole Agricultural Park is uniquely suited to nursery and shadehouse uses and does not require soil like more traditional agricultural uses.

The DEIS reiterates the frequently-cited opinion of the agricultural consultant that vast amounts of sugarcane and pineapple lands, irrigation water, and related infrastructure are available. We assert that these lands and other resources are not necessarily available for diversified agricultural use. An example is the situation involving the Hamakua Sugar Company lands. The major creditor, Western Farm Credit Bank, has not displayed any interest in making their lands available for agricultural use.

Summary

It is our understanding that the EIS process represents the only opportunity for us to argue on behalf of the 200-acre expansion of the Keahole Agricultural Park. We strongly believe that the expansion of the Keahole Agricultural Park should be accommodated as a functional part of the urban expansion plans for the Keahole area, and that the expansion area should be reclassified from Conservation to Agricultural District. Should you desire any further clarification or additional information on our position, please contact me at 973-9550, or Dr. Paul J. Schwind, at 973-9469.

Thank you for the opportunity to comment.

c: Office of State Planning (attn. Mary Lou Kobayashi)
Helber Hastert and Fee, Planners (attn. Scott Ezer)

Helber Hastert
Planners

May 28, 1993

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 1, 1993. We will respond to your comments in the order they appear in your letter

West Hawaii Regional Plan. You correctly note that the West Hawaii Regional Plan recognizes the potential for expanding the Keahole Agricultural Park site. While the potential does exist, the Office of State Planning (OSP) believes it is more appropriate to direct expansion of the agricultural park program to other State-owned lands north of the petition area. In a regional context, it is not inconsistent to shift the expansion of ag park resources to another site within the region.

Demand for Agricultural Park Lots. We acknowledge the increase of an additional thirteen farmers to the list of those seeking lots at the Keahole location. This growing list certainly indicates the regional interest in agribusiness in West Hawaii. The description of demand being "problematic" for the Keahole Agricultural Park should also be viewed in a regional context. OSP believes that this demand can be satisfied by another agricultural park located within the region.

Cost/benefit of Keahole Agricultural Park expansion. You point out that the relative cost to expand the Keahole Agricultural Park would be less expensive than developing a new agricultural park along the Mamalahoa Highway (especially water source and distribution). This assertion may be true if comparisons are made strictly to the costs of expanding the number of agricultural lots in the region. Another consideration for any cost/benefit analysis should be the potential social benefits that could be realized by the urbanization of the petition area in terms of the production of new affordable housing and diversified employment opportunities.

DOA's commitment to water development. You note that DOA has committed to participate in the development of new water sources and that the share of the water earmarked for DOA is not transferable outside the joint agency water service area. OSP has indicated it will coordinate the resolution of this problem with you, and will respond to your concerns under separate cover.

Buffer zone around the Keahole Agricultural Park. In the discussion under "Mitigation Measures", the DEIS states that future planning for the petition area should

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be sensitive to the compatibility of uses surrounding the agricultural park. Light industrial uses or golf course fairways might offer compatible transitional uses. We note that it is the Department's position that when conflicts between agricultural and non-agricultural uses occur, that encroaching uses and not the existing farm business that should bear the full cost of implementing mitigating measures.

Agricultural alternative to the proposed action. The discussion in Chapter 7 of the DEIS concerning the agricultural alternative for the petition area was not intended to be confused with the expansion of the agricultural park. The agricultural alternative should be viewed as an alternative use for the entire petition area, not just the 200-acre area south of the existing agricultural park. We assume you concur with the DEIS conclusion that a large-scale agricultural use alternative would not be an appropriate long-term use of these strategically situated public lands. It is recognized that the costs and benefits of alternate sites for an agricultural park elsewhere in the region need to be carefully analyzed. Although it is probable that large tracts of land will become available for alternative uses if sugar cane and pineapple plantations are phased out, it is not necessarily true that all of this land will be set aside for agricultural activities. We merely wished to point out that the potential exists for other lands to absorb the demand for agricultural production that are more suitable for agricultural activities elsewhere on the Big Island and throughout the State. It is possible that this could occur in Hamakua or other locations as well.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda
Office of State Planning

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

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May 21, 1993
RE:0627

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Draft Environmental Impact Statement
Urban Expansion of State Lands
Keahole to Kailua Region
North Kona, Hawaii

The Office of State Planning (OSP) is requesting an amendment to the State Land Use District Boundaries for approximately 2,640 acres of land in the Keahole area of North Kona, Hawaii from Agricultural and Conservation to Urban. Of the acreage, approximately 1,400 acres in the western (makai) half of the petition area are within the State Conservation District (General Subzone) and the balance of about 1,200 acres in the eastern (mauka) half of the petition area is within the State Agricultural District. A small portion of the land in the Agricultural District is in the western half of the petition area, immediately mauka of the existing State-owned Keahole Agricultural Park. The petition is based on a recommendation made by OSP as part of the Draft State Land Use Boundary Review for the island of Hawaii), which identifies the petition area for urban reclassification as a Priority Area for Action.

Approximately 500 acres in the northeastern portion of the petition area are proposed for the West Hawaii Campus of the University of Hawaii. Other uses for the remainder of the petition area have yet to be defined, although a mix of urban uses is expected, including but not limited to housing, parks, commercial uses, light industrial uses, roadways, and public facilities. Specific acreages and locations for uses have not yet been determined.

The Environmental Center has reviewed the document with the assistance of Terry Hunt, Anthropology; Kathleen Wilson, Urban and Regional Planning; and Andrew Tomlinson of the Environmental Center.

General Comments

In general, we find this DEIS to be comprehensive and well prepared. The document includes an adequate description of the existing environment and provides as through an assessment of possible impacts to that environment from the boundary amendment and planned urbanization, as may be expected, since specific intended development actions in the proposed petition area have yet to be determined. As such, it appears that the intent of Chapter 343, House Revised Statues (HRS), has been fulfilled by the document.

Furthermore, we concur with the stated intention and requirement that further assessment be conducted for each individual development action within the proposed petition area. We look forward to reviewing the subsequent Environmental Assessments, Environmental Impact Statements, and permits, etc. for each specific action in the petitioned area.

Natural Hazards (p. 4-7)

Although the DEIS correctly identifies the petition area as lying within seismic Zone 3 for structural specifications under the 1988 Uniform Building Code (UBC), the UBC is subject to periodic revision. Current geophysical assessments are questioning the appropriateness of a Zone 3 classification for the Big Island, and it may well be that in the near future, the area will be upgraded to Zone 4. Thus, although the DEIS is technically correct, given that it is a long-range planning document, some references to the likelihood of changes in building codes reflecting more appropriate recognition of existing seismic hazards would be advisable.

Flora (p. 4-17)

The DEIS also correctly identifies the existence of uhiuhi adjacent to and 'aiea in the petition area, but does not note the potential fire hazard to these species. The final EIS should discuss the potential hazards to these species from increased access, roadways, and other related developments that would raise the possibility of grassland and dry shrubland fires. Some provision for buffering individual trees and/or fire suppression should be included in the final EIS.

Water Disposal (p. 6-9)

Longterm monitoring of surface ocean water chemistry at the NELH has detected a gradual rise in concentrations of dissolved Nitrate(NO_3). The rise has been roughly proportional to the increase in population in the North Kona-South Kohala region. Given that pristine seawater is both an aesthetic advantage and a necessary resource for research

at the NELH, the prospect of doubling or tripling the population is worrisome. As a long-range planning instrument, the DEIS should note the concern about nearshore water quality, and there should be considerable attention paid to alternative wastewater management strategies.

Conclusion

We applaud the initiative of the OSP to cultivate long-term planning in the North Kona area and in the entire State of Hawaii through its recognition of development alternatives and direction of urbanization toward specified areas. The preparation and processing of this DEIS for the proposed boundary amendment from Keahole to Kailua, undertaken by the State, also represents a superior example of the intent of Chapter 343, HRS. While other private projects have attempted to include specific multiple development actions under the umbrella of one proposed action in the Chapter 343 process, which has rendered the documents vague and incomplete, the DEIS for the Keahole to Kailua Urban Expansion provides a solid framework and basis of information for the intended future description and assessment of the various phases and projects of urbanization that will be specifically addressed in subsequent Chapter 343, HRS, documents.

Thank you for the opportunity to review this document. We hope our comments have been helpful.

Sincerely,

John T. Harrison

John Harrison, Ph.D
Environmental Coordinator

cc: OEQC
Office of State Planning
Helbert, Hastert & Fee Planners ✓
Kathleen Wilson
Terry Hunt
Roger Fujioka
Andrew Tomlinson

Helbert Hastert
Planners

May 28, 1993

Mr. John Harrison, Ph.D.
Environmental Coordinator
University of Hawaii at Manoa
Environmental Center
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Dr. Harrison:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 21, 1993. We have reviewed your comments and offer the following responses.

Natural Hazards. We appreciate the information noting that current geophysical assessments are questioning the appropriateness of a Zone 3 (seismic) classification for the Big Island and that this classification might be amended to a Zone 4 classification (a higher risk factor). Should this classification be changed, standards in the uniform building code (UBC) for the Big Island would have to be amended. Consequently, all buildings which would apply for building permits under the new specifications would have to meet stricter design specifications for seismic risk.

Flora. Urban development can potentially increase the risk to endangered plants and habitats. This risk is not necessarily limited to the direct destruction of individual plants or larger habitats. You correctly note that other factors, such as increased access and grassland and dry shrubland fire could impact these areas.

For these reasons, the DEIS contains suggested mitigation measures that could require the establishment of a nature study park (or parks) around areas with endangered or rare and vulnerable plants. Specific mitigation measures related to fire prevention would be identified during the preparation of a fire contingency plan, which would be subject to the approval of the Department of Land and Natural Resources, Forestry and Wildlife Division, prior to any application for county rezoning.

Wastewater Disposal. You suggest that as a long-range planning document, the DEIS should note the concern about nearshore water quality and that there should be considerable attention paid to alternative wastewater management strategies. We refer you to Sections 4.3 (Geologic and Hydrologic Setting) and 6.5 (Wastewater Disposal) of the DEIS which discuss concerns related to nearshore water quality.

Section 4.3 notes that "urbanization of the petition area will increase the opportunity for pollutants to enter groundwater via storm runoff or as leachate from materials applied to

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landscaped areas (fertilizers, pesticides, etc.). Pathways followed by groundwater as it migrates to the ocean are the result of the volcanic origins of the island and its relatively young geologic age, which has created myriad subsurface pathways through porous lava to the ocean. Within the region makai of the petition area, there is particular concern about maintaining the quality of groundwater and the nearshore environment because nearshore waters have been classified "AA" by the State Department of Health (DOH) and because of proximity to the Natural Energy Laboratory of Hawaii Authority (NELHA), which relies on the availability of pristine ocean water."

Section 6.5 discusses alternative disposal methods and the possible need to use treated wastewater as an irrigation source (possibly for a golf course within the petition area). As stated in the DEIS, "the use of sewage effluent as an irrigation source has been studied extensively in Hawaii, and it has been demonstrated that secondary-treated wastewater can be used successfully for irrigation and concurrently for aquifer recharge. It has also been demonstrated that natural grassed systems act as a living surface filter and a subsurface trickling filter, outperforming secondary treatment in improving water quality under certain conditions."

It is also recognized that is possible that not all of the treated wastewater can be used for irrigation purposes, necessitating other disposal methods for the remaining , including underground injection.

For all of these reasons, the DEIS suggests a number of mitigation measures designed to preserve and monitor existing ground and ocean water quality in the vicinity of the petition area. These include:

- participation in a regional water quality monitoring program;
- preparation of an environmental risk assessment for the construction and operation of any golf course proposed in the petition area;
- hiring a qualified golf course manager to oversee the irrigation of the golf course and application of fertilizers and pesticides to the golf course;
- compliance with Department of Health conditions for new golf course developments;
- participation in the funding and construction of adequate wastewater transmission and disposal; facilities; and,
- elevated wastewater treatment to the 2 NTU standard, if wastewater is to be used as an irrigation source.

The eventual selection of a wastewater management strategy for the petition area will be dependent on the final land use plan that is developed and regional demands. It is probable that such a strategy will include the use of treated wastewater for irrigation with the balance discharged via underground injection.

We appreciate your review of the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda
Office of State Planning
OEQC
Kathleen Wilson
Terry Hunt
Roger Fujioka
Andrew Tomlinson

JOHN WAIHEE
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

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PHONE (808) 734-2161

May 20, 1993

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TO: Ms. Ester Ueda
State Land Use Commission

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS), URBAN EXPANSION STATE LANDS, KEAHOLE TO KAILUA REGION

We appreciate this opportunity to comment on the DEIS for Urban Expansion State Lands, Keahole to Kailua Region, North Kona, Hawaii. Project area TMK: 7-3-09:05 and 08; 7-3-10:02; and 7-3-10:por 33.

We do not have negative comments specifically directed at this DEIS. However, the project elevation appears to range from approximately 120-850 feet above sea level. The impact of terrain amplification of high winds and heavy rainfall associated with tropical cyclones and hurricanes require consideration. Structures within the project area should be designed and constructed to resist potentially destructive winds resulting from tropical cyclone/hurricane force winds at that elevation. These structures could then be surveyed for use as potential public shelters.

Our State Civil Defense planners and technicians are available to discuss this further if there is a requirement. Please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

bc: Mr. Scott Ezer
Helber Hastert & Fee, Planners

Helber Hastert
Planners

May 28, 1993

Mr. Roy C. Price, Sr.
Vice Director of Civil Defense
State of Hawaii
Department of Defense
Office of the Director of Civil Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Mr. Price:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 20, 1993. We have reviewed your comments and offer the following responses.

We note that the range of elevation found on the site could contribute to terrain amplification of high winds and heavy rainfall associated with tropical cyclones and hurricanes. The specifications for structures that would be built in the urbanized petition area to withstand these winds should be determined when zoning approvals are sought and an urban design plan is formulated. In addition to strict adherence to building code requirements, mitigation measures could include landscaping to serve as windbreaking features.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda
Office of State Planning

Helber Hastert & Fee
Grosvenor Center, PBT Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

IN REPLY REFER TO:
93:PPE/2428

May 24, 1993

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TO: Ms. Esther Ueda, Executive Officer
State Land Use Commission

FROM: ~~Joseph K. Conant~~
Executive Director

SUBJECT: Draft EIS for the Urban Expansion of State Lands, Keahole to Kailua Region

Policies A(3) and B(3) of the State Housing Functional Plan seek to ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable homeownership or rental housing opportunities. We note on page 5-2 of the draft EIS, that the petitioner is recommending that the Land Use Commission attach an affordable housing condition to its approval. The proposed condition satisfactorily addresses the affordable housing policies of the State housing plan.

Thank you for the opportunity to comment.

c: Mary Lou Kobayashi, OSP
Scott Ezer, Helber Haster & Fee, Planner
OEQC

Helber Hastert
Planners

June 4, 1993

Mr. Joseph K. Conant, Executive Director
State of Hawaii
Department of Budget and Finance
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

Dear Mr. Conant:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 24, 1993.

We note your acknowledgment that the proposed condition of approval for the boundary petition offered as mitigation measure on page 5-2 of the DEIS satisfactorily addressing the affordable housing policies of the State Functional Housing Plan.

Thank you for reviewing the DIES. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda, LUC
Office of State Planning
Brian J.J. Choy, OEQC

Helber Hastert & Fee
Grosvenor Center, PBI Tower
733 Bishop Street, Suite 2500
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

May 24, 1993

In reply, please refer to:
92-327/epo

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To: The Honorable Ester Ueda
State Land Use Commission

From: John C. Lewin, M.D.
Director of Health

Subject: Draft Environmental Impact Statement

Urban Expansion of State Lands
Keahole to Kailua Region
North Kona, Hawaii

Thank you for allowing us to review and comment on the subject document. We have previously commented on this project in our letters dated September 30, 1992 and February 25, 1993. We have the following additional comments to offer on the Draft Environmental Impact Statement:

Air Quality

Our Clean Air Branch has noted a possible discrepancy within section 4.14, Air Quality. The Environmental Impact Statement reports in the Affected Environment subsection that the "existing ambient air quality within the vicinity of the generating station exceeds both State of Hawaii and Federal air quality standards" while in the Cumulative Impacts subsection it reports that "no national or state ambient air quality standards would be exceeded as the result of the proposed expansion of the generating station." Since the Department does not have knowledge of exceedances of state or national air quality standards in that area and EPA approved air quality dispersion models typically overpredict air quality impacts when compared to actual ambient air quality monitoring data, the Department believes that the Affected Environment subsection may be erroneous.

If you have any questions, please call Mr. Tyler K. Sugihara of the Clean Air Branch at 586-4200.

c: Clean Air Branch
Office of State Planning
Helber Hastert & Fee
Hilo, District Health Office

Helber Hastert
Planners

June 4, 1993

Mr. John C. Lewin, M.D., Director
Department of Health
State of Hawaii
P.O. Box 338
Honolulu, Hawaii 96813

Dear Dr. Lewin:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 24, 1993.

We note that you point a possible discrepancy within Section 4.14 of the DEIS, Air Quality. We received a similar comment from the Energy Division of the Department of Business, Economic Development and Tourism. Language in the section you refer to will be amended as follows (language to be deleted is bracketed, language to be added is underscored):

"Based on the results of this monitoring, existing ambient air quality within the vicinity of the generating station [exceed] meets both State of Hawaii and Federal air quality standards."

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning
Esther Ueda, LUC

Helber Hastert & Fee
Grosvenor Center, PRI Tower

733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Telephone 808 545-2055
Facsimile 808 545-2050

JOHN WAIHEE
GOVERNOR

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
STP 8.5217

May 24, 1993

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HELBER HASTERT & FEE
PLANNERS

Ms. Esther Ueda
State Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands
Keahole to Kailua Region

The DEIS projects that traffic on Queen Kaahumanu Highway will exceed its capacity by the year 2000. We also note the possible creation of a substantial amount of direct employment attributed to the petition area. Accordingly, it is important that the local road network be carefully coordinated, designed, and developed to complement the highway.

We fully support all of the recommendations stated under Mitigation Measures on Page 6-4 of the DEIS.

The italicized paragraph on page 4-15 should be revised as follows (additions denoted by underscoring "__" and deletions denoted by brackets "[ ]"):

> [The developer and/or landowner should attenuate the noise level within commercial or industrial sensitive areas exposed to noise levels of 60 Ldn by a minimum of 25 decibels to achieve the desired goal of 45 Ldn interior sound level. That] No residential or condominium units be constructed within areas exposed to noise levels of 60 Ldn or greater. It is also recommended that the developer/landowner grant an avigation and noise easement [(right of flight)] to the State of Hawaii in a form prescribed by the State Department of Transportation on any portion of the petition area [found to exceed noise levels] exceeding 55 Ldn, attributable to [flight operations at] Keahole Airport operations.

A sample of an avigation and noise easement is attached.

The noise contours utilized in the DEIS may no longer be current. Therefore, we are unable to comment on the noise impacts on the proposed development. Since the boundaries and detailed nature of uses to be developed are not specified, we cannot assess any subsequent noise impacts. We will be updating the Keahole Airport noise exposure maps in the future. However, until such time, the developer should be aware that portions of the petition area are possibly within the 55-60 Ldn noise contour and/or subject to disclosure requirements as stated in Chapter 467-31, Hawaii Revised Statutes (attached). For this disclosure, the noise exposure maps of Keahole Airport Noise Compatibility Program, November 1987, may be used.

The developer and/or landowner must continue to assess the impacts of the development as more details on the proposed uses become available to insure that any adverse noise and traffic impacts are properly mitigated.

We appreciate the opportunity to provide comments.

Sincerely,

Rex D. Johnson
Director of Transportation

Enc.

bc: Ms. Mary Lou Kobayashi - OSP
Mr. Scott Ezer - Helber Hastert & Fee, Planners
Mr. Brian J. J. Choy - OEQC

Helber Hastert
Planners

June 4, 1993

Mr. Rex Johnson, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 24, 1993. We will respond to your comments in the order they appear in your letter

Local Road Network Design. We agree that it is important that the local road network be carefully coordinated, designed, and developed to complement the highway. The petitioner will closely coordinate this effort with your department.

Mitigation Measures. We note your full support of the mitigation stated on page 6-4 of the DEIS.

Recommended Amendments to page 4-15. The italicized paragraph on page 4-15 will be revised according to the suggestions in your letter.

Noise Contours. We note your comment that the noise contours in the DEIS may no longer be current and that you will updating the Keahole Airport noise exposure maps in the future. We received similar information from the Airports Districts office of the Federal Aviation Administration during the comment period for this DEIS. The Office of State Planning hopes to kept apprised of work being conducted in this area to ensure that future development within the petition area will be consistent with future noise exposure maps. In this situation, as you suggest in your letter, noise exposure maps of Keahole Airport Noise Compatibility Program, November 1987, will be used for the Final EIS.

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Office of State Planning
Esther Ueda, LUC
Brian J.J. Choy, OEQC

Helber Hastert & Fee — 733 Bishop Street, Suite 2590 — Telephone: 808 545-2055
Grosvenor Center, PRI Tower — Honolulu, Hawaii 96813 — Facsimile: 808 545-2050

JOHN WAIHEE
GOVERNOR OF HAWAII

KEITH W. AHUE, CHAIRPERSON
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DONA L. HANAIKE

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
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DOC. ID.: 2829

MAY 26 1993

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MAY 27 1993
OFFICE OF STATE PLANNING

39824

MEMORANDUM

TO: Mr. Harold Masumoto, Director
Office of State Planning

FROM: Keith W. Ahue, Chairperson
Board of Land and Natural Resources

SUBJECT: Draft Environmental Impact Statement (DEIS) Urban Expansion State Lands, Keahole to Kailua Region, Hawaii, TMK: (various)

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Our Department's Division of Water and Land Development comments that water requirements for the proposed land use scenarios should be coordinated with them to be incorporated into the North Kona Water Master Plan.

Our Historic Preservation Division is currently reviewing the archaeological survey report for this project. Once we complete that review, we will comment on the Draft EIS. At this time, we have yet to approve the adequacy of the survey of the university site, to agree with significance evaluations or to agree with mitigation proposals. Because these are State lands, it is important to emphasize that compliance with Chapter 6E will have occurred prior to any disposition of the lands.

In addition, our Division of Boating and Ocean Recreation comments that this proposal emphasizes the need for expansion of recreational boating facilities in the area, especially Honokohau.

Please feel free to call Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Helber Hastert
Planners

June 4, 1993

Mr. Keith W. Ahue
Chairperson
Board of Land and Natural Resource
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ahue

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by memorandum dated May 1, 1993. We will respond to your comments in the order they appear in your memorandum.

North Kona Water Master Plan. The Office of State Planning (OSP) recognizes the need to coordinate future water requirements for the petition area so that they may be incorporated into the North Kona Water Master Plan.

Historic Preservation Division Comments. We understand that the Historic Preservation Division will be providing comments concerning the archaeological survey reports prepared for this project under separate cover.

Recreational Boating. We note that urbanization of the petition area emphasizes the need for expansion of recreational boating facilities in the region. Section 6.3 of the DEIS recognizes this probable impact.

Thank you for reviewing the DEIS. A copy of your memorandum and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda, LUC
Office of State Planning

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone: 808 545-2055
Facsimile: 808 545-2050

Engineers
Planners
Economists
Scientists

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PLANNERS

May 21, 1993

PDX34061.27

Esther Ueda
State Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, HI 96813

Subject: Comments on Draft EIS, Urban Expansion State Lands

Dear Ms. Ueda:

The Hawaii Electric Light Company, Inc. (HELCO) is committed to the reliable delivery of power to the residents of the Island of Hawaii in a manner that causes the least adverse impact to the environment and surrounding communities. To that end, HELCO offers the following comments on the Draft EIS for Urban Expansion Lands, Keahole to Kailua Region, North Kona.

1. HELCO has revised its site plan and equipment specifications for the unit addition at the Keahole Generating Station. Consequently, the projected noise levels at and around the station have been reduced from those included in the Draft EIS. Existing and projected noise contours for the Keahole Generating Station are enclosed.

2. The exhaust stack for the proposed unit addition at the Keahole Generating Station will be 104 feet high.

3. HELCO has published a Draft EIS for the proposed additional Keahole-Kailua 69-kV transmission line, and has identified the mauka edge of the Queen Kaahumanu Highway right-of-way as the preferred corridor for the new transmission line. HELCO is in the process of preparing a Draft EIS for a new Keahole-Keamuku 69-kV or 138-kV transmission line.

1585 Kapiolani Blvd. Suite 1420
808 943-1133

4. Information regarding the health effects of electric and magnetic fields (EMF) are inconclusive. In 1991, the State of Hawaii issued a policy of prudent avoidance regarding electric and magnetic fields from electric power lines. The policy states:

> A prudent approach is needed at this time to regulate electric and magnetic fields around low-frequency electric power facilities, including high-voltage transmission lines. The existing research data are inconclusive and not sufficient enough for adequate, accurate risk assessment. However, the data suggest that a "prudent avoidance" approach to siting new facilities is appropriate. Where technically feasible and practical, public exposures should be minimized. Too little is presently known to be able to determine where or what rules would provide useful public-health protection.

Prudent avoidance suggests that construction of population-intensive uses be avoided in close proximity to the existing transmission corridors within the petition area.

Thank you for the opportunity to review and comment on the Draft EIS.

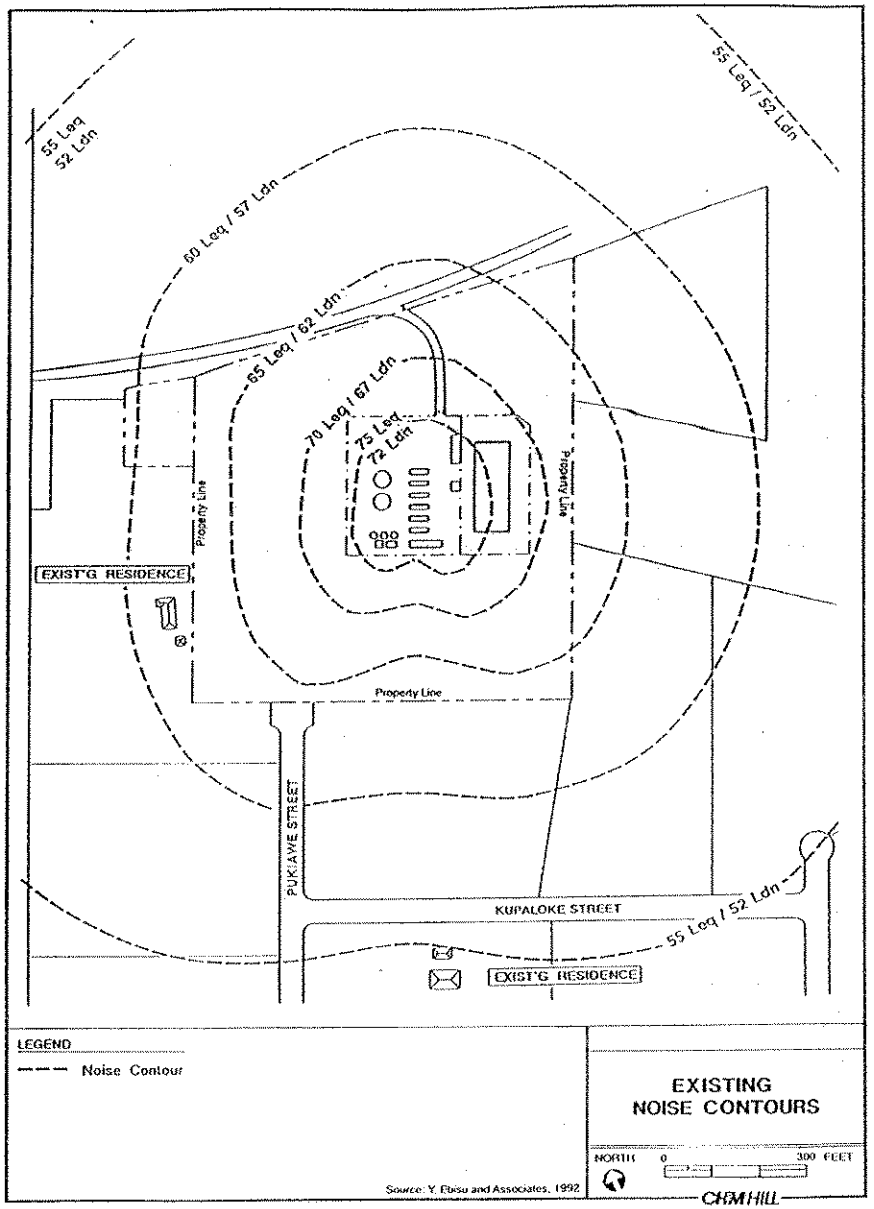
Sincerely,

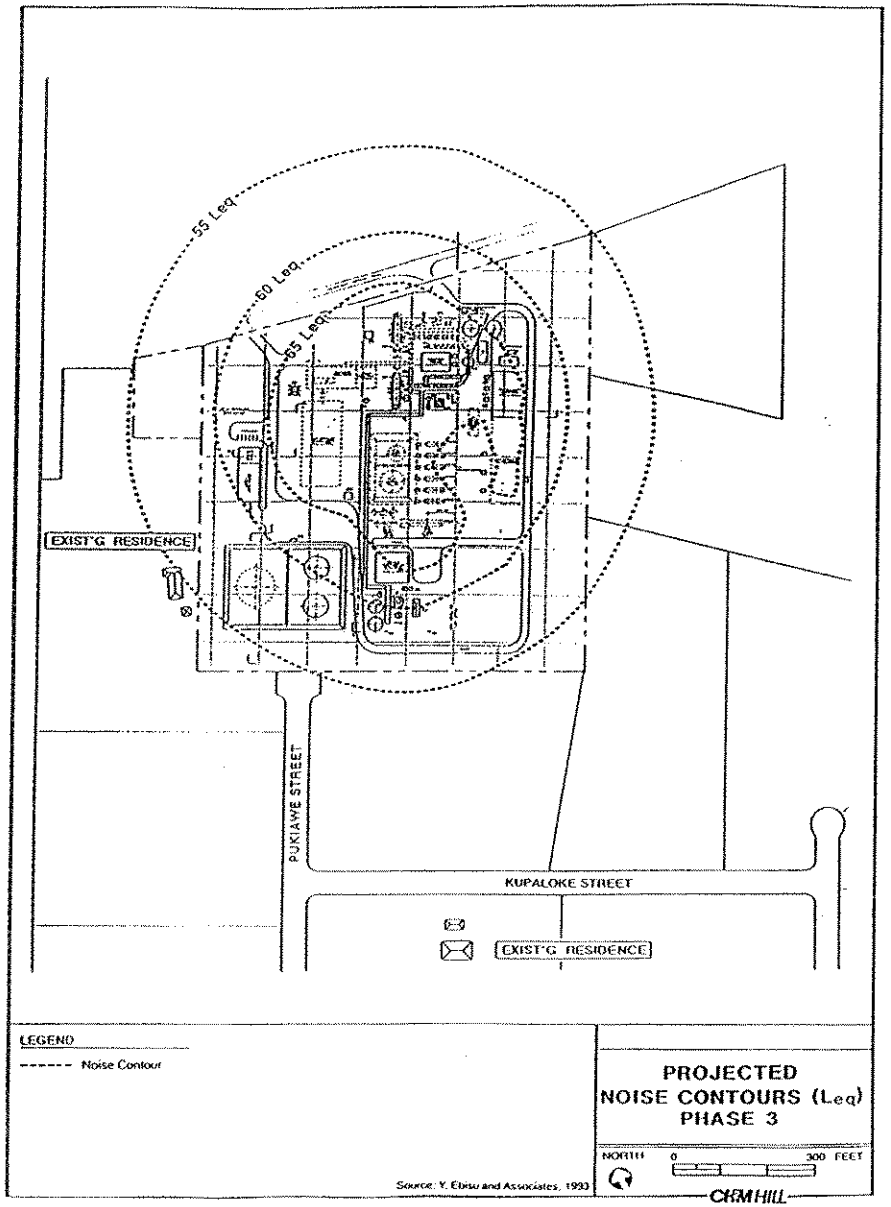
CH2M HILL

Albert Lono Lyman
Senior Project Manager

copies:
Office of State Planning
Helber Hastert & Fee, Planners
Clyde Nagata/HELCO

HNL/65/010.51

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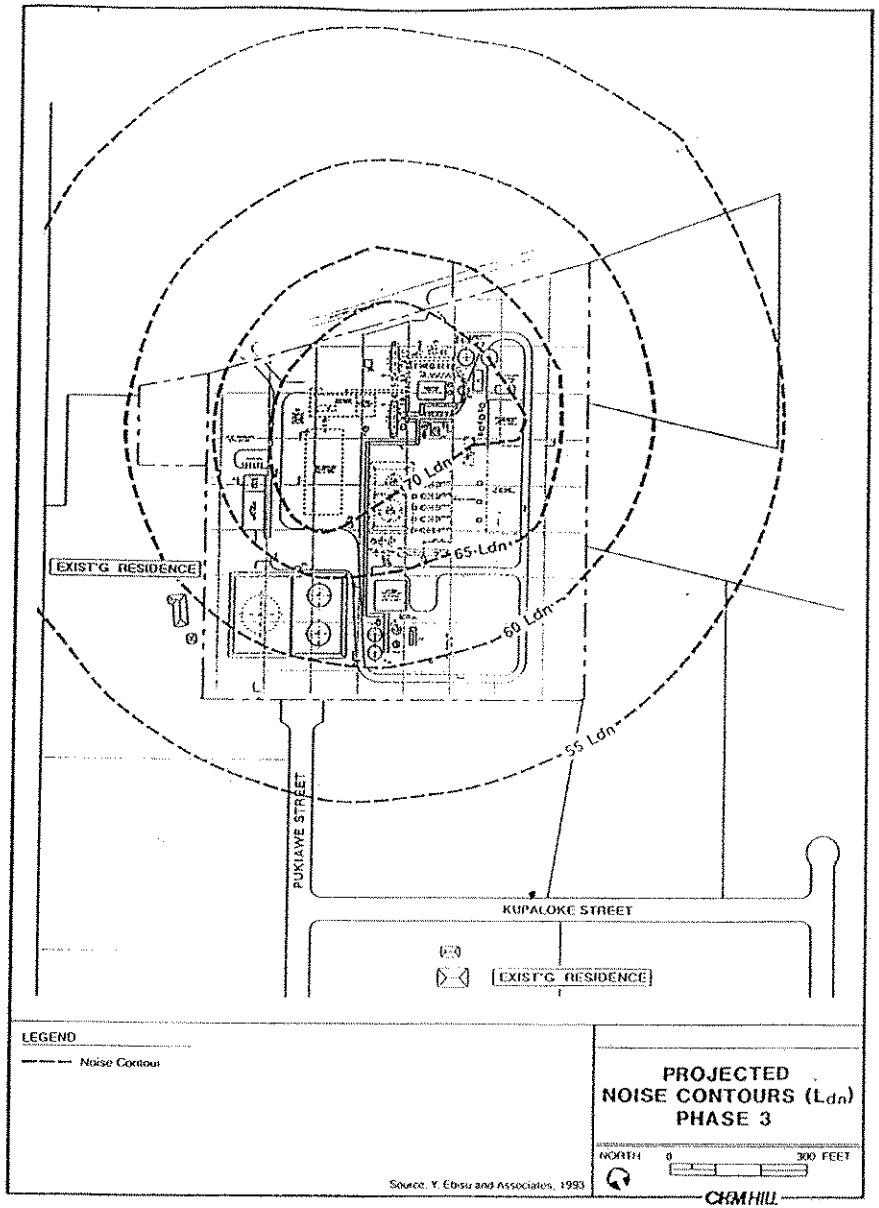
CH2M HILL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NOISE CONTOURS (Ldn)
PHASE 3
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300 FEET
Source: Y. Ebisu and Associates, 1993
CH2M HILL

Helber Hastert
Planners

June 15, 1993

Mr. Albert Lono Lyman
Senior Project Manager
CH2M Hill
1585 Kapiolani Blvd., Suite 1420
Honolulu, Hawaii 96814-4530

Dear Mr. Lyman

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for submitting comments on the draft environmental impact statement (DEIS) for the above project by letter dated May 21, 1993. We will respond to your comments in the order they appear in your letter.

Revised Projected Noise Contours. We note that HELCO has revised its site plan and specifications for the unit addition at the Keahole Generating Station, resulting in reduced noise levels at and around the station. We appreciate this updated information, and will include it in the Final EIS (FEIS).

Exhaust Stack Height. You mention that the exhaust stack height for the proposed unit addition at the Keahole Generating Station will be 104 feet. On page 4-31 of the DEIS, the exhaust stack height is identified as 100 feet. This will be revised in the FEIS.

69 kV Transmission Line. We note that HELCO has published a Draft EIS for the proposed additional Keahole-Kailua 69 kV transmission line, which includes the identification of the mauka edge of the Queen Kaahumanu Highway right-of-way as the preferred corridor for the new transmission line. Page 6-11 of the DEIS acknowledges this possibility.

Electric and Magnetic Fields. You mention that the health effects of electric and magnetic fields (EMF) are inconclusive and that the State of Hawaii has issued a policy of prudent avoidance regarding electric fields from power lines, which suggests that construction of population-intensive uses be avoided in close proximity to the existing transmission corridors within the petition area. The Office of State Planning intends to coordinate with HELCO and the Department of Health concerning this policy and future land uses within the petition area.

Helber Hastert & Fee
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Telephone 808 545-2055
Facsimile 808 545-2050

Helber Hastert
Planners

Thank you for reviewing the DEIS. A copy of your letter and this response will be appended to the Final EIS.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Esther Ueda, LUC
Office of State Planning
Clyde Nagata, HELCO

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JUN 10 1 55 PM '93
LAND USE COMMISSION
STATE OF HAWAII

June 1, 1993

MEMORANDUM:

LOG NO: 8069
DOC NO: 9305RC40

TO: State Land Use Commission

FROM: Don Hibbard, Administrator, Historic Preservation Division

SUBJECT: **Draft EIS -- Urban Expansion State Lands -- Historic Preservation Concerns (Office of State Planning)**
Multiple, North Kona, Hawaii

The Office of State Planning and our Division developed a scope of work for an up-to-date synthesis of settlement patterns for this region, to enable predictions of site patterns in the study area. This was to provide a context for understanding the likely site patterns in this petition. In our recent review of the report prepared by PHRI, we found that the report did not meet our expectations in that it had not prepared an up-to-date synthesis of settlement patterns for the region and project area, rather it had relied on prior studies. We are now consulting with PHRI, their immediate client (Helber, Hastert & Kimura) and the Office of State Planning on how to resolve this matter. Additionally, the West Hawaii university archaeological inventory survey has some problems which need to be addressed before we can find that inventory survey to be acceptable. Until these reports are resolved the Draft EIS sections on page 4-19 through 4-27 are not accurate on several matters.

The Draft EIS is generally correct in noting likely site patterns based on prior work. However, the studies in the region have found field system ruins extending below the 425 foot contour, and these are definitely remains of the Kona Field System which is eligible for inclusion on the National Register of Historic Places.

Most important, the Draft EIS does state acceptable mitigation measures on pages 4-27. Since no acceptable archaeological inventory survey is yet available for the project area, each prospective developer will need an inventory survey and then mitigation. Those conditions in the Draft EIS -- which were worded by our Division -- should definitely be conditions to any approved LUC petition to ensure "no adverse effect" to significant historic sites.

c: Office of State Planning

RC:lll

JOHN WAIHEE
GOVERNOR OF HAWAII

KEITH AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCE

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JOHN P. KEPPELER II
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HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

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

July 15, 1993

Mr. Alan Walker
PHRI
305 Mohouli Street
Hilo, Hawaii 96720

LOG NO: 8858
DOC NO: 9307RC20

Dear Mr. Walker:

SUBJECT: Revised Archaeological Inventory Survey Report, University Site (OSP)
Makaula, North Kona, Hawaii

Thank you for your July 9, 1993, submittal of this revised report (Henry & Rosendahl 1993. Archaeological Inventory Survey, Kailua to Keahole Region State Lands, LUC Project 500-Acre University Site. PHRI ms 1298-070793.).

We agree that all sites have been found, totaling 43 sites. The background research makes it clear that the following sites were expected in the project area: transitory temporary habitation sites and inland-heading trails in the lower elevations and informal agricultural fields and associated temporary habitations above the 450 foot contour. Seaward of the project area would have been the bulk of the permanent habitation sites in the coastal areas, and upland of the project area more formal agricultural fields with temporary habitations and some permanent habitations would be expected.

Site descriptions are acceptable for inventory level work, with the transect counts of agricultural features in site 18,891 quite interesting and useful. The summary of the temporary habitations on pages 52-53 is not quite good and very useful for comparative purposes. Findings tended to correspond with the expectations. Small agricultural features were found to extend down to the mid-300 foot elevations, but such features were denser above the 400 foot elevations and had more variation at higher elevations. This fits with the model of greater amounts of agricultural activity at higher elevations due to increasing rainfall. Temporary habitations (in tube caves and small surface structures) were present throughout the project area, but again were more common at higher elevations among the fields. No major inland-heading trails were identified, as well as no permanent habitations or major religious structures. Tube cave 15302 is considered to have possibly had a ceremonial function, but not as a major heiau. Burials were confirmed at only one site (a tube cave with 4 individuals, 15298), and possible burials were identified for a few features at 3 other sites.

We agree with the significance evaluations with two exceptions. Site 18,891 -- the informal remnant of the Kona Field System -- is suggested to have research potential on page 66 which indicates that it still is significant for its information content. Also, site 15298 is a refuge cave with 4 burials in part of the cave, and it would appear to be significant for more than just traditional cultural significance, but also for its information content. Dr. Cordy of our staff spoke with you about these points on July 15, 1993, and you agreed with our evaluations on these two sites; please do follow-up on this agreement in writing, however.

This means that 18 sites are considered "no longer significant", since they had no deposits and their surface features have been fully recorded in the survey. Thus, 25 significant historic sites are present in the project area.

We agree with your mitigation recommendations for these 25 sites. The recommendations would be archaeological data recovery for 16 of the sites (the 15 in your report plus 18,891) and preservation for 9 sites (all burial sites, the tube with possible ceremonial use, and several temporary habitations reflecting the best examples of their type).

Four sites currently are considered burial sites, and all are currently slated for preservation. 15298, a cave, has a portion used for burial with 4 individuals present. Three of the sites slated for preservation are only identified as containing possible burial features at this time (15276, 15295, 15292), and you propose to test these features to verify if they are indeed burials. We have no problem with this proposal, and it can be done at any time to help clarify mitigation measures. You must, however, have your client submit proposals for treatment of the burials (preservation in-place, some disinterments) to our Hawai'i Island Burial Council for approval. Until a decision is made, the mitigation for those sites is not considered finalized.

To ensure a "no adverse effect" to the significant historic sites, our Division will recommend the following conditions be attached to any approved Land Use Commission petition:

1. The mitigation treatment for the few burial sites in this project area must be approved by the State Historic Preservation Division's Hawai'i Island Burial Council in accordance with Chapter 6E.

2. Once the form of mitigation for the burials are finalized, then the petitioner must prepare a detailed historic preservation mitigation plan for the treatment of all 25 significant historic sites in two parts -- a preservation plan for the sites to be preserved (including burial sites) and an archaeological data recovery plan for the sites to undergo data recovery. This plan must be approved by the State Historic Preservation Division before it is implemented. That Division must also verify in writing the successful execution of the plan.

If you have any questions, please feel free to contact Ross Cordy of our staff at 587-0012.

Sincerely yours,

Ross Cordy

for Don Hibbard, Administrator

c: M. L. Kobayashi, Office of State Planning
E. Ayau, Burial Program

RC:ill

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
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CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

July 19, 1993

Mr. Alan Walker
PHRI
305 Mohouli Street
Hilo, Hawaii 96720

Log No: 8908
Doc No: 9307RC25

Dear Mr. Walker:

SUBJECT: **2nd Revision to Kailua to Keahole Synthesis -- State LUC Petition**
Multiple, North Kona, Hawaii

Thank you for your July 15, 1993, submittal of this revised report (Henry, Goodfellow & Maly 1993. Archaeological Assessment Study, Kailua to Keahole Region State Lands LUC Project. PHRI ms. 1275-071493.). The revisions were in response to our letter of July 6, 1993.

We find the revisions acceptable, understanding that the survey samples did not have enough information to separate out permanent vs temporary habitations at this time. In the future, however, we would recommend that any surveys used for analyzing function should gather enough surface information to make that distinction, because habitation analyses are much more meaningful when permanent and temporary habitations can be differentiated.

We have but one informational point. On page 9, para. 4 and Table 1 (p. 6), the 1975 Cordy work was not just restricted to Kohanaiki; it also extended along the coast in Ooma 1 and 2 and Kaiaca 4 and 5 in your study area. 12 sites were identified in the Ooma areas with about 40 volcanic glass dates processed, and 10 sites were identified in the Kaiaca areas with about 50 volcanic glass dates. As in Kohanaiki, the focus of the work was on identifying permanent habitation sites and evaluating social ranking and population patterns. Actually, you might want to revise the paragraph and table to correct this part of the background work. If you do so, just send us the replacement pages.

We now find this report to acceptably meet the intent of the scope of work. It is a good overview of likely settlement patterns based on prior archaeological and archival work and based on new archival work. It has predicted the types of sites likely to be in the petition area and has evaluated and slightly modified this prediction based on some new survey work.

These predictions will enable our office, county agencies, and prospective users of the land to anticipate the types of historic sites that will be present and to more efficiently budget for and conduct archaeological inventory surveys of specific portions of the petition area as they come in for separate county permits.

Sincerely yours,

for Don Hibbard, Administrator

c: Mary Lou Kobayashi, Office of State Planning
Virginia Goldstein, Planning Dept., County of Hawaii

RC:lli

Helber Hastert
Planners

July 19, 1993

Mr. Don Hibbard, Administrator
State of Hawaii
Department of Land and Natural Resources
State Historic Preservation Division
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Mr. Hibbard:

Draft Environmental Impact Statement (DEIS)
Urban Expansion State Lands-Keahole to Kailua Region
North Kona, Hawaii

Thank you for your comments on the revised Archaeological Inventory Survey Report and the Synthesis Report for the above project by letters addressed to Mr. Alan Walker of Paul H. Rosendahl, Ph.D., Inc (PHRI), the project archaeologist, dated July 15 and July 19, 1993, respectively.

We note that you find both archaeological reports acceptable and that you have requested that PHRI follow-up in writing on two points discussed in your July 15 letter concerning the inventory survey: (1) site 15298 is a refuge cave with four burials in part of the cave, and it would appear significant for more than just traditional cultural significance, but also for information content, and (2) site 18891 - the informal remnant of the Kona Field System - is suggested to have research potential which indicates that it still is significant for its information content. We understand that this will be done by PHRI under separate cover.

We also note that you recommend two conditions be attached to any approved Land Use Commission petition to ensure a "no adverse effect" to the significant historic sites. The Office of State Planning concurs with your recommendations.

We appreciate the effort and cooperation exhibited by your staff, principally Dr. Ross Cordy, in reviewing both reports.

Sincerely,

HELBER HASTERT & FEE, Planners

Scott Ezer
Senior Associate

cc: Mary Lou Kobayashi, Office of State Planning
Esther Ueda, State Land Use Commission
Alan Walker, PHRI

Helber Hastert & Fee
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733 Bishop Street, Suite 2590
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LAND USE SCENARIO METHODS AND FINDINGS

This report documents the methods, findings and sources of information used in preparing the three land use scenarios presented in Chapter 2 of the EIS.

The purpose of the scenario approach presented was to identify a probable range of land uses, and associated environmental impacts. Specifically, the scenarios identify a range of impacts to domestic water supply, wastewater, and employment.

The overall approach consisted of two major steps:

(I) a survey of large-scale master-planned communities to identify the range of likely land uses and approximate land use allocations, and

(II) a spreadsheet analysis of three land use scenarios to determine the range of possible impacts to domestic water supply, wastewater and employment.

I. SURVEY OF COMPARABLE DEVELOPMENTS

Using recent EIS documents and other master plan reports, a survey of eleven major master-planned developments was conducted to identify land uses and acreages for each project. Projects surveyed included:

C&C of Honolulu (7)	Hawaii County (2)	Maui County (2)
Village of Kapolei	Queen Lilioukalani Trust	Maui Lani
Wahiawa Lands	Villages of Lai'opua	Villages of Le'ali'i
Ewa by Gentry		
Waiawa by Gentry		
Royal Kunia Ph. II		
Waikele		

Based on the review of projects, a series of typical land uses was identified and acreages from each of the projects were allocated to the specific land use categories. The range of typical land uses are identified below:

Land Use	Comment
Residential	includes single and multi-family homes
Neighborhood Commercial	convenience commercial only
Civic	includes schools, churches, park and rides, day care, etc.
Employment Center	includes regional commercial, offices, business technology parks, etc.
Light Industrial	includes facilities for storage and distribution of agricultural, wholesale and retail products; automotive services sales and rentals; contractor base yards; etc.
Parks	typically includes dedicable parks (i.e., neighborhood, community and district parks).
Golf Course(s)	18-hole course(s) with ancillary uses (clubhouses, maintenance facilities, etc.).
Open Space/Circulation	includes roadway ROW, historic and biological preserves, pasture/agricultural areas, etc.

Table 1 on the following page provides the acreage and acreage allocation (in percent) for each of the eleven projects with regard to the referenced land uses. For example, the Villages of Le'alii (HFDC project) encompasses a 1,120-acre area, with 490 acres or 44 percent devoted to residential use. Summary tabulations from the survey are provided in Table 2 below.

Table 2: Master Planned Community Survey Summary Statistics

	Range		Average	
Land Use	**Acres**	**Percent**	**Acres**	**Percent**
Residential	304 - 1,174	29 - 75	567	54.8
Commercial	0 - 22	0 - 3	11	1.2
Civic	6 - 111	1 - 10	42	4.2
Employment	0 - 594	0 - 52	64	6.1
Light Industrial	0 - 188	0 - 20	35	3.3
Parks	14 - 46	1 - 4	29	3.0
Golf Course	0 - 353	0 - 26	159	16.4
Open Space/Circulation	18 - 414	3 - 37	114	10.9
Totals	**577 - 1,910**		**1,021**	**100.0**

Table 1: Summary of Master Planned Community Comparables

Land Use	Villages of Lealii (Lah) Acres	% Alloc.	Villages of Laiopua Acres	% Alloc.	Villages of Kapolei Acres	% Alloc.	Wahiawa Lands Acres	% Alloc.
Residential	490	44%	589	59%	502	56%	367	44%
Commercial	6	1%	28	3%	11	1%	22	3%
Civic	27	2%	91	9%	66	7%	35	4%
Employment	0	0%	0	0%	0	0%	60	7%
Light Industrial	0	0%	0	0%	0	0%	33	4%
Parks	33	3%	30	3%	26	3%	31	4%
Golf Course	150	13%	195	20%	185	21%	204	25%
Open Space/Circ.	414	37%	57	6%	100	11%	80	10%
Total	1120	100%	990	100%	890	100%	832	100%

Land Use	Mililani Mauka Acres	% Alloc.	Ewa by Gentry Acres	% Alloc.	Waiawa by Gentry Acres	% Alloc.	Maui Lani Acres	% Alloc.
Residential	830	75%	680	67%	1174	61%	656	65%
Commercial	5	0%	6	1%	10	1%	22	2%
Civic	111	10%	7	1%	12	1%	33	3%
Employment	0	0%	0	0%	0	0%	0	0%
Light Industrial	0	0%	30	3%	188	10%	0	0%
Parks	46	4%	37	4%	41	2%	27	3%
Golf Course	0	0%	188	19%	353	18%	172	17%
Open Space/Circ.	108	10%	63	6%	132	7%	102	10%
Total	1100	100%	1011	100%	1910	100%	1012	100%

Land Use	Royal Kunia Ph II Acres	% Alloc.	Waikele Acres	% Alloc.	QLT Acres	% Alloc.
Residential	314	48%	304	53%	332	29%
Commercial	0	0%	13	2%	3	0%
Civic	6	1%	6	1%	70	6%
Employment	0	0%	46	8%	594	52%
Light Industrial	130	20%	0	0%	0	0%
Parks	16	2%	23	4%	14	1%
Golf Course	172	26%	128	22%	0	0%
Open Space/Circ.	18	3%	58	10%	122	11%
Total	655	100%	577	100%	1135	100%

Table 3 identifies average residential densities for each project and indicates a cumulative average residential density of 8.8 dwellings per acre (within a range of 5.2 du/ac to 12.2 du/ac).

Table 3: Residential Density

Project	Residential Acres	Residential Units	Rsidential Density
Le'ali'i Villages	490	4,284	8.7
Lai'opua Villages	589	4,158	7.1
Kapolei Villages	502	5,000	10.0
Wahiawa Lands	367	3,100	8.4
Mililani Mauka	830	6,600	8.0
Ewa Gentry	680	8,300	12.2
Waiawa Gentry	1,174	12,896	11.0
Maui Lani	656	3,400	5.2
Royal Kunia	314	2,400	7.6
Waikele	304	2,700	8.9
QLT	332	1,992	6.0
Totals	**6,238**	**54,830**	**8.8**

II. DEVELOPMENT SCENARIOS

Having identified historical ranges in land use allocations, it is then possible to look at several land use scenarios by varying the land use allocations or land use acreages.

Three scenarios were analyzed. In general, it was assumed the site K-K would be well suited for light industrial and employment uses due to its location within the growing region, and its proximity to the Keahole Airport and the Queen Kaahumanu Highway, and proximity to the proposed UH West Hawaii campus. It was also assumed that the site would have less desirability for residential uses, relative to other master planned communities in the region and elsewhere in the state, in part due to competitive forces and also due to the higher locational advantages for light industrial and employment generating uses.

The three scenarios looked at varying levels of residential, employment center and light industrial uses. Each scenario provided at least one 18-hole golf course, with Scenario III providing two courses. Residential support uses (neighborhood commercial, civic and parks) were held constant at the average allocation identified in Table 2.

The entire petition area is about 2,640 acres which includes the 500-acre West Hawaii UH Campus. For purposes of the scenario analysis, the residual acreage of 2,140 acres was used for the land use allocation, with the 500-acre University campus added back in.

Household Size. Residential population was determined using a factor of 2.7 persons per household which was the average household size for the North Kona District recorded in the 1990 Census.

Domestic Water and Wastewater. Domestic water and wastewater requirements identified in Table 4 were determined using County and State standards (cited following Table 4).

Direct Employment. Direct employment multipliers were derived from a review of socio-economic impact studies of four recent large-scale Oahu projects. The projects included Kapolei Business Park (all commercial), Makaiwa Hills (all residential), Kapolei City (mixed use) and Wahiawa Lands Development (mixed use). Full citations of each study are reported in section II of the References. Some judgment was used in terms of estimating appropriate floor area ratios and adapting ratios to the land use categories established for this analysis. The ratios identified in Table 4 provide a supply-side, planning-level estimate of projected direct employment. Subsequent studies should be conducted based on actual land use plans and market information (when available) to refine estimates reported herein.

Table 5 (at end) presents the three scenarios in terms of land use acreage and percent allocation, and resultant dwelling units, residential population, domestic water requirement, wastewater generation and direct employment. The bold faced type in the "Percent Allocation" and "Acres" columns represent variables which where preset for each scenario. Remaining values in the two columns are based on the average allocation discussed above, or, as in the case of open space/circulation, represent the residual or area left over. In Scenario I for example, approximately 754 acres or 35.2 percent of the site would be reserved for open space/circulation uses.

Table 4: Standards and Multipliers

Land Use	Domestic Water*	Wastewater**	Direct Employment***
Residential	500 gal/du	85 gpca	1/20 du
N. Commercial	4,350 gal/ac.	40 p/a @ 15 gpd	1/200 sf @ 0.2 FAR
Civic	4,000 gal/ac	140 p/a @ 15 gpd	1/400 sf @ 0.2 FAR
Employment Center	5,227 gal/ac	40 p/a @ 15 gpd	1/325 sf @ 0.3 FAR
Light Industrial	4,350 gal/ac	100 p/a @ 15 gpd	10/ac
Parks	4,000 gal/ac	400 p/a @ 10 gpd	1/6 ac
Golf Course	20,000 gal/course	20,000 gal/course	40/course

Definitions
gal/du: gallons per dwelling unit
gal/ac: gallons per acre
gpca: gallons per capita
p/d: persons per acre
gpd: gallons per day
FAR: ratio of floor area to lot size

Notes
* Water System Standards, Board of Water Supply, C&C of Honolulu
** Design Standards of the Division of Wastewater Management, Department of Public Works, C&C of Honolulu & Hawaii Administrative Rules, Chapter 11, Wastewater Systems
*** Multipliers derived from a review of recent EIS reports (cited in References)

Indirect and Induced Employment Direct employment provided by the project will stimulate indirect and induced jobs. Indirect jobs are created by goods and services needed to support project operations. Induced jobs are created when workers in direct jobs spend their money to buy goods and services.

Indirect employment and induced jobs are created throughout the economy and not just in the particular direct job classification or region. Actual indirect and induced job components can be analyzed using the state's input-output model applied to each of the projected job classifications.

Each classification has its own unique multiplier ranging from below 0.5 to well over 2.5. For purposes of this order of magnitude analysis, a gross indirect and induced multiplier of 1.0 has been assumed, resulting in the following employment impacts.

Table 6: Direct, Indirect and Induced Employment

	Direct	Indirect & Induced	Total
Scenario I	9,303	9,303	18,606
Scenario II	16,782	16,782	33,564
Scenario III	13,091	13,091	26,182

As identified in Table 6, total direct, indirect and induced employment ranges from 18,606 in Scenario I to 33,564 in Scenario II.

REFERENCES

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II. EMPLOYMENT MULTIPLIERS

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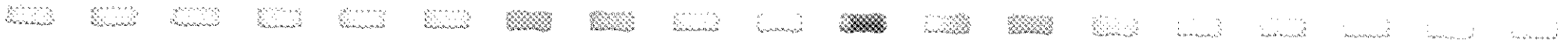


DRAINAGE REPORT

General Description

The existing drainage area at the study area (onsite and offsite) (see Fig. 1) covers approximately 8,279 acres (12.9 square miles) which extends from the undeveloped Makaula - Ooma Mauka Tract to Queen Kaahumanu Highway directly mauka of Keahole Airport. This area includes existing residential developments (Kona Palisades, Kona Acres, Kona Hills Estates, Kona Coast View, Kona Wonder View, and Kohana Iki Homesteads). The elevations range from 5,200 to 120 feet above mean sea level. Average ground slope varies from 4 to 18 percent, the average slope of the area to be rezoned being approximately 5 percent.

Reference to the Federal Emergency Management Agency's Flood Insurance Rate Map reveals the study area to be Zone X. Zone X refers to areas determined to be outside the 500-year flood plain.

The soil type varies, consisting of extremely stony silt loam known as Puukala on the mauka tip of the drainage area; extremely stony muck known as Kiloa, Kona, Lalaau and Puna; extremely stony peat known as Kaimu and Punaluu; and lava known as Aa and Pahoehoe. These soils are very permeable, values ranging from 6.3 to 20 inches per hour. (Soil Survey of Island of Hawaii, pp. 22, 31-34, 48, 76, 78 and 80).

The annual rainfall in the study area ranges from 20 to 75 inches. The mean annual soil temperature is between 56 to 74 degrees Fahrenheit. Natural vegetation consists of guava, lantana , Koa Haole, guineagrass, ohia, fern, Christmas berry, californiagrass, kikuyugrass, puakeawe, natal redtop and sand bur. (Atlas of Hawaii, 2nd ed., p. 63 and Soil Survey of Island of Hawaii, pp. 22, 31-34 and 48).

Existing Drainage System

The existing storm runoff generally sheet flows overland and ultimately, most of the runoff will percolate into the lava fields. The existing developments have no continuous underground drainage system. The roads are asphalt concrete paved and have side swales with periodic CRM ditch structures and connecting

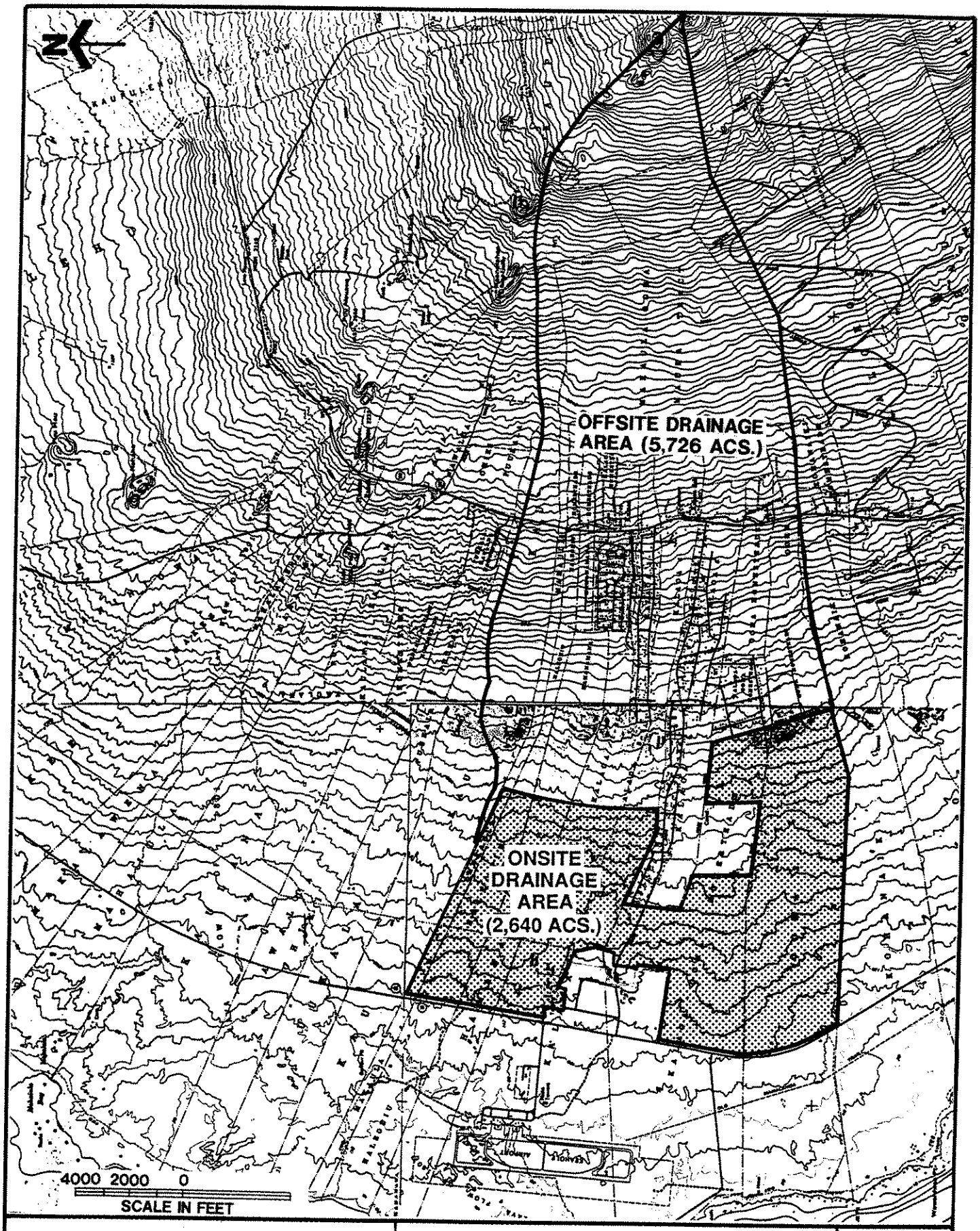
drainage pipes which direct the runoff below a road entrance and transition the runoff back onto the road swales. The runoff sheet flows onto the open areas of the petitioned area which consist of highly permeable stony soils which diminish the overland runoff. Existing drainage runoff does flow under Queen Kaahumanu Highway through a series of fourteen (14) corrugated metal pipe culverts ranging in size from 30-inch to 96-inch diameters.

The study area was analyzed in accordance with Storm Drainage Standards, Department of Public Works, County of Hawaii, October 1970. The existing offsite drainage basin is approximately 5,726 acres and the existing onsite drainage basin is approximately 2,553 acres. The existing drainage basins are greater than 100 acres in size; the "Design Curve for Peak Discharge vs. Drainage Area," Plate 6, page 19 of the Standards was used to determine the approximate 100-year recurrence interval runoff. The existing offsite peak runoff is 3500 cfs and the existing onsite peak runoff is 2300 cfs. The existing offsite and onsite peak runoff amounts to 4,300 cfs.

Impacts to Downstream Properties and Drainage Systems

Site investigation and interviews with local residents revealed no existing flooding problems within the study area. One woman did mention that during a large storm, runoff within the existing swales along Kaimi Nani Drive may erode the asphalt pavement and the County must repair the swales.

The change in land use zoning of the State land from agriculture to urban will not affect downstream properties. The additional peak onsite runoff, that development would cause is estimated to be 1000 cfs. This additional runoff can be precluded from entering into the downstream properties by installing a system of swales and underground drainage structures which would channel the runoff into a system of dry wells.



West Hawaii EIS	DRAINAGE AREAS	Figure 1

BOTANICAL SURVEY
WEST HAWAI'I BOUNDARY REVIEW
KAILUA TO KEAHOLE REGION, NORTH KONA, HAWAI'I

by

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BOTANICAL SURVEY
WEST HAWAI'I BOUNDARY REVIEW
KAILUA TO KEAHOLE REGION, NORTH KONA, HAWAI'I

INTRODUCTION

The ±2,600-acre project site is bounded by the Queen Ka'ahumanu Highway on the west or makai end, a number of subdivisions and undeveloped lands on the east or mauka end, and undeveloped lands on the north and south. The site encompasses portions of the following ahupua'a -- Maka'ula, Haleohiu, Hamanamana, Kalaoa, and 'O'oma 2. Kaimi Nani Drive bisects the property. For the purposes of the botanical studies, the portion of the project site north of Kaimi Nani Drive was designated the "northern half" and the portion south of Kaimi Nani was designated the "southern half". Elevation on the northern half ranges from about 160 ft. along Queen Ka'ahumanu Highway to approximately 600 ft. along the mauka boundary. On the southern half, elevation is roughly 120 ft. along the highway and about 860 ft. along the mauka boundary.

The vegetation on the project site varies from grassland with low, scattered shrubs on the lower elevations to open and closed shrublands on the upper elevation portions of the site. Native, dry, lowland shrubs and trees are found throughout the site but are more numerous on 'a'a lava flows; they are a major component of the open and closed shrublands on the property. Uhiuhi (Caesalpinia kavaiensis), an officially listed endangered species, is known from the adjacent Pu'uhonua parcel (TMK: 7-3-10: portion

27). A Category 1 candidate endangered species, the 'aiea (Nothocestrum breviflorum), has been found on the neighboring Kau ahupua'a. Rare and vulnerable species found on adjacent properties include Bidens micrantha subspecies ctenophylla and hala pepe (Pleomele hawaiiensis).

Field studies to assess the botanical resources on the project site were conducted on 28-29 August and 11-12 September 1992. The field survey team consisted of three botanists. The primary objectives of the botanical study were to: 1) provide a general description of the major vegetation types, 2) inventory the flora, 3) search for threatened and endangered species protected by Federal and State laws as well as rare and vulnerable species, and 4) identify areas of potential environmental concerns and propose appropriate mitigation measures.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps and a very recent, colored, aerial photograph (1" = 1,100 ') were examined to determine the locations of large 'a'a lava flows and outcroppings, vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

In this region, 'a'a flows generally tend to support a greater number of native plant species including several rare and endangered elements. Thus, these areas were more intensively surveyed than the pahoehoe, fountain grass dominated portions of the site. A walk-through (pedastrian) survey method was used, with the three team members spaced from 30 to 100 ft. apart depending upon the density of the vegetation cover (see Figure 1 for transect locations). Notes were made on plant associations

and distribution, substrate types, topography, exposure, drainage, moisture gradients, etc. Plant identifications were made in the field; plants which could not be positively determined were collected for later determination in the herbarium and for comparison with the most recent taxonomic literature. In addition to the pedastrian survey, a low-level (30 to 50 ft. altitude) aerial survey using a helicopter was made of the areas most likely to support rare and endangered plants.

The species recorded during the field studies are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. A survey taken at a different time and under varying environmental conditions would no doubt yield slight variations in the species list especially of the weedy, annual plants.

VEGETATION DESCRIPTION

Three major vegetation types are recognized on the project site: fountain grass grassland, open mixed shrubland, and closed mixed shrubland. The distribution of these vegetation types is influenced by environmental factors such as substrate type and rainfall gradient. Fountain grass grassland occurs on the lower elevation portions of the site, largely on pahoehoe flows. Open mixed shrubland occurs on 'a'a flows from about the 400 ft. elevation contour upwards, while closed mixed shrubland is found from about the 640 ft. elevation, generally on more weathered pahoehoe and 'a'a substrates. Annual rainfall is about 20 inches on the lower portions of the site and increases upslope to about 30 inches. A list of all those species inventoried within each of the three major vegetation types is presented in the checklist at the end of the report.

A Category 1 candidate endangered species, the 'aiea (Nothocestrum breviflorum), is found on the northern half of the property in open mixed shrubland. A rare and vulnerable species, Bidens micrantha ssp. ctenophylla, occurs as scattered patches within the open mixed shrubland and the closed mixed shrubland.

Fountain Grass Grassland

The general physiognomy of this vegetation type is of low tufts of grass with scattered shrubs and, occasionally, a few trees. Fountain grass (Pennisetum setaceum), a perennial species, from 1 to 4 ft. tall, and native to northern Africa, is the dominant plant cover. On some rocky outcroppings pili grass (Heteropogon contortus) and Natal redtop grass (Rhynchelytrum repens) may become locally common. Native lowland shrubs scattered throughout the grassland include 'uhaloa (Waltheria indica), the native caper or maiapilo (Capparis sandwichiana), 'ilima (Sida fallax), and a'ali'i (Dodonaea viscosa). Shrubs of noni (Morinda citrifolia), a plant of very early Polynesian introduction, is also occasional in this vegetation type. Introduced or alien shrubs include koa-haole or ekoa (Leucaena leucocephala), Christmas berry (Schinus terebinthifolius), klu (Acacia farnesiana), indigo (Indigofera suffruticosa), and pluchea (Pluchea symphytifolia). The shrubs are generally of low stature, from 1 to 6 ft. tall. A few trees of kiawe (Prosopis pallida) are found in some swale areas, adjacent to the highway, on the southern half of the site.

The amount of plant cover within this vegetation type is variable. Along the lower elevation portions of the site, closer to the Queen Ka'ahumanu Highway, the plant cover may be 30 to 50%; this portion of the site receives the least amount of rainfall. Along the "wetter" mauka limits of the grassland, plant cover becomes dense, about 80 to 90% cover and shrubs become numerous.

Two minor variants of the grassland vegetation are recognized. On the southern half of the site is a large area which has recently been burned, about 4 to 6 months ago, and vegetation cover is sparse, about 30 to 40% cover. Blackened stubs of fountain grass and burnt koa-haole and Christmas berry shrubs are everywhere. In a few relatively level areas with very thin soil, young plants of 'ilima and 'uhaloa have sprouted and are locally abundant.

The second variant is found on the 'a'a lava flows near the highway. A largely barren flow is found on the northwestern corner of the project site and several smaller flows occur on the southwestern corner. The vegetation cover is very sparse, about 3 to 5%, with scattered patches of fountain grass occurring primarily in depressions. A few, scattered native components can be found here; these include maiapilo and naio or false sandalwood (Myoporum sandwicense) shrubs and the fuzzy-leaved form of 'ohi'a (Metrosideros polymorpha).

Open Mixed Shrubland

This vegetation type occurs at about the 400 ft. elevation on the project site. Shrub cover is open, that is, less than 60%, and one can easily see and move between the shrubs and few trees. The shrubs are from 6 to 15 ft. tall and the trees are from 15 to 25 ft. tall. The shrub cover is a mix of native and introduced species, with the native species locally abundant in certain areas.

Native woody components common in this vegetation type are lama (Diospyros sandwicensis), alahe'e (Canthium odoratum), kolomona (Senna gaudichaudii), naio, mamane (Sophora chrysophylla), a'ali'i, and maiapilo. A few scattered trees of 'ohi'a, 'ohe (Reynoldsia sandwicensis), and wiliwili (Erythrina sandwicensis) are occasionally encountered. Somewhat dense tangles of huehue vines

(Cocculus trilobus) are frequently found, usually sprawling over low shrubs and on the ground, tripping unwary botanists.

Introduced or alien shrubs which are common components in the open mixed shrubland are Christmas berry and koa-haole. Trees of silk oak (Grevillea robusta), a native of Queensland, Australia, are scattered throughout this vegetation type. On the southern half of the site, near a rock wall, is a grove of large, old mango trees (Mangifera indica), probably planted there by the paniolos (cowboys). The ubiquitous fountain grass is abundant in some areas.

Substrate type appears to have an influence on the distribution of the native and introduced components. In areas with broken, weathered pahoehoe, fountain grass is very dense, often obscuring the ground, and shrubs are less dense, about 20 to 30%, with a'ali'i being the most abundant element. On this substrate, koa-haole shrubs often form small thickets, up to 6 ft. tall, in swale areas.

The rough, clinkery 'a'a flow areas are often dominated by a lama-alahe'e-naio association. Other native shrubs and trees are also more frequent on these 'a'a flows. Plant cover varies from 30 to as much as 60%, with flows on the southern half commonly having a denser cover of shrubs and trees. Bidens micrantha spp. ctenophylla is locally common on these lava flows, especially on the southern half of the property. Fountain grass occurs only as small, scattered patches on the 'a'a substrate. In places, the 'a'a may be lichen encrusted. One plant of 'aiea (Nothocestrum breviflorum), a Category 1 candidate endangered species, is found on the 'a'a flow on the northern half of the property.

Closed Mixed Shrubland

In this vegetation type, the shrub cover becomes closed, greater than 60%, often with Christmas berry forming dense thickets, 12 to 18 ft. tall. Trees also become more numerous, sometimes forming small stands. Some native, woody elements common in the open mixed shrubland become uncommon to rare here.

As in the open mixed shrubland, two variants of this shrubland can be recognized, their distribution based primarily upon substrate type. On areas with thin soils over pahoehoe, these are probably areas with Punaluu extremely rocky peat (Sato et al. 1973), the shrubland consists of dense Christmas berry with fountain grass filling in the matrix between the thickets. On areas with 'a'a and rocky pahoehoe outcroppings or knolls, native trees and shrubs such as lama, alahe'e, and mamane are common. The rocks are often covered by a thin layer of moss, due to the somewhat greater rainfall on this portion of the project site. In some places, there may be a dense undergrowth of air plant (Kalanchoe pinnata). A few small stands of kukui (Aleurites moluccana), 20 to 30 ft. tall, are also found on this substrate type.

In the closed mixed shrubland, 'ohe trees (Reynoldsia sandwicensis) become occasional, while silk oak becomes common to locally abundant, often forming small stands of trees. Among the native elements which become uncommon to rare in the closed shrubland are Bidens micrantha ssp. ctenophylla, kolomona, naio, and a'ali'i.

THREATENED AND ENDANGERED SPECIES

On adjacent parcels: Prior to the field studies, a search was made of the literature to prepare a list of threatened and

endangered, as well as rare and vulnerable plants, which might occur on the ±2,600-acre project site.

An officially listed endangered species, the uhiuhi (Caesalpinia kavaiensis), is found on the adjacent Pu'uhonua Estates Subdivision (TMK: 7-3-10: portion 27) at about the 720 ft. elevation (Linney and Char 1988). A listed endangered species is protected by the Endangered Species Act of 1973, as amended, and by Hawaii State law (H.R.S. 195-D) which protects all Federal and State listed plants on all lands within the State. Endangered means any species that is in danger of extinction throughout all or a significant portion of its range. The uhiuhi was listed in July 1986 (U.S. Fish and Wildlife Service 1986) under its old name, Mezoneuron kavaiense.

The uhiuhi on the Pu'uhonua property consists of one individual about 12 ft. tall; the main trunk has died back and the plant has produced many long and sturdy branches from the basal area. Although Linney and Char (1988) found many seed pods with mature seeds on the plant and on the ground around the plant, no young plants or seedlings were observed. The uhiuhi is found in mixed, open dry-shrubland on an 'a'a rockpile near a rock wall (Figure 1). The uhiuhi, a member of the Fabaceae or pea family, is a large shrub to medium-sized tree (up to 30 ft. tall) with dark, heavy wood which was used by the Hawaiians to make spears and fishing implements called la'au melomelo or la'au makalei (Rock 1913, Lamoureux 1982). The leaves are twice divided into smaller, pale bluish-green leaflets. The flowers are in cone-shaped clusters at branch tips; each flower 1.25 inches long, pinkish-purple to dark red.

A Category 1 candidate endangered species, the 'aiea (Nothocestrum breviflorum) is found on the adjacent Kau ahupua'a (Char 1990a) to the north of the project site at about the 480 ft. elevation

in the interface between fountain grass grassland and mixed shrubland (Figure 1). A Category 1 candidate endangered species is one for which the U.S. Fish and Wildlife Service (1990) "... has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species." A listing packet for 24 Hawai'i island species, including the 'aiea, is currently being prepared by the local U.S. Fish and Wildlife Service for review.

The 'aiea, a woody member of the Solanaceae or tomato family, is a small tree, 10 to 30 ft. tall. It is found in lowland, dry to mesic forest and shrubland vegetation from the Ka'u District north to Waimea. It is a stout tree with grayish-white bark. The thickish, almost succulent leaves, are clustered towards the ends of the branches. Flowers are numerous, short-stalked, pale greenish-yellow, and fragrant. The fruit, when ripe, is a reddish-orange berry with many wrinkled, brown seeds.

Two species considered rare and vulnerable (Wagner et al. 1990) are known from the general area. The first, Bidens micrantha subspecies (ssp.) ctenophylla (no common name), a member of the Asteraceae or sunflower family, has been recorded on the project site as well as on adjacent parcels. Plants are found in the open and closed mixed shrublands along the HELCO powerline corridor above the 600 ft. elevation, on the 'O'oma 2 and 'O'oma Homesteads, and on the Pu'uhonua Estates Subdivision (Char 1988, Char 1990b, Linney and Char 1988). The Bidens is an erect, much-branched, perennial herb, from 2 to 7 ft. tall, with large, dense clusters of yellow daisy-like flowers borne at the ends of branches. Although the Bidens may be locally common in places, it is limited to a range that is subject to future development, and so will become progressively rarer.

The second rare species is the hala pepe (Pleomele hawaiiensis), a member of the Agavaceae or agave (sisal) family. Like the Bidens it is endemic only to the island of Hawai'i. One plant was found on the Kau ahupua'a at about the 650 ft. elevation (Char 1990a). Hala pepe is a small tree, from 15 to 20 ft. tall, with long tapering leaves. In form, it resembles many of the Dracaena species used in landscaping or for potted specimens; it is closely related to this genus. The flowers of the hala pepe are white to pale yellow and are borne in compact clusters; the fruit is a red berry, when ripe.

On the project site: During the course of the limited field studies (see areas covered by transects, Figure 1), one live plant of 'aiea was found at about the 480 ft. elevation on an 'a'a flow covered by somewhat sparse open mixed shrubland. The 'aiea plant is about 12 ft. tall with about half of its branches dead or dying, it appears to be an old specimen. Although it produces a profusion of flowers, there are very few fruits. Three small ripe fruits were collected and later examined under the dissecting microscope in the laboratory. The majority of the seeds were aborted. The few seeds which appeared viable did not germinate when left on moistened filter paper in a covered petri dish. No seedlings or young plants were observed during our field studies. One, long-dead 'aiea plant was also found east of the live plant on the same lava flow.

Bidens micrantha ssp. ctenophylla occurs scattered throughout the project site in the two shrubland types. On some of the 'a'a outcroppings on the southern half of the property, it is locally common, occuring in large numbers and many size classes.

DISCUSSION AND RECOMMENDATIONS

Stretching across the lower slopes of Hualalai, from Kealakehe to Pu'uwa'awa'a and between the Queen Ka'ahumanu and Mamalahoa (or Belt) Highways, three distinct bands of vegetation can be observed. The lower band, above the Queen Ka'ahumanu Highway, is grassland; the middle band is shrubland; and the mauka band is dry to mesic forest. Most often the boundaries between the three bands are not distinct, with one type grading into the other where they meet (interface or overlap area). Rainfall, and to a lesser extent substrate type, appears to be the the main factor in determining the elevational limits of each of the bands.

These broad bands or zones of vegetation can be further subdivided into vegetation types or plant communities. On the project site three major vegetation types are recognized. They are fountain grass grassland and two variants of the shrubland -- open mixed shrubland and closed mixed shrubland.

In general, the fountain grass grassland tends to have fewer species, that is, it is species poor. The introduced fountain grass is an aggressive species which tends to crowd out other plants, especially smaller herbaceous species and seedlings of shrubs and trees. It is very fire-adapted and soon resprouts after a fire has passed through an area. It is considered particularly insidious because it is able to invade lava flow areas previously dominated by native plants, where it interferes with native plant regeneration, disrupts natural plant succession, and allows wildfires to spread over a wider range because of its dense growth (Cuddihy and Stone 1990).

The largest number and diversity of native species occurs in the two mixed shrubland vegetation types. Some common native woody components in the shrubland are lama, alahe'e, naio, mamane,

kolomona, and a'ali'i. Among the introduced plants, Christmas berry, silk oak, and koa-haole are common. One small tree of 'aiea (Nothocestrum breviflorum), a Category 1 candidate endangered species, is found in open mixed shrubland at the 480 ft. elevation.

The following recommendations are offered. The portions of the project site covered by fountain grass grassland are not likely to contain endangered or rare and vulnerable species. No further detailed field studies are recommended for the grassland areas. The open mixed shrubland supports one tree of 'aiea and a large population of Bidens micrantha ssp. ctenophylla, a rare and vulnerable species. Given the limited time spent on the project site and the areas covered, it is possible that there may be a few more trees of 'aiea on the site, and, perhaps, uhiuhi (Caesalpinia kavaiensis). The closed mixed shrubland may also harbor endangered or rare species; the vegetation is dense and visibility is limited. A more intensive survey is recommended for these areas. Any future developments proposed for the project site will need to consider endangered and rare and vulnerable plants as they are of particular interest to regulatory agencies. Projects that affect endangered species (listed, candidate, proposed) will need U.S. Fish and Wildlife as well as State approval; any projects or actions that adversely affect these plants should be coordinated with the State Department of Land and Natural Resources, Division of Forestry and Wildlife.

Suggestions for appropriate mitigation measures for future development of the site include establishment of a nature study park (or parks) around the areas with endangered or rare and vulnerable plants. Such a park along with a mitigation plan for the conservation of native species has already been prepared for the uhiuhi trees on the State's Villages of La'i'opua, formerly

known as the Kealakehe Planned Community (Belt Collins & Associates 1990; P. Weissich and Associates, Inc., 1991). A mitigation effort similar to that prepared for the La'i'opua project should be acceptable to the government agencies which oversee the protection of endangered species.

Landscaping with native plants already found on the project site and the surrounding areas is another mitigation measure which should be considered. Suitable native material, which have already been suggested in other reports such as in the Pu'uhonua and La'i'opua (Kelalakehe) studies, include 'ohe, Bidens, uhiuhi, mamane, kolomona, alahe'e, wiliwili, 'ulei, maiapilo, etc. These natives are attractive and are adapted to the local environmental conditions, thus, requiring less water and little soil, if any.

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PLANT SPECIES LIST -- West Hawai'i Boundary Review Project

A checklist of all those terrestrial, vascular plant species inventoried on the project site during the field studies is presented below. The species are arranged alphabetically by families within each of three groups: Ferns and Fern Allies, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux (1984), while the flowering plants, Monocots and Dicots, are in accordance with the most recent treatment of the Hawaiian flora by Wagner et al. (1990).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:
   - E = endemic = native only to the Hawaiian Islands
   - I = indigenous = native to the islands and also elsewhere throughout the Pacific
   - P = Polynesian = plants of Polynesian introduction prior to Western contact (1778); not native
   - X = introduced or alien = all those plants introduced by humans, intentionally or accidentally, after Western contact; not native.
4. Presence (+) or absence (-) of a particular species within each of three vegetation types recognized on the project site (see text for description):
   - fg = Fountain Grass Grassland
   - os = Open Mixed Shrubland
   - cs = Closed Mixed Shrubland

Scientific name	Common name	Status	Vegetation type fg	os	cs
FERNS AND FERN ALLIES					
NEPHROLEPIDACEAE (Sword Fern Family)					
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X	+	+	+
POLYPODIACEAE (Common Fern Family)					
Phymatosorus scolopendria (Burm.) Pic.-Ser.	laua'e, lauwa'e	X	-	+	+
SINOPTERIDACEAE (Cliffbrake Fern Family)					
Doryopteris decipiens (Hook.) J. Sm.	kumu-niu, 'iwa'iwa	E	+	+	-
PSILOTACEAE (Whisk Fern Family)					
Psilotum nudum (L.) Beauv.	moa, pipi	I	-	-	+
FLOWERING PLANTS					
MONOCOTS					
AGAVACEAE (Sisal Family)					
Cordyline fruticosa (L.) A. Chev.	ti, ki	P	+	+	+
COMMELINACEAE (Spiderwort Family)					
Commelina benghalensis L.	hairy honohono	X	-	-	+
Rhoeo spathacea (Sw.) Stern	tradescantia	X	-	-	+
LILIACEAE (Lily Family)					
Asparagus setaceus (Kunth) Jessop	asparagus fern	X	-	-	+
POACEAE (Grass Family)					
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	X	+	+	-
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili, piligrass	I	+	-	-

Scientific name	Common name	Status	Vegetation type		
			fg	os	cs
Melinis minutiflora P. Beauv.	molassesgrass	X	-	+	+
Oplismenus hirtellus (L.) Beauv.	basketgrass, honohono				
	kukui	X	-	-	+
Panicum maximum Jacq.	Guinea grass	X	-	-	+
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X	+	+	+
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	+	+	+
DICOTS					
ACANTHACEAE (Acanthus Family)					
Ruellia graecizans Backer	scarlet ruellia	X	-	-	+
ANACARDIACEAE (Mango Family)					
Mangifera indica L.	mango, manako	X	-	+	-
Schinus terebinthifolius Raddi	Christmas berry	X	+	+	+
APOCYNACEAE (Dogbane Family)					
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X	-	+	+
ARALIACEAE (Ginseng Family)					
Reynoldsia sandwicensis A. Gray	'ohe	E	-	+	+
Schefflera actinophylla (Endl.) Harms	octopus tree, umbrella tree	X	-	-	+
ASTERACEAE (Sunflower Family)					
Ageratum conyzoides L.	maile hohono	X	-	-	+
Bidens micrantha ssp. ctenophylla (Sherff) Nagata & Ganders		E	-	+	+
Bidens pilosa L.	Spanish needle, beggar's tick, ki	X	-	-	+
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	-	-	+
Emilia fosbergii Nicolson	red pualele	X	-	+	+

Scientific name	Common name	Status	Vegetation type fg	os	cs
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	+	+	+
Tridax procumbens L.	coat buttons	X	+	–	–
BIGNONIACEAE (Bignonia Family)					
Jacaranda mimosifolia D. Don	jacaranda	X	–	–	+
CACTACEAE (Cactus Family)					
Opuntia ficus-indica (L.) Mill.	panini	X	+	+	–
CAPPARACEAE (Caper Family)					
Capparis sandwichiana DC.	maiapilo, puapilo	E	+	+	–
CARICACEAE (Papaya Family)					
Carica papaya L.	papaya, mikana	X	–	+	+
CONVOLVULACEAE (Morning-glory Family)					
Ipomoea indica (J. Burm) Merr.	koali	I	+	+	+
CRASSULACEAE (Orpine Family)					
Kalanchoe pinnata (Lam.) Pers.	air plant	X	–	+	+
Kalanchoe tubiflora (Harv.) Raym.-Hamet	chandelier plant	X	–	+	+
CUCURBITACEAE (Gourd Family)					
Coccinia grandis (L.) Voight	coccinea	X	–	+	–
Momordica charantia L.	wild bittermelon	X	–	–	+
EBENACEAE (Ebony Family)					
Diospyros sandwicensis (A. DC.) Fosb.	lama	E	–	+	+
EUPHORBIACEAE (Spurge Family)					
Aleurites moluccana (L.) Willd.	kukui	P	–	–	+
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	+	+	+

Scientific name	Common name	Status	Vegetation type		
			fg	os	cs
FABACEAE (Pea Family)					
Acacia farnesiana (L.) Willd.	klu	X	+	+	+
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	+	+	+
Crotalaria pallida Aiton	smooth rattlepod, pikakani	X	–	–	+
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X	–	+	–
Erythrina sandwicensis Degener	wiliwili	E	–	+	–
Indigofera suffruticosa Mill.	indigo, 'iniko	X	+	+	+
Leucaena leucocephala (Lam.) de Wit	koa-haole, ekoa	X	+	+	+
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X	+	–	–
Senna gaudichaudii (Hook. & Arnott) H. Irwin & Barneby	kolomona	I	–	+	+
Senna pendula (Humb. & Bonpl. ex Willd.) H. Irwin & Barneby		X	–	+	–
Sophora chrysophylla (Salisb.) Seem.	mamane	E	–	+	+
Tephrosia purpurea (L.) Pers.	'ahuhu, 'auhuhu	P	–	+	+
LAMIACEAE (Mint Family)					
Hyptis pectinata (L.) Poit.	comb hyptis	X	–	–	+
Plectranthus parviflorus Willd.	spur flower, 'ala 'ala wai nui	I	–	+	+
MALVACEAE (Mallow Family)					
Sida acuta ssp. carpinifolia (L. f.) Borssum Waalkes	acute-leaved sida	X	–	–	+
Sida fallax Walp.	'ilima	I	+	+	+
MENISPERMACEAE (Moonseed Family)					
Cocculus trilobus (Thunb.) DC.	huehue	I	–	+	+
MORACEAE (Mulberry Family)					
Ficus microcarpa L. f.	Chinese banyan	X	–	–	+
MYOPORACEAE (Naio Family)					
Myoporum sandwicense A. Gray	naio	I	+	+	+

Scientific name	Common name	Status	Vegetation type		
			fg	os	cs
MYRTACEAE (Myrtle Family)					
Metrosideros polymorpha Gaud.	'ohi'a, 'ohi'a lehua	E	+	+	+
Psidium cattleianum Sabine	strawberry guava	X	-	-	+
Psidium guajava L.	guava	X	-	+	+
PAPAVERACEAE (Poppy Family)					
Argemone glauca (Nutt. ex Prain) Pope	pua kala, kala	E	-	+	-
PASSIFLORACEAE (Passionflower Family)					
Passiflora edulis forma flavicarpa Degener	passionfruit, liliko'i	X	-	-	+
Passiflora foetida L.	scarlet-fruited passion-flower, pohapoha	X	-	-	+
Passiflora suberosa L.	huehue haole	X	-	-	+
PHYTOLACCACEAE (Pokeweed Family)					
Rivina humilis L.	rouge plant, coral berry	X	-	-	+
PIPERACEAE (Pepper Family)					
Peperomia leptostachya Hook. & Arnott	'ala'ala wai nui	I	-	+	+
PLUMBAGINACEAE (Leadwort Family)					
Plumbago zeylanica L.	'ilie'e, hilie'e	I	-	-	+
PORTULACACEAE (Purslane Family)					
Portulaca oleracea L.	pigweed, common purslane	X	+	+	+
Portulaca pilosa L.		X	-	+	-
PROTEACEAE (Protea Family)					
Grevillea robusta A. Cunn. ex R. Br.	silk oak, silver oak, 'oka kilika	X	+	+	+
ROSACEAE (Rose Family)					
Osteomeles anthyllidifolia (Sm.) Lindl.	'ulei, u'ulei	I	-	-	+

Scientific name	Common name	Status	Vegetation type		
			fg	os	cs
RUBIACEAE (Coffee Family)					
Canthium odoratum (G. Forster) Seem.	alahe'e, walahe'e	I	-	+	+
Morinda citrifolia L.	noni	P	+	+	+
SAPINDACEAE (Soapberry Family)					
Dodonaea viscosa Jacq.	a'ali'i	I	+	+	+
SCROPHULARIACEAE (Figwort Family)					
Lophospermum erubescens D. Don	larger roving sailor, creeping gloxinia	X	-	-	+
SOLANACEAE (Tomato Family)					
Nothocestrum breviflorum A. Gray	'aiea	E	-	+	-
Solanum americanum Mill.	popolo	I?	-	-	+
STERCULIACEAE (Cacao Family)					
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?	+	+	-
VERBENACEAE (Verbena Family)					
Lantana camara L.	lantana, lakana	X	+	+	+
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	owi, oi	X	-	-	+
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain, owi, oi	X	-	-	+

FIGURE 1. Distribution of vegetation types and locations of endangered species on the West Hawai'i project site and adjacent parcels.

Vegetation types

fg = Fountain Grass Grassland

os = Open Mixed Shrubland

cs = Closed Mixed Shrubland

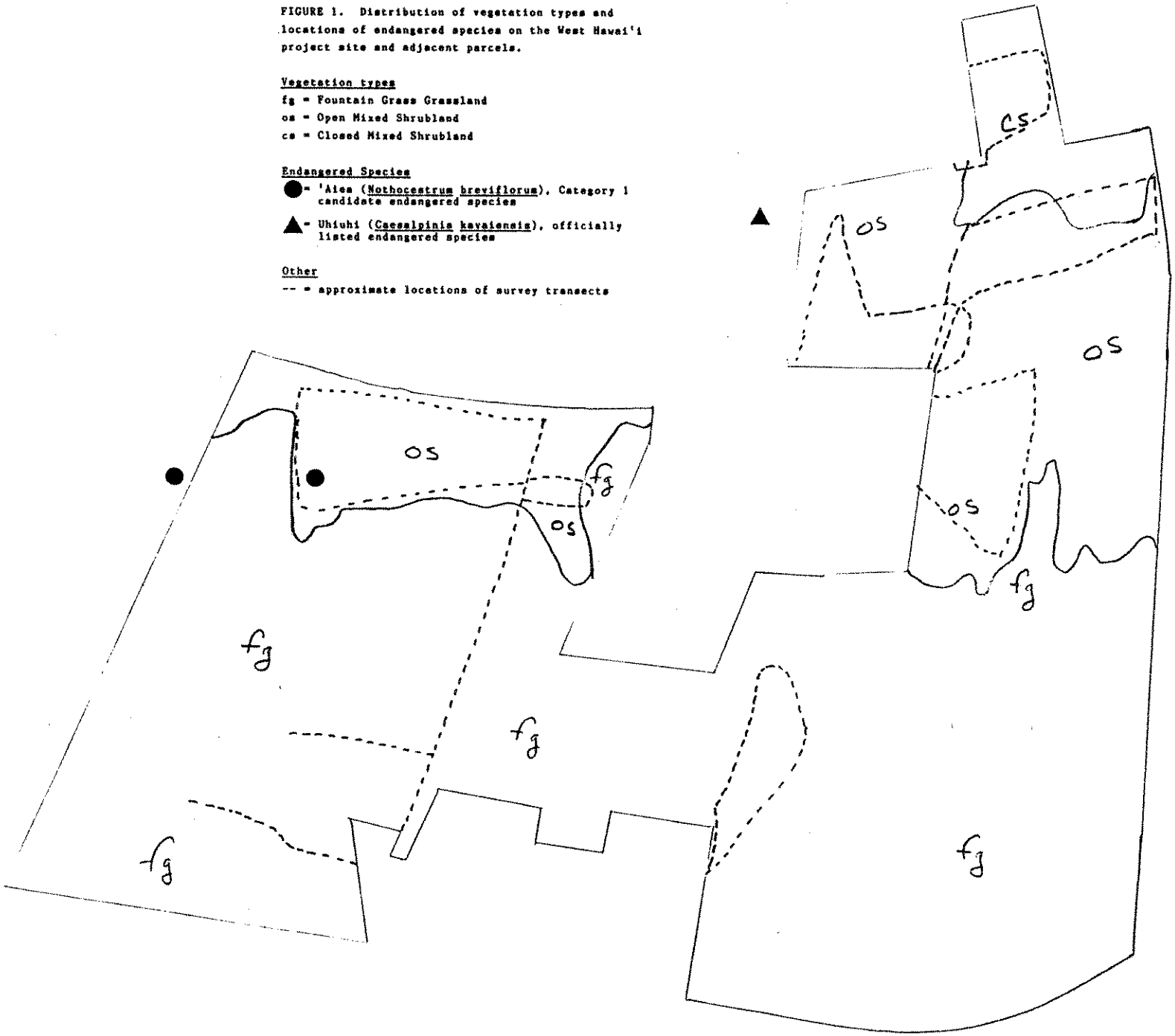
Endangered Species

● = 'Alea (Nothocestrum breviflorum), Category 1 candidate endangered species

▲ = Uhiuhi (Caesalpinia kavaiensis), officially listed endangered species

Other

-- = approximate locations of survey transects



SURVEY OF THE AVIFAUNA AND FERAL MAMMALS ON STATE-OWNED LANDS IN THE KAILUA TO KEAHOLE REGION, NORTH KONA, HAWAII

Prepared for

Helber Hastert and Fee

by

Phillip L. Bruner
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Director, Museum of Natural History
Environmental Consultant - Faunal (Bird & Mammal) surveys

7 October 1992

INTRODUCTION

The purpose of this report is to summarize the findings of a four day (7-8 September, 3-4 October 1992) bird and mammal field survey conducted on State owned lands at Kailua-Keahole, included are reference to pertinent literature as well as unpublished faunal reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely be found there given the type of habitats available.

2- Provide some baseline data on the relative (estimated) abundance of each species.

3- Determine the presence or likely occurrence of any native fauna particularly any that are listed as "Endangered" or "Threatened".

4- Identify any sites or habitat that may be unique or of special importance to wildlife.

GENERAL SITE DESCRIPTION

Figure One indicates the limits of the area surveyed for birds and mammals. Dry grass and open barren lava flows cover most of

the lower elevation portions of the site. A mixture of introduced and native trees and brush form a dense thicket of vegetation in the higher (above the 400 foot contour) sections. No wetland habitat suitable for waterbirds was found on the property.

Weather during the field survey was variable with both clear and cloudy conditions. Winds were from the ENE at 10-20 mph.

STUDY METHODS

The survey consisted of a walking tour of the property and nearby lands. Field observations were made with binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon/early evening. At various locations eight minute counts were made of all birds seen or heard (Fig.1). Between these count (census) stations any special observations of birds were also noted. These data provide the basis for the relative (estimated) abundance figures given in this report (Table 1). Published and unpublished reports of birds known from similar habitat elsewhere were also consulted in order to assess what possible species might be expected in this region (Bruner 1989a, 1989b, 1989c, 1990, 1991, 1992; Pratt et al. 1987; Hawaii Audubon Society 1989; David 1989, 1990). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to

trap mammals in order to obtain additional data on their abundance and distribution. Three evenings were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinereus semotus).

Scientific names used herein follow those given in Hawaii's Birds (Hawaii Audubon Society 1989); Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987) and Mammal Species of the World (Honacki et al. 1982).

RESULTS AND DISCUSSION

Resident Endemic (Native) Birds:

No endemic birds were observed on the survey. The only species which potentially could occur in this area are: Short-eared Owl or Pueo (Asio flammeus sandwichensis) and the endangered Hawaiian Hawk or 'Io (Buteo solitarius). These two birds forage in open grasslands as well as forests and agricultural fields (Pratt et al. 1987; Hawaii Audubon Society 1989).

Migratory Indigenous (Native) Birds:

The only migratory species recorded on the survey was the Pacific Golden Plover (Pluvialis fulva). Long term detailed studies of this bird have shown that they are both site-faithful (return each year

to the same area) and territorial (actively defend their foraging space) (Johnson et al. 1981, 1989). A total of 14 plover were counted on the survey. Open patches in the grassland and lava flows at lower elevations provide usable habitat for this species. The only other migratory species that might occur with any regularity on this property is the Ruddy Turnstone (Arenaria interpres).

Resident Waterbirds and Seabirds:

No waterbirds or seabirds were found on this property. The absence of wetlands and the accessibility of predators restricts their occurrence.

Exotic (Introduced) Birds:

Seventeen species of exotic birds were recorded during the field survey (Table 1). The relative abundance data for these species were similar to that gathered on nearby lands (Bruner 1989a, 1989b, 1989c, 1990, 1991, 1992). Other species which may also occur on or near the property include: Barn Owl (Tyto alba), Ring-necked Pheasant (Phasianus colchicus) and Lavender Waxbill (Estrilda caerulescens) (Pratt et al. 1987; Hawaii Audubon Society 1989; David 1989, 1990).

Feral Mammals:

A total of six Small Indian Mongoose (Herpestes auropunctatus) were observed. Skeletal remains of feral goats were noted in several lava tubes. Live goats or fresh scats were not found. Pig tracks were seen and residents whose lands adjoin the eastern forested sections

reported that pigs were common in this area. No trapping was conducted in order to assess the relative abundance of mammals.

Records of the endemic and endangered Hawaiian Hoary Bat are relatively limited but the species does occur on the island of Hawaii (Tomich 1986; Kepler and Scott 1990). No bats were found on the survey. The natural history of this bat and its ecological requirements here in Hawaiiare poorly known. They generally roost solitarily in trees and forage for flying insects at dusk often over bays and ponds or forest clearings.

CONCLUSION

A brief field survey of a large area such as this one can provide only a limited perspective of the wildlife. The number of species and the relative abundance of each may vary throughout the year due to available resources and reproductive success. Birds which are migratory will quite obviously be found only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987; Moulton et al. 1990). Thus only long term studies can provide a comprehensive view of the bird and mammal populations in a particular area. Nevertheless, some general conclusions related to bird and mammal activity on this site are provided below:

1- The survey was conducted by walking the entire site and stopping periodically to conduct eight minute counts of all birds seen or heard. These data provided the numbers necessary to calculate the relative abundance estimates given in Table One. All habitats (grassland, parkland, forest and open lava flows) were examined.

2- No endemic species were recorded, however, Pueo and 'Io may occur at times at this location.

3- The only migratory bird discovered on the survey was the Pacific Golden Plover. Their numbers were low due to limited suitable open, low grass habitat.

4- The numbers of exotic birds recorded were typical of this region of the island. No unusual exotic species were found. A few species known from this area were not recorded but may occur on the property.

5- No wetlands exist on this site thus no waterbirds were found.

6- No unusual concentrations of mammals were noted. The endangered Hawaiian Hoary Bat was not recorded at this site but potentially could occur here.

7- No particularly special or unique bird or mammal habitat was discovered on this property. Dry grasslands, open lava flows, and mixed exotic and native second growth dry forest habitats are abundant at this elevation in West Hawaii.

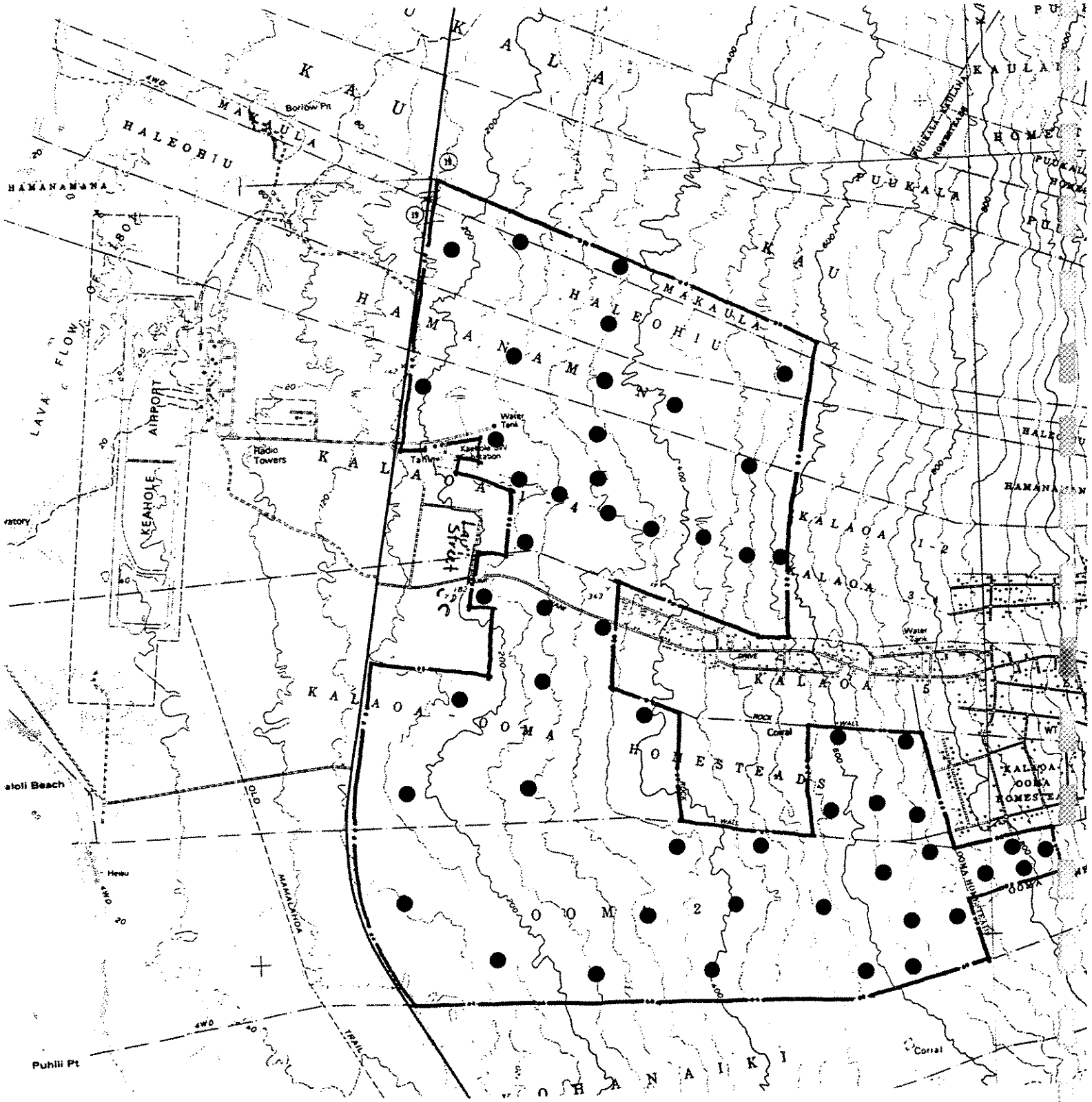

Fig. 1. Location of faunal survey with census stations marked as solid circles.

TABLE 1

Exotic (introduced) birds recorded at Kailua, Keahole, State Lands, North Kona, Hawaii

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Kalij Pheasant	Lophura leucomelana	R = 7
Black Francolin	Francolinus francolinus	U = 3
Gray Francolin	Francolinus pondicerianus	R = 6
Rock Dove	Columba livia	R =20
Spotted Dove	Streptopelia chinensis	U = 4
Zebra Dove	Geopelia striata	A =14
Common Myna	Acridotheres tristis	C = 9
Northern Mockingbird	Mimus polyglottus	R = 1
Northern Cardinal	Cardinalis cardinalis	U = 2
Yellow-billed Cardinal	Paroaria capitata	R = 8
Japanese White-eye	Zosterops japonicus	A =12
Yellow-fronted Canary	Serinus mozambicus	C = 8
Nutmeg Mannikin	Lonchura punctulata	A =11
Warbling Silverbill	Lonchura malabarica	R =13
Saffron Finch	Sicalis flaveola	C = 9

TABLE 1 (cont.)

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
House Finch	Carpodacus mexicanus	C = 7
House Sparrow	Passer domesticus	C = 8

* (see page 11 for key to symbols)

KEY TO TABLE 1

Relative abundance = Number of times observed during survey or average number on eight minute counts in appropriate habitat.

A = abundant (ave. 10+)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

R = recorded (seen or heard at times other than on 8 min. counts or on one count only). Number which follows is the total number seen or heard over the duration of the survey.

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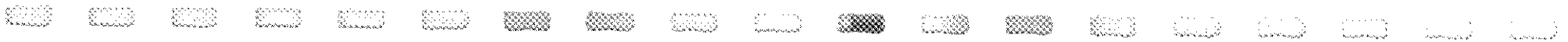

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DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
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HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

July 27, 1992

MEMORANDUM

LOG NO: 5927
DOC NO: 3512c

TO: Harold S. Masumoto, Director, Office of State Planning

ATTENTION: Mary Lou Kobayashi

FROM: for Ross Cordy
Don Hibbard, Administrator
State Historic Preservation Division

SUBJECT: State Land District Boundary Review -- Kailua to Keahole State Lands
Multiple, North Kona, Hawaii
TMK: 7-3-9: 2, 5, 8; 7-3-10: 33

This responds to your memorandum of July 21, 1992. Ross Cordy of our staff has also had discussions on this matter with Mary Lou Kobayashi and Judith Henry of your staff, most recently on July 27, 1992.

The area proposed for re-districting is a large area (2,000 acres). The County General Plan has parts of this area within its Kailua to Keahole plans, with general proposed uses for the area. It is our understanding that OSP is proposing the rezoning to coincide with the County general plans. Thus, this is a general redistricting, not rezoning for specific projects. It is our understanding that specific development plans will be submitted by prospective applicants at later dates, with submittals to the county for permits.

The County planning for this area conducted a background summary of prior archaeological and historical records to document known historic site patterns and likely patterns. No specific archaeological inventory surveys were required, as these would be handled by specific applicants.

We have no objection to the same procedures that the County used being followed by OSP for the redistricting. These are esstentially the requirements you mention.

For the petition, our office would expect to see a detailed background synthesis of prior archaeological, historical and oral historical work and some new historical work (e.g., with Mahele, Grants, and Boundary Commission documentes). This synthesis should indicate likely land use patterns in prehistoric,

early historic and late 1800s times. It should indicate areas which have undergone archaeological survey, noting which surveys were adequate inventory surveys. It should predict site patterns in unsurveyed areas. And it should consult with our office to identify general preservation goals for this northern area of Kona. Our office did such a synthesis for Kalaoa and 'O'oma ahupua'a in 1985, excluding detailed historical and oral historical research (Cordy 1985. Working Paper 1, Hawaii Island Archaeology: Ooma & Kalaoa Ahupua'a, Kekaha, North Kona. Ms. on file, State Historic Preservation Division). Although three additional ahupua'a are involved (Hamanamana, Haleohiu, and Makaula), the prior synthesis could serve as a baseline and be upgraded. (This is essentially your Item 2.)

We would additionally recommend the following conditions be proposed for attachment to any approved petition, to ensure survey and mitigation and a "no adverse effect" to significant historic sites.

1. Each prospective future developer shall have an archaeological inventory survey conducted by a professional archaeologist prior to submitting an application to the County of Hawaii for rezoning. The findings of this survey shall be submitted to the State's Historic Preservation Division in report format for adequacy review. This Division must verify that the survey report is acceptable, must approve significance evaluations, and must approve mitigation commitments for significant historic sites.

2. If significant historic sites are present, then each prospective future developer shall agree to develop and execute a detailed historic preservation mitigation plan -- prior to any ground altering construction in the area. The State's Historic Preservation Division must approve this plan, and that Division must verify in writing to the Land Use Commission that the plan has been successfully executed.

Condition 1 is essentially your Item 1. It needs to be done before submittal of rezoning applications to the County. It particularly will determine if certain sites need preservation, thereby allowing timely planning for such preservation. Condition 2 commits the developer to carry-out the mitigation commitments after the application, as a condition prior to land alteration. It is anticipated that Condition 2 (or one with similar wording) would also be attached as a condition to any approved County permit.

If you have any further questions, please feel free to contact our office. Ross Cordy is our contact person for this project (587-0012).

RC:amk

Report 1275-071493

Archaeological Assessment Study
Kailua to Keahole Region
State Lands
LUC Project

Lands of Makaula, Hale'ohi'u, Hamanamana
Kalaoa 1-4, Kalaoa-'O'oma, and 'O'oma 2
North Kona District, Island of Hawai'i

PHRI **Paul H. Rosendahl, Ph.D., Inc.**
Archaeological • Historical • Cultural Resource Management Studies & Services

Report 1275-071493

Archaeological Assessment Study
Kailua to Keahole Region
State Lands
LUC Project

Lands of Makaula, Hale'ohi'u, Hamanamana Kalaoa 1-4, Kalaoa-'O'oma, and 'O'oma 2 North Kona District, Island of Hawai'i

BY

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JULY 1993

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SUMMARY

At the request of Mr. Scott Ezer of Helber Hastert & Fee, on behalf of their client, the Office of State Planning-State of Hawaii, Paul H. Rosendahl, Ph.D., Inc. (PHRI), recently conducted an archaeological assessment of approximately 2,640 acres of State-owned lands situated inland of Keahole Point, in the North Kona District, on the Island of Hawaii. The basic purpose of the project was to conduct assessment studies sufficient to enable predictions concerning the probable nature and distribution of archaeological resources within the overall project area.

Seven archaeological investigations have been previously conducted within the project area, and these projects identified 32 sites. Formal types identified were cave, modified outcrop, *ahu* (cairn), wall, enclosure, platform, trail, lava tube, pahoehoe excavation, mound and terrace. During the ground survey portion of the current project, 42 sites, including a portion of the northern fringe of the Kona Field System (Site 6601) were identified. The sites comprised the following formal types: alignment, *ahu*, burial, C-shape, cave, enclosure, lava tube, L-shape, overhang, mound, modified outcrop, pahoehoe excavation, pavement, petroglyph, platform, terrace, trail and wall. Functional types tentatively identified were agriculture, habitation, transportation, burial, rock art, quarry, boundary marker, and possible ranching.

During previous investigations in the project area, and during the present project, sites significant for information value and cultural value, as well as sites significant as excellent examples of site types, were identified. Most, if not all, of the sites identified were significant for information value. Sites significant for cultural value comprised trails, burials, rock art (petroglyphs), refuge caves, and miscellaneous historic-period sites. Sites significant as excellent examples of site types included a variety of formal types in excellent structural condition. Such sites included rock art (petroglyphs), unique site complexes, trails, as well as common features such as C-shape wall-shelters, terraces, enclosures, and walls.

The results of archaeological work previously conducted in the project area and the immediate vicinity were reviewed and evaluated in terms of their implications for prehistoric land use patterns. Extensive historic documentary research was conducted, and the results were added to the synthesis of previous work. Current models of settlement and land use patterning in the Kona area were compared and evaluated with respect to this synthesis, with the end result being the creation of a more refined predictive model. This model was then used to predict site type and distribution within the current project area. Comparison of the survey findings with the model's predictions indicate a high correspondence between the predicted distributions and the survey findings. Further work should focus on hypothesis testing, while the data base is being built through additional inventory surveys.

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INTRODUCTION

BACKGROUND

At the request of Mr. Scott Ezer of Helber Hastert & Fee, on behalf of their client, the Office of State Planning - State of Hawaii, Paul H. Rosendahl, Ph.D., Inc. (PHRI) recently conducted an archaeological assessment of approximately 2,640 acres of state-owned lands situated inland of Keahole Point, in the North Kona District on the Island of Hawaii. More specifically, these lands are immediately inland of Queen Kaahumanu Highway and within the Lands of Makaula, Hale'ohi'u, Hamanamana, Kalaoa 1-4, Kalaoa-*'O'oma*, and *'O'oma* 2 (Figure 1). The basic purpose of the project was to conduct assessment studies sufficient to enable predictions concerning the probable nature and distribution of archaeological resources within the project area.

The lands within the current project area were recommended for reclassification to the Urban District during the Five-year Boundary Review. As this represents a general redistricting and not a rezoning for specific projects, only an archaeological assessment rather than an inventory survey is required. Once project-specific development options have been selected on the basis of all preliminary planning considerations, full archaeological inventory survey of specified project areas will be necessary.

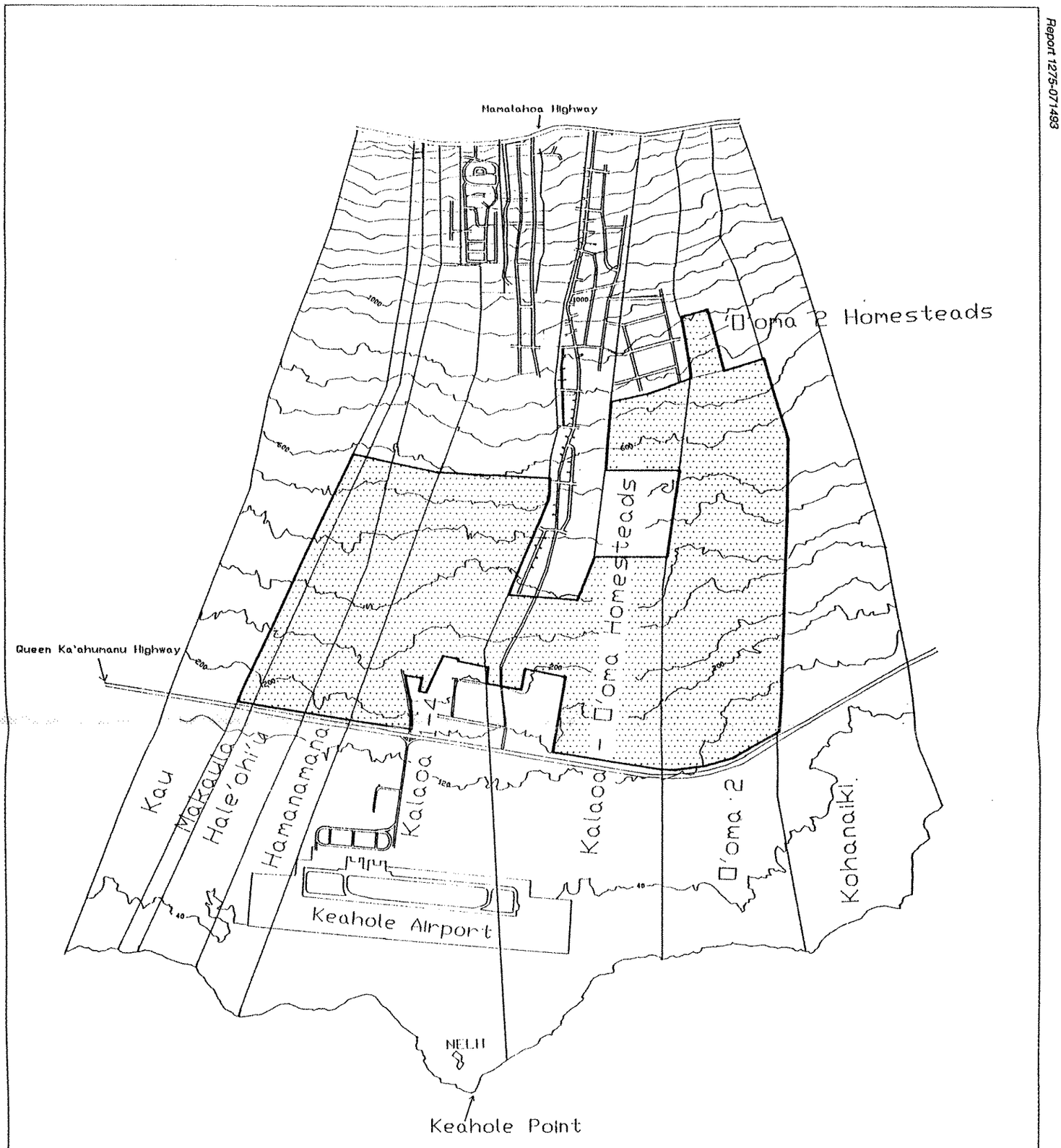
SCOPE OF WORK

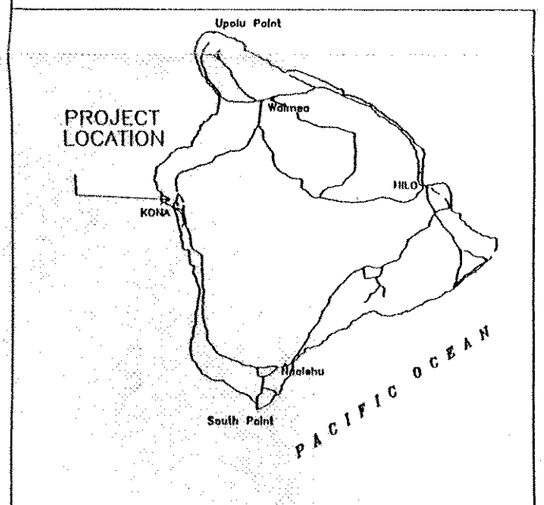
The basic purpose of the current project was to conduct assessment studies sufficient to enable predictions concerning the probable nature and distribution of archaeological resources within the overall project area. An archaeological assessment is extensive rather than intensive in scope. A study of this type permits predictions concerning both the general nature and variety of archaeological remains present, and the probable general distribution and density of such remains. Using the information obtained during such a study, it is possible to discuss the probable significance of the archaeological resources that are present in the project area, and to formulate recommendations and estimates for any subsequent archaeological work that might be necessary or appropriate. Such work would include an archaeological inventory survey as an appropriate second phase.

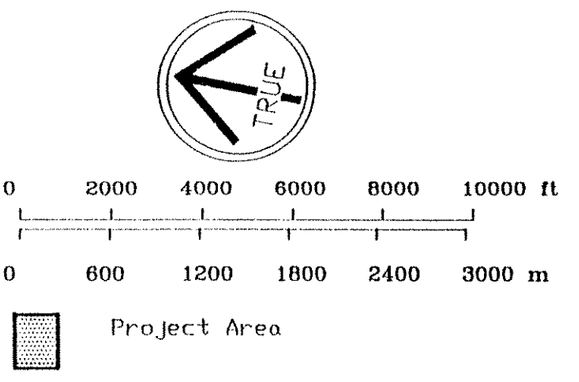
Based on a review of readily available background literature, the familiarity of PHRI with both the general project area and the current requirements of State and County review authorities, and based on discussions with Mr. Scott Ezer of Helber Hastert & Fee, and Dr. Ross Cordy, chief archaeologist in the DLNR-SHPD, the following specific tasks were determined to constitute an adequate and appropriate scope of work for the archaeological assessment:

1. Conduct archaeological background research involving review and evaluation of readily available archaeological reports and records, archaeological and historical literature, historic documents and records, and cartographic sources relevant to the overall project area;









PHRI PAUL H. ROSENDAHL, Ph.D., INC
ARCHAEOLOGICAL • HISTORICAL • CULTURAL
RESOURCE MANAGEMENT STUDIES & SERVICES

Kailua to Keahole Region State Lands
LUC Project Assessment Study
PHRI Project 92-1275

Figure 1.
PROJECT AREA LOCATION

2. Draft a synthesis, including a predictive model of settlement and land use for the project area;

3. Conduct a variable-coverage (i.e., sample coverage), low-level (30-50 ft altitude) helicopter reconnaissance of the project area, with special emphasis on identifying and plotting on aerial photographs and/or maps **(a)** any sites observed (both previously identified and newly identified), **(b)** areas believed likely to contain new (previously unidentified) sites, and **(c)** areas devoid of sites (e.g., relatively recently and/or extensively eroded lands, mechanically altered lands);

4. Conduct a variable-coverage (i.e., sample coverage) surface survey of the project area to identify and plot the locations of previously identified and newly identified sites. Results of the ground surface survey are to be used as a means of testing the predictive model (Item 2, above) of settlement and land utilization;

5. Analyze background and field data, and prepare appropriate reports.

The significance of archaeological remains within the overall project area were to be tentatively assessed in terms of **(a)** the National Register criteria stated in the Code of Federal Regulations (36 CFR Part 60), and **(b)** the criteria for evaluation of traditional cultural values prepared by the national Advisory Council on Historic Preservation. DLNR-SHPD and the HCPD use these criteria to evaluate eligibility for the Hawaii State and National Registers of Historic Places.

The general significance of all archaeological remains identified during the current study were also tentatively assessed in terms of three PHRI Cultural Resource Management (CRM) value modes, which are derived from the above federal evaluation criteria. The value modes are potential scientific research value, interpretive value, and cultural value. Scientific research value refers to the potential of archaeological resources for producing information useful in the understanding of cultural history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

PROJECT AREA DESCRIPTION

The current project area consists of approximately 2,640 acres situated in the Lands of Makaula, Hale'ohi'u, Hamanamana, Kalaoa 1-4, Kalaoa-*'O'oma*, and *'O'oma* 2, North Kona District, Island of Hawaii. The project area extends east from the *mauka* (east) side of Queen Kaahumanu Highway approximately 2.7 miles (4.5 km). The furthest inland point of the project area is approximately 4.8 miles (7.7 km) from the Pacific Ocean. It is bounded on the south by the Land of Kohana-iki and on the north by the Land of Kau. Rainfall in the project area averages from 20 to 30 inches per year (Armstrong 1983). Mean annual temperature for the project area is c. 75 degrees.

The project area rises in elevation from approximately 120 feet above mean sea level (AMSL) to 840 feet AMSL. Lava tube systems dissect the area and are oriented primarily *mauka-makai*. The project area generally conforms to the description of the project area vicinity presented in *Detailed Land Classification, Island of Hawaii* (Baker et al. 1965).

The lower elevations of this land are characterized mainly by almost bare, relatively unweathered aa and pahoehoe flows (lithosols) from Hualalai and Mauna Loa volcanoes. Precipitation is low, and soil material is generally lacking (Baker et al. 1965:5).

There are three classifications of soil/terrain types within the project area (Sato et al. 1973). These soil types include aa lava flows, pahoehoe lava flows and Punaluu extremely rocky peat. These soil types and their distribution are described below.

Aa Lava Flows - Aa lava flows comprise c. 1,100 acres (44%) of the project area. According to Sato et al. "[t]his lava has practically no soil covering and is bare of vegetation, except for mosses, lichens, ferns, and a few small ohia trees...is rough and broken...[i]t is a mass of clinkery, hard glassy, sharp pieces piled in tumbled heaps" (1973:34).

Pahoehoe Lava Flows - Pahoehoe flows comprise c. 875 acres (35%) of the project area. This soil/terrain type consists solely of prehistoric period flows. According to Sato et al., "[t]his lava has a billowy, glassy surface that is relatively smooth...[i]n some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Pahoehoe lava has no soil covering and is typically bare of vegetation except for mosses and lichens. In areas of higher rainfall, however, scattered ohia trees, ohelo berry, and `a`ali`i have gained a foothold in cracks and crevices" (1973:34).

Punaluu Extremely Rocky Peat - This soil/terrain type comprises 525 acres (21%) of the project area. According to Sato et al., "[t]he Punaluu series consists of well-drained, thin organic soils over pahoehoe lava bedrock...[r]ock outcrops occupy 40 to 50 percent of the surface. In a representative profile the surface layer is black peat about 4 inches (0.10 m) thick. It is underlain by pahoehoe lava bedrock" (1973:48).

Vegetation within the project area is predominately introduced grasses, shrubs, and scattered trees. The relatively barren, lower portions of the project area are covered mostly with sparse grass, mainly fountain grass (*Pennisetum setaceum* [Forsk.] Chiov.) and native *pili* grass (*Heteropogon contortus* [L.] Beauv.); and scattered shrubs such as *'ilima* (*Sida fallax* Walp.), *noni* (*Morinda citrifolia*), and *koa-haole* (*Leucaena glauca*). In the upper portions of the project area, vegetation is moderately dense and consists primarily of Christmas-berry (*Schinus terebinthifolius* Raddi), *lama* (*Diospyros ferra* var. *sandwicensis* [A.DC.] Fosb.), *alahe'e* (*Canthium odoratum* [Forst.] Seem.), *laua'e* (*Microsorium scolopendria* [Burm.] Copel.), bitter yam (*Dioscorea bulbifera* [L.]), air plant (*Bryophyllum pinnatum* [Lam.] Kurz), mango (*mangifera indica* L.), purple strawberry guava (*Psidium cattleianum* Sabine), *ki* (*Cordyline terminalis* [L.] Kunth.), and ferns (*Nephrolepis* sp.).

PREVIOUS RESEARCH

PREVIOUS ARCHAEOLOGICAL WORK

Numerous archaeological investigations have been conducted within, and in the immediate vicinity of the current project area. These investigations range in intensity from field checks and reconnaissance surveys to full-scale data recovery (Table 1). The locations of most of these previous investigations are illustrated in Figure 2 (at end). The projects that are not represented in Figure 2 are those that are documented in report form but for which field maps were not included, or those for which the maps that are available are not specific enough to positively identify the locations of the findings. The general findings of each project are summarized below in terms of survey coverage, level of recording, and range of site/feature types identified.

PROJECT AREA STUDIES

Seven archaeological investigations have been conducted within the boundaries of the current project area (Figure 2): Ching (1971), Rosendahl (1973), Davis (1977), Hammatt and Folk (1980), M.L.K. Rosendahl (1989), Walker and Rosendahl (1990a) and Dowden and Graves (1992).

The earliest archaeological work conducted within the current project was an archaeological reconnaissance survey of the Kailua-Kawaihae Road Corridor project area (Ching 1971). The survey area, which measured approximately 2,000 feet wide by 23 miles long, passed through the extreme northwestern portion of the current project area. The survey resulted in the identification of 665 archaeological features including 443 habitation structures, 30 enclosures, nine burials, 27 trails, 115 *ahu*, 18 special purpose features, and 23 features of indeterminate function. Although none of these features were encountered within the current project area, five sites, including two substantial complexes (Complexes A and D) and three trails (600, 603, and 630), were recorded immediately west of the northwest boundary (Figure 2).

Rosendahl (1973) conducted salvage excavations of the sites recorded by Ching (1971) along the Kailua-Kawaihae Road from Anaeho'omalu Bay to Keahole Point. While Rosendahl's study area intersects the west side of the current project area, salvage work conducted during the study affected only the five sites noted above; none of which are located within the current project area. Although no mention is made in the text, the location of these sites, on or near the centerline of the highway corridor, indicates that they were destroyed during road construction.

In 1977, Davis conducted a brief reconnaissance survey in portions of Kalaoa 1-5 and *'O'oma* 1 for the Keahole Agricultural Park. The area of the survey extended from Queen Ka'ahumanu Highway to the 400 ft contour and included a narrow transect in the Kalaoa 4 *ahupua'a* that ended at the 800 ft elevation. Davis' work resulted in the identification of 22 sites with at least 59 component features; the majority of which were associated with habitation and/or agriculture. Unfortunately, Davis limited site descriptions to the habitation

Table 1. Summary of Previous Archaeological Work

PROJECT AREA:

Year	Researcher	Level of Study	Study Area
1971	Ching	Reconnaissance	S. Kohala to N. Kona
1973	Rosendahl	Salvage	Keahole - Anaeho'omalu
1977	Davis	Reconnaissance	Keahole Ag Park
1980	Hammatt and Folk	Excavation/Recon	Keahole Ag Park
1989	Rosendahl, M.L.K.	Inventory Survey	'O'oma II
1990a	Walker and Rosendahl	Inventory Survey	'O'oma II
1992	Dowden and Graves	Inventory Survey	Kalaoa 1-4

GENERAL STUDY AREA:

Year	Researcher	Level of Study	Study Area
n.d.	Reinecke	Reconnaissance	Kailua to N. Kohala
1968-69	Ching, Cluff and Riley	Survey/Salvage	Keahole Point
1971-72	State Inventory Survey	Reconnaissance	Kailua to Kohala
1975	Rosendahl and Kirch	Reconnaissance	Keahole - NELH*
1975	Cordy	Reconnaissance	Kohana-iki
1978	Rodgers-Jourdane	Reconnaissance	Keahole - NELH
1979	Barrera	Reconnaissance	Keahole Airport
1979	Bonk	Reconnaissance	Keahole Airport
1980	Rosendahl	Survey/Excavation	Keahole - NELH
1982	Soehren	Reconnaissance	Kalaoa 4
1984	Clark	Reconnaissance	Keahole - NELH
1985a	Barrera	Reconnaissance	'O'oma II
1985b	Barrera	Reconnaissance	Keahole Point
1985	Cordy	Synthesis	'O'oma & Kalaoa
1985	Rosendahl	Reconnaissance	Kohana-iki
1985	Soehren	Reconnaissance	Kalaoa 4
1986a	Cordy	Field Check	Keahole Point
1986b	Cordy	Field Check	'O'oma II
1987	Donham	Reconnaissance	'O'oma II
1987	Barrera	Reconnaissance	Keahole Airport
1987b	Barrera	Reconnaissance Survey	Keahole Airport
1987	Telea and Rosendahl	Reconnaissance	Kalaoa 4
1987	Cordy	Field Check	Kalaoa 3
1987	Walker and Haun	Reconnaissance	Kalaoa 4
1988	Ching	Reconnaissance	Kalaoa 5
1988	Barrera	Recon. Survey/Salvage Exc.	Kohana-iki and Kaloko
1988	Walker and Haun	Data Recovery	Kalaoa 4
1989	Walker and Rosendahl	Inventory Survey	Kalaoa
1990b	Walker and Rosendahl	Inventory Survey	Kalaoa 4
1990c	Walker and Rosendahl	Inventory Survey	Kalaoa - 'O'oma II
1991	O'Hare and Rosendahl	Inventory Survey	Hamanamana
1992	O'Hare and Goodfellow	Data Recovery	Kohana-iki
1992	Thompson and Goodfellow	Data Recovery	Kalaoa 4
1992	Graves	Sensitivity Study	N. Kona to S. Kona

** Natural Energy Laboratory Hawaii*

features, providing only minimal references to formal types and functions for the remaining features. No sketch maps or photographs of the sites were included in the report, and Sites 6429, 6430, and 6435 were not plotted on his project area map.

The Hammatt and Folk (1980) study, conducted by Archaeological Research Center Hawaii (ARCH) for the Hawaii State Department of Agriculture, consisted of excavations at selected sites within the proposed Keahole Agricultural Park, and a surface reconnaissance survey of c. 370 acres located north of the proposed Keahole Agricultural Park. Twelve sites or site complexes originally identified by Davis (1977) were excavated, and a large amount of portable remains (artifacts, marine shell midden, and ecofactual material) was recovered. Three radiocarbon and 13 volcanic glass samples were collected during the excavations. The radiocarbon samples were submitted to Beta Analytic, Inc., of Miami, Florida, and the volcanic glass samples were submitted to the University of Hawaii archaeology lab (volcanic glass) for age determination. The results indicated an age range of AD 1400-1700 for the radiocarbon samples, and AD 1480-1808 for the volcanic glass samples. During the surface reconnaissance, 18 archaeological sites were identified, including *ahu*, a wall, a circular enclosure, a platform, a trail, and lava tubes. Although these sites were recommended for further archaeological work, site descriptions did not include sketch maps, photographs or a site location map to help assess impacts of future development in this area. None of the sites were given State site numbers.

Margaret Rosendahl conducted an archaeological inventory survey of the Kohana-iki Resort Water Development Project Area - *'O'oma* 2 Water System, situated in *'O'oma* 2 (M.L.K. Rosendahl 1989). During the field work, four sites were identified within the proposed corridor. The sites consisted of both single and multiple features of the following formal types: pits, wall, cave, rockshelter, terraces, and *papamu*. Functional types were ceremonial, quarry, marker, and boundary or agriculture. With the exception of one, all sites appeared to be prehistoric. Site descriptions, accompanied by photographs and/or sketch maps were included in the report, and all sites were located on the project map.

Walker and Rosendahl (1990a) conducted Phase I (Site Identification) of an archaeological inventory survey of the *'O'oma* 2 Water System Development project area, situated in *'O'oma* 2. During the survey, 13 sites containing 27 component features were identified. The principal types of sites and features identified were mounds of varying sizes possibly related to agricultural activities. Several caves (one containing human burial remains), enclosures, cairns, a trail segment, a boulder alignment, and a terrace were also noted. Given that the scope of work called for site identification only, no sketch maps, photographs or descriptive information about the sites were included in the report.

Finally, Dowden and Graves conducted an inventory survey of the 15-acre HELCO Keahole Parcel project area in Kalaoa 1-4 (1992), including a small corner of the parcel previously surveyed by Davis (1977). During the field work, four quarry sites consisting of seven pahoehoe excavations were identified. The sites ranged in physical condition from poor to good. Each of the four sites were recorded in detail. Subsurface testing was not conducted, as there were no cultural deposits within the identified features.

STUDIES IN ADJACENT PARCELS

In order to more accurately assess the archaeological potential of the current project area, a larger, more comprehensive study area was established. This study area encompasses

larger portions of the six *ahupua'a* that make up the current project area, and includes the Land of Kau to the north and the Land of Kohana-iki to the south. Similarly it extends from the coastline east to the Mamalahoa Highway. By examining site distribution throughout the larger study area the interactive nature of settlement patterns and land use systems can be considered.

The earliest recorded field work conducted in the vicinity of the current project area was conducted for the Bernice P. Bishop Museum (BPBM) by John E. Reinecke. Reinecke located major coastal sites in the Districts of North Kona and South Kohala. Despite the fact that Reinecke's site descriptions are very brief and that no site maps were compiled, his data provide a historical perspective on the condition of some sites as they were 62 years ago (Reinecke n.d.:15-16).

Ching, Cluff and Riley conducted a reconnaissance survey and salvage operations along a two-mile extension of the Kailua-Kawaihae Road Corridor, and the area in the vicinity of the Keahole Airport (1968-69). A total of 343 sites were identified and recorded during the survey. Ching, Cluff and Riley divided the sites into two categories—inland and coastal areas. The inland portion, which extended from 800 feet to three miles *mauka* of the coast, contained 117 features. These features include 73 walled enclosures, 11 paved terraces, four platforms, five shelter caves, one petroglyph, seven walls, one filled crack, and 15 *ahu* (cairns). The coastal portion, which extended approximately 800 feet inland from the coast, contained 216 features. These features included 47 stone walled enclosures, 22 shelter caves, three terraces, six paved platforms, 19 walls, 27 water catchments, one well, one wet cave, 29 salt pans, 13 *papamu*, two possible burials, four filled cracks, four hearths, one fire pit, 33 *ahu* and a cluster of petroglyphs. Because a complete copy of Ching, Cluff and Riley's report was not available, however, no site location information was available.

In 1971-72, the Department of Land and Natural Resources (DLNR) began an inventory of known archaeological sites and revisited a number of sites located by Reinecke. State inventory numbers were assigned to seven coastal sites at this time, by B.J. Martin, who completed Hawaii Register of Historic Places (HRHP) forms for them. Sketch maps were compiled, and features were given letter designations at four of these seven sites.

Rosendahl and Kirch conducted an archaeological reconnaissance survey of a parcel of land at Keahole Point in conjunction with the preparation of an Environmental Impact Statement for the Natural Energy Laboratory Hawaii (1975). The survey identified both single-feature sites and multiple-feature complexes. Fourteen localities were identified and include two walled shelters, nine habitation complexes, a cave shelter and enclosure, a cave shelter and cairn, and a platform and enclosure. Of these, eleven were tentatively correlated with sites described by Reinecke (1968-69), and five were determined to have State Site number designations from previous investigations.

Rogers-Jourdane conducted an archaeological reconnaissance survey at the NELH property at Keahole Point (1978). The survey area consisted of approximately 22.5 acres, including three access corridors and two construction areas. The primary purpose of the project was to establish potential impact to previously recorded sites within the area and to locate any previously unrecorded sites within the project area. Eleven sites, including single-feature sites and feature complexes, were identified during the project. These sites included three cairns, two walls, a cave shelter, a lava bubble shelter, a U-shaped enclosure and wall, a cave shelter and cairn, a platform and modified depression, and an enclosure

and wall. Site recordation included short descriptions of the sites, photographs, and a site location map.

Barrera conducted an archaeological reconnaissance survey along the rights-of-way of two proposed emergency service roads at the Keahole Airport (1979). The survey found no archaeological remains within the northern service road right-of-way. The survey of the southern service-road right-of-way resulted in the identification of two sites, a crude habitation shelter and a complex consisting of twelve features. These features were a platform, a habitation shelter, two C-shape shelters, and eight mounds. Short descriptions of the sites and component features were provided, accompanied by sketch maps, photographs and a site location map.

Bonk conducted an archaeological reconnaissance survey at the Keahole Airport in the Land of Kalaoa (1979). At the time of the survey, at least half of the project area had been leveled by bulldozing, with approximately one-seventh of the leveled area occupied by a car rental agency. Due to the extensive disturbance in the area, Bonk reported that there were no archaeological artifacts, structures, or remains in the leveled area. The rest of the project area, unaffected by bulldozing, was not examined in detail as no specific development was planned for it. Subsequent to Bonk's initial survey and recommendations, however, Ms. Pat Beggerly of the State Historic Preservation Office notified Bonk of the presence of a small petroglyph field noted by Ching (1971). Bonk made a sketch map of the petroglyphs, plotted their location on his project area map, and noted that the airport had already established a protective buffer around them.

Rosendahl conducted an intensive archaeological survey and salvage project at the NELH (1980). The survey resulted in the identification of eight sites, containing 59 component features. These sites include four complexes, two overhang shelters and two cairns (*ahu*). Most of the sites and features were found to be in poor to fair condition, and many of the individual features had been previously disturbed or dismantled. Test excavations were conducted within the cave shelter features of two of the complexes. These excavations showed little potential for further data recovery. Site data include detailed maps and descriptions of the identified sites and features, as well as presentation of the excavation findings.

In conjunction with his dissertation project, Cordy (1981) surveyed a strip along the shoreline within the *ahupua'a* of Kohana-iki. In the course of his survey, Cordy designated 12 sites, comprising some 23 component features, and conducted surface collections and limited test excavations. Thirty hydration-rind dates from ten sites yielded an overall age range of AD 1432-1874, with most falling between AD 1505-1730. Based on his findings, Cordy concluded that permanent habitation along the coast of Kohana-iki began in the 1400s AD. Detailed site descriptions, including maps and photographs, are provided for the 12 sites.

During his reconnaissance survey of 6.8 acres (TMK:3-7-3-05:13) at 1,000 ft AMSL in Kalaoa 4, Soehren (1982) recorded two structures, a house platform and a square enclosure, that he interpreted as an agricultural *heiau*. While short site descriptions were provided, no sketch maps or site location maps were included in the reports.

Clark conducted an archaeological reconnaissance survey at the Natural Energy Laboratory Hawaii at Keahole Point, North Kona (1984). The project area was approximately 320 acres and encompassed the coastal portions of the Lands of Hamanamana, Kalaoa 1-4, and Kalaoa-'O'oma. The survey identified 24 archaeological sites, composed of 60 indi-

vidual features. These features include 14 enclosures, two historic house sites, four trails, five *ahu*, two *papamu*, five brackish pools, five cave shelters, nine rock-filled crevices, one petroglyph area, two C-shape shelters, four walls, and numerous rock alignments. Short descriptions of the sites and features are provided in the report, accompanied by sketch maps and a site location map.

Barrera conducted an archaeological reconnaissance survey of c. 450 acres at Keahole Point (1985a). The survey identified 45 sites, including two midden scatters, 15 rock mounds, 15 habitation shelters, one cave, three pahoehoe excavations, six C-shape shelters, one wall, one petroglyph, and a portion of the Mamalahoa Trail. Because DLNR was updating their site numbering system at the time, Barrera assigned temporary site numbers to his findings. Short descriptions of the sites, accompanied by photographs and a site location map, are provided in the report.

Field work was conducted in *'O'oma* II in 1985 by Barrera, who undertook reconnaissance-level survey of the *'O'oma* II Resort project area for Helber, Hastert, Van Horn and Kimura (Barrera 1985b). Due to problems with Barrera's report, and because the survey was not done to inventory level, the client requested a review and field check of work by Dr. Ross Cordy of the Historic Sites Section of DLNR. Cordy returned to *'O'oma* II and examined the northern one-third of the inland section of the survey area, as well as a small section of the northern coastal survey area (Cordy 1986b). Consequently, a field check was conducted in June of 1986. Cordy concluded that Barrera had not adequately identified all large sites within the project area (Cordy 1986b:1). According to Cordy:

> Of the 12 large coastal sites, only 9 were identified in the 1985 survey. (Two unidentified sites were located seaward of the Jeep road in an area which Barrera did not survey.) Of the nine identified sites, only a few of the known features were recorded at 3 sites (D15-1, -3, and -6); and at 2 sites (D15-4, -8), descriptions do not easily compare with the 1975 intensive survey.

In 1985, Cordy compiled an overview study of the *'O'oma* and Kalaoa *ahupua'a* (Cordy 1985). This overview was compiled as a working paper by the Historic Sites Section of the Hawaii Department of Land and Natural Resources for use by researchers and contractors working within the focal area. The paper was designed for use in cultural resource management and contains information on local environment, prior archaeological work, site patterning, chronological data, and an interpretive overview. Cordy also lists specific sites that have high potential for preservation, for interpretive value or for cultural value (religious structures). The settlement pattern model proposed by Cordy as part of this work is discussed in the Settlement Pattern model section below.

Rosendahl conducted an archaeological reconnaissance survey of the c. 470-acre Kohana-iki Development project area (1985). A total of 18 sites and feature complexes were recorded during the survey. Of these, 17 had been previously recorded and one was newly identified. Included were a total of 49 component features, of which 38 were previously recorded and 11 were newly identified (nine at previously recorded sites, and two at the one newly identified site). Formal feature types included walled shelters and enclosures, cave shelters, walls, low stone alignments, pavements, raised stone platforms, surface midden and artifact concentrations, a partially filled sinkhole, and a kerbstone-lined

trail. The report included short descriptions of the sites and a site location map, but did not provide sketch maps, photographs or detailed site descriptions.

In a subsequent survey of another parcel in the Kalaoa 4 *ahupua'a* (TMK:3-7-3-10:33), Soehren (1985) recorded several historic roads and a coastal-inland foot trail. Short site descriptions and a project area map were provided, but no sketch maps or site location information was included in the report.

Cordy conducted a field check in the Natural Energy Laboratory Hawaii area in Kalaoa 5, primarily as a planning tool for the routing of seawater pipelines into the HOST Park area (1986a). Eleven of the 24 sites identified by Clark were examined. Descriptions of their current condition and the potential for impact by construction activities were presented. Site data also included detailed sketch maps of the component features, as well as functional interpretations of the 11 sites.

Donham conducted an archaeological reconnaissance survey and testing program at the *'O'oma* II Resort project area (1987). The program consisted of a high-intensity pedestrian reconnaissance survey of the coastal zone within the project area (shoreline to 300 m inland), and an intensive survey with testing of sites previously identified in the inland portion of the project area. A total of 27 new sites with 130 features were located during the reconnaissance phase, and 54 new features were located at previously recorded sites. These new findings brought the total of archaeological sites located within the project area to 74, with 279 component features. Fifteen permanent habitation complexes were identified within the coastal area of *'O'oma* II. Nine of these sites had been previously tested by Cordy (1981), and temporal as well as functional interpretations of the sites were offered. Other sites included 34 temporary habitation or shelter sites, four footpath segments, five burial sites, two shrines, and a high-walled enclosure. Subsurface testing or controlled surface collection was conducted at ten inland sites during this study. A total of 69 hydration-rind age determinations were obtained for 15 sites within the project area, with calendric ranges from AD 1430-1755. Ranges determined for temporary sites fall within a much narrower span of AD 1550-1755.

Barrera conducted an archaeological reconnaissance survey on two parcels at the Keahole Airport (1987a). Survey Area 1 consisted of 11 acres slated for a ground transportation facility. Survey Area 2 consisted of 40 acres proposed for the expansion of the south ramp. No archaeological sites were identified within Survey Area 1, but in Survey Area 2, two sites were identified, the Mamalahoa Trail and a site complex containing 11 features (10306). These features included four mounds and seven habitation shelters. Short site descriptions, accompanied by sketch maps, photographs and a site location map, were included in the report.

Later in 1987, Barrera conducted a survey of five additional parcels at Keahole Airport as part of the proposed airport expansion project (Barrera 1987b). The five parcels, designated as Survey Areas I-V, comprised the following areas: Survey Area I consisted of approximately 150 acres of undisturbed pahoehoe lava, Survey Area II consisted of approximately 17 acres previously excavated as a borrow pit, Survey Area III consisted of 55 acres previously excavated as a borrow pit, Survey Area IV consisted of 130 acres on top of the 1801 AD lava flow, and Survey Area V consisted of 3 acres on the 1801 AD lava flow. Six sites, including two cave shelters, two pahoehoe excavations, a cairn and a complex comprising a lava tube shelter and a small petroglyph field, were identified in Survey Area I. These sites were assigned habitation and/or indeterminate functions. No sites were

encountered in Survey Areas II, III, IV or V. Site documentation included short site descriptions, photographs and a site location map.

In 1987 PHRI conducted a reconnaissance survey of a parcel (TMK:3-7-3-05:86) in the proposed Kona Palisades Subdivision, in Kalaoa 4 (Telea and Rosendahl 1987). Fourteen features at six sites were identified. A full inventory survey was later conducted in this parcel (Walker and Rosendahl 1990b), and 18 additional features were recorded. Fifteen pits, five platforms, four walls, two caves, three mounds, two terraces, and one C-shape were recorded. They were assigned an agriculture, habitation, or boundary function. One cave and one mound were tested, and midden and indigenous and historic artifacts were recovered. Charcoal recovered from an excavation in one cave and from the surface of another cave yielded radiocarbon age ranges from AD 1552 to 1956. Detailed site descriptions, accompanied by sketch maps, photographs and site location information, were provided for all sites and features.

Cordy (1987) conducted a field check of a parcel in the proposed Kona Coast Subdivision in the Kalaoa 3 *ahupua'a* (TMK:3-7-3-28:5). He recorded one large platform/terrace, which he interpreted as either an agricultural *heiau* or a historic house platform. A short site description, sketch map and site location map were provided to document the site.

Walker and Haun (1987) identified 17 features from four sites during a reconnaissance survey conducted by PHRI on a parcel of land in Kalaoa 4 Ahupua'a (TMK:3-7-3-05:87). These features included two agricultural complexes that were identified by Walker and Haun as part of a northern extension of the Kona Field System. A habitation/burial cave and a historic-period boundary wall were also recorded. Subsequent detailed recording was conducted at the sites and eight test units were excavated at three of the sites (Walker and Haun 1988). A small amount of midden and one bone fishhook were recovered from the test units and four radiocarbon dates ranging from AD 1280 to 1955 were obtained from recovered charcoal.

In 1988, Barrera conducted an intensive survey and salvage excavations in the upland portions of Kohana-iki and Kaloko (Barrera 1988). During his initial survey of this area in 1985 (Barrera 1985c), Barrera found that the Kaloko portion of the project had been subjected to extensive clearing during the 1940-1950s. Survey of this portion resulted in the identification of four sites (not included in Table A-1) in areas of older mango and *kukui* growth. In contrast, Barrera's survey of the largely undisturbed Kohana-iki portion resulted in the identification of 139 sites with 167 component features. These features include abundant mounds, platforms, terraces, enclosures, walls, C-shapes, and walled shelter; as well as the lower portion of the historic period Kohana-iki Homesteads (Site T-59). Site documentation included short descriptions, sketch maps, photographs and site location information; but did not include age or function assessments. In 1988 Barrera returned to the parcel and recorded the sites in detail. Excavations were subsequently conducted at 26 of the sites. Hydration-rind samples recovered from these excavations yielded dates ranging from AD 1465-1742.

Ching conducted an archaeological reconnaissance survey in the Proposed 15 Acre Subdivision, Kalaoa 5 (1988). He did not identify any archaeological sites or portable remains, and based on the negative results, recommended no further archaeological work of any kind for the inland 15 acres (Ching 1988:5). Mr. Ralsten Nagata, Hawaii State Parks Administrator/Deputy State Historic Preservation Officer, reviewed Ching's report and indicated that he would not agree that the report was adequate until more information was

provided and his staff could conduct a field check of the area. Further work in this parcel remains to be completed.

Walker and Rosendahl conducted an archaeological inventory survey in the c. 140 acre Pu'uhonua Subdivision Development Parcel, located in Kalaoa 5 (1989), which partially overlapped Ching's (1988) project area. The survey resulted in the identification of 34 previously unrecorded sites. These sites included both single- and multiple-feature components. Formal feature types included terraces, cave/lava tubes, walls, platforms, mounds, C-shapes, cairns, pahoehoe excavations, pits and a pit complex, alignments, enclosures, overhangs, trails, a retaining wall, a pavement, and a modified outcrop. Functional types identified were boundary, habitation, agriculture, refuge, burial, possible burial, water catchment, rock art, transportation, marker, quarry and features of indeterminate function. Detailed site descriptions, accompanied by sketch maps, photographs and site location information, were presented for each site.

Walker and Rosendahl conducted an archaeological inventory survey of an adjacent parcel for the Kona Palisades Development project (Walker and Rosendahl 1990c). During the survey, seven sites containing 12 component features were identified within or immediately adjacent to the project area. One site (Site 11271) had been previously identified by Walker and Haun (1988). Six new sites were identified. Formal feature types identified among the 12 features include terrace, cave, wall, platform, mound and water trough. Functional types include agriculture, habitation, boundary, refuge, and animal husbandry. Again, detailed site descriptions, accompanied by sketch maps, photographs and site location information, were presented for each site.

O'Hare and Rosendahl conducted survey and testing in the Kalaoa View Estates Development Project, and identified seven sites consisting of 31 features (1991). The 31 features comprised the following formal types: terrace, rock mound, cairn, C-shape, platform, enclosure, lava blister and complex. The functional categories consisted of habitation, agriculture, boundary, trash pit and indeterminate. Site documentation included detailed descriptions, sketch maps and site location information. One temporary habitation feature, a C-shape, was dated to AD 1280-1430 and the other prehistoric temporary habitation, a modified lava blister, was dated to AD 1630-1890. The prehistoric permanent habitation feature, a platform, was dated to AD 1500-1680.

O'Hare and Goodfellow conducted data recovery field work for the 470-acre Kohana-iki Resort project area, located in Kohana-iki (1992). The field work consisted of detailed recording of 31 sites (224 features) that had been previously recorded in the project area and seven sites that were newly recorded during data recovery. The 38 sites consisted of 11 permanent habitation sites, 11 temporary habitation sites, five ceremonial sites, one boundary marker site, one transportation site, two aquiculture sites, two agriculture sites, and three sites with indeterminate functions. The features at the sites included 28 platforms, 15 terraces, 12 pavements, 16 enclosures, 17 walls, four alignments, three trails, 31 cairns, five rock mounds, 21 cave shelters, ten overhang shelters, nine walled overhangs, 17 walled depressions, 13 filled depressions, three quarries, one cupboard and 11 petroglyphs. The data recovery also included subsurface testing of 40 features at 21 sites. One-hundred nine excavation units were placed at various features, including 19 cave/rock shelters, 11 platforms, three terraces, three filled depressions, two enclosures, and two pavements. Indigenous and historic artifacts and midden were recovered from the excavation units. The units also yielded 26 radiocarbon samples (recovered from 15 features at 14 sites). The samples yielded age ranges spanning AD 1020-1950.

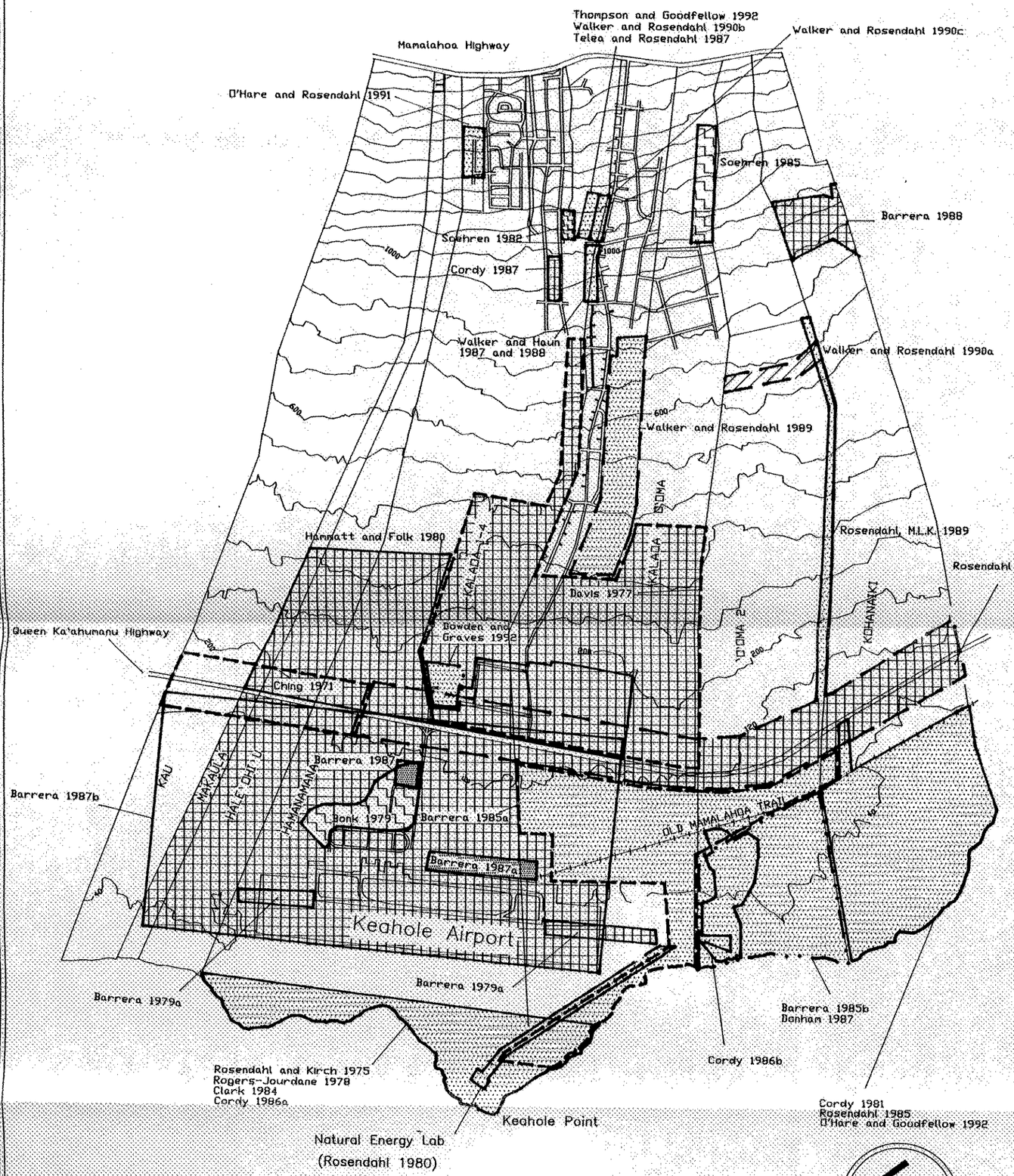
Data recovery was conducted in the proposed Kona Palisades Subdivision, Kalaoa 4 in 1991 (Thompson and Goodfellow 1992). No additional features were recorded, but detailed recording took place at four of the sites previously identified by Walker and Rosendahl (1990b). Twenty-five test units were excavated in 14 features and in two areas near features. Midden was recovered from seven of the features, indigenous artifacts were recovered from seven features, and historic artifacts from six. Eleven radiocarbon dates for seven features of the four sites were obtained (Thompson and Goodfellow 1992). These dates ranged from AD 1460 to 1955 for two temporary habitation cave shelters, from AD 1450 to 1950 for four permanent habitation platforms, and AD 1410 to 1520 for one agricultural terrace. The sites and features were interpreted to be a northern extension of the Kona Field System.

Graves, Thompson and Rosendahl conducted an archaeological sensitivity study associated with the planning and construction of two new 138kV transmission lines, located north of Kailua-Kona, in the Districts of North and South Kona, and South Kohala (Graves 1992). The objectives of the study were to map areas of archaeological sensitivity, based on site densities, and to identify possible broad corridors for the proposed transmission lines (corridors that would avoid all sites or affect the fewest numbers of sites). Based on a review of all reports concerning projects conducted within the study area, a map reflecting areas of archaeological sensitivity was generated, to be used as a guideline for subsequent development.

DISCUSSION

Background research indicates that 41 previous archaeological investigations, ranging in scope from "walk-throughs" to intensive surveys and data recovery projects, have been conducted within the study area. Together, these investigations have yielded data on 445 sites with 1,085 component features (Appendix A); providing an important database for the study of prehistoric land use patterns throughout the *ahupua'a* of Kau, Makaaula, Hale'ohi'u, Hamanamana, Kalaoa 1-5, *'O'oma* 1 and 2, and Kohana'iki. Despite the wealth of information represented by this database, it should be emphasized that there are wide variations in the thoroughness of survey coverage and site recording methods provided by each investigation (Figure 3). With the exception of the coastal areas and a few small parcels in the intermediate and upland zones, few of the parcels have been systematically surveyed; a fact which makes the data obtained from them difficult to quantify. Until such time that the gaps in the survey records for these parcels are filled, predictions of site density or distribution within the study area will be necessarily qualitative in nature.

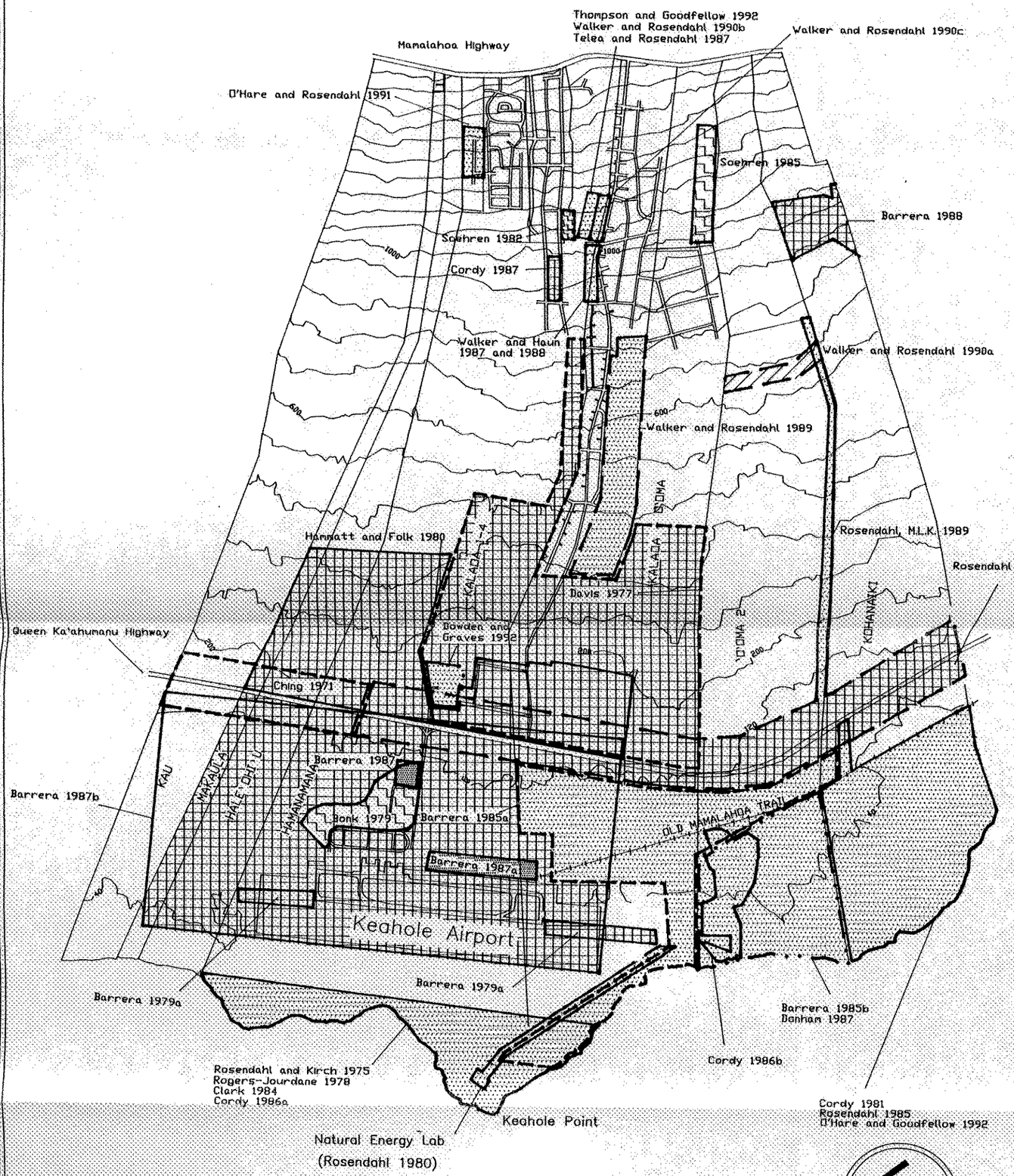
Initial examination of the distribution patterns depicted in Figure 2 (at end) indicates that most of the archaeological sites recorded to date are close to the coast, between the 0-40 foot contours. Although the greater apparent concentration of sites near the coast may be a function of sampling bias (10 of the 39 projects were conducted in this area), the availability of the rich marine resources and the ruggedness of the surrounding terrain would have provided ample incentive for coastal occupation. Site density drops off above the 40 foot contour, but this area was still moderately occupied and was no doubt associated with the adjacent coastal strip. Functional site-types identified in the immediate coastal zone generally consist of habitation (both temporary and permanent), quarry, transportation, burial or shrine, rock art, and marker. Formal site types include complex, cave, *ahu* (cairn), enclosure, footpath and trail, midden scatter, modified outcrop, overhang,



LEGEND

- Sites located, mapped and recorded to current standards
- Sites located; need additional mapping and recording
- Not all sites located; need additional mapping and recording
- No systemetic survey undertaken; should be resurveyed

PHRI PAUL H. ROSENDAHL, Ph.D., INC. ARCHAEOLOGICAL * HISTORICAL * CULTURAL RESOURCE MANAGEMENT STUDIES & SERVICES	Archaeological Assessment Study Kailua to Keahole Region State Lands LUC Project PHRI Project 92-1275	Figure 3. Levels of Project Area Surveys



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Station "Ka-hou-hale" (The [one who] thrust through the house)
Kama's old goat pen is northwest of this station, and a new cattle pen is to the southwest. The station is said to be on the boundary of Kalaoa 4 & 5 (pages 131-132).

Station "Nēnē" (a Hawaiian goose)
The station is marked by a hole drilled in a large boulder which is said to be on the boundary between Hāmanamana and Hale'ohi'u (pages 133-134).

Agriculture and Ranching: Evolving Land Use in the Historic Period

The following is an overview of the evolution of land use in the project area (text quoted from Kalima's original historical research for this project):

> Agriculture has changed drastically in the Kona area, as it has throughout the Hawaiian chain, with the introduction of foreign plants and animals. Handy tells us that in the Kona area, where the rain for taro planting is seasonal, dry taro was planted in individual holes filled with mulch. Clearing the upland forest for this type of planting was termed *umoki* (Handy 1940:47-48). Handy records a detailed account of these planting methods, by Kepelino, a native of Kona (ibid:48). In 1794, Captain Vancouver introduced goats and cattle to the Kona area, and after an initial 10-year *kapu*, they were for many years the mainstay of industry.
>
> The 1850s saw the development of large-scale commercial ranching and agriculture, after the Mahele and after an 1850 law permitting foreigners to own land. Coffee, grazing-land, and for a time, sugar cane, gradually replaced traditional subsistence crops such as taro and *uala*. Chinese and Hawaiian labor was utilized on coffee plantations, located in the fertile belt above the 800 ft elevation. At elevations of 500 to 3,000 ft tobacco was grown commercially, from this time until about 1930 (Schilt 1984:24).
>
> In the 1890s rising prices produced a boom in coffee-growing in North Kona. Contributing to the boom were the introduction of the ladybird beetle, from Australia, to combat white scale, and the opening of former Crown lands for leasing under the Provisional Government (1894). Although coffee prices fell in the late 1890s and sugar cane plantations expanded with U.S. annexation in 1898, coffee-growing persisted in Kona because coffee could be grown on land that was too rocky for sugar cane (Schilt 1984:25).

In 1980, Larry Kimura, Hawaiian language instructor at the University of Hawai'i interviewed Margaret Spinney, a native resident of Kalaoa. Excerpts of that interview are included here because they tell us something of the nature of the community earlier this century, c. 1920s. Mrs. Spinney comments:

> There was only a footpath....Of course in those days the land was clear. There was not all of these bushes and plants that you see now covering the landscape. The vegetation was so low, very low; you could see all the way down to Kailua. Now, when you look, you can't see Kailua; its all blocked with this dense growth of vegetation.

> My mother...planted several acres with lau hala. This would be the *lau hala kokala'ole.* ...And so when the lau hala trees grew to maturity, she had a lot of lau hala to use for her own weaving. Most of the people of Kalaoa would go to these fields that my mother planted to get their *lau hala* to use.

In response to a question about the ethnic make-up of the community at the time of her childhood, Mrs. Spinney stated:

> They were Hawaiian people. Later, Japanese came and lived together with the Hawaiians that were living here.

During this project, PHRI Historical Researcher Lehua Kalima conducted an interview (October 14, 1991) with a Hawaiian resident of Kalaoa, a Mr. Karin Haleamau. Kalima summarizes his recollections here:

> Mr. Haleamau's grandmother was raised in this area, and when he was a young boy, he worked in the fields near the project area. He recalled that the project area vicinity was farm land, even before the time of his birth, and it was once cultivated in taro. He also remembered coffee and avocados being grown there. Mr. Haleamau reported that clearing in the area was done by hand, in order to preserve the soil. When this was done, the rocks that were cleared away were piled into neat mounds, which may account for the numerous rock piles still present. Mr. Haleamau knew of no burials or graves in the area.

In Summary

This report presents an overview of history, settlement, and land use in the Kekaha region of Kona 'akau. Settlement starts with Hawaiian occupation (legendary sources as those above, note that the region was well populated by c. 1200) when the small protected bays and shoreline were settled. Initially, planting would have occurred in and around the coastal communities, and as the population grew and the political and religious systems became more formalized, the communities spread out. The *ko kula kai-ko kula uka* (coastal and upland plains) in the low forested zone were planted with important staple and supplemental crops which were less water dependent than the *kalo wai* (wet taro), which was the staple of the *ko'olau* (windward) side of the island. *Pu'epu'e* (planting in built-up mounds), *mākālua* and *'umoki* (planting in dugout-mulched holes) are three methods of planting techniques which are recorded as having been extensively used in Kona.

Crops such as sweet potatoes, sugar cane, bananas, yams, breadfruit, gourds, and coconuts etc., provided the "bread" of the Hawaiian diet. On the upper slopes, agricultural practices would have included propagation and harvesting of the endemic *olonā* (*Touchardia latifolia*) for cordage, and *'awa* (*Piper methysticum*) for ceremonial and domestic use, and the collecting of various woods and resources from the upland forests (woods were used for spears, basketry, paddles, canoes, and tools, etc.)

Fishing in this region was considered some of the best on Hawai'i, and it is likely that a great deal of energy went into harvesting of other ocean resources. Though farmers gathered some ocean resources, and fishermen grew some food plants, it is generally accepted that the fishermen primarily provided fish and other ocean resources to the planters who in turn supplied the fisherman with their agricultural products.

Legendary descriptions of this region depict viable communities and describe the various resources on which they depended for their survival. The legendary picture is so different from the way things are now that one must ask, what has so completely changed the face of Kekaha? The answer appears two-fold: (a) the active volcanism of Hualālai and (b) changes in land-use practices over the last 150 years. Around the time of Western contact, Hualālai reclaimed much of the land used for settlements, agriculture, and fishponds. The lava flows, along with subsequent ranching, has significantly modified the prehistoric landscape.

Following unification of the islands under the rule of Kamehameha I, large portions of land were given to *ali'i* who had supported the chief and remained loyal to his descendants. Associated with these loyal chiefs were the *maka'āinana* or people of the land. Following the Māhele of 1848, the lands were further divided between Kamehameha's descendants; additionally, small parcels of land were also given to natives who had lived upon, and worked the land. During this period, the Hawaiian population was in decline and by the mid 1800s, foreign land use in the forms of upland ranching, and cultivation of coffee and other crops, was being developed along with other Western business interests. Subsequent ranching stripped the mountain slopes of even more forest, and as the forest disappeared, water catchment became unreliable. The famed water caves dried up, and the remaining *ki'owai* (fresh water sources) on the shore became more brackish. As the water resources dried up and Western land use practices replaced traditional methods, Hawaiian communities gradually disappeared.

By the late 1800s and through the early 1900s, immigrant populations were on the rise and often the immigrants outnumbered the native Hawaiians. There is little documentation on occurrences in Kekaha at the time, and in general, by the 1920s and 1930s many of the native tenants were gone, and few buildings were present. The following is a further summary of settlement and land use in the project area. The summary is by Kalima, and is quoted from her original historical research for this project.

> The Kalaoa area has been arid and hot as least since the time of the first Western visitors. In most of the Kekaha lands, the population was concentrated on the coast, and most fields were in the upland forest. Trails (with associated shelters) connected the two areas (Cordy 1985:5). Cordy dates the beginning of permanent settlement in Ooma 2 to the years 1400-1450 (1985:37-38). The 1801 lava flow wiped out the coastal settlements in Kalaoa. Schmitt cites the population decrease between 1778 and 1819 as 52%, from 300,000 to 145,000 (Schmitt 1977:25).
>
> Cordy also sums up the various conflicting views concerning the population in the general vicinity of the project area. Cordy indicates that Reinecke (n.d.) thought there was once a population in the hundreds, and that the scarcity of remains was the result of destruction by man, cattle, and storms, or else any remains left were in sandy areas and were not discernible or were a short distance inland. Ching (1971) agrees, citing legends suggesting [a] large population for the lands above the study area (North Kona). He believes the trails in the Kalaoa area pointed to inland permanent settlement there. He also argues that fishponds and fishing grounds, and the large number of archaeological sites, refuge caves, and holua slides in the North Kona area suggest that Kalaoa was a productive land of great value (ibid.). Cordy emphasizes the harsh environmental setting and argues that the population was always low, containing only small villages of fishermen. Thus he feels that the number of sites is not unusual for 400 years of occupation. Cordy used counts of permanent house sites to create population estimates (Cordy 1987:244-5) that suggested that the population of *'O'oma* 1 and 2 and Kalaoa 4

and 5 together was never more than 102 people, and was at a maximum between c. 1750 and 1780.

According to Schmitt (1977:13), the population of North Kona declined to 1,753 in 1890 and then increased to 3,819 in 1900. By 1866 most of the land flanking the Mamalahoa Highway had been sold (Soehren 1985). All the early grants had frontage on the "alaloa mauka" or upper belt road, now known as the Mamalahoa Highway, which lies at about the 1,700-ft elevation. Another road, at about the 1100-ft elevation, Alanui Kauila, served the lower ends of these grants (ibid.). Soehren notes that these arterial roads connected the upland farm lots of the various ahupua`a with one another, with the port and urban center at Kailua and with the rest of the island (ibid.). Portions of the Alanui Kauila are now part of Kauila Street in Kona Coast View subdivision, while Ahiahi Street in Kona Palisades follows approximately the route of Alanui Kama, a lower branch of Alanui Kauila (ibid.).

Communication between different elevations within the ahupua'a was provided by *mauka-makai* trails such as the Alanui Kauhini (probably Ka-uhini, grasshopper [ibid.]). One of the trails in Kalaoa mentioned by Ching (1971) could very well be the Alanui Kauhini. It is a trail that runs mauka-makai. It is shown on Map No. 6 by J.S. Emerson, dated January 1889, Homestead lots, Akahipuu Section, N. Kona, Hawaii, and was in existence before the government subdivided the Kalaoa lands and began selling lots in 1852 (Soehren 1985). A portion of the trail is shown well above the Mamalahoa Highway, but much of it has been omitted from the 1889 map (ibid.). In the report on their survey of Kalaoa 4, Telea and Rosendahl (1987) state that the trail was once used for the transportation of people and produce between the upland agricultural zone and the coastal habitation zone.

Shortly after World War II, a jeep trail was bulldozed from Mamalahoa Highway to the shore near Keahole Point (Soehren 1985). The upper portion of this road followed the Alanui Kauhini, past private farm lands to the state land below (ibid.). Over the years the trail was maintained by periodic bulldozing until the Queen Ka'ahumanu Highway provided easier access to the shore (ibid.).

Today the upper forest zone of the Kalaoa area is well-populated, with the Kona Palisades Subdivision occupying much of the area. The intermediate zone is slowly being developed as part of the industrial and residential areas expanding out of Kailua. No permanent human habitation was ever reestablished on the coast after the 1801 lava flow inundated much of the area. The coastal area is now home to the Keahole Airport and OTEC, the Natural Energy Laboratory of Hawaii. OTEC uses the temperature difference between the warm water of the ocean surface and cold water from the depths to generate electricity, which may provide an alternative energy source for the rapidly increasing Kona population (Clark 1985:115).

Reminiscences of a Kekaha Native Son

While modern researchers have varying opinions on the nature and conditions of life of the people who once called Kekaha-wai-'ole "home," their interpretations are based upon cursory observations. Today, one can see only a shadow of what once was. The most authoritative voices on the history of this region are those of the *hoa'āina* (native tenants of the land), who watched their home change, and saw the demise of their way of life. The

> Kaloko is like that place mentioned above, it is a land without people at this time. The men, women, and children have all passed away. The only one who remains is J.W. Ha'au, he is the only native descendant upon the land.
>
> At Kohanaiki, there were many people on this land between 1870 and 1878. These were happy years with the families there. In those years Kaiakoili was the *haku* 'āina (land overseer)... Now the land is desolate, there are no people, the houses are quiet. Only the houses remain standing, places simply to be counted. I dwelt here with the families of these homes. Indeed it was here that I dwelt with my *kahu hānai* (guardian), the one who raised me. All these families were closely related to me by blood, while on my fathers' side, I was tied to the families of Kaloko. I am a native of these lands.
>
> The lands of *'O'oma*, and Kalaoa, and all the way to Kaulana and Mahai'ula were also places of many people in those days, but today there are no people. At Mahai'ula is where the great fishermen of that day dwelt. Among the fishermen were Pu'ukō'ai, Pā'ao'ao senior, Ka'ao, Kai'a, Ka'ā'īkaula, Pāhia, and John Ka'elemakule Sr., who now dwells at Kailua.
>
> Ka'elemakule moved from this place [Mahai'ula] to Kailua where he prospered, but his family is buried along these beloved shores. He is the only one who remains alive today... (Kihe:6/12/1924)

Kihe attributes the great decline of the Hawaiian way of life to two facts: (a) by the turn of the century, Hawaiian children had to go to schools at which only English was spoken, thus there was a breakdown of communication between the elders, parents, and children; and (b) the increased rate of Hawaiian marriages to people of other nationalities.

SYNTHESIS AND MODELS

Chronological Framework

The establishment of a chronological framework was a primary goal for the current project, as such a framework provides a context in which to view general settlement patterns. The chronological framework presented below is based on dating results derived from Rosendahl (1980), Hammatt and Folk (1980), Cordy (1981, 1985, 1986a, 1986b), Donham (1987), Walker and Haun (1988), Walker and Rosendahl (1989, 1990b, 1990c), O'Hare and Rosendahl (1991), O'Hare and Goodfellow (1992), and Thompson and Goodfellow (1992) (Table 2). Correlation of these results with important cultural developments follows the chronologies for South Kohala-North Kona area presented in Donham (1987:142-145) and Jensen (1989, 1990). Those chronologies include data collected by Cordy (1981, 1985, 1986), Hommon (1976), and Kirch (1980, 1985).

Initial occupation of West Hawaii appears to have occurred between AD 600-800, with occupation being restricted to the southern end of South Kohala around Anaehoomalu Bay. Jensen characterized the early occupation of this area as follows:

> For the earlier time periods, it is possible to envision sporadic exploitation of the coastal and upland resources of West Hawaii by small groups who resided elsewhere during most of the year, probably along the windward coast.

Table 2. Summary of Dating Results for Study Area

Site/Feat.	Formal Type	Function	Dating Results (AD)
Kau	**no dating results available**		
Makaula	**no dating results available**		
Hale'oh"u	**no dating results available**		
Hamanamana			
16097 B	Lava Blister	Agric./ Habitation	1800-1940 (C14)
16099 A	Enclosure	Agric./ Habitation	1667-1896 (C14)
16099 B	C-shape	Agric./ Habitation	1280-1430 (C14)
16100 B	Lava Blister	Agric./ Habitation	1630-1890 (C14)
16101	Platform	Agriculture	1470-1680 (C14)
16102 C	Platform	Agric./ Habitation	1500-1680 (C14)
Kalaoa 1-4			
——	Lighthouse		1906
5601	Walled Shelter	Temporary Habitation	1610-1730 (VG)
10194 (DI6-5)	Enclosure	Permanent Habitation	1720-1860 (VG)
10195 (DI6-6)	Complex	Permanent Habitation	1680-1760 (VG)
10196 (DI6-7)	Enclosure	Permanent Habitation	Historic
10197 (D16-8)	House Found.	Permanent Habitation	Historic
10198 (D16-9)	Complex	Permanent Habitation	Historic
10199 (DI6-10)	Enclosure	Animal Pen?	Historic
10200 (DI6-11)	Enclosure	Permanent Habitation	Historic
10963 B	Terrace	Habitation/Ceremonial	1430-1660 (C14)
10963 C	Leveled Area	Habitation/Ceremonial	1440-1670 (C14)
10985 A	Terrace/Mound	Agriculture	1280-1400 (C14)
10985 C	Mound	Agriculture	1650-1955 (C14)
14135	Cave	Temporary Habitation	1460-1894 (C14)
14136 A	Cave	Permanent Habitation	1660-1955 (C14)
14136 B	Stepped Platform	Permanent Habitation	1650-1950 (C14)
14137	Complex	Permanent Habitation	1650-1950 (C14)
14137 B	Stepped Platform	Permanent Habitation	1790-1950 (C14)
14137 C	Platform	Permanent Habitation	1790-1950 (C14)
14137 E	Platform	Permanent Habitation	1450-1890 (C14)
14140 C	Cave	Temporary Habitation	1640-1955 (C14)
14140 D	Cave	Temporary Habitation	1476-1700 (C14)
14665 B	Terrace	Agriculture	1410-1520 (C14)
Kalaoa-*'O'oma*			
262	Cave-Sink	Temporary Habitation	1330-1610 (C14)
1917 A	Enclosure	Habitation	1590-1690 (VG)
1917 8	Cave	Habitation	1540-1670 (VG)
1918 (D15-09)	Walled Shelter	Permanent Habitation	Historic
1919 (D15-10)	Walled Shelter	Permanent Habitation	1730-1870
1920 (D15-11)	Complex	Permanent Habitation	1510-1890 (VG)
5602	Complex	Temporary Habitation	1600-1670 (VG)
5751 F	Cave	Temporary Habitation	1620-1955 (C14)
6753	Cave	Temporary Habitation	1620-1955 (C14)
5757 B	Terrace	Habitation	1660-195S (C14)
5764 A	Cave	Habitation	1640-1955 (C14)
6417 (D15-74)	Complex	Permanent Habitation	Historic
6418 (D15-73)	Cave	Temporary Habitation	1470-1850 (VG)
6421 (D15-69)	Cave	Temporary Habitation	1600-1840 (C14)
6432 (D15-87)	Wall	Boundary	Historic
10205 (D15-12)	Complex	Permanent Habitation	1570-1860 (VG)
10207 (D15-14)	Complex	Permanent Habitation	1570-1860 (VG)
10208 (D15-15)	Complex	Permanent Habitation	1600-1790 (VG)
10227 (D15-94)	Enclosure	Permanent Habitation	1900s

Table 2. (cont.)

Site/Feat.	Formal Type	Function	Dating Results (AD)
'O'oma 2			
(D15-06)	Complex	Permanent Habitation	1540-1650 (VG)
1910 (015-01)	Complex	Permanent Habitation	1490-1830 (VG)
1910 (016-02)	Complex	Permanent Habitation	1550-1660 (VG)
1911 (015-16)	Enclosure	Animal Pen	Historic
1912 (D15-03)	Complex	Permanent Habitation	1560-1760 (VG)
1914 (D1S-04)	Complex	Permanent Habitation	1750-1820 (VG)
1914 (D15-05)	Complex	Permanent Habitation	1430-1720 (VG)
1914 (D15-08)	Complex	Permanent Habitation	1480-1860 (VG)
1015 (D16-19)	Complex	Ceremonial/Perm. Hab	1590-1720 (VG)
1916 (D15-07)	Complex	Permanent Habitation	1490-1780 (VG)
14135	Cave	Temporary Habitation	1630-1950 (C14)
14136 A	Cave	Permanent Habitation	1660-1955 (C14)
18764	Complex	Temporary Habitation	1662-1754 (VG)
18765	Mod. Overhang	Temporary Habitation	1713-1749 (VG)
18777	Complex	Habitation	1664-1756 (VG)
18777 A	Walled Sink	Habitation/Agric.	1526-1766 (VG)
16787	Cave	Temporary Habitation	1640-1746 (VG)
18799	Complex	Temporary Habitation	1573-1675 (VG)
18811 B	U-shape Wall	Temporary Habitation	1648-1713 (VG)
Kohana-iki			
1905 (D14-06)	Complex	Permanent Hab/Cerem.	1565-1700 (VG)
1905 E	Platform	Permanent Hab/Cerem.	1440-l70O (C14)
1906 (D14-07)	Complex	Permanent Habitation	1600-1740 (VG)
1907 (D14-11)	Complex	Permanent Hab/Cerem.	1460-1710 (VG)
10693 D		N/A	1502-1665 (VG)
10698		N/A	1643-1669 (VG)
10700		N/A	1491-1678 (VG)
10702		N/A	1607-1639 (VG)
10730		N/A	1618-1642 (VG)
10734 H		N/A	1468-1667 (VG)
10734 K		N/A	1468-1496 (VG)
10736		N/A	1465-1628 (VG)
10740		N/A	1698-1742 (VG)
14566 V	Cave Shelter	Permanent Habitation	1800-1940 (C14)
14570 A	Cave Shelter	Temporary Habitation	1470-1950 (C14)
14571 A	Cave Shelter	Temporary Habitation	1290-1440 (C14) 1410-1670 (C14)
14574 A	Cave Shelter	Temporary Hab/Cerem.	1180-1420 (C14) 1440-1950 (C14)
14583 (D14-05)	Complex	Permanent Habitation	1580-1700 (VG)
14583 D	Walled Depression	Permanent Habitation	1390-1660 (C14)
14584 B	Cave Shelter	Temporary Hab/Cerem.	1370-1530 (C14)
14587 B	Overhang Shelter	Temporary Hab/Cerem.	1440-1890 (C14)
14599 A	Overhang Shelter	Temporary Habitation	1410-1690 (C14)
14611 B	Pavement	Temporary Habitation	1260-1640 (C14)
14620 A	Overhang Shelter	Temporary Habitation	1650-1950 (C14)
14620 B	Overhang Shelter	Temporary Habitation	1410-1670 (C14)
14627 B	Enclosure	Permanent Hab/Cerem.	1390-1650 (C14)
14629 (D14-02)	Complex	Permanent Hab/Cerem.	1500-1600 (VG)
14629 (D14-04)	Complex	Permanent Hab/Cerem.	1610-1700 (VG)
14629 D	Terrace	Permanent Hab/Cerem.	1390-1660 (C14) 1790-1950 (C14)
14630 (D14-09)	Complex	Permanent Habitation	1440-1660 (VG)
14630 A	Platform	Permanent Habitation	1020-l520 (C14) 1440-1660 (C14) 1640-1950 (C14)
14631 (D14-10)	Complex	Permanent Habitation	1575-1830 (VG)
14532 (D14-12)	Complex	Permanent Habitation	1455-1720 (VG)

Shortly after this period of initial occupation, beginning perhaps as early as AD 900 in some areas, population Increases In the more favorable windward zones led to more frequent exploitation of agriculturally marginal lands in West Hawaii (Barrera 1971, Kirch 1985). Areas in the northern end of North Kona and the southern end of South Kohala appear to have been utilized first, followed by more general exploitation of West Hawaii lands by AD 1000. Increased use of these areas was generally marked by the establishment of small, relatively isolated pockets of semi-permanent to permanent occupations at certain favorable coastal locations. Population size throughout this period of expansion (AD 900-1200) into West Hawaii appears to have been relatively low (Kirch 1985). Evidence for occupation of the current study area is provided by the AD 1020 date for initial occupation of Kohana-iki, and the AD 1260-1430 dates for initial occupation of 'O'oma, Kalaoa and Hamanamana.

According to Kirch, population size remained fairly stable until AD 1200, at which time a pronounced increase began to occur (Kirch 1985:288). Data from the Kekaha region suggests, however, that dispersion of the population would have been restricted by the barren conditions and lack of fresh water which characterize much of the region; such that population growth would have been limited to coastal areas such as Anaehoomalu, Kiholo, Kaupulehu and Kukio (Jensen 1989). Evidence from the current study area supports this hypothesis; although a few sites in the study area date to this period, there is insufficient evidence to support a population increase prior to AD 1400 in this portion of North Kona. Coastal resources continued to be exploited sporadically by non-resident populations, while habitation sites appear to have been selected based on proximity to available water and established coastal residential areas.

Cordy's work suggests that as the population increased in certain parts of North Kona, substantial uninhabited zones remained between established residential areas (Cordy 1981:173). These zones may have served as a means of delimiting specific resource catchment zones along the coast, as well as to provide room for further growth. Initial settlement of these zones, including several areas of previously unoccupied coastline, seems to have occurred by AD 1400 throughout the study area (Cordy 1981:168, Donham 1987, Jensen 1989), and was accompanied by increased use of temporary features throughout the region. Kirch argues that these expansions were representative of large-scale population growth occurring throughout West Hawaii and posits that the population nearly doubled each century between AD 1200 and 1600 (Kirch 1985:288). It was during this expansion period that the *ahupua'a* territorial system is thought to have combined with pre-existing social stratification systems to form the Hawaiian socio-political structure documented from the historic period (Kirch 1986, Donham 1987:142).

Initial occupation of upland areas also appears to have occurred during this period, starting around AD 1400 at Lapakahi (Rosendahl 1972:495), and varying from AD 1300-1500 in the *ahupua'a* between North Kohala and South Kona. Initial movement into the uplands most likely involved small populations living in temporary shelters associated with marginal agriculture and use of upland trail systems. Larger scale expansion and settlement of the upland regions was predicated on developments in agricultural technology, however, and would have occurred somewhat later. In his study of prehistoric sites in O'oma and Kalaoa *ahupua'a*, Cordy (1985:38) proposed that upland populations were small until AD 1500-1600 and that intensive agriculture was not developed in the area until AD 1500. As part of his argument, Cordy reviewed dates from 24 sites and listed the earliest date recovered from each *ahupua'a*. The earliest dates for Kalaoa 5 at that time were AD 1400 (for a temporary habitation feature) and AD 1510 (for a permanent habitation feature). The earli-

est known date for Kalaoa 4 was AD 1610 for a temporary habitation feature, and AD 1680 for a permanent habitation feature. All of these dates were obtained from coastal sites.

While research since 1985 has pushed back the date of initial occupation for Hamanamana, Kalaoa, O'oma and Kohana-iki, Cordy's chronology for gradual settlement and agricultural intensification is generally consistent with the data presented in Table 3. Of the ten sites dated prior to AD 1400, the majority are temporary habitations located in coastal Kohana-iki, suggesting that population growth was initially restricted to the south of the study area. Spread of settlement to the northern *ahupua'a* and into the uplands appears to have occurred throughout the study area between AD 1400-1600, with upland sites in Hamanamana and Kohana-iki dating slightly earlier than those in the other *ahupua'a*. Upland sites in the northern portions of the parcel have been interpreted as agricultural sites; thus supporting the argument that upland settlement was agriculturally motivated; while early upland sites in the southern *ahupua'a* are temporary habitations. Although none of the upland agricultural sites in the southern *ahupua'a* have been dated, the presence of agricultural sites in Kealakehe that date to c. AD 1511-1638 (Walker and Rosendahl 1988), suggests that agricultural intensification may have affected the southern portions of the study area by AD 1550-1650.

Rosendahl argues that expansion of occupation into upland areas and the concurrent intensification of agriculture in West Hawaii was followed by specialization of production in coastal and upland areas, culminating in significantly altered economic and social patterns sometime around AD 1500 (Rosendahl 1972:499). Hommon, following Rosendahl, argues that increased specialization in coastal and upland production led to the establishment of a variety of reciprocal ties between the two areas, and to exchange of specialized commodities (Hommon 1976: 258). Concurrent settlement of upland and coastal areas is not documented for the historic period, however, and may have ended shortly after the expansion period.

The dating results from the current study area generally support this pattern, although the association of the proposed population increase with specialization and coastal-inland trade has yet to be established. Occupation of the study area between AD 1500-1700 appears to have been characterized by higher population and an increased range of activities. Of the 101 sites and features listed in Table 3, 39 yielded dates between AD 1500-1750, while over 30 yielded date ranges between AD 1650-1955. That population growth was accompanied by increased activities is evidenced by the appearance of sites with ceremonial functions, a greater number of permanent habitations, and an increased range of formal feature types associated with habitation and agriculture.

Population growth apparently leveled off by AD 1600, and was followed by a regional population decline after c. AD 1700 (Kirch 1985). Dates from Awakee (Donham 1987a) support this model, documenting that population began to decline between AD 1700-1800. Jensen notes a decrease in utilization of non-permanent features at Anaehoomalu after AD 1700, and argues that the hypothesized changes in settlement patterns, induced by the evolution of upland agriculture and initiation of trade, could easily account for a population decline such as that modeled by Kirch (Jensen 1989: 112). Additional explanations for the purported population decline have been advanced by Kirch and others, including the appearance of major economic and political centers such as Kawaihae, Waimea and Kailua, and the development of major prehistoric transportation routes which linked population centers with one another, both of which may have contributed to reduced dependence on the coastal areas between Kailua and Kawaihae (Jensen 1989: 112). By the mid-1800s, permanent coastal sites were generally abandoned.

In his recent archaeological investigations near Pauoa Bay, Welch (1989) re-evaluated existing cultural chronologies for Anaehoomalu and Kalahuipuaa, based primarily on a re-evaluation of volcanic glass dating results obtained from various sources. The accepted chronologies, particularly those advocated by Kirch (1985) and Hommon (1976), were generated in large part on the basis of volcanic glass dates, which were in turn based on an age formula developed In the 1970s by Morgenstein. Welch's research involved recalculating the volcanic glass age estimates using the range of alteration formulas available in the literature: (a) Michel's exponential formula, based on induced hydration experiments involving Puuwaawaa glass, (b) the Mohlab formula, which assumes that patina develops at 51.10 microns-squared/1,000 years under certain conditions of temperature and humidity (Kona airport mean values are used for these variables), and (c) Morgenstein's linear formula. The results obtained with all three formulas were then compared.

The results of Welch's comparison appear to document that significantly different dates can be achieved for individual samples of volcanic glass, depending on the formula selected for calculation (Welch 1989:97):

> Relative to the linear formula, the exponential formula reduces the age of recent specimens and increases the age of earlier specimens. As a result, longer spans of occupation are indicated than previously reported on the basis of Morgenstein's dates. Hawaiian occupation of these areas [may thus] date both earlier and later than previously estimated.

Based on this observation, Welch suggested that use of the Morgenstein formula may have artificially created the population "decline" which was first suggested by Hommon (1976) and later supported by data from Anaehoomalu (Barrera 1971) and Kalahuipuaa (Kirch 1979). Several shortcomings in these arguments were previously noted by Clark (1987), not the least of which was the fact that the dating results obtained using Morgenstein's formula for volcanic glass hydration rates could not be easily reconciled with the available radiocarbon dates. Use of the more recent formulas used by Mohlab and Michels significantly increases the number of post-1750 dates on datable samples, and leads one inevitably to Welch's conclusion that for much of West Hawaii:

> ... abandonment of many of the sites does not seem to have occurred until at least 1800, while Anaehoomalu [and some other areas] appears to have been occupied until 1900..." (Welch 1989:97).

Use of these same formulas may push estimates of initial occupation back in time as well, thus extending the occupational sequence for the entire region. While there are currently no artifact seriations which can be used to substantiate this model for the earlier end of the sequence, extension of the sequence into the 19th and 20th centuries should be supported by the recovery of historic-era artifact types and/or artifacts manufactured from historically introduced materials.

Evidence from the current study area supports Welch's contention. Over 30 of the sites in the project area yielded date ranges between AD 1650-1955 (Table 3), eight of which were clearly post-contact. Table 3 also documents ten sites interpreted as historic in age based on the use of historic construction methods and materials, as well as the presence of historic period artifacts. Perhaps more compelling, however, is the evidence provided by the historic documentary research. Although few histories are specific to the study area itself, records of the Proto-historic and early historic periods provide information for the lands of Kekaha as a whole. Observations made by I'i (1959), Menzies (1920) and

Boringer (1985) indicate that, during Proto-historic times, fishing was the primary activity pursued in the coastal areas and supported a small population involved in the exploitation and trade of marine resources. Springer also notes that exploitation of resources from the dryland forest, such as hardwoods, supplemented the subsistence economy of these populations (Springer 1985). Wilkes noted that a considerable trade was kept up between the north and south end of the district, with the barren north providing fish and salt in trade for food and clothing provided by their neighbors to the south. Finally, Ellis' diaries from his voyage of 1823 indicate that the Kekaha lands contained several villages, numerous plantations and extensive fishponds; many of which were destroyed by the 1801 Huehue flow from Hualalai (Ellis 1963:30-31).

Land tenure documents indicate that the *ahupua'a* of Hamanamana was awarded to Princess Ruth Ke'alikolani (LCA 7716) in the Great Mahele of 1848. Makaula was listed as Government Land, while Hale'ohi'u, designated as Crown Lands In the *Mahele*, remained as the personal property of the King. Kalaoa 1-4 and 'O'oma were passed to the Government by Kamehameha III (Indices 1929:31. 35) and were subsequently reclassified as Government Lands. Parcels from these lands were sold as grants throughout the year, primarily for homestead purposes and fishing. Land between 1,000-2,400 ft elevation was sold in lots of c. 50 acres, and a series of grants was issued from 1852-1864 for use of these parcels (Cordy 1985:6 and Soehren 1982:3). Although the Grant texts provide no documentation of specific land use, Maly observes that features such as stone cairns, upland trails and thoroughfares, and house sites, were often used to indicate placement of grant boundaries.

Two LCA awards were identified within the *ahupua'a* of Kalaoa, above the study area (LCA 7899 and 7937). Both were house lots and associated agricultural land (probably sweet potato or dryland taro) located In Kalaoa 4 and 5. No maps identifying the locations of these two LCAs were found, but association with place- and personal-names indicate that they were in the region above the 1,800 foot elevation. Maly and Kalima (as part of the historic research for this project) also reviewed the land indexes in the collection of the State of Hawaii archives for information concerning land use during the monarchy period and found that Hale'ohi'u, Makaula, Hamanamana and Kalaoa 1-4 were largely unoccupied. Most areas in these *ahupua'a* appeared to be rocky and desolate, with utilized land consisting primarily of 3rd rate pasturage. Kalaoa 5 was believed to be good land, although the only patent recorded was again for 3rd rate pasturage. The best lands within 'O'oma I and 2 were sold by 1865, with the unpatented lands being described as 3rd rate land (1865 letter from Wiltse to the Interior Department; Appendix C).

Records from the late historic period include (1) documents relating to the Homestead Act of 1884, (b) George Bowser's account of his 1880 visit to North Kona and (c) Emerson's 1888 survey notes. Letters to Wm Alexander, chief land surveyor of the Government in 1888, indicate that 33 Hawaiians made petitions for land in the *ahupua'a* of Hamanamana through 'O'oma 2nd. Explanations offered in these petitions indicated the need for increased grazing land for their goats, since goat raising was the only way that one could make a living in these lands. Despite the grim picture of conditions suggested by these petitions, Maly and Kalima note that subsequent petitions included references to cultivation of coffee and mango trees. The cultivation of fruit trees was also noted by Bowser, who observed that bananas, mangoes, oranges and pineapples were profuse on the barren lava fields (1880:93). Emerson's field notes offer little information concerning land use in the 1880s, but provide a record of several archaeological sites within the study area, including a cairn, pit and cave complex on the border of Pu'ukala and Kau, a small *heaiu* on

the border of Kau and Makaula, a burial cave on the border of Hale'ohi'u and Makaula, and a "war cave" in 'O'oma 1st.

By the end of the 1800s, land use in North Kona had undergone significant alterations from the dryland cultivation and fishing practiced during prehistoric and proto-historic times. Maly summarizes the gradual replacement of Hawaiian lifestyle in this area as the result of two major factors: the 1801 eruption of Hualalai, and changing land use patterns over the last 150 years. The lava flows from Hualalai reclaimed much of the land used for settlement, agriculture and fishponds; reducing the land to a shadow of its former condition. Introduction of foreign plants and animals brought about additional changes, as once-barren lava fields became overgrown with *kiawe* and other weedy shrubs, and goat and cattle raising became a mainstay of local industry. The 1850s saw the development of large-scale commercial ranching and agriculture as a result of the shift to private land-ownership brought about by the Mahele and an 1850 law permitting foreigners to own land. Coffee, grazing land, tobacco and sugar cane gradually replaced traditional subsistence crops such as taro and *uala*; stripped the land of forests, and caused disruptions in the water catchment systems. As the water resources dried up and Western land use practices replaced traditional methods, Hawaiian communities gradually disappeared. After 1890, coffee became the leading agricultural crop in western Hawaii, while eastern Hawaii shifted to large-scale sugar cane and macadamia nut production (Schilt 1984: 24-25). Today, the upland and intermediate zones are covered with coffee plantations, housing developments, and light industry. On the coast are the Keahole Airport and the Natural Energy Laboratory. The coast has not been utilized for permanent human habitation since the 1801 lava flow.

Review of Previous Models

One of the primary goals of this study was the formulation of an accurate predictive model of prehistoric settlement and land use within the current project area. This task will be accomplished in three parts: (1) a review and evaluation of previous settlement pattern models for West Hawaii, (2) a synthesis of these concepts with the observations of site patterning in the current study area and (3) a discussion of the implications of this synthesis for predicting site distribution patterns in the unsurveyed portions of the project area.

Apart from the general chronological models for Hawaiian settlement proposed by Kirch (1979) and Hommon (1976), settlement pattern models for West Hawaii are primarily based on the interrelationship of environment and cultural adaptation. These models generally distinguish between land use patterns developed in response to coastal and/or upland environments, and stress the need to understand prehistoric land use in the context of changing conditions. Five such models are outlined below.

Rosendahl (1973:60-61, 65-66) proposed general patterns of aboriginal settlement for the North Kona area, based on ethnohistoric and ethnographic sources. From these sources, Rosendahl divided the area of occupation into three principal environmental zones: a narrow and arid coastal zone associated with the exploitation of marine resources; a sloping, rocky, barren, midland zone; and an upland habitation-agricultural zone. He notes that the forest zone, further inland, was used, but was rarely inhabited. Rosendahl summarized these occupational zones as follows:

> **Coastal Zone** - Housing appeared as small clusters or fishing hamlets, along the shore and frequently found near fishponds and small bays. The inhabitants were

principally engaged in marine exploitation (including in-shore and deep-water fishing, gathering shellfish, production of salt and aquaculture). Very limited agriculture including coconut, sweet potatoes, and possibly bananas raised in small beach areas and tiny pockets of sand and gravel in barren flows. These may have provided supplies for travelers going by canoe between Kailua and Kawaihae.

Barren Zone Occupation - Temporary shelter and the mauka-makai foot trails evidence the movement of people and goods between the coast and uplands. Both terrestrial and marine resources; midden remains from habitation evidence; access to both upland and coastal zones. Artifacts and structural remains are indicative of recurrent use of temporary occupation features.

Upland occupation - This appears to be a major occupation area, with scattered, small residential hamlets (probably above 2,000 ft and 25 inches-per-year rainfall). Extensive agriculture exploitation is indicated and composed of dryland swidden cultivation. The principal crops were dryland taro and sweet potato, with other crops including breadfruit, bananas, paper mulberry, ti, and sugar cane.

Although Rosendahl's model lacks clear geographic definition of the environmental zones, and fails to describe potential changes In the land use patterns associated with each zone through time, it does provide information concerning expected site distribution and land use patterns within each zone. Further, the overall generality of the model removes it from the restricted context of Rosendahl's original study area, and improves its utility for examining areas to the south.

Davis' work in the Keahole Agricultural Park also resulted in the identification of three terrestrial or environmental zones applicable to the current study area (Davis 1977: 19-21). A summary of these zones is as follows:

The Coastal Zone - Consists of barren, rocky shorelines, isolated bays with coralline beach formations, inland ponds, brackish basal water, fresh water springs, and strand vegetation occurring in limited soil deposits. It originates at the coastline and extends to approximately 300 meters inland, or from the 0-9 meter contour (0-30 feet).

The Transitional or Barren Zone - Consists of bare, non-disintegrated lavas, arid conditions, limited dry scrub vegetation (fountain grass, lantana and noni), which increases east the of highway. Little or no soil development is in evidence. This zone originates at the 9-12 meter contour (30-39 feet), or 300-600 meters inland from coast (984-1969 feet), and extends to the 130 meter contour (425 feet).

The Upland Forest Zone - Consists of moderate soil development and adequate rainfall. This zone begins with the appearance of koa haole and Christmas berry, and continues to a mixed, broadleaf forest vegetation. It originates at 130 meter contour (425 feet), continuing east.

Although Davis included little information concerning the types of sites expected in the lower two zones, he made the following observations about site types in the upland forest zone:

Here also begins the lower margin of the upland agricultural systems with extensive prehistoric site remains including house enclosures, stone platforms, high

> stacked ahu (cairns), stone walls and the numerous stone mounds suggesting that the local crop was largely sweet potato (Davis 1977:21).

The primary utility of Davis' model is the combination of clear geographical criteria with vegetation data to define the three environmental zones. With the exception of the comments on upland site patterns, however, Davis fails to take the next step and describe the site distribution and land use patterns expected within each zone. Chronological associations are also neglected, making Davis' model little more than a study in ecological zonation in North Kona, rather than a model of adaptation to the environment through time.

Cordy summarized archaeological findings in the Lands of 'O'oma and Kalaoa (1985). Like Rosendahl (1973) and Davis (1977) he divided the study area into three environmental zones and examined site locations and types within each land unit:

> The **Coastal Zone** extends from the shoreline to 164 ft (50 meters), with a maximum elevation of 20 ft (six meters). It is composed of low pahoehoe with some sand beaches. Features here include trails, caves, enclosures, platforms, pools, cairns, C-shapes, and pavings. Cordy suggests that there are at least 22 permanent house sites located right along the shore. The permanent structures included platforms, enclosures, and pavings with relatively shallow fill.

Also located in the Coastal Zone, according to Cordy, are sites interpreted as temporary dwelling areas, with feature types such as caves and C-shaped shelters. These are located just inland of the Coastal Zone, at the interface with the Barren Zone, or along the shore in areas not used as permanent housing. Two very large structures interpreted as *heiau* were found in 'O'oma 1, in the Coastal Zone.

> **The Barren Zone** is a band from the 20 ft contour (six meters) to c. 0.8-1.4 kilometers inland, with sites that appeared to consist mostly of a few mauka-makai trails, the early historic Mamalahoa Trail (which parallels the shore), a few C-shaped structures and caves near the trails, and cairns that may have been associated with the trails. With some exceptions, habitation sites contained only shallow deposits and appeared to be temporary, with shallow deposits.

At the 200-400 ft level (61-122 meters) of Kalaoa 5 and 'O'oma 1, site density increased, according to Cordy, and he reported large numbers of cave shelters in tubes branching off of sinks and on the floors of the sinks. These were marked by extensive features that Cordy felt may have been indicative of recurrent, short-term usage. A number of surface cairns in the vicinity might have marked trail locations and associated caves. A single historic, walled, permanent structure (with associated features) was found near the upper end of the Barren Zone (ibid.:32).

> **The Upland Zone** consisted of rough aa and soil terrain, and extended from the 426-ft elevation to 3,379 ft (130-1,030 meters), and up to six kilometers from shore. Only three archaeological investigations had been conducted at the time of Cordy's work in this zone, but indications of upland agricultural features, platforms, mounds, and walls were noted. Cordy reported virtually continuous sites beginning at the c. 450 ft elevation extending up to at least the 800 ft contour (and perhaps beyond). There were indications that this was the lower margin of an upland agricultural system including house enclosures, stone platforms, high-stacked ahu, stone walls and the numerous stone mounds suggesting that the local crop was largely sweet potato (Davis IN Cordy 1985).

By including both well-defined geographical data for each zone and clear descriptions of the formal and functional site types encountered to date in each area, Cordy's model has considerably greater utility for predicting site distribution in unsurveyed areas, in comparison to those proposed by either Davis or Rosendahl. The model has the further advantage of tying site distribution patterns to the regional chronology, if only in general terms, and lays the groundwork for future research in North Kona.

Hammatt followed the same basic zonation proposed by Cordy, but did not discuss the definition of his zones in any detail (Hammatt 1987:69-71). His model, which was formulated for an intermediate elevation parcel in Kealakehe, was intended to provide a picture of upland settlement to contrast with the more frequently studied coast. Hammatt argued that the lack of trails connecting the upland with coastal settlements suggested less formalized integration of the uplands with the coast; in contrast to the models posited by Rosendahl (1973) and Hommon (1976). That some level of interaction between the uplands and coast existed was indicated by the presence of marine midden in upland sites, but the lack of artifacts associated with marine exploitation and the small quantity of marine midden suggest a fairly irregular or tentative network. Based on his survey data, Hammatt observed that upland Kealakehe was characterized by scattered house lots associated with cultivation of sweet potato and taro in small garden plots. Cultivation was extended into arable microenvironments at lower elevations, conforming to the "belt of residence" about half a mile wide at the lower edge of the forest boundary, where taro and breadfruit could be easily cultivated. This main *mauka* agricultural vegetation zone is closely related to the 50" isohyet rainfall line which veers significantly inland north of Kailua town (Hammatt 1987:70). This inland shift of the upland-intermediate zone boundary would have resulted in greater expenditures of time and labor on the part of coastal residents commuting to upland agricultural areas, as compared to their neighbors to the south. Hammatt argues that the twelve kilometer round trip from the coast to his study area would have promoted greater specialization toward either fishing or farming rather than the practice of both occupations which was certainly common in the lands to the south. This occupational specialization is supported by the artifact assemblage which Includes only four artifacts, small amounts of marine material, and no artifacts with a clear marine related purpose.

Hammatt's model differs from the models presented above in several ways. First, it is clearly restricted to the upland zone, and consequently provides little information concerning site distribution patterns in the region as a whole. Second, the model places a greater emphasis on coastal-upland interaction, perhaps due to the apparent negative evidence for the type of interaction posited for the population centers in North Kona-Southern Kohala. It should be noted, however, that Hammatt's study area was located in the intermediate zone, not the uplands, and lacked habitation structures. His arguments on the nature of the artifact and ecofact assemblages within the uplands are thus somewhat suspect, and should be reevaluated in the context of actual upland sites. Finally, Hammatt's model is limited by the absence of a chronological framework to refine site distribution data through time.

Barrera, like Hammatt, adopted the three environment zones described by Cordy (1985). The project area upon which his model is based corresponds to that of his 1985 Keahole Point study (1985a) in coastal and intermediate Kalaoa. Based on data from survey and excavations within the parcel, Barrera posited the following model of settlement and land use within North Kona:

> Certain especially favorable locations (small protected bays such as Kaloko, North Kona, Anaehoomalu, South Kohala, for example) were being exploited by the tenth and eleventh centuries. A permanent inland agriculturally-oriented population developed by the 15th century, preceding most of the permanent coastal habitation. This is supported by recent excavation data in sites four miles from the ocean in the ahupua'a of Kohanaiki. Here several permanent habitation structures and a large, well-built Men's House situated in the midst of agricultural fields were being utilized by the late 15th century. There was indirect access to ocean products through trade, and possibly temporary or intermittent direct access (Barrera 1987). Lateral expansion from the early exploitation centers along the relatively less productive coastlines did not occur until the 16th century. This is followed in the late 17th and early 18th centuries by a period during which temporary coastal habitation evolves into more permanent occupation with full time exploitation of marine and agricultural resources. The end of the sequence is marked by an abandonment of the agricultural fields in the early 18th century, with a concentration on marine resources and a tendency towards nucleation of coastal settlements that was interrupted by historic contact (Barrera 1987:231).

Despite the clear focus of subsistence activities on exploitation of locally available marine and avian resources, and the later addition of animal husbandry, Barrera notes that some form of coastal-upland interaction was also present during the occupation sequence.

> It is difficult to ascertain the degree of interaction with the uplands, either directly or through trade or gift exchange with residents of that area, but clear evidence that this took place is present in the form of kukui shells in many of the coastal sites. The main problem in this regard is the differential preservation of the various remains in the archaeological record. We have lots of mollusc shells and a fair amount of fish, mammal and bird bone but virtually no highly perishable vegetal remains (Barrera 1987: 226).

Habitation sites in the project area ranged from temporary to permanent, depending on the occupation period, and included a category of "crude" shelters which Barrera interpreted as hunting blinds and/or storage areas. He notes that coastal populations were generally small in all phases, not because of the arid conditions in this area, but because of the limits of the marine environment.

> It should be noted that the widely held view that the availability of water was a prime element limiting population size along the coast does not stand up to scrutiny. The limiting factor was in fact the relatively poor capacity of the marine environment to provide subsistence (Barrera 1987:221).

Barrera's model like Cordy's combines site distribution and land use patterns with elements of a regional chronology. His model provides specific data on patterns within his study area, and notes the probability of interaction between the coast and uplands without making it the entire focus of his model, in the manner of Hammatt's discussion. Once the study area are extrapolated to the larger region, however, Barrera emphasizes broad patterns at the expense of more utilitarian information on site distribution and land use patterns within the various ecozones. The end result is a general framework rather than a predictive model.

Synthesis of Models with Site Distribution Data

The preceding models, though varying in detail, have several common elements. First, there is general agreement on separation of the region into three basic environmental zones: the coastal zone, the barren or intermediate zone, and the upland zone. Second, all five models associate the coastal zone with marine exploitation and the upland zone with dryland cultivation. Depending on their proximity to the coast or uplands, sites within the barren zone are interpreted as extensions of the two major patterns into marginal areas, or as sites related to travel between the two poles (e.g., trails, shelters, etc.). Third and finally, all of the models posit some level of interaction between the coast and uplands, although there is little agreement concerning the nature and intensity of this interaction. Of the three models that actually define geographic boundaries for the environmental zones, Davis' stands out as offering the greatest detail, especially in terms of biotic distinctions between zones. Rosendahl provides more analysis of the types of subsistence activities associated with each zone, while Cordy provides information concerning site functions beyond subsistence. Only two of the models, those proposed by Cordy and Barrera, present their hypotheses in the context of a regional chronology. As was stated above, however, Barrera's model becomes too generalized at this point and offers little more than a restatement of the chronological framework outlined in the beginning of this section. Cordy's model, in contrast, provides sufficient detail to differentiate site distribution patterns through time.

Synthesizing the best elements of the five models with the data on site patterning in the current study area, the following settlement pattern model is posited for the study area:

Coastal Zone: Consists of barren, rocky shorelines, isolated bays with coralline beach formations, inland ponds, brackish basal water, fresh water springs, and strand vegetation occurring in limited soil deposits. It originates at the coastline and extends to approximately 300 meters inland, or from the 0-9 meter contour (0-30 feet). Formal feature types include cave, *ahu*, enclosure, footpaths and trails, midden scatters, modified outcrops, overhangs, pahoehoe excavations, petroglyph, platform, sinkholes, terraces, modified lava tubes, walled shelters, pools, cairns, C-shapes, and pavings. Functional types consist primarily of habitations (both temporary and permanent) quarry, transportation, burial or shrine, art/communication and marker. The majority of sites are prehistoric in age, with habitation sites providing evidence of greater permanence and increasing nucleation through time. Permanent habitation sites are located along the shore and frequently found near fishponds and small bays; while temporary habitations (caves and C-shaped shelters) are located just inland of the Coastal Zone, at the interface with the Barren Zone, or along the shore in areas not used as permanent housing. Ceremonial structures, such as shrines and *heiau* tend to be positively correlated with permanent habitations. The inhabitants were principally engaged in marine exploitation (including in-shore and deep-water fishing, gathering shellfish, production of salt and aquaculture). Very limited agriculture, including the raising of coconut, sweet potatoes, and possibly bananas took place in small beach areas or in tiny pockets of sand and gravel in barren flows. These may have provided supplies for travelers going by canoe between Kailua and Kawaihae.

Barren Zone - Consists of bare, non-disintegrated lavas, arid conditions, limited dry scrub vegetation (fountain grass, lantana and *noni*), which increases east of the highway. Little or no soil development is in evidence. This zone originates at the 9-12 meter contour (30-39 feet), or 300-600 meters inland from the coast (984-

1,969 feet), and extends to the 130 meter contour (425 feet). Sites consist mostly of a few *mauka-makai* trails, the early historic Mamalahoa Trail (which parallels the shore), pahoehoe quarries, crude platforms and walled structures, a few C-shaped structures and caves near the trails, and cairns that may have been associated with the trails. With some exceptions, habitation sites contain only shallow deposits and appear to be temporary, with shallow deposits. At the 200-400 ft level (61-122 meters) site density increases and cave shelters in tubes branching off of sinks and on the floors of the sinks become a common site type. These features are generally marked by extensive features indicative of recurrent, short-term use. A number of surface cairns in the vicinity may mark trail locations and associated caves. Apart from boundary walls, trails and some cairns, the majority of features appear to be associated with prehistoric use of the zone. Temporary shelters and the *mauka-makai* foot trails evidence the movement of people and goods between the coast and the uplands. Both terrestrial and marine resources in midden remains from habitation evidence access to both upland and coastal zones. Artifacts and structural remains are indicative of recurrent use of temporary occupation features.

Upland Forest Zone - Consists of rough aa terrain with moderate soil development and adequate rainfall. Extends from the 426-ft elevation to 3,379 ft (130-1,030 meters), up to six kilometers from shore. This zone begins with the appearance of *koa-haole* and Christmas-berry, and continues to a mixed, broadleaf forest vegetation. This appears to be a major occupation area, with scattered, small residential hamlets (probably above 2,000 ft and 25 inches-per-year rainfall). Feature types consist of upland agricultural features, platforms, mounds, and walls, with virtually continuous sites beginning at the c. 450 ft elevation extending up to at least the 800-ft contour (and perhaps beyond). Features found at the uppermost elevations of the parcel appear to represent the lower margin of the upland agricultural system, and include house enclosures, stone platforms, high-stacked *ahu*, stone walls and numerous stone mounds. Although a large number of features are associated with prehistoric land use, subsequent ranching and large-scale agriculture during the historic period have obscured or destroyed much of the earlier patterning, making it difficult to establish the original distribution of prehistoric features. Primary land use during prehistoric times is associated with dryland swidden cultivation. The principal crops were dryland taro and sweet potato, with other crops including breadfruit, bananas, paper mulberry, ti, and sugar cane. Historic period land use is associated with ranching, habitation and large-scale agriculture.

Implications for the Current Project

The current project area does not contain any portion of the Coastal 14 Zone, but does contain portions of the Barren and Upland Zones. Based on factors discussed above, the Barren Zone extends from the Queen Ka'ahumanu Highway along the western boundary of the project area (c. 80-120-ft elevation), inland to approximately the 400-foot elevation. Site types within the Barren Zone are expected to reflect transitory occupation and to include types such as C-shapes and cave/sink complexes and transportation routes between the coast and the Upland Zone. The Upland Zone begins at approximately the 450-ft contour and continues inland to the easternmost edge of the project area (c. 840-foot elevation) and beyond. Given the distribution of sites encountered within the study area at the same elevations, it is probable that the Upland Zone portion of the project area will exhibit a

nearly continuous distribution of sites and features related to agriculture, and possibly, temporary habitation,

Given the small number of projects and variable survey coverage provided by previous investigations in the Barren and Upland portions of the study area, the survey performed as part of the current project will not only provide a test of the above model, but will add much needed data on site distribution and land use patterns within these zones. The results of the survey are presented below. Evaluation of the model and the anticipated site distribution patterns against the survey findings will be presented in Section 4.

FINDINGS

PHASE 1 - AERIAL RECONNAISSANCE

Methods

The aerial reconnaissance survey (Phase 1) was conducted by helicopter on September 16, 1992. The helicopter flew north-south transects over the project area at an elevation of approximately 50 feet. Sites located from the helicopter were marked by dropping pink flagging tape attached to rocks. The flagging tape was inscribed with the PHRI project number, the temporary site number (AS-#), and the date.

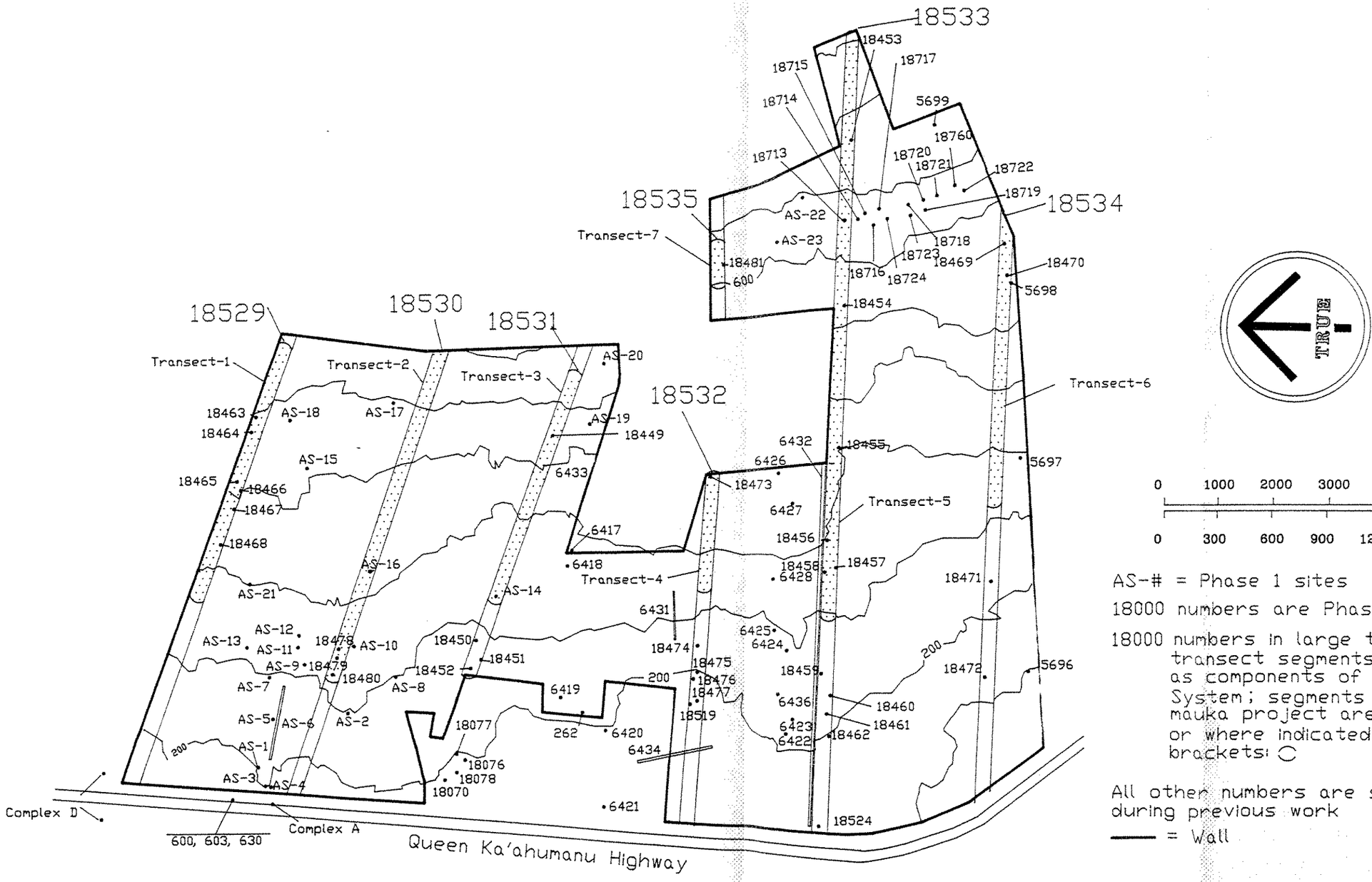
Findings

During the aerial survey, 23 sites were identified. Their locations are shown on Figure 4. Of the 23 sites, 11 were newly recorded, while 12 had been identified during prior surveys. Six sites, though located within areas subjected to prior survey, had not been identified during those surveys. Nine sites recorded during the aerial survey were identified as representing the 18 sites and features noted (but not recorded), by Hammatt and Folk during their 1980 reconnaissance survey. Table 3 lists the sites by the PHRI temporary aerial sur-

Table 3.
Results of Aerial Reconnaissance Survey

AS-	Site Type	Area of Prior work	Previous Site Number
1	Trail	Hammatt & Folk Recon.	Identified - None
2	C-shape	Hammatt & Folk Recon.	Unrecorded
3	Complex	Hammatt & Folk Recon.	Identified - None
4	Enclosure	Hammatt & Folk Recon.	Identified - None
5	*Ahu*	Hammatt & Folk Recon.	Identified - None
6	Pavement	Hammatt & Folk Recon.	Identified - None
7	Mound	Hammatt & Folk Recon.	Unrecorded
8	Lava tube	Hammatt & Folk Recon.	Identified - None
9	Pahoehoe excav.	Hammatt & Folk Recon.	Unrecorded
10	Lava tube	Hammatt & Folk Recon.	Identified - None
11	Lava tube	Hammatt & Folk Recon.	Identified - None
12	Lava tube	Hammatt & Folk Recon.	Identified - None
13	Aa excav.	Hammatt & Folk Recon.	Unrecorded
14*	Complex	Davis 1977	Unrecorded
15	Lava tube	None	None
16†	Enclosure	Hammatt & Folk Recon.	Unrecorded
17	Complex	None	None
18	Overhang	None	None
19	Complex	Davis 1977	6433
20	Complex	Davis 1977	6433
21	Historic wall	Davis 1977	6432
22	Enclosure	None	None
23	Enclosure	None	None

* *Subsumed under Site 18531*
† *Subsumed under Site 18530*



AS-# = Phase 1 sites

18000 numbers are Phase 2 sites

18000 numbers in large type are transect segments proposed as components of Kona Field System; segments terminate at mauka project area boundary or where indicated by brackets: ⊂

All other numbers are sites identified during previous work

—— = Wall

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Figure 4.
LOCATIONS OF ALL SITES
IDENTIFIED WITHIN PROJECT AREA

vey number (AS-#) and correlates previously examined areas and any site numbers formerly assigned. With the exception of AS-14 and AS-16, which were located within Ground-survey Transects 2 and 3, respectively, the sites recorded during the Phase I aerial survey were not checked on the ground. AS-14 and AS-16 were subsumed under Sites 18531 and 18530, respectively, and were not given significance assessments or treatment recommendations.

PHASE 2- GROUND SURFACE SURVEY

Methods

The Phase 2 field work consisted of a variable-coverage pedestrian survey covering approximately 11.5% of the project area. Survey transects were oriented *mauka-makai* in order to (a) obtain data for a representative sample of sites and features within the major *ahupua'a* and (b) provide data useful in correlating site distribution with elevation and climate within the project area. Placement of the survey transects was determined using a systematic sampling design, and resulted in the selection of seven evenly spaced transects within the project area (Figure 3). The pedestrian survey of each transect was conducted by four archaeologists walking *mauka-makai* sweeps. Due to the general lack of vegetation and good visibility in most of the project area, the average interval between crew-members was 20 meters.

When sites or features were identified, metal site tags were affixed to their southwest corner. The tags were inscribed with the PHRI project number, temporary site number, date and recorder's initials. Pink flagging tape, bearing the same information, was placed at the sites to aid in relocating them. Sites were briefly recorded on standardized PHRI summary forms, and their locations were plotted on topographic maps.

Findings

The ground survey of the current project area resulted in the identification of 42 newly recorded sites (Figure 4). These sites include 12 complexes, eight modified lava tubes, six caves, six modified outcrops, three pahoehoe-lined trails, one terrace, one modified blister, one pahoehoe excavation, one platform, and one *ahu*. The sites are summarized by site number, formal and functional type, CRM Value Mode Assessments, and recommended field work tasks in Table 4. Appendix B lists the identified sites and features by the assigned state site numbers, corresponding PHRI temporary field numbers, formal type, and transect number.

Formal Feature Types

The Phase 2 field work resulted in the identification of 22 formal site and feature types within the current project area. These include *ahu*, alignment, C-Shape, cave, enclosure, filled crack, historic shack, L-shape, midden, modified blister, modified depression, modified lava tube, modified outcrop, mound, overhang, pahoehoe excavation, pavement, petroglyph, platform, terrace, trail and wall. The frequencies of formal types are listed in Table 5.

Functional Feature Types

Sites and features identified during the Phase 2 field work were assigned to nine functional categories. These categories were agriculture, habitation, possible habitation,

Table 4.
Summary of Newly Identified Sites and Features

Site Number	Formal Type	Tentative Functional Interpretation	Tentative CRM Value Mode Assess. R	I	C	Tentative Field Work Tasks DR	SC	EX
18449	Trail	Transportation	H	H	H	+	-	-
18450	Terrace	Agriculture	L	L	L	+	-	-
18451	Mod. outcrop	Agriculture	L	L	L	+	-	-
18452	Mod. outcrop	Agriculture	L	L	L	+	-	-
18453	House platform	Habitation	H	H	M	+	+	+
18454	Complex	Habitation/agriculture	H	H	H	+	+	+
18455	Complex	Habitation/agriculture	H	H	H	+	+	+
18456	Lava tube	Possible habitation	M	M	M	+	-	-
18457	Cave	Habitation	H	H	H	+	+	+
18458	Trail	Transportation	H	H	H	+	-	-
18459	Lava tube	Possible habitation	M	M	M	+	-	-
18460	Lava tube	Possible habitation	M	M	M	+	+	+
18461	Mod. blister	Agriculture	L	L	L	+	-	-
18462	Cave	Habitation	H	H	H	+	+	+
18463	Lava tube	Possible habitation	M	M	M	+	-	-
18464	Lava tube	Possible habitation	M	M	M	+	-	-
18465	Cave	Habitation	H	H	H	+	+	+
18466	Cave	Habitation	H	H	H	+	+	+
18467	Cave	Habitation/refuge	H	H	H	+	+	+
18468	Complex	Habitation/agriculture	M	M	M	+	-	-
18469	Trail	Transportation	H	H	H	+	-	-
18470	Complex	Rock art/agriculture	H	H	H	+	-	-
18471	Pahoehoe ex.	Quarry	L	L	L	+	-	-
18472	Mod. outcrop	Agriculture	L	L	L	+	-	-
18473	Complex	Rock art/burial	H	H	H	+	+	+
18474	Lava tube	Possible habitation	M	M	M	+	-	-
18475	Mod. outcrop	Agriculture	L	L	L	+	-	-
18476	Mod. outcrop	Agriculture	L	L	L	+	-	-
18477	*Ahu* (cairn)	Marker	M	L	L	+	-	-
18478	Lava tube	Possible habitation	M	M	M	+	-	-
18479	Lava tube	Possible habitation	M	M	M	+	-	-
18480	Mod. outcrop	Agriculture	L	L	L	-	-	-
18481	Cave	Habitation	H	H	H	+	+	+
18519	Mod. outcrop	Agriculture	L	L	L	+	-	-
18524	Pahoehoe excavation	Quarry	L	L	L	+	-	-
Proposed Components of Kona Field System								
18529	Complex	Agriculture/quarry/habitation	M	M	M	+	-	-
18530	Complex	Habitation/boundary/agriculture	M	M	M	+	-	-
18531	Complex	Agriculture/habitation/boundary	M	M	M	+	-	-
18532	Complex	Quarry/agriculture/marker	L	L	L	+	-	-
18533	Complex	Ag./boundary/hab./marker/quarry	M	M	M	+	-	-
18534	Complex	Agriculture/quarry	L	L	L	+	-	-
18535	Complex	Agriculture	L	L	L	+	-	-

Cultural Resource Management Value Mode Assessment
Nature: R = scientific research, I = Interpretative, C = Cultural
Degree: H = high, M = moderate, L = low

Tentative Field Work Tasks Recommended:
DR = detailed recording (scaled drawings, photographs, and written descriptions)
SC = surface collections
EX = limited excavations.

marker, transportation, burial, rock art, boundary and quarry. Functional site type frequencies are summarized in Table 6.

Table 5.
Frequencies of Formal Site and Feature Types

Formal Type	Count	Percent
Ahu	7	2.16
Alignment	5	1.54
C-shape	3	0.92
Cave	9	2.78
Enclosure	8	2.47
Filled crack	6	1.85
Historic shack	1	0.31
L-shape	1	0.31
Midden	1	0.31
Mod. blister	11	3.40
Mod. depression	2	0.62
Mod. lava tube	8	2.47
Mod. outcrop	151	46.60
Mound	61	18.83
Overhang	1	0.31
Pahoehoe ex.	17	5.25
Pavement	1	0.31
Petroglyph	2	0.62
Platform	5	1.54
Terrace	9	2.78
Trail	3	0.92
Wall	12	3.70
TOTAL	**324**	**100.00**

Table 6.
Frequencies of Functional Site Types

Function	Count	Percentage
Agriculture	19	32.75
Habitation	14	24.10
Possible habitation	8	13.80
Marker	3	5.15
Transportation	3	5.15
Burial	1	1.75
Rock art	2	3.50
Boundary	3	5.15
Quarry	5	8.65
TOTAL	**58**	**100.00**

Agriculture - Most of the recorded sites (N=19) were assigned agricultural functions (18450 through 18452, 18454 and 18455, 18461, 18468, 18470, 18472, 18475 and 18476, 18480, and 18529 through 18535). Each of the seven transects examined during Phase 2 contained elements of an agricultural system. The agricultural features generally appeared prehistoric in form, but the historic remains in the project area suggested they may also have been utilized historically. These features (n=284) included 151 modified outcrops, 61 mounds, 17 pahoehoe excavations, 12 walls, 11 modified blisters, eight enclosures, nine terraces, seven *ahu*, six filled cracks, five alignments, five platforms, three C-shapes, two modified depressions, one overhang, one midden scatter, one L-shape, and one historic shack.

The presence of many dryland agricultural features, and the relatively high density of these features, may indicate that fringe elements of the Kona Field System (Site 6601) extend as far north as the current project area. This hypothesis, along with similar assertions made by O'Hare and Rosendahl (1991), Walker and Haun (1988) and Walker and Rosendahl (1989), will be evaluated in the conclusion section of this report.

Habitation - Fourteen of the recorded sites were assigned a habitation function (18453-55, 18457, 18462, 18465-68, 18481, 18529-31, and 18533). Features assigned this function were caves showing evidence of modification and occupation, small C-shaped and L-shaped enclosures, and a house platform.

Possible Habitation - Eight of the recorded sites were assigned a possible habitation function (18456, 18459, 18460, 18463, 18464, 18474, 18478, and 18479). These were primarily lava tubes. None of these appeared to have been modified, but they may reveal evidence of occupation upon future examination.

Marker - This functional interpretation was assigned to three of the recorded sites (18477, 18532, and 18533). All features in this category were *ahu* (cairns).

Transportation - Three of the recorded sites were assigned a transportation function (18449, 18458, and 18469). All three are pahoehoe-lined trails crossing aa flows.

Burial - One of the recorded sites was assigned a burial function (18473). This site consisted of disturbed human remains inside a small lava tube.

Rock Art - This functional interpretation was assigned to two of the recorded sites (18470 and 18473). These features were components of other larger sites and consisted of petroglyphs etched into the surface of exposed pahoehoe.

Boundary - Three of the recorded sites are assigned a boundary function (18530, 18531, and 18533). These are generally walls that are probably associated with a historic occupation of the project area.

Quarry - This functional interpretation is assigned to five of the recorded sites (18471, 18529, 18532, 18533, and 18534). Features of this type are primarily pahoehoe excavations.

CONCLUSION

DISCUSSION

Aerial and pedestrian surveys conducted within the current project area resulted in the identification of 42 new sites (Figure 4), Formal feature types identified include *ahu*, alignment, cave, C-shape, enclosure, filled crack, historic shack, L-shape, midden scatter, modified blister, modified depression, modified lava tube, modified outcrop, mound, overhang, pahoehoe excavation, pavement, petroglyph, platform, terrace, trail and wall. Functional interpretations assigned to these features include agriculture, habitation, possible habitation, marker, transportation, burial, rock art, boundary and quarry. Appendix B lists the identified sites and features by State Site number, corresponding PHRI temporary field numbers, formal type and transect number.

Separation of the survey area into the two zones specified by the model above provides the following distribution of formal and functional feature types:

Barren Zone - Formal types within the portions of the project area assigned to the Barren Zone include terrace (1), modified outcrop (67), modified lava tube (6), cave (3), pahoehoe trail (1), modified blister (6), pavement (1), mound (13), pahoehoe excavation (10), *ahu* (7), wall (1), enclosure (1), platform (1) and filled crack (1). Functionally, these features comprise seven of the nine categories identified within the project: agriculture, habitation, possible habitation, quarry, transportation, marker, and boundary. Agricultural features are the most abundant (mounds and modified outcrops), followed by habitations and possible habitations, the majority of which appear to be temporary dwellings. Quarries and boundary features are approximately equal in occurrence, while markers and transportation features are the least common.

Upland Forest Zone - Formal types identified within the portions of the project area assigned to the upland forest zone include pahoehoe trail (2), platform (5), mound (139), cave (6), terrace (8), modified lava tube (2), petroglyph (2), filled crack (5), modified blister (8), pahoehoe excavation (7), L-shape (1), enclosure (7), C-shape (3), wall (11), midden scatter (1), alignment (5), modified depression (2), overhang (1), historic shack (1), *ahu* (1) and modified outcrop (183). Functional types include all nine of the major types defined for the project area: habitation, possible habitation, agriculture, marker, rock art, burial, quarry, transportation and boundary. Again, agricultural features are the most common, followed by habitations, quarries, boundary, markers, transportation, and rock art/burial (descending order of abundance).

Based on these findings, therefore, the barren and upland forest zones share a number of common formal and functional feature types. The range and abundance of each feature type is considerably more abundant in the upland zone, however, indicating that this area was most likely associated with more intensive use. Both areas were utilized primarily for cultivation and habitation, suggesting that the barren zone may have closer ties to the upland zone than to the coast, at least within the boundary of the project area. Perhaps more interesting to note, however, is the general lack of transportation features in the bar-

ren zone, a fact which calls into question the assumption that there was regular interaction between the coast and the uplands via the barren zone. While there is always the possibility that further survey will identify more transportation features In between the current survey transects, the current evidence argues for a low level of interaction between the coast and the higher elevations, supporting Hammatt's suggestion that the distance between the two areas was too great for regular interaction. Similarly, the sheer density of agricultural features in both barren and upland areas supports Hammatt's contention that physical separation of the uplands from the coast resulted in agricultural specialization and extension of cultivation into arable microenvironments.

Comparison of these findings to the expected distribution noted in Section 2 indicates a fairly low correspondence between the predictions and the findings. The range of formal and functional types encountered in the project area was broader than expected, as was overall feature density, but given the low coverage provided for these areas by previous research, this result is not unexpected. Areas of rough and exposed aa lava flows did not contain substantial archaeological sites and features but, given the occasional observation of aboriginal trails across the lava flows, should not be neglected in future studies. It is also important to note that caves and lava tubes may be found anywhere within the project area, and will probably result in the identification of otherwise unpredicted feature types. These feature types may include burial caves, refuge caves, *ahu*, trails and associated agricultural features.

Despite the lack of correspondence in these areas, however, the major formal and functional types were accurately predicted, and confirm that the primary focus of settlement and land use in the barren zone and lower uplands was dryland cultivation. Agricultural features (33% of the total), including modified outcrops, terraces, and mounds, extend from approximately the 280-ft contour to the eastern boundary (840 ft) and beyond, with feature-density decreasing below the 300-ft elevation. This distribution is consistent with informal agricultural systems recorded in Kau and Kealakehe, and conforms to descriptions of northern portions of the Kona Field System (Cordy 1985, Cordy *et al.* 1992).

Habitation features (38%), including C-shapes, L-shapes, and lava tube caves, were also identified. These features are thought to represent primarily temporary occupations, but require further recording and testing before this hypothesis can be confirmed. Other features (29%) include pahoehoe excavations, cairns, petroglyphs and trail segments (interpreted as quarries, markers, ceremonial/communication features, and transportation features, respectively).

Contrary to expectations, transportation features were the least common functional type noted. This finding tends to support Hammatt's contention that coastal-upland interaction patterns in North Kona and South Kohala were fairly irregular and informal in nature. Given the nature of the terrain in the project area, and the fact that numerous inland-heading trails have been recorded in Kaloko and Honokohau; however, it is possible that transportation features are under-represented in the current sample. Trails over pahoehoe are generally difficult to detect unless they are clearly marked (boulder-lined, faced) or involve excavation of a corridor through the pahoehoe fields (e.g., historic trails). It should also be noted that few sites in the barren or upland zones have been excavated, and that our information concerning artifact and ecofact assemblages associated with settlement of these zones is far from complete. Until further survey and/or excavation can establish the nature of artifact and ecofact assemblages from both the barren and upland regions, par-

ticularly regarding the distribution of marine resources to these areas any hypotheses regarding the nature of coastal-inland interaction must remain tentative.

An historic period component has also been recorded within the current project area, evidenced by a historic shack and numerous historic land-division walls. It is also possible that an undetermined number of mounds and modified outcrops may be associated with historic land use. Because different technology was employed, and different crops were grown during this latter period (i.e., animal husbandry and coffee), site locations will not necessarily reflect the environmental restrictions imposed on the prehistoric occupants of the area.

Conclusions

Based on the distribution of sites within the study area (combined data from previous work and survey data from this project), the following general observations concerning land use can be made (Figure 5a-e).

Habitation sites: Habitation sites in the study area comprise a range of formal feature types and include temporary, semi-permanent and permanent habitations. Temporary habitations are the most common habitation type and are distributed throughout all of the major *ahupua'a* and each of the environmental zones. Permanent and semi-permanent habitations have a more restricted distribution, and are most commonly encountered in the coastal zone.

Agricultural sites: Agricultural features in the study area comprise a more restricted range of feature types, although this observation may be altered by future work in the barren and upland zones. Agricultural features are generally rare in the coastal zone, and appear to be correlated with fruit tree cultivation rather than the more intensive dryland agriculture associated with the upper elevations. Density of agricultural features increases with elevation, with the loosely scattered features of the lower barren zone giving way to denser concentrations in the upper barrens and a virtually continuous band of agricultural features in the uplands. This pattern is consistent with previous observations of agricultural field systems in North Kona-South Kohala, and supports the observation that such systems represent a northern extension of the Kona Field System.

Ceremonial sites: Ceremonial sites identified in the study area include small *heiau*, shrines and burial sites. Such features are generally rare in the study area, and appear to concentrate in the coastal zone. While the sample of ceremonial features is small, tentative correlation of their location with other feature types suggests that coastal ceremonial sites are associated with permanent habitations, barren area sites are associated with lave tube systems, and upland sites are asociated with agricultural fields.

Transportation/Marker/Boundary sites: Features identified as trails, markers and boundaries are also fairly rare in the study area. Approximately five such features are located in the coastal zone; these are primarily short trail segments associated with habitation features. The percentage of feature types in this category increases with elevation, but shifts in emphasis from trails to markers and boundary features (refer to discussion of trails above). It should be noted that the identification of rock piles and mounds as markers is extremely tentative in some areas; and that reexamination of these features may indicate an agricultural rather than

marker function for many of them. Boundary features, which are almost entirely walls and wall segments, include both historic and prehistoric features. Given the tendency for historic period residents to reuse cobbles from previous walls, however, the distribution of prehistoric features may well be obscured.

Quarry Sites: Quarry sites are rare in the project area, with only two being found on the coast and eight in the barren or upland zone. Quarry features are composed entirely of pahoehoe excavations, and show a clear correlation with pahoehoe flows in the study area. Given the small size of most such features, and the general difficulty associated with their identification (there are a lot of natural features which appear similar), however, the actual number of quarries in the study area has probably been underestimated.

In conclusion, the data from the current project make several important contributions to the study of prehistoric development in the North Kona area. First, the report provides a synthesis and refinement of previous settlement pattern models for the North Kona area and presents a new single model. A test of this model against data from previously unsurveyed areas indicated a high degree of correspondence between the predicted distribution patterns and the field data, and argue for the utility of the model for future research. Second, the report provides an updated and accurate database of site and feature information from the study area. The maps and tables provided in this report summarize site location information, formal and functional data, and chronological data for all of the sites identified to date in the study area, making this the most complete database for the North Kona area currently available. Third, the combination of the survey coverage map and the general significance assessments and recommended treatments provided for the newly identified sites, offer valuable guidelines for future work within the project area and the larger study area.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Sites identified during the current project were not recorded to inventory level; none of the archaeological remains identified was mapped or extensively recorded, and no subsurface testing was undertaken. The results presented in this document are meant to serve as a baseline study for future archaeological studies within the project area. In order to accurately assess the archaeological potential of any portion of the current project area, it is recommended that full-scale, inventory level investigations be undertaken prior to development.

The significance of archaeological remains within the overall project area were, however, tentatively assessed In terms of (a) the National Register criteria stated in the Code of Federal Regulations (36 CFR Part 60), and (b) the criteria for evaluation of traditional cultural values proposed by the national Advisory Council on Historic Preservation. DLNR-SHPD and the HCPD use these criteria to evaluate eligibility for both the Hawaii State and National Register of Historic Places.

Sites potentially significant as representative examples of site types are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction... or that represent a significant and distinguishable entity whose components may lack individual distinction.

Sites determined to be potentially significant for information content fall under Criterion D, which defines significant resources as ones which "...have yielded, or may be likely to yield, information important in prehistory or history."

Sites with potential cultural significance are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP Draft Report, August 1985). The guidelines define cultural value as "...the contribution made by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth." The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value."

All 42 sites identified during the ground survey were assessed as significant for information value. In addition, seven sites (Sites 18449, 18453, 18458, 18467, 18469, 18470, and 18473) were considered excellent examples of site types. Seven sites were tentatively assessed as significant for cultural value. These were sites 18449 (trail), 18453 (house platform), 18458 (trail), 18467 (refuge cave), 18469 (trail), 18470 (complex containing petroglyphs), and 18473 (complex containing a burial tube and petroglyphs). Further data collection is tentatively recommended for all 42 newly identified sites. Preservation with interpretive development is tentatively recommended for Sites 18449, 18453, 18458, 18469, and 18470; and preservation "as is" is recommended for Sites 18467 and 18473.

For the sites with apparent cultural significance, it is possible that further examination will result in a final recommendation of either preservation "as is," or preservation with interpretive development. Future archaeological examinations of these sites should take this into consideration. Tentative significance assessments and recommended general treatments for all newly identified sites and features are summarized in Table 7.

Table 7.
Summary Of Tentative General Significance Assessments and Recommended General Treatments

SIHP Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
18450	+	-	-	-	+	-	-	-
18451	+	-	-	-	+	-	-	-
18452	+	-	-	-	+	-	-	-
18454	+	-	-	-	+	-	-	-
18455	+	-	-	-	+	-	-	-
18456	+	-	-	-	+	-	-	-
18457	+	-	-	-	+	-	-	-
18459	+	-	-	-	+	-	-	-
18460	+	-	-	-	+	-	-	-
18461	+	-	-	-	+	-	-	-
18462	+	-	-	-	+	-	-	-
18463	+	-	-	-	+	-	-	-
18464	+	-	-	-	+	-	-	-
18465	+	-	-	-	+	-	-	-
18466	+	-	-	-	+	-	-	-
18468	+	-	-	-	+	-	-	-
18471	+	-	-	-	+	-	-	-
18472	+	-	-	-	+	-	-	-
18474	+	-	-	-	+	-	-	-
18475	+	-	-	-	+	-	-	-
18476	+	-	-	-	+	-	-	-
18477	+	-	-	-	+	-	-	-
18478	+	-	-	-	+	-	-	-
18479	+	-	-	-	+	-	-	-
18480	+	-	-	-	+	-	-	-
18481	+	-	-	-	+	-	-	-
18519	+	-	-	-	+	-	-	-
18524	+	-	-	-	+	-	-	-
18529	+	-	-	-	+	-	-	-
18530	+	-	-	-	+	-	-	-
18531	+	-	-	-	+	-	-	-
18532	+	-	-	-	+	-	-	-
18533	+	-	-	-	+	-	-	-
18534	+	-	-	-	+	-	-	-
18535	+	-	-	-	+	-	-	-
Subtotal	**35**	**0**	**0**	**0**	**35**	**0**	**0**	**0**
18449	+	-	+	+	+	-	+	-
18458	+	-	+	+	+	-	+	-
18469	+	-	+	+	+	-	+	-
18470	+	-	+	+	+	-	+	-
Subtotal	**4**	**0**	**4**	**4**	**4**	**0**	**4**	**0**
18467	+	-	+	+	+	-	-	+
18473	+	-	+	+	+	-	-	+
Subtotal	**2**	**0**	**2**	**2**	**2**	**0**	**0**	**2**
18453	+	-	+	+	+	-	+	-
Subtotal	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**0**
Total	**42**	**0**	**7**	**7**	**42**	**0**	**5**	**2**

General Significance Categories:

A=Important for information content, further data collection necessary (CRM value mode assessment = scientific research value)

X=Important for information content, no further data collection necessary (CRM value mode assessment = scientific research value)

B=Excellent example of site type at local, regional, island, state, or national level (CRM value mode assessment = interpretive value)

C=Culturally significant (CRM value mode assessment = cultural value)

Recommended General Treatments:

FDC=Further data collection necessary (further survey and testing, and possibly subsequent data recovery/mitigation excavations)

NFW=No further work of any kind necessary; sufficient data collected, archaeological clearance recommended; no preservation potential (possible inclusion into landscaping suggested for consideration)

PID=Preservation with some level of interpretive development recommended (including appropriate related data recovery work) and

PAI=Preservation "as is," with no further work (and possible inclusion into landscaping), or minimal further data collection necessary

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APPENDIX A:

Summary of Previously Identified Sites and Features Within the Project Area

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
		Ching Complex A	Complex	Permanent Hab.	Rosendahl 1973, Ching 1971
		Ching Complex D	Complex	Permanent Hab.	Rosendahl 1973, Ching 1971
	-	Cordy (1987)	Platform/terrace	Ag. Heiau/Historic house platform	Cordy 1987
2		?	Mamalahoa Trail	Transportation	
185	D16-17	Ching 183	Opihi shell trail (seg)	Transportation	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986
246	D16-15		Opihi-shell trail (seg)	Transportation	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986
262	D15-72		Cave	Permanent Hab.	Hammatt & Folk 1980, Davis 1977
500	D16-21	Bonk T-1	Petroglyphs	Communication	Bonk 1979
600			Trail	Transportation	Rosendahl 1973, Ching 1971
603			Trail	Transportation	Rosendahl 1973, Ching 1971
630			Trail	Transportation	Rosendahl 1973, Ching 1971
1902		Reinecke 58	Complex (2)	Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Walled shelter		
			B - Walled shelter		
1905	D14-08		Complex (8)	Permanent Hab./Ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Enclosure		
			B - Platform		
			C - Alignment		
			D - Rock mound		
			E - Platform		
			F - Pavement		
			G - Cave shelter		
			H - Filled depression		
1906	D14-07		Complex (6)	Permanent Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Platform		
			C - Wall		
			D - Enclosure		
			E - Wall		
			F - Walled depression		
1907	D14-11		Complex (3)	Permanent Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Enclosure		
			C - Enclosure		
1908		Reinecke 61	Enclosure	Ag.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
1909	D14-08		Complex (9)	Ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Platform		
			C - Platform		
			D - Platform		
			E - Platform		
			F - Platform		
			G - Platform		
			H - Platform		
			I - Platform		
1910	D15-01	Reinecke 68m Barrera (1985b) T-31	Complex (6)+	Hab./ ceremonial	Barrera 1985b, Donham 1987
			A - Coral pavement		
			B - Walled shelter		
			C - C -shape		
			D - Platform		
			E - Walled shelter		
			F - Walled shelter		
1910	D15-02	Barrera (1985b) T-29, 30	Complex (4)	Hab./ ceremonial	Barrera 1985b, Donham 1987
			A - Enclosure		
			B - Enclosure		
			C - Steppingstone Trail		
			D - Walled shelter		
1911	D15-16	Reinecke 69, Barrera (1985b) T-32	High-walled enclosure	Animal husbandry	Barrera 1985b, Donham 1987
M-1911	D15-17	Reinecke 69, Barrera (1985b) T-34	Platform	Hab.	Barrera 1985a, Donham 1987
1912	D15-03	Barrera (1985b) T-35	Complex (5)	Hab./ poss burial	Barrera 1985a, Donham 1987
			A - Low enclosure		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			B - Rock mound		
			C - Terrace		
			D - Terrace		
			E - Filled depression		
1913	D15-18	Reinecke 70	Complex (4)	Ceremonial	Barrera 1985a, Donham 1987
			A - Enclosed platform		
			B - Platform		
			C - Platform		
			D - Platform		
M-1914	D15-04	Reinecke 71, Barrera (1985b) T-18	Complex (13)	Hab./ ceremonial	Barrera 1985a, Donham 1987, Cordy 1986b
			A - Platform		
			B - Platform		
			C - Small Platform		
			D - Faced depression		
			E - Pavement		
			F - Shrine		
			G - Pavement/midden		
			H - Pavement		
			I - Enclosure		
			J - Enclosure		
			K - Cave shelter		
			L - Excav. (cupboard)		
			M - Cairn		
1914	D15-05	Reinecke 72	Complex (3)	Hab./ Indeterminate	Barrera 1985a, Donham 1987, Cordy 1986b
			A - Platform		
			B - Enclosure		
			C - Enclosure		
M	D15-08	Barrera (1985b) T-36	Complex (4)	Hab.	Barrera 1985a, Donham 1987, Cordy 1986b
			Platform		
			Paving		
			Cupboard		
			Wall		
1914	D15-09	Reinecke 73, Barrera (1985b) T-18	Complex (13)	Hab./ ceremonial	Barrera 1985a, Donham 1987, Cordy 1986b
			A - Platform		
			B - Platform		
			C - Paved depression		
			D - Cave shelter		
			E - Terrace		
			F - Wall		
			G - Cave shelters (2)		
			H - Midden piles		
			I - Platform		
			J - Rubble-filled depression		
			K - Paved depression		
			L - Cave shelter		
			M - Cairn on platform		
1915	D15-19	Reinecke 66,67,74, Barrera (1985b)T-36	Complex (6)	Ceremonial/ historic	Barrera 1985a, Donham 1987, Cordy 1986b
			A - Platform	Hab.	
			B - Pavement		
			C - Low-walled shelter		
			D - Rubble piles		
			E - Rock mound		
			F - Filled depression		
1916	D15-07	Reinecke 75	Complex (9)	Hab.	Barrera 1985a, Donham 1987, Cordy 1986b
			A - Platform		
			B - Platform		
			C - Platform		
			D - Large Paved area		
			E - Rubble pile		
			F - Pavement		
			G - Walled cave shelter		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			H - Coral concentration		
			I - Alignment		
1917	D15-20	Barrera (1985a) T-40	Complex	Hab.	Barrera 1985b
			A - Walled shelter		
			B - Wall segment		
			C - Lava Blister cave		
1918	D15-09	Barrera (1985a) T-41	Walled shelter	Hab.	Barrera 1985b
1919	D15-10	Barrera (1985a) T-35	Walled shelter	Hab.	Barrera 1985b
5901			Complex (39)+	Temp. Hab.	Rosendahl 1980
			A - Papamu		
			B - Walled shelter		
			C1 - Papamu		
			C2 - Papamu		
			C3 - Papamu		
			C4 - Platform		
			C5 - Cupboard		
			D1 - Walled shelter		
			D2 - Cairn		
			E1 - Walled shelter		
			E2 - Rubble pile		
			F1 - Walled shelter		
			F2 - Rubble pile		
			G - Platform		
			H - Platform		
			I - Platform		
			J - Walled shelter		
			K - Walled shelter		
			L - Filled depression		
			M - Filled depression		
			N - Rest. Lighthouse Found.		
			O - Filled depression		
			P - Platform		
			Q - Modified sinkhole		
			R - Surf. Art. concentration		
			S - Cupboard		
			T - Walled shelter		
			U - Modified sinkhole		
			V - Stone circle		
			W - Surf. Art. concentration		
			X1 - Platform		
			X2 - Cyst/Crypt		
			Y1 - Platform		
			Y2 - Petroglyphs		
			Y3 - Platform		
			Z - Petroglyphs		
			AA - Walled shelter		
			BB - Surf. Art. concen.		
			CC1 - Walled shelter		
			CC2 - Walled shelter		
			DD1 - Surf. Art. concen.		
			DD2 - Surf. Art. concen.		
			EE - Stone circle		
			FF - Cairn		
5902	D15-89		Complex	Temp. Hab.	Rosendahl 1980
			A - Petroglyph		
			B - Papamu		
			C - Grinding depression		
			D - Pecked area		
			E - Cairn		
			F - Cave shelter		
			G - Wall		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			H - Cairn		
			I - Stone pile		
5603	015-62	Barrera (1985a) T-36	Cave	Hab.	Barrera 1985a
5604	015-59	Barrera (1985a) T-33	Complex (4)	Temp. Hab.	Barrera 1985a
			A - Cave		
			B - Cairn		
			C - Cairn		
			D - Cairn		
5605	015-88		Overhang Shelter	Temp. Hab.	Rosendahl 1980
5606			Cairn	Indeterminate	Rosendahl 1980
5607			Cairn	Indeterminate	Rosendahl 1980
5696			Pits	Quarry	MLK Rosendahl 1989
5697			Complex	Ceremonial/ Hab.	MLK Rosendahl 1989
5698			Mound	Marker	MLK Rosendahl 1989
5699			Wall	Boundary/ Ag.	MLK Rosendahl 1989
5745			Wall	Boundary	Walker & Rosendahl 1990b
5746			Wall	Boundary	Walker & Rosendahl 1990b
5747			Wall	Boundary	Walker & Rosendahl 1990b
5748			Enclosure	Hab.	Walker & Rosendahl 1990b
5749			Complex (4)	Hab.-Ag.	Walker & Rosendahl 1990b
			A - Overhang		
			B - Retaining Wall		
			C - Pit		
			D - Pit		
5750			Complex (2)	Hab.	Walker & Rosendahl 1990b
			A - Overhang		
			B - Terrace		
5751			Complex (17)	Hab.-Refuge-Burial-Water catchment	Walker & Rosendahl 1990b
			A - Cave/Lava tube		
			B - Terrace		
			C - Terrace		
			D - Terrace		
			E - Pit complex		
			F - Cave/Lava tube		
			G - Terrace		
			H - Terrace		
			I - Wall		
			J - Wall		
			K - Wall		
			L - Terrace		
			M - Wall		
			N -	C -shape	
			O - Wall		
			P - Alignment		
			Q - Alignment		
5752			Complex (2)	Indeterminate	Walker & Rosendahl 1990b
			A - Mound		
			B - Mound		
5753			Cave/Lava Tube	Hab.-Refuge	Walker & Rosendahl 1990b
5754			Complex (4)	Hab.-Rock Art	Walker & Rosendahl 1990b
			A - Cave/Lava tube		
			B - Terrace		
			C - Cave/Lava tube		
			D - Terrace		
5755			Complex (4)	Hab.	Walker & Rosendahl 1990b
			A - Platform		
			B - Terrace		
			C - Platform		
			D - Cave/Lava tube		
5756			Complex (3)	Hab.-Ag.	Walker & Rosendahl 1990b
			A - Cave/Lava tube		

State #	BPBM #	Other Site #	Formal Type	*Tentative Functional Interpretation	References
			B - Platform		
			C - Mound		
5757			Complex (3)	Hab.	Walker & Rosendahl 1990b
			A - Cave/Lava tube		
			B - Terrace		
			C - Terrace		
5758			Cave/Lava tube	Hab.	Walker & Rosendahl 1990b
5759			Cave/Lava tube	Hab.-burial	Walker & Rosendahl 1990b
5760			Trail	Transportation	Walker & Rosendahl 1990b
5761			Complex (3)	Hab.	Walker & Rosendahl 1990b
			A - C -shape		
			B - Cave/Lava tube		
			C - Terrace		
5762			Platform	Poss. burial	Walker & Rosendahl 1990b
5763			Trail	Transportation	Walker & Rosendahl 1990b
5764			Complex (10)	Hab.	Walker & Rosendahl 1990b
			A - Cave/Lava Tube		
			B - Terrace		
			C - Terrace		
			D - Mound		
			E - Paved area		
			F - Mound		
			G - Boulder alignment		
			H - Terrace		
			I - Terrace		
			J - C -shape		
5765			Cairn	Marker	Walker & Rosendahl 1990b
5766			Cairn	Marker	Walker & Rosendahl 1990b
5767			Cairn	Marker	Walker & Rosendahl 1990b
5768			Pahoehoe Excav.	Quarry	Walker & Rosendahl 1990b
5769			Pahoehoe Excav.	Quarry	Walker & Rosendahl 1990b
5770			Complex (2)	Quarry	Walker & Rosendahl 1990b
			A - Pahoehoe Excav.		
			B - Pahoehoe Excav.		
5771			Complex (2)	Hab.	Walker & Rosendahl 1990b
			A - Cave/Lava tube		
			B - Cave/Lava tube		
5772			Enclosure	Hab.	Walker & Rosendahl 1990b
5773			Complex (3)	Hab.	Walker & Rosendahl 1990b
			A - Cave/Lava tube		
			B - Platform		
			C - Terrace		
5774			Complex (2)	Hab.	Walker & Rosendahl 1990b
			A - Terrace		
			B - C -shape		
5775			Platform	Marker	Walker & Rosendahl 1990b
5776			Complex (3)	Hab.	Walker & Rosendahl 1990b
			A - Terrace		
			B - Terrace		
			C - Modified outcrop		
5777			Cairn	Marker	Walker & Rosendahl 1990b
5778			Complex (2)	Hab.-burial	Walker & Rosendahl 1990b
			A - Cave/Lava tube		
			B - Cave/Lava tube		
6417	015-74		Complex (10)	Hab./Ag.	Davis 1977
			A - Enclosure		
			B - Enclosure		
			C - Enclosure		
			D - Circular depression		
			E - Circular depression		
			F - Paved path		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			G - Petroglph (historic)		
			H - Enclosure		
			I - Wall		
			J - Enclosure		
6418	D15-73		Cave	Hab.	Davis 1977
6419	D15-71		Complex (3)	Ag / Marker	Davis 1977
			A - Platform		
			B - Enclosure		
			C - Ahu		
6420	D15-70		Cave	Hab.	Hammatt & Folk 1980, Davis 1977
6421	D15-69		Cave	Hab.	Rosendahl 1973, Hammatt & Folk 1980, Davis 1977
6422	D15-79		Complex (3)	Hab / Marker	Davis 1977
			A - Cave		
			B-C - Ahu (2)		
6423	D15-80		Complex (8)	Hab / Marker	Davis 1977
			A - Cave		
			B - Platform		
			C-H - Mounds (6)		
6424			Cave	Hab.	Davis 1977
6425	D15-83		Cave	Hab.	Davis 1977
6426	D15-66		Modified Outcrop	N/a	Davis 1977
6427	D15-85		Cave	Hab.	Davis 1977
6428	D15-84		Ahu (2)	Marker	Davis 1977
6429			Cave	Burial	Davis 1977
6430			Cave	Hab.	Davis 1977
6431	D15-76		Ahu	Marker	Davis 1977
6432	D15-87		Wall	Boundary	Davis 1977
6433			Complex (7)+	Ag / Hab.	Davis 1977
			Enclosures		
			Modified Outcrops		
			Ahu		
			Mounds		
6434			Complex	Hab./Marker	
			Ahu (8)		
			Platform		
			Cave		
6435			Ahu	Marker	Hammatt & Folk 1980, Davis 1977
6436	D15-81		Ahu	Marker	Davis 1977
6437			Ahu	Marker	Rosendahl 1973, Hammatt & Folk 1980, Davis 1977
6961			Walled shelter	Temp. Hab.	Barrera 1979a
6962			Complex (12)	Temp. Hab.	Barrera 1979a
			A - Walled depression (well)		
			B - Mound		
			C - Walled shelter		
			D - C -shape		
			E - Mounds (3)		
			F - C -shape		
			G - Mounds (3)		
			H - Mound		
10151	D15-27	Barrera (1985a) T-1	Midden Scatter	Temp. Hab	Barrera 1985a
10152	D15-28	Barrera (1985a) T-2	Cairn	Indeterminate	Barrera 1985a
10153	D15-29	Barrera (1985a) T-3	Cairn	N/a	Barrera 1985a
10154	D15-30	Barrera (1985a) T-4	Walled shelter	Hab	Rosendahl 1973, Hammatt & Folk 1980, Davis 1977
10155	D15-31	Barrera (1985a) T-5	Cave	Hab	Barrera 1985a
10156	D15-32	Barrera (1985a) T-6	Cairn	N/a	Barrera 1985a
10157	D15-35	Barrera (1985a) T-7	Cairn	N/a	Barrera 1985a
10158	D15-36	Barrera (1985a) T-8	Cleared depression	N/a	Barrera 1985a
10159	D15-36	Barrera (1985a) T-9	Complex (4)	Hab.	Barrera 1985a
			A - C -shape		
			B - C -shape		
			C - C -shape		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
10160	D15-36	Barrera (1985a) T-10	Mound	N/a	Barrera 1985a
10161	D15-37	Barrera (1985a) T-11	Complex (3)+	N/a	Barrera 1985a
			A - Mound		
			B - Dismantled mounds		
			C - C -shape		
10162	D15-38	Barrera (1985a) T-12	Mound	N/a	Barrera 1985a
10163	D15-39	Barrera (1985a) T-13	C -shape	Hab.	Barrera 1985a
10164	D15-40	Barrera (1985a) T-14	Cleared depression	N/a	Barrera 1985a
10165	D15-41	Barrera (1985a) T-15	C -shape	Hab.	Barrera 1985a
10166	D15-42	Barrera (1985a) T-16	Walled blister	Hab.	Barrera 1985a
10167	D15-43	Barrera (1985a) T-17	Mound	N/a	Barrera 1985a
10168	D15-44	Barrera (1985a) T-18	Walled shelter	N/a	Barrera 1985a
10169	D15-45	Barrera (1985a) T-19	Mound	N/a	Barrera 1985a
10170	D15-46	Barrera (1985a) T-20	Enclosure	Hab.	Barrera 1985a
10171	D15-47	Barrera (1985a) T-21	Walled shelter	Hab.	Barrera 1985a
10172	D15-48	Barrera (1985a) T-22	C -shape	Hab.	Barrera 1985a
10173	D15-49	Barrera (1985a) T-23	C -shape	Hab.	Barrera 1985a
10174	D15-50	Barrera (1985a) T-24	Mound	N/a	Barrera 1985a
10175	D15-51	Barrera (1985a) T-25	Walled blister	Hab.	Barrera 1985a
10176	D15-52	Barrera (1985a) T-26	Mound	N/a	Barrera 1985a
10177	D15-53	Barrera (1985a) T-27	Complex (4)	Hab.	Barrera 1985a
			A - Walled shelter		
			B - Walled shelter		
			C - Walled shelter		
			D - Walled shelter		
10178	D15-54	Barrera (1985a) T-28	Petroglyphs (2)	Indeterminate	
10179	D15-55	Barrera (1985a) T-29	Walled shelter	Hab.	Barrera 1985a
10180	D15-56	Barrera (1985a) T-30	Walled shelter	Hab.	Barrera 1985a
10181	D15-57	Barrera (1985a) T-31	Mounds (2)		Barrera 1985a
10182	D15-58	Barrera (1985a) T-32	Complex (3)+	Hab.	Barrera 1985a
			A - Walled shelters		
			B - Mounds		
			C - Midden scatters		
10184	D15-60	Barrera (1985a) T-35	Modified blister	Indeterminate	Barrera 1985a
10185	D15-31	Barrera (1985a) T-37	Midden scatter	Temp. Hab.	Barrera 1985a
10187	D15-64	Barrera (1985a) T-42	Mounds (4)	N/a	Barrera 1985a
10188	D15-65	Barrera (1985a) T-43	Mounds (2)	N/a	Barrera 1985a
10189	D15-66	Barrera (1985a) T-44	Mound	N/a	Barrera 1985a
10190	D15-67	Barrera (1985a) T-45	C -shape	Hab.	Barrera 1985a
10191	D18-13		Complex (2)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
			A - Cave shelter		
			B - Alu		
10192	D18-14		Ophir-shell trail (seg)	Transportation	
10194	D16-05	Reinecke 86a, Rosendahl & Kirch 13	Enclosure		Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
10195	D16-06	Reinecke 86e,i; Rosendahl & Kirch 13	Complex (2)	N/a	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
			A - Platform		Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
			B - Enclosures (3)		
10196	D16-07	Reinecke 86b, Rosendahl & Kirch 13	Enclosure	N/a	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
10197	D16-08	Reinecke 86f	House Foundation	Historic Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
10198	D16-09	Reinecke 86h,j; Rosendahl & Kirch 13	Complex (2)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
			A - Enclosure		
			B - C -shape		
10200	D16-11	Reinecke 86c, Rosendahl & Kirch 13	Enclosure	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998
10201	D16-12		Complex (2)	Hab.	Rosendahl 1990
			A - Enclosure		
			B - Wall		
10205	D15-12	Reinecke 81, Rosendahl & Kirch 8	Complex (3)	Hab./Special purpose	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1998, Barrera 1985b
			A - Enclosure		
			B - Platform		
			C - Platform		
			D - Platform		

State #	BPBM #	Other Site #	Format Type	Tentative Functional Interpretation	References
10206	D15-13		Platform	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
10207	D15-14	Reinecke 83, Rosendahl & Kirch 10	Complex (3)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986
			A - Enclosure		
			B - Enclosure		
			C - Platform		
10208	D15-15	Reinecke 84, Rosendahl & Kirch 11	Complex (10)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986
			A - Enclosure		
			B - Platform		
			C - Boulder scatter		
			D - Cave shelter		
			E - Petroglyph		
			F - Ahu		
			G - Ahu		
			H - Cave shelter		
			I - Walls (2)		
			J - Cave shelter w/ pond (2)		
10209	D15-21		Rock-filled crevices	Indeterminate	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
10210	D15-22		Rock-filled crevice	Indeterminate	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
10211	D15-23	Reinecke 82, Rosendahl & Kirch 9	Complex (2)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
			A - Platform		
			B - Enclosure		
10212	D15-24		Complex (2)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
			A - Modified cave shelter		
			A1 - Platform		
			A2 - Platform		
			A3 - Wall		
			A4 - Wall		
			A5 - Rock pile		
			B - Wall		
10213	D15-25		Complex (2)	N/a	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
			A - Cave shelter		
			B - Platform		
10214	D15-26		Ahu (cairn)	Indeterminate	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
10223	D15-90		Walls	N/a	
10224	D15-91	Soehren (1990) T-1	Platform	N/a	Soehren 1985
10225	D15-92	Soehren (1990) T-2	Platform	N/a	Soehren 1985
10226	D15-93		Complex (3)+	N/a	Soehren 1985
			A - Mounds		
			B - Platform		
			C - Platform		
10227	D15-94	Soehren (1990) T-3	Enclosure w/platform	N/a	Soehren 1985
10306			Complex (11)	Hab.	Barrera 1987
			A - Mound		
			B - Walled shelter		
			C - Mound		
			D - Walled shelter		
			E - Walled shelter		
			F - Walled shelter		
			G - Walled shelter		
			H - Walled shelter		
			I - Mound		
			J - Walled shelter		
			K - Pahoehoe Excav.		
10675	-		Pahoehoe Excav.	Indeterminate	Barrera 1987b
10676	-		Cairn	Marker	Barrera 1987b
10677	-		Cave	Hab.	Barrera 1987b
10678	-		Cave	Indeterminate	Barrera 1987b
10679	-		Complex (2)	Temp. Hab.	Barrera 1987b
			A. Lava tube		
			B. Petroglyphs		
10681	-	-	Enclosure	Ranching	Barrera 1988

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
10684			Platform	Hab./ Poss. burial	Barrera 1988
10685			C-shape	Indeterminate	Barrera 1988
10687			Mound	N/A	Barrera 1988
10688			Retaining wall	N/A	Barrera 1988
10689			Mound	N/A	Barrera 1988
10690			Mound	N/A	Barrera 1988
10691			Mound	N/A	Barrera 1988
10692			Mound	N/A	Barrera 1988
10693			Complex (8)	N/A	Barrera 1988
			A. Platform		Barrera 1988
			B. Platform		Barrera 1988
			C. Mound		Barrera 1988
			D. Mound		Barrera 1988
			E. Terrace		Barrera 1988
			F. Wall		Barrera 1988
			G. Wall		Barrera 1988
			H. Wall		Barrera 1988
10694			Mound/wall	N/A	Barrera 1988
10695			Mound	N/A	Barrera 1988
10696			Mound	N/A	Barrera 1988
10697			Mound/platform	N/A	Barrera 1988
10698			Terrace	N/A	Barrera 1988
10699			Terrace	N/A	Barrera 1988
10700			C-shape	Hab.	Barrera 1988
10701			Terrace	N/A	Barrera 1988
10702			Mound/wall	N/A	Barrera 1988
10703			Mound	N/A	Barrera 1988
10704			Mound/wall	N/A	Barrera 1988
10705			Mound	N/A	Barrera 1988
10706			Mound	N/A	Barrera 1988
10707			Mound	N/A	Barrera 1988
10708			Mound	N/A	Barrera 1988
10709			Mound	N/A	Barrera 1988
10710			Mound	N/A	Barrera 1988
10711			Mound	N/A	Barrera 1988
10712			Mound	N/A	Barrera 1988
10713			Mound	N/A	Barrera 1988
10714			Mound	N/A	Barrera 1988
10715			Mound	N/A	Barrera 1988
10716			Mound	N/A	Barrera 1988
10717			Mound	N/A	Barrera 1988
10718			Mound	N/A	Barrera 1988
10719			Mound	N/A	Barrera 1988
10720			Mound	N/A	Barrera 1988
10721			Mound	N/A	Barrera 1988
10722			Mound	N/A	Barrera 1988
10723			Mound	N/A	Barrera 1988
10724			Terrace	N/A	Barrera 1988
10725			Mound	N/A	Barrera 1988
10726			Mound	N/A	Barrera 1988
10727			Mound	N/A	Barrera 1988
10728			Mound	N/A	Barrera 1988
10729			Mound	N/A	Barrera 1988
10730			Shelter	Hab.	Barrera 1988
10731			Mound	N/A	Barrera 1988
10732			Mound	N/A	Barrera 1988
10733			Mound	N/A	Barrera 1988
10734			Complex (14)	N/A	Barrera 1988
			A. Wall		Barrera 1988
			B. Enclosure		Barrera 1988
			C. Mound		Barrera 1988

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			D. Mound		Barrera 1988
			E. Mound		Barrera 1988
			F. Terrace		Barrera 1988
			G. Mound		Barrera 1988
			H. Shelter		Barrera 1988
			I. Mound		Barrera 1988
			J. Mound		Barrera 1988
			K. Mound		Barrera 1988
			L. Mound		Barrera 1988
			M. Mound		Barrera 1988
10735			Lava Blister/overhang	N/A	Barrera 1988
10736			Walled shelter	N/A	Barrera 1988
10737			Complex (3)	N/A	Barrera 1988
			A. Enclosure		Barrera 1988
			B. Retaining wall		Barrera 1988
			C. Wall		Barrera 1988
10738			Complex (3)	N/A	Barrera 1988
			A. Platform		Barrera 1988
			B. Mound		Barrera 1988
			C. Mound		Barrera 1988
10740			Lava Tube cave	N/A	Barrera 1988
10741			Mound	N/A	Barrera 1988
10742			Mound	N/A	Barrera 1988
10743			Mound	N/A	Barrera 1988
10744			Mound	N/A	Barrera 1988
10745			Platform	Hab.	Barrera 1988
10746			Retaining wall	N/A	Barrera 1988
10747			Wall	N/A	Barrera 1988
10748			Wall segments (3)	N/A	Barrera 1988
10749			Wall segments (2)	N/A	Barrera 1988
10750			Mound	N/A	Barrera 1988
10751			Mound	N/A	Barrera 1988
10752			Mound	N/A	Barrera 1988
10753			Mound	N/A	Barrera 1988
10754			Mound	N/A	Barrera 1988
10755			Mound	N/A	Barrera 1988
10756			Platform	N/A	Barrera 1988
10757			Mound	N/A	Barrera 1988
10758			Wall	N/A	Barrera 1988
10759			Retaining wall	N/A	Barrera 1988
10760			Mound	N/A	Barrera 1988
10761			Mound	N/A	Barrera 1988
10762			Terrace	N/A	Barrera 1988
10763			Terrace	N/A	Barrera 1988
10764			Rubble pile	N/A	Barrera 1988
10765			Cistern	Water catchment	Barrera 1988
10766			Retaining Wall	N/A	Barrera 1988
10767			Mound	N/A	Barrera 1988
10768			Mound	N/A	Barrera 1988
10769			Mound	N/A	Barrera 1988
10770			Platform	N/A	Barrera 1988
10771			Platform	Hab.	Barrera 1988
10772			Platform	N/A	Barrera 1988
10773			Platform	N/A	Barrera 1988
10774			Mound	N/A	Barrera 1988
10775			Mound	N/A	Barrera 1988
10776			Terrace	N/A	Barrera 1988
10777			Platform	N/A	Barrera 1988
10778			Platform	N/A	Barrera 1988
10779			Mound	N/A	Barrera 1988
10780			Modified Lava blister	N/A	Barrera 1988

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
10781			Mound	N/A	Barrera 1988
10783			Retaining wall	N/A	Barrera 1988
10784			Mound	N/A	Barrera 1988
10785			Platform	N/A	Barrera 1988
10786			Mound	N/A	Barrera 1988
10787			Mound	N/A	Barrera 1988
10788			Platform	N/A	Barrera 1988
10789			Mound	N/A	Barrera 1988
10790			Mound	N/A	Barrera 1988
10791			Wall	N/A	Barrera 1988
10792			Mound	N/A	Barrera 1988
10793			Platform	N/A	Barrera 1988
10794			Wall	N/A	Barrera 1988
10795			Platform	Hab	Barrera 1988
10796			Mound	N/A	Barrera 1988
10797			Mound	N/A	Barrera 1988
10798			Mound	N/A	Barrera 1988
10799			Mound	N/A	Barrera 1988
10800			Mound	N/A	Barrera 1988
10801			Mound	N/A	Barrera 1988
10888			Mound	N/A	Barrera 1988
10889			Mound	N/A	Barrera 1988
10890			Mound	N/A	Barrera 1988
10891			Mound	N/A	Barrera 1988
10892			Mound	N/A	Barrera 1988
10893			Mound	N/A	Barrera 1988
10894			L-shape	N/A	Barrera 1988
10896			Mound	N/A	Barrera 1988
10898			Mound	N/A	Barrera 1988
10897			Mound	N/A	Barrera 1988
10898			Mound	N/A	Barrera 1988
10899			Mound	N/A	Barrera 1988
10900			L-shape	N/A	Barrera 1988
10901			Mound	N/A	Barrera 1988
10902			Mound	N/A	Barrera 1988
10903			Mound	N/A	Barrera 1988
10904			Mound	N/A	Barrera 1988
10905			Mound	N/A	Barrera 1988
10906			Mound/wall	N/A	Barrera 1988
10907			Mound	N/A	Barrera 1988
10908			Mound	N/A	Barrera 1988
10909			Mound	N/A	Barrera 1988
10910			Wall	N/A	Barrera 1988
10911			Mound	N/A	Barrera 1988
10958			Complex (3)+	Ag	Walker & Haun 1987, 1988
			A - Mound		
			B - Pit		
			C - Pit		
10993			Complex (7)	Hab./Ceremonial	Walker & Haun 1987, 1988
			A - Cave		
			B - Terrace		
			C - Leveled area		
			D - Pit		
			E - Wall		
			F - Mound		
			G - Mound		
10995			Complex (12)+	Ag	Walker & Haun 1987, 1988
			A - Terrace/mound		
			B - Mound		
			C - Mound		
			D - Terrace/mound		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			E - Mound		
			F - C -shape		
			G - Mound		
			H - Mound		
			I - Mound		
			J - Mound		
			K - Mound		
			L - Mound		
11271			Wall	Boundary	Walker & Rosendahl 1990c
14135			Cave	Temp. Hab.	Thompson & Goodfellow 1992, Walker & Rosendahl 1990b, Tekea & Rosendahl 1987
14136			Complex (2)	Permanent Hab.	Thompson & Goodfellow 1992, Walker & Rosendahl 1990b, Tekea & Rosendahl 1987
			A - Cave		
			B - Stepped Platform		
14137			Complex (7)	Permanent Hab.	Soehren 1982
			A - Wall		
			B - Stepped platform		
			C - Platform		
			D - Linear Mound		
			E - Platform		
			F - C -shape		
			G - Mound		
14138			Complex (3)	Ag.	Walker & Rosendahl 1990c
			A - Terrace		
			B - Terrace		
			C - Platform		
14139			Water trough	Animal Husbandry	Walker & Rosendahl 1990c
14140			Complex (4)	Hab.-refuge	Walker & Rosendahl 1990c
			A - Wall		
			B - Terrace		
			C - Cave		
			D - Cave		
14141			Terrace	Indeterminate	Walker & Rosendahl 1990c
14142			Mound	Ag.	Walker & Rosendahl 1990c
14143			Terrace	Ag.	Thompson & Goodfellow 1992, Walker & Rosendahl 1990b, Tekea & Rosendahl 1987
14565			Complex (51)+	Ag.	Soehren 1982
			Area T -102 -		
			A - Wall		
			B - Terrace		
			C - Platform		
			D - Terrace		
			E - Terrace		
			F - Terrace		
			G - Pit		
			Area T -101 -		
			A - Mounds (10)		
			B - Pits (33)		
			C - Wall		
14566	D14-03		Complex (25)	Permanent Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Enclosure		
			C - Platform		
			D - Cave shelter		
			E - Cave shelter		
			F - Enclosure		
			G - Walled depression		
			H - Walled overhang		
			I - Pavement		
			J - Cave shelter		
			K - Petroglyph (papamoi)		
			L - Enclosure		
			M - Pavement burial		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			N - Terrace		
			O - Terrace		
			P - Cave shelter		
			S - Walled depression		
			T - Wall		
			U - Overhang shelter		
			V - Cave shelter		
			W - Pavement		
			X - Cairn		
			Y - Cairn		
			Z - Cupboard		
			AA - Steppingstone Trail		
14570			Complex (2)	Temp. Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Cave shelter		
14571			Complex (2)	Temp. Hab./Poss. ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Cave shelter		
14572			Complex (3)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Alignment		
			C - Cave shelter		
14574			Complex (2)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Walled overhang		
14579		10-27-03	Walled depression	Ag	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
14580	D14-01		Complex (4)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Overhang shelter		
			B - Terrace		
			C - Terrace		
			D - Petroglyph		
14583	D14-06		Complex (30)	Permanent Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Pavement		
			B - Enclosure/ pavement		
			C - Walled depression		
			D - Walled depression		
			E - Walled overhang		
			F - Walled overhang		
			G - Wall		
			H - Wall		
			I - Walled depression		
			J - Walled overhang		
			K - Walled depression		
			L - Walled depression		
			M - Walled depression		
			N - Filled depression		
			O - Cairn		
			P - Quarry		
			Q - Walled depression		
			R - Walled overhang		
			S - Quarry		
			T - Walled overhang		
			U - Walled overhang		
			V - Walled depression		
			W - Walled overhang		
			X - Quarry		
			Y - Walled depression		
			Z - Cairn		
			AA - Filled depression		
			BB - Filled depression		
			CC - Walled depression		

Site #	BPBM #	Other Site #	Formal Type	*Tentative Functional Interpretation	References
			DD - Walled depression		
14584			Complex (2)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Overhang shelter		
			B - Cave shelter		
14587			Complex (9)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Overhang shelter		
			C - Pavement		
			D - Pavement		
			E - Cairn		
			F - Cairn		
			G - Cairn		
			H - Cairn		
			I - Cairn		
14591			Complex (2)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992 -
			A - Overhang shelter		
			B - Pavement		
14594			Complex (12)	Marker/ Temp Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cairn		
			B - Cairn		
			C - Cairn		
			D - Cairn		
			E - Cairn		
			F - Cairn		
			H - Cairn		
			I - Cairn		
			J1 - Cairn		
			J2 - Cave		
			J3 - Cairn		
			K - Cairn		
			L - Cairn		
			M - Cairn		
			N - Cairn		
			O - Cairn		
14595			Complex (14)	Temp. Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Wall		
			B - Enclosure		
			C - Platform		
			D - Rock mound		
			E - Platform		
			F - Wall		
			G - Platform		
			H - Wall		
			I - Wall		
			J - Wall		
			K - Rock Mound		
			L - Cave shelter		
			M - Platform		
			N - Platform		
14599			Complex (3)	Temp. Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Overhang Shelter		
			B - Wall		
			C - Wall		
14609			Complex (4)	Temp. Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Cave shelter		
			C - Walled Depression		
			D - Cairn		
14611			Complex (9)	Temp. Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Walled depression		
			B - Pavement		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			C - Overhang shelter		
			D - Overhang shelter		
			E - Terrace		
			F - Cairn		
			G - Terrace		
			H - Terrace		
			I - Filled depression		
14620			Complex (3)	Temp. Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Overhang shelter		
			B - Overhang shelter		
			C - Platform		
14622			Wall	Aquaculture	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
14624			Complex (3)	Temp. Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cave shelter		
			B - Cairn		
			C - Cairn		
14626			Complex (2)	Ag.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Enclosure		
			B - Pavement		
14627			Complex (4)	Permanent Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Wall		
			B - Enclosure		
			C - Terrace		
			D - Terrace		
14629	D14-02		Complex (22)	Permanent Hab./ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Pavement		
			C - Enclosure		
			D - Terrace		
			E - Terrace		
			F - Terrace		
			G - Terrace		
			H - Filled depression		
			I - Filled depression		
			J - Terrace		
			K - Terrace		
			L - Filled depression		
			M - Filled depression		
			N - Cairn		
			O - Midden		
			P - Midden		
			Q - Midden		
			R - Pavement		
			S - Alignment		
			T - Filled depression		
			U - Cairn		
			V - Steppingstone Trail		
14630	D14-09		Complex (5)	Permanent Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Platform		
			C - Platform		
			D - Platform		
			E - Modified outcrop		
14631	D14-10		Complex (3)	Permanent Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Platform		
			B - Enclosure		
			C - Wall		
14632		10-27-12	Complex (10)	Permanent Hab.	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Wall		
			B - Filled depression		
			C - Wall		

State #	BPBM #	Other Site #	Formal Type	*Tentative Functional Interpretation	References
			D - Midden		
			E - Rock Mound		
			F - Fitted depression		
			G - Rock mound		
			H - Midden		
			I - Midden		
			J - Midden		
15132			Petroglyph (papamu)	Recreation	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
15133			Complex (7)	Recreation/ ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Petroglyph (turtle)		
			B - Petroglyph (human)		
			C - Petroglyph (human)		
			D - Petroglyph (human)		
			E - Petroglyph (spiral)		
			F - Petroglyph (human)		
			G - Petroglyph (human)		
15134			Petroglyph	Recreation/ ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
15135			Alignment	Indeterminate	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
15136			Fitted Depression	Indeterminate	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
15137			Cave	Burial/ ceremonial	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
15138			Complex (3)	Indeterminate	Cordy 1981, Rosendahl 1985, O'Hare & Goodfellow 1992
			A - Cairn		
			B - Enclosure		
			C - Enclosure		
16080			Pahoehoe Excav.	Indeterminate	Barrera 1987b
16096			Enclosure	Boundary	O'Hare & Rosendahl 1991
16097			Complex (5)	Ag / Hab.	O'Hare & Rosendahl 1991
			A - Platform		
			B - Lava Blister		
			C - Rock Mound		
			D - Rock Mound		
			E - Terraces		
16098			Complex (16)	Ag / Hab.	O'Hare & Rosendahl 1991
			A - Enclosure		
			B - Lava Blister		
			C - Terrace		
			D - Terrace		
			E - Terrace		
			F - Cairn		
			G - Rock Fragment		
			H - Lava Blister		
			I - Enclosure		
			J - Lava Blister		
			K - Terrace		
			L - Cairn		
			M - Enclosure		
			N - Terrace		
			O - Cairn		
			P - Cairn		
16099			Complex (2)	Ag / Hab.	O'Hare & Rosendahl 1991
			A - Enclosure		
			B - C shape		
16100			Complex (3)	Ag / Hab.	O'Hare & Rosendahl 1991
			A - Enclosure		
			B - Lava Blister		
			C - Cairn		
16101			Platform	Ag	O'Hare & Rosendahl 1991
16102			Complex (3)	Ag / Hab.	O'Hare & Rosendahl 1991
			A - Terrace		
			B - Terrace		
			C - Platform		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
18076			Pahoehoe Excav.	Quarry	Davis 1977, Dowden & Graves 1992
18077			Complex (2)	Quarry	Hammatt & Folk 190, Davis 1977, Dowden & Graves 1992
			A - Pahoehoe Excav.		
			B - Pahoehoe Excav.		
18078			Pahoehoe Excav.	Quarry	Rosendahl 1973, Hammatt & Folk 1980, Davis 1977
18079			Complex (3)	Quarry	Rosendahl 1973, Hammatt & Folk 1980, Davis 1977
			A - Pahoehoe Excav.		
			B - Pahoehoe Excav.		
			C - Pahoehoe Excav.		
18713		Walker & Rosendahl (1990a) 802-1	Linear Mound	Boundary	Walker & Rosendahl 1990a
18714		Walker & Rosendahl (1990a) 802-2	Mound	Ag	Walker & Rosendahl 1990a
18715		Walker & Rosendahl (1990a) 802-3	Mound	Ag	Walker & Rosendahl 1990a
18716		Walker & Rosendahl (1990a) 802-4	Enclosure	Hab.	Walker & Rosendahl 1990a
18717		Walker & Rosendahl (1990a) 802-5	Complex (3)	Transportation/ Hab.	Walker & Rosendahl 1990a
			A - Cairn		
			B - Trail		
			C - Enclosure		
18718		Walker & Rosendahl (1990a) 802-6	Complex (12)	Ag / Hab.	Walker & Rosendahl 1990a
			A-I - Mounds		
			J - Enclosure		
			K-L - Mounds		
18719		Walker & Rosendahl (1990a) 802-7	Cave	Burial	Walker & Rosendahl 1990a
18720		Walker & Rosendahl (1990a) 802-8	Cairn	Marker	Walker & Rosendahl 1990a
18721		Walker & Rosendahl (1990a) 802-9	Cave	Hab.	Walker & Rosendahl 1990a
18722		Walker & Rosendahl (1990a) 802-11	Complex (2)	Indeterminate/ Marker	Walker & Rosendahl 1990a
			A - Boulder alignment		
			B - Cairn		
18723		Walker & Rosendahl (1990a) 802-12	Caves (2)	Hab.	Walker & Rosendahl 1990a
18724		Walker & Rosendahl (1990a) 802-13	Terrace	Hab.	Walker & Rosendahl 1990a
18760		Walker & Rosendahl (1990a) 802-10	Cave	Hab.	Walker & Rosendahl 1990a
18761		Barrera (1985b) T-01	Complex (4)	Indeterminate	Barrera 1985b, Donham 1987
			A - Cairn		
			B-D - Pahoehoe Clearings		
18762		Barrera (1985b) T-02	Pahoehoe Clearing	Indeterminate	Barrera 1985b, Donham 1987
18763		Barrera (1985b) T-03	Cairns (2)	Indeterminate	Barrera 1985b, Donham 1987
18764		Barrera (1985b) T-04	Complex (4)	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
			A - Cave shelter		
			B - Walled shelter		
			C-D - Cairns		
18765		Barrera (1985b) T-05	Mod. Overhang Shelter	Temp. Hab.	Barrera 1985b, Donham 1987
18766		Barrera (1985b) T-06	Cave Shelter	Temp. Hab.	Barrera 1985b, Donham 1987
18767		Barrera (1985b) T-07	Cave Shelter	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18768		Barrera (1985b) T-08	Complex (4)	Indeterminate	Barrera 1985b, Donham 1987
			A-C - Cairns		
			D - Rubble pile		
18769		Barrera (1985b) T-09	Cairns (2)	Indeterminate	Barrera 1985b, Donham 1987, Cordy 1986b
18770		Barrera (1985b) T-10	Cairns (3)	Indeterminate	Barrera 1985b, Donham 1987
18771		Barrera (1985b) T-11	Cave shelter	Temp. Hab.	Barrera 1985b, Donham 1987
18772		Barrera (1985b) T-12	Cave Shelter	Temp. Hab.	Barrera 1985b, Donham 1987
18773		Barrera (1985b) T-13	Mound	Burial	Barrera 1985b, Donham 1987
18774		Barrera (1985b) T-14	Complex (5)	Permanent Hab /ceremonial	
			A - Filled blister		
			B - Coral pavement		
			C - Coral pavement		
			D - Filled Depression		
			E - Cairn		
18775		Barrera (1985b) T-15	Complex (7)	Permanent Hab.	Barrera 1985b, Donham 1987
			A - Faced wall		
			B - Pavement		
			C - Overhang shelter		
			D - Overhang shelter		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			E - Wall		
			F - Large cairn		
			G - Faced terrace		
18776		Barrera (1985b) T-16	Wall	Indeterminate	Barrera 1985b, Donham 1987
18777		Barrera (1985b) T-17	Complex (4)		Barrera 1985b, Donham 1987
			A - Walled sinkhole		
			B - Cave shelter		
			C - Low platform		
			D - Surface midden		
18778		Barrera (1985b) T-18	Wall	Hab.	Barrera 1985b, Donham 1987
18779		Barrera (1985b) T-19	Complex (3)	Transportation	Barrera 1985b, Donham 1987
			A - Trail		
			B-D - Cairns		
18780		Barrera (1985b) T-20	Platform	Burial/shrine	Barrera 1985b, Donham 1987, Cordy 1986b
18781		Barrera (1985b) T-21	Rock mound	Poss. burial	Barrera 1985b, Donham 1987, Cordy 1986b
18782		Barrera (1985b) T-22	Complex (3)	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
			A - Cave shelter		
			B - Petroglyphs		
			C - L -shaped wall		
18783		Barrera (1985b) T-23	Walled shelter	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18784		Barrera (1985b) T-24	Cave shelter	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18785		Barrera (1985b) T-25	C -shaped wall	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18786		Barrera (1985b) T-26	Footpath	Transportation	Barrera 1985b, Donham 1987, Cordy 1986b
18787		Barrera (1985b) T-27	Cave shelter	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18791		Barrera (1985b) T-31	Complex (3)	Ceremonial	Barrera 1985b, Donham 1987
			A - Coral pave./terrace		
			B-C - Cairns		
18793		Barrera (1985b) T-33	Cairn	Indeterminate	
18797		Barrera (1985b) T-37	C -shape	Hab.	
18799		Barrera (1985b) T-39	Collapsed Lava tube	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
			A - Terrace		
			B - Terrace		
			C - Terrace		
			D - Terrace		
18801		Barrera (1985b) T-41	Complex (4)	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
			A - Cave shelter		
			B - Cleared area		
			C - Cupboard		
			D - Faced Excav.		
18802		Barrera (1985b) T-42	Walled blister	Indeterminate	Barrera 1985b, Donham 1987, Cordy 1986b
18803		Barrera (1985b) T-43	Complex (3)	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
			A - Cave shelter		
			B - Cave shelter		
			C - Cave shelter		
18804		Barrera (1985b) T-44	C -shape	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18805		Barrera (1985b) T-45	Overhang shelter	Temp. Hab.	Barrera 1985b, Donham 1987, Cordy 1986b
18806		Barrera (1985b) T-46	Cairns (2)	Indeterminate	Barrera 1985b, Donham 1987, Cordy 1986b
18807		Barrera (1985b) T-47	Complex (2)+	Temp. Hab.	
			A - Overhang shelter		
			B - Cave shelter		
18808		Barrera (1985b) T-48	Complex (4)	Permanent Hab./Burial	Barrera 1985b, Donham 1987
			A - Platform		
			B - Salt pan stone		
			C - Platform		
			D - Wall		
18809		Barrera (1985b) T-49	Platform	Permanent Hab.	Barrera 1985b, Donham 1987
18810		Barrera (1985b) T-50	Pahoehoe Clearing	Temp. Hab.	Barrera 1985b, Donham 1987
18811		Barrera (1985b) T-51	Complex (2)	Temp. Hab.	Barrera 1985b, Donham 1987
			A - C -shaped wall		
			B - U -shaped wall		
18812		Barrera (1985b) T-52	Modified Outcrop	Temp. Hab.	Barrera 1985b, Donham 1987

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
18813		Barrera (1985b) T-53	Complex (4)	Transportation	Barrera 1985b, Donham 1987
			A - Path		
			B-D - Cairns		
18814		Barrera (1985b) T-54	Faced Excav.	Storage	Barrera 1985b, Donham 1987
18815		Barrera (1985b) T-55	Complex (3)	Temp Hab./Quarry	Barrera 1985b, Donham 1987
			A - C -shaped wall		
			B - Modified Outcrop		
			C - Modified Outcrop		
18816		Barrera (1985b) T-56	Complex (3)	Quarry	Barrera 1985b, Donham 1987
			A - Cairn		
			B - Pahoehoe Excav.s (6)		
			C - Pahoehoe Excav.s (6)		
18817		Barrera (1985b) T-57	Complex (3)	Temp. Hab.	
			A - C -shaped wall		
			B - C -shaped wall		
			C - Cairn		
18818		Barrera (1985b) T-58	Complex (3)	Temp. Hab.	Barrera 1985b, Donham 1987
			A - Modified Outcrop		
			B - Cairn		
			C - Wall		
18819		Barrera (1985b) T-59	Walled Shelter	Temp. Hab.	
18820		Barrera (1985b) T-60	Complex (2)	Permanent Hab.	Barrera 1985b, Donham 1987
			A - Hearth		
			B - Stone alignment		
18821		Barrera (1985b) T-61	Complex (7)	Temp. Hab.	Barrera 1985b, Donham 1987
			A - Cave shelter		
			B - Cave shelter		
			C - Overhang shelter		
			D - Overhang shelter		
			E - Cairn		
			F - Rubble pile		
			G - Rubble pile		
			H - Overhang shelters (2)		
18822		Barrera (1985b) T-62	Platform	Poss. burial	Barrera 1985b, Donham 1987
18823		Barrera (1985b) T-63	Complex (13)	Permanent Hab.	Barrera 1985b, Donham 1987
			A - Cairn/mound		
			B - Cairn		
			C - Rubble pile		
			D - Rubble pile		
			E - Pavement		
			F - Enclosure		
			G - Rubble pile		
			H - Rubble pile		
			I - Alignment		
			J - Modified outcrop		
			K - Cairn/shrine		
			L - Large cairn		
			M - Cave shelter		
18824		Barrera (1985b) T-64	Complex (18)	Permanent Hab.	Barrera 1985b, Donham 1987
			A - C -shaped wall		
			B - Excav.s (2)		
			C - Overhang shelters		
			D - Rubble piles (2)		
			E - Rubble pile		
			F - Walled shelter		
			G - Rubble pile		
			H - C -shaped wall		
			I - Pavement		
			J - Walled, filled crevice		
			K - Rubble pile		
			L - Cairns (2)		

State #	BPBM #	Other Site #	Formal Type	Tentative Functional Interpretation	References
			M - Modified outcrop		
			N - Surface midden/rubble		
			O - Cave shelter		
			P - Cairn		
			Q - Cleared blister shelter		
			R - Enclosure		
18825		Barrera (1985b) T-65	Walls (partial)	Indeterminate	Barrera 1985b, Donham 1987
18826		Barrera (1985b) T-66	Complex (9)	Permanent Hab.	Barrera 1985b, Donham 1987
			A - C -shaped wall		
			B - Cairns (3)		
			C - Walled depression		
			D - U -shaped wall		
			E - Rubble piles (3)		
18827		Barrera (1985b) T-67	Complex (17)	Permanent Hab.	Barrera 1985b, Donham 1987
			A - Cave shelter		
			B - Cave shelter		
			C - Large cairn		
			D - Cairn		
			E - Pahoehoe Excav.s (3)		
			F - Cairn		
			G - Walled shelter		
			H - Cairn		
			I - Rubble-filled deprsn.		
			J - Cave shelter		
			K - Small cairn		
			L - Modified overhang		
			M - Alignment		
			N - Pahoehoe clearing		
			O - Pahoehoe clearing		
			P - Cairn		
			Q - Modified overhangs (2)		
18828		Barrera (1985b) T-68	Modified Blister	Indeterminate	Barrera 1985b, Donham 1987
18829		Barrera (1985b) T-69	Complex (7)	Temp. Hab.	Barrera 1985b, Donham 1987
			A - Walled shelter		
			B - Walled shelter		
			C - Cairn		
			D - Alignment/ surf. rubble		
			E - Cairn		
			F - Rubble pile		
			G - Rubble pile		
18830		Barrera (1985b) T-70	Complex (3)	Temp. Hab.	Barrera 1985b, Donham 1987
			A - C -shape		
			B - C -shape		
			C - Cairn		
18831		Barrera (1985b) T-71	Steppingstone Trail	Transportation	Barrera 1985b, Donham 1987
18832		Barrera (1985b) T-72	Rubble pile	Indeterminate	
18833		Barrera (1985b) T-73	Cairns (2)	Indeterminate	Barrera 1985b, Donham 1987
18834		Barrera (1985b) T-34	Complex (4)	Hab.	Rosendahl & Kirch 1975, Rogers-Jourdane 1978, Clark 1984, Cordy 1986, Barrera 1985b
			A - Walled shelter		
			B - Walled shelter		
			C - Canoe shed		
			D - Mound		

APPENDIX B:

Summary of Sites and Features Identified During the Current Project

State Site No.	Feature No.	Feature Type	PHRI Temp. Field No.	Transect No.
18449		Pahoehoe trail	1275-8	3
18450		Terrace	1275-33	3
18451		Modified outcrop	1275-34	3
18452		Modified outcrop	1275-35	3
18453	A	House platform	1275-65	5
18453	B	Mound (2)	1275-65	5
18454	A	Cave	1275-93	5
18454	B	Terrace	1275-93	5
18455	A	Cave	1275-115	5
18455	B	Modified outcrop	1275-115	5
18456		Modified lava tube	1275-120	5
18457		Cave	1275-122	5
18458		Pahoehoe trail	1275-123	5
18459		Modified lava tube	1275-125	5
18460		Modified lava tube	1275-126	5
18461		Modified blister	1275-127	5
18462		Cave	1275-128	5
18463		Modified lava tube	1275-131	1
18464		Modified lava tube	1275-132	1
18465		Cave	1275-137	1
18466		Cave	1275-138	1
18467		Cave	1275-139	1
18468	A	Cave	1275-144	1
18468	B	Modified outcrop	1275-144	1
18468	C	Pavement	1275-144	1
18468	D	Mound (2)	1275-144	1
18469		Pahoehoe trail	1275-151	6
18470	A	Petroglyph	1275-159	6
18470	B	Filled crack	1275-159	6
18470	C	Modified outcrop	1275-159	6
18471		Pahoehoe excavation	1275-182	6
18472		Modified outcrop	1275-183	6
18473		Petroglyphs	1275-192	4
18474		Modified lava tube	1275-209	4
18475		Modified outcrop	1275-210	4
18476		Modified outcrop	1275-211	4
18477		*Ahu*	1275-212	4
18478		Modified lava tube	1275-255	2
18479		Modified lava tube	1275-256	2
18480		Modified outcrop	1275-257	2
18481		Cave	1275-261	7
18519		Modified outcrop	1275-213	4
18524		Pahoehoe excavation	1275-129	5
18529	A	Modified blister	1275-130	1
18529	B	Modified outcrop (2)	1275-133	1
18529	C	Pahoehoe excavation	1275-134	1
18529	D	Mound	1275-135	1
18529	E	L-Shape	1275-136	1
18529	F	Enclosure	1275-140	1
18529	G	Pahoehoe excavation	1275-141	1
18529	H	Mound	1275-142	1

State Site No.	Feature No.	Feature Type	PHRI Temp. Field No.	Transect No.
18529	I	Modified outcrop	1275-143	1
18529	J	Modified outcrop (2)	1275-145	1
18529	K	Pahoehoe excavation	1275-146	1
18530	A	Enclosure	1275-214	2
18530	B	Modified outcrop	1275-215	2
18530	C	Modified outcrop	1275-216	2
18530	D	Modified outcrop	1275-217	2
18530	E	Modified outcrop	1275-218	2
18530	F	Modified outcrop	1275-219	2
18530	G	Modified outcrop (4)	1275-220	2
18530	H	Modified outcrop (2)	1275-221	2
18530	H1	Modified blister	1275-221	2
18530	I	Modified outcrop (3)	1275-222	2
18530	J	Modified outcrop (2)	1275-223	2
18530	K	Modified outcrop (3)	1275-224	2
18530	L	Modified outcrop	1275-225	2
18530	M	Modified outcrop	1275-226	2
18530	N	Modified outcrop	1275-227	2
18530	O	Modified outcrop	1275-228	2
18530	P	Modified outcrop (3)	1275-229	2
18530	Q	Modified outcrop	1275-230	2
18530	R	Modified outcrop	1275-231	2
18530	S	Modified outcrop	1275-232	2
18530	T	Modified outcrop	1275-233	2
18530	U	Modified outcrop	1275-234	2
18530	V	Modified outcrop	1275-235	2
18530	W	Modified outcrop	1275-236	2
18530	W1	Mound	1275-236	2
18530	X	Modified outcrop	1275-237	2
18530	Y	Modified outcrop	1275-238	2
18530	Z	Modified outcrop	1275-239	2
18530	AA	Modified outcrop (6)	1275-240	2
18530	AA1	Mound	1275-240	2
18530	AB	Modified outcrop	1275-241	2
18530	AC	Modified outcrop	1275-242	2
18530	AD	Mound	1275-243	2
18530	AE	Modified outcrop (3)	1275-244	2
18530	AF	Modified outcrop	1275-245	2
18530	AF1	Wall	1275-245	2
18530	AG	Modified outcrop (2)	1275-246	2
18530	AH	Modified outcrop	1275-247	2
18530	AI	Modified outcrop (2)	1275-248	2
18530	AI1	Mound	1275-248	2
18530	AJ	Enclosure	1275-249, AS-16	2
18530	AJ1	Platform	1275-249	2
18530	AK	Mound	1275-250	2
18530	AL	Modified outcrop	1275-251	2
18530	AM	Modified outcrop (3)	1275-252	2
18530	AM1	Filled crack	1275-252	2
18530	AN	Modified outcrop	1275-253	2
18530	AO	Modified outcrop	1275-254	2
18531	A	Modified outcrop	1275-1	3
18531	B	Enclosure	1275-2	3
18531	C	C-Shape	1275-3	3
18531	D	Mound	1275-4	3
18531	E	Wall	1275-5	3
18531	F	Mound (3)	1275-6	3
18531	F1	Filled crack	1275-6	3

State Site No.	Feature No.	Feature Type	PHRI Temp. Field No.	Transect No.
18531	F2	Modified outcrop (2)	1275-6	3
18531	G	Modified outcrop	1275-7	3
18531	G1	Terrace	1275-7	3
18531	H	Modified outcrop (2)	1275-9	3
18531	H1	Mound (4)	1275-9	3
18531	I	Mound (5)	1275-10	3
18531	I1	Modified outcrop (2)	1275-10	3
18531	J	Mound	1275-11	3
18531	K	Shell midden	1275-12	3
18531	L	Modified outcrop (2)	1275-13	3
18531	M	Modified outcrop	1275-14	3
18531	N	Modified outcrop (2)	1275-15	3
18531	O	Mound (6)	1275-16	3
18531	O1	C-Shape	1275-16	3
18531	P	Modified outcrop (2)	1275-17	3
18531	P1	Mound (3)	1275-17	3
18531	P2	Enclosure	1275-17	3
18531	P3	Alignment	1275-17	3
18531	Q	Modified outcrop (3)	1275-18	3
18531	R	Modified outcrop	1275-19	3
18531	S	Platform	1275-20	3
18531	S1	Mound	1275-20	3
18531	S2	Modified outcrop (3)	1275-20	3
18531	T	Modified outcrop (6)	1275-21	3
18531	T1	Mound	1275-21	3
18531	U	Modified outcrop (3)	1275-22	3
18531	U1	Mound (12)	1275-22	3
18531	V	Modified blister	1275-23	3
18531	W	Modified outcrop	1275-24	3
18531	X	Modified outcrop (2)	1275-25	3
18531	X1	Modified blister	1275-25	3
18531	Y	Modified outcrop	1275-26	3
18531	Z	Pahoehoe excavation	1275-27, AS-14	3
18531	AA	*Ahu*	1275-28, AS-14	3
18531	AB	Mound	1275-29, AS-14	3
18531	AC	Mound	1275-30, AS-14	3
18531	AD	Mound	1275-31, AS-14	3
18531	AE	Modified outcrop	1275-32, AS-14	3
18532	A	Pahoehoe excavation	1275-184	4
18532	B	Modified outcrop	1275-185	4
18532	B1	Pahoehoe excavation	1275-185	4
18532	C	Modified outcrop (2)	1275-186	4
18532	D	Modified outcrop (2)	1275-187	4
18532	E	Modified outcrop	1275-188	4
18532	E1	Modified blister (2)	1275-188	4
18532	F	Modified outcrop	1275-189	4
18532	G	Modified outcrop	1275-190	4
18532	H	Mound (2)	1275-191	4
18532	I	Modified outcrop	1275-193	4
18532	J	Modified outcrop (5)	1275-194	4
18532	K	Modified outcrop	1275-195	4
18532	K1	Mound	1275-195	4
18532	L	Mound	1275-196	4
18532	L1	Modified blister	1275-196	4
18532	L2	Modified outcrop (3)	1275-196	4
18532	M	Modified outcrop	1275-197	4
18532	N	Modified outcrop	1275-198	4
18532	O	Modified outcrop (4)	1275-199	4

State Site No.	Feature No.	Feature Type	PHRI Temp. Field No.	Transect No.
18532	P	Modified outcrop (2)	1275-200	4
18532	Q	Modified outcrop (3)	1275-201	4
18532	Q1	*Ahu*	1275-201	4
18532	R	Pahoehoe excavation	1275-202	4
18532	S	Modified outcrop	1275-203	4
18532	T	Mound	1275-204	4
18532	U	Pahoehoe excavation	1275-205	4
18532	V	*Ahu*	1275-206	4
18532	W	*Ahu* (2)	1275-207	4
18532	X	*Ahu*	1275-208	4
18533	A	Historic wall	1275-36	5
18533	B	Platform	1275-37	5
18533	C	Historic shack	1275-38	5
18533	D	Historic wall	1275-39	5
18533	E	Terrace	1275-40	5
18533	F	Wall	1275-41	5
18533	G	Modified outcrop	1275-42	5
18533	G1	Mound	1275-42	5
18533	H	Mound	1275-43	5
18533	I	Mound	1275-44	5
18533	J	*Ahu*	1275-45	5
18533	J1	C-Shape	1275-45	5
18533	K	Mound	1275-46	5
18533	L	Mound	1275-47	5
18533	M	Mound (4)	1275-48	5
18533	N	Mound	1275-49	5
18533	O	Mound	1275-50	5
18533	P	Mound (2)	1275-51	5
18533	Q	Terrace	1275-52	5
18533	R	Mound	1275-53	5
18533	S	Wall	1275-54	5
18533	T	Mound (16)	1275-55	5
18533	T1	Modified outcrop (2)	1275-55	5
18533	T2	Terrace	1275-55	5
18533	U	Mound (2)	1275-56	5
18533	V	Modified outcrop	1275-57	5
18533	W	Mound	1275-58	5
18533	X	Mound	1275-59	5
18533	Y	Mound (2)	1275-60	5
18533	Y1	Modified outcrop	1275-60	5
18533	Z	Mound (10)	1275-61	5
18533	AA	Mound (5)	1275-62	5
18533	AA1	Terrace	1275-62	5
18533	AA2	Modified outcrop	1275-62	5
18533	AB	Mound (4)	1275-63	5
18533	AC	Wall	1275-64	5
18533	AD	Mound (6)	1275-66	5
18533	AE	Modified outcrop	1275-67	5
18533	AF	Filled crack (2)	1275-68	5
18533	AG	Modified outcrop	1275-69	5
18533	AG1	Mound	1275-69	5
18533	AG2	Mound (2)	1275-69	5
18533	AH	Alignment	1275-71	5
18533	AH1	Mounds (4)	1275-71	5
18533	AI	Terrace	1275-72	5
18533	AJ	Wall	1275-73	5
18533	AJ1	Enclosure	1275-73	5
18533	AK	Filled crack	1275-74	5

State Site No.	Feature No.	Feature Type	PHRI Temp. Field No.	Transect No.
18533	AL	Modified outcrop	1275-75	5
18533	AM	Modified depression	1275-76	5
18533	AN	Mound	1275-77	5
18533	AN1	Wall	1275-77	5
18533	AO	Modified depression	1275-78	5
18533	AP	Mound	1275-79	5
18533	AQ	Mound (3)	1275-80	5
18533	AQ1	Modified outcrop	1275-80	5
18533	AR	Modified outcrop	1275-81	5
18533	AR1	Mound	1275-81	5
18533	AS	Modified outcrop	1275-82	5
18533	AT	Modified outcrop	1275-83	5
18533	AU	Wall	1275-84	5
18533	AV	Wall	1275-85	5
18533	AW	Pahoehoe excavation	1275-86	5
18533	AX	Terrace	1275-87	5
18533	AX1	Alignment	1275-87	5
18533	AY	Platform	1275-88	5
18533	AY1	Enclosure	1275-88	5
18533	AY2	Modified outcrop	1275-88	5
18533	AZ	Modified outcrop	1275-89	5
18533	BA	Modified outcrop	1275-90	5
18533	BB	Modified outcrop	1275-91	5
18533	BC	Modified outcrop (2)	1275-92	5
18533	BC1	Mound	1275-92	5
18533	BD	Platform	1275-94	5
18533	BE	Pahoehoe excavation	1275-95	5
18533	BF	Mound (4)	1275-96	5
18533	BG	Overhang	1275-97	5
18533	BG1	Wall	1275-97	5
18533	BH	Pahoehoe excavation	1275-98	5
18533	BI	Enclosure	1275-99	5
18533	BJ	Modified outcrop	1275-100	5
18533	BK	Modified outcrop	1275-101	5
18533	BL	Modified outcrop (3)	1275-102	5
18533	BM	Modified outcrop (5)	1275-103	5
18533	BN	Modified outcrop	1275-104	5
18533	BO	Modified outcrop	1275-105	5
18533	BP	Modified outcrop	1275-106	5
18533	BQ	Modified outcrop	1275-107	5
18533	BR	Alignment	1275-108	5
18533	BS	Modified outcrop	1275-109	5
18533	BT	Modified outcrop (3)	1275-110	5
18533	BU	Modified outcrop	1275-111	5
18533	BU1	Mound	1275-111	5
18533	BU2	Pahoehoe excavation	1275-111	5
18533	BV	Modified outcrop	1275-112	5
18533	BW	Modified outcrop (4)	1275-113	5
18533	BX	Modified outcrop	1275-114	5
18533	BY	Modified blister (2)	1275-116	5
18533	BZ	Modified outcrop	1275-117	5
18533	CA	Modified outcrop	1275-118	5
18533	CB	Modified outcrop	1275-119	5
18533	CB1	Pahoehoe excavation	1275-119	5
18533	CC	Modified blister	1275-121	5
18533	CC1	Modified outcrop	1275-121	5
18533	CD	Pahoehoe excavation	1275-124	5
18534	A	Modified outcrop (2)	1275-147	6

State Site No.	Feature No.	Feature Type	PHRI Temp. Field No.	Transect No.
18534	B	Mound	1275-148	6
18534	B1	Modified outcrop	1275-148	6
18534	C	Mound	1275-149	6
18534	D	Modified outcrop (4)	1275-150	6
18534	E	Modified outcrop	1275-152	6
18534	F	Modified outcrop	1275-153	6
18534	G	Modified outcrop (2)	1275-154	6
18534	H	Modified outcrop (3)	1275-155	6
18534	I	Modified outcrop (5)	1275-156	6
18534	J	Modified outcrop (4)	1275-157	6
18534	K	Modified outcrop (9)	1275-158	6
18534	L	Modified outcrop (3)	1275-160	6
18534	L1	Modified blister	1275-160	6
18534	M	Modified outcrop	1275-161	6
18534	N	Modified outcrop (2)	1275-162	6
18534	O	Modified outcrop	1275-163	6
18534	P	Mound	1275-164	6
18534	Q	Modified outcrop (4)	1275-165	6
18534	R	Modified outcrop (3)	1275-166	6
18534	S	Mound	1275-167	6
18534	S1	Modified outcrop (5)	1275-167	6
18534	T	Modified outcrop	1275-168	6
18534	U	Modified outcrop	1275-169	6
18534	V	Modified outcrop	1275-170	6
18534	V1	Mound (2)	1275-170	6
18534	V2	Filled crack	1275-170	6
18534	W	Alignment	1275-171	6
18534	X	Modified outcrop	1275-172	6
18534	Y	Modified outcrop	1275-173	6
18534	Z	Modified outcrop	1275-174	6
18534	AA	Modified outcrop	1275-175	6
18534	AB	Modified blister	1275-176	6
18534	AC	Modified outcrop (2)	1275-177	6
18534	AD	Modified outcrop	1275-178	6
18534	AE	Modified outcrop	1275-179	6
18534	AF	Modified outcrop	1275-180	6
18534	AG	Pahoehoe excavation	1275-181	6
18535	A	Mound (3)	1275-258	7
18535	B	Modified outcrop	1275-259	7
18535	C	Mound (3)	1275-260	7
18535	D	Modified outcrop	1275-262	7
18535	E	Modified outcrop	1275-263	7
18535	F	Modified outcrop	1275-264	7

APPENDIX C: TWO LETTERS

SCHEDULE A.

To the Honorable LORRIN A. THURSTON,

MINISTER OF THE INTERIOR:

This Schedule hereto attached, shows in full the standing and everything concerning those that bid for the "Homestead" lots from the Government land of Makaula (being the place which J. S. Emerson laid out for homesteading) to Kohanaiki joining Kohanaiki, purchased land of Kaiakoili (k) and the Ahupuaa of Kaloko, and called Schedule A.

Explanation: 1. Kailiino (k). He has no real property known in this Government, or in this dictrict, he is poor in every way, and he bid for Makaula Lot No. 8. He is a resident in that place, and he has planted coffee, mangoes, and they are growing on said lot, and that is why he went and worked together with the surveyor, and that is why he bid for same, and he had the best reason for bidding for that place, because, he had things growing there. It would not be proper to accept the claims of others, unless he fails in his bid.

2. J. W. H. Isaac Kihe: Has no other real property in this Government, he is a person who has nothing at all, and is holding a Government position, that of "School Teacher." He bid for Kamanamana, Lot 7 B., and he has planted thereon, and is a resident of that place.

3. S. Mahauluae (k), has no real property in this Government, he is a person who has nothing at all, and that is why he bid for a lot for himself, Lot 6 A., Ham.

4. P. Manuia (k) has no real property, is poor in every way, and that is why he bid for land for himself, and he has helped at work, Lot 6 C., Hamanamana.

5. S. M. Kaawa (k), has no other land, and he is poor, and that is why he bid for a place to live on, Lot 6 E., Hamanamana.

6. Kinoulu (k) has no real property of any kind, bid for Kalaoa 1, Lot 6 D.

7. C. Haleman (k) has no real property of any kind, bid for Kalaoa 1, Lot 6 F., and he is a resident of the place &c.

Figure a. Letter Requesting that Remaining Government Lands between Hāmanamana and 'O'oma 2nd be Sold to a Hui of Hawaiian Residents who live in the Lands between Makāula to Kohanaiki. State Archives Land File - December 26, 1888.

TRANSLATION:

To the Honorable WILLIAM D. ALEXANDER, Esq.,

Chief Land Surveyor of the Government.

With thanks.

We, the undersigned, the old residents who reside from "Makaula" to "Ooma 2," joining "Kohanaiki," hereby petition and we also file this petition with you, and for you to consider and conferring with the Minister of the Interior, whether to consent or refuse the petition which we humbly file, and at the same time setting forth the nature of the land and the boundaries desired.

We ask that all be sold to us as a Hui, that the remnants of all the Government lands from "Hamanamana" to "Ooma two (2)" that is, from the Government remnant of Hamanamana", "Kalaoa 1, 2, 3, 4, 5," "Ooma 1 & 2," running until it meets the sea. Being the remnants remaining from the lands "Homesteaded" lately, and remaining after the sale of the lands formerly sold by the Government, these are the remnants which we wish to buy as a "HUI." If you consent, and also the "Minister of the Interior," for these reasons:

1. The "remnants of Government lands" aforesaid, join our land kuleanas which were lately surveyed, and for that reason we believe it proper that they be sold to us.

2. The "kuleanas" that were surveyed for us is not sufficient to live on in every respect, they are too small, and is not in accordance with the law, that is one hundred acres, (Laws 1888.)

Figure b. Letter to Lorrin A. Thuston, Minister of the Interior, from Native Residents of Lands between Makāula and 'O'oma 2nd (Land Matters, n.d., Document No. 255, Hawai'i State Archives).

3. Because of our belonging to and as old residents of said places, is why we ask that consent be granted us for the sale to us and not to any one from other places, or we may be put to trouble in the future.

With these reasons, we leave this with you, and for you to approve, and we also adhere to our first offer per acre, and the explanations in regard to said offer.

FIRST: The price per acre to be 10¢ per acre.

SECOND: The nature of the land is rocky and lava stone in all from one end to the other, and there is only one kind of animal which can roam thereon, and it is goats, and that is the only thing to make anything out of, and to benefit us if we acquire it.

THIRD: If this land is acquired by others, they will probably cause us trouble, because, the kuleanas which we have got is very small and not enough, not 20 acres of the land were acquired by us, very few of the lots reach 20 acres or more.

And because of these reasons and the explanation herein, we leave before your excellency for the granting of the consent or not.

We are, with love,

Your humble and obedient servants,

1. G. KALEOHANO and 32 others.

From us, humbly and truly &c.

To W. D. ALEXANDER, Esqr.,

Chief Land Surveyor of the Government,

Love to you.

We leave this petition before you, and all have signed this petition. By us through our secretary,

Dec. 26, A. D. 1888, J. W. H. ISAAC KIHE, JR.,

Kalaoa, N. Kona

Translated by
E. H. Hart.

Figure b. (cont.)

Report 1298-070793

Archaeological Inventory Survey
Kailua to Keahole Region State Lands
LUC Project - 500-Acre University Site

Lands of Makaula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4
North Kona District, Island of Hawaii

PHRI

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Report 1298-070793

Archaeological Inventory Survey Kailua to Keahole Region State Lands LUC Project - 500-Acre University Site

Lands of Makaula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4 North Kona District, Island of Hawaii

by

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Supervisory Archaeologist

and

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Principal Archaeologist

Prepared for

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July 1993

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SUMMARY

Between December 7, 1992 and January 29, 1993, Paul H. Rosendahl, Ph.D., Inc., (PHRI) conducted an archaeological inventory survey of the Kailua to Keahole Region State Lands LUC Project—500-acre University Site, located in the Lands of Makaula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4, North Kona District, Island of Hawaii. The overall objective of the survey was to provide information sufficient to satisfy the historic preservation regulatory review requirements of the Hawaii County Planning Department (HCPD) and the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD).

The field work was conducted December 7, 1992-January 29, 1993 under the supervision of Project Supervisors James Head, B.A., Jack D. Henry, B.S., and Constance O'Hare, B.A. Hawaii Projects Manager Donna K. Graves, M.A., and Principal Archaeologist Dr. Paul H. Rosendahl provided overall direction for the project.

During the survey, 43 sites were identified. Of the 43 sites, 16 had been previously identified. The sites included the following formal feature types: midden deposit, modified outcrop, terrace, enclosure, stacked rock, mound, wall, pahoehoe excavation, alignment, modified lava tube, cupboard, petroglyph, modified depression, steppingstone trail, cairn, platform, pavement, utilized lava tube, cleared area, and pecked stone. The feature types comprised the following functional types: habitation, agriculture, indeterminate, multiple, transportation, habitation (refuge), communication, marker, recreation, ceremonial, quarry, and boundary. In addition to the above, numerous minor agricultural features were identified in the project area, indicating that the area may constitute a northern extension of the Kona Field System. The features (approximately 3,000) were not separately recorded, but rather, were counted and grouped by transect.

Based on federal and state evaluation criteria, 33 of the 43 sites identified during the present project are assessed as significant solely for information value. No further work is recommended for 19 of the 33 sites; 15 of the 33 sites are recommended for further data collection. Three sites are assessed as valuable for information content and provisionally significant for cultural value, due to the possible presence of human skeletal remains. Further data collection followed by provisional preservation "as is" are recommended for these three sites. Three other sites are assessed as valuable for information content and as excellent examples of site types and are recommended for further data collection followed by preservation with some level of interpretive development. Two sites are evaluated as significant for information content and as excellent examples of site types, and are recommended for preservation with some level of interpretive development, but with no further archaeological work recommended. Finally, one site is evaluated as culturally significant due to the confirmed presence of four human burials. Preservation "as is," as well as further data collection are recommended.

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INTRODUCTION

BACKGROUND

At the request of Mr. Scott Ezer of Helber, Hastert & Fee (HH&F), on behalf of their client, the Office of State Planning - State of Hawaii (OSP), Paul H. Rosendahl, Ph. D., Inc. (PHRI) recently conducted an archaeological inventory of the Kailua to Keahole Region State Lands LUC Project—500-acre University Site, located in the Lands of Makaula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4, North Kona District, Island of Hawai'i. The overall objective of the inventory survey was to provide information sufficient to satisfy all historic preservation regulatory review requirements of the Hawaii County Planning Department (HCPD) and the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD).

The field work for the current project was conducted December 7, 1992 - January 29, 1993, by a crew of five to eight under the supervision of Project Supervisors James Head, B.A., Jack D. Henry, B.S., and Constance O'Hare, B.A. Donna K. Graves, M.A., Projects Manager - Hawaii, and Principal Archaeologist Dr. Paul H. Rosendahl provided overall direction for the project. Crew members included Field Archaeologists Martin Boudreau, B.S., Sheryl Dowden, B.S., Mikele Fager, B.A., Michael Stubing, B.A., and Field Technician Chris Kitchens. Completion of the field work required approximately 1,543 labor hours.

SCOPE OF WORK

The basic purpose of an inventory survey is to identify—to discover and locate on available maps—feature of potential archaeological significance present within a specified project area. An *inventory survey* is an initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted with the primary aim of determining the presence or absence of archaeological resources. A survey of this type indicates both the general nature and the variety of archaeological remains present, and the distribution and density of such remains. It permits a general significance assessment of the archaeological resources, and facilitates formulation of recommendations and estimates for any *mitigation* work that might be necessary. Such work could include further data collection involving detailed recording of sites and features, and selected test excavations. It might also include subsequent data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and cultural values.

The basic objectives of the present survey were fourfold: (a) to identify (find and locate) all sites and site complexes present within the project area; (b) to evaluate the potential general significance of all identified archaeological remains; (c) to determine the possible impacts of proposed development upon the identified remains; and (d) to define the general scope of any subsequent further data collection and/or other mitigation work that might be necessary or appropriate.

Based on a review of readily available background literature, familiarity with the project area, extensive familiarity with the current requirements of review authorities, and based on discussions with Mr. Scott Ezer of HH&F, and Dr. Ross Cordy, chief archaeologist in the DLNR-SHPD, the following specific tasks were determined to constitute an adequate scope of work for the inventory survey:

1. Review archaeological and historical literature relevant to the project area, and conduct limited historical documentary research (emphasis on readily available literature and documentary sources) and interviews with local informants;

2. Conduct 100% coverage low-level (c. 30-50 ft altitude) aerial survey (helicopter) of the entire 500-acre project area, with special emphasis upon identifying and plotting on aerial photographs and/or maps (a) sites observed (both previously known and newly encountered), (b) areas believed to contain new (previously not known) sites, and (c) areas devoid of sites (e.g., relatively recently and/or extensively eroded lands, or mechanically altered lands);

3. Conduct a 100% coverage surface survey of the entire project area;

4. Conduct limited subsurface testing—by means of manual excavations—in the project area (a) to determine the presence or absence of potentially significant buried cultural features or deposits, and (b) to obtain suitable samples for age determination analyses;

5. Analyze field and historical research date, and prepare appropriate reports.

The inventory survey was conducted in accordance with the standards for inventory-level survey recommended by the DLNR-SHPD. The significance of archaeological remains identified within the project area was assessed in terms of (a) the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60), and (b) the criteria for evaluation of traditional cultural values prepared by the National Advisory Council on Historic Preservation (ACHP 1985). The DLNR-SHPD and the Hawaii County Planning Department use these criteria to evaluate eligibility for both the Hawaii State and National Registers of Historic Places.

PROJECT AREA DESCRIPTION

The project area is bounded on the north by the Land of Kau and on the south by the land of Kalaoa 5. The eastern boundary is a line running north-south at about the 600 ft (183 m) level; the western boundary is a north-south line near the 400 ft (122 m) contour (Figure 1).

The 500-acre (202 ha) University site is part of a larger area comprising approximately 2,640 acres (1018 ha) of state-owned lands situated inland of Keahole Point. Rainfall in the project area is 20 to 30 inches (51 to 76 cm) per year (Armstrong 1983:63). Mean annual temperature for the project area is c. 65 degrees F. (18 degrees C.).

Lava tube systems dissect the project area and are oriented primarily *mauka-makai*. The project area generally conforms to Baker et al.'s (1965) description of lands extending from Keamuku (Waikoloa) and Ka'upulehu almost to the Kona airport. The lower portions of the project area comprise bare, relatively unweathered aa and pahoehoe flows (lithosols) from Hualalai and Mauna Loa volcanoes. In these areas precipitation is low and soil is generally lacking (Baker et al. 1965:5).

Within the project area are two terrain types (Sato et al. 1973)—aa and pahoehoe lava flows. Aa flows comprise c. 180 acres (40% of the project area). According to Sato et al. "[t]his lava has practically no soil covering and is bare of vegetation, except for mosses, lichens, ferns, and a few small `ohi`a trees...is rough and broken...[i]t is a mass of clinkery, hard glassy, sharp pieces piled in tumbled heaps" (1973:34). Pahoehoe flows comprise c. 290 acres (60% of the project area). This terrain type consists solely of prehistoric flows. According to Sato et al., "[t]his lava has a billowy, glassy surface that is relatively smooth...[i]n some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Pahoehoe lava has no soil covering and is typically bare of vegetation except for mosses and lichens. In areas of higher rainfall, however, scattered `ohi`a trees, `ohelo berry, and `a`ali`i have gained a foothold in cracks and crevices" (1973:34). According to Moore et al. (1987:574) the flows in the project area are a part of the Hualalai Volcanics and date from 1,000-5,000 years before present, although most of the flows date to 1,000-3,000 years before present.

Char & Associates (1992) has done a botanical survey for the vicinity of the project area (Botanical Survey of the West Hawai'i Boundary Review, Kailua to Keahole Region, North Kona, Hawai'i). The following information is taken from this earlier survey. Char identifies two major vegetation types in the current project area. A third type (Closed Mixed Shrubland) identified by Char in her study area is not present in the current study area.

One type found in the current area is Fountain Grass Grassland. In general, this type comprises low tufts of grass with scattered shrubs and a few trees. Grasses found in the area include fountain grass (*Pennisetum setaceum* [Forssk.] Chiov.), a perennial species, one to four feet tall. This grass, native to northern Africa, is the dominant ground cover. On rocky outcrops, *pili* grass is found (*Heteropogon contortus* [L.] P. Beauv. ex Roem. & Schult.) along with Natal redtop grass (*Rhynchelytrum repens* [Willd.] Hubb.). Native shrubs scattered throughout the area include *'uhaloa* (*Waltheria indica* L.), caper or *maiapilo* (*Capparis sandwiciana* DC.), *'ilima* (*Sida fallax* Walp.), and *'a'ali'i* (*Dodonaea viscosa* Jacq.). A few *noni* (*Morinda citrifolia* L.), a very early Polynesian introduction, are also present. Alien species in the project area include *koa-haole* or *ekoa* (*Leucaena leucocephala* [Lam.] de Wit), Christmas-berry (*Schinus terebinthifolius* Raddi), klu (*Acacia farnesiana* [L.] Willd.), indigio (*Indigofera suffruticosa* Mill.), pluchea (*Pluchea symphytifolia* [Mill.] Gillis), and a few *kiawe* (*Prosopis pallida* [Humb. & Bonpl. ex Willd.] Kunth).

Plant cover within Fountain Grass Grassland portion of the project area varies with elevation. In the lower portions of the study area, where there is the least amount of rainfall, the plant cover may range between 30 and 50%. In the more *mauka* portions of the grasslands, where there is more rain, the cover is denser (about 80 to 90% cover) and shrubs are more numerous.

The other vegetation type in the project area is Open Mixed Shrubland. This type is found at about the 400 ft (121.9 m) level. At this elevation, the shrub cover is somewhat open and one can pass quite easily through the vegetation. There are shrubs and small trees 6-25 ft tall. This cover is a mixture of both native and introduced species, with native species abundant in some areas. Native species found in this vegetation

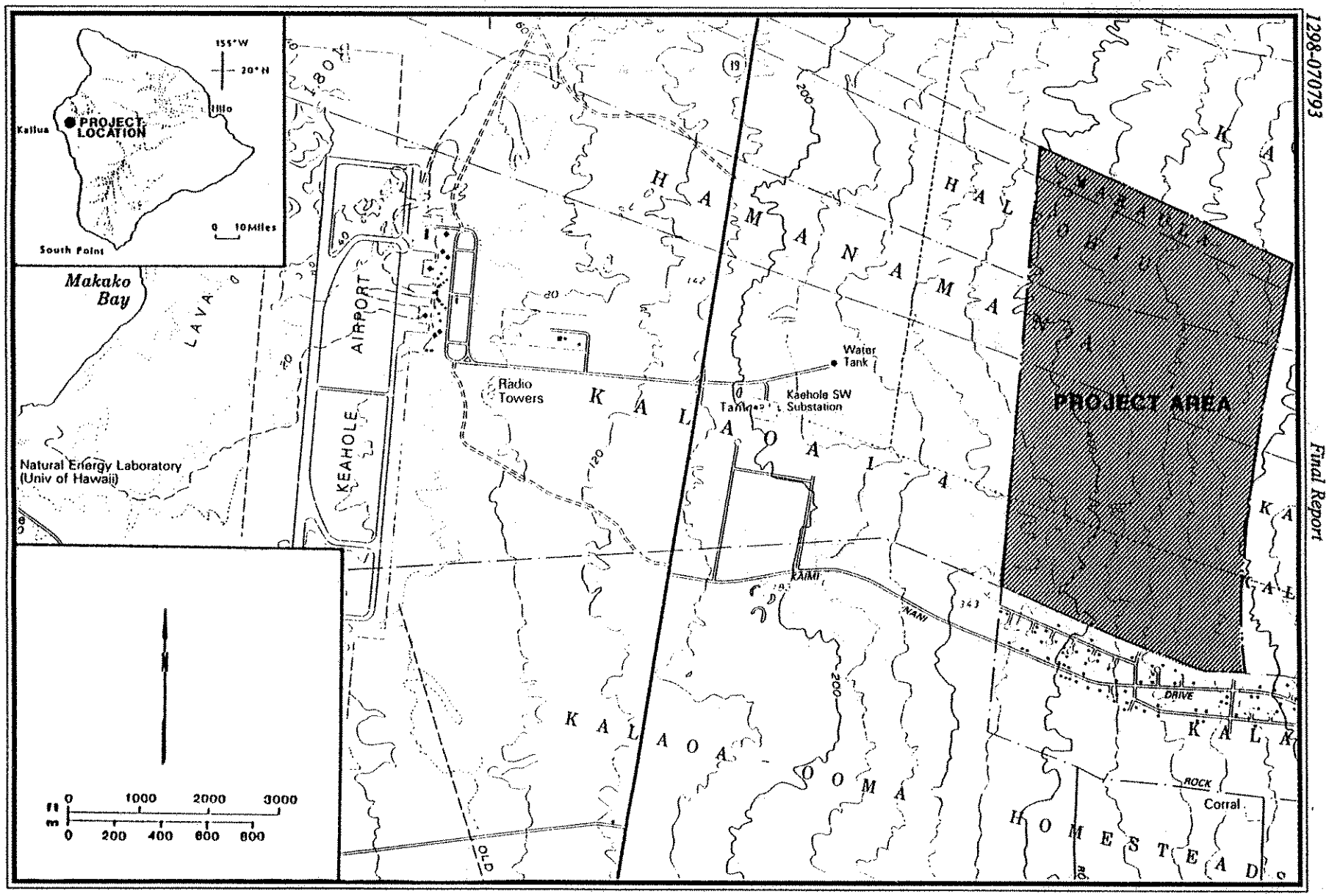


Figure 1. Project Area Location

type include *lama* (*Diospyros sandwicensis* [A. DC.] Fosb.), *alahe'e* (*Canthium odoratum* [G. Forster] Seem.), *kolomana* (*Senna gaudichaudii* [Hook. & Arnott] H. Irwin & Barneby), *mamane* (*Sophora chrysophylla* [Salisb.] Seem.), *a'ali'i*, and *maiapilo*. A few scattered examples of *'ohi'a* (*Metrosideros polymorpha* Gaud.), *'ohe* (*Reynoldsia sandwichensis* A. Gray), and *wiliwili* (*Erythrina sandwicensis* Degener) are sometimes found. Dense tangles of *huehue* vines (*Cocculus trilobus* [Thunb.] DC.) are quite common. Introduced species common in the the Open Mixed Shrubland include Christmasberry and *koa-haole*. Scattered examples of silver or silk oak (*Grevillea robusta* A. Cunn. ex R. Br.) are found here as well.

Substrate type seems to have an influence on the distribution of both the native and alien species in the project area. In areas where there is broken and weathered pahoehoe, the fountain grass is very dense, and the shrubs are less dense, with *a'ali'i* the most abundant. Also found here in lower, swale areas are *koa-haole* shrubs. In the rough aa flow areas, native species are dominant and are associated with a *lama-alahe'e-naio*. Fountain grass is present only in small, scattered patches on the aa, and in some places, the aa is lichen-encrusted.

Char (1992:8) writes that the *'aiea* (*Nothocestrum breviflorum* A. Gray), a Category 1 candidate endangered species, is found on the aa flow in the northern half of the property.

PREVIOUS ARCHAEOLOGICAL WORK

Study Area

In order to more accurately assess the archaeological potential of the current project area a larger study area was first examined by Henry and Graves (1993). This study area encompassed larger portions of the four *ahupua'a* the current project area is within and included the Land of Kau to the north and the Land of Kohana-iki to the south.

Numerous archaeological investigations have been conducted within this larger study area. The investigations range from field checks and reconnaissance surveys to full-scale data recovery projects. The locations of most of the previous investigations are illustrated in Figure 2 (at end). The projects that are not shown on Figure 2 are those that are documented in reports but for which field maps were not included, or those for which the maps that are available are not specific enough to positively identify the locations. A summary of all prior archaeological work in the vicinity of the current project is presented in Table 1.

The earliest recorded field work conducted in the study area was done for Bernice P. Bishop Museum in 1930, by John E. Reinecke. Reinecke identified major coastal sites in the Districts of North Kona and South Kohala. Despite the fact that Reinecke's site descriptions are very brief and he supplied no site maps, his data provide a historical perspective on the condition of some sites as they were 62 years ago (Reinecke n.d.:15-16).

Ching, Cluff and Riley (1968) conducted a reconnaissance survey and salvage operations along a two-mile extension of the Kailua-Kawaihae Road Corridor, and the area in the vicinity of the Keahole Airport (1968-69). A total of 343 sites were identified and recorded during the survey. Ching, Cluff and Riley divided the sites into two categories, inland and coastal areas. The inland portion, which extended from 800 feet to three miles *mauka* of the coast contained 117 features. The features included 73 walled enclosures, 11 paved terraces, four platforms, five shelter caves, one petroglyph, seven walls, one filled crack, and 15 ahu (cairns). The coastal portion, which extended from the coast approximately 800 feet inland, contained 216 features. These features included 47 stone walled enclosures, 22 shelter caves, three terraces, six paved platforms, 19 walls, 27 water catchments, one well, one wet cave, 29 salt pans, 13 *papamu*, two possible burials, four filled cracks, four hearths, one fire pit, 33 *ahu* and a cluster of petroglyphs. Due to the unavailability of a complete copy of Ching, Cluff and Riley's report, no site location information was available.

In 1971-72, the Hawaii Department of Land and Natural Resources began an inventory of known archaeological sites and revisited a number of sites located by Reinecke. State inventory numbers were assigned to seven coastal sites at this time and Hawaii Register of Historic Places (HRHP) forms were completed for the sites. The sites were sketched, and features at four of seven sites were assigned letter designations.

Rosendahl and Kirch (1975) conducted an archaeological reconnaissance survey of a parcel of land at Keahole Point in conjunction with the preparation of an Environmental Impact Statement for the Natural Energy Laboratory Hawaii (NELH) (1975). The survey identified both single-feature sites and multiple-feature complexes. Fourteen localities were identified, including two walled shelters, nine habitation complexes, a cave shelter and enclosure, a cave shelter and cairn, and a platform and enclosure.

Clark conducted an archaeological reconnaissance survey on property belonging to the Natural Energy Laboratory Hawaii (NELH) at Keahole Point, North Kona (1984). The

Table 1.

SUMMARY OF PREVIOUS ARCHAEOLOGICAL WORK IN STUDY AREA

Year	Researcher	Level of Study	Area
1930	Reinecke	Reconnaissance	Kailua to N. Kohala
1968-69	Ching, Cluff & Riley	Survey/Salvage	Keahole Point
1971-72	State Invent. Survey	Reconnaissance	Kailua to Kohala
1971	Ching	Reconnaissance	S. Kohala to N. Kona
1973	Rosendahl	Salvage	Keahole - Anaeho'omalu
1975	Rosendahl and Kirch	Reconnaissance	Keahole - NELH*
1977	Davis	Reconnaissance	Keahole Ag Park
1978	Rogers-Jourdane	Reconnaissance	Keahole - NELH
1979	Barrera	Reconnaissance	Keahole Airport
1979	Bonk	Reconnaissance	Keahole Airport
1980	Hammatt and Folk	Excav./Recon.	Keahole Ag Park
1980	Rosendahl	Surv./Excav.	Keahole - NELH
1981	Cordy	Reconnaissance	Kohana-Iki
1982	Soehren	Reconnaissance	Kalaoa 4
1984	Clark	Reconnaissance	Keahole - NELH
1985a	Barrera	Reconnaissance	'O'oma II
1985b	Barrera	Reconnaissance	Keahole Point
1985	Cordy	Summary	'O'oma & Kalaoa
1985	Rosendahl	Reconnaissance	Kohana-iki
1985	Soehren	Reconnaissance	Kalaoa 4
1986a	Cordy	Field Check	Keahole Point
1986b	Cordy	Field Check	'O'oma II
1987	Donham	Reconnaissance	'O'oma II
1987	Barrera	Reconnaissance	Keahole Airport
1987	Telea and Rosendahl	Reconnaissance	Kalaoa 4
1987	Cordy	Field Check	Kalaoa 3
1987	Walker and Haun	Reconnaissance	Kalaoa 4
1988	Ching	Reconnaissance	Kalaoa 5
1988	Walker and Haun	Data Recovery	Kalaoa 4
1989	Rosendahl, M.L.K.	Invent. Survey	'O'oma II
1989	Walker and Rosendahl	Invent. Survey	Kalaoa
1990a	Walker and Rosendahl	Invent. Survey	'O'oma II
1990b	Walker and Rosendahl	Invent. Survey	Kalaoa 4
1990c	Walker and Rosendahl	Invent. Survey	Kalaoa-'O'oma II
1991	O'Hare and Rosendahl	Invent. Survey	Hamanamana
1992	Dowden and Graves	Invent. Survey	Kalaoa 1-4
1992	O'Hare and Goodfellow	Data Recovery	Kohana-iki
1992	Thompson & Goodfellow	Data Recovery	Kalaoa 4
1992	Thompson & Rosendahl	Sensitiv. Study	N. Kona to S. Kohala
1993	Henry and Graves	Arch. Assessment	Makaula, Hale'ohi'u, Hamanamana, Kalaoa 1-4, Kalaoa 5, 'O'oma, and 'O'oma 2

**Natural Energy Laboratory Hawaii*

project area was approximately 320 acres and encompassed the coastal portions of the Lands of Hamanamana, Kalaoa 1-4, and Kalaoa-'O'oma. The survey identified 24 archaeological sites composed of 60 features. The features include 14 enclosures, two historic house sites, four trails, five *ahu*, two *papamu*, five brackish pools, five cave shelters, nine rock-filled crevices, one petroglyph area, two C-shape shelters, four walls, and numerous rock alignments.

Cordy conducted a field check in the NELH area in Kalaoa 5, primarily as a planning tool for the routing of seawater pipelines into the HOST Park area (1986a). Eleven of the 24 sites identified by Clark were examined. Descriptions of their current condition and of the potential for the sites being affected by development work were presented.

Rogers-Jourdane conducted an archaeological reconnaissance survey at the NELH property at Keahole Point (1978). The survey area was approximately 22.5 acres and included three access corridors and two construction areas. The primary purpose of the project was to assess the potential effects of development on previously recorded sites in the area and to locate previously unrecorded sites. Eleven sites were identified during the project—three cairns, two walls, a cave shelter, a lava bubble shelter, a U-shaped enclosure and wall, a cave shelter and cairn, a platform and modified depression, and an enclosure, and a wall. No sites were identified within the utility corridor.

Barrera conducted an archaeological reconnaissance survey along the rights-of-way of two proposed emergency service roads at the Keahole Airport (1979). The survey found no archaeological remains within the northern service road right-of-way. The survey of the southern service road right of way resulted in the identification of two sites, a crude habitation shelter and a complex consisting of twelve features. These features were a platform, a habitation shelter, two C-shape shelters, and eight mounds.

Bonk conducted an archaeological reconnaissance survey at the Keahole Airport in the Land of Kalaoa (1979). At the time of the survey, at least half of the project area had been leveled by bulldozing, with approximately one-seventh of the leveled area occupied by a car rental agency. Due to extensive disturbance, no artifacts, structures, or other remains were found in the leveled area. The remaining portion of the project area, unaffected by bulldozing, was not examined in detail as no specific development was planned for it.

Rosendahl conducted an intensive archaeological survey and salvage project at the Natural Energy Laboratory Hawaii (1980). The survey resulted in the identification of eight sites containing 59 component features. The sites included four complexes, two overhang shelters, and two cairns (*ahu*). Most of the sites and features were found to be in poor to fair condition, and many of the individual features had been previously disturbed or dismantled. Test excavations were conducted within the cave shelter features of two of the complexes. These excavations showed limited potential for further significant data recovery.

In conjunction with his dissertation project, Cordy (1981) surveyed a strip along the shoreline within the *ahupua'a* of Kohana-iki. In the course of his survey, Cordy designated 12 sites comprising some 23 component features, and he conducted surface collections and limited test excavations at the sites. Thirty hydration-rind dates from ten sites yielded an overall range of AD 1432-1874, with most in the range of AD 1505-1730. Cordy concluded that permanent habitation along the coast of Kohana-iki began in the 1400s AD.

During Rosendahl's reconnaissance survey of the c. 470-acre Kohana-iki Development project area (Rosendahl 1985), 18 sites and feature complexes were recorded. Of these, 17 had been previously recorded. The sites included 49 component features, of which 38 had been previously recorded. Eleven features were newly identified (nine at previously recorded sites, and two at the one newly identified site). Formal feature types included walled shelters and enclosures, cave shelters, walls, low stone alignments, pavements, raised stone platforms, surface midden and artifact concentrations, a partially filled sinkhole, and a kerbstone-lined trail.

O'Hare and Goodfellow conducted data recovery field work for the 470-acre Kohana-iki Resort project area, located in Kohana-iki (1992). The field work consisted of detailed recording of 31 sites (224 features) that had been previously recorded in the project area and seven sites that were newly recorded during data recovery. The 38 sites consisted of 11 permanent habitation sites, 11 temporary habitation sites, five ceremonial sites, one boundary marker, one transportation site, two aquaculture sites, two agriculture sites, and three sites with indeterminate functions. The features at the sites included 28 platforms, 15 terraces, 12 pavements, 16 enclosures, 17 walls, four alignments, three trails, 31 cairns, five rock mounds, 21 cave shelters, ten overhang shelters, nine walled overhangs, 17 walled depressions, 13 filled depressions, three quarries, one cupboard and 11 petroglyphs. The data recovery also included subsurface testing of 40 features at 21 sites. One-hundred nine excavation units were placed at various features, including 19 cave/rock shelters, 11 platforms, three terraces, three filled depressions, two enclosures, and two pavements. Indigenous and historic artifacts and midden were recovered from the excavation units. The

units also yielded 26 radiocarbon samples (recovered from 15 features at 14 sites). The samples yielded age ranges spanning AD 1020-1950.

During his reconnaissance survey of 6.8 acres (TMK:3-7-3-05:13) in Kalaoa 4, Soehren (1982) recorded two structures, a house platform and a square enclosure, that he interpreted as an agricultural *heiau*. In a subsequent survey of another parcel in Kalaoa 4 (TMK:3-7-3-10:33), Soehren (1985) recorded several historic roads and a coastal-inland foot trail.

In 1985 Barrera conducted a reconnaissance survey of the 'O'oma II Resort project area for Helber, Hastert, Van Horn and Kimura (Barrera 1985a). Subsequently, Helber, Hastert, Van Horn and Kimura asked Dr. Ross Cordy of the Historic Sites Section of DLNR to review and field-check the work by Barrera. Cordy examined the northern one-third of the inland section of the survey area, as well as a small section of the northern coastal survey area (Cordy 1986b). Cordy's review of Barrera's report resulted in the conclusion that Barrera had not adequately identified all large sites within the project area (Cordy 1986b:1). A field check was conducted in June of 1986. According to Cordy:

> Of the 12 large coastal sites, only 9 were identified in the 1985 survey. (Two unidentified sites were located seaward of the Jeep road in an area which Barrera did not survey.) Of the nine identified sites, only a few of the known features were recorded at 3 sites (D15-1, -3, and -6); and at 2 sites (D15-4, -8), descriptions do not easily compare with the 1975 intensive survey.

Subsequently, Donham conducted an archaeological reconnaissance survey and testing program at the 'O'oma II Resort project area (1987). The program consisted of a high-intensity pedestrian reconnaissance survey of the coastal zone within the project area (shoreline to 300 m inland), and an intensive survey with testing of sites previously identified in the inland portion of the project area. Subsurface testing or controlled surface collection was conducted at ten inland sites during this study. A total of 27 new sites with 130 features were located during the reconnaissance phase, and 54 new features were located at previously recorded sites. These new findings brought the total of archaeological sites located within the project area to 74, with 279 component features. Fifteen permanent habitation complexes were identified within the coastal area of 'O'oma II. Nine of these sites had been previously tested by Cordy (1981), and the sites had been assigned temporal as well as functional interpretations. Thirty-four temporary habitation or shelter sites were identified. In addition, four footpath segments, five burial sites, two shrines, and a high-walled enclosure were noted. A total of 69 hydration-rind age determinations have been completed for 15 sites within the project area, resulting in calendric ranges of AD 1430 to 1755. Ranges determined for temporary sites fall within a much narrower span of AD 1550 to 1755.

Barrera conducted an archaeological reconnaissance survey of c. 450 acres at Keahole Point (1985b). The survey identified 45 sites, including two midden scatters, 15 rock mounds, 15 habitation shelters, one cave, three pahoehoe excavations, six C-shape shelters, one wall, one petroglyph, and a portion of Mamalahoa Trail. Because DLNR was updating their site numbering system at the time, Barrera assigned temporary site numbers to his findings.

In 1985, Cordy conducted an overview study of 'O'oma and Kalaoa *ahupua'a* (Cordy 1985). The overview was presented as a paper by the Historic Sites Section of the DLNR for use by researchers and contractors working within the area. The paper contained information on local environment, prior archaeological work, site patterning, chronological data, and included an interpretive overview. Cordy also listed specific sites that had high potential for preservation.

Barrera conducted an archaeological reconnaissance survey of two parcels at the Keahole Airport (1987). Survey Area 1 consisted of 11 acres slated for a ground transportation facility. Survey Area 2 consisted of 40 acres proposed for the expansion of the south ramp. No archaeological sites were identified within Survey Area 1, but in Survey Area 2 two sites were identified—Mamalahoa Trail and a site complex containing 11 features. The features included four mounds and seven habitation shelters.

In 1987 PHRI conducted a reconnaissance survey of a parcel (TMK:3-7-3-05:86) in the proposed Kona Palisades Subdivision, in Kalaoa 4 (Telea and Rosendahl 1987). Fourteen features at six sites were identified. A full inventory survey was later conducted in this parcel (Walker and Rosendahl 1990b), and 18 additional features were recorded— 15 pits, five platforms, four walls, two caves, three mounds, two terraces, and one C-shape. The features were assigned agriculture, habitation, or boundary functions. One cave and one mound were tested, and midden and indigenous and historic artifacts were recovered. Charcoal recovered from an excavation in one cave and from the surface of another cave yielded radiocarbon age ranges from AD 1552 to 1956.

Data recovery was conducted in the same Kona Palisades parcel in 1991 (Thompson and Goodfellow 1992). No additional features were recorded, but detailed recording took

place at four of the sites previously identified by Walker and Rosendahl (1990b). Twenty-five test units were excavated in 14 features and in two areas near features. Midden was recovered from seven of the features, indigenous artifacts were recovered from seven features, and historic artifacts were recovered from six. Eleven radiocarbon dates for seven features of the four sites were obtained (Thompson and Goodfellow 1992). These dates ranged from AD 1460 to 1955 for two temporary habitation cave shelters, from AD 1450 to 1950 for four permanent habitation platforms, and AD 1410 to 1520 for one agricultural terrace. The sites and features were interpreted to constitute a northern extension of the Kona Field System.

Walker and Rosendahl conducted an archaeological inventory survey of an adjacent parcel for the Kona Palisades Development project (Walker and Rosendahl 1990c). During the survey, seven sites containing 12 component features were identified within or immediately adjacent to the project area. One site (Site 11271) had been previously identified by Walker and Haun (1988). Six new sites were identified. Formal feature types identified included terrace, cave, wall, platform, mound and water trough. Functional types included agriculture, habitation, boundary, refuge, and animal husbandry. This survey was followed by limited archaeological data recovery in the parcel (Walker and Haun 1988). Radiocarbon dates returned from this work included AD 1280-1490, from a dryland agricultural feature at Site 10985.

Cordy (1987) conducted a field check of a parcel in the proposed Kona Coast Subdivision in the Kalaoa 3 Ahupua'a (TMK:3-7-3-28:5). He recorded one large platform/terrace, which he interpreted as either an agricultural *heiau* or a historic house platform.

Walker and Haun (1987) conducted a reconnaissance survey of a parcel of land in Kalaoa 4 Ahupua'a (TMK:3-7-3-05:87) and identified 17 features at four sites. The features included two agricultural complexes that were identified by Walker and Haun as part of a northern extension of the Kona Field System. A habitation/burial cave and a historic-period boundary wall were also recorded. Subsequent detailed recording was conducted at the sites and eight test units were excavated at three of the sites (Walker and Haun 1988). A small amount of midden and one bone fishhook were recovered from the test units and four radiocarbon dates ranging from AD 1280 to 1955 were obtained from recovered charcoal.

Ching (1988) conducted a survey of 15 acres in Kalaoa 5 and did not identify any archaeological sites or portable remains. Based on the survey results, Ching recommended no further archaeological work of any kind for the 15 acres (Ching 1988:5). Ralston Nagata, Hawaii State Parks Administrator/Deputy State Historic Preservation Officer, reviewed Ching's report and indicated that he would not agree that the report was adequate until more information was provided and his staff could conduct a field check of the area.

Walker and Rosendahl conducted an archaeological inventory survey in the c. 140-acre Pu'uhonua Subdivision Development Parcel, located in Kalaoa 5 (1989), which partially overlapped Ching's (1988) project area. The survey resulted in the identification of 34 previously unrecorded sites. These sites included both single and multiple features. Formal feature types included terraces, cave/lava tubes, walls, platforms, mounds, C-shapes, cairns, pahoehoe excavations, pits and a pit complex, alignments, enclosures, overhangs, trails, a retaining wall, a pavement, and a modified outcrop. Functional types identified included boundary, habitation, agriculture, refuge, burial, possible burial, water catchment, rock art, transportation, marker, quarry and features of indeterminate function.

O'Hare and Rosendahl conducted survey and testing in the Kalaoa View Estates Development Project, and identified seven sites consisting of 31 features (1991). The 31 features comprised the following formal types: terrace, rock mound, cairn, C-shape, platform, enclosure, lava blister and complex. The functional categories consisted of habitation, agriculture, boundary, trash pit and indeterminate. One temporary habitation feature, a C-shape, was dated to AD 1280-1430, and a prehistoric temporary habitation, a modified lava blister, was dated to AD 1630-1890. A prehistoric permanent habitation feature, a platform, was dated to AD 1500-1680.

Thompson and Rosendahl in 1992 conducted an archaeological sensitivity study associated with the planning and construction of two new 138kV transmission lines, located north of Kailua-Kona, in the Districts of North and South Kona, and South Kohala (Thompson and Rosendahl 1992). The objectives of the study were to map areas of archaeological sensitivity, based on site densities, and to identify possible broad corridors for the proposed transmission lines (corridors that would avoid all sites or affect the fewest numbers of sites). Based on a review of all reports concerning projects conducted within the study area, a map reflecting areas of archaeological sensitivity was generated, to be used as a guideline for subsequent development.

Project Area Studies

Only two archaeological studies and a recent archaeological assessment appear to have been conducted within the

boundaries of the current project area (Figure 2). The two previous studies were done by Davis (1977) and Hammatt and Folk (1980); the Hammatt and Folk work, however, may have been done just outside the project area. The archaeological assessment was by Henry and Graves (1993).

The Davis study was a brief reconnaissance survey conducted in portions of the various Kalaoa *ahupua'a*. The study was done in conjunction with development of the Keahole Agricultural Park. The survey included a narrow transect in Kalaoa 4 Ahupua'a. This transect ended at the 800 ft contour. Davis only described sites in the upland areas of the Kalaoas, and only in general terms.

The Hammatt and Folk (1980) study, conducted by Archaeological Research Center Hawaii (ARCH) for the Hawaii State Department of Agriculture, consisted of excavations at selected sites within the proposed Keahole Agricultural Park, and a surface reconnaissance survey of c. 370 acres located north of the proposed Keahole Agricultural Park. The surface reconnaissance survey is located in the westernmost portion of the present study or just outside. Twelve sites or site complexes originally identified by Davis (1977) were excavated, and a large amount of portable remains (artifacts, marine shell midden, and ecofactual material) were recovered. Three radiocarbon and 13 volcanic glass samples were collected during the excavations. The radiocarbon samples were submitted to Beta Analytic, Inc., of Miami, Florida; the volcanic glass samples were submitted to the University of Hawaii archaeology lab (volcanic glass) for age determination. The radiocarbon samples yielded an age range of AD 1400-1700, and the volcanic glass samples yielded age ranges of AD 1480-1808. During the surface reconnaissance, 18 archaeological sites were identified, including *ahu*, a wall, a circular enclosure, a platform, a trail, and lava tubes. The sites were recommended for further archaeological work, but no site location map was included within the Hammatt and Folk report.

In 1992, Henry and Graves (1993) conducted an archaeological assessment of approximately 2,500 acres (1012 ha) of State-owned property in the Lands of Makaula, Hale'ohi'u, Hamanamana, Kalaoa 1-4, Kalaoa-'O'oma, and 'O'oma 2. The basic purpose of the project was to conduct studies sufficient to enable predictions concerning the probable nature and distribution of archaeological resources within the overall project area.

Seven previous archaeological investigations within the Henry and Graves' project area identified 32 sites. The sites included a northern portion of the Kona Field System (Site 6601), which continues at higher elevations and extends to c. 4 km to the north. Formal fields with *kuaiwi* walls are present at higher elevations. Informal portions of the field system extend to lower elevations. Formal feature types within the Henry and Graves study area include cave, modified outcrop, *ahu*, wall, enclosure, platform, trail, lava tube, pahoehoe excavation, mound, terrace, pavement, C-shape, L-shape, alignment, petroglyph, and overhang. Functional types tentatively identified include agriculture, habitation, transportation, burial, rock art, quarry, boundary marker, and possible ranching.

Using identified sites as a baseline, current models of prehistoric settlement and land use were examined to see if they could be used to predict site type and distribution. Preliminary results indicate that while findings in the project area generally conform to current models, those models cannot yet be considered reliable for making predictions regarding the probable nature and distribution of site types.

Summary

Background research indicates that 39 previous archaeological investigations have been conducted within the Henry and Graves (1993) study area. As depicted in Figure 2, most of the archaeological sites recorded are close to the coast, between the 0-20 foot contours. This is hardly surprising when considering the rich marine resources of the area. Site density drops off from the 20-40 foot contour but this area was still moderately occupied. Functional site types identified in the immediate coast include habitation (both temporary and permanent), quarry, transportation, burial or shrine, rock art, and marker. Formal site types include complex, cave, *ahu* (cairn), enclosure, footpath and trail, midden scatter, modified outcrop, overhang, pahoehoe excavation, petroglyph, platform, rock filled crevice, sinkhole, terrace, modified lava tube, walled shelter, and wall. The diversity and abundance of features suggest that a full range of permanent habitation activities took place in the area.

Inland of the coastal strip, up to somewhere near the 400-foot elevation, site density is generally low. This area, which typically consists of weathered and unvegetated pahoehoe and aa flows, is situated between the primary resource procurement zones, i.e., between the coast and the agricultural uplands, so a general lack of evidence of occupation was expected. Sites types identified in this area included C-shaped enclosure, trail, modified blister, pahoehoe excavation, platform, and walled shelter. Functional types included temporary habitation, quarry, and transportation—such types reflect transitory occupation of the area.

In the uplands, between the 400-foot contour and Mamalahoa Highway, isolated agricultural features were identified—rock mounds, modified outcrops, and terraces.

Whether these are remnants of a larger field system has not yet been determined. One of the problems with determining the abundance and distribution of these agricultural features in the general area is the paucity of archaeological investigations in upland areas. As can be seen on Figure 2 within the study area only 14 studies have been conducted above the 400-foot contour. Also present in the uplands are the remains of probable temporary habitation structures, such as enclosures and modified caves.

Table 2 summarizes the previously identified archaeological sites found within the study area (of Henry and Graves 1993) and several additional nearby sites. The table includes cultural resource management value mode assessments and recommended field work tasks for sites.

SUMMARY OF HISTORICAL DOCUMENTARY RESEARCH

Historical Researcher Lehua Kalima and Cultural Resources Specialist Kepa Maly have conducted historical documentary research for the Kailua to Keahole Region State Lands LUC Project area. The research, presented as Appendix B, is briefly summarized here.

Traditionally, the district between Honokahau and Kapalaoa was known as Kekaha. A recently translated Hawaiian legend, The Legend of Ka-Miki (Maly, in prep.), indicates that the traditional boundary of Kekaha ran:

> [From] The uplands of Hikuhia, which is above Napu'u (pu'alu) and the waterless Kekaha; which reaches from Keahualono on the rocky plain of Kaniku, to the hill of Pu'uokaloa [at Keahuolu].

Soehren, using other sources, also defines Kekaha as reaching from a cairn near the Kohala-Kona border (Keahualono) to the *ahupua'a* of Keahuolu (1963:1). Missionary census data for the year 1835 reports that 1,244 people lived in Kekaha (Schmitt 1973:31). Whether or not the area was inhabited by a similar number of people in prehistoric times has not yet been established.

According to tradition, Kekaha was a region "valued by ruling chiefs, inhabited by attendant chiefs, and upon occasions abused by warring chiefs" (Kalakaua 1973:31). During the early 18th century there was war between Mau`i and Hawai`i, and the Mau`i people "cut down the trees throughout the land of Kona." These acts of war were of no small consequence, for "to fell trees of such usefulness was considered truly inhuman" (Springer 1985:23).

Schilt (1984) writes that in pre-contact times, an ancient chief, 'Umi-a-Liloa, used the many caves in the vicinity of the project area for refuge. Cordy (1985) identified the Kalaoa area as home of the high priest, Kaluolapa, who presided over ceremonies in Hale'ohi'u and Kalaoa. Cordy states that his source for this information is Kelly (1973:111). Kelly's source was a 1911 Hawaiian language newspaper article entitled "Place Names in Kona" (*Ke Au Hou*, Feb. 15, 1911; trans. from Ethnographic Notes, Vol. 1., B.P. Bishop Museum Library).

During the early historic period, Menzies was in North Kona and described the area as "barren and rugged" (1920:99) although it is assumed that he never visited the current project area. Ellis noted the 1801 Hu`ehu`e Flow from Hualalai and how it had destroyed villages, plantations, and fishponds (Ellis 1963:30-31).

During the Great Mahele of 1848, Kalaoa 1-4 was set aside as Government Land (Board of Commissioners 1929). Most of the land between the 1,000 ft and 2,400 ft contours was soon sold, and from 1852 to 1864, a series of grants were issued in the *ahupua'a*. The grants were typically sold as lots of about 50 acres, and most of them were agricultural parcels (Cordy 1985:6 and Soehren 1982:3).

When Handy began a study of the Hawaiian planter, in 1930, there were still some taro plantations above Kalaoa and (Handy and Handy 1972:523). Several methods of dryland planting practiced in the Kona area are described by Handy and Handy (1972:105-109). Most methods involved clearing the vegetation by weeding or burning, clearing the planting ground of stones, and mulching the ground over the planted crops with some type of vegetation (grass, ferns, sugar cane tops, *kukui* leaves, etc.)(Ibid:108). The stones that had been cleared from the fields were then piled into low walls or mounds. Garden areas at Kuakini (Schilt 1984:40) were characterized by such clearing piles stacked against natural outcrops. These piles might also have acted as agricultural features themselves, as the stones would act as mulch and retain surface moisture. Sweet potatoes were grown on similar mounds (Ellis 1963:23), and although sweet potatoes were not reported to have grown on this land historically, they might have been grown here in prehistoric times.

Coffee was first cultivated in the Kona area in the 1840s. After the Great Mahele, foreigners were allowed to own land, and coffee plantations worked by Chinese and Hawaiian laborers were established in the area above Kona, at elevations above 800 feet. Kelly (1971) reported that coffee was grown on three acres in the Kalaoas in 1880. Coffee grew

Table 2.

SUMMARY OF PREVIOUSLY IDENTIFIED SITES IN HENRY AND GRAVES (1993) STUDY AREA

Site/Fea. Designation	Formal Type	Tentative Functional Interpretation	CRM Value R	I	C
Ching 1971					
Complex A*	Complex	Habitation	N/A		
Complex D*	Complex	Habitation	N/A		
600	Trail	Transportation	N/A		
603	Trail	Transportation	N/A		
630	Trail	Transportation	N/A		
Rosendahl 1973***					
Davis 1977					
262*	Cave	Habitation	N/A		
6417*	Complex (7) Walls (2) Enclosure (3) Platforms (2)	Agriculture/Habitation	N/A		
6418*	Cave	Habitation	N/A		
6419*	Complex Platform Enclosure *Ahu*	Agriculture/Marker	N/A		
6420*	Cave	Habitation			
6421*	Cave	Habitation	N/A		
6422*	Complex Cave *Ahu* (2)	Habitation/Marker	N/A		
6423*	Complex Cave Platform Mounds (6)	Habitation/Marker	N/A		
6424*	Cave	Habitation	N/A		
6425*	Cave	Habitation	N/A		
6426*	Mod Outcrop	N/A	N/A		
6427*	Cave	Habitation	N/A		
6428*	*Ahu* (2)	Marker	N/A		
6429*	Cave	Burial	N/A		
6430*	Cave	Habitation	N/A		
6431*	*Ahu*	Marker	N/A		
6432*	Wall	Boundary	N/A		
6433**	Complex Enclosures Mod. Outcrops *Ahu* Mounds	Agriculture/Habitation	N/A		
6434*	Complex *Ahu* (8) Platform Cave	Habitation/Marker	N/A		
6435*	*Ahu*	Marker	N/A		
6436*	*Ahu*	Marker	N/A		
6437*	*Ahu*	Marker	N/A		

**Outside project area*
***Within project area*
****Salvage Work Only - No New Sites*
N/A = Not Assigned
Cultural Resource Management
Value Mode Assessment—Nature: R = scientific research, I = interpretive, C = cultural
—Degree: H = high, M = moderate, L = low

Table 2. (cont.)

Site/Fea. Designation	Formal Type	Tentative Functional Interpretation	CRM Value R	I	C
Hammatt & Folk 1980					
N/A*	*Ahu* (10)	N/A	N/A		
N/A*	Wall	N/A	N/A		
N/A*	Enclosure	N/A	N/A		
N/A*	Platform	N/A	N/A		
N/A*	Trail	N/A	N/A		
N/A*	Lava tube (4)	N/A	N/A		
Rosendahl, M.L.K. 1989					
5696*	Pits	Quarry	L	L	L
5697*	Complex	Ceremonial/Habitation	H	H	H
5698*	Mound	Marker	L	L	L
5699*	Wall	Boundary/Agriculture	L	L	L
Walker & Rosendahl 1990a					
802-1*	Linear mound	Boundary	M	L	L
802-2*	Mound	Agriculture	M	L	L
803-3*	Mound	Agriculture	M	L	L
802-4*	Enclosure	Habitation	M	L	L
802-5*	Complex (3)	Transportation/Habitation	M	L	M/H
A	Cairn				
B	Trail				
C	Enclosure				
802-6*	Complex (12)	Agriculture/Habitation	M	L	L
A-I	Mounds				
J	Enclosure				
K-L	Mounds				
802-7*	Cave	Burial	M	L	H
802-8*	Cairn	Marker	M	L	L
802-9*	Cave	Temp. Habitation	M	L	L
802-10*	Cave	Habitation	M	L	L
802-11*	Complex (2)	Indeterminate/Marker	M	L	L
A	Boulder align.				
B	Cairn				
802-12*	Caves (2)	Habitation	M	L	L
802-13*	Terrace	Habitation	M	L	L
Dowden & Graves 1992					
18076*	Pahoehoe Ex.	Quarry	M	L	L
18077*	Complex (2)	Quarry	M	L	L
A	Pahoehoe Ex.				
B	Pahoehoe Ex.				
18078*	Pahoehoe Ex.	Quarry	M	L	L
18079*	Complex (3)	Quarry	M	L	L
A	Pahoehoe Ex.				
B	Pahoehoe Ex.				
C	Pahoehoe Ex.				

best on the fertile leeward slopes of Hualalai and Mauna Loa, at elevations of 800-1,700 ft, the same area in which upland taro thrived (Goto 1979:5). Coffee gradually replaced taro in these areas.

Coffee growers in the Kona area experienced booms and busts over the years. In the 1850s the coffee crop suffered through drought and blight. In 1880, the crop rebounded and an "abundance of fruit" was found on the hills behind [Kailua] town" (Bowser 1880:549). Most of the coffee in this period was grown on large plantations. In 1889, the world coffee market collapsed. As a result, there was a shift from large plantations owned by Caucasians to smaller plots that were frequently owned by Japanese immigrants, individuals, or families, who had completed their three years of service on the sugar cane plantations (Lind n.d.:19). In 1918, a frost killed the coffee crop in Brazil and prices for Kona coffee soared.

A legend translated by Maly (Maly in prep.) concerns the legendary figure, Ka-Miki, and his brother, Maka-'iole, who journeyed around the island during the time of Pili-a-Ka'aiea (Pili), sovereign chief of all Kona around the 13th century. During this journey, the brothers competed along the trails and in the contest arenas of the royal courts of the chiefs of Hawai'i island districts. Their story provides information on hundreds of place name origins, site and community histories, and other information.

SETTLEMENT MODELS

Chronological Framework

A chronology for South Kohala-North Kona area has been presented in Donham (1987:142-145) and has been summarized in Dowden and Graves (1992). Donham's chronology includes data collected by Cordy (1981, 1985, 1986), Hommon (1976), and Kirch (1980, 1985).

Initial occupation of the northern end of North Kona occurred at Anaeho'omalu in c. AD 900 (Barrera 1971). By AD 900 population growth in agriculturally favorable windward environments reached the point that it became necessary to exploit areas less favorable to agriculture (such as the northern portion of Kona) (Kirch 1985). Initial occupation of sites *makai* of the current project date to c. AD 1030, which generally conforms to the above time scale. Kirch (1985) states that the overall population in West Hawai'i appears to have been low, and remained fairly stable, until c. AD 1200 (1985:288), when a significant increase probably occurred. Due to the generally arid, rocky environment and the lack of fresh water in the North Kona District, the increase was probably restricted to certain areas in the northern end of the district, such as Anaeho'omalu, and probably Kiholo, Ka'upulehu, and Kuki'o.

Cordy's work suggests that as the population increased in certain areas of North Kona, substantial zones in between such areas remained uninhabited (Cordy 1981:173). Initial settlement of these uninhabited zones, and probably along the entire coast as well, began c. AD 1400 at Kohana-Iki and 'O'oma II (Cordy 1981:168). During this period the population began to expand; it is suggested that it nearly doubled each century between AD 1200 and 1600; the expansion was followed by an eventual equilibrium and finally a decline (Kirch 1985:288).

In his study of prehistoric sites in the 'O'oma and Kalaoa Ahupua'a, Cordy (1985:38) proposed that populations were small until AD 1500-1600 and that intensive agriculture was not developed in the area until AD 1500. Cordy reviewed dates from 24 sites and listed the earliest date recovered from each *ahupua'a*. The earliest dates for Kalaoa 5 at that time were AD 1400 (for a temporary habitation feature) and AD 1510 (for a permanent habitation feature). The earliest known date for a temporary habitation feature in Kalaoa 4 was AD 1610, and AD 1680 for a permanent habitation feature. All of the dates were obtained from coastal sites.

Based on the presence of upland habitation and agricultural sites in Kealakehe that date to c. AD 1511-1638 (Walker and Rosendahl 1988), it seems likely that initial upland occupation of portions of North Kona may have occurred by AD 1550-1650. However, agricultural sites dating to AD 1280-1490 have been documented for upland Kalaoa 4 (Walker and Haun 1988). Upland expansion at 'O'oma II has been suggested to have begun c. AD 1650-1700 (Donham 1987:144). This is supported by a radiocarbon date of AD 1645-1950 that was obtained from a hearth in a habitation feature at Kealakehe (Hammatt et al. 1987).

The previous research has provided ample evidence for the prehistoric use of North Kona. The research indicates there was early occupation of favorable coastal areas followed by later expansion into more marginal areas and into upland areas. Based on Cordy's (1985) examination of *kuleana* claims made after the Great Mahele of 1848, aboriginal land use appears to have continued into the historic period, particularly in the uplands.

The Ahupua'a Settlement Model

One of the primary goals of the Henry and Graves (1993) study was the formulation of an accurate predictive model of prehistoric settlement and land use within their (and thus the current) project area. Portions of the overall study area have already been subjected to varying levels of archaeological

examination, and this data has proven valuable. However, an analysis of the resources of both the overall the the current specific project area, in isolation from the nearby coastal and upland forests, provides only a partial view of the *ahupua'a* system of the area.

The *ahupua'a* is a socio-economic unit that provided access to a variety of environmental zones. The coastal areas were used primarily for exploitation of marine resources. The intermediate region, between the coast and the forest, was used for dryland cultivation of taro (*Colocasia esculenta* [L.] Schott) and *wauke* (*Broussonetia papyrifera* [L.] Vent) (the latter used for the production of *kapa* or bark cloth) (Handy and Handy 1972:225-227). It has also been suggested (Hommon 1976:267) that the introduction (c. AD 1270) of new crops more suitable to the thin soils and arid conditions of leeward Hawaii, e.g., sweet potatoes (*Ipomoea batatas* [L.] Lam.), allowed agricultural production on what formerly may have been unproductive lands, particularly in the *kula*, or intermediate zone. The inland forested areas provided plentiful raw materials, such as wood for the production of house frames and canoes; *olona* (*Touchardia latifolia* Gaud.), a native shrub whose bark was used in the production of fishing nets and lines; and feathers for cloaks, capes and helmets. Thus the *ahupua'a* was a relatively independent, self-sufficient unit.

The *ahupua'a* was usually "controlled by a lesser chief, who in turn appointed one or more stewards to oversee production, organize work parties, collect tribute, and in other ways represent the chief" (Kirch 1985:2). The lesser chiefs, in turn, paid tribute to paramount chiefs that controlled districts (groups of *ahupua'a*), and eventually whole islands. Hommon has termed this the "supra-*ahupua'a* political hierarchy" and attributes its complexity to the environmental diversity present within the enlarged resource area, i.e. the *ahupua'a*, which not only supplied most of the needs of its inhabitants, but allowed for contributions to the larger political complex (1976:71).

Environmental Settlement Models

If the underlying structure of the *ahupua'a* system is based on the exploitation of different environmental zones, then a closer examination of these zones should allow us to make predictions about the types of activities that occurred within each zone. Several researchers have attempted to clarify the extent and nature of the use of the various zones; these include Rosendahl (1973), Davis (1977) and Cordy (1985). The information in these studies should be useful in predicting more precisely the types of sites expected to be found in the present project area, and their distribution.

Rosendahl (1973:60-61, 65-66) proposed general patterns of aboriginal settlement for the North Kona area, based on ethnohistoric and ethnographic sources. From these sources, Rosendahl divided the area of occupation into three principal environmental zones: a narrow and arid coastal zone concerned with the use of marine resources; a sloping and rocky, barren midland zone, and an upland habitation-agricultural zone. He notes that the further *mauka* forest zone was used, but rarely inhabited. Rosendahl summarized these occupational zones as follows:

> **Coastal Occupation** - Housing appeared as small clusters, fishing hamlets, along the shore and frequently found near fishponds and small bays. The inhabitants were principally engaged in marine exploitation (including in-shore and deep-water fishing, gathering shellfish, production of salt and aqua-culture. Very limited agriculture including coconut, sweet potatoes, and possibly bananas raised in small beach areas and tiny pockets of sand and gravel in barren flows. These may have provided supplies for travellers going by canoe between Kailua and Kawaihae.
>
> **Barren Zone Occupation** - Temporary shelter and the *mauka-makai* foot trails evidence the movement of people and goods between the coast and uplands. Both terrestrial and marine resources midden remains from habitation evidence access to both upland and coastal zones. Artifacts and structural remains are indicative of recurrent use of temporary occupation features.
>
> **Upland Occupation** - This appears to be a major occupation area, with scattered, small residential hamlets (probably above 2,000 ft and 25 inches-per-year rainfall). Extensive agriculture exploitation is indicated and composed of dryland swidden cultivation. The principal crops were dryland taro and sweet potato, with other crops including breadfruit, bananas, paper mulberry, ti, and sugar cane.

Davis' work in the Keahole Agricultural Park also resulted in the identification of three terrestrial or environmental zones applicable to the current study area (Davis 1977:19-21). A summary of these zones is as follows:

> **The Coastal Zone** - Consists of barren, rocky shorelines, isolated bays with coralline beach formations, inland ponds, brackish basal water, fresh water springs, and strand vegetation occurring in

limited soil deposits. It originates at the coastline and extends to approximately 300 meters inland, or from the 0-9 meter contour (0-30 feet).

The Transitional or "Barren" Zone - Consists of bare, non-disintegrated lavas, arid conditions, limited dry scrub vegetation (fountain grass, lantana and *noni*), which increases east of the highway. Little or no soil development is in evidence. This zone originates at the 9-12 meter contour (30-39 feet), or 300-600 meters inland from coast (984-1969 feet), and extends to the 130 meter contour (425 feet).

The Upland Forest Zone - Consists of moderate soil development and adequate rainfall. This zone begins with the appearance of koa haole and Christmas berry, and continues to a mixed, broadleaf forest vegetation. It originates at 130 meter contour (425 feet), continuing east.

Davis also makes observations about site types in the upland forest zone; the observations are pertinent to the current project:

> Here also begins the lower margin of the upland agricultural systems with extensive prehistoric site remains including house enclosures, stone platforms, high stacked ahu (cairns), stone walls and the numerous stone mounds suggesting that the local crop was largely sweet potato (Davis 1977:21).

Cordy summarized archaeological findings in the Lands of 'O'oma and Kalaoa (1985). Like Rosendahl (1973) and Davis (1977) he divided the study area into three environmental zones and examined site locations and types within each land unit. He described the Coastal Zone as running from the shoreline to 164 ft (50 meters) inland, with a maximum elevation of 20 ft (six meters). The zone, composed of low pahoehoe with some sand beaches, included trails, caves, enclosures, platforms, pools, cairns, C-shapes, and pavings. Cordy suggested there were at least 22 permanent house sites located right along the shore. The permanent structures included platforms, enclosures, and pavings with relatively shallow fill. Also in the zone were temporary dwelling areas—caves and C-shapes. These were located just inland of the Coastal Zone, at the interface with the Barren Zone, or along the shore in areas not used as permanent housing. Two very large structures interpreted as *heiau* were found in 'O'oma 1, in the Coastal Zone.

Cordy described the Barren Zone of 'O'oma and Kalaoa much as Rosendahl did, in terms of environment and features. He described a band from the 20 ft contour (six meters) to c. 0.8-1.4 kilometers inland, with sites that appeared to consist mostly of a few *mauka-makai* trails, the early historic Mamalahoa Trail (which parallels the shore), a few C-shaped structures and caves near the trails, and cairns that may have been associated with the trails. With some exceptions, habitation sites contained only shallow deposits, and appeared to be temporary, with shallow deposits.

At the 200-400 ft level (61-122 meters) of Kalaoa 5 and 'O'oma 1, site density increased, according to Cordy, and he reported large numbers of cave shelters in tubes branching off of sinks and on the floors of the sinks. These were marked by extensive features that Cordy felt may have been indicative of recurrent, short-term usage. A number of surface cairns in the vicinity might have marked trail locations and associated caves. A single historic, walled, permanent structure (with associated features) was found near the upper end of the Barren Zone (ibid.:32).

The Upland Zone, according to Cordy (1985), consisted of rough aa and soil terrain from 426 ft to 3,379 ft (130-1,030 meters) elevation and up to six kilometers from shore. Only three projects had been conducted in this zone at the time of Cordy's work, and the projects had found upland agricultural features, platforms, mounds, and walls. Cordy reported virtually continuous sites beginning at the c. 450 ft elevation extending up to at least the 800 ft contour, and perhaps beyond. There were indications that this was the lower margin of an upland agricultural system that included house enclosures, stone platforms, high-stacked *ahu*, stone walls. Also present were numerous stone mounds, suggesting that the local crop was largely sweet potato (Davis IN Cordy 1985).

The preceding models of settlement, though varying in detail, describe similar findings, posed in a context of distinct environmental zones. Davis and Cordy provide a description of the environment in each zone, with Davis focusing primarily on soil development and elevation, and Cordy making additional observations about the site types associated with each zone, which he defined using elevation. Rosendahl did not define the variables used to differentiate the zones, but focused on the activities that may have been conducted within them, based on ethnographic research. Each of these approaches, however, defines a starting point for testing elements of the environmental model and developing expectations for site types and distribution within the project area. For the purposes of the Henry and Graves (1993) study, two variables

were hypothesized as being potential indicators of site type and distribution; these were (a) soil type and (b) elevation.

Implications for the Current Project

The current project area is within the Barren and Uplands Zones, as described above. It was anticipated the Barren Zone extended from the western boundary of the project area (c. 300-320 ft [92-98 m] elevation), inland to approximately the 400 ft (122 m) elevation. Site types within the Barren Zone was expected to reflect transitory occupation, and was expected to include types such as C-shapes and cave/sink complexes and transportation routes between the coast and the uplands. The Upland Zone was expected to originate at approximately the 450-ft contour and continue inland to the easternmost edge of the project area (c. 600 ft [183 m] elevation) and beyond. The Uplands Zone was expected to exhibit a nearly continuous distribution of sites and features, related to agriculture and possibly temporary habitation.

FIELD METHODS AND PROCEDURES

On December 7, 1992, Project Supervisor James A. Head, B.A., and Field Archaeologist Sheryl Dowden, B.S., conducted an aerial survey of the project area using a helicopter piloted by Mr. Kaohu Sproat of Mauna Kea Helicopters, Inc. The project area had been subjected to an earlier aerial survey (Phase 1) on September 16, 1992 by Henry and Graves (1993) in conjunction with an archaeological assessment for the area. It was felt at that time that further aerial reconnaissance would not be productive. Henry and Graves used north-south transects over the project area at an approximate altitude of 50 ft (15 m). Sites located from the helicopter were marked by dropping pink flagging tape attached to rocks onto the site. The flagging tape was inscribed with the PHRI project number, the temporary site number (AS-), and the date.

During the Henry and Graves aerial survey, 23 sites were identified. The locations of identified sites were plotted on a computer-generated topographic map, presented as Figure 2. Figure 2 also shows the locations of previous surveys in the area. These sites consist of aa excavations, *ahu*, C-shapes, complexes, enclosures, a lava tube, mounds, overhangs, a pavement, pahoehoe excavations, a trail, and a historic wall. Of the 23 sites, 11 were newly recorded, while 12 had been identified during prior surveys. Six sites, though located within areas subjected to prior survey, had not been identified during those surveys. Nine sites recorded during the aerial survey were identified as representing the 18 sites and features noted (but not recorded) by Hammatt and Folk during their 1980 reconnaissance survey. Table 3 lists the sites by the PHRI temporary Aerial Survey number (AS-) and correlates previously examined areas and any site numbers formerly assigned.

During the current project, a helicopter was used to identify access routes into the survey area, especially the eastern boundary and the northern portions. It was also used to mark the corners and rough boundaries of the project area—pink flagging tape tied to rocks were dropped from the air. The marking was aided by points on the ground that had been flagged by a State survey crew.

The ground survey covered 100% of the project area. All areas were examined by crews ranging in size from 5-6 individuals. Spacing between sweeping crew members ranged between 10-15 meters. A series of transects travelling either north/south were done with one exception. Transect 2 travels along the northern boundary going mostly east/west. The project area was divided into four roughly equal areas by the existing power line, and two mostly parallel flagged lines which traveled east-west from the upper to the lower boundary (Figure 3). These sweep or transect lines were numbered consecutively from number 1-71 and agricultural and other non-habitation features (i.e. modified outcrops, mounds, terraces, and pahoehoe excavations) were counted. Such features were also enumerated by type within each transect, but were not separately recorded. Both Transect 1 (which traveled along the western boundary) and Transect 2 were examined twice, so their features are only counted once. Appendix A provides detailed descriptions for each site.

All sites were described on standard PHRI site survey record forms and were photographed using 35 mm black-and-white film (PHRI Roll No. 4347-4350, 4352-4356, 4358-4359, and 4361-4364). Detailed recording of sites included written descriptions, measurements, and plan maps. Each site or the primary feature within each site complex, was marked with pink-and-blue flagging tape, and with an aluminum tag bearing the temporary site number, date, the letters "PHRI," and the PHRI project number (92-1298). This aluminum tag was usually tied to a small stone, which was then wrapped in pink or blue flagging tape. The stone was placed on a prominent part of the site, usually at the recording datum. All sites were assigned one- or two-digit PHRI temporary field numbers prefixed with "1298-," beginning with "1298-1 (Table 3)."

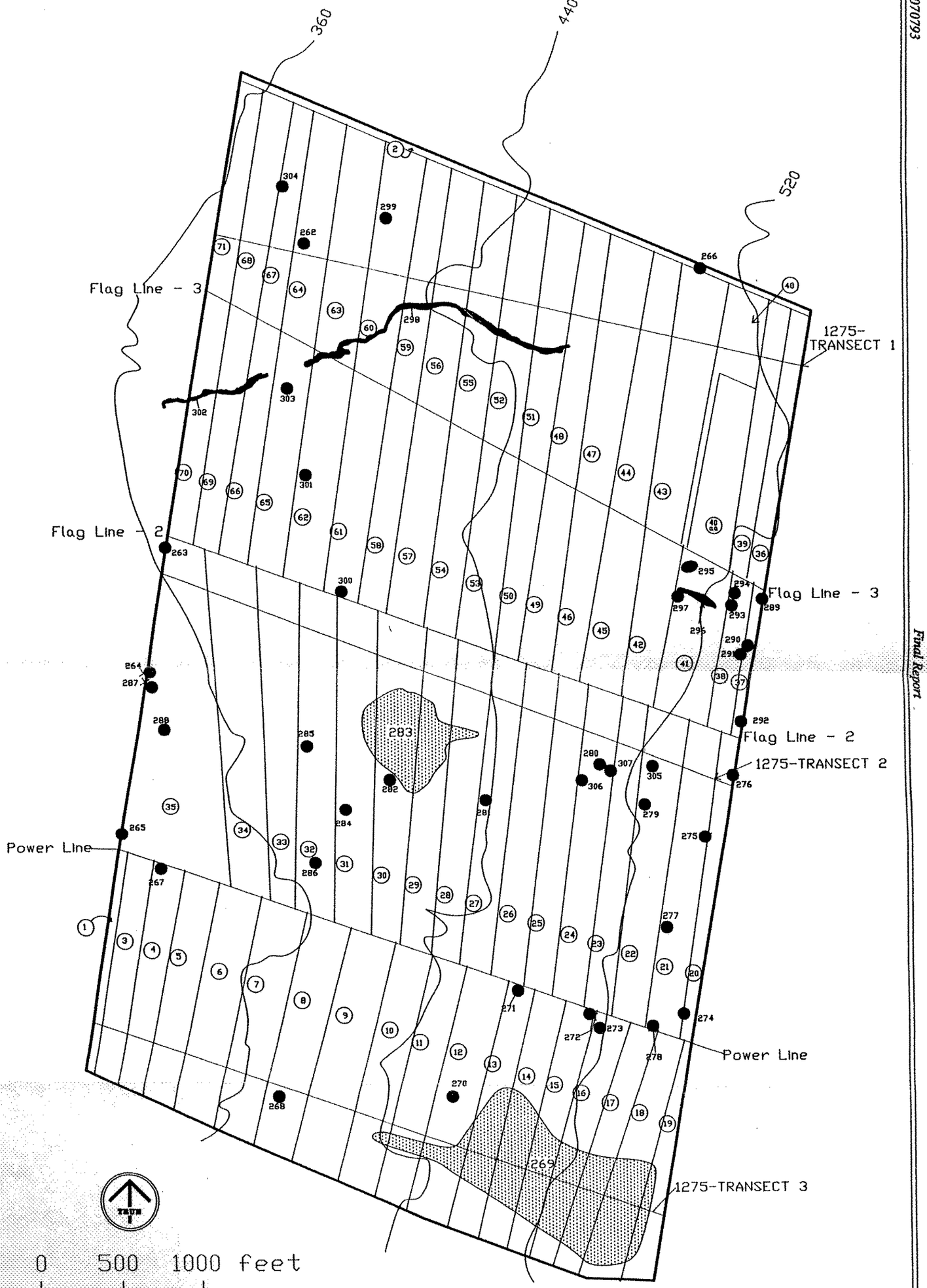
During recording of the sites, possible diagnostic artifacts and potential radiocarbon samples were collected. These will be discussed in following sections.

Table 3.

CORRELATION OF SITE NUMBERS

*SIHP	PHRI
15262	1298- 1
15263	1298- 2
15264	1298- 3
15265	1298- 4
15266	1298- 5
15268	1298- 7
15269	1298- 8
15270	1298- 9
15272	1298-12
15273	1298-14
15275	1298-17
15276	1298-18
15278	1298-20
15279	1298-22
15280	1298-24
15281	1298-25
15282	1298-29
15283	1298-31
15284	1298-33
15285	1298-35
15286	1298-37
15287	1298-38
15288	1298-39
15289	1298-40
15290	1298-41
15291	1298-42
15292	1298-43
15293	1298-45
15294	1298-46
15295	1298-47
15296	1298-52
15297	1298-57
15298	1298-65
15299	1298-66
15300	1298-71
15302	1298-74
15303	1298-75
15304	1298-76
15305	1298-78
15306	1298-79
15307	1298-80

* *State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five-digit numbers prefixed by 50-10-28 (50=State of Hawaii; 10=Island of Hawaii; 28=USGS 7.5' series quad map ["Kailua, Hawaii"]).*



NOTE:
THREE-DIGIT NUMBERS ARE SIHP NUMBERS PREFIXED BY 50-10-28-15
(50=STATE OF HAWAII; 10=ISLAND OF HAWAII; 28=USGS 7.5' SERIES
QUADRANGLE MAP (KAILUA, HAWAII); 15=SITE NUMBER PREFIX.)

PHRI PAUL H. ROSENDAHL, Ph.D., INC. ARCHAEOLOGICAL • HISTORICAL • CULTURAL RESOURCE MANAGEMENT STUDIES & SERVICES	308 HOHOU; STREET HILO, HAWAII 96720 (808) 969-1763, 961-6998(FAX)	Archaeological Inventory Survey Kailua to Keahole Region State Lands LUC Project-500-Acre University Site PHRI Project 92-1298	Figure 3. PROJECT AREA WITH TRANSECT AREAS

FINDINGS

SURFACE FINDINGS

During the survey, 42 sites were identified.* The sites comprise 21 complexes (multiple-feature sites) and 21 single-feature sites (Table 4). Of the 42 sites, 16 had been previously identified. These included long, linear transects containing features, several habitation caves, and Site 6433, originally identified by Davis (1977). All previously identified sites were combined with sites identified during this project. The most common recorded formal feature type in the project area is midden deposit (n=99). The following types were also identified: modified outcrop, terrace, enclosure, stacked rock, mound, wall, pahoehoe excavation, alignment, modified lava tube, cupboard, petroglyph, modified depression, steppingstone trail, cairn, platform, pavement, utilized lava tube, cleared area, and pecked stone (Table 5). The feature types comprised the following functional types: habitation, agriculture, agricultural/possible burial, indeterminate/possible burial, habitation-possible burial, indeterminate, multiple, transportation, habitation (refuge), communication, marker, recreation, ceremonial, quarry, and boundary (Table 6). Generally, the features combined to form site complexes assigned to the broader functional categories of habitation, multiple (including both habitation and some other function, indeterminate, agriculture, storage, marker, recreation and communication. In addition to the above, numerous minor agricultural features were identified in the project area, indicating that the area may constitute a northern extension of the Kona Field System. The features (approximately 3,000) were not separately recorded, but rather, were counted and grouped by transect (Table 7), and were assigned a single site number (18891).

Site Function

Habitation - Twenty-seven sites with habitation features were identified in the project area. Sites and features were defined as temporary (or longer-duration) versus permanent habitations, based on criteria defined by Cordy (1981:66). In his revised model, Cordy includes the following criteria: size (permanent is larger, with areas greater than 16 m^2); construction (permanent housing exhibits substantial construction; short-term housing is often poorly constructed); presence of internal stratified features, such as firepits (such pits are found in temporary camps, not in permanent housing); presence of special-purpose structures (small, special purpose structures for work and storage are associated with permanent housing, not with short-term camps); and lastly, location (permanent housing is usually clustered on the coast, either along the shore or at valley mouths, or on sides of valleys; short-term camps are found along trails, near agricultural fields, or on the coast).

Based on surface appearance, none of the features identified during the current project was assigned a permanent habitation function, even though they all met one or more of the above criteria. At all sites the assemblage of surface artifacts or ecofacts was limited; this, however, may have been a function of differential preservation or may have reflected disposal/discard patterns. There were features in caves which did exhibit substantial deposits of midden, but as Cordy (1981) points out, this alone cannot be used as an indicator of permanent habitation. A better indicator of permanence would be diversity of midden types or a more diverse assemblage of artifacts. A permanently occupied structure would be expected to evidence a fuller range of subsistence, craft, and domestic activities. It was initially thought that Site 15298 of the current project might have been used for permanent habitation, as the site has skylights that would have made the cave more suitable for such use. Cordy notes, however, that caves were not used for permanent habitation.

There is an example of a possible late-1800s, semi-permanent house terrace or paving in the project area (Feature D, at Site 15298). Cordy notes that such structures are expected in the Upland Forest Zone between 430-2,200 ft above sea level (Cordy 1985:43). Feature D (Figure 4) meets Cordy's (1981:66) size criteria, but is not of substantial construction. It is not known, at present, if there are internal structures at the feature, but it does appear that there are other special purpose structures nearby. The feature is not in an area that permanent habitations are usually found in. The feature may be associated with the Upland Forest agricultural features.

Another candidate for extended use is Feature A at Site 15285. This large enclosure meets Cordy's (1981) size criteria, is of substantial construction, and has a small storage cupboard in the northeast corner. The feature is located in the center of the project area at roughly 120 m (400 ft) elevation and is probably associated with the many possible agricultural features (mounds, modified outcrops, terraces) located upslope of it.

A variety of feature types in the project area appear to have been used for temporary (or seasonal, or recurrent) habitation. These types include lava tube caves, enclosures, platforms, modified outcrops, modified depressions, terraces, alignments, pavements, and C-shaped walls. Site 15281 (Figure 5) is an example of a small habitation site.

** This number does not include Site 18891, the 3,000+ ubiquitous agricultural features in the project area.*

Table 4.

SUMMARY OF IDENTIFIED SITES AND FEATURES

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15262	Complex (4)#	Multiple	M	L	L	-	-	+
A	Mound	Indeterminate						
B	Mound	Agriculture						
C	Mound	Agriculture						
D	Terrace	Habitation*						
15263	Modified depression	Indeterminate	M	L	L	-	-	-
15264	Complex (2)	Habitation	M	L	L	-	-	-
A	Modified outcrop	Habitation						
B	Modified outcrop	Habitation						
15265	Modified depression	Indeterminate	L	L	L	-	-	-
15266	Complex (2)	Habitation	M	L	L	-	-	-
A	Terrace	Habitation						
B	Terrace	Indeterminate						
15268	Alignment	Habitation	M	L	L	+	-	-
15269	Complex (26)	Multiple	M	L	L	+	-	+
A	Platform	Habitation						
B	Steppingstone trail	Transportation						
C	Terrace	Habitation						
D	Mound	Agriculture						
E	Terrace	Agriculture						
F	Cairn	Marker						
G	Steppingstone trail	Transportation						
H	Terrace	Multiple						
I	Wall	Agriculture						
J	Enclosure	Indeterminate						
K	Wall	Habitation						
L	Terrace	Habitation						
M	Terrace	Habitation						
N	Wall	Habitation						
O	Steppingstone trail	Transportation						
P	Steppingstone trail	Transportation						
Q	Enclosure	Habitation						

* *All habitation sites listed here are for temporary habitation*

\# *Number of component features within complex*

Cultural Resource Management

Value Mode Assessment—Nature: R = scientific research, I = interpretive, C = cultural

—Degree: H = high, M = moderate, L = low

Field Work Tasks: DR = detailed recording (scaled drawings, photographs, and written descriptions), SC = surface collections, EX = limited excavations.

Note: Site 18891, the 3,000+ ubiquitous agricultural features, is not included on this table.

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
R	Terrace	Habitation						
S	Cairn	Marker						
T	Modified lava tube	Multiple						
U	Steppingstone trail	Transportation						
V	Terrace	Habitation						
W	Cupboard	Storage						
X	Wall	Habitation						
Y	Wall	Habitation						
Z	Platform	Habitation						
15270	Cupboard	Storage	M	L	L	+	-	-
15272	Complex (4)	Habitation	L	L	L	-	-	-
A	Enclosure	Habitation						
B	Mound	Agriculture						
C	Mound	Indeterminate						
D	Modified depression	Indeterminate						
15273	Complex (5)	Agriculture	L	L	L	-	-	-
A	Modified depression	Indeterminate						
B	Excavation	Quarry						
C	Modified outcrop	Agriculture						
D	Modified outcrop	Agriculture						
E	Mound	Agriculture						
15275	Modified lava tube	Indeterminate	L	L	L	-	-	-
15276	Complex (5)	Multiple	M	L	M	+	-	+
A	Excavation	Habitation						
B	Alignment	Habitation						
C	Utilized lava tube	Habitation						
D	Mound	Indeterminate						
E	Mound	Agriculture/Poss. Burial						
15277	Complex (7)	Habitation	M	M	M	+	-	-
A	Terrace	Habitation						
B	Excavation	Indeterminate						
C	Alignment	Indeterminate						
D	Terrace	Habitation						
E	Modified lava tube	Habitation						
F	Terrace	Habitation						
G	Steppingstone trail	Transportation						
15278	Complex (2)	Habitation	M	L	L	-	-	+
A	Wall	Habitation						
B	Wall	Habitation						
15279	Terrace	Habitation	L	L	L	-	-	-

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15280	Cupboard	Storage	L	L	L	-	-	-
15281	Complex (5)	Habitation	M	M	M	-	-	-
A	Modified lava tube	Habitation						
B	Alignment	Indeterminate						
C	Modified outcrop	Indeterminate						
D	Excavation	Multiple						
E	Modified depression	Multiple						
15282	Utilized lava tube	Storage	M	L	L	+	-	-
15283	Complex (72)	Multiple	M	L	L	+	-	+
A	Terrace	Habitation						
B	Wall	Habitation						
C	Terrace	Habitation						
D1-D53	Modified outcrop (53)	Agriculture						
E1-E6	Mound (6)	Agriculture						
F	Wall	Agriculture						
G	Modified lava tube	Agriculture						
H	Modified depression	Agriculture						
I	Wall	Agriculture						
J1	Excavation	Agriculture						
J2	Excavation	Agriculture						
K	Alignment	Agriculture						
L	Terrace	Agriculture						
M	Terrace	Agriculture						
15284	Modified lava tube	Habitation	M	L	L	+	-	-
15285	Complex (2)	Habitation	H	H	M	-	-	-
A	Enclosure	Habitation						
B	Cupboard	Storage						
15286	Complex (4)	Habitation	L	L	L	+	-	-
A	Modified outcrop	Indeterminate						
B	Alignment	Habitation						
C	Midden	Habitation						
D	Other (water catchment)	Habitation						
15287	Petroglyph	Recreation	M	L	L	-	-	-
15288	Cairn	Marker	M	L	L	-	-	-
15289	Enclosure	Indeterminate	L	L	L	-	-	-
15290	Complex (4)	Habitation	M	M	L	-	-	+
A	Alignment	Indeterminate						
B	Platform	Habitation						
C	Enclosure	Habitation						
D	Mound	Agriculture						

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15291	Complex (2)	Indeterminate	M	M	L	+	-	+
A	Enclosure	Indeterminate						
B	Wall	Indeterminate						
15292	Complex (8)	Multiple	M	M	M	-	-	+
A	Enclosure	Indeterminate						
B	Terrace	Multiple						
C	Wall	Multiple						
D	Terrace	Indet./Poss. Burial						
E	Cleared area	Habitation						
F	Pavement	Transportation						
G	Terrace	Indeterminate						
H	Excavation	Indeterminate						
15293	Platform	Habitation	M	M	L	+	-	+
15294	Enclosure	Indeterminate	L	L	L	+	-	-
15295	Complex (5)	Habitation	M	L	L	-	-	+
A	Platform	Habitation/Poss. Burial						
B	Terrace	Indeterminate						
C	Enclosure	Habitation						
D	Enclosure	Habitation						
E	Terrace	Indeterminate						
15296	Complex (8)	Habitation	M	L	M	+	-	+
A	Steppingstone trail	Transportation						
B	Terrace	Habitation						
C	Enclosure	Habitation						
D	Excavation	Habitation						
E	Cupboard	Habitation						
F	Alignment	Habitation						
H	Enclosure	Habitation						
I	Enclosure	Habitation						
15297	Complex (4)	Habitation	M	M	M	+	-	-
A	Pavement	Habitation						
B	Terrace	Habitation						
C	Terrace	Habitation						
D	Terrace	Habitation						
15298	Complex (165+)	Multiple	H	H	H	+	+	+
A	Pavement	Indeterminate						
B	Modified outcrop	Indeterminate						
C	Mound	Multiple						
D	Terrace	Habitation						
E	Cupboard	Storage						
F	Mound (2)	Agriculture						

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R I C	Field Work Tasks DR SC EX
15298 (cont.)				
G	Other (entryway)	Transportation		
H1	Enclosure	Multiple		
H2	Terrace	Multiple		
H3	Terrace	Multiple		
H4	Cupboard	Storage		
I1	Petroglyph (4)	Communication		
I2	Petroglyph (2)	Communication		
I3	Petroglyph (1)	Recreation		
I4	Pecked stone (2)	Recreation		
J	Excavation	Quarry		
K	Terrace	Habitation		
BA	Terrace	Habitation		
BB	Wall	Habitation		
BC	Pavement	Habitation		
BD	Mound	Indeterminate		
BE	Midden	Habitation		
BF	Midden	Habitation		
BG	Terrace	Habitation		
BH	Wall	Habitation		
BI	Wall	Habitation		
BJ	Pavement	Habitation		
BK	Midden	Habitation		
BL	Enclosure	Indeterminate		
BM	Wall	Habitation		
BN	Midden	Habitation		
BO	Wall	Habitation		
BP	Enclosures (2)	Habitation		
BQ	Alignment	Habitation		
BR	Midden	Habitation		
BS	Midden	Habitation		
BT	Alignment	Habitation		
BU	Other (water catchment)	Habitation		
BV	Platform	Multiple		
BW	Terrace	Habitation		
BY	Other (6) (lamp holder)	Habitation		
BZ	Modified outcrop	Indeterminate		
BBA	Modified outcrop	Indeterminate		
BBB	Alignment	Habitation		
BBC1	Terrace	Indeterminate		
BBC2	Cupboard	Indeterminate		
BBC3	Mound	Indeterminate		
BBD	Mound	Boundary		
BBE	Midden (77)	Habitation		
BBF	Wall	Habitation (refuge)		
BBG	Other (2) (water catchment)	Habitation		
BBH	Steppingstone trail (6 sections)	Transportation		
BBI	Midden	Habitation		
BBJ	Midden	Habitation		

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15298 (cont.)								
BBK	Alignment	Habitation (refuge)						
BBL	Modified outcrop	Indeterminate						
BBM	Other (water catchment)	Habitation						
BBN	Wall	Habitation (refuge)						
BBO	Enclosure	Habitation (refuge)						
BBP	Alignment	Habitation (refuge)						
BBQ	Enclosure	Habitation (refuge)						
BBR	Midden	Habitation						
BBS	Cairn	Marker						
BBT	Midden	Indeterminate						
BBU	Modified lava tube	Indeterminate						
BBV	Midden	Indeterminate						
BBW	Modified outcrop	Indeterminate						
BBX	Midden	Habitation						
BBY	Cleared area	Habitation						
BBZ	Wall	Indeterminate						
BCA	Modified depression	Habitation						
BCB	Wall	Habitation (refuge)						
BCC	Midden	Habitation (2 sections)						
BCD	Terrace	Indeterminate						
BCE	Modified lava tube	Habitation (refuge)						
15299	Modified outcrop	Habitation	M	L	L	-	-	-
15300	Utilized lava tube	Habitation	M	L	L	-	-	+
15302	Complex (31+)	Multiple	H	H	M	+	+	-
BA	Other (3)(water catc., lamp holder)	Habitation						
BB	Alignment	Transportation						
BC	Enclosure	Indeterminate						
BD	Other (water catchment)	Habitation						
BE	Other (lamp holder)	Habitation						
BF	Other (water catchment)	Habitation						
BG	Wall	Transportation						
BH	Enclosure (2)	Ceremonial						
BI	Cairn	Marker						
BJ	Wall	Habitation						
BK	Terrace	Habitation						
BL	Wall	Indeterminate						
BM	Enclosure (2)	Multiple						
BN	Midden (8)	Habitation						
BO	Other (water catc./indeterminate)	Habitation						
BP	Other (water catchment)	Habitation						
BQ	Other (water catchment)	Habitation						
BX	Modified lava tube	Indeterminate						
BY	Modified depression	Storage						
BZ	Terrace	Habitation						

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15302 (cont.)								
BBA	Alignment	Indeterminate						
BBB	Other (water catchment)	Habitation						
15303	Modified lava tube	Habitation	M	L	L	+	-	-
15304	Petroglyph	Communication	H	H	M	-	-	-
15305	Cairn	Marker	L	L	L	-	-	-
15306	Cupboard	Storage	L	L	L	-	-	-
15307	Enclosure	Habitation	L	L	L	-	-	-

Table 5.

FREQUENCIES OF FORMAL FEATURE TYPES

Formal Type	Number	%	SIHP No./Feature
Midden	99	25.4	15286(C)15298(BE, BF, BK, BN, BR, BS, BBE-77, BBI, BBJ, BBR, BBT, BBV, BBX, BCC), 15302(BN-8)
Modified outcrop	65	16.7	15264(A, B), 15273(C, D), 15281(C), 15283(D1-D53-53), 15286(A), 15298(B, BZ, BBA, BBL, BBW), 15299
Terrace	38	9.8	15262(D), 15266(A, B), 15269(C, E, H, L, M, R, V), 15277(A, D, F), 15279, 15283(A, C, L, M), 15292(B, D, G), 15295(B, E), 15296(B), 15297(B-D), 15298(D, H2, H3, K, BA, BG, BW, BBC1, BCD), 15302(BK, BZ)
Enclosure	26	6.7	15269(J, Q), 15272(A), 15285(A), 15289, 15290(C), 15291(A), 15292(A), 15294, 15295(C, D), 15296(C, H, I), 15298(H1, BL, BP-2, BBO, BBQ), 15302(BC, BH-2, BM-2), 15307
Wall	24	6.2	15269(I, K, N, X, Y), 15278(A, B), 15283(B, F, I), 15291(B), 15292(C), 15298(BB, BH, BI, BM, BO, BBF, BBN, BBZ, BCB), 15302(BG, BJ, BL)
Mound	22	5.7	15262(A-C), 15269(D), 15272(B, C), 15273(E), 15276(D, E), 15283(E1-E6-6), 15290(D), 15298(C, F-2, BD, BBC3, BBD)
Other	22	5.7	15286(D), 15298(G, BU, BY-6, BBG-2, BBM), 15302(BA-3, BD-BF, BO-BQ, BBB)
Alignment	15	3.9	15268, 15276(B), 15277(C), 15281(B), 15283(K), 15286(B), 15290(A), 15296(F), 15298(BQ, BT, BBB, BBK, BBP), 15302(BB, BBA)
Modified lava tube	10	2.6	15269(T), 15275, 15277(E), 15281(A), 15283(G), 15284, 15298(BBU, BCE), 15302(BX), 15303
Excavation	9	2.3	15273(B), 15276(A), 15277(B), 15281(D), 15292(H), 15296(D), 15283(J1-J2-2), 15298(J)
Cupboard	9	2.3	15269(W), 15270, 15280, 15285(B), 15296(E), 15298(E, H4, BBC2), 15306
Petroglyph	9	2.3	15287, 15298(I1-4, I2-2, I3), 15304
Modified depression	8	2.1	15263, 15265, 15272(D), 15273(A), 15281(E), 15283(H), 15298(BCA), 15302(BY)
Steppingstone trail	8	2.1	15269(B, G, O, P, U), 15277(G), 15296(A), 15298(BBH)
Cairn	6	1.5	15269(F, S), 15288, 15298(BBS), 15302(BI), 15305
Platform	6	1.5	15269(A, Z), 15290(B), 15293, 15295(A), 15298(BV)
Pavement	5	1.3	15292(F), 15297(A), 15298(A, BC, BJ)
Utilized lava tube	3	0.8	15274(C), 15282, 15300
Cleared area	2	0.5	15292(E), 15298(BBY)
Pecked stone	2	0.5	15289(I4-2)
TOTAL	**388**	**99.9**	

Note: This table does not include Site 18891, the 3,000+ ubiquitous agricultural features.

Table 6.

FREQUENCIES OF FUNCTIONAL FEATURE TYPES

Function Type	Number	%	SIHP No./Feature
Habitation*	205	52.6	15262(D), 15264(A, B), 15266(A), 15268, 15269(A, C, K-N, Q, R, V, W-Z), 15270, 15272(A), 15276(A-C), 15277(A, D-F), 15278(A, B), 15286(C), 15279, 15280, 15281(A), 15282, 15283(A-C), 15284, 15285(A, B), 15286(B, D), 15290(B, C), 15292(E), 15293, 15295(C, D), 15296(B-E, F, H, I), 15297(A-D), 15298(D, E, H4K, BA-BC, BE, BF-BK, BM-BO, BP-2, BQ, BR-BU, BW, BY-6, BBB, BBE-77, BBG-2, BBI, BBJ, BBM, BBR, BBX, BBY, BCA), BCC), 15299, 15300, 15302(BA-3, BD-BF, BJ, BK, BN-8, BO, BP, BQ, BY, BZ, BBB), 15303, 15306, 15307
Agriculture	80	20.6	15262(B, C), 15269(D, E, I), 15272(B), 15273(C-E), 15283(D1-D53-53, E1-E6-6, F-I, J1-J2-2, K-M), 15290(D), 15298(F-2),
Indeterminate	45	11.6	15262(A), 15263, 15265, 15266(B), 15269(J), 15272(C, D), 15273(A), 15275, 15276(D), 15277(B, C), 15281(B, C), 15286(A), 15289, 15290(A), 15291(A, B), 15292(A, G, H), 15294, 15295(B, E), 15298(A, B, BD, BL, BZ, BBA, BBC1-BBC3, BBL, BBT-BBW, BBZ, BCD), 15302(BL, BX, BBA)
Multiple	13	3.4	15269(H, T), 15281(D, E), 15292(B, C), 15298(C, H1-H3, BV), 15302(BC, BM-2), 15304
Transportation	12	3.1	15269(B, G, O, P, U), 15277(G), 15292(F), 15296(A), 15298(G, BBH), 15302(BB, BG)
Habitation (refuge)	8	2.1	15298(BBF, BBK, BBN-BBQ, BCB, BCE)
Communication	7	1.8	15298(I1-4, I2-2), 15304
Marker	6	1.5	15269(F, S), 15288, 15298(BBS), 15302(BI), 15305
Recreation	4	1.0	15287, 15298(I3, I4-2)
Ceremonial	2	0.5	15302(BH-2)
Quarry	2	0.5	15273(B), 15298(J)
Boundary	1	0.3	15298(BBD)
Habitation/poss. burial	1	0.3	15295(A)
Indeter./poss. burial	1	0.3	15292(D)
Agri./poss. burial	1	0.3	15276(E)
TOTAL	**388**	**99.9**	

Note: This table does not include Site 18891, the 3,000+ ubiquitous agricultural features in the project area.
** All habitation sites in this table are for temporary habitation.*

Table 7.

AGRICULTURAL FEATURES BY TRANSECT - SITE 18891

Trans. No.	Modified Outcrop	Mound	Phh. Excav.	Terrace	Other	Transect Total
3	0	3	0	0	1	4
4	0	0	0	0	0	0
5	0	1	1	0	0	2
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	2	2
9	0	0	0	0	0	0
10	26	6	2	2	2	38
11	12	11	1	0	5	29
12	23	14	1	1	2	41
13	26	38	4	3	3	74
14	4	38	3	1	18	64
15	9	52	3	0	6	70
16	23	37	5	2	11	78
17	22	37	0	2	8	69
18	8	26	2	4	11	51
19	29	33	0	0	2	64
20	66	59	6	2	10	143
21	62	44	4	5	12	127
22	90	26	2	0	9	127
23	98	20	6	0	1	125
24	96	16	7	0	7	127
25	26	4	6	1	1	39
26	83	8	2	0	4	97
27	77	7	2	0	2	88
28	101	2	9	0	3	115
29	129	11	7	0	12	159
30	131	7	9	0	3	150
31	71	2	1	0	0	74
32	45	5	2	0	2	54
33	23	3	1	0	0	27
34	50	2	1	0	0	53
35	42	0	4	0	1	47
36	5	2	0	0	0	7
37	38	16	1	0	0	55
38	35	5	0	0	11	51
39	3	3	1	0	1	8
40	0	0	1	0	0	1
40A	2	0	0	0	0	2
40AA	0	2	1	0	0	3
41	70	9	8	1	3	91
42	60	19	1	1	0	81
43	5	1	2	0	0	8
44	14	1	13	0	0	28
45	48	5	3	0	1	57

Table 7. (cont.)

Trans. No.	Modified Outcrop	Mound	Phh. Excav.	Terrace	Other	Transect Total
46	32	12	1	0	0	45
47	9	4	1	0	2	16
48	11	2	0	0	0	13
49	28	4	4	0	0	36
50	19	5	1	0	0	25
51	17	4	4	0	1	26
52	24	2	6	0	0	32
53	32	2	2	0	1	37
54	45	10	10	0	2	67
55	42	7	8	0	3	60
56	23	4	13	0	3	43
57	38	9	5	0	3	55
58	50	3	13	0	4	70
59	19	1	13	0	3	36
60	43	8	11	0	9	71
61	45	3	13	0	4	65
62	41	1	17	0	6	65
63	20	2	11	0	1	34
64	27	7	8	0	5	47
65	46	3	6	0	3	58
66	38	2	9	0	6	55
67	13	1	7	0	1	22
68	11	0	11	0	0	22
69	20	1	5	1	7	34
70	17	2	6	0	5	30
71	3	0	3	0	0	6
Totals:	**2365**	**672**	**309**	**25**	**222**	**3593**

(Total does not include steppingstone trails)

FINDINGS

SURFACE FINDINGS

During the survey, 42 sites were identified.* The sites comprise 21 complexes (multiple-feature sites) and 21 single-feature sites (Table 4). Of the 42 sites, 16 had been previously identified. These included long, linear transects containing features, several habitation caves, and Site 6433, originally identified by Davis (1977). All previously identified sites were combined with sites identified during this project. The most common recorded formal feature type in the project area is midden deposit (n=99). The following types were also identified: modified outcrop, terrace, enclosure, stacked rock, mound, wall, pahoehoe excavation, alignment, modified lava tube, cupboard, petroglyph, modified depression, steppingstone trail, cairn, platform, pavement, utilized lava tube, cleared area, and pecked stone (Table 5). The feature types comprised the following functional types: habitation, agriculture, agricultural/possible burial, indeterminate/possible burial, habitation-possible burial, indeterminate, multiple, transportation, habitation (refuge), communication, marker, recreation, ceremonial, quarry, and boundary (Table 6). Generally, the features combined to form site complexes assigned to the broader functional categories of habitation, multiple (including both habitation and some other function, indeterminate, agriculture, storage, marker, recreation and communication. In addition to the above, numerous minor agricultural features were identified in the project area, indicating that the area may constitute a northern extension of the Kona Field System. The features (approximately 3,000) were not separately recorded, but rather, were counted and grouped by transect (Table 7), and were assigned a single site number (18891).

Site Function

Habitation - Twenty-seven sites with habitation features were identified in the project area. Sites and features were defined as temporary (or longer-duration) versus permanent habitations, based on criteria defined by Cordy (1981:66). In his revised model, Cordy includes the following criteria: size (permanent is larger, with areas greater than 16 m^2); construction (permanent housing exhibits substantial construction; short-term housing is often poorly constructed); presence of internal stratified features, such as firepits (such pits are found in temporary camps, not in permanent housing); presence of special-purpose structures (small, special purpose structures for work and storage are associated with permanent housing, not with short-term camps); and lastly, location (permanent housing is usually clustered on the coast, either along the shore or at valley mouths, or on sides of valleys; short-term camps are found along trails, near agricultural fields, or on the coast).

Based on surface appearance, none of the features identified during the current project was assigned a permanent habitation function, even though they all met one or more of the above criteria. At all sites the assemblage of surface artifacts or ecofacts was limited; this, however, may have been a function of differential preservation or may have reflected disposal/discard patterns. There were features in caves which did exhibit substantial deposits of midden, but as Cordy (1981) points out, this alone cannot be used as an indicator of permanent habitation. A better indicator of permanence would be diversity of midden types or a more diverse assemblage of artifacts. A permanently occupied structure would be expected to evidence a fuller range of subsistence, craft, and domestic activities. It was initially thought that Site 15298 of the current project might have been used for permanent habitation, as the site has skylights that would have made the cave more suitable for such use. Cordy notes, however, that caves were not used for permanent habitation.

There is an example of a possible late-1800s, semi-permanent house terrace or paving in the project area (Feature D, at Site 15298). Cordy notes that such structures are expected in the Upland Forest Zone between 430-2,200 ft above sea level (Cordy 1985:43). Feature D (Figure 4) meets Cordy's (1981:66) size criteria, but is not of substantial construction. It is not known, at present, if there are internal structures at the feature, but it does appear that there are other special purpose structures nearby. The feature is not in an area that permanent habitations are usually found in. The feature may be associated with the Upland Forest agricultural features.

Another candidate for extended use is Feature A at Site 15285. This large enclosure meets Cordy's (1981) size criteria, is of substantial construction, and has a small storage cupboard in the northeast corner. The feature is located in the center of the project area at roughly 120 m (400 ft) elevation and is probably associated with the many possible agricultural features (mounds, modified outcrops, terraces) located upslope of it.

A variety of feature types in the project area appear to have been used for temporary (or seasonal, or recurrent) habitation. These types include lava tube caves, enclosures, platforms, modified outcrops, modified depressions, terraces, alignments, pavements, and C-shaped walls. Site 15281 (Figure 5) is an example of a small habitation site.

** This number does not include Site 18891, the 3,000+ ubiquitous agricultural features in the project area.*

Table 4.

SUMMARY OF IDENTIFIED SITES AND FEATURES

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15262	Complex (4)#	Multiple	M	L	L	-	-	+
A	Mound	Indeterminate						
B	Mound	Agriculture						
C	Mound	Agriculture						
D	Terrace	Habitation*						
15263	Modified depression	Indeterminate	M	L	L	-	-	-
15264	Complex (2)	Habitation	M	L	L	-	-	-
A	Modified outcrop	Habitation						
B	Modified outcrop	Habitation						
15265	Modified depression	Indeterminate	L	L	L	-	-	-
15266	Complex (2)	Habitation	M	L	L	-	-	-
A	Terrace	Habitation						
B	Terrace	Indeterminate						
15268	Alignment	Habitation	M	L	L	+	-	-
15269	Complex (26)	Multiple	M	L	L	+	-	+
A	Platform	Habitation						
B	Steppingstone trail	Transportation						
C	Terrace	Habitation						
D	Mound	Agriculture						
E	Terrace	Agriculture						
F	Cairn	Marker						
G	Steppingstone trail	Transportation						
H	Terrace	Multiple						
I	Wall	Agriculture						
J	Enclosure	Indeterminate						
K	Wall	Habitation						
L	Terrace	Habitation						
M	Terrace	Habitation						
N	Wall	Habitation						
O	Steppingstone trail	Transportation						
P	Steppingstone trail	Transportation						
Q	Enclosure	Habitation						

* *All habitation sites listed here are for temporary habitation*

\# *Number of component features within complex*

Cultural Resource Management

Value Mode Assessment—Nature: R = scientific research, I = interpretive, C = cultural

—Degree: H = high, M = moderate, L = low

Field Work Tasks: DR = detailed recording (scaled drawings, photographs, and written descriptions), SC = surface collections, EX = limited excavations.

Note: Site 18891, the 3,000+ ubiquitous agricultural features, is not included on this table.

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
R	Terrace	Habitation						
S	Cairn	Marker						
T	Modified lava tube	Multiple						
U	Steppingstone trail	Transportation						
V	Terrace	Habitation						
W	Cupboard	Storage						
X	Wall	Habitation						
Y	Wall	Habitation						
Z	Platform	Habitation						
15270	Cupboard	Storage	M	L	L	+	-	-
15272	Complex (4)	Habitation	L	L	L	-	-	-
A	Enclosure	Habitation						
B	Mound	Agriculture						
C	Mound	Indeterminate						
D	Modified depression	Indeterminate						
15273	Complex (5)	Agriculture	L	L	L	-	-	-
A	Modified depression	Indeterminate						
B	Excavation	Quarry						
C	Modified outcrop	Agriculture						
D	Modified outcrop	Agriculture						
E	Mound	Agriculture						
15275	Modified lava tube	Indeterminate	L	L	L	-	-	-
15276	Complex (5)	Multiple	M	L	M	+	-	+
A	Excavation	Habitation						
B	Alignment	Habitation						
C	Utilized lava tube	Habitation						
D	Mound	Indeterminate						
E	Mound	Agriculture/Poss. Burial						
15277	Complex (7)	Habitation	M	M	M	+	-	-
A	Terrace	Habitation						
B	Excavation	Indeterminate						
C	Alignment	Indeterminate						
D	Terrace	Habitation						
E	Modified lava tube	Habitation						
F	Terrace	Habitation						
G	Steppingstone trail	Transportation						
15278	Complex (2)	Habitation	M	L	L	-	-	+
A	Wall	Habitation						
B	Wall	Habitation						
15279	Terrace	Habitation	L	L	L	-	-	-

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15280	Cupboard	Storage	L	L	L	-	-	-
15281	Complex (5)	Habitation	M	M	M	-	-	-
A	Modified lava tube	Habitation						
B	Alignment	Indeterminate						
C	Modified outcrop	Indeterminate						
D	Excavation	Multiple						
E	Modified depression	Multiple						
15282	Utilized lava tube	Storage	M	L	L	+	-	-
15283	Complex (72)	Multiple	M	L	L	+	-	+
A	Terrace	Habitation						
B	Wall	Habitation						
C	Terrace	Habitation						
D1-D53	Modified outcrop (53)	Agriculture						
E1-E6	Mound (6)	Agriculture						
F	Wall	Agriculture						
G	Modified lava tube	Agriculture						
H	Modified depression	Agriculture						
I	Wall	Agriculture						
J1	Excavation	Agriculture						
J2	Excavation	Agriculture						
K	Alignment	Agriculture						
L	Terrace	Agriculture						
M	Terrace	Agriculture						
15284	Modified lava tube	Habitation	M	L	L	+	-	-
15285	Complex (2)	Habitation	H	H	M	-	-	-
A	Enclosure	Habitation						
B	Cupboard	Storage						
15286	Complex (4)	Habitation	L	L	L	+	-	-
A	Modified outcrop	Indeterminate						
B	Alignment	Habitation						
C	Midden	Habitation						
D	Other (water catchment)	Habitation						
15287	Petroglyph	Recreation	M	L	L	-	-	-
15288	Cairn	Marker	M	L	L	-	-	-
15289	Enclosure	Indeterminate	L	L	L	-	-	-
15290	Complex (4)	Habitation	M	M	L	-	-	+
A	Alignment	Indeterminate						
B	Platform	Habitation						
C	Enclosure	Habitation						
D	Mound	Agriculture						

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15291	Complex (2)	Indeterminate	M	M	L	+	-	+
A	Enclosure	Indeterminate						
B	Wall	Indeterminate						
15292	Complex (8)	Multiple	M	M	M	-	-	+
A	Enclosure	Indeterminate						
B	Terrace	Multiple						
C	Wall	Multiple						
D	Terrace	Indet./Poss. Burial						
E	Cleared area	Habitation						
F	Pavement	Transportation						
G	Terrace	Indeterminate						
H	Excavation	Indeterminate						
15293	Platform	Habitation	M	M	L	+	-	+
15294	Enclosure	Indeterminate	L	L	L	+	-	-
15295	Complex (5)	Habitation	M	L	L	-	-	+
A	Platform	Habitation/Poss. Burial						
B	Terrace	Indeterminate						
C	Enclosure	Habitation						
D	Enclosure	Habitation						
E	Terrace	Indeterminate						
15296	Complex (8)	Habitation	M	L	M	+	-	+
A	Steppingstone trail	Transportation						
B	Terrace	Habitation						
C	Enclosure	Habitation						
D	Excavation	Habitation						
E	Cupboard	Habitation						
F	Alignment	Habitation						
H	Enclosure	Habitation						
I	Enclosure	Habitation						
15297	Complex (4)	Habitation	M	M	M	+	-	-
A	Pavement	Habitation						
B	Terrace	Habitation						
C	Terrace	Habitation						
D	Terrace	Habitation						
15298	Complex (165+)	Multiple	H	H	H	+	+	+
A	Pavement	Indeterminate						
B	Modified outcrop	Indeterminate						
C	Mound	Multiple						
D	Terrace	Habitation						
E	Cupboard	Storage						
F	Mound (2)	Agriculture						

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R I C	Field Work Tasks DR SC EX
15298 (cont.)				
G	Other (entryway)	Transportation		
H1	Enclosure	Multiple		
H2	Terrace	Multiple		
H3	Terrace	Multiple		
H4	Cupboard	Storage		
I1	Petroglyph (4)	Communication		
I2	Petroglyph (2)	Communication		
I3	Petroglyph (1)	Recreation		
I4	Pecked stone (2)	Recreation		
J	Excavation	Quarry		
K	Terrace	Habitation		
BA	Terrace	Habitation		
BB	Wall	Habitation		
BC	Pavement	Habitation		
BD	Mound	Indeterminate		
BE	Midden	Habitation		
BF	Midden	Habitation		
BG	Terrace	Habitation		
BH	Wall	Habitation		
BI	Wall	Habitation		
BJ	Pavement	Habitation		
BK	Midden	Habitation		
BL	Enclosure	Indeterminate		
BM	Wall	Habitation		
BN	Midden	Habitation		
BO	Wall	Habitation		
BP	Enclosures (2)	Habitation		
BQ	Alignment	Habitation		
BR	Midden	Habitation		
BS	Midden	Habitation		
BT	Alignment	Habitation		
BU	Other (water catchment)	Habitation		
BV	Platform	Multiple		
BW	Terrace	Habitation		
BY	Other (6) (lamp holder)	Habitation		
BZ	Modified outcrop	Indeterminate		
BBA	Modified outcrop	Indeterminate		
BBB	Alignment	Habitation		
BBC1	Terrace	Indeterminate		
BBC2	Cupboard	Indeterminate		
BBC3	Mound	Indeterminate		
BBD	Mound	Boundary		
BBE	Midden (77)	Habitation		
BBF	Wall	Habitation (refuge)		
BBG	Other (2) (water catchment)	Habitation		
BBH	Steppingstone trail (6 sections)	Transportation		
BBI	Midden	Habitation		
BBJ	Midden	Habitation		

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15298 (cont.)								
BBK	Alignment	Habitation (refuge)						
BBL	Modified outcrop	Indeterminate						
BBM	Other (water catchment)	Habitation						
BBN	Wall	Habitation (refuge)						
BBO	Enclosure	Habitation (refuge)						
BBP	Alignment	Habitation (refuge)						
BBQ	Enclosure	Habitation (refuge)						
BBR	Midden	Habitation						
BBS	Cairn	Marker						
BBT	Midden	Indeterminate						
BBU	Modified lava tube	Indeterminate						
BBV	Midden	Indeterminate						
BBW	Modified outcrop	Indeterminate						
BBX	Midden	Habitation						
BBY	Cleared area	Habitation						
BBZ	Wall	Indeterminate						
BCA	Modified depression	Habitation						
BCB	Wall	Habitation (refuge)						
BCC	Midden	Habitation (2 sections)						
BCD	Terrace	Indeterminate						
BCE	Modified lava tube	Habitation (refuge)						
15299	Modified outcrop	Habitation	M	L	L	-	-	-
15300	Utilized lava tube	Habitation	M	L	L	-	-	+
15302	Complex (31+)	Multiple	H	H	M	+	+	-
BA	Other (3)(water catc., lamp holder)	Habitation						
BB	Alignment	Transportation						
BC	Enclosure	Indeterminate						
BD	Other (water catchment)	Habitation						
BE	Other (lamp holder)	Habitation						
BF	Other (water catchment)	Habitation						
BG	Wall	Transportation						
BH	Enclosure (2)	Ceremonial						
BI	Cairn	Marker						
BJ	Wall	Habitation						
BK	Terrace	Habitation						
BL	Wall	Indeterminate						
BM	Enclosure (2)	Multiple						
BN	Midden (8)	Habitation						
BO	Other (water catc./indeterminate)	Habitation						
BP	Other (water catchment)	Habitation						
BQ	Other (water catchment)	Habitation						
BX	Modified lava tube	Indeterminate						
BY	Modified depression	Storage						
BZ	Terrace	Habitation						

Table 4. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
15302 (cont.)								
BBA	Alignment	Indeterminate						
BBB	Other (water catchment)	Habitation						
15303	Modified lava tube	Habitation	M	L	L	+	-	-
15304	Petroglyph	Communication	H	H	M	-	-	-
15305	Cairn	Marker	L	L	L	-	-	-
15306	Cupboard	Storage	L	L	L	-	-	-
15307	Enclosure	Habitation	L	L	L	-	-	-

Table 5.

FREQUENCIES OF FORMAL FEATURE TYPES

Formal Type	Number	%	SIHP No./Feature
Midden	99	25.4	15286(C)15298(BE, BF, BK, BN, BR, BS, BBE-77, BBI, BBJ, BBR, BBT, BBV, BBX, BCC), 15302(BN-8)
Modified outcrop	65	16.7	15264(A, B), 15273(C, D), 15281(C), 15283(D1-D53-53), 15286(A), 15298(B, BZ, BBA, BBL, BBW), 15299
Terrace	38	9.8	15262(D), 15266(A, B), 15269(C, E, H, L, M, R, V), 15277(A, D, F), 15279, 15283(A, C, L, M), 15292(B, D, G), 15295(B, E), 15296(B), 15297(B-D), 15298(D, H2, H3, K, BA, BG, BW, BBC1, BCD), 15302(BK, BZ)
Enclosure	26	6.7	15269(J, Q), 15272(A), 15285(A), 15289, 15290(C), 15291(A), 15292(A), 15294, 15295(C, D), 15296(C, H, I), 15298(H1, BL, BP-2, BBO, BBQ), 15302(BC, BH-2, BM-2), 15307
Wall	24	6.2	15269(I, K, N, X, Y), 15278(A, B), 15283(B, F, I), 15291(B), 15292(C), 15298(BB, BH, BI, BM, BO, BBF, BBN, BBZ, BCB), 15302(BG, BJ, BL)
Mound	22	5.7	15262(A-C), 15269(D), 15272(B, C), 15273(E), 15276(D, E), 15283(E1-E6-6), 15290(D), 15298(C, F-2, BD, BBC3, BBD)
Other	22	5.7	15286(D), 15298(G, BU, BY-6, BBG-2, BBM), 15302(BA-3, BD-BF, BO-BQ, BBB)
Alignment	15	3.9	15268, 15276(B), 15277(C), 15281(B), 15283(K), 15286(B), 15290(A), 15296(F), 15298(BQ, BT, BBB, BBK, BBP), 15302(BB, BBA)
Modified lava tube	10	2.6	15269(T), 15275, 15277(E), 15281(A), 15283(G), 15284, 15298(BBU, BCE), 15302(BX), 15303
Excavation	9	2.3	15273(B), 15276(A), 15277(B), 15281(D), 15292(H), 15296(D), 15283(J1-J2-2), 15298(J)
Cupboard	9	2.3	15269(W), 15270, 15280, 15285(B), 15296(E), 15298(E, H4, BBC2), 15306
Petroglyph	9	2.3	15287, 15298(I1-4, I2-2, I3), 15304
Modified depression	8	2.1	15263, 15265, 15272(D), 15273(A), 15281(E), 15283(H), 15298(BCA), 15302(BY)
Steppingstone trail	8	2.1	15269(B, G, O, P, U), 15277(G), 15296(A), 15298(BBH)
Cairn	6	1.5	15269(F, S), 15288, 15298(BBS), 15302(BI), 15305
Platform	6	1.5	15269(A, Z), 15290(B), 15293, 15295(A), 15298(BV)
Pavement	5	1.3	15292(F), 15297(A), 15298(A, BC, BJ)
Utilized lava tube	3	0.8	15274(C), 15282, 15300
Cleared area	2	0.5	15292(E), 15298(BBY)
Pecked stone	2	0.5	15289(I4-2)
TOTAL	**388**	**99.9**	

Note: This table does not include Site 18891, the 3,000+ ubiquitous agricultural features.

Table 6.

FREQUENCIES OF FUNCTIONAL FEATURE TYPES

Function Type	Number	%	SIHP No./Feature
Habitation*	205	52.6	15262(D), 15264(A, B), 15266(A), 15268, 15269(A, C, K-N, Q, R, V, W-Z), 15270, 15272(A), 15276(A-C), 15277(A, D-F), 15278(A, B), 15286(C), 15279, 15280, 15281(A), 15282, 15283(A-C), 15284, 15285(A, B), 15286(B, D), 15290(B, C), 15292(E), 15293, 15295(C, D), 15296(B-E, F, H, I), 15297(A-D), 15298(D, E, H4K, BA-BC, BE, BF-BK, BM-BO, BP-2, BQ, BR-BU, BW, BY-6, BBB, BBE-77, BBG-2, BBI, BBJ, BBM, BBR, BBX, BBY, BCA), BCC), 15299, 15300, 15302(BA-3, BD-BF, BJ, BK, BN-8, BO, BP, BQ, BY, BZ, BBB), 15303, 15306, 15307
Agriculture	80	20.6	15262(B, C), 15269(D, E, I), 15272(B), 15273(C-E), 15283(D1-D53-53, E1-E6-6, F-I, J1-J2-2, K-M), 15290(D), 15298(F-2),
Indeterminate	45	11.6	15262(A), 15263, 15265, 15266(B), 15269(J), 15272(C, D), 15273(A), 15275, 15276(D), 15277(B, C), 15281(B, C), 15286(A), 15289, 15290(A), 15291(A, B), 15292(A, G, H), 15294, 15295(B, E), 15298(A, B, BD, BL, BZ, BBA, BBC1-BBC3, BBL, BBT-BBW, BBZ, BCD), 15302(BL, BX, BBA)
Multiple	13	3.4	15269(H, T), 15281(D, E), 15292(B, C), 15298(C, H1-H3, BV), 15302(BC, BM-2), 15304
Transportation	12	3.1	15269(B, G, O, P, U), 15277(G), 15292(F), 15296(A), 15298(G, BBH), 15302(BB, BG)
Habitation (refuge)	8	2.1	15298(BBF, BBK, BBN-BBQ, BCB, BCE)
Communication	7	1.8	15298(I1-4, I2-2), 15304
Marker	6	1.5	15269(F, S), 15288, 15298(BBS), 15302(BI), 15305
Recreation	4	1.0	15287, 15298(I3, I4-2)
Ceremonial	2	0.5	15302(BH-2)
Quarry	2	0.5	15273(B), 15298(J)
Boundary	1	0.3	15298(BBD)
Habitation/poss. burial	1	0.3	15295(A)
Indeter./poss. burial	1	0.3	15292(D)
Agri./poss. burial	1	0.3	15276(E)
TOTAL	**388**	**99.9**	

Note: This table does not include Site 18891, the 3,000+ ubiquitous agricultural features in the project area.
** All habitation sites in this table are for temporary habitation.*

Table 7.

AGRICULTURAL FEATURES BY TRANSECT - SITE 18891

Trans. No.	Modified Outcrop	Mound	Phh. Excav.	Terrace	Other	Transect Total
3	0	3	0	0	1	4
4	0	0	0	0	0	0
5	0	1	1	0	0	2
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	2	2
9	0	0	0	0	0	0
10	26	6	2	2	2	38
11	12	11	1	0	5	29
12	23	14	1	1	2	41
13	26	38	4	3	3	74
14	4	38	3	1	18	64
15	9	52	3	0	6	70
16	23	37	5	2	11	78
17	22	37	0	2	8	69
18	8	26	2	4	11	51
19	29	33	0	0	2	64
20	66	59	6	2	10	143
21	62	44	4	5	12	127
22	90	26	2	0	9	127
23	98	20	6	0	1	125
24	96	16	7	0	7	127
25	26	4	6	1	1	39
26	83	8	2	0	4	97
27	77	7	2	0	2	88
28	101	2	9	0	3	115
29	129	11	7	0	12	159
30	131	7	9	0	3	150
31	71	2	1	0	0	74
32	45	5	2	0	2	54
33	23	3	1	0	0	27
34	50	2	1	0	0	53
35	42	0	4	0	1	47
36	5	2	0	0	0	7
37	38	16	1	0	0	55
38	35	5	0	0	11	51
39	3	3	1	0	1	8
40	0	0	1	0	0	1
40A	2	0	0	0	0	2
40AA	0	2	1	0	0	3
41	70	9	8	1	3	91
42	60	19	1	1	0	81
43	5	1	2	0	0	8
44	14	1	13	0	0	28
45	48	5	3	0	1	57

Table 7. (cont.)

Trans. No.	Modified Outcrop	Mound	Phh. Excav.	Terrace	Other	Transect Total
46	32	12	1	0	0	45
47	9	4	1	0	2	16
48	11	2	0	0	0	13
49	28	4	4	0	0	36
50	19	5	1	0	0	25
51	17	4	4	0	1	26
52	24	2	6	0	0	32
53	32	2	2	0	1	37
54	45	10	10	0	2	67
55	42	7	8	0	3	60
56	23	4	13	0	3	43
57	38	9	5	0	3	55
58	50	3	13	0	4	70
59	19	1	13	0	3	36
60	43	8	11	0	9	71
61	45	3	13	0	4	65
62	41	1	17	0	6	65
63	20	2	11	0	1	34
64	27	7	8	0	5	47
65	46	3	6	0	3	58
66	38	2	9	0	6	55
67	13	1	7	0	1	22
68	11	0	11	0	0	22
69	20	1	5	1	7	34
70	17	2	6	0	5	30
71	3	0	3	0	0	6
Totals:	**2365**	**672**	**309**	**25**	**222**	**3593**

(Total does not include steppingstone trails)

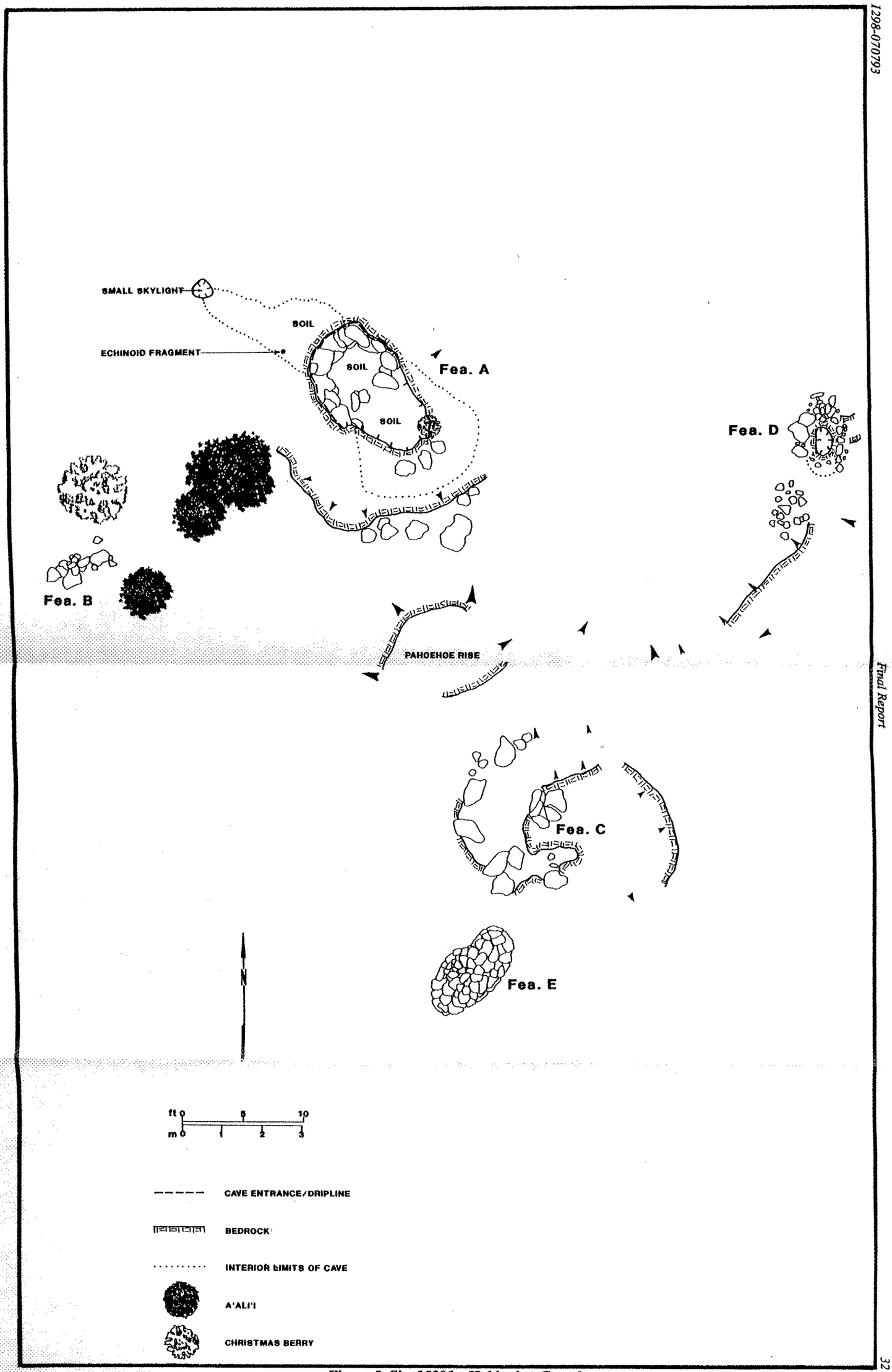


Figure 5. Site 15281 - Habitation Complex

There are cases in which features appear to have midden deposits sufficient to indicate permanent habitation—such as the features near the western skylight in Area 1 of Site 15298. However, testing is needed to confirm the nature and depth of cultural deposits. Feature BV (in the same area), another possible permanent habitation, is of substantial constuction and is c.16.0 sq meters. The site is in a lava tube cave, but does receive natural light through a large skylight.

Sites 15298 and 15304 were divided into "areas" to aid in the discussion of function and construction. Site 15298 (Figure 6, at end) was divided into five areas (1-5) based on locations of features. Area 1 begins at the *makai* end of the lava tube cave and extends to the major constriction in the tube. Area 2 is the constricted area of the cave. Area 3 is a refuge area and extends to the rockfall which has been altered for passage, and Area 4 extends from the rockfall to the *mauka* entrance. Area 5 includes the surface features thought to be associated with the cave features. Human remains were found in Area 2, Area 3, and Area 4 of the site.

Site 15302 (Figure 7, at end) was also divided into five areas. Area 1 begins at the *mauka* entrance and extends to the first of the ledges. Area 2 extends from the ledges to the end of the rooffall. Area 3 includes the features constructed in the channel and toward the skylight. Area 4 extends from Area 3 to the end of the upper channel. Area 5 includes all of the features located in the lower channel.

Multiple Function - These seven sites (15.2%) are possible habitation sites and also have other functions. These include agriculture, refuge, or ceremonial functions (see below).

Agriculture - Three sites were assigned both agricultural and habitation functions. One of the sites, Site 15283, is a large complex of three possible temporary habitation features (two terraces and a wall) and 69 other probable agricultural features (Figure 8). The features include mounds, walls, pahoehoe excavations, terraces, and approximately 50 modified outcrops. Site 15269 (Figure 9) also had multiple functions, including habitation, agriculture, and transportation.

Many features in the project area have been assigned an agricultural function. The features are found in varying densities in association with temporary habitation complexes and at widely scattered locations. All agricultural features were not recorded individually; rather, a count of the formal types was kept by survey transect (Table 7; survey transects are illustrated in Figure 3).

For management purposes, a single new site number (Site 18891) was assigned to the overall agricultural features, with the boundaries of the project area serving as the site boundary. The new number was assigned even though it is likely that the agricultural features are part of the Kona Field System (Site 6601).

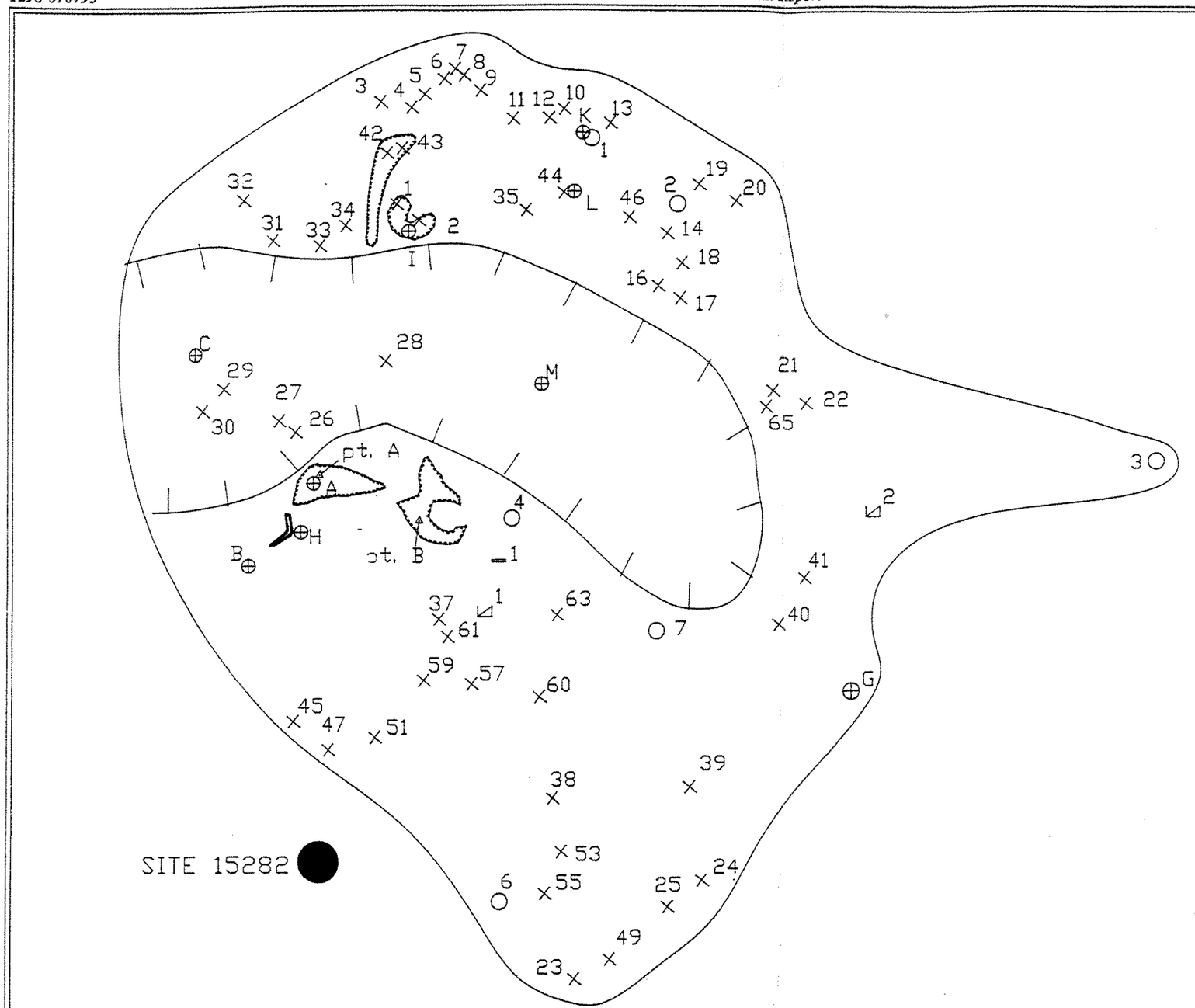
Formal feature types encountered in the project area include modified outcrop, mound, and terrace. These types were determined using the following descriptions:

Modified Outcrop - This feature type is usually assigned after eliminating other possible feature types (e.g., not piled enough to be a mound, rocks are scattered rather than aligned, etc.); this feature type is usually amorphous in plan view and usually consists of a scatter of rocks on top of bedrock or a bedrock outcrop. The rocks sometimes form rough rings; the surface of the feature is usually irregular, and bedrock is often exposed in the center of the feature. If the outcrop itself is excavated, then the feature was designated an excavation, not a modified outcrop.

Mound - A quadrangular, oval, linear, or amorphous structure of piled rocks; the feature is conical or dome-shaped in profile, with sloping sides; the sides are not faced. The feature is usually designated after other types have been considered and eliminated (construction is piled rather than stacked, as in a platform, cairn, or wall; or sides are not faced, as in a faced mound). If rocks fill a depression and then are piled above the lip of the depression, the feature was designated a mound and not a filled depression.

Terrace - A quadrangular, oval, linear, or amorphous structure with at least one side consisting of material piled or stacked more than one course high; also, at least one side must be flush with the ground surface or abut some natural or artificial feature (e.g., one side of a terrace is built against the side of an elevated outcrop so that the surface of the terrace is flush with the top of the outcrop; or, the terrace is built on a southwest slope, so that the northeast side is level with the ground, but the southwest side is built up to create a level surface for the terrace). Terraces may be higher than long, or longer than high; sides may be piled, stacked, or faced; the terrace surface may be level, convex, concave or irregular. Terraces may incorporate natural outcrops into the structure.

Using the numbers generated from surface examination during the survey sweeps, distributional patterns (in terms of density per examination area) were determined. Counts of the following feature types were kept: modified outcrop, mound,





0 50 100 feet
0 10 20 30meters

LEGEND

- MODIFIED-OUTCROP
- MOUND
- WALL
- EXCAVATIONS
- OTHER FEATURES
- BEDROCK OUTCROP

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Figure 8.
SITE 15283
AGRICULTURE-HABITATION COMPLEX

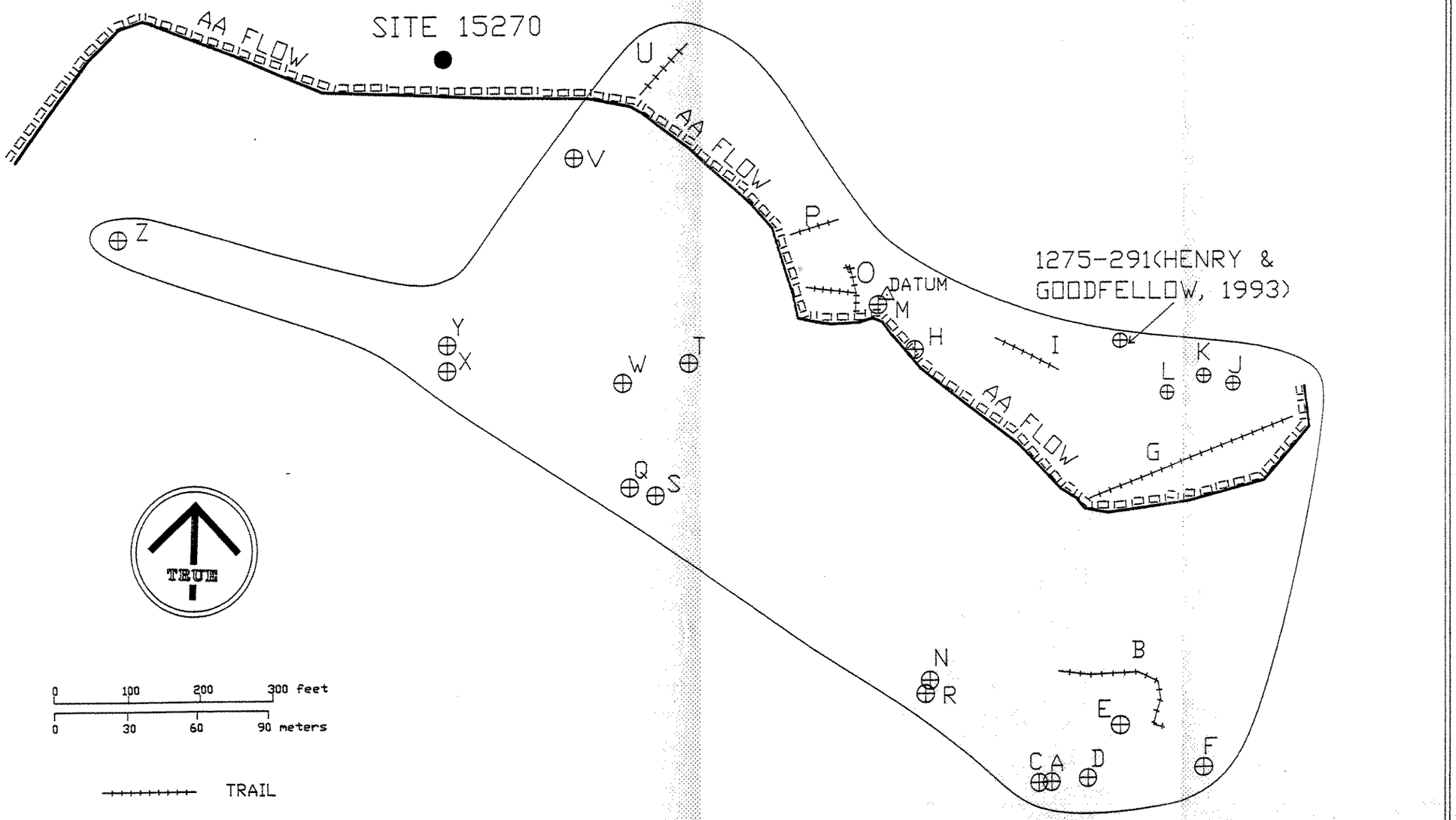

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Figure 9.
SITE 15269
HABITATION-TRANSPORTATION COMPLEX

pahoehoe excavation, terrace, and other (including alignments, filled crevices and depressions, etc.). The features assigned to the "other" category were not present in sufficient numbers to determine distribution. Site distribution is discussed in detail, and distribution maps are provided, in the Conclusion section. The following is a summary of the findings for each agricultural type.

Modified outcrops are the most common feature type in the project area. Over 2,000 examples were noted. Density of the features appears to change with elevation. The modified outcrops appear to be most dense in the central portion of the project area (at about 120 m [400 ft] elevation) where 100+ examples were noted in three separate transects. Other areas almost as dense are found directly *mauka* and continue to the eastern boundary. There is another block of transects in the north and northwest parts (at slightly under 110 m [360 ft] elevation) with counts almost as high. There seems to be a strong correlation between these features and pahoehoe lava, with almost no examples found on aa lava.

About 700 mounds were counted in the project area (Table 7). They are most common in a single transect along the eastern boundary of the project area, at an elevation of c. 175 m (570 ft). Other dense areas are slightly downslope to the west and to the southwest. They appear to be present only very rarely below this level, with ten or less found per sample transect. Mounds tend to be associated with pahoehoe rather than aa lava.

Terraces have the most limited distribution of the sampled agricultural features of Site 18891. Twenty-five terraces were noted in the project area. As indicated by the various models, they tend to be most common at the higher elevations. The greatest density (5) was found in Transect 21, near the eastern boundary of the project area, at c. 180 m (590 ft) elevation, in an area of heavy agricultural use. Transects 18 and 13, both of which are over 150 m (500 ft) in elevation, have three or more terraces. Only a few other transects have terraces, and except for a single example, in Transect 69 near the western border, the transects are all all well over the 120 m (400 ft) elevation level. As with all other sampled features of Site 18891, the features tended to be associated more with pahoehoe than aa lava.

The agricultural features are the most dense near the center (Transect 29) and on the eastern edge of the project area. This increasing density with elevation had been expected, since settlement pattern models generated for this area had indicated that once the Upland Forest Zone was reached (c. 130 m [430 ft]), "...near continuous archaeological sites..." (Cordy 1985:43) could be expected. However modified outcrops, at least in the northwest corner, were noted, in varying densities, extending to the western boundary.

Clusters of agricultural features in the project area were roughly determined, although it must be remembered that the cluster distribution is somewhat artificial since transect areas were not equal in size.

There is a heavy concentration of all agricultural features between the Power Line and Flag Line 2 (both of which are arbitrary sampling limits), extending from the upper (or eastern project boundary) down to c. 120 m (400 ft). Topography in this region is generally level, becoming flatter as elevation decreases. Concentrations of features are also found in the uplands between the southern boundary and the Power Line, and between Flag Lines 2 and 3. Again, both of the concentrations begin at high elevations (c. 150 m [500 ft]) and continue to the upper (or eastern boundary). Another medium-density area (51-100 examples per transect) is present at the middle elevations (c. 130 m [440 ft]) and extends to almost the western boundary at c. 115 m [380 ft]. The northernmost transect area (between Flag Line 3 and the northern boundary), in the middle and low elevations, contains more that 50 agricultural features in only two transects. The upper portion of this sample area is covered by an aa lava flow.

Topography and increasing elevation (with available moisture) are the two factors that most likely influenced the patterning of agricultural features in the project area. The area of heavier concentrations (the areas between Flag Lines 2 and 3 [Transects 54, 57, 58, 61, 62, 65, and 66]) lies near the dense concentration between Flag Line 2 and the Power Line on a wide ridge extending *makai*. Because it is near Site 15283 and has similar wide, flat terrain, it is likely associated with the heavily-used area around Site 15283.

A sample of the agricultural features was taken at Site 15283, an agriculture-habitation complex located in the densest part of the informal agricultural features of Site 18891. Size, construction, orientation, and other data were recorded for over 70 features. The spatial relationship between these features was mapped (Figure 8), as a sample of the Site 18891 features. The sample is discussed further in the Conclusion section, and the Conclusion section also includes a table that summarizes the findings of the sample.

The distribution of pahoehoe excavations, a possible agricultural (or quarry) feature, was also recorded (Moore and Bevacqua 1972:17-18). These features (which were considered in the overall count) were highly concentrated

within a single transect at c. 120 m (400 ft), between Flag Lines 2 and 3, and there were similarly high concentrations just to the *mauka* and immediately north.

There were few agricultural features in the southwest or northeast parts of the survey area, probably due to the presence of aa flows.

Refuge - Portions of Areas 2 and 3 of Site 15298, lava tube, may have served a refuge function. These portions had restricted entries. There are water catchment areas within the Area 3 section, as well as charcoal concentrations that indicate that fires had been used for cooking and/or lighting. Other areas (1 and 4) within Site 15298 apparently served a habitation function.

Ceremonial - Three sites, two lava tubes and one open site, are thought to have served both habitation and possible ceremonial functions. Feature D of Site 15292, based on appearance, may be a burial mound. Site 15292 is located on a long tube line near the upper project boundary. Another cave (Site 15276) is also located near the *mauka* boundary. This small blister cave contains habitation features, and there are two small mounds possibly containing burials located north of it. The other site which contains a potential burial feature is found at Site 15295 (Figure 10), an open site located in the same general area as Sites 15292 and 15295. At Site 15295, Feature A, a projection has been built on the northwest corner of the habitation platform. The size of this extension is c. 1.5 m by 1.2 by 0.40 m and has a single upright slab on the west side.

Site 15302, a large tube, may have served for both habitation and for ceremonial purposes. The site does not appear to contain human remains. Site 15302 is located on the same *mauka-makai* tube line as Site 15298, a major habitation and refuge cave. Site 15302 has at least 30+ features ranging from water catchment/lampholders to walls and enclosures. This large tube has a channel running down the center of it, and in the channel are enclosures. There are low stacked walls along the top of the channel. *Makai* of the channel is a skylight, and here the cave divides into an upper and lower chamber. The upper chamber ends at a large upright basalt slab; the lower continues *makai* and passes out of the project area.

Indeterminate - Those sites for which a definite function could not be determined were the next most frequent site function (n=6). These sites included two modified depressions, a modified lava tube, two enclosures, and a small complex of two features (an enclosure and a wall). These features were generally too small or disturbed to assign a definite function, but most or all are probably associated with temporary habitation. The single feature at Site 15294 is an example (Figure 11).

Agriculture - A single site number (Site 18891) was assigned to all agricultural features not recorded with habitation complexes. Features of this site were not recorded individually, rather numbers (per survey transect) for distribution studies (Table 7) were recorded.

Storage - Four prehistoric sites appear to have served a storage function. All are single-feature sites; three are cupboards and one is a small collapsed blister. Within the latter were the remains of a few marine gastropods, indicating the feature may have functioned for storage or waste disposal.

Marker - Two sites (Sites 15288 and 15305) may have served as markers to target habitations, trails, or some other feature or resource. Both sites consist of cairns.

Recreation - One site, a *papamu* game board used for playing the Hawaiian game *konane* was assigned a recreational function. This site was located close to another temporary habitation site in the most *makai* portion of the project area. Another *papamu* board, associated with Site 15298, a habitation and refuge cave, was also identified in the project area.

Communication - One site, Site 15304, a petroglyph, was assigned a communication function. The site consisted of a single cross or "X" pecked into the basalt (Figure 12). From the area of the petroglyph one can view the coast, the island of Mau`i, and the uplands. The arms of the figure were aligned at 158-338 degrees and 72-252 degrees; perhaps they served as a guide to particular features or resources.

SUBSURFACE FINDINGS

The subsurface testing for this project included placing four test units at three sites (15269, 15276, and 15292)(Figures 13 and 14), and placing four trowel tests at Site 15276.

Site 15269, Feature N, TU-2

Site 15269 is a probable prehistoric complex of at least 26 features—two platforms (Feature A and Z), five steppingstone trails (Feature B, G, O, P, and U), six terraces (Feature C, E, H, L, M, R, and V), one mound (Feature D), two cairns (Feature F and S), one wall (Feature I), two enclosures

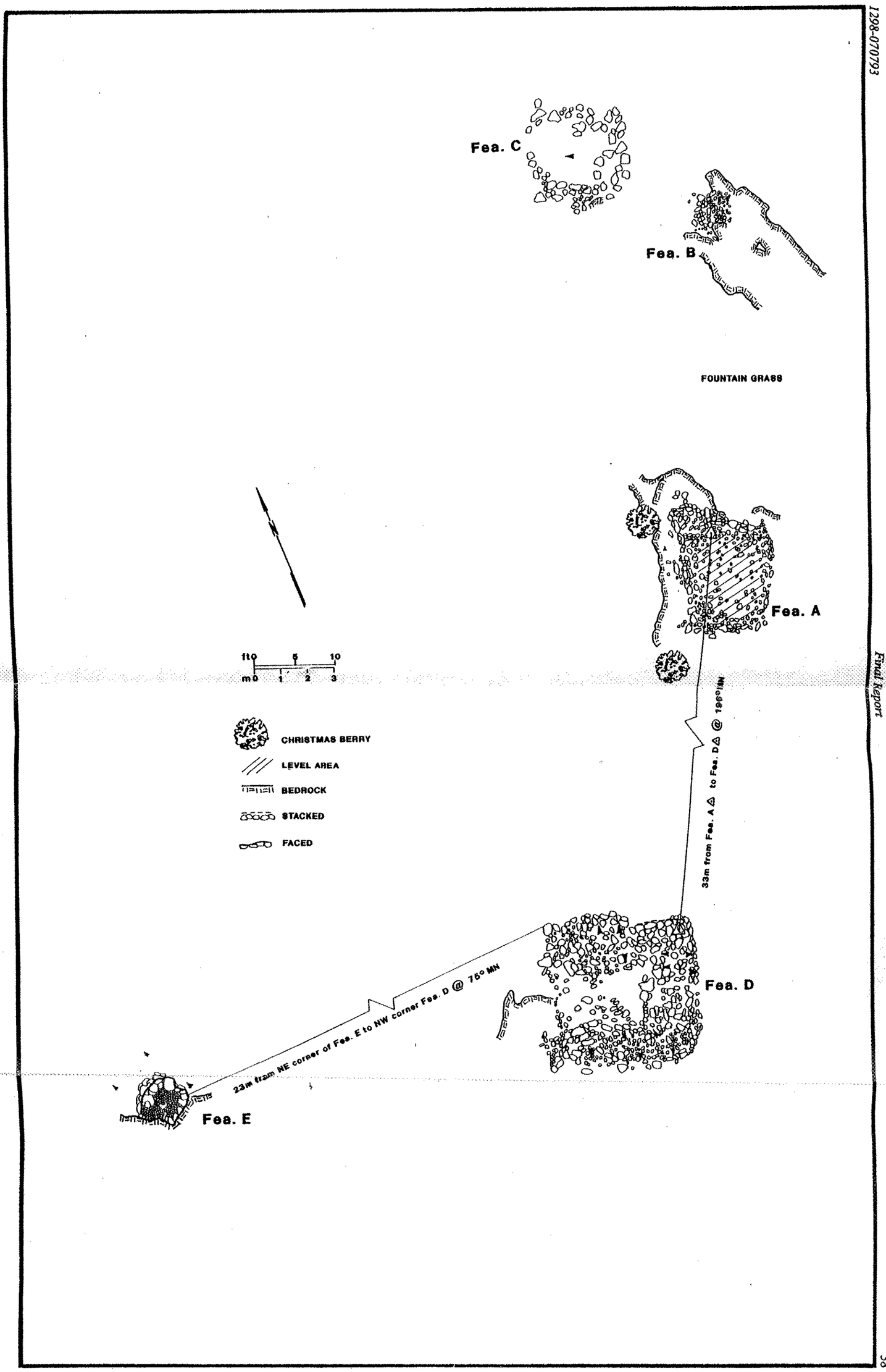


Figure 10. Site 15295 - Habitation - Possible Ceremonial Complex

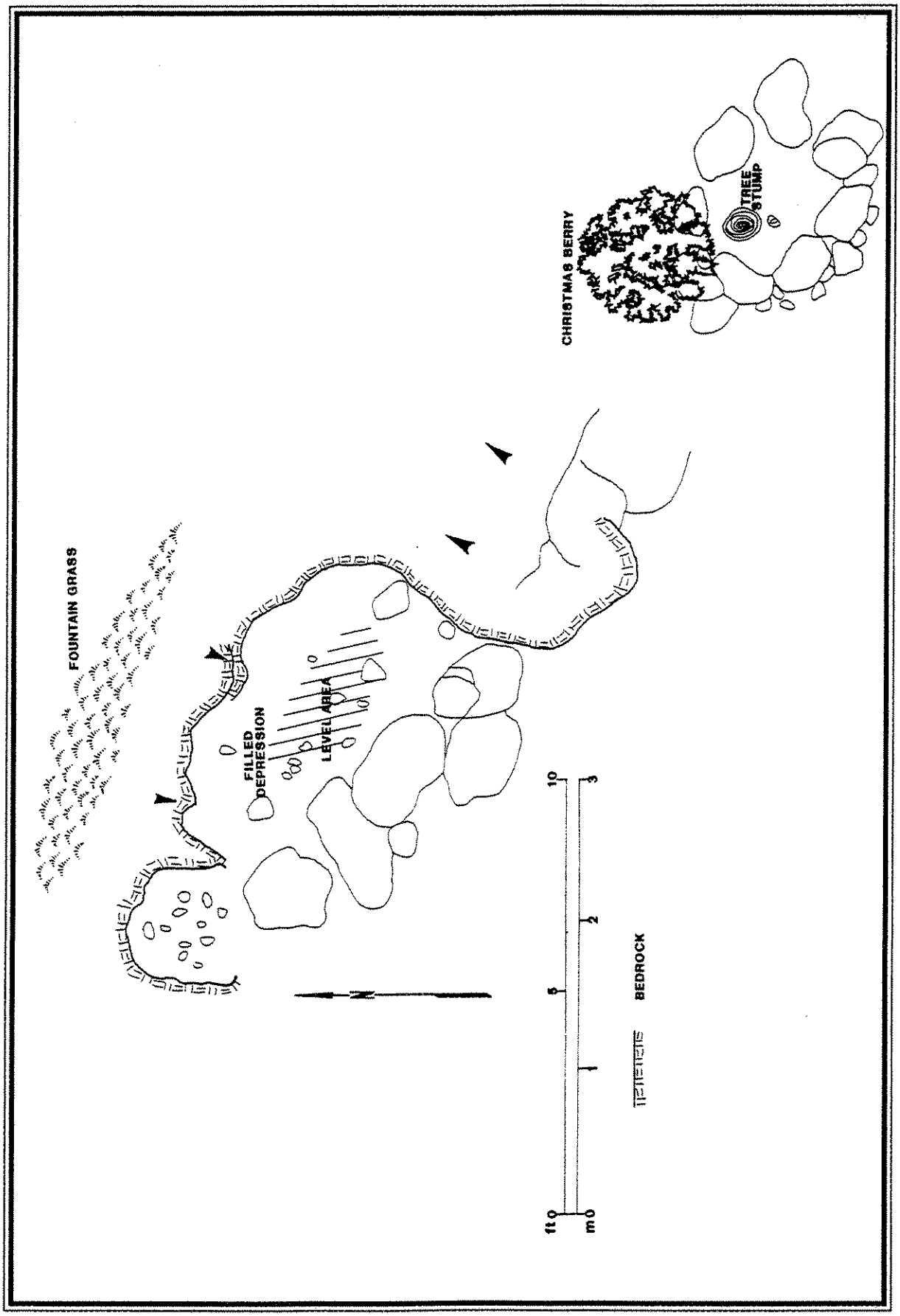


Figure 11. Site 15294 - Indeterminate Function

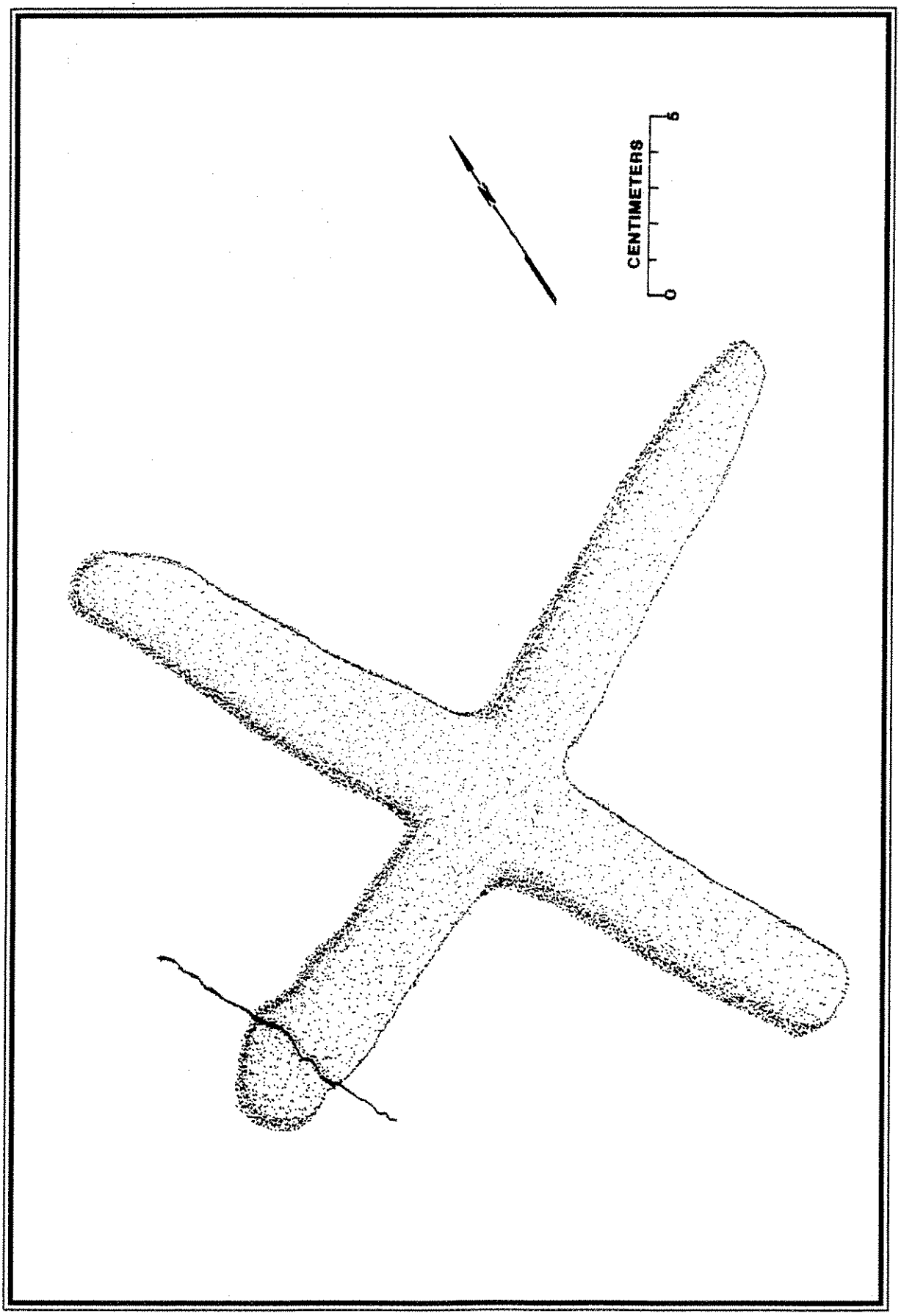


Figure 12. Site 15304 - Communication

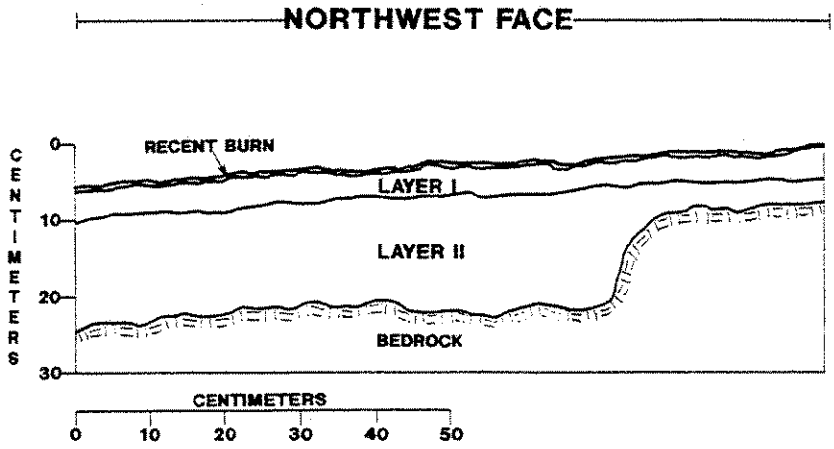


Figure 13. Profile of Site 15269

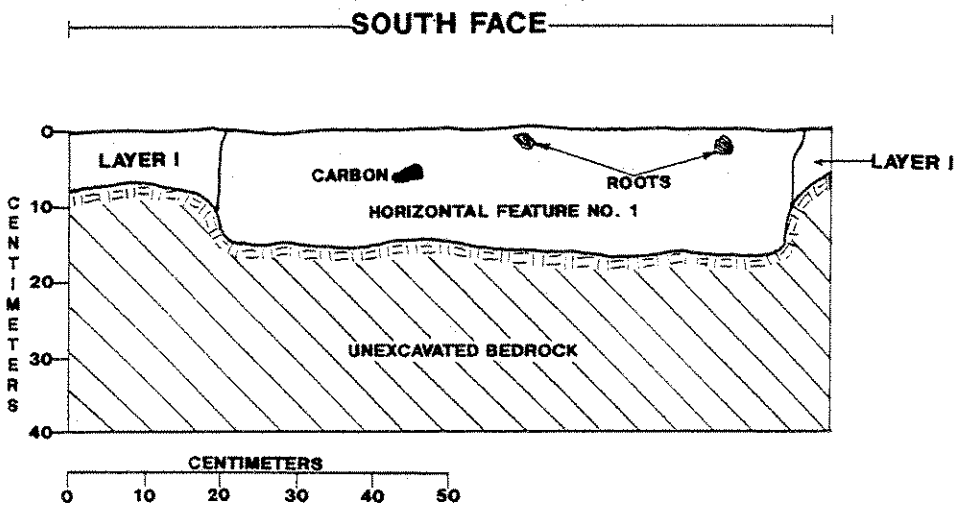


Figure 14. Profile of Site 15276

(Feature J and Q), three C-shapes (Feature K, N, and X), one modified lava tube (Feature T), one cupboard (Feature W), and one wall with cupboard (Feature Y).

Test Unit 1 (1.0 m by 1.0 m) was placed in the interior of Feature N, Site 15269. The surface layer of the unit, 0-8 cm deep, consisted of recently burned brown silt loam soil mixed with ash, charcoal, and heavy roots. Layer I appeared non-cultural. Layer II contained 3-4 *kukui* nut fragments and some ecofacts. It is most probably cultural. No radiocarbon samples were obtained from the unit. The unit, which was terminated at 28 cmbs, at bedrock, displayed the following stratigraphy:

Site 15269
Feature N
TU-1, West Face

Layer	Description
I	0-8 cmbs, ranges from 1-8 cm in thickness; very dark brown (10YR 2/2 moist); stony silty loam; weak, coarse single grain structure; loose, friable, slightly sticky, plastic consistence; many micro roots; culturally sterile; abrupt, wavy boundary;
II	8-18 cmbs, ranges from 1-11 cm in thickness; black (10YR 2/1 moist); cobbly silt loam; weak, fine single grain structure; soft, friable, sticky, plastic consistence; many roots; *kukui* nuts intermixed with soil; layer terminates on bedrock.

Test Unit 2 at the same site was placed in Feature Y, an L-shaped wall that appears to originally have been a C-shape wall. A 1.0 m by 1.0 m unit was placed in the interior of the L-shape. Layer I (0-10 cmbs) appeared to be an upper, non-cultural humic layer—dark brown silty loam with signs of recent burning on the surface. Layer II was 5-25 cmbs and was terminated on bedrock. Layer II was a black cultural layer with many roots; a partial coral abrader and ecofacts were present in the layer. A non-discrete charcoal sample was collected from the layer (see Data Analyses). The unit displayed the following stratigraphy:

Site 15269
Feature Y
TU-2, NE Face

Layer	Description
I	0-10 cmbs, ranges from 4-5 cm in thickness; mottled black and dark brown (10YR 2/1 and 7.5YR 3/4 moist); silty clay; moderate very fine to medium crumb structure; soft, very friable, slightly sticky, slightly plastic consistence; many micro to medium vesicular and tubular roots; many micro to fine interstitial pores; culturally sterile; abrupt, smooth boundary;
II	5-25 cmbs, ranges from 3-16 cm in thickness; black (10YR 2/1 moist); silty clay; moderate very fine to medium crumb structure; soft, very friable, slightly sticky, slightly plastic consistence; many micro to fine vesicular and tubular roots; many micro to fine interstitial pores; interpreted as cultural layer based on presence of charcoal and marine shell; layer terminates on bedrock.

Site 15276, Feature A, TU-1

Site 15276 is in a lava tube in the extreme eastern portion of the project area. Feature A is an oval firepit 0.6 by 0.4 m containing two boulders. This feature is 0.50 m east of the skylight in the cave and near the southern wall. The surface of the firepit consisted of white and gray ash with some charcoal. Test Unit 1 (0.50 m by 0.50 m) was placed in the northern half of HF-1 (Horizontal Feature 1), within the pit. The sides of HF-1 were 0.04 m deep and the center was c. 0.07 m deep. Marine shell was found on the surface of HF-1, but no cultural material was found within the feature. The excavation was terminated at c. 0.07 m, when bedrock was encountered. A non-discrete charcoal sample was collected from the excavation (RC-1483; see Data Analyses). The unit displayed the following stratigraphy:

Site 15276
Feature A
TU-1, South Face

Layer	Description
I	0-4 cmbs; dark brown (10YR 2/2 moist); silt; structureless; loose, loose, non-sticky, non-plastic consistence; rare roots; interpreted as cultural layer due to presence of HF-1; layer terminates on bedrock.
HF-1	0-7 cmbs; black (10YR 2/1 moist); ashy silt; structureless; soft, very friable, slightly sticky, non-plastic consistence; marine shell noted on surface; layer terminates on bedrock.

Four trowel tests were placed at this site to determine if additional cultural deposits were present (Table 8). Two tests

(TT-1 and -2) were placed in Feature B, an alignment of six medium-sized boulders; one test (TT-3) was placed in an area of scattered rock fall to the east of HF-1/; another test (TT-4) was dug just south of Feature A/HF-1. The results of this testing are presented in Table 8.)

Site 15292, Feature A, TU-2

This site complex is located in a lava tube cave and includes one double enclosure (Feature A), three terraces (Feature B, D, and G), one wall (Feature C), one cleared area (Feature E), one pavement (Feature F), and one excavation (Feature H). Test Unit 2 was a 0.10 by 0.20 excavation placed in the northwest corner of Feature A and dug through one layer. Depth to bedrock in the test unit was 0.07 m and all soil was collected for analysis. A non-discrete sample carbon sample from the unit was submitted for radiocarbon analysis (RC-1488; see Data Analyses) TU-2 displayed the following stratigraphy:

Site 15292
Feature A
TU-2, South Face

Layer	Description
I	0-7 cmbs; black (10YR 2/1 moist); mixed silt and charcoal; structureless; soft, very friable, slightly sticky, non-plastic consistence; layer terminates on bedrock.

Site 15298, Feature BCC, Surface

Site 15298 is a large complex of over 165 features. The site consists of a lava tube, pavements, enclosures, petroglyphs, walls, and midden. Feature BCC is charcoal and ash midden found in two sections (BCC1 and BCC2) in the most *mauka* portion of Area 4 near the *mauka* cave entrance. BBC1 is a small ashy area that is c. 4 m south-southwest of the *mauka* entrance. The area is circular and measures (0.40 m by 0.40 m). BCC2, a larger ashy area, is c. 1.0 m southwest of BBC1, is circular, and is roughly 2.0 m in diameter. This concentration is on a pile of roof fall consisting of large cobbles and boulders. Ash was collected from a 0.25 m by 0.25 m area of BCC2. The ash consisted of a thin black layer (c. 0.01 m deep) which overlay a white/gray ashy deposit c. 0.14 m thick. Also present in both of the ashy areas were charcoal fragments, ecofacts, and rat bone. A radiocarbon sample from this site (RC-1487) was submitted for analysis (see Data Analyses).

Site 15302, Feature BC, Surface

Site 15302 is a lava tube cave on the same tube line as Site 15298. It includes 31+ features and appears to have served multiple functions including habitation, transportation, ceremonial, and others. Feature BC is an rectangular enclosure of undetermined function on the bedrock floor of the cave. This enclosure consists of a wall extending from the south cave wall to a major rockfall on both the *makai* and *mauka* sides. A distinct burned area was found in the cave. Both charcoal and burned wood were collected from the burned area. There was also a pig tusk in the cave.

Table 8.

TROWEL TESTS AT SITE 15276

TT#	Depth(bs)	Layer	Cultural Material
1	0-3	I	—
2	0-7	I	Surface marine shell
3	0-5	I	
4	0-5	I	

Comments: Soils consisted of large dark brown peds and terminated at bedrock (all tests)

DATA ANALYSES

By Susan T. Goodfellow, Ph.D.

AGE DETERMINATIONS

Objectives and Methods

The purpose of age determination analysis is to provide initial chronological data to aid in assessing the relative significance of sites in a project area. Five charcoal samples were chosen from discrete cultural deposits within Sites 15269, 15276, 15292, 15298 and 15302 for age determination using radiocarbon analysis. Samples were selected based on the amount and nature of datable material present, stratigraphic context, and overall distribution within the project area. The samples were submitted for radiocarbon analysis to Beta Analytic Inc. of Miami, Florida.

Using standard procedures, the samples were pretreated with an acid, alkali, acid series of soakings to remove carbonates and humic acids. After pretreatment, samples were combusted to form carbon dioxide gas, combined with lithium to separate the carbon, and hydrolized for conversion to liquid form. The liquid was then catalyzed to form benzene and placed in a liquid scintillation counter to determine the amounts of carbon-13 and carbon-12. Due to their small size, the samples were given quadruple counting time to insure statistical accuracy. The isotope values obtained during the counting process were then used to calculate the carbon-13/carbon-12 ratio for each sample, with the final result being determined relative to international standards in order to reduce errors produced by carbon isotope fractionation. Processing of the five samples proceeded normally.

Results

The results of the radiocarbon age determination are summarized in Table 9. The age for each sample is reported as a range corresponding to the calendric age +/- two standard deviations. Ages were calibrated using the tables provided in Stuiver and Pearson (1986), which correct for variations in atmospheric carbon over time.

As shown in Table 9, one of the samples produced a definitive age range, while the four remaining samples produced multiple age ranges. Multiple ranges are caused by "flat" regions in the calibration curve, which correspond to periods when atmospheric carbon decreased at a rate greater than 1.2 ppm/10 years, resulting in more than one possible fit of a sample to the calibration curve. While multiple age ranges are more difficult to interpret archaeologically, detailed examination of the statistical curves, combined with evidence from feature stratigraphy, generally provides a means of selecting one age range as more probable than the others. Based on these criteria, the most likely age ranges for the five samples are as follows (list is in provenience order):

RC-1486 AD 1664-1891 (78% probability)
RC-1488 AD 1793-1949 (61% probability)
RC-1485 AD 1487-1815 (86% probability)
RC-1487 AD 1791-1951 (58% probability)

The results of the age determination analysis span 463 years, extending from AD 1487 to the present (present = AD 1950). Within this period, the results from specific samples can be grouped into two clusters. The first cluster consists of samples RC-1486 from Site 15269, RC-1483 from Site 15276, and RC-1485 from Site 15302, all of which yielded age ranges spanning the late prehistoric to early historic period. Examination of the one sigma statistics and the remains associated with the samples suggests that samples RC-1486 and RC-1485 are more likely late prehistoric, while RC-1483 is early historic; however, it is not sufficiently definitive to provide more restricted age ranges for the samples. The second cluster consists of samples RC-1488 from Site 15292 and RC-1487 from Site 15298, both of which yielded historic age ranges. The interpreted age ranges for samples in both clusters are consistent with known stratigraphic relationships and do not appear to be affected by contamination.

Based on the results of the age determination analysis, initial occupation of the project area occurred during the prehistoric period, possibly beginning as early as AD 1487, at Feature BC of Site 15302. Feature BC is a pavement interpreted as a habitation feature, and was associated with a few wood fragments. Initial occupation of Feature Y of Site 15269 apparently occurred during the late prehistoric period and, given the partial overlap between the age ranges for samples RC-1486 and -1485, may have been contemporaneous with Feature BC of Site 15302. Feature Y is a wall interpreted as a habitation feature, and is associated with a coral abrader and sparse marine shell. Evidence for historic period occupation of the site derives from Feature A (excavation) of Site 15276, Feature B (terrace) of Site 15292 and Feature BBC2 (cupboard) of Site 15298, none of which was associated with portable remains.

Table 9.

SUMMARY OF RADIOCARBON AGE DETERMINATIONS

PHRI Lab.No. (RC-)	Lab. No. BETA-	Provenience	C-14 Age Yrs. B.P. (one sigma)	C-13/ C-12 Ratio	C-13 Adjusted * C-14 Age Yrs. B.P.	Calendric Range Yrs. AD
Site 15269						
1486	60890	Feat. Y, TU-2, Layer II, 05-25 mbs	20 + 50	-17.1	150 ± 50	1664-1891 1907-1955 #
Site 15276						
1483	60887	Feat. A, TU-1, HF-1, Layer I, 00-07 cmbs	120 + 90	-24.4	130 ± 90	1635-1955
Site 15292						
1488	60892	Feat. B, Surface, % of modern	100.6 + 0.8	-16.6	90 ± 70	1669-1778 1793-1949
Site 15298						
1487	60891	Feat. BCC(2), Layer I, 00-05 cmbs	50 + 90	-23.1	80 ± 90	1667-1788 1791-1951
Site 15302						
1485	60889	Feat. BC, Surface	250 + 50	-25.4	240 ± 50	1487-1692 1729-1815 1923-1955 #

** Calibrated according to Stuiver and Pearson (1986). Range at two sigmas.*
 # Denotes influence of bomb C-14.

PORTABLE ARTIFACTS

Four indigenous artifacts were recovered from the project area. Indigenous artifacts are those made using traditional Hawaiian manufacturing techniques and local raw materials. The inventory of indigenous artifacts from the current project area is fairly narrow in content, and consists of domestic items and tools. A detailed tabulation of the artifacts by provenience is presented in Table 10. The results of the artifactual analysis are discussed below.

Domestic Items

Two artifacts identified as domestic items were recovered from the surface of Feature BG of Site 15298. The artifacts were classified as picks manufactured from bird bone, and measure 9.7 by 0.5 by 0.5 cm and 7.8 by 0.4 by 0.4 cm, respectively. The retention of the articular end of the original bone at the ends of both picks suggests that modification of the bone prior to use was minimal, and was restricted to sharpening one end of the specimens. Picks were generally used to extract meat from marine shells.

Tools

Two artifacts identified as tools were encountered in the deposits of Sites 15269 and 15298. The tools, classified as an abrader and an adze, respectively, are described in detail below.

Abrader - Coral and scoria abraders are evaluated according to their overall shape in plan view, following the classification system and nomenclature set forth by Suggs (1961) to describe coral abraders found at Nuku Hiva in the Marquesas Islands, French Polynesia. In this system, abraders are either informal, meaning that the shape of the raw material is dominant; or formal, indicating that the characteristics of the raw material have been extensively modified by use. Cross-sections are generally taken perpendicular to a line between the tip and butt of the abrader, while the number of abrasion faces is indicative of preferential abrasion on a given surface.

The abrader recovered from Feature Y of Site 15269 is a partial specimen manufactured of coral. It is trapezoidal in cross section, with two distinct faces of abrasion; it measures 2.5 by 1.2 by 1.2 cm. It is short triangular in plan view. Coral abraders apparently served as several kinds of tools prehistorically, ranging from "rubbers" used to finish canoes and wooden bowls (Buck 1957), to saws or files used in the manufacture of bone and shell fishhooks (Emory, Bonk, and Sinoto 1968; Suggs 1961). The variety of shapes, edges and worn surfaces represented by the abraders in the current assemblage suggests that the abraders served as multipurpose tools. Use of a particular surface over a period of time might generate a sawing or filing edge, which in turn would wear down during use to a new shape that could serve a new purpose.

Adze - Adzes are described according to a system developed by PHRI (based on work done by Craib [1971]), which records attributes such as cross-sectional shape, shape in plan view, poll shape, cutting-edge morphology, number and placement of ground surfaces, bevel type and angle, the nature of side surfaces, and the presence or absence of tangs. Terminology follows Buck, Emory, Skinner, and Stokes (1930), except that "face" and "base" are substituted for "front and "back."

Table 10.

Detailed Distribution of Portable Artifacts

Material	15269 Fea.Y TU-2 II 1	15298 Fea.BG Surf.	15298 Fea.BU Surf.	15298 Sub Total	Grand Total
Indigenous					
Domestic Items					
Bone					
Pick	-	2	-	2	2
Subtotal Domestic Items	**0**	**2**	**0**	**2**	**2**
Tools					
Basalt					
Adze Frag.	-	-	1	1	1
Coral					
Abrader	1	-	-	0	1
Subtotal Tools	**1**	**0**	**1**	**1**	**2**
Grand Total	**1**	**2**	**1**	**3**	**4**

The adze recovered from Feature BU of Site 15298 is a poll and midsection fragment manufactured from aphanitic basalt. The specimen is ground on the poll and sides and measures 5.3 by 5.2 by 2.6 cm. It is quadrangular in cross section, with a rectangular poll and flat sides, and appears to be untanged. Adzes are generally associated with woodworking, particularly canoe manufacture.

Discussion

In general, the artifact assemblage encountered during the current investigation suggests that a fairly narrow range of prehistoric activities was carried out within the project area. Eating is indicated by the picks, although these could have been deposited on the surface of the feature as part of historic recreational activities unassociated with occupation of Feature BG. Woodworking, such as carving of figurines or manufacturing canoes, are suggested by the adze fragment and the coral abrader, although the latter artifact may have been used for a variety of abrading tasks.

ECOFACTUAL REMAINS

Objectives and Methods

Ecofactual remains are archaeologically significant on a number of levels, as the variety and content of food remains contained within a given cultural deposit provide useful information concerning prehistoric diet and resource utilization patterns. The analysis of ecofactual remains for inventory survey projects thus has two primary objectives:

1. To determine the variety and distribution of ecofactual remains present in each cultural deposit encountered within the project area; and

2. To provide an indication of dietary and resource exploitation patterns for each site, and for the project area as a whole.

All ecofactual remains recovered from the project area were analyzed in detail in the laboratory. Detailed analysis involves splitting the sample into two size classes by it through 1/4-in and 1/8-in mesh screens. One-hundred percent of the material retained in the 1/4-in screen is completely sorted to the lowest taxonomic level possible, while the material retained in the 1/8-in screen is inspected for both artifactual material and for taxa not encountered in the larger portion of the sample. Marine shell identifications are verified and augmented using Kay (1979). No vertebrate faunal remains were identified in the samples.

The sampling design outlined above is adapted from Kirch (1979), based on a series of experiments measuring the relative distribution of molluscan and bone material retained on each screen. Kirch concluded that use of the screens increased the speed of the sorting without decreasing either the accuracy or statistical validity of the overall analysis. The taxonomic distribution and weight of material retained on the 1/4-in screen should thus be considered as representative of the variety and relative percentages of each taxon present in the entire sample.

Results

Ecofactual remains were encountered in test units excavated in Features N and Y of Site 15269 and on the surface of Feature BC of Site 15302. The results of the analysis are presented in Table 11. Total weights for each taxon (in grams) are tabulated by site and feature, with subtotals indicating the combined weight per feature for each larger material class (e.g., gastropods). The total weight of each taxon within the assemblage is provided in the final column of each table, while the grand total represents the combined weight of all the ecofactual materials derived from the analyzed deposits.

By weight, 36.10% of the 14.41 grams of ecofactual remains recovered from the project area is contributed by marine gastropods, 10.62% by bivalves, 1.89% by other invertebrates, and 51.4% by vegetal remains. Marine gastropods included remains of Patellidae, Neritidae and Cypraeidae, but were dominated by unidentified gastropods. Bivalves were comprised exclusively of *Isognomon californica*, while other invertebrate remains were comprised entirely of Echinoidea. The vegetal remains were dominated by *Aleurites moluccanca* (*kukui*), but included carbonized plant remains and unidentified wood fragments.

The ecofactual assemblages associated with the three features are fairly distinct from the project area total discussed above in content and relative distribution. The samples recovered from Feature Y of Site 15269 contributed the greatest abundance of remains by weight, and correspondingly mirror the project area totals above. In contrast, the samples recovered from Feature N of Site 15269 and Feature BC of Site 15302 are composed entirely of vegetal remains. The Feature N sample contains 2.49 grams of *Aleurites moluccana*, while the Feature BC sample contains 0.88 grams of unidentified wood.

Discussion

The results of the ecofactual analysis indicate that subsistence patterns in the project area included the collection and consumption of a small variety of shell fish, ranging from several taxa of marine gastropods to bivalves and sea urchins. In general, the marine invertebrates included in the assemblage are common inhabitants of the shorelines, shallow-water areas, solution benches and fringing reefs of the windward islands of the Hawaiian chain and would have been easily accessible to local populations. The

Table 11.

DETAILED DISTRIBUTION OF ECOFACTUAL REMAINS

Material	15269 Fea.N TU-1 II 1-3	Fea.Y TU-2 I 1-2	II 1-3	Fea.Y Sub Total	Site 15269 Sub Total	15302 BC Surf.	Grand Total
Mollusca							
Gastropoda							
Patellidae							
Cellana sp.	-	-	0.85	0.85	0.85	-	0.85
Neritidae							
N. picea	-	-	0.34	0.34	0.34	-	0.34
Cypraeidae	-	0.44	1.37	1.81	1.81	-	1.81
Unidentified gast.	-	2.20	-	2.20	2.20	-	2.20
Subtotal Gastropoda	**0.00**	**2.64**	**2.56**	**5.20**	**5.20**	**0.00**	**5.20**
Bivalvia							
Isognomonidae							
I. california	-	-	1.53	1.53	1.53	0.00	1.53
Subtotal Bivalvia	**0.00**	**0.00**	**1.53**	**1.53**	**1.53**	**0.00**	**1.53**
Other Invertebrates							
Echinoidea	-	-	0.27	0.27	0.27	0.00	0.27
Subtotal Other Invertebrates	**0.00**	**0.00**	**0.27**	**0.27**	**0.27**	**0.00**	**0.27**
Subtotal Invertebrates	**0.00**	**2.64**	**4.36**	**7.00**	**7.00**	**0.00**	**7.00**
Vegetal Remains							
Charcoal	-	-	1.29	1.29	1.29	-	1.29
Aleurites moluccana	2.49	-	2.75	2.75	5.24	-	5.24
Wood	-	-	-	0.00	0.00	0.88	0.88
Subtotal Vegetal Remains	**2.49**	**0.00**	**4.04**	**4.04**	**6.53**	**0.88**	**7.41**
Grand Total	**2.49**	**2.64**	**8.40**	**11.04**	**13.53**	**0.88**	**14.41**

most common taxa are noted below, with comments on their occurrence and probable economic value (taken from Titcomb *et al.* 1978: 337-353):

Patellidae - Members of the family Patellidae, or limpets, were called *'opihi* by the Hawaiians. The *'opihi* were extremely well-liked as food and were reportedly the most commonly eaten shellfish. They were usually eaten raw raw and salted, sometimes with seaweed. They were sometimes washed and cooked in the shell by plunging them into a calabash filled with water heated by hot stones. This way, the broth (*kai*) could be used, especially by the sick and young. The meat itself was pulled from the shells or sometimes scooped out with a smaller, empty *'opihi* shell. *'Opihi*, especially *'opihi 'awa*, were used extensively as medicine and were also associated with sorcery. Although no examples of utilized *'opihi* shells were encountered in the current project area, empty *'opihi* shells were often used for scooping, peeling and scraping because of their sharp edges.

Within the Hawaiian island chain, *Cellana spp.* are generally found on basalt shorelines from the spray-zone seaward to the calcareous algal zone, except for *C. talcosa* which occurs at depth of one to ten centimeters along abrupt coastlines. Taxa used by the Hawaiians included *C. talcosa* (*'opihi ko'ele*), *C. sandwichensis* (*'opihi 'alinalina*) and *C. exarata* (*'opihi makaiauli*).

Neritidae - *Nerita picea* and *Theodoxus neglectus* are both known to the Hawaiians as *pipipi*. *Pipipi* is a general name for small mollusks, and is used with modifying terms to indicate various species with habits and habitats similar to nerites. *N. picea* is the most common taxon of *pipipi* and is the dominant nerite along Hawaiian shorelines; it is abundant on all rocky substrates from the splash zone to the high water mark just above the littorines. *Theodoxus neglectus* is euryhaline and is found not only at seaward edges, but also in brackish water. They are found immersed, both on the surface of the substratum and under rocks and rubble. *Pipipi* were used as food, and a needle or pick to remove the meat. Some were eaten as they were collected, while others were cooked by boiling or by broiling after wrapping the shell in leaves. Some people made a broth and added other shellfish for flavor. Empty shells were commonly strung in *lei* or bracelets.

Cypraeidae - Members of the family Cypraiedae were known as *leho* by the Hawaiians and were of major importance in the economy as food, ornaments, tools and octopus fishing lures. To prepare *leho* for eating, the shells were broken open and the meat was removed and worked with salt. The flesh was then wrapped in *ti* leaves and cooked over coals. Sometimes they were simply boiled the shell, after which the meat was eaten. Small yellow and white *leho* were reserved for the *ali'i* to use as ornaments and they were occasionally used as currency. Larger shells were used to make scrapers for removing the skin from cooked taro and breadfruit, and for grating coconut. Cowrie scrapers with a sharp, serrated edge were also used to incise *wauke* bark to remove it from the plant. The *mauritius*, and sometimes the tiger cowries, were used as part of octopus lure assemblies.

The habitat of the cowries ranges from the intertidal zone to depths of about 100 m. The most common species in the Hawaiian Islands are found in shallow water, under loose rocks and boulders, along the shoreline and in crevices at the seaward edge of solution benches and fringing reefs.

Bivalves - While none of the more common bivalves encountered in the current assemblage was extensively described by Titcomb, she does refer to use of bivalves, generally. Bivalves were not extensively used as food, although members of the families Chamidae (rock oysters), Mytilidae and Isognomonidae (mussels) were eaten when they were available. More common uses of bivalves as raw material in fishhook manufacture, or as sources of pearls (oysters). Most bivalves are found near the shorelines and within fringing reefs, where there are sandy areas for burrowing.

In addition to marine resources, the presence of vegetal material in the assemblage indicates that terrestrial resources were also utilized by local populations. The vegetal assemblage contains predominantly prehistorically introduced taxa; most of which were not utilized for food. *A. moluccana*, for example, has several additional uses documented in the ethnological records of the Bernice P. Bishop Museum, including the manufacture of *kukui* nut candles and torches, *kukui lei*, and as a raw material in *kapa* manufacture; while the carbonized plant remains and wood fragments may represent fuel rather than food debris.

CONCLUSION

DISCUSSION

The present project has added significantly to the number and types of archaeological sites known in the Lands of Makaula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4. Forty-three sites with thousands of component features were identified. The formal feature types encountered were midden deposit, modified outcrop, terrace, enclosure, wall, mound, other, alignment, excavation, modified lava tube, cupboard, petroglyph, modified depression, steppingstone trail, cairn, platform, pavement, utilized lava tube, cleared area, and pecked stone. Most of these feature types are common elsewhere on Hawai'i Island, especially in middle-elevation areas in South Kohala and North Kona. One feature unusual in the general vicinity was identified during this project—Site 15298, a refuge cave. Functional types encountered included habitation, agriculture, indeterminate, multiple, transportation, habitation (refuge), communication, marker, recreation, ceremonial, quarry, and boundary. These functional types fell into the broader functional categories of habitation, indeterminate, agriculture, storage and other, as discussed below:

1. **Habitation** - Habitation features were fairly common throughout the project area and were grouped into 27 site complexes. Most of the habitation features are in two major habitation caves (Sites 15298 and 15302), which appear to have been intensively used (Table 12, Figure 15). Based on size, construction, structural morphology, and associated ecofacts and artifacts, the habitations appear to have been temporary/periodic rather than permanent.

   This category also includes multi-function sites where there were indications of other activities occurring in conjunction with habitation. These included agriculture, refuge, and/or ceremonial functions.

   Temporary habitation sites are found in all areas of the project area except the recent lava flow in the northeast corner. As with the agricultural features, the temparary habitation sites tend to be concentrated in the upper elevations of the project area.

2. **Indeterminate** - These sites (n=6) were the next most commonly recorded. These features were generally too small or too disturbed to allow an accurate determination of function. It appears that most of the sites (including modified depressions, a lava tube, enclosures, and a wall) were used for short-duration habitation.

3. **Agriculture** - This designation was assigned to the general background scatter of agricultural features (Site 18891). It appears that in the project area the density of these features increases with elevation. Previous models (Rosendahl 1973, Davis 1977, Cordy 1985 have indicated little use of the barren (or middle) zone for agriculture; this is due to the bare, non-disintegrated lava, arid conditions, and lack of soil. Previous models suggest the coastal zone also was little used. The findings of this project generally agree with the previous models. The number of modified outcrops in Site 18891 (Figure 16) drops significantly in the lower elevations of the southwest portion of the project area. The northwest portion, likewise, also drops, but not as rapidly. Terraces become uncommon below c. 120 meters (400 ft), with only a single example found. Mounds, another possible agricultural feature, also were rare below 120 meters (400 ft). All agricultural features appear to increase in number above the c. 120 m elevation; this is probably due to the increase in moisture at this elevation (the increase roughly follows the 20 inch [513 mm] isohyetal line; Armstrong et al. 1983:63). Vegetation becomes more dense at this elevation, clearly indicating this moisture shift.

4. **Storage and Other** - Of the sites in these categories, the petroglyphs (recreation and communication functions) were the most interesting. Two *papamu*, used as game boards for *konane*, were identified during the current survey. One was located in the western portion of the project area, and the other was found in association with the large habitation and refuge cave (Site 15298) in the northwestern corner of the project area. At this latter site there were also other petroglyphs—triangular-bodied anthropomorphic figures and a dot motif. A single "X" petroglyph located at Site 15304 may have served as a guide to a habitation or place where there was a natural resource.

Previous archaeological work in this area (Soehren 1985:1-2) indicates there are coastal-inland trails in the vicinity of the project area. Such a trail is the nearby Alanui Kauhini, which

Table 12.

SUMMARY OF TEMPORARY HABITATION FEATURES

*SIHP Site	Feature	Formal Type	Qnty.	Location Sweep #	Deposit P/A†	Cluster/ Indiv.	Area (m^2)
Surface Features (62)							
15262	D	Terrace	1	#64	P	C	16.34
15264	A	Mod. outcrop	1	#35	P	C	32.39
	B	Mod. outcrop	1	#35	P	C	11.20
15266	A	Terrace	1	#43	A	C	27.20
15268	—	Alignment	1	#8	A	I	4.25
15269	A	Platform	1	#18	A	C	36.58
	C	Terrace	1	#18	A	C	19.98
	K	Wall	1	#18	A	C	9.80
	L	Terrace	1	#18	A	C	17.16
	M	Terrace	1	#15	A	C	9.60
	N	Wall	1	#16	P	C	17.00
	Q	Enclosure	1	#13	A	C	25.38
	R	Terrace	1	#16	A	C	34.10
	T	Mod. lava tube	1	#13	A	C	14.08
	V	Terrace	1	#13	P	C	29.68
	W	Cupboard	1	#13	A	C	1.56
	X	Wall	1	#12	A	C	37.20
	Y	Wall	1	#12	P	C	31.68
	Z	Platform	1	#10	A	C	10.15
15270	—	Cupboard	1	#12	A	I	1.40
15272	A	Enclosure	1	#15	A	C	9.00
15276	C	Util. lava tube	1	#20	P	C	58.85
15277	A	Terrace	1	#21	A	C	50.00
	D	Terrace	1	#21	A	C	12.00
	E	Mod. lava tube	1	#21	A	C	30.00
	F	Terrace	1	#21	P	C	16.12
15278	A	Wall	1	#21	A	C	15.60
	B	Wall	1	#21	A	C	2.88
15279	—	Terrace	1	#22	A	I	16.28
15280	—	Cupboard	1	#24	A	I	1.70
15281	A	Mod. lava tube	1	#27	P	C	32.19
15282	—	Util. lava tube	1	#30	P	I	14.30
15283	A	Terrace	1	#30	A	C	11.39
	B	Wall	1	#30	A	C	43.20
	C	Terrace	1	#31	A	C	5.15
15284	—	Mod. lava tube	1	#31	A	I	15.60
15285	A	Enclosure	1	#32	P	C	80.00
15290	B	Platform	1	#37	A	C	14.40
	C	Enclosure	1	#37	A	C	24.75
15293	—	Platform	1	#38	A	I	18.70
15295	C	Enclosure	1	#41	A	C	22.55
	D	Enclosure	1	#41	P	C	26.24
15296	B	Terrace	1	#41	A	C	15.00
	C	Enclosure	1	#41	A	C	31.36
	D	Excavation	1	#41	A	C	0.78
	E	Cupboard	1	#41	A	C	2.16
	F	Alignment	1	#41	A	C	13.09
	H	Enclosure	1	#41	P	C	19.32
	I	Enclosure	1	#41	A	C	19.36
15297	A	Pavement	1	#41	A	C	1.05
	B	Terrace	1	#41	P	C	9.90
	C	Terrace	1	#41	A	C	6.08
	D	Terrace	1	#41	A	C	1.45
15298	D	Terrace	1	#48	A	C	23.22
	E	Cupboard	1	#48	A	C	12.32
	H4	Cupboard	1	#50	A	C	0.11
	K	Terrace	1	#50	A	C	24.00
15300	—	Util. lava tube	1	#61	P	I	1.14
15299	—	Mod. outcrop	1	#60	P	I	51.33
15303	—	Mod. lava tube	1	#65	A	I	1.26
15206	—	Cupboard	1	#24	A	I	1.84
15307	—	Enclosure	1	#23-24	A	I	17.48

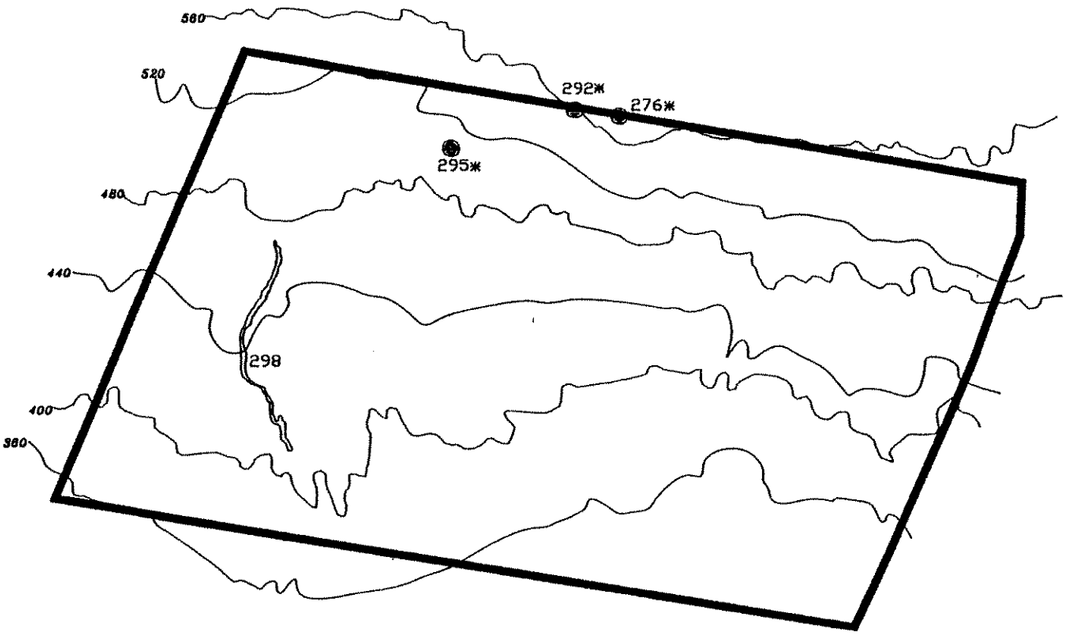
* *SIHP = State Inventory of Historic Places*
† *P/A = Present or absent*

Table 12. (cont.)

SIHP Site	Feature	Formal Type	Qnty.	Location Sweep	Deposit P/A	Cluster/ Indiv.	Area (m^2)
Subsurface Features (144)							
15276	A	Excavation	1	#20	P	C	0.24
	B	Alignment	1	#20	P	C	0.70
15286	B	Alignment	1	#32	A	C	2.40
	C	Midden	1	#32	P	C	0.10
	D	Other (water catchment)	1	#32	A	C	0.08
15292	E	Cleared area	1	#37	P	C	2.55
15298	BA	Terrace	1	#62	A	C	1.65
	BB	Wall	1	#62	A	C	1.80
	BC	Pavement	1	#62	P	C	20.91
	BE	Midden	1	#63	P	C	0.80
	BF	Midden	1	#63	P	C	4.62
	BG	Terrace	1	#63	P	C	1.43
	BH	Wall	1	#63	P	C	6.15
	BI	Wall	1	#63	A	C	6.72
	BJ	Pavement	1	#63	P	C	6.16
	BK	Midden	1	#63	P	C	13.39
	BM	Wall	1	#63	P	C	2.00
	BN	Midden	1	#63	P	C	0.72
	BO	Wall	1	#63	P	C	3.23
	BP	Enclosure	2	#63	P	C	1.00
	BQ	Alignment	1	#63	P	C	0.72
	BR	Midden	1	#63	P	C	58.50
	BS	Midden	1	#63	P	C	2.19
	BT	Alignment	1	#63	P	C	0.50
	BU	Other (water catchment)	1	#63	P	C	1.02
	BW	Terrace	1	#63	P	C	9.10
	BY	Other (lamp holder)	6	#60	P	C	0.18
	BBB	Alignment	1	#60	P	C	0.06
	BBE	Midden	77	#48-65	P	C	0.01
	BBG	Other (water catchment)	2	#60	A	C	0.16
				#60	A	C	0.08
	BBI	Midden	1	#59	P	C	0.91
	BBJ	Midden	1	#59	P	C	0.45
	BBM	Other (water catchment)	1	#59	A	C	0.48
	BBR	Midden	1	#56	P	C	0.16
	BBT	Midden	1	#56	P	C	0.64
	BBX	Midden	1	#56	P	C	1.74
	BBY	Cleared area	1	#56	—	C	5.09
	BCA	Mod. depression	1	#55	A	C	3.24
	BCC	Midden	2	#48	P	C	8.80
15302	BA	Other (water catchment & lamp holder)	3	#66	P	C	2.98
	BD	Other (water catchment)	1	#69	P	C	0.54
	BE	Other (lamp holder)	1	#69	P	C	0.04
	BF	Other (water catchment)	1	#69	A	C	0.27
	BJ	Wall	1	#69	P	C	7.40
	BK	Terrace	1	#69	P	C	6.22
	BN	Midden	8	#66-70	P	C	0.12
	BO	Other (water catchment & indeterminate)	1	#69	P	C	0.42
	BP	Other (water catchment)	1	#69	P	C	0.39
	BQ	Other (water catchment)	1	#69-70	A	C	1.60
	BZ	Terrace	1	#69	A	C	10.90
	BBB	Other (water catchment)	1	#69	P	C	0.38



A. BURIAL/POSSIBLE BURIAL

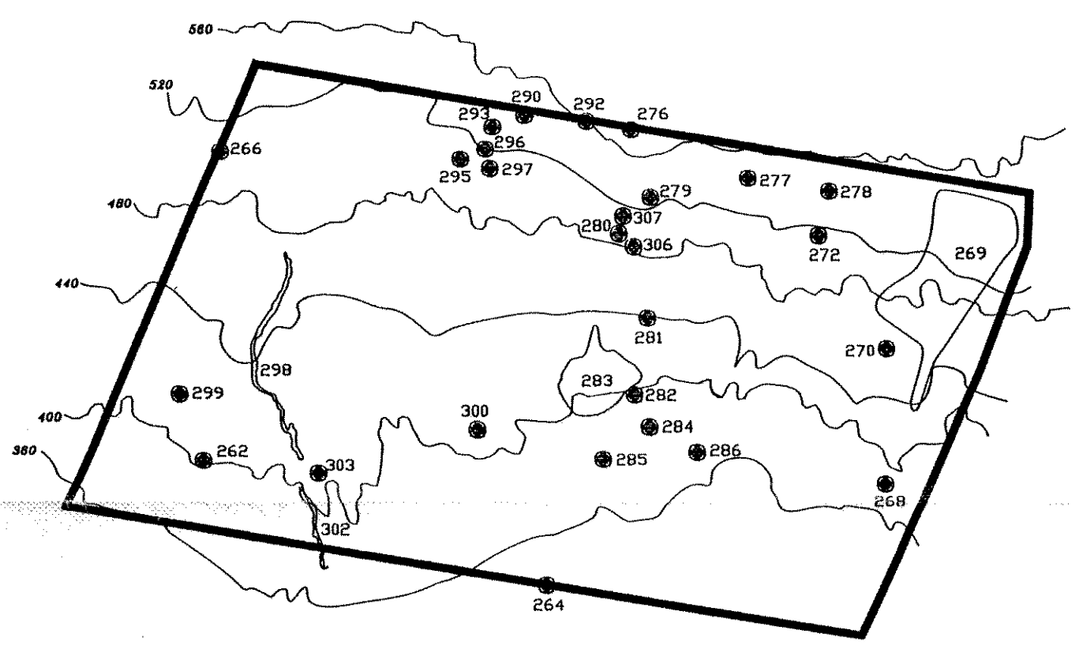


NOTE:
THREE-DIGIT NUMBERS ARE SIHP NUMBERS PREFIXED BY 50-10-28-15
(50=STATE OF HAWAII; 10=ISLAND OF HAWAII; 28=USGS 7.5' SERIES
QUADRANGLE MAP (KAILUA, HAWAII); 15=SITE NUMBER PREFIX.)

0 500 1000 ft
0 100 200 300 m

* = POSSIBLE BURIAL

B. TEMPORARY HABITATION



NOTE:
THREE-DIGIT NUMBERS ARE SIHP NUMBERS PREFIXED BY 50-10-28-15
(50=STATE OF HAWAII; 10=ISLAND OF HAWAII; 28=USGS 7.5' SERIES
QUADRANGLE MAP (KAILUA, HAWAII); 15=SITE NUMBER PREFIX.)

0 500 1000 ft
0 100 200 300 m

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Archaeological Inventory Survey
Kailua to Keahole Region State Lands
LUC Project-600-Acre University Site
PHRI Project 92-1298

Figure 15.
DISTRUBUTION OF
TEMPORARY HABITATIONS AND
BURIALS/POSSIBLE BURIALS

is shown on an Emerson map dated January 1889. This trail, south of the current project area, may retrace a prehistoric foot trail; portions of the present trail within the Kona Palisades Subdivision have been destroyed by bulldozing (ibid:2). In the report for a survey in Kalaoa 4 (Telea and Rosendahl 1987) it is noted that the trail was used to move both people and agricultural produce between the upland agricultural and coastal habitation zones. Soehren (1985) also identified two early-historic roads, Alanui Kauila and Alanui Kama, south of the current project area. Henry et al. (1993:68) reported that trails were generally rare in their study area, which includes the present project area. Five trails were found in the coastal zone—all were short segments associated with habitation features. The percentage of trails increased with elevation.

Intensive archaeological survey of the present project area did not locate major coastal-inland trails; however, several steppingstone trails were found. These were composed of pahoehoe slabs placed in alignments across rough aa flows. The lack of a major *mauka-makai* trail in the survey area could mean that the trail found by Soehren (1985) served as the major coastal-inland trail for the general area. This trail perhaps had smaller branches, and perhaps the steppingstone trails identified constitute portions of the branches.

In the Ka'upulehu area, north of the present project area, are two major *mauka-makai* foot trails (1319 and 10977) (Head et al. 1992). The topography of the Ka'upulehu area is similar to portions of the present project area. The Ka'upulehu area has wide, grassy, mostly flat areas. Cairns were placed along the two trails to mark indistinct areas. Based on the Ka'upulehu area, it seemed likely that similar markers would be found in the current project area. The current surface inventory identified six cairns—four on the surface and two in caves. The four surface cairns were Features F and S at Site 15269; Site 15288, and Site 15305. At Site 15269, a habitation-transportation complex, Features F and S lie in a rough *mauka-makai* alignment with Feature B, a steppingstone trail over aa lava. The cairns may be associated with Soehren's (1985) Alanui Kauhini Trail, although it is difficult to determine this from the map Soehren provides.

Site 15288 is a cairn near the seaward boundary of the project area. The cairn is west of Site 15285, a temporary habitation, and does not appear to mark the site. Site 15305 is a cairn near the upper, *mauka* edge of the project area. This second cairn is east of Site 15288 and with the Site 15288 cairn could have marked a *mauka-makai* (inland-coastal) former trail; however, there was no indication of a trail in these areas. If a trail were present at one time, then it could be speculated that perhaps Site 15285 served as temporary habitation for those passing through the project area.

SITE DISTRIBUTION

Habitation areas in the project area are of two types—those within lava tubes and those on the surface. Lava tubes were used for habitations, some with little modification and others with significant modification, depending on the intended use. A good example of a lava tube habitation is Site 15298, a habitation and refuge cave. Most of the surface sites are on pahoehoe, rather than on aa. The features found on aa are mostly transportation features like steppingstone trails.

Agricultural features (Site 18891) are ubiquitous in the project area, but appear to be denser in the upper elevations. They are especially dense (101-150 features per transect) in the area between Flag Line 2 and the power line. The greatest density was in Transect 29 (between Flag Line 2 and the power line) as it passed through Site 15283. The area with the fewest agricultural features appears to be the northeast portion of the project area, where there is a more recent, and barely vegetated aa flow. The most common agricultural features are distributed in the project area as follows: (a) modified outcrops are found in a higher percentage at medium to higher elevations within the project area, and more modified outcrops are found in pahoehoe areas (Figure 16); (b) mounds are found in both pahoehoe and aa lavas in the upper elevations, and there is a moderate to high correlation of mounds and modified outcrops in the area between the power line and Flagline 3. Mounds are negatively correlated with aa lava in the southeastern corner of the project area (Figure 17); (c) pahoehoe excavations are found in highest concentrations in the lower elevation bands, in conjunction with aa flows. Some pahoehoe excavations are also documented on older pahoehoe lava flows, where there is also a positive correlation with both modified outcrops and mounds (Figure 18); and (d) terraces are generally correlated with pahoehoe flows and are mostly restricted to the upper elevations. They appear to be found in association with mounds and modified outcrops (Figure 19). In general, agricultural features at Site 18991 were concentrated in the eastern portion of the project area (Figure 20).

The agricultural features generally lack the diversity of those in areas closer to the core of the Kona Field System, and it appears that the features were not as intensively used. In order to gain information on the distribution of agricultural feature types in the project area, Site 15283 (Figure 8), in the central portion of the project area, was studied in detail. This site has approximately 70 agricultural features—modified outcrops, mounds, walls, terraces, depressions, and excavations (Table 13). The site has 53 modified outcrops with average lengths of 2.67 m and average heights of 0.31 m.

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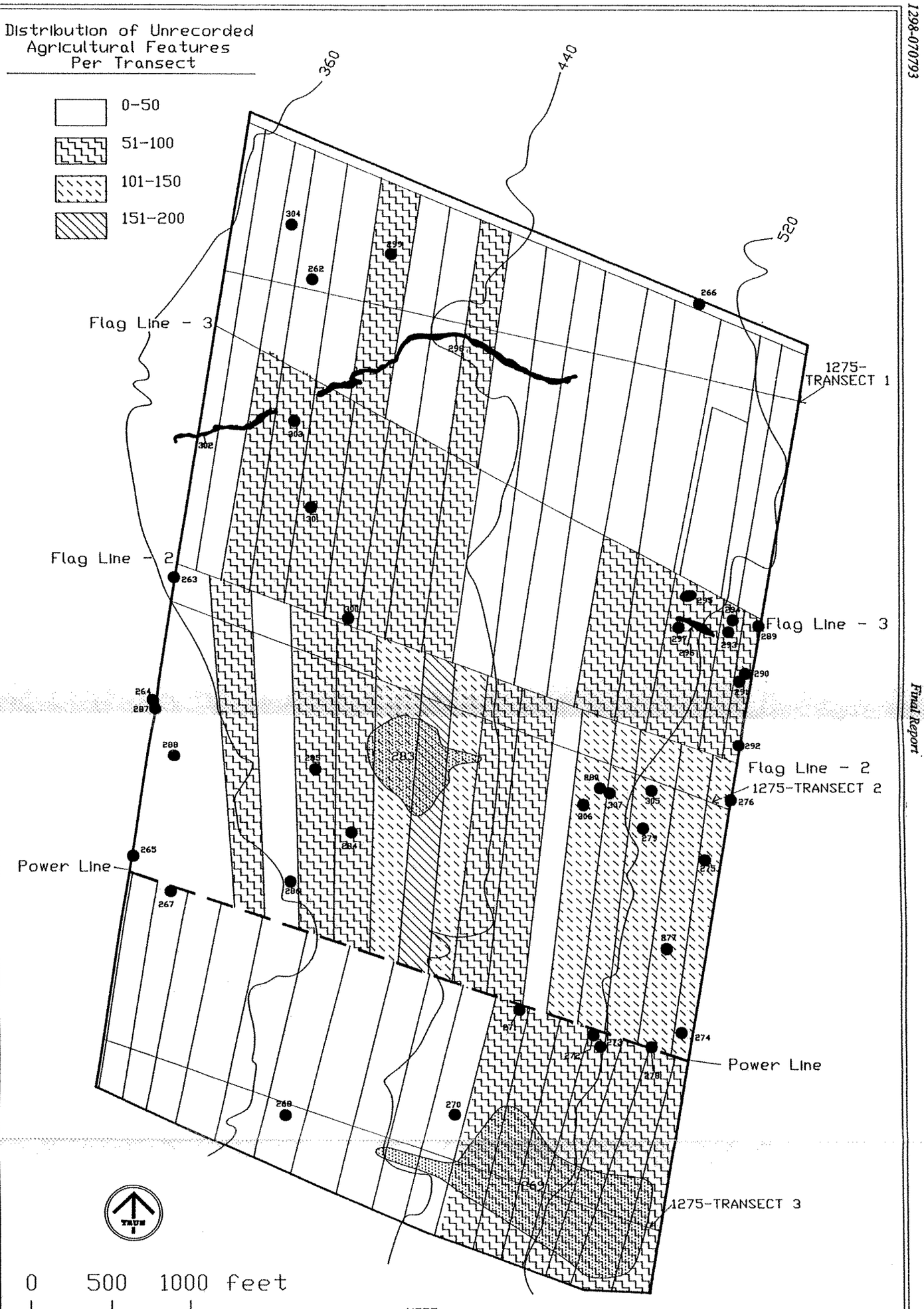

NOTE:
THREE-DIGIT NUMBERS ARE SIHP NUMBERS PREFIXED BY 50-10-28-15
(50=STATE OF HAWAII; 10=ISLAND OF HAWAII; 28=USGS 7.5' SERIES
QUADRANGLE MAP (KAILUA, HAWAII); 15=SITE NUMBER PREFIX.)

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Figure 20.
DISTRIBUTION OF AGRICULTURAL FEATURES
AT SITE 18891

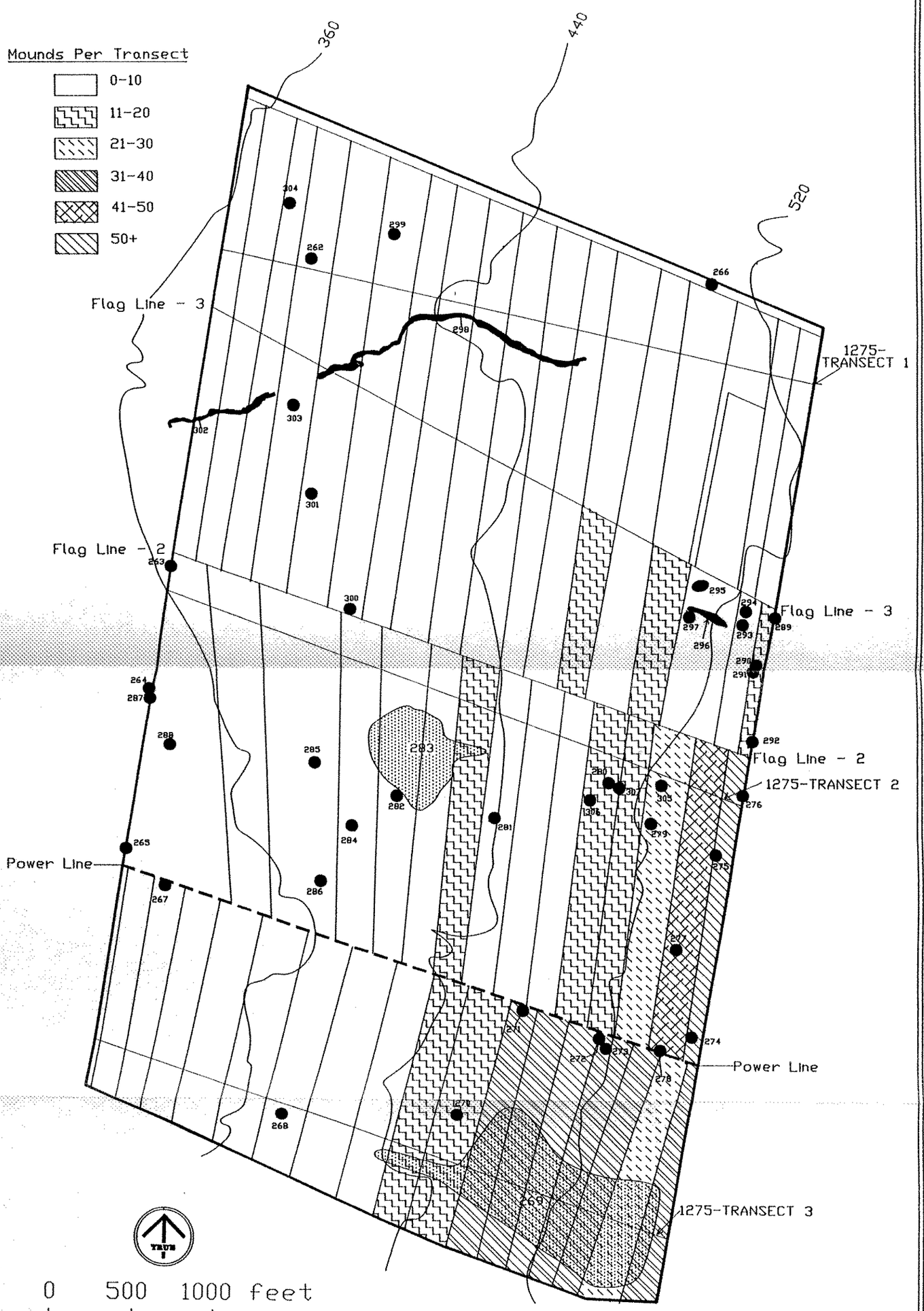

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Figure 17.
DISTRIBUTION OF MOUNDS
AT SITE 18891

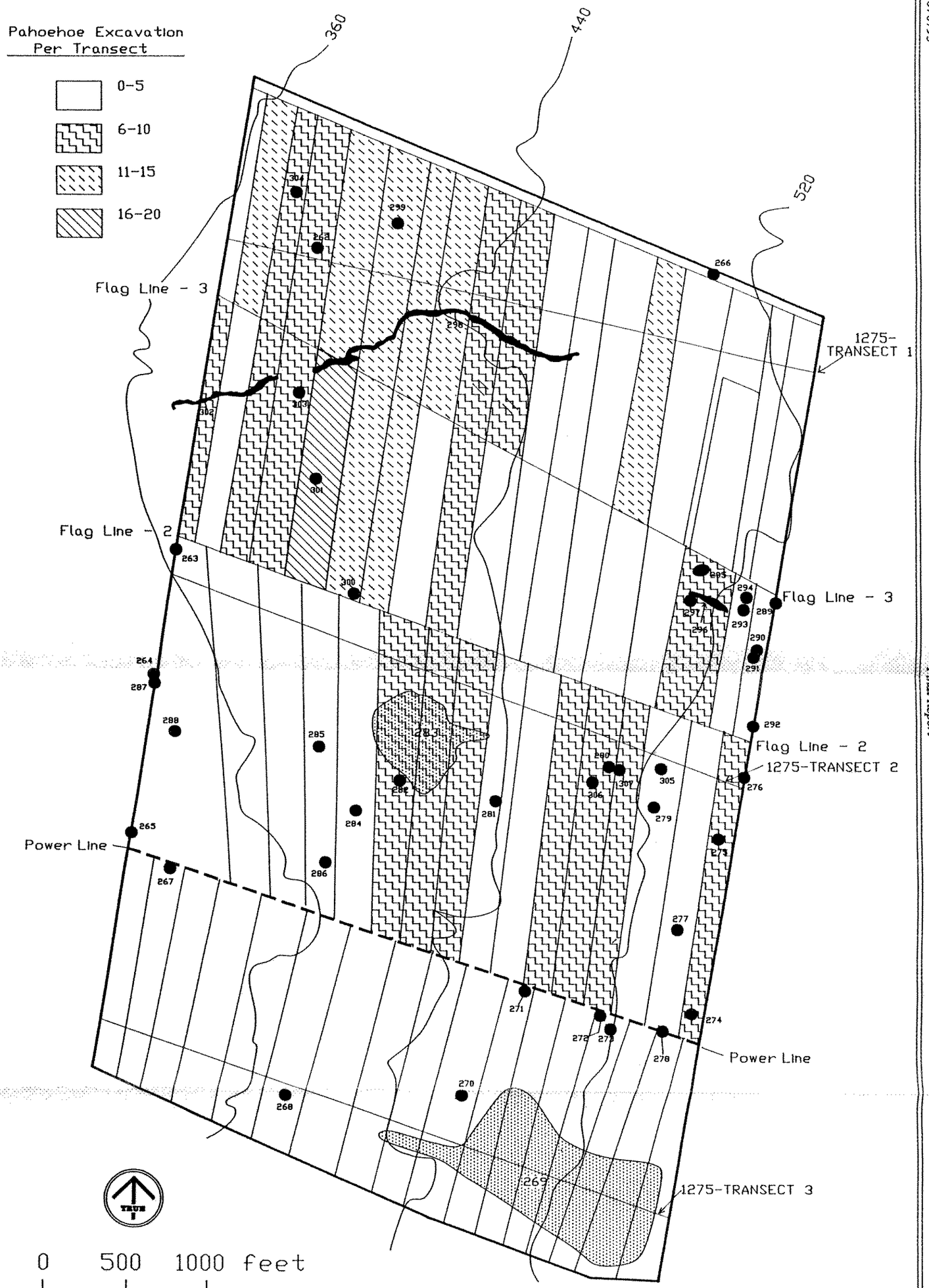

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Figure 18.
DISTRIBUTION OF PAHOEHOE EXCAVATIONS AT SITE 18891

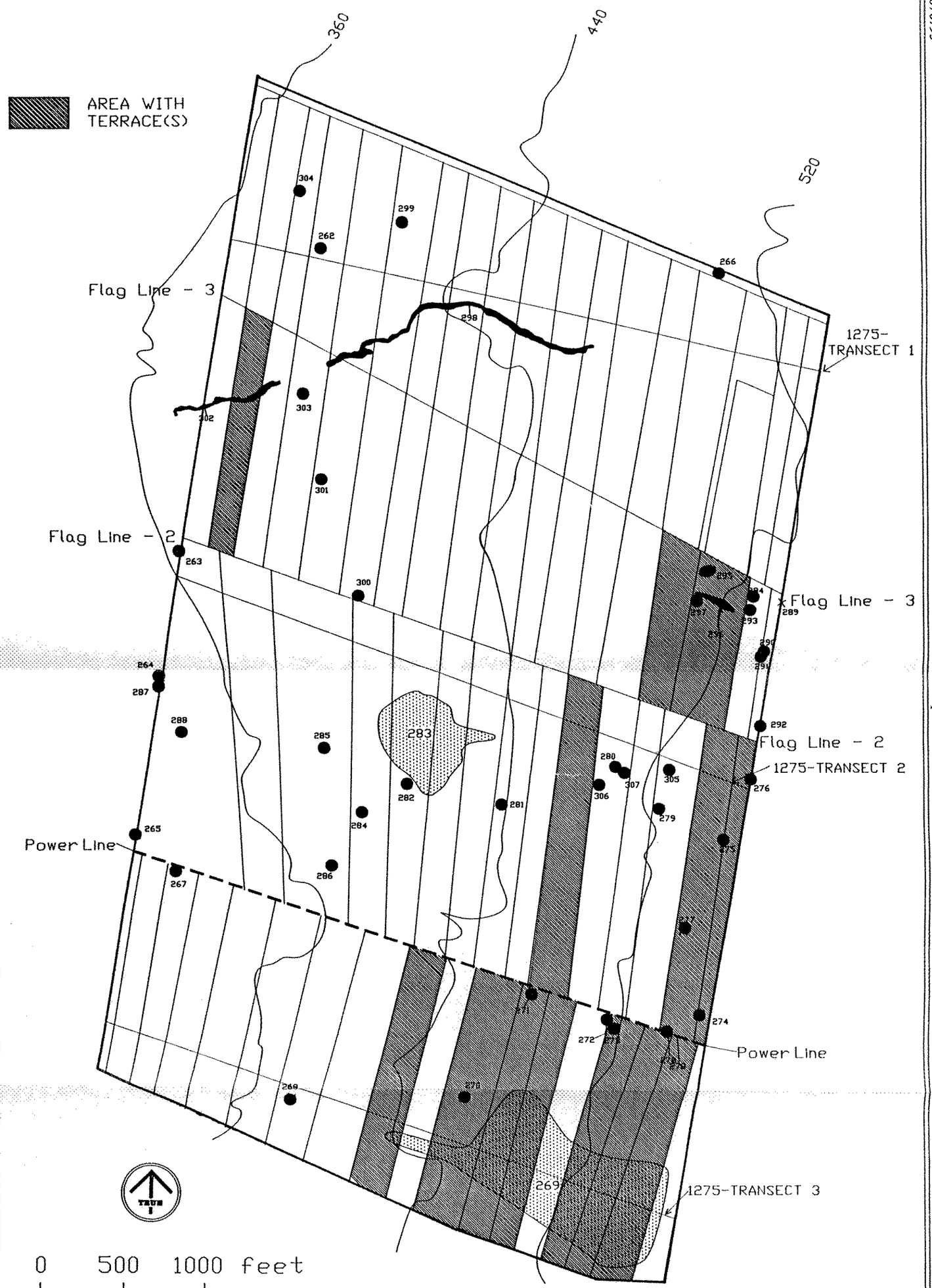

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Figure 19.
DISTRIBUTION OF TERRACES
AT SITE 18891

Table 13.

FEATURE SAMPLE AT SITE 15823

Feature	L	W	Orientation	Ht-Range	% Placed	% Piled	No. of Courses	Max.Diam.	Planting Plots*	Comments
D01	1.24	0.98	20 - 200 degrees	0.15-0.27	95	5	1-2	0.35	P	Boulders are in the W & S perimeter; cobbles in interior. PP = 0.60 by 0.60
D02	2.00	1.50	160 - 340 degrees	0.07-0.24	90	10	1-2	0.25-0.40	N	Fea.. on top & adj. to W side of blister; boulders on top; cobbles to side
D03	1.20	0.90	104 - 284 degrees	0.08-0.18	95	5	1-2	0.35	Y	5 large boulders w/smaller cobbles (0.25 m diameter). PP = 0.25 by 0.25
D04	0.75	0.55	80 - 260 degrees	0.06-0.17	100	0	1	0.13-0.32	N	Only 8 large cobbles/small boulders scattered on phh bedrock
D05	1.52	0.85	102 - 282 degrees	0.06-0.24	75	25	1-2	0.18-0.30	N	C. 20 cobbles & boulders placed & piled on broken pahoehoe blister edge
D06	1.57	0.80	0 - 180 degrees	0.11-0.20	95	5	1-2	0.18-0.35	Y	C. 20 phh cobbles & boulders piled against a blister to E; boulders around other edges. PP = 0.30 by 0.40.
D07	1.03	0.94	122 - 302 degrees	0.07-0.20	100	0	1	—	Y	C. 15 cobbles, 20 pebbles, cobbles placed on E&W side; some on edge, pebble in interior. PP = 0.65 by 0.50.
D08	1.28	0.78	10 - 190 degrees	0.07-0.18	100	0	1	0.11-0.17	P	C. 7 large cobbles 0.17 md along E side, S side formed by blister slope, rest small cobbles.
D09	1.75	1.08	154 - 334 degrees	0.06-0.20	100	0	1	0.25-0.75	N	Scatter of cobbles (c. 0.25-0.75 md)
D10	1.50	0.40	124 - 304 degrees	0.06-0.29	100	0	1	0.10-0.30	N	C. 20 phh cobbles & sm. boulders (0.10-0.30);a tight cluster
D11	1.40	0.70	158 - 338 degrees	0.04-0.20	85	15	1-2	0.10-0.40	N	Large cobbles & boulders piled on top and adjacent to W side of phh slope
D12	1.40	0.83	0 - 180 degrees	0.07-0.22	90	10	1-2	0.42	Y	Boulders around perimeter, 1 sm cobble c. 0.11 by 0.75 in interior. PP = 0.50 by 0.50.
D13	1.60	0.41	32 - 212 degrees	0.10-0.60	100	0	1	0.22-0.36	N	C. 10 boulders (0.22-0.36 md) scattered, 4 tightly clustered
D14	0.95	0.80	78 - 258 degrees	0.07-0.24	100	0	1	0.25-0.37	Y	C. 5 bould. (0.25-0.37) in rough circle; smaller cobble in interior (0.10-0.19) 45 by 0.30.
D16	1.40	1.05	116 - 296 degrees	0.05-0.28	95	5	1-2	0.16-0.32	N	Scatter of c. 15 cobbles and boulders (0.16-0.32 md)
D17	0.92	0.60	78 - 258 degrees	0.20-0.25	100	0	1	0.25-0.50	Y	5 boulders in rough semicircle (0.25-0.50 md); bare interior. PP = 0.35 by 0.35.
D18	1.40	0.00	20 - 200 degrees	0.20-0.25	100	0	1	0.16-0.22	N	C. 11 boulders scattered, not tightly clustered; rocks (c. 0.16-0.22 md)
D19	1.63	1.33	144 - 324 degrees	0.10-0.29	55	45	—	—	N	Cobbles & boulders placed & piled into an L-shape.
D20	0.87	0.80	40 - 220 degrees	0.00-0.25	0	0	0	—	Y	4 boulders & cobbles in rough circle; small cobbles in interior. Interior space = 0.41 by 0.36. Site 1275-239
D21	1.40	1.00	—	0.07-0.21	0	0	1	—	Y	A square pile of boulders, 1 course high w/+15 stones, smaller boulders placed in interior, larger boulders in exterior. Fea. D65 is 2.00 m at 191 degrees
D22	4.00	1.80	267 - degrees	0.03-0.34	0	0	1	—	N	Old Site 1275-235. A linear mod. o/c running E-W w/boulders & cobbles 1 course high placed on a phh o/c. Fea. J2 is 15.00 m at 142 degrees. +15 stones
D23	4.50	4.30	275 - 268 degrees	0.04-0.33	0	0	1	—	N	Old Site 12750237. 1 marine shell fragment. A large phh o/c w/+15 boulders placed all over it, 1 course high. Fea. D41 is 10.00 m at 166 degrees.

Note: Stones placed *are one-course high; stones* piled *are more than one course high.*

* *P = Possible, N = No, Y = Yes*

Table 13. (cont.)

Feature	L	W	Orientation	Ht-Range	% Placed	% Piled	No. of Courses	Max.Diam.	Planting Plots	Comments
D24	2.90	2.10	315 - 322 degrees	0.15-0.35	99	1	1	—	N	A phh o/c w/an align. of 8 flat boulders (0.80 by 0.40) running E-W w/5 smaller subangular boulders placed around the align. All 1 course high. Fea. D39 is 15.00 m at 355 degrees.
D25	2.00	1.20	321 - 327 degrees	0.08-0.25	98	2	1-2	—	N	Old site 1298-28. Mod. o/c consists of subangular boulders & flat, rectangular boulders 1-2 courses high, 11 boulders in all. Fea. D55 is at 273 degrees at 20.00 m, Fea. J5 is 37 degrees at 6.00 m
D26	13.75	5.00	323 - 336 degrees	0.02-0.46	0	0	1	—	N	Old Site 1298-27. A large phh o/c running E-W. At the east edge, there is an align. of 10 boulders running E-W. Several stones are placed around it. Further W are more piles of subangular & rounded boulders. Everything is 1 course high.
D27	1.43	0.90	134 - 314 degrees	0.06-0.35	100	0	1	0.25-0.33	N	C. 4 boulders at N wall (0.25-0.33 md) & c. 15 cobbles tightly clustered (c. 0.12-0.25 md) at SE ext.; tightly clustered feature
D28	1.96	0.90	173 - 353 degrees	0.11-0.42	100	0	1	0.25-0.62	N	C. 8 boulders (0.25-0.62) scattered on top of blister
D29	1.30	0.30	10 - 190 degrees	0.14-0.90	100	0	1	0.27-0.30	N	C. 6 boulders scattered over the area, no tight alignments (0.27-0.30 md)
D30	1.64	0.91	111 - 291 degrees	0.12-0.24	95	5	1-2	0.13-0.47	N	C. 16 cobbles & boulders in tight cluster (0.13-0.47 md)
D31	1.72	0.92	60 - 240 degrees	0.09-0.30	95	5	1-2	0.50	N	Tightly placed cobbles (0.75-0.25 m); a few scattered boulders up to 0.50 m
D32	1.20	0.58	10 - 190 degrees	0.10-0.25	100	0	1	0.25-0.40	N	C. 6 boulders scattered in area, no tight alignment
D33	1.42	1.10	82 - 262 degrees	0.08-0.40	100	0	1-2	0.35-0.40	Y	Boulders (0.35-0.40) on N & S side, cobbles 0.08-0.20 in interior. PP = 1.42 by 0.38.
D34	1.72	0.87	80 - 260 degrees	0.05-0.27	55	45	1-2	0.10-0.22	N	Small-medium cobbles (0.10-0.22) w/1 course of cobbles ext/1-2 courses of cobbles & boulders in interior, ext. not depressed
D35	4.63	0.66	78 - 258 degrees	0.04-0.26	70	30	1-3	—	N	Phh boulders and cobbles placed and piled on top and adjacent to N face of low blister; tightly placed cobbles (c. 0.07-0.10 m) piled up to 3 courses
D37	3.90	1.40	326 - 358 degrees	0.17-0.40	95	5	1-2	—	N	A linear pile of boulders running NW-SE, 1-2 courses high. This is constructed on a phh o/c. Boulders are subangular & rounded. Fea. D61 is 1.70 at 344 degrees.
D39	10.60	9.10	310 - 314 degrees	0.11-0.42	0	0	1	—	N	A large phh o/c w/6 piles of boulders placed on the o/c. There are 6 piles containing 5-9 boulders 1 course high & amorphously shaped. Fea. D24 is 15.00 m at 175 degrees. Fea. G is 59 degrees at 24.00 m.
D40	2.00	1.60	288 - 286 degrees	0.08-0.23	100	0	1	—	Y	A 1 course high pile of boulders placed on a phh o/c. Fea.. is circular w/larger boulders around the outside. Fea.. G is 13.00 m at 144 degrees. +10 stones
D41	1.20	1.20	282 - 278 degrees	0.12-0.30	—	0	1	—	N	A 1 course high, circular pile of 14 boulders constructed on a phh o/c. Fea. D40 is 8.00 m at 190 degrees. Fea. G is 168 degrees at 15.00 m
D42	2.07	0.62	90 - 270 degrees	0.04-0.35	55	45	1-2	0.25-0.40	N	W half consists of C&B 1 course high, E half 1 course of slabs on top of 1 course of boulders at base (0.25-0.40)
D43	1.40	0.82	80 - 260 degrees	0.09-0.22	100	0	1	0.25-0.50	N	Small-medium boulders (0.25-0.50) placed on bedrock; tight cluster
D44	1.83	1.25	112 - 292 degrees	0.07-0.19	70	30	1-2	0.30-0.40	P	Phh boulders (0.30-0.40) on N side piled to 2 courses, cobbles on S side not piled. PP = 1.65 by 1.20.
D45	5.90	4.50	5 - 35 degrees	0.07-0.30	—	100	1-2	—	N	A phh outcrop running E-W c. 6.10 by 5.00 m w/+30 cobbles to boulders placed on the outcrop. Fea.. B is 359 degrees at 30.00 m

Table 13. (cont.)

Feature	L	W	Orientation	Ht-Range	% Placed	% Piled	No. of Courses	Max.Diam.	Planting Plots	Comments
D46	1.50	1.27	70 - 250 degrees	0.12-0.50	80	20	2	0.25-0.55	N	Rectangular area with c. 10 large boulders (c. 0.25-0.55 m) placed tightly together
D47	5.50	4.40	260 - 24 degrees	0.11-0.45	100	0	2	—	N	A large phh o/c w/+20 large boulders placed on the o/c, most are 1 course high; 6 small boulders piled at SE corner 2 courses high. Fea.. D45 is c. 5.00 m at 320 degrees
D49	1.60	1.35	348 - 12 degrees	0.03-0.20	—	—	1	—	N	A small phh o/c w/a circular pile of 14 cobbles placed 1 course high. Fea. D47 is 297 degrees at 8.00 m. Fea. D51 is at 19 degrees at 6.00 m
D51	9.00	4.10	346 - 11 degrees	0.07-0.30	—	—	1	—	N	A large phh o/c running E-W w/several places containing stones in a circular pile 1 course high. Piles contain 3-5 boulders. Fea. D49 is 6.00 m at 199 degrees
D53	2.10	1.50	337 - 349 degrees	0.10-0.28	95	5	1-2	—	N	A circular pile of boulders 1-2 courses high. Fea. E6 is 3.50 m at 107 degrees, Fea. J3 is 320 degrees at 20.00 m
D55	7.00	3.20	330 - 341 degrees	0.05-0.17	0	0	1	—	N	A large phh o/c running E-W contains 3 small areas of piles 1 course high. These contain small cobbles & are amorphously shaped. Fea. E6 is at 258 degrees at 5.00 m
D57	5.60	5.00	325 - 345 degrees	0.03-0.45	60	40	1-2	—	N	A large phh o/c w/+30 boulders piled 1-2 courses high. Most boulders subangular; 3 flat, rectangular. This fea. is oval-shaped. Fea. D26 is 5.00 m at 120 degrees. Fea. J3 is 20.00 m at 247 degrees.
D59	1.30	1.30	334 - 359 degrees	0.11-0.24	0	0	1	—	N	A small phh o/c w/10 boulders placed 1 course high in a small area. Fea. J3 is 10.00 m at 233 degrees. Fea. D57 is 10.00 m at 86 degrees.
D61	1.60	1.00	320 - 350 degrees	0.08-0.28	0	0	1	—	N	A small phh o/c w/13 cobbles-boulders placed 1 course high in a linear pile running E-W. Fea. D59 is 10.00 m at 207 degrees.
D63	1.80	1.20	296 - 306 degrees	0.05-0.22	0	0	1	—	N	A linear pile of cobbles-boulders running E-W, 1 course high. This is placed on a phh o/c which runs E-W. Fea. G is 110 degrees at 50.00 m. +15 stones.
D65	2.20	1.50	260 - 250 degrees	0.08-0.21	0	0	1	—	N	A 1 course high mod. o/c piled w/boulders in an oval shape. Constructed on a phh o/c with +15 rounded & subangular boulders.
E01	0.63	0.60	0 - 180 degrees	0.18-0.35	0	100	2	0.22-0.37	N	Round dome-shaped mound of cobbles & boulders (uniform size) associated w/fea.
E02	1.66	0.80	70 - 250 degrees	0.00-0.20	45	55	—	—	Y	Fea. 1275-240 boulders & 1 cobble outside small cobble area
E03	2.40	1.70	268 - degrees	0.09-0.47	20	80	2-3	—	N	Old Site 1275-234. A 2-3 course high mound piled w/boulders running E-W. Constructed on a phh o/c. Contains +25 boulders.
E04	6.50	1.30	—	0.03-0.51	25	75	2-3	—	N	A 2-3 course high mound piled w/+15 boulders running E-W. Several other boulders are placed around the mound. Fea. A is 281 degrees at 35.00 m.
E06	1.40	1.30	334 - 347 degrees	0.03-0.40	25	75	2-3	—	N	A circular, stacked 2-3 course high pile of cobbles and boulders. Constructed on bedrock; the surface is irregular. Fea. D53 is c. 3.50 m at 287 degrees
E07	2.50	1.00	293 - degrees	0.13-0.27	20	80	2-3	—	N	A 2-3 course high pile of subangular boulders. Fea. is circular & constructed on a phh o/c. Old Site 1275-238 consists of +15 stones. Fea. D63 is 15.00 m at 270 degrees.
J01	4.00	2.50	345 - 12 degrees	0.13-0.40	50	50	1-3	—	N	A phh exc. (1.50 E-W by 0.60 by 0.24) is in the center of a phh o/c; c. 8 boulders have been placed back inside exc. & 6 boulders are placed around exc. Fea. D51 is c. 1.20 m at 180 degrees
J02	2.30	1.70	314 - 324 degrees	0.20-0.60	0	0	—	—	N	A phh exc. (1.60 by 0.80 by 0.40 m) is in center of a phh o/c. 10 boulders are placed around exc. No boulders inside exc. Fea. D25 is 6.00 m at 217 degrees. Fea. D24 is 3.00 m at 248 degrees.

Construction of the outcrops range from a loose scatter of pahoehoe boulders to tight clusters of pahoehoe cobbles and boulders of which about 45% are stacked two to three courses high.

Mounds at Site 15283 were differentiated from modified outcrops on the basis of the following: if more than 50% of the cobbles and boulders were piled only one course high, the feature was designated a modified outcrop. The diameters of mounds ranged from c. 0.63 to 6.50 m, with an average diameter of c. 2.06 m. The height of the mounds ranged from c. 0.20 to 0.51 m, with an average height of c. 0.35 m. The shape of the mounds in plan view ranged from round to oval to linear. Most were constructed of regularly sized pahoehoe cobbles and boulders, but one (Feature E2) consisted of small cobbles surrounded on the edges by boulders.

Three walls were noted at Site 15283. The walls were 8.0 to 1.9 m long, with an average length of 4.9 m. Average height was 0.48 m, and height ranged from 0.72 to 0.21 m. The walls were generally constructed of small cobbles to large pahoehoe boulders, and were up to six courses high. One example (Feature B, an L-shaped wall) was constructed atop a pahoehoe outcrop.

Terraces at Site 15283 were designated based on guidelines presented in Appendix C. Four terraces were found at the site. The terraces were 1.7 to 4.2 m high, with an average of 2.7 m. The area of the features ranged from 2.4 to 11.4 m, with an average of 6.0 m^2. The largest terrace at the site Feature A was built on top of a ropy pahoehoe outcrop, c. 3.0 m above the surrounding terrain. The feature is constructed of slabs of ropy pahoehoe, cobble to boulder-size, placed atop outcrop to form a mostly level surface.

Two pahoehoe excavations were at Site 15283. The features consisted of pahoehoe *pukas* (holes) excavated in the bedrock and refilled with the removed stones. The features were roughly circular, and the excavated areas averaged c. 1.1 m^2. The features may be the result of quarrying for scoriaceous lava, volcanic glass, or other suitable toolstone. Athough there are many possible quarries in the project area, no abrader depressions directly associated with them were found. Abrader depressions are quite common in some coastal areas on the Big Island (Jensen 1991) and some possible examples were located near Site 15298. The overall distribution of the pahoehoe excavations in the project area may be related to the distribution of pahoehoe with particular characteristics, or it may simply be that quarries were located in places easily accessible from both the coast and the uplands. The re-use of these features for agricultural planting areas is another possibility. Moore and Bevecqua (1972:17-20) examined a series of "pahoehoe holes" in Waikoloa *ahupua`a*. They postulated six possible cultural functions for each and presented arguments for each. The functions included: (a) burial, (b) agriculture, (c) storage, (d) shelter, (e) abrader quarry, and (f) source of construction stone.

CHRONOLOGY

Age determination results derived from radiocarbon analysis during the current project range from AD 1487-1950. One group of age ranges spans the late prehistoric to early historic periods, with two dates from the former period and one from the latter. Two other dates appeared to be of historic origin. Other researchers have obtained radiocarbon and volcanic-glass age ranges from the immediate vicinity of the current project area. These include AD 1400-1700 (radiocarbon) and AD 1480-1808 (volcanic glass) from the Keahole Agricultural Park (Hammatt and Folk 1980); AD 1470-present from Site 14140 at the Kona Palisades Development (Walker and Rosendahl 1990:13); AD 1280-1900 from Sites 10963 and 10985 at Kona Palisades Subdivision (Walker and Haun 1988:26); AD 1410-1955 from data recovery work at Kona Palisades Subdivision (Thompson and Goodfellow 1992:20-21); AD 1610 for Kalaoa 4 (Cordy 1985:28); and AD 1518-present from four sites in Kalaoa 5 (Walker and Rosendahl 1989:35).

When data from the radiocarbon results, the historical documentary research, from local informants, and from other archaeological projects are analyzed together, a general pattern for the Kekaha area begins to emerge. The first population centers were most probably near the coast, where the ocean and shoreline resources were most abundant. The coastal resources provided protein, but there was a lack of carbohydrates. This lack was filled by cultivation in the uplands—the growing of sweet potatoes, taro, breadfruit, bananas, and other foods. The cultivation took place perhaps as early as AD 1200 or 1300. The period between AD 1500-1700 appears to have been the period in which the project area was cultivated most intensely; this, however, is speculative—there are few radiocarbon dates from the project area and thus the chronological framework is far from complete. Historic land use of the upland gardens included the cultivation of items such as cabbage, melons, onions, beans, coffee, corn, and other crops (Schilt 1984:6).

SUMMARY

Based on the current work, some general observations can be made. Agricultural features (Site 18891) are by far the

most common fuctional feature types in the survey area. There are thousands of these features, which comprise components of a northern extension of the Kona Field System; the features may extend as far north as the Hu'ehu'e Ranch headquarters in Kukio Ahupua'a. The second most common functional type is temporary habitation. The temporary habitation features in the project area include C-shaped walls, enclosures, platforms, modified outcrops, modified depressions, terraces, alignments, and lava tube caves. Some of the temporary habitation features should be more fully recorded, mapped, and tested to determine if they were used for longer-term habitation.

The uplands of the project area, between 400-600 ft above sea level, contain numerous agricultural features—such as modified outcrops, rock mounds, and terraces (Site 18891). The modified outcrops are more dense at the higher elevations and are especially thick between Flag Line 2 and the power line right-of-way. The features are more common on pahoehoe than on aa. Mounds also are denser at higher elevations, and there is a moderate to high ratio of mounds to modified outcrops, expecially between Flag Line 3 and the Power Line to the south. Terraces are also found in greater density in the upper elevations, on pahoehoe flows. It is probable that in these areas of denser features there was limited cultivation of food crops such as dryland sweet potato (*'uala*, *Ipomoea batatas* [L.]Poir), which did not require elaborate systems or care. As suggested by environmental settlement models of previous researchers (Rosendahl 1973, Davis 1977, and Cordy 1985), the increasing density of features was expected at higher elevations. The second most common functional feature type found in the project area was habitation. The habitation features in the project area, including C-shaped walls, enclosures, platforms, modified outcrops, modified depressions, terraces, alignments, and lava tube caves, are thought to reflect temporary or periodic habitation. Some features, however, should be more fully recorded, mapped, and tested to determine if they may be of longer-term habitation. Other features in the project area served various functions, such as recreation, communication, and storage.

Of the models which have been generated for the vicinity of the project area, the one by Cordy (1985) has perhaps the greatest practicality in predicting site distribution. Cordy also considers site distribution patterns in terms of the regional chronology, and suggests future research topics in the area.

Two cave sites used for habitation are especially significant; one (Site 15298) because of its probable refuge function and the other (Site 15302) because of its possible ceremonial function. Site 15298 was divided into five sections, with two of them (Sections 2 and 3) modified to serve a refuge function. In Section 2 the passage was modified to constrict it, so that entrance would be limited to one person at a time. Section 3 appears to have been inhabited periodically. According to Ellis (1963:62, 78), refuge caves may have been utilized by children and elderly persons, as well as by women who did not accompany their husbands or brothers into battle. In the Kuakini Highway Corridor study, Schilt found that those caves for which either chronological determinations or estimates were available had refuge phases that post dated c. AD 1500 to 1600. She also notes that this is the approximate period of late precontact political strife as well as the intensification of the leeward field systems. Schilt says due to the Makahiki festival (with an associated ban on warfare), warfare would have been allowed from March to October. This is Kona's wettest season and thus there might have been water available for those who sought refuge in the caves (Schilt 1984:294-296). No dated samples were returned from the refuge portion of the cave during the current project. A date of AD 1791-1951 was obtained near the *mauka* entrance of the Site 15298 cave, but the sample was obtained from near the surface. Other large caves (both habitation and refuge) are known southwest of the current project area (Hammatt and Folk 1980), indicating there may be still other caves in the general area.

The project findings indicate there are few archaeological features on the recent aa flows. This was also indicated by the data gathered by Henry and Graves (1993). Some trails do cross the recent flow, and there are some small, isolated storage features present.

The uplands between about the 400 ft (120 m) and the upper limits of the project area (c. 600 ft or 180 m) contain numerous agricultural features such as modified outcrops, rock mounds, and terraces. The modified outcrops were more dense at the upper elevations and were especially thick between Flag Line 2 and the power line right-of-way. The features are more common on pahoehoe lava than on aa. Mounds also were denser at higher elevations, and there was a moderate to high ratio of mounds to modified outcrops, expecially between Flag Line 3 and the Power Line to the south. Terraces were also found in greater density in the upper elevations, on pahoehoe flows. It is probable that in those areas of denser features there was limited cultivation of food crops such as dryland sweet potato (*'uala*, *Ipomoea batatas* [L.]Poir), which did not require elaborate systems or care. As suggested by environmental settlement models of previous researchers (Rosendahl 1973, Davis 1977, and Cordy 1985), this increasing density was expected at higher elevations. However, it is clear that the settlement patterns postulated to

date are not specific enough (as indicated in Henry and Graves [1993:26]) to adequately predict or even explain site distribution in this section of West Hawaii.

SUGGESTED FUTURE RESEARCH

Future research in the area should consider the following questions:

1. What is the relationship between habitations found in the lava tube caves and the surface architecture? Were these loci used by different groups exploiting different resources or cultivating different crops?

2. Are the sites contemporaneous, or do some of the cave sites represent earlier, more temporary habitations, with the surface occupations defining later, more permanent habitations and work areas? Are there portions of the cave sites (or surface features) that were used for longer-term habitation? More datable samples from throughout the project area must be located and analyzed.

3. What part do the ubiquitous agricultural features at Site 18891 (modified outcrops, mounds, terraces) play in the Kona Field System? Further study of the areas between Kailua, Kealakehe, and the project area could determine the density of agricultural features in the area, and how the feature morphology changes as distance from the center of the field system increases.

4. What was the purpose of the pahoehoe excavations in the project area? Were they simply procurement areas for scoriaceous lava, used for abraders, or were they intended as "moisture sinks" for use in agriculture, or were they used for both purposes. In several of the pahoehoe excavations the rocks had been replaced in a manner that would help retain water in the excavations so that crops would have been sustained longer. The potential for identifying trade patterns involving the high-quality scoriaceous lava in the project area—through petrographic or geochemical analyses—should be investigated. Were the materials used only locally (in this and nearby *ahupua`a*) or were they of sufficient quality to be exported to other areas?

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Significance categories used in the site evaluation process are based on the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). The Hawaii State Historic Preservation Office uses these criteria for evaluating cultural resources. Sites determined to be potentially significant for information content fall under Criterion D, which defines significant resources as ones which "have yielded, or may be likely to yield, information important in prehistory or history" (36 CFR Sec. 60.4). Sites potentially significant as representative examples of site types are evaluated under Criterion C, which defines significant resources as those that "embody the distinctive characteristics of a type, period, or method of construction...or that represent a significant and distinguishable entity whose components may lack individual distinction" (36 CFR Sec. 60.4). General significance assessments and recommended general treatments for all identified sites are summarized in Table 14. Specific field work tasks for individual sites are summarized in Table 4.

Sites with potential cultural significance are evaluated under guidelines prepared by the Advisory Council on Historic Preservation, entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP 1985). The guidelines define cultural value as "...the contribution made by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth." The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value."

To further assist the client with decisions regarding the subsequent treatment of resources, the general significance of all archaeological remains identified during the survey was also evaluated in terms of three cultural resource management value modes which are derived from the previously mentioned federal evaluation criteria. Sites were evaluated in terms of potential scientific research, interpretive, and/or cultural values. *Research value*, refers to the potential of archaeological resources for producing information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and inter-regional levels of organization. *Interpretive value* refers to the potential of

Table 14.

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

**SIHP Site Number	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
15263	-	+	-	-	-	+	-	-
15264	-	+	-	-	-	+	-	-
15265	-	+	-	-	-	+	-	-
15266	-	+	-	-	-	+	-	-
15272	-	+	-	-	-	+	-	-
15273	-	+	-	-	-	+	-	-
15275	-	+	-	-	-	+	-	-
15279	-	+	-	-	-	+	-	-
15280	-	+	-	-	-	+	-	-
15287	-	+	-	-	-	+	-	-
15288	-	+	-	-	-	+	-	-
15289	-	+	-	-	-	+	-	-
15294	-	+	-	-	-	+	-	-
15299	-	+	-	-	-	+	-	-
15303	-	+	-	-	-	+	-	-
15305	-	+	-	-	-	+	-	-
15306	-	+	-	-	-	+	-	-
15307	-	+	-	-	-	+	-	-
18891	-	+	-	-	-	+	-	-
Subtotal:	**0**	**19**	**0**	**0**	**0**	**19**	**0**	**0**

* *Provisional assessment; definite assessment pending completion of further data collection.*

** *State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five-digit numbers prefixed by 50-10-28 (50=State of Hawaii; 10=Island of Hawaii; 28=USGS 7.5' series quad map ["Kailua, Hawaii"]).*

General Significance Categories:

A=Important for information content, further data collection necessary (CRM value mode assessment = scientific research value)
X=Important for information content, no further data collection necessary (CRM value mode assessment = scientific research value)
B=Excellent example of site type at local, regional, island, state, or national level (CRM value mode assessment = interpretive value)
C=Culturally significant (CRM value mode assessment = cultural value)

Recommended General Treatments:

FDC=Further data collection necessary (further survey and testing, and possibly subsequent data recovery/mitigation excavations)
NFW=No further work of any kind necessary; sufficient data collected; no preservation potential (possible inclusion into landscaping suggested for consideration)
PID=Preservation with some level of interpretive development recommended (including appropriate related data recovery work) and
PAI=Preservation "as is," with no further work (and possible inclusion into landscaping), or minimal further data collection necessary

Table 14. (cont.)

SIHP Site Number	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
15262	+	-	-	-	+	-	-	-
15268	+	-	-	-	+	-	-	-
15269	+	-	-	-	+	-	-	-
15270	+	-	-	-	+	-	-	-
15277	+	-	-	-	+	-	-	-
15278	+	-	-	-	+	-	-	-
15282	+	-	-	-	+	-	-	-
15283	+	-	-	-	+	-	-	-
15284	+	-	-	-	+	-	-	-
15286	+	-	-	-	+	-	-	-
15290	+	-	-	-	+	-	-	-
15291	+	-	-	-	+	-	-	-
15293	+	-	-	-	+	-	-	-
15297	+	-	-	-	+	-	-	-
15300	+	-	-	-	+	-	-	-
Subtotal:	**15**	**0**	**0**	**0**	**15**	**0**	**0**	**0**
15276	+	-	-	*	+	-	-	*
15292	+	-	-	*	+	-	-	*
15295	+	-	-	*	+	-	-	*
Subtotal:	**3**	**0**	**0**	**3**	**3**	**0**	**0**	**3**
15285	+	-	+	-	+	-	+	-
15296	+	-	+	-	+	-	+	-
15302	+	-	+	-	+	-	+	-
Subtotal:	**3**	**0**	**3**	**0**	**3**	**0**	**3**	**0**
15281	-	+	+	-	-	+	+	-
15304	-	+	+	-	-	+	+	-
Subtotal:	**0**	**2**	**2**	**0**	**0**	**2**	**2**	**0**
15298	+	-	-	+	+	-	-	+
Subtotal:	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**1**
Total:	**22**	**21**	**5**	**4**	**22**	**21**	**5**	**4**

archaeological resources for public education and recreation. *Cultural value*, within the framework for significance evaluation used here, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values. See Table 4 for individual assessments of sites.

Based on the federal and state criteria described above, 33 of the 43 sites identified during the present project are assessed as significant solely for information value. No further work is recommended for 19 of the 33 sites; they lack cultural deposits and portable remains, and data collected from them during the present survey is considered sufficient. Their preservation is not essential, although they could be considered for inclusion into development landscaping. Fifteen of the 33 sites are recommended for further data collection, this could include detailed recording, surface collection or excavation. Specific recommendations for further data collection are shown in Table 4.

Three sites are assessed as valuable for information content and are assessed as provisionally significant for cultural value, due to the possible presence of human skeletal remains. Two of the three sites (Sites 15276 and 15295) will require more detailed recording, as well as burial testing (at Feature E at Site 15276, and Feature A at Site 15295). The remaining site (Site 15292, Feature D) has been identified as a potential burial; this site may be outside of the project area and should first be accurately plotted to determine its exact location. All three sites are recommended for provisional preservation "as is."

Three sites are assessed as valuable for information content and as excellent examples of site types and are recommended for further data collection followed by preservation with some level of interpretive development. Site 15285 is a large temporary habitation enclosure with an internal storage feature. It may be associated with hundreds of modified outcrops and other possible agricultural features which begin at this elevation and extend to the eastern edge of the project area, at c. 180 m (600 ft). The site should be studied to determine its relationship to these features. Site 15285 is well constructed and is an excellent example of a temporary or extended habitation site at its general elevation. Site 15296 is a habitation-transportation complex found at an elevation of c. 170 m (560 ft). This site, consisting of eight features, includes a steppingstone trail (in a cave), an alignment, and several enclosures. The site appears to be well preserved. Site 15296 is an excellent example of a lower upland habitation complex that is probably associated with the agricultural features (Site 18891). A better overall map of the site is needed, and Features A and E (caves) need to be further explored. Testing should occur, especially at Feature B, to determine if radiocarbon dating samples are present.

Site 15302 is a large lava tube located in the upper barren zone on the western edge of the project area. Elevation in the area of the site is about 115 m (380 ft). The site is located along the same large tube system as Site 15298 and includes 31+ well-constructed features that have multiple functions (including habitation, transportation, storage, and other). (Site 15298 [just *mauka*] is a burial cave that will be recommended to be sealed after data collection has taken place. The cave is unstable and dangerous). Site 15302 is wide and stable and is an excellent example of the use of lava tube caves for short-term habitation and possible ceremonial purposes. A radiocarbon age determination falling between AD 1487-1815 was returned from the interior surface of Feature BC. Recommended further work includes further data collection to determine the feasibility for preserving the site.

Two sites (Site 15281 and Site 15304) are evaluated as significant for information content and as excellent examples of site types, and are recommended for preservation with some level of interpretive development, but with no further archaeological work recommended. The two sites have been mapped, described, photographed, and their locations have been plotted. Neither of the sites contain cultural deposits suitable for excavation. Site 15281 is a temporary habitation complex located at c. 140 m (470 ft) elevation. It consists of a modified lava tube used for habitation, and four other features which may have been used for agriculture. The site is a good example of a temporary habitation used seasonally in association with agriculture. Site 15304 is a single petroglyph found near the western edge of the project area. The petroglyph is an "X" or cross (Figure 11) pecked into the pahoehoe lava. The north arm appears to point to central Maui. The east arm is toward Mount Hualalai, the west is toward Keahole Point, and the south may point to Site 15298, located just across the ridge.

One site (Site 15298) has been evaluated as culturally significant due to the confirmed presence of four human burials. Preservation "as is," as well as further data collection is recommended. It is recommended that after the further data collection is complete, Areas 1-4 of Site 15298 be sealed, to preserve the burials and to prevent access, as the cave is unstable and therefore dangerous. There are several petroglyphs (Features I1-I4) located on the surface above a sinkhole in Area 1; these should be studied as well.

Regarding the burials identified within the project area, preservation "as is" has been recommended. However, if

disinterments are necessary, the procedures of Chapter 6E (Historic Preservation, Haw. Rev. Stat., as amended by Act 306 [1990 S.L.H.]) should be followed. In that case, DLNR-SHPD would be notified and would then contact the Hawaii Island Burial Council. Subsequently, the developer, the DLNR, and the Burial Council would work out a burial treatment plan.

Prior to further work in the project area, as an important initial step, it is recommended that all identified sites be accurately located and plotted on an appropriately scaled topographic map of the project area. The plotting should be done by professional surveyors assisted by an archaeologist. The locational plotting will greatly aid in development planning by allowing further-archaeological-work determinations (further data collection, data recovery, and/or preservation) to be more precisely considered on a site-by-site basis.

It should be noted that the data presented here were derived from a 100% surface inspection and limited subsurface testing. There is always the possibility, however remote, that potentially significant unidentified cultural remains will be encountered in the project area during future archaeological investigations or subsequent development. In such situations, archaeological consultation should be sought immediately.

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APPENDIX A

SITE DESCRIPTIONS

STATE NO.: 15262 **PHRI TNO.*:** 1298-1
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Undulating, unbroken, bare pahoehoe sloping west-southwest; this site is on top of a high knoll.
VEGETATION: Dense fountain grass, one small *noni* tree near Feature C.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple
DESCRIPTION: The site complex consists of three mounds (Features A-C) and one terrace (Feature D). The overall site dimensions are c. 16.50 m (at 70°-187°) by 7.50 m (at 97°-273°).

FEATURE A: Mound
ADJACENT TERRAIN: This feature is constructed on bare, level pahoehoe on top of high knoll.
VEGETATION: Fountain grass covers the area around the feature
ORIENTATION: 43°-223°
FUNCTION: Indeterminate
DIMENSIONS: 2.40 m by 1.70 m by 0.20-0.32 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The feature is a rectangular mound located at 64° northeast of the water tower and 84° northeast of Pine Trees Beach. The feature is constructed of pahoehoe cobbles, boulders and slabs (c. 0.15-0.35 m in diameter) piled over a slightly inflated blister. The top of the blister appears to be naturally broken. The north and west sides of the mound are fairly straight and are composed of perimeter boulder material which is slightly looser than the interior stones. The east and south sides are more amorphous and lie over the broken part of the blister. The highest point of the mound is toward the center, making the mound a low dome in profile. The rocks possibly cover a natural hole or an excavated area in the bedrock.

FEATURE B: Mound
ADJACENT TERRAIN: Undulating pahoehoe flows top of a knoll
VEGETATION: Moderate growth of fountain grass and one small *noni* tree.
FUNCTION: Agriculture
DIMENSIONS: 1.40 m by 1.30 m by 0.48 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A circular mound consisting of approximately 25 small boulders stacked two courses high. These subangular pahoehoe stones range from c. 0.24-0.43 m in diameter. This feature is on the west edge of the knoll. No portable remains or cultural deposits were observed at this feature.

FEATURE C: Mound
ADJACENT TERRAIN: Undulating pahoehoe flows on top of a knoll
VEGETATION: Moderate growth of fountain grass and one small *noni* tree.
FUNCTION: Agriculture
DIMENSIONS: 2.90 m (east-west) by 1.50 m (north-south) by 0.09-0.31 m
CONDITION: Good
INTEGRITY: Unaltered

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* *PHRI temporary number*

DESCRIPTION: A linear mound consisting of approximately 30 small cobbles to medium boulders, stacked one to two courses high. These subangular pahoehoe stones range from 0.04-0.48 m in diameter. This feature is on the southern edge of the knoll. It is oriented at c. 6.00 m at 208°. No portable remains or cultural deposits were observed at this feature.

FEATURE D: Terrace
ADJACENT TERRAIN: Edge of ridge (north-south generally). Pahoehoe fields; some aa in area.
VEGETATION: Fountain grass, *noni*
FUNCTION: Habitation
DIMENSIONS: 4.30 m (north-south) by 3.80 m (east-west) by 0.30 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A low terrace just below the ridge top on the north. The terrace is constructed of subangular gravel and cobbles (c. 0.05-0.25 m in diameter) with large cobbles and small boulders around the perimeter. Bedrock is exposed in several perimeter areas. The terrace floor is level and consists of several layers of rock. The terrace is generally flush with the ground surface, but it is slightly raised (c. 0.10-0.15 m) along the west edge. A pahoehoe excavation is c. 4.00 m west of the west edge of the terrace. The slabs are inside the excavation and push under remaining slab. Soil is present on the floor of the excavation. The terrace abuts the ridge on the south side. A pahoehoe outcrop on the ridge top is c. 0.85 m above the terrace. This feature was not tested.

STATE NO.: 15263 **PHRI TNO.:** 1298-2
SITE TYPE: Modified depression
TOPOGRAPHY: Rolling pahoehoe flows with pressure ridges both north and south of the site.
VEGETATION: Dense fountain grass, *'ilima*, redtop, and *noni*.
SITE ELEVATION: About 355 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DESCRIPTION: This site is a filled depression. Rocks ranging from cobbles to boulders (c. 0.06-0.80 m in diameter) have been used to partially fill a pahoehoe channel. At least three of the larger stones have been placed along the southwest edge of the feature to retain the rocks upslope. The smaller cobbles are limited to the northern section of the depression, with medium and large boulders elsewhere. There is a *puka* on the southwest which measures c. 0.82 m by 0.60 m by 0.90 m. There is just over c. 0.01 m of organic soil. No portable remains or cultural deposits were noted at this site.

STATE NO.: 15264 **PHRI TNO.:** 1298-3
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Rolling pahoehoe flows with pressure ridges both north and south of the site.
VEGETATION: Dense fountain grass, *'ilima*, redtop, and *noni*.
SITE ELEVATION: About 350 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of two modified outcrops (Features A and B). The overall site dimensions are c. 17.30 m north-south by 7.50 m east-west.

FEATURE A: Modified outcrop
ADJACENT TERRAIN: Rolling pahoehoe flows with pressure ridges and low overhangs.
VEGETATION: Fountain grass, *'ilima*, and *koa-haole*.

ORIENTATION: 80°-260°
FUNCTION: Habitation
DIMENSIONS: 7.90 m by 4.10 m by 0.55 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: A pahoehoe bedrock outcrop was modified with large 0.10 m by 0.50 m) on the east. The opening is small and probably could not have been entered. Also on Feature A are two boulders (c. 0.37-0.40 m in diameter) located c. 4.00 m at 68°, and many small cobbles (c. 0.06-0.16 m), possibly filling a small depression between. Features A and B are c. 3.00 m west of the west project boundary. It (what?) is c. 100.00 m south of FL2 and c. 350.00 m north of the power line. Site 15287 is c. 20.00 m south. No portable remains were noted at this feature, however, a c. 0.05 m thick deposit of black organic soil was observed.

FEATURE B: Modified outcrop
ADJACENT TERRAIN: Rolling pahoehoe flows with pressure ridges and low overhangs.
VEGETATION: Fountain grass, *'ilima*, and *koa-haole.*
FUNCTION: Habitation
DIMENSIONS: 4.00 m (80°-260°) by 2.80 m by 1.10 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature B is somewhat larger than Feature A and may have begun as an excavation of the pahoehoe. The central "hole" measures c. 1.66 m by 1.10 m and appears to have once been open on the southwest side. The natural (or broken) excavation was walled in by building another side on the southwest, using pahoehoe boulders (c. 0.40-0.60 m in diameter). Single and multiple pahoehoe cobbles and boulders (c. 0.15-0.47 m) have been placed around the top of the enclosed area on the north, south, and the east. There is a small natural overhang (blister) on the south interior (c. 0.25 m maximum height) which may have been used for storage. Large boulders (c. 0.50-0.70 m) are found on the floor of the feature and maximum height is c. 0.75.

STATE NO.: 15265 **PHRI TNO.:** 1298-4
SITE TYPE: Modified depression
TOPOGRAPHY: Gently rolling pahoehoe flows slightly sloping west. Low cracked pressure ridge.
VEGETATION: Fountain grass, sparse *koa-haole*, *'ilima*, *pua-pilo*.
SITE ELEVATION: About 330 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DESCRIPTION: This site is a crevice in the pahoehoe that has been filled by piling pahoehoe boulders (c. 0.25-0.40 m in diameter) inside and on to the south. This alignment widens toward the south end and is bounded on the east by a smaller depression filled with cobbles and boulders (c. 0.06-0.37 m in diameter). In this latter depression, the larger stones are located around the outside, with smaller ones in the center. The top of this filled depression is lower than both the pahoehoe outcrop north and the alignment west. No portable remains or cultural deposits were noted at this site.

STATE NO.: 15266 **PHRI TNO.:** 1298- 5
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Rolling pahoehoe flows with slight dip to the west. There is a large *mauka-makai* lava tube system in the area
VEGETATION: Pluchea, fountain grass, *koa-haole*, *wilelaiki*, *laua'e*, *'a'ali'i*, sparse *koa-haole*, *noni*, and *lama*.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric

FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of two terraces (Features A and B). The overall site dimensions are 16.10 m (62°-242°) by 6.00 m (152°-332°).
FEATURE A: Terrace
ADJACENT TERRAIN: Rolling pahoehoe flows with slight dip west. There is a large *mauka-makai* lava tube system in the area
VEGETATION: Pluchea, fountain grass, *koa-haole*, *wilelaiki*, *laua'e*, *'a'ali'i*, sparse *koa-haole*, *noni*, and *lama*.
FUNCTION: Habitation
DIMENSIONS: 8.50 m (east-west) by 3.20 m by 0.90 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a terrace abutting the southeast wall of the southern sink. It is shaped in a linear curve as it roughly follows the outline of the sink pattern. This construction could have once extended northeast, but some slumping has taken place. The feature appears to be constructed on small pahoehoe cobble and boulder rubble on the floor of the tube. Construction material is scoriaceous pahoehoe c. 0.06-0.75 m in diameter. Large boulders are used as footers along the base, while the smaller stones are on the surface and may have served as a rough paving before the slumping occurred. The intact portions of the wall appear to be relatively vertical, but not faced. The surface is irregular but may have been level before slumping occurred on the north and material came off of the sink wall to the south. It is possible there was a short wall c. 1.50 m long by 0.80 m high which came from the southeast wall of the sink and was placed on the southern portion of Feature A. There is a roughly aligned wall (c. 0.35-0.60 m high) in this location.

FEATURE B: Terrace
ADJACENT TERRAIN: Rolling pahoehoe flows with slight dip west. There is a large *mauka-makai* lava tube system in the area.
VEGETATION: Pluchea, fountain grass, *koa-haole*, *wilelaiki*, *laua'e*, *'a'ali'i*, sparse *koa-haole*, *noni*, and *lama*.
FUNCTION: Indeterminate
DIMENSIONS: 5.30 m (113°-293°) by 3.70 m (23°-203°) by 0.50 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a triangular terrace or rubble wall. The north area of the triangle abuts the north wall of the lava tube. The terrace is constructed of pahoehoe cobbles and boulders (c. 0.17-0.90 m in diameter) and appears to be built on the rough pahoehoe of the cave floor. Sizes of materials are mixed, but most of the larger stones are in a rough alignment on the south side. Materials are roughly piled up to three courses thick. All sides (except the north) are one course high. The top of the feature is mostly flat with a slope to the northeast (inside the arch cave). There may have been some natural movement in this direction as well. A rough paved area is included in the long dimension, since it may or may not be associated with the feature.

This feature is just inside the southern dripline of the arch cave. It is c. 17.00 m from the southern end of the sink. No portable remains or cultural deposits were noted at this feature.

STATE NO.: 15268 **PHRI TNO.:** 1298- 7
SITE TYPE: Alignment
TOPOGRAPHY: Aa lava flows and ridges. Pahoehoe and Kona Palisades to the south
VEGETATION: Sparse lantana, *noni*, *koa-haole*, fountain grass, on flow. Dense fountain grass, etc. on pahoehoe to the south.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This site is composed of two roughly parallel low walls and a possible cleared or level area between them. The wall on the northwest is fairly straight and c. 1.70 m long. It is sitting atop aa on top of the ridge. Materials consist of aa small cobbles to boulders (c. 0.06-0.44 m in diameter) which have been stacked (and roughly faced) two to three courses high. There are two of the large boulders (or slabs) on the west end with the remainder of smaller stacked aa. The wall on the south is a straight line. This wall is tied into a large aa boulders (c. 1.45 m by 0.70 m by 0.65 m) on the east.

The area between appears somewhat cleared (at least on the north) with the floor consisting of small (c. 0.02-0.06 m) pieces of aa. The south half of the interior has larger stones (c. 0.15-0.30 m) and does not appear cleared.

No portable remains or cultural deposits were observed on the surface of this feature.

STATE NO.: 15269 **PHRI TNO.:** 1298- 8
SITE TYPE: Complex (26 Features)
TOPOGRAPHY: Undulating pahoehoe with slight slope west-southwest; north side is bounded (inclusive) by an elevated aa flow
VEGETATION: Dense fountain grass
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple
DESCRIPTION: The site complex consists of two platforms (Features A and Z), five steppingstone trails (Features B, G, O, P, and U), six terraces (Features C, E, H, L, M, R, and V), one mound (Feature D), two cairns (Features F and S), five walls (Features I, K, N, X, and Y) two enclosures (Features J and Q), one modified lava tube (Feature T), and one cupboard (Feature W).

FEATURE A: Platform
ADJACENT TERRAIN: Undulating pahoehoe slightly sloping west-southwest; north side is bounded (inclusive) by an elevated aa flow
VEGETATION: Dense fountain grass
FUNCTION: Habitation
DIMENSIONS: 6.20 m (east-west) by 5.90 m (north-south) by 0.60 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a square platform built on top of an aa flow with a southern slope. The feature is constructed of aa gravel, cobbles, and boulders. The perimeter of the feature is outlined with one to three courses of subangular cobbles and boulders (c. 0.20-0.60 m in diameter) placed randomly on the top of the feature. In the southeast corner there is what appears to be an entry ramp running c. 1.20 m southwest to the top of the feature. About 2.75 m northeast of the southwest corner is a possible collapsed cupboard (c. 1.00 m by 1.00 m in diameter) consisting of pahoehoe slabs (c. 0.40 m diameter on average).

No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE B: Steppingstone trail
ADJACENT TERRAIN: Undulating pahoehoe
VEGETATION: Fountain grass
FUNCTION: Transportation
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: This feature is roughly oriented east-northeast to west-southwest and is a discontinuous pahoehoe slab steppingstone trail over the southern side of an aa flow. A fairly continuous section begins in the east-northeast and then curves around to the west where it becomes a roughly rectangular shape. This trail is set on a jutting, slightly triangular section coming off the main flow in a southerly direction. The size of the slabs vary from c. 0.03-0.08 m (broken fragments) to larger, flat slabs c. 0.55 m by 0.55 m by 0.10 m and c. 0.60 m by 0.47 m by 0.12 m. Average size is c. 0.30 m by 0.30 m by 0.08 m. This feature appears to be a transportation route on the edge of and running over the aa flow. No portable remains were observed other than the transported pahoehoe slabs from which this feature is constructed, and no cultural deposits were noted on the surface of this feature.

FEATURE C: Terrace
ADJACENT TERRAIN: This feature is set on undulating pahoehoe

VEGETATION: Fountain grass
FUNCTION: Habitation
DIMENSIONS: 7.40 m (north-south) by 2.70 m (east-west) by 0.60 m
CONDITION: Poor
INTEGRITY:
DESCRIPTION: The terrace appears to be constructed of informally piled aa and a small amount of pahoehoe gravel and cobbles, ranging in size from c. 0.20-0.30 m. The surface and sides exhibit a fairly high amount of displacement, and overall the feature, while discernible, does not have distinct edges. The long axis, measuring c. 2.40 m, runs roughly north-south. The east side of the feature abuts natural ground, and the west side is roughly eight to nine courses high (difficult to distinguish) to keep the surface level against the western down grade of the terrain. The short axis (east-west) varies from c. 0.17-2.70 m wide. The feature is irregular in plan view, with a distinctive "hook" at the north end. The sides, visible only on the south and west edges, slope gradually. At the time of construction, the sides may have been formally stacked, but at present individual courses cannot be determined. The surface is irregular, and slopes slightly from the east-west. No portable remains or cultural deposits were observed on the surface of the feature.

FEATURE D: Mound
ADJACENT TERRAIN: Undulating aa and pahoehoe flows. Area is gently sloping west.
VEGETATION: Moderate growth of fountain grass, *koa-haole*, and *laua'e*.
FUNCTION: Agriculture
DIMENSIONS: 1.80 m (north-south) by 1.40 m by 1.00
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A square mound stacked two to four courses high with angular aa cobbles and boulders. The feature is placed upon an aa flow, which slopes south. The east side is stacked higher than the west side (like a terrace). The surface is irregular. Cobbles (c. 0.09-0.17 m in diameter) are placed in the center (interior) of feature, and the exterior contains boulders (c. 0.23-0.80 m in diameter). One large boulder (c. 0.80 m by 0.50 m by 0.40 m) makes up the western part of the wall of the feature. Feature B is located c. 25.00 m due north. Feature A is c. 10.00 m at 286°, and Feature C is c. 7.00 m at 238°. No portable remains or cultural deposits were noted on the surface of the feature.

FEATURE E: Terrace
ADJACENT TERRAIN: Undulating aa and pahoehoe flows. Area is gently sloping downward to the west
VEGETATION: Moderate growth of lantana, fountain grass, *koa-haole*, *noni*, *'a'ali'i*, and unidentified vines.
FUNCTION: Agriculture
DIMENSIONS: 2.50 m (northwest-southeast) by 1.90 m by 1.10 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A semi-circular terrace with angular, aa boulders (c. 0.23-0.56 m in diameter) stacked four to five courses high. The west edge is elevated c. 1.10 m above an underlying aa flow and flush against an eastern flow. The top of the terrace sits c. 0.36 m above the aa flow and is c. 0.40 m wide. The aa flow makes up the other c. 1.50 m of total width. No portable remains or cultural deposits were observed on the surface of the feature.

FEATURE F: Cairn
ADJACENT TERRAIN: Undulating pahoehoe with many swells and dips
VEGETATION: Dense fountain grass, *wilelaiki*, *koa-haole*, *kolomona*, *noni*, and *koali*.
FUNCTION: Marker
DIMENSIONS: 0.80 m (102°-282°) by 0.70 m by 0.51 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: A circular cairn has been constructed by stacking medium to large pahoehoe cobbles up to four courses high on bare pahoehoe bedrock. The rocks range from c. 0.10-0.25 m in maximum diameter. Most of the larger cobbles are on the outside and most of the medium cobbles on the interior, but the cairn is not core-filled because there are still

some small cobbles on the exterior and medium cobbles on the interior (especially at the base). There is some collapse on the south side, but probably not from the top, so the height now is probably equal to the original height. The sides are partially faced, but the top surface is fairly irregular. Features A and B can clearly be seen from this cairn. This feature could have marked the east extension of this temporary habitation/agricultural complex. The letters FW have been etched into the pahoehoe c. 2.20 m southwest of the cairn.

This feature is near the southeast corner of the project area on Sweep 19. Feature A is c. 75.00 m at 74°. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE G: Steppingstone trail
ADJACENT TERRAIN: Undulating aa flow. This flow is higher than the surrounding area.
VEGETATION: Sparse growth of fountain grass, *wilelaiki*, lantana, and *noni*.
FUNCTION: Transportation
DIMENSIONS: 120.00 m (east-west) by 0.60 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A c. 120.00 m steppingstone trail runs basically east-west except for the east half, where it begins to travel northeast-southwest The trail is discontinuous. There are about 44 flat pahoehoe boulders placed along the trail. Beginning at the west end, the trail travels east for c. 71.00 m and contains about 32 flat pahoehoe boulders. The trail becomes like a goat trail with worn aa and no boulders for the next c. 18.00 m. Then about 12 flat boulders extend until the end of the aa flow. The trail ranges from c. 0.32-0.60 m wide. The subangular, flat pahoehoe boulders range from c. 0.23-0.71 m in diameter. The trail is within a c. 0.60 m wide small depression.

There are about six possible aa excavations along the sides of the trail in the west half.

Feature B is c. 50.00 m at 175° from the west end of Feature G. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE H: Terrace
ADJACENT TERRAIN: This feature is situated on undulating pahoehoe
VEGETATION: Fountain grass, *wilelaiki*, *koa-haole*, and *'ilima*.
FUNCTION: Multiple
DIMENSIONS: 4.50 m (80°-260°) by 3.50 m by 0.60 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is oriented east-northeast to west-southwest (80°-260°) with the west end (c. 3.50 m) somewhat larger than the east end (c. 1.70 m). This feature is mostly piled, however, a short section (c. 1.20 m) is stacked three to four courses high. This stacked section is oriented upslope/downslope, and roughly set in c. 0.70 m north of the southern edge (mid-feature). The short section is c. 0.15 m above the one course rubble below. The north side of the feature rests against an elevated bedrock outcrop.

This feature is constructed of blocky/subangular pahoehoe from c. 0.05 m by 0.05 m to 0.20 m by 0.20 m. In addition, occasional slabs c. 0.30 m by 0.20 m by 0.08 m were observed mixed in with the blocky basalt.

No portable remains or cultural deposits were associated with this feature.

FEATURE I: Wall
ADJACENT TERRAIN: Undulating pahoehoe flow
VEGETATION: Fountain grass, *koa-haole*, *wilelaiki*, *'ilima*, and *noni*.
FUNCTION: Agriculture
DIMENSIONS: 32.00 m (northwest-southeast) by 0.40 m by 0.80
CONDITION: Good
INTEGRITY: Unaltered

DESCRIPTION: Feature I is a distinct, mostly intact low rock wall constructed on an east-west oriented ridge top. The wall is built on pahoehoe and aa outcrops situated near the top of the ridge. The wall itself is aligned in an approximate northwest-southeast direction, although it is a serpentine shape with numerous curves (notably more in the northwest half), making an exact direction impossible to determine. The feature is c. 32.00 m long, measured along the general curvature. The wall varies from one to three courses high (c. 0.20-0.80 m, average c. 0.50-0.60 m), and is built from pahoehoe boulders varying from c. 0.10-0.75 m in diameter, with the average boulder between 0.35-0.50 m. The boulders have been formally stacked, and in some areas faced, to form fairly even, steeply sloping to vertical sides. The top of the wall is irregular, and there was no apparent attempt to level it. The wall is generally one course wide, c. 0.20-0.40 m in width. An area of one to two courses of piled aa was found abutting the wall and extending between c. 0.40-100.00 m north or northeast of the wall. It was speculated this may have served as support for the wall. Along the wall there were numerous gaps between intact sections of the wall, some between c. 3.00-4.00 m long.

No portable remains or cultural deposits were observed at this feature.

FEATURE J: Enclosure
ADJACENT TERRAIN: Undulating pahoehoe flow in between two aa flows. Area is flat, but c. 15.00 m south it begins to slope downward.
VEGETATION: Thick grass, sparse *koa-haole*, *'ilima*, and *wilelaiki*.
FUNCTION: Indeterminate
DIMENSIONS: 6.00 m (east-west) by 5.40 m by 0.80
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: An oval enclosure with the walls built on top of bedrock and the interior a depression with small cobbles and irregular surface paving. Some of the bedrock shows through on the west wall. The walls are constructed of cobbles and about four small boulders. All sides are sloping. The interior (depression) measures c. 2.80 m (north-south) by 1.60 m (east-west) by 0.60 m deep. The rounded, pahoehoe cobbles in the interior are c. 0.05-0.11 m in diameter.

The west wall is c. 1.40 m wide, the north wall is c. 1.60 m wide, the east wall is c. 3.00 m wide, and the south wall is c. 1.10 m wide. All walls are constructed of subangular and rounded pahoehoe. The cobbles measure c. 0.05-0.21 m in diameter, and the boulders are c. 0.24-0.31 m in diameter.

A possible entrance is at the south end. Feature K is c. 7.00 m at 297°, Feature L is c. 12.00 m at 263°, Feature G is due south at c. 20.00 m, and the southeast corner of the project boundary is c. 140° and c. 250.00 m. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE K: Wall
ADJACENT TERRAIN: Undulating pahoehoe flow in between two aa flows
VEGETATION: Thick fountain grass, sparse *koa-haole*, *'ilima*, and *wilelaiki*.
FUNCTION: Habitation
DIMENSIONS: 3.50 m (north-south) by 2.80 m by 0.50 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: A C-shaped wall with the opening facing the west. This feature is two to four courses high. The center wall is constructed of small rounded, pahoehoe cobbles c. 0.05-0.09 m in diameter. The two ends of feature are constructed with large, subangular, flat pahoehoe slabs and boulders c. 0.30-0.58 m in diameter. The center wall is c. 2.00 m wide and c. 0.50 m high. The two side walls are c. 0.90 m wide and c. 0.30 m high. The feature showed deterioration from rocks tumbling down over the bedrock that it is built on.

Feature I is c. 270° at c. 50.00 m, Feature J is c. 7.00 m at 107°, and Kona Palisades are c. 250.00 m due south. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE L: Terrace
ADJACENT TERRAIN: Undulating pahoehoe flow between two aa flows. Area is flat but begins to slope down to the west.

VEGETATION: Thick fountain grass, sparse *wilelaiki*, and *'ilima*.
FUNCTION: Habitation
DIMENSIONS: 4.40 m (north-south) by 3.90 m by 0.65
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A square terrace, three to four courses high. The south end is elevated. The surface is flat and level. The feature is constructed of small subangular and rounded pahoehoe cobbles c. 0.05-0.23 m in diameter and boulders c. 0.24-0.50 m in diameter. The west, east, and the north ends are flush with the bedrock.

Feature K is at 60° at c. 10.00 m, Feature J is at 98° at c. 15.00 m, Kona Palisades houses are c. 200.00 m due south, and Feature is located north of an aa flow which contains Feature G. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE M: Terrace
ADJACENT TERRAIN: This feature is set on undulating pahoehoe
VEGETATION: Fountain grass and *noni*
FUNCTION: Habitation
DIMENSIONS: 3.20 m (east-northeast to west-southwest at 65°-245°) by 3.00 m by 1.40 m
CONDITION: Good-excellent
INTEGRITY: Unaltered
DESCRIPTION: This feature is oriented east-northeast to west-southwest at 65°-245°. The south-southeast end is slightly larger (3.20 m). This feature is built against an elevated bedrock outcrop to the north-northwest. A "lining" of perimeter subangular pahoehoe large cobbles and small boulders (c. 0.20 m by 0.15 m to 0.45 m diameter) is faced and stacked three to eight courses high. The interior of this feature is filled with smaller subangular pahoehoe (c. 0.05 m in diameter to 0.35 m by 0.20 m).

No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE N: Wall
ADJACENT TERRAIN: Rough broken pahoehoe with pockets of aa
VEGETATION: Dense fountain grass and low *koa-haole*.
FUNCTION: Habitation
DIMENSIONS: 5.00 m (0°-360°) by 3.40 m by 0.98
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: A C-shaped structure has been constructed of pahoehoe cobbles and boulders (c. 0.07-0.60 m in maximum diameter) piled and stacked on a broken pahoehoe outcrop. The cobbles and boulders have been piled on the exterior side of the C-shape so that this side slopes gently down to the surface. Stones were tightly stacked on the interior to create faced walls. On the south interior wall, a slab has been placed on edge at the base of the interior wall, and slabs have been stacked horizontally on top. The other interior walls have collapsed somewhat. There are no more sections remaining where horizontal slabs have been stacked on top, but there are several places left intact on the interior wall where vertical slabs have been placed upright on an edge against the interior wall. Sometimes these slabs have been buttressed on the interior by piled stones. The intact south wall is c. 0.85 m high, the partially collapsed north wall is c. 0.69 m high, and the partially collapsed east wall is c. 0.90 m high. The exterior sides form a perfect semi-circle but the interior walls are more squared off. The west end of the north walls might grade gradually into the naturally fractured outcrop, so at first sight, this arm of the "C" looks long. The north and south walls are c. 1.10-1.20 m wide and the east wall is c. 1.90 m wide. This feature is located on the north and adjacent to Feature R and on top of a broken pahoehoe outcrop.

FEATURE O: Steppingstone trail
ADJACENT TERRAIN: Aa outcrop
VEGETATION: Dense fountain grass.
FUNCTION: Transportation
DIMENSIONS: 21.00 m (93°-273°) by 19.00 m (164°-364°)

CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature O is composed of about 78 pahoehoe slabs placed on the surface of an aa outcrop. The slabs form two trails, roughly perpendicular to each other, and a third, somewhat smaller trail, parallel to one of the larger trails. One of the larger trails contains 40 slabs, measures c. 19.00 m, and is generally straight on an alignment of 164°-344°. The second large trail has an end point on the first trail, c. 6.00 m from its south end. This trail contains about 19 slabs, is c. 21.00 m long, and is fairly straight on an alignment of 93°-273°. The third trail is somewhat L-shaped, with the smaller section adjoining the first trail at a point c. 15.00 m from the south end, and the larger portion parallel to the first trail. The smaller section contains about three slabs, is c. 1.70 m long, and is aligned at 74°-254°.

The larger portion has about 16 slabs, is c. 3.70 m long, and is on an alignment of 168°-348° from the west end of the smaller section. It contains relatively smaller (c. 0.20-0.30 m), closely spaced slabs than the other trails. The other slabs range from c. 0.20-0.60 m in size, and are spaced anywhere from c. 0.00-1.00 m apart, with several gaps up to c. 2.00 m, especially on the second trail. The slabs are all broken, tabular pahoehoe lying on top of or slightly embedded in the aa flow. The trails are all one course wide. The first trail is diagonal to the breadth of the flow, with one end point on one side of the flow and the other end point c. 8.00 m from the apposite side. The second trail runs east, parallel to the length of the flow at c. 1.00-2.00 m from one side of the flow.

No portable remains or cultural deposits were observed on the surface of the feature.

FEATURE P: Steppingstone trail
ADJACENT TERRAIN: Undulating pahoehoe with slight slope west-southwest; north side is bounded by an elevated aa flow
VEGETATION: Dense fountain grass
FUNCTION: Transportation
DIMENSIONS: 21.00 m (0°-242°) by 0.40 m by 0.15 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature P is a steppingstone trail consisting of about 38 aligned pahoehoe slabs (c. 0.20-0.60 m in diameter). The east end of the feature begins c. 10.00 m west of a pahoehoe flow that is oriented east-west, and slopes west. The feature continues c. 21.00 m at an orientation and ends at what appears to be a collapsed aa cupboard. This feature curves slightly north and slopes west. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE Q: Enclosure
ADJACENT TERRAIN: This feature is set on the south side of a low hillcrest. The south side slopes down at c. 30°.
VEGETATION: Fountain grass, *koa-haole*, and lantana.
FUNCTION: Habitation
DIMENSIONS: 5.40 m (90°-270°) by 4.70 m by 0.90 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a rectangular enclosure, oriented east-west. An elevated bedrock pahoehoe outcrop (circular) comprises nearly half of the north wall starting in the northeast corner. It is constructed of subangular pahoehoe cobbles and small boulders (c. 0.10-0.40 m). The main material for this feature, however, is slab pahoehoe, measuring from c. 0.15 m by 0.15 m by 0.10 m to 1.00 m by 0.60 m by 0.20 m. The east and west walls are less collapsed than (especially) the south wall and range from five to eight courses high. The south wall is collapsed in the middle of the wall to two to three courses.

The north wall is roughly four to six courses high. A large vertical slab (c. 1.00 m by 0.60 m) is just inside of the northwest corner, creating a (possible) cupboard-like area. The inside area of this structure is c. 3.60 m (east-west) by 3.00 m (north-south). The inside floor is fairly flat with a c. 10° slope to the south. The walls range from c. 0.80-0.95 m wide.

This feature is roughly c. 15.00 m at 290° from Feature S. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE R: Terrace
ADJACENT TERRAIN: Rolling pahoehoe flows and aa flow to northeast
VEGETATION: Dense fountain grass, scattered *noni*, *koa-haole*, *'a'ali'i*, *'iniko*, and *'ilima*.
FUNCTION: Habitation
DIMENSIONS: 6.20 m (north-south) by 5.50 m by 1.20 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature R is a quadrangular structure with the *makai* wall raised above the surrounding terrain. The east or *mauka* side is flush with the terrain and both the north and south extents are slightly raised above the flow, which makes up the bulk of the terrace. Material used is generally scoriaceous pahoehoe (size range c. 0.03-0.83 m) gravel, cobbles, and boulders. These materials are stacked and faced up to seven courses high on the *makai* or western face. This faced side is near vertical but slopes slightly to the east at the top. There is a gentle slope to the upper part of the feature (c. 0.30 m higher). Then the surface of the feature is mostly flat and leveled or paved with very small gravel to cobbles (range c. 0.03-0.20 m). The condition of the feature is good. This feature is c. 25.00 m at 80° Feature B and c. 4.00 m at 30° to Feature N. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE S: Cairn
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west
VEGETATION: Thick fountain grass and moderate growth of *koa-haole*.
FUNCTION: Marker
DIMENSIONS: 1.20 m (north-south) by 1.00 m by 1.05 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A stacked, six to seven course high, domed/quadrangular cairn. The sides are vertical and faced. The feature is constructed of subangular pahoehoe boulders c. 0.24-0.50 m in diameter. This feature is placed upon bedrock. The interior is solid in most places, but able to see through some of the cracks.

This feature is c. 100.00 m north of Kona Palisades. Feature R is c. 8.00 m at 281°. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE T: Modified lava tube
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west.
VEGETATION: Thick fountain grass and moderate growth of *'ilima* and *koa-haole*.
FUNCTION: Habitation-other
DIMENSIONS: 4.40 m (north-south) by 3.20 m by 1.10 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A small round sink (c. 1.50 m by 1.50 m by 0.60 m) is a collapsed lava tube. There appear to be three tubes, but all are blocked off by boulders. One tube goes north, another northwest, and another south. The entrance to the north and northwest tubes extends back c. 1.60 m from the sink.

The south lava tube has a small terrace constructed over it. The terrace is c. 2.00 m (north-south) by 1.60 m (east-west) by 0.60 m in diameter. The northern end is in the sink and elevated to become flush with the southern half. The surface is flat and level. It is constructed with small cobbles (c. 0.05-0.12 m in diameter) and larger boulders (c. 0.27-0.70 m in diameter). This structure is subangular pahoehoe piled two to three courses high. The center of the sink contains several boulders piled and may have tumbled down off of the top area of the sink. Then the northern sink continues underground for c. 1.60 m where two tubes begin. These tubes are blocked off by subangular pahoehoe boulders c. 0.40-0.61 m in diameter. Stones are piled in place two to four courses high.

On top of the sink, several stones are placed around. One upright is at the center of the western edge and appears to be a retaining wall to hold back several other stones behind it. The stones measure c. 0.37 m by 0.10 m by 0.48 m in diameter.

The stones are boulders two to three courses high. About 5.00 m west, there are some marine shell fragments on a pahoehoe flat. Feature S is c. 60.00 m at 98°. No portable remains or cultural deposits were observed on the surface of the feature.

FEATURE U: Steppingstone trail
ADJACENT TERRAIN: An elevated aa flow
VEGETATION: Sparse fountain grass with a few scattered low *wilelaiki*.
FUNCTION: Transportation
DIMENSIONS: 30.00 m by 0.55 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Large pahoehoe slabs have been placed horizontally on top of an aa flow. The stones are not set into the flow. Most have the convex side face up.

The trail extends from the south base of the aa flow at 18° for c. 3.70 m. The slabs are c. 0.50-0.55 m maximum diameter and spaced c. 0.00-0.25 m apart. The trail curves northwest at 48° for c. 6.00 m across the top of the flow. There is a gap (at 30°) from this point to the next slab at c. 0.55 m northwest. From here the trail becomes serpentine for c. 11.80 m at generally 48°. The slabs are c. 0.30-0.45 m in maximum diameter and spaced rather closely (0.00-0.50 m apart). The larger aa chunks seem to have been cleared away under and c. 0.20 m to each side of the slabs. The slabs lie on a level, clear, somewhat depressed aa path. There is a possible aa planting area to the west at this point, and scattered aa slabs around these areas, but no clear branches or forks to the path.

No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE V: Terrace
ADJACENT TERRAIN: Undulating pahoehoe with slight slope to west-southwest. North side or side is bounded (inclusive) by an elevated aa flow
VEGETATION: Dense fountain grass
FUNCTION: Habitation
DIMENSIONS: 5.60 m (northeast-southwest) by 5.30 m by 2.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature V is a low (c. 2.00 m) natural hill which has been modified with stacked walls along the top, and a small faced terrace on the south side, along with an enclosure which abuts the terrace on the natural surface at the base of the hill.

The hill is somewhat oval, measures c. 5.00 m on the short axis by c. 8.00 m on the long axis, has varying slope gradients, and is generally aligned from northwest-southeast.

Tabular fragments of pahoehoe, ranging from c. 0.10-0.50 m in size, are piled on a c. 5.30 m section of the upper reaches of the northerly wall to form a rough terrace. The terrace is small, as the rocks did not reach the base of the hill, except as a result of collapse. The southeast end of the hilltop also has a small amount pahoehoe slabs piled on it, although no distinct shape or pattern is apparent. The edge of the hill on the southerly side has a vertical terrace, faced two to seven courses, averaging five to six courses high, built against it. The terrace is built from bedrock at the base to a height up to c. 1.20 m along the steeply sloping side of the hill. The terrace creates a small surface area, c. 3.30 m long by 0.70-0.90 m wide, which is uneven and slopes steeply to the ground past the southeast end. This terrace is made mainly of pahoehoe and some aa rocks, c. 0.10-0.75 m in size. The front of the terrace is faced, with the courses somewhat mixed but still distinct and forming a linear, straight wall.

The wall of this terrace forms the north wall of a half circle-shaped enclosure. A low rock wall abuts the wall at either end, and forms a half circle which encloses a level pahoehoe outcrop within its interior. The rock wall is constructed from pahoehoe and aa rocks c. 0.20-0.65 m in size. The wall is one to three courses high (c. 0.10-0.40 m) and four to ten courses

wide (c. 0.60-1.50 m), although the wall has undergone a high amount of collapse. A lower, one course high section on the south section of the circle may have been an entry. About six rocks were found isolated in the center of the circle, and may have been either wall fall or a separate sub-feature. This feature is c. 100.00 m at 110° to the north end of the first trail of Feature O and c. 40.00 m at 42° to Feature U. No portable remains were observed on the surface of the feature. A small amount of soil was present on the pahoehoe outcrop within the enclosure.

FEATURE W: Cupboard
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west
VEGETATION: Thick fountain grass and sparse *koa-haole* and *'ilima*.
FUNCTION: Habitation
DIMENSIONS: 1.30 m (north-south) by 1.20 m by 0.50 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: A broken pahoehoe blister containing two flat pahoehoe boulder slabs covering the hole (*puka*). Several smaller cobbles are placed within the *puka*. The two boulder slabs range from 0.40-0.60 m in diameter and c. 0.10 m thick.

The hole is c. 0.40-0.60 m deep and c. 0.60 m by 0.60 m in diameter. The surrounding area is pahoehoe flow. Feature V is at 343° at c. 50.00 m, Kona Palisades houses are due south at c. 50.00 m, Feature Y is at 271° at c. 50.00 m, and Feature T is at 252° at c. 30.00 m. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE X: Wall
ADJACENT TERRAIN: This feature is set on a plateau-like hill crest (sloping to the west) with a steeper incline immediately to the west. This is situated on slightly undulating pahoehoe
VEGETATION: Fountain grass and *'ilima*
FUNCTION: Habitation
DIMENSIONS: 6.20 m (north-south at 10°-190°) by 6.00 m (100°-280°) by 0.83 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This structure is C-shaped with the opening facing north-northwest. The south wall is terraced and is c. 2.50 m at the widest point. It is constructed on the south side of a pahoehoe bedrock outcrop and is stacked three to four courses high of subangular and slab pahoehoe c. 0.10-0.40 m length/diameter. The interior of the terrace is filled with smaller pahoehoe fragments c. 0.10-0.15 m in size. From the southeast corner portion of the terrace, the structure continues as a wall stacked and piled three to four courses high and then turns, creating a C-shape. This wall section contains subangular blocky pahoehoe (contains less slab-like components than the terrace) and is c. 0.15-0.40 m in diameter (agricultural area) and averages roughly c. 1.40 m wide.

In the southeast portion of the terrace, a circular/vertical cupboard feature is present. This is roughly c. 0.40 m by 0.40 m and is c. 0.60 m deep, with bedrock visible at the bottom. The interior of the feature is flat pahoehoe.

This feature is at 168° at c. 7.00 m from Feature Y. A very limited amount of ecofacts were observed at this feature. No cultural deposits were observed on the surface of this feature.

FEATURE Y: Wall
ADJACENT TERRAIN: Broken pahoehoe area. The site is on a high knoll
VEGETATION: Dense fountain grass, small papaya, and *'ilima*.
FUNCTION: Habitation
DIMENSIONS: 6.60 m (100°-280°) by 4.80 m by 0.67 m
CONDITION: Good
INTEGRITY: Altered
DESCRIPTION: This feature appears to be a C-shape that was added onto to make an L-shaped wall later. The central portion of the structure consists of stones from gravel to boulder size (c. 0.05-0.55 m in maximum diameter) piled to form a C-shaped wall with a dome-shaped profile (interior and exterior sides slope gradually to ground surface). The original

dimension of the feature were probably c. 4.20 m (east-west) by 3.60 m (north-south) with an interior space of c. 2.30 m by 1.30 m. The walls were c. 0.45 m high and c. 1.10-2.00 m wide. It appears that the gravel and smaller cobbles were used mainly in the interior, and the large cobbles and boulders on the sides of the walls.

The C-shape was altered and expanded. The west end of the north wall was expanded c. 2.20 m west. The east end of the north wall was expanded c. 2.00 m south. The structure now resembles an L-shape. These wall expansions were constructed differently. They both consist of two to three courses of large, horizontally stacked slabs with one to two courses of large cobbles and boulders piled on top. The base of these sides are faced, but the surface is irregular (not smooth or dome shaped in profile). The west extension wall is c. 0.30-0.67 m high; the east extension wall is c. 0.43-0.65 m high. Both walls are c. 1.10-1.40 m wide. At the southeast corner, a cupboard has been constructed.

The east wall of the cupboard is the same as the east wall of the structure. The north wall consists of two pahoehoe slabs on edge, perpendicular to the east wall. The south wall consists of three slabs stacked horizontally to the east wall. The west side consists of one slab laid over the ends of the north and south wall of the cupboard. Therefore, the cupboard can be reached from the top or under the west side. The cupboard is c. 1.30 m north-south by c. 0.80 m east-west for total size. The interior space is c. 0.45 m by 0.40 m by 0.40 m deep. The slabs are c. 0.52-0.60 m in maximum diameter.

FEATURE Z: Platform
ADJACENT TERRAIN: Rolling pahoehoe lava flows with scattered outcrops and valleys. A large aa flow (containing Site 15270 and Site 15268) is present c. 40.00 m north.
VEGETATION: Fountain grass, lantana, *'ilima* on outcrop. Surrounding is fountain grass, scattered *koa-haole*, *'ilima*, and *lauki*.
FUNCTION: Habitation
DIMENSIONS: 3.50 m (east-west) by 2.90 m (north-south) by 1.30 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a platform built upon a pahoehoe outcrop that provides good views in all directions. The platform is slightly rectangular and constructed of pahoehoe cobbles and boulders (range c. 0.10-0.70 m) which were used to fill the void which result from the longitudinal (east-west) splitting of the outcrop. The platform is apparent past the east edge of the outcrop. The perimeter of the feature is composed both of portions of the outcrop and one to two courses of subangular, large (0.30 m average) cobbles along the south side. On the north, portions of the outcrop are again used, but a section c. 3.00 m long has been carefully stacked and faced up to five courses high. The western edge is composed of large boulders (from the outcrop) and the east side looks to be only two to three courses and built upon the outcrop. The surface is mostly level, and the south and west sides (which are mostly portions of outcrop) slope gently. The stacked north and east sides are mostly vertical. This feature is on the western or *makai* end of the site surrounded by agriculture features.

This feature is located at Sweep 10, c. 60.00-70.00 m north of Palisades, 285° to southwest of project corner, and 297° at c. 120.00 m to Site 15268. Feature V is at 70°. No portable remains or cultural deposits were observed on the surface of this feature.

STATE NO.: 15270 **PHRI TNO.:** 1298- 9
SITE TYPE: Cupboard
TOPOGRAPHY: Rolling aa flow atop pahoehoe. There are widely scattered pahoehoe outcrops and knobs to the south. This is on the south edge of the first aa flow north of Palisades Subdivision.
VEGETATION: Sparse *noni*, *wilelaiki*, *koa-haole*, fountain grass, and *pua-pilo* surrounding site. No vegetation right at site. There is dense fountain grass and scattered *koa-haole*, etc. on pahoehoe to south.
SITE ELEVATION: About 435 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric

FUNCTIONAL INTERPRETATION: Storage
DIMENSIONS: 1.40 m (east-west) by 1.00 m by (north-south) by 0.82 m
DESCRIPTION: This feature is a cupboard formed by two vertical aa slabs placed on an angle. This is on the north and northwest sides of an existing aa flow, forming a small hole. The surface of the southern portion has been raised to the level of the slab's top by roughly piling aa boulders (size range c. 0.15-0.30 m) c. 0.35-0.40 m high. The floor of the hole (*puka*) is also small aa.

STATE NO.: 15272 **PHRI TNO.:** 1298-12
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Undulating pahoehoe flow sloping down to the west.
VEGETATION: Fountain grass, *wilelaiki*, *koa-haole*, moderately heavy vegetation.
SITE ELEVATION: About 500 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of one enclosure (Feature A), two mounds (Features B and C), and one modified depression (Feature D). The overall site dimensions are c. 14.40 m east-northeast to west-southwest by 10.50 m north-northwest to south-southeast.

FEATURE A: Enclosure
ADJACENT TERRAIN: Slightly rolling pahoehoe lava gradually sloping downward to the west.
VEGETATION: Fountain grass, along with *wilelaiki*, *noni* and several unidentified shrubs.
FUNCTION: Habitation
DIMENSIONS: 3.00 m by 3.00 m by 0.55 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a U-shaped enclosure composed of three walls, with the south side open. These walls are constructed of irregular pahoehoe cobbles and boulders (size range 0.10 to 0.50 m). The walls are piled one to two courses high, and two to three courses wide. These walls are generally c. 3.00 m long and the opening is about 210°. The enclosure is constructed on a fairly smooth pahoehoe flow, with a small hollow or tube located in the center of the opening.

FEATURE B: Mound
ADJACENT TERRAIN: Undulating pahoehoe flows. The terrain slopes gently downward to the west.
VEGETATION: Fountain grass around feature.
FUNCTION: Agriculture
DIMENSIONS: 1.90 m (east-southeast to west-northwest) by 1.60 m by 0.17-0.43 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a circular mound constructed of large aa cobbles ranging from c. 0.05 to 0.20 m in diameter. The mound is piled one to two courses high around the edges, and higher in the center.

FEATURE C: Mound
ADJACENT TERRAIN: Slightly rolling pahoehoe lava, gradually sloping downward to the west.
VEGETATION: Fountain grass, along with *wilelaiki*, *noni* and several unidentified shrubs.
FUNCTION: Indeterminate
DIMENSIONS: 1.38 m by 0.50 m by 0.20-0.50 m
CONDITION: Fair
INTEGRITY: Unaltered

DESCRIPTION: Feature C is also a mound which is two to three courses high. It is possible the feature may have been a rock alignment before it collapsed on either side of the long axis. The mound is constructed of 25-30 pahoehoe cobbles and boulders that are irregular in shape, and range from c. 0.20 to 0.50 m in size.

FEATURE D: Modified depression
ADJACENT TERRAIN: Undulating pahoehoe flats sloping downward to the west.
VEGETATION: *Koa-haole*, fountain grass, and *wilelaiki*.
FUNCTION: Indeterminate
DIMENSIONS: 2.70 m (east-northeast to west-southwest) by 1.20 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature D is a filled depression constructed between two pahoehoe ridges running at 166°, with c. 2.50 m between the ridges. There are large pahoehoe cobbles (c. 0.20 to 0.40 m in diameter) and small boulders (c. 0.40 to 0.50 m in diameter filling in the hole or depression. This produces a level top between the two pahoehoe ridges.

STATE NO.: 15273 **PHRI TNO.:** 1298-14
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Undulating pahoehoe flows which slope downward to the west. The site is adjacent to an aa flow.
VEGETATION: Fountain grass, *wilelaiki*, and *koa-haole*.
SITE ELEVATION: About 520 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site complex consists of one modified depression (Feature A), one excavation (Feature B), two modified outcrops (Features C and D), and one mound (Feature E). The overall site dimensions are c. 15.50 m (east-northeast to west-southwest) by 5.30 m (north-northwest to south-southeast).

FEATURE A: Modified depression
ADJACENT TERRAIN: Slightly rolling pahoehoe lava sloping gradually downward to the west.
VEGETATION: Fountain grass with *wilelaiki* and *koa-haole*.
FUNCTION: Indeterminate
DIMENSIONS: 5.00 m by 2.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a pahoehoe depression and crack which has been filled with pahoehoe cobbles. The cobbles are dark gray to black, irregularly shaped, and from c. 0.05-0.40 m in diameter. The cobbles appear to have been placed with no definite pattern or order. They are level with, or a little higher than the surrounding pahoehoe surface. The depression and crack are irregular in plan view. Depth of the depression and crack could not be determined as no excavation of the feature was done.

No portable remains and soils were noted on the surface of the feature. Cultural deposit consists of the rock fill within the feature.

FEATURE B: Excavation
ADJACENT TERRAIN: Undulating pahoehoe flows sloping downward to the west.
VEGETATION: Fountain grass, *wilelaiki*, and *koa-haole*.
FUNCTION: Quarry
DIMENSIONS: 4.50 m by 2.50 m by 0.40 m
CONDITION: Good
INTEGRITY: Unaltered

DESCRIPTION: A c. 2.10 m by 0.75 m pahoehoe excavation is on top of a pahoehoe flow. The feature is c. 0.20-0.55 m deep and is partially filled in with medium pahoehoe cobbles. These stones range from c. 0.10-0.20 m in diameter. To the east is a pile of large pahoehoe cobbles probably pulled out from the excavation. The stones are c. 0.20-0.40 m in diameter. This feature is c. 2.70 m southwest of Feature A and c. 4.10 m east of Feature C. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE C: Modified outcrop
ADJACENT TERRAIN: Slightly rolling pahoehoe lava sloping gradually downward to the west.
VEGETATION: Fountain grass, *wilelaiki*, and *koa-haole*.
FUNCTION: Agriculture
DIMENSIONS: 2.60 m (east-west) by 1.00 m by 0.05-0.35 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a modified pahoehoe outcrop. Approximately 20-30 pahoehoe rocks and cobbles, along with 5-10 aa cobbles, were apparently placed on an exposure of pahoehoe lava. The cobbles are all dark gray to black irregularly shaped, and range from c. 0.05-0.50 m in size. There is no obvious pattern to the placement of the rock.

No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE D: Modified outcrop
ADJACENT TERRAIN: Undulating pahoehoe flows sloping downward to the west.
VEGETATION: Fountain grass and *wilelaiki*.
FUNCTION: Agriculture
DIMENSIONS: 2.70 m (north-northwest to south-southeast) by 1.80 m by 0.35 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Approximately 25 basalt stones are placed on a pahoehoe ridge at the west end of the site. These stones are large pahoehoe cobbles (c. 0.15-0.40 m in diameter) and small pahoehoe boulders (c. 0.35-0.60 m in diameter). These stones are one to two courses high. They fill a crack and continue down the ridge.

This feature is c. 1.50 m west of Feature C. No portable remain or cultural deposits were observed at this feature.

FEATURE E: Mound
ADJACENT TERRAIN: Undulating pahoehoe flows sloping downward to the west.
VEGETATION: Fountain grass and *wilelaiki*.
FUNCTION: Agriculture
DIMENSIONS: 2.50 m (north-south) by 2.40 m by 0.20-0.48 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature consists of a large, circular mound constructed of large, subangular pahoehoe cobbles and small boulders roughly piled one to three courses high. These stones range from c. 0.22 to 0.50 m in diameter. The northwest corner of the mound slopes off of the pahoehoe ridge.

STATE NO.: 15275 **PHRI TNO.:** 1298-17
SITE TYPE: Modified lava cave
TOPOGRAPHY: Undulating pahoehoe flow with slight slope to the west north west.
VEGETATION: *Koa-haole*, *wilelaiki*, lantana, and fountain grass.
SITE ELEVATION: About 580 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric

FUNCTIONAL INTERPRETATION: Indeterminate
DESCRIPTION: The opening of the lava tube cave is c. 1.5 by 0.70 m and oriented at 206°. From the central cave (below the entrance) caves radiate out at 90°, 282°, and 256°. All tubes were explored to a c. 0.30 m deep.

The cave located at 256° contains a single water catchment (gourd rest) area, but no other cultural items were located. This gourd rest is c. 1.00 by 0.70 m and is composed of slab-like roof flakes c. 0.20 by 0.35 m in length.

The east end is c. 0.15 m high and two courses; the single course west end is c. 0.28 m high. The interior portion of the feature is c. 0.07 m high. A single piece of unidentified wood is located c. 0.50 m south. The construction is located c. 6.00 m into the tube from the central area.

STATE NO.: 15276 **PHRI TNO.:** 1298-18
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Gently rolling pahoehoe flow with slight slope to west. Site is on low cracked pressure ridge trending southwest at 230°.
VEGETATION: Dense fountain grass around cave opening. A few lantana bushes and *wilelaiki* are also present.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple
DESCRIPTION: The site complex consists of one excavation (Feature A), one alignment (Feature B), one utilized lava tube (Feature C), and two mounds (Features D and E). The overall site dimensions are c. 10.70 m (east-west) by 5.50 m.

FEATURE A: Excavation
ADJACENT TERRAIN: Inside lava tube. All pahoehoe and basalt materials
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.60 m by 0.40 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: This pit is oval and c. 0.60 m by 0.40 m. The skylight roof fall encompasses the pit, but two boulders appear to have been placed around the pit. These subangular, pahoehoe boulders range from c. 0.22-0.31 m in diameter.

This feature is in the eastern chamber, c. 0.50 m east of the skylight roof fall and toward the south wall. No portable remains or cultural deposits were observed at this feature.

FEATURE B: Alignment
ADJACENT TERRAIN: Inside lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 1.40 m (east-west) by 0.50 m by 0.26-0.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: An alignment running c. 1.40 m east-west with six medium sized boulders. The alignment begins at the skylight roof fall and extends east until it meets the wall. Another entrance to a lava tube is c. 1.30 m north. This feature is one course high. The subangular, pahoehoe boulders are c. 0.26-0.50 m in diameter.

FEATURE C: Utilized lava tube
ADJACENT TERRAIN: The cave entrance opens at the top of a collapsed pahoehoe blister. There are pockets of aa around the site (c. 25.00 m away)
VEGETATION: Dense fountain grass around cave opening and a few lantana bushes.

FUNCTION: Habitation
DIMENSIONS: 10.70 m (east-west) by 5.50 m by 0.51-1.67 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The cave entrance is at the top of a collapsed pahoehoe blister. The west chamber ends c. 5.00 m past the entrance. The east chamber continues east and then travels north for c. 20.00 m. The east chamber contains Features A and B. This feature is in the southeast quad of the project area, on the eastern boundary line.

Portable remains consist of marine shell. HF1 (Feature A) found at entrance (c. 7-10 cmbs).

FEATURE D: Mound
ADJACENT TERRAIN: Westward sloping pahoehoe field
VEGETATION: *Koa-haole* and lantana.
FUNCTION: Indeterminate
DIMENSIONS: 2.90 m by 1.70 m by 0.46
ORIENTATION: 113°-293°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Crudely piled subangular pahoehoe cobbles to small boulders on top of a pahoehoe outcrop. At the easternmost end are two upright pahoehoe slabs. One is at the very end of the mound and measures c. 0.34 m by 0.30 m by 0.10 m. This appears to delineate the end. This upright extends c. 0.27 m above the surface of the mound in that area. Rubble is all around the mound c. 0.50 m.

A small pahoehoe outcrop c. 1.90 m at 30° has two overturned slabs on top. The pahoehoe outcrop under the linear mound appears broken (excavated) along the edge.

This feature is c. 42.00 m at 148° to the main entrance (Feature C. Feature E (linear mound) is c. 2.84 m (center to center) at 210°. Both mounds are oriented in the same direction. No portable remains were noted at this feature, and it was not tested.

FEATURE E:: Mound
ADJACENT TERRAIN: Undulating broken pahoehoe with slight slope to west-southwest
VEGETATION: Dense fountain grass, scattered *koa-haole*, and some lantana.
FUNCTION: Indeterminate/Possible Burial
DIMENSIONS: 2.80 m by 1.72 m by 0.06-0.31 m
ORIENTATION: 116°-296°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A low, rectangular mound of pahoehoe cobbles and boulders piled one to three courses in a depressed area on top of bedrock (possibly excavated). The cobbles range from c. 0.07-0.25 m in diameter. Most of the smaller cobbles are in the center of the feature. The boulders are up to c. 0.36 m in maximum diameter. There are also some large slabs up to c. 0.46 m in maximum diameter. The surface of the mound is fairly level, but irregular. There was no attempt to create a smooth surface. The sides slope gradually. The north, west, and south sides are clear, but the east side merges gradually with some naturally fractured pahoehoe along a crack leading to the east end of Feature D. This feature is c. 2.84 m south of the center of Feature D. Features D and E (mounds) are oriented parallel to each other. No portable remains were observed at this feature. May be agricultural or a burial mound.

STATE NO.: 15277 **PHRI TNO.:** 1298-19
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Slightly rolling pahoehoe and aa flows interspersed with moderate to dense vegetation
VEGETATION: Predominantly *wilelaiki* and fountain grass along with other unidentified plants.

SITE ELEVATION: About 515 ft AMSL
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of three terraces (Features A, D, and F), one excavation (Feature B), one alignment (Feature C), one modified lava tube (Feature E), and one steppingstone trail (Feature G). The overall site dimensions are c. 34.00 m (east-west) by 32.00 m (north-south).

FEATURE A: Terrace
ADJACENT TERRAIN: Aa and pahoehoe flows sloping west
VEGETATION: Fountain grass.
FUNCTION: Habitation
DIMENSIONS: 10.00 m (east-west 0°-262°) by 5.00 m (north-south)
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a tri-level terrace oriented at 262° east-west. The feature is constructed of pahoehoe gravel, cobbles, boulders, and slabs. The north-northwest and west facing walls of the top or easternmost terrace are faced with pahoehoe boulders and upright pahoehoe slabs (c. 0.50-0.60 m in diameter) one to three courses high. The south-southeast facing wall consists of pahoehoe cobbles and boulders (c. 0.20-0.60 m in diameter) stacked one to two courses high. The perimeter of the middle terrace is outlined with one to two courses of subangular cobbles and boulders (c. 0.10-0.30 m in diameter). The south-southeast facing wall of the lower or westernmost terrace consists of stacked subangular cobbles and boulders one to three courses high. The west-facing wall is faced with subangular pahoehoe boulders and slabs (c. 0.30-0.40 m in diameter) two to three courses. The interior of these terraces is paved with pahoehoe gravel and cobbles. The eastern side of this feature abuts a pahoehoe excavation. This excavation is on the rim of a collapsed lava blister. The slabs produced from the excavation were probably used in the construction of the feature.

FEATURE B: Excavation
ADJACENT TERRAIN: Slightly rolling pahoehoe and aa flows interspersed with moderate to dense vegetation
VEGETATION: Predominantly *wilelaiki* and fountain grass along with other unidentified plants.
FUNCTION: Indeterminate
DIMENSIONS: 4.00 m (north-south) by 0.50 m (east-west)
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a pahoehoe excavation into a pahoehoe outcrop that runs parallel to the east edge of the top terrace of Feature A. This feature is c. 4.00 m (north-south) by 0.50 m (east-west) by 0.05-0.10 m deep. The products of this excavation were possibly used in the construction of Feature A.

No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE C: Alignment
ADJACENT TERRAIN: Slightly rolling pahoehoe and aa flows
VEGETATION: *Wilelaiki* and fountain grass
FUNCTION: Indeterminate
DIMENSIONS: 1.10 m (0°-252°) by 0.25 m by 0.15 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature C is an alignment of nine subangular pahoehoe cobbles breeching a pahoehoe flow that runs east-west. Average height of the cobbles is c. 0.10-0.15 m. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE D: Terrace
ADJACENT TERRAIN: Slightly rolling pahoehoe and aa flows
VEGETATION: Fountain grass and *wilelaiki*.
FUNCTION: Habitation
DIMENSIONS: 6.00 m by 2.00 m by 0.60 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature D is an elongated, irregularly shaped terrace composed mainly of aa and pahoehoe gravel and cobbles piled from two to possibly ten courses high (courses were hard to distinguish). The long axis measures c. 6.00 m and runs from 130°-310°. The short axis is c. 2.00 m and runs from 70°-250°. The terrace abuts a pahoehoe flow on the northeast flank, with higher and higher courses culminating in about ten courses on the southwest side. The surface is fairly irregular, with a downward slope to the northwest. The sides, which are visible only on the southwest, are gradually sloping. The terrace appears to have been constructed by informally piling cobbles (c. 0.03-0.10 m diameter) to level the natural grade of the terrain. A small area at the southeast end contains large cobbles and small boulders (c. 0.20-0.45 m in diameter), while the southwest wall at this end is constructed of three to four courses stacked in a steeply sloping wall. The sides range from c. 0.50-0.60 m high. Because of its proximity to the entrance to Feature E, a small overhang, Feature D may have served as an extension of the habitation space of Feature E.

No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE E: Modified lava tube
ADJACENT TERRAIN: Slightly rolling pahoehoe and aa flows
VEGETATION: Fountain grass and *wilelaiki*.
FUNCTION: Habitation
DIMENSIONS: 6.00 m (east-west) by 5.00 m (north-south) by 0.90 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature E is a pahoehoe overhang with a rock mound on one of its sides. The overhang may have been a collapsed blister or tube. One edge forms a shallow (c. 0.50-0.75 m), low (c. 0.50-0.90 m) interior with a steeply sloping roof, measuring c. 3.00 m long, and opening south. This edge leads into a small, shallow, covered tube. The tube is c. 1.50 m long, narrows from c. 0.90 m wide at the entrance to c. 0.70 m at the rear, and is c. 0.90 m high at the entrance and c. 0.70 m at the rear. The surface of the tube is fairly level and consists of bedrock and small pockets of soil. The west-facing opening may have been modified by breaking some of the pahoehoe from the roof to enlarge it. No other modification or utilization is noted in either the overhang or the tube. The edge of pahoehoe bedrock leading southwest from the tube has been modified by piling about 25-40 pahoehoe boulders (c. 0.25-0.45 m in diameter) on it.

The boulders are two to three courses high, although no actual courses could be distinguished. The boulders appear to be informally placed into an irregularly shaped, gradually sloping mound. The mound itself is c. 2.80 m on an axis of 50°-230° at c. 1.80 m on an axis of 140°-320°, and is c. 0.30-0.70 m high.

No portable remains were noted on the surface of this feature. A small amount of soil was found in the tube.

FEATURE F: Terrace
ADJACENT TERRAIN: Slightly rolling pahoehoe and aa flows
VEGETATION: Fountain grass and *wilelaiki*.
FUNCTION: Habitation
DIMENSIONS: 6.20 m (east-west) by 2.60 m (north-south) by 0.50
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature F is an irregularly shaped terrace constructed against a pahoehoe flow. The north edge of the terrace is level with the ground, while consecutively higher courses of rock are piled to the south to counter the grade of the terrain. The surface of the terrace is uneven, and slopes downward from both north-south, and east-west. The sides are only visible

on the south and west, and are irregular and gradually sloping. The terrace ranges from one to two courses on the north side, to possibly ten courses on the south side, although courses are difficult to determine. Both aa and pahoehoe rocks, varying from c. 0.03-0.45 m in diameter, appear to be informally piled on top of each other.

Portable remains noted on the surface of this feature include one fragment of coral. No cultural deposits were noted.

FEATURE G: Steppingstone trail
ADJACENT TERRAIN: Slightly rolling pahoehoe and aa flows
VEGETATION: Fountain grass and *wilelaiki*.
FUNCTION: Transportation
DIMENSIONS: 5.60 m (0°-262°)
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature G is a steppingstone trail that traverses an aa flow leading to and/or from Feature A (tri-level terrace). The steppingstone trail is made up of pahoehoe slabs from c. 0.20-0.60 m in diameter. The trail runs north-northwest at 256°. Eleven steppingstones were located. No portable remains or cultural deposits were noted on the surface of this feature.

STATE NO.: 15278 **PHRI TNO.:** 1298-20
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Broken pahoehoe area with slope to west-southwest
VEGETATION: Dense fountain grass, *wilelaiki*, and honeysuckle vines.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This site complex consists of two walls (Features A and B). The overall site dimensions are c. 6.60 m (315°-135°) by 2.80 m.

FEATURE A: Wall
ADJACENT TERRAIN: Undulating pahoehoe flows. Area is gently sloping downward to the west.
VEGETATION: Thick fountain grass and moderate growth of *koa-haole*, *wilelaiki*, and *'a'ali'i*.
FUNCTION: Habitation
DIMENSIONS: 4.80 m (northwest-southeast) by 3.25 m by 0.17-0.52 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A crescent-shaped wall with the opening facing northwest. The feature runs northwest to southeast and is two courses high. The feature is composed of medium-sized subangular and flat pahoehoe boulders (c. 0.27-0.62 m). Two boulders are upright. One is on the southwest corner and one is on the northeast corner. The surface of the feature is irregular and the sides slope down. Constructed on bedrock. Thickness of the wall running east-west is c. 1.20 m and the adjoining wall running north-south is c. 1.61 m wide.

Feature B is c. 1.20 m at 128°. The power line road is c. 12.00 m due south. The eastern boundary line of the project area is c. 50.00 m at 200°. No portable remains or cultural deposits are observed at this feature.

FEATURE B: Wall
ADJACENT TERRAIN: Undulating pahoehoe flows. Area is gently sloping downward to the west
VEGETATION: Thick fountain grass and moderate growth of *koa-haole*, *wilelaiki*, and *'a'ali'i*.
FUNCTION: Habitation
DIMENSIONS: 2.40 m (north-south) by 1.20 m by 0.12-0.39 m
CONDITION: Excellent

INTEGRITY: Unaltered
DESCRIPTION: A linear wall, two courses high, runs north-south. Some areas slope down. The surface is flat and level. The stones are subangular, pahoehoe cobbles to boulders ranging from c. 0.12-0.48 m in diameter. The feature is constructed on bedrock.

Feature A is located c. 1.20 m at 308° away. The power line road is c. 12.00 m due south. The eastern boundary line of the project area is c. 50.00 m at 200°.

STATE NO.: 15279 **PHRI TNO.:** 1298-22
SITE TYPE: Terrace
TOPOGRAPHY: Undulating pahoehoe flows
VEGETATION: Dense fountain grass and thick *'a'ali'i*.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This is a generally square terrace constructed of small cobbles and large boulders (c. 0.07-0.50 m) roughly piled and mostly level on top. The *makai* edge and northern edge appear roughly faced. Large stones appear to be placed around the edges, with smaller paving stones near the center. No portable remains or cultural deposits were noted at this feature.

STATE NO.: 15280 **PHRI TNO.:** 1298-24
SITE TYPE: Cupboard
TOPOGRAPHY: Broken undulating pahoehoe with slope to west-southwest. Site is on a elevated outcrop area with several naturally fractured blisters.
VEGETATION: Fountain grass, *wilelaiki*, *kolomona*, and *lama*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Storage
DESCRIPTION: The east side of a blister has collapsed naturally. Some of the slabs found on the surface of the blister have been moved to create a small opening to the blister, which was probably used for storage. At a minimum, only two rocks were moved to make the space. A large slab (c. 0.92 m by 0.68 m by 0.10 m) was probably pushed back from the blister, and one slab (c. 0.56 m by 0.30 m by 0.05 m) was placed upright next to this space. This resulted in a square hole (c. 0.25 m wide by 0.08 m high) which allowed access to the space under the blister. The cupboard space, therefore, is located under the blister roof, with access from the north side though a square vertical hole. The interior cupboard space would be c. 0.35 m by 0.35 m.

No portable remains or cultural deposits were observed on the floor of this feature.

STATE NO.: 15281 **PHRI TNO.:** 1298-25
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Rolling pahoehoe flows with lava tubes and blisters. There is a very gentle slope to ocean.
VEGETATION: Fountain grass, *wilelaiki*, *'ilima*, *'a'ali'i*.
SITE ELEVATION: About 470 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation

DESCRIPTION: The site complex consists of one modified lava tube (Feature A), one alignment (Feature B), one modified outcrop (Feature C), one excavation (Feature D), and one modified depression (Feature E). The overall site dimensions are c.21.50 m (north-northeast to south-southwest) by 21.00 m (north-northwest to south-southeast).

FEATURE A: Modified lava tube
ADJACENT TERRAIN: Pahoehoe flow sloping west.
VEGETATION: Fountain grass, *wilelaiki*, *'ilima*.
FUNCTION: Habitation
DIMENSIONS: 8.70 m by 3.70 m by 1.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a modified lava tube. This small pahoehoe blister has small pahoehoe slabs placed along the western overhang areas. Feature A utilizes roof fall slabs. These slabs have sealed off portions of the overhang and may have been used to create storage areas. A single marine ecofact, *Echinoid* (sp.), was noted inside. The eastern portion of the feature also has an overhang (c. 0.60 m high) which may have provided some protection. There are additional pahoehoe slabs stacked one to two courses high on the western edge of the blister which may have provided additional protection. The blister is roughly oval, and the pahoehoe slabs used in the construction range from c. 0.10 to 0.75 m in diameter. The blister is dome-shaped in profile.

FEATURE B: Alignment
ADJACENT TERRAIN: Pahoehoe flow sloping west.
VEGETATION: Fountain grass, *wilelaiki*, *'ilima*.
FUNCTION: Indeterminate
DIMENSIONS: 1.90 m by 0.80 m by 0.40 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a rough linear alignment of about six to ten pahoehoe cobbles and boulders (c. 0.07 to 0.70 m in diameter). The alignment is c. 1.90 m long, one course high, and ranges from c. 0.30 to 0.80 m wide. The alignment is on top of an exposed pahoehoe flow.

FEATURE C: Modified outcrop
ADJACENT TERRAIN: Pahoehoe flow sloping west.
VEGETATION: Fountain grass, *wilelaiki*, *'ilima*.
FUNCTION: Indeterminate
DIMENSIONS: 2.60 m by 1.80 m by 0.30 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a roughly circular alignment of pahoehoe cobbles and boulders (0.10 to 0.60 m in diameter). The stones are placed one course high, with gaps up to 0.60 m in places on top of an exposed pahoehoe flow. There are pahoehoe slabs (0.45 by 0.60 by 0.10 to 0.60 m tall) located vertically along the west side.

FEATURE D: Excavation
ADJACENT TERRAIN: Pahoehoe sloping west.
VEGETATION: Fountain grass, *wilelaiki*, and *'ilima*.
FUNCTION: Multiple
DIMENSIONS: 0.55 m by 0.46 m by 0.72 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a roughly circular alignment of pahoehoe cobbles and boulders (c. 0.10 to 0.60 m in diameter). The stones are placed one course high with gaps up to 0.60 m in places on top of an exposed pahoehoe flow. There are pahoehoe slabs (c. 0.45 by 0.60 by 0.10-0.60 m high) located vertically along the west side.

FEATURE E: Modified depression
ADJACENT TERRAIN: Pahoehoe sloping west.
VEGETATION: Fountain grass, *'ilima*, and lantana.
FUNCTION: Multiple
DIMENSIONS: 2.50 m by 1.40 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature E is a filled depression composed of two pahoehoe ridges which run mostly parallel in a northeast to southwest direction. The void between these ridges is filled with cobbles and boulders (0.10 to 0.40 m diameter) with the sizes intermixed. The fill material consists of subangular pahoehoe. Depth of the fill material is unknown. The top of the feature is level and flat.

STATE NO.: 15282 **PHRI TNO.:** 1298-29
SITE TYPE: Utilized lava tube
TOPOGRAPHY: Undulating pahoehoe with some elevated outcrops and some collapsed blisters
VEGETATION: Dense fountain grass, scattered low *'a'ali'i*, *kolomoa*, and *koa-haole*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Storage
DESCRIPTION: A small blister has collapsed, leaving an opening (c. 0.45 m north-south by 0.40 m) to a small cave. The cave floor is c. 0.95 m below the lip. The opening is at the top of the cave.

There is a scatter of roof fall below the opening, but no signs of modification of the entrance or inside the cave. There is a slight scatter of cowrie shell inside the cave.

This site is located c. 25.00 m at 88° to Feature D33 of Site 15283, c. 75.00 m at 350° to Point A of Site 15283. Portable remains are limited to a few cowrie shells on the cave floor. No cultural deposits were noted.

STATE NO.: 15283 **PHRI TNO.:** 1298-31
SITE TYPE: Complex (72 Features)
TOPOGRAPHY: Uneven broken pahoehoe with a few elevated pahoehoe outcrops
VEGETATION: Dense fountain grass, some *wilelaiki*, *lama*, *alahe'e-haole*, and *koali*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple
DESCRIPTION: This site complex consists of four terraces (Features A, C, L, and M), three walls (Features B, F, and I), 53 modified outcrops (Features D1-D65), six mounds (Features E1-E7), one modified lava tube (Feature G), one modified depression (Feature H), two excavations (Features J1 and J2), and one alignment (Feature K).

FEATURE A: Terrace
ADJACENT TERRAIN: Rolling pahoehoe flows with occasional pahoehoe outcrops. Major aa flow terminus at 356° c. 200.00 m.
VEGETATION: Fountain grass and pluchea on outcrop, dense fountain grass surrounded by *wilelaiki*, *'a'ali'i*, *koa-haole*, *koali*, and *'ilima*.
FUNCTION: Habitation
DIMENSIONS: 4.22 m (north-south) by 2.70 (east-west) by 0.60
CONDITION: Fair

INTEGRITY: Unaltered

DESCRIPTION: Feature A is a terrace built atop a ropy pahoehoe outcrop. The outcrop flow is raised at least c. 3.00 m above the surrounding area. Ropy pahoehoe slabs from cobble to boulder size (c. 0.08-0.58 m in diameter) are placed on the outcrop to form a mostly level surface which slopes slightly south. On the east-southeast face of the terrace, cobbles and boulders have been roughly piled to fill a void and create a mostly level surface. This feature is near the site datum. It is on a high pahoehoe outcrop with good views in all directions. Feature B is c. 7.00 m at 215°. No portable remains or cultural deposits were observed at this feature.

FEATURE B: Wall

ADJACENT TERRAIN: Rolling pahoehoe flows with outcrops.

VEGETATION: Dense fountain grass surrounding. Sparse lantana, *'a'ali'i*, *koa-haole*, *pua-pilo*, and *'oka-kilika*.

FUNCTION: Habitation

DIMENSIONS: 8.00 m (north-south) by 5.40 m (east-west) by 0.72 m

CONDITION: Fair

INTEGRITY: Unaltered

DESCRIPTION: Feature B is a short, wide wall built off of an outcrop. It is constructed of small cobbles to large pahoehoe boulders (c. 0.10-0.61 m in diameter). The larger boulders are placed atop a pahoehoe outcrop and progressively smaller stones complete the construction. It is stacked up to six courses high and faced on the southwest, northwest, and north. The top is roughly level, with a slight slope southwest. This level section is c. 2.00 m long and then it becomes rough, degrading into an additional c. 5.00 m length that appears to have collapsed to the west. Overall, it appears that it was an L-shaped wall. This feature is at 228° and c. 7.00 m from Feature A datum. No portable remains or cultural deposits were noted at this feature.

FEATURE C: Terrace

ADJACENT TERRAIN: The surrounding terrace is undulating bare pahoehoe with the ground sloping gently southwest. The terrace is adjacent to a small collapsed blister.

VEGETATION: Dense fountain grass surrounding. Sparse lantana, *'a'ali'i*, *koa-haole*, *pua-pilo*, and *'oka-kilika*.

FUNCTION: Habitation

DIMENSIONS: 2.86 m (70°-250°) by 1.80 m by 0.80

CONDITION: Good

INTEGRITY: Unaltered

DESCRIPTION: This feature consists of a semicircular terrace constructed adjacent to two collapsed blisters. It appears as if the southern blister was excavated, but the northern blister probably collapsed naturally. The collapse of the south blister created an entrance to a small cave (c. 1.90 m by 1.70 m by 0.90 m). There is a soil deposit c. 0.03 m thick on the bottom of the cave floor, but no ecofactual or artifactual material was observed. The entrance to this cave faces southwest at 250° and is c. 0.90 m wide and c. 0.60 m high. Southwest of the entrance is a linear depressed area c. 1.50 m long at 250°. The width cannot be determined since the depressed area has been filled with subangular pahoehoe cobbles, boulders, and slabs. The fill extends south to the other (excavated) blister. The fill of the depressed area has created a roughly rectangular terrace oriented at 90°-270°. The west end is composed of one course stone over the pahoehoe bedrock. The south side fills the excavated blister area, either to the same level of the top of the blister or from c. 0.30 m below the top of the excavated blister. The east side is level with the top of the excavated blister. The north side is free-standing and elevated c. 0.55-0.80 m above the collapsed blister in front of the cave entrance. Rocks have been stacked two to three courses high (c. 0.55-0.80 m high) with some attempts to make a vertical side, but it is not faced.

This feature is located at 138° to Point A and c. 128° to Point B. No portable remains were noted on the surface of this feature.

FEATURE D: Modified outcrop (53)

ADJACENT TERRAIN: The land slopes gently southwest. The ground surface consists of bare broken pahoehoe. There are many dips and swells.

VEGETATION: Dense fountain grass with scattered low *wilelaiki* and low *koa-haole*, and some *koali*.

FUNCTION: Agriculture

DIMENSIONS: 13.75 m by 2.67 m by 0.91 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature D consists of 53 modified outcrops. These features are built of pahoehoe cobbles and boulders placed and loosely piled on top of bare pahoehoe bedrock. The size of the features range from a maximum diameter of c. 0.175-13.75 m. The average length of the features is c. 2.67 m. The height of the features ranges from c. 0.13-0.91 m, with the average maximum height c. 0.31 m. The shape of the features range from highly amorphous to linear and to rock rings, probably used as planting pits. The form of the features range from a loose scatter of pahoehoe boulders to a tight cluster of pahoehoe cobbles and boulders with up to 45% of the material piled two to three courses high.

FEATURE E: Mound (6)
ADJACENT TERRAIN: Broken pahoehoe with many swells and dips
VEGETATION: Dense fountain grass, some *alahe'e-haole* and *wilelaiki*.
FUNCTION: Agriculture
DIMENSIONS: 6.50 m (length) by 0.51 m (high)
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature E consisted of six mounds. Mounds are differentiated from modified outcrops on the basis of piled material. If more than 50% of the cobbles and boulders are piled two or more courses high, the feature is designated as a mound. If more than 50% of the construction material consists of rocks placed only one course high, the feature is designated a modified outcrop. The maximum diameter of the mounds ranges from c. 0.63-6.50 m, with an average maximum diameter of c. 2.06 m. The maximum height ranges from c. 0.20-0.51 m, with an average height of c. 0.35 m. The shape of the features range from round to oval to linear. Most are constructed of regularly-sized pahoehoe cobbles and boulders, but one (Feature E2) consists of boulders around the perimeter of the feature with the smaller cobbles in the interior.

FEATURE F: Wall
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west
VEGETATION: Moderate growth of *lama* and fountain grass.
FUNCTION: Agriculture
DIMENSIONS: 1.85 m (east-west) by 1.00 m by 0.54 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A linear wall running c. 1.85 m east-west, stacked with boulders two to three courses high. The southern half of wall appears to have collapsed, as there is rubble to the south. The wall is c. 0.60 m thick (east-west) and stands c. 0.54 m tall. The wall is built on top of a pahoehoe outcrop and abuts the large pahoehoe outcropping where datum point B is located.

The surface of the feature is irregular, and the sides of the wall slope down to the north and south.

The subangular, pahoehoe boulders range from c. 0.22-0.51 m in diameter.

Site 15285 is at 305° and c. 120.00 m, the site datum point A is at 301° and c. 30.00 m, Datum point B is at 303° and c. 15.00 m, Feature J1 is c. 7.00 m at 197°, and Feature E4 is c. 8.00 m at 206°. No portable remains or cultural deposits were detected on the surface of the feature.

FEATURE G: Modified lava tube
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west
VEGETATION: Thick fountain grass. Dense lantana and unknown small saplings.
FUNCTION: Agriculture
DIMENSIONS: 1.70 m (east-west) by 0.98 m by 0.50 m.
CONDITION: Good

INTEGRITY: Unaltered
DESCRIPTION: Situated on a pahoehoe outcrop running (east-west), is a small (c. 1.00 m by 0.50 m by 0.40 m) opening to a small lava tube running underground to the east. The lava tube continues east at c. 8.00 m, but is too small to crawl through. The entrance is 85% blocked off by large boulders, as if the tube was utilized for storage or extracting materials and the stones replaced.

There are about 15 subangular, pahoehoe boulders (c. 0.24-0.40 m in diameter) placed one to three courses high. Site 15285 is at 298° and c. 200.00 m, the site datum point A is at 291° and c. 80.00 m, and Feature D24 is at 212° and c. 40.00 m. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE H: Modified depression
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west. Area to the east is relatively flat.
VEGETATION: Thick fountain grass and saplings.
FUNCTION: Agriculture
DIMENSIONS: 2.30 m (north-south) by 2.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A naturally raised pahoehoe outcrop is at the edges of the amorphous depression (c. 2.30 m by 2.00 m in diameter). Stones were placed in the depression, filling it to the level of the pahoehoe outcrop. The feature surface is flat and level. The stones are small, subangular, pahoehoe boulders, c. 0.23-0.31 m in diameter.

FEATURE I: Wall
ADJACENT TERRAIN: Pahoehoe flats with many dips and swells
VEGETATION: Dense fountain grass many low *lama* and some low *wilelaiki*.
FUNCTION: Agriculture
DIMENSIONS: 4.70 m (58°-238°) by 1.31 m by 0.21 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Pahoehoe cobbles and boulders (c. 0.15-0.43 m) are piled and placed in a linear area. The rocks on the west end are generally piled two courses high, while on the south end the rocks are merely placed.

The terrain is bare, level pahoehoe that slopes west-southwest, parallel to the length of the feature. There are no planting plots in the interior. The surface is uneven, and bedrock can be seen through the feature in many places, so it is not possible that anything is buried underneath. This is probably just a modified outcrop that is lower than usual.

No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE J1: Excavation
ADJACENT TERRAIN: Undulating pahoehoe flows sloping gently downward to the west.
VEGETATION: Thick fountain grass and small *alahe'e-haole*.
FUNCTION: Agriculture
DIMENSIONS: 1.60 m (north-south) by 1.00 m by 0.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A *puka* measuring c. 0.56 m (east-west) by 0.50 m (north-south) by 0.36 m (deep) is c. 0.12 m north of a small pile of stones which were extracted from the *puka*. The *puka* is in the center of a pahoehoe outcrop running east-west. The *puka* is oval-shaped. The stones are small cobbles and one small boulder, piled one course high. The rounded and subangular pahoehoe stones measure 0.03-0.10 m in diameter. The subangular boulder measures c. 0.30 m in diameter.

Also, some stones are placed back in the *puka* and fill the center of it. The *puka* continues under the surface, back for c. 1.34 m west and c. 2.89 m east.

The *makai* water tank is at 287°, Site 15285 is at 304° and c. 130.00 m, the site datum point A is at 314° and c. 30.00 m, datum point B is at 328° and c. 14.00 m, Feature D26 is c. 13.00 m at 152°, and Feature F1 is c. 7.00 m at 17°. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE J2: Excavation
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping west.
VEGETATION: Thick fountain grass and sparse growth of unidentified saplings.
FUNCTION: Agriculture
DIMENSIONS: 1.60 m (north-south) by 1.00 m by 0.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A circular hole (*puka*), c. 0.31 m deep and c. 1.60 m wide is in the center of a pahoehoe outcrop running north-south. The *puka* is filled with the boulders that were probably removed at one time. The subangular, pahoehoe boulders range from c. 0.25-0.44 m in diameter. These boulders are just placed back into the hole.

FEATURE K: Alignment
ADJACENT TERRAIN: Undulating broken pahoehoe with many swells and dips
VEGETATION: Dense fountain grass and some *alahe'e-haole*
FUNCTION: Agriculture
DIMENSIONS: 1.52 m (118°-298°) by 0.30 m by 0.12 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Two parallel alignments of pahoehoe cobbles and boulders are placed on a bare pahoehoe outcrop. The alignments are spaced c. 0.25 m apart. The rocks range from c. 0.12-0.33 m in maximum diameter. One end of the alignments abuts an oval mound (Feature E1). The north alignment is slightly shorter (c. 1.48 m) than the south alignment (c. 1.52 m). No portable remains or cultural deposits were noted on the surface of the feature.

FEATURE L: Terrace
ADJACENT TERRAIN: Uneven pahoehoe flats with slope west-southwest.
VEGETATION: Dense fountain grass, scattered low *wilelaiki*, and *lama*.
FUNCTION: Agriculture
DIMENSIONS: 1.70 m (20°-282°) by 1.43 m by 0.24 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The terrace has been constructed on a natural depressed portion of a pahoehoe swell. The terrace is roughly rectangular and the south side is flush with the surface of the bedrock (the bedrock slopes down to the north). The north, west, and east sides are all elevated above the surface of the bedrock by alignments of pahoehoe boulders (c. 0.20-0.32 m maximum diameter).

The interior and south side is composed of pahoehoe gravel and cobbles (c. 0.03-0.15 m maximum diameter). This results in the interior being depressed c. 0.10-0.20 m below the level of the perimeter stones. The perimeter boulders are c. 0.07-0.24 m above the level of the bedrock.

Very little of the gravel in the interior is piled more than one course high. Care has been taken to make the west and north sides look straight. The east side follows the edge of the pahoehoe swell.

No portable remains or cultural deposits were observed on the surface of the feature.

FEATURE M: Terrace
ADJACENT TERRAIN: Broken, uneven pahoehoe
VEGETATION: Dense fountain grass and *alahe'e-haole*.
FUNCTION: Agriculture

DIMENSIONS: 2.00 m (104°-284°) by 1.60 m by 0.70 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The rectangular terrace is constructed on the north side of a bare pahoehoe outcrop that slopes down about 10° south. The south side of the terrace is flush with the surface of the north side of the outcrop. Pahoehoe cobbles have been piled up from the base of the outcrop to the top, but only an area of c. 0.62 m (perpendicular to the pahoehoe outcrop) has been constructed so that the surface is level with the top of the outcrop. The rest of the terrace slopes down parallel to the outcrop slope. The terrace is constructed of pahoehoe cobbles, boulders and slabs with most of the slabs on top. The rocks range from c. 0.16-0.60 m in maximum diameter. The length of the terrace is parallel to the pahoehoe outcrop edge. The terrace width is perpendicular to the outcrop edge. And the height of the outcrop, from base to top, is equal to the height of the terrace.

No portable remains or cultural deposits were observed on the surface of this feature.

STATE NO.: 15284 **PHRI TNO.:** 1298-33
SITE TYPE: Modified lava tube
TOPOGRAPHY: Undulating pahoehoe with elevated outcrop and collapsed lava tube
VEGETATION: Dense fountain grass with scattered *koa-haole*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This cave has some possible internal modifications (an alignment and a charred area) in the east section. The entrance is through the top in a hole (c. 2.64 m long by 1.00 m wide). It drops c. 1.30 m from the top to the cave floor. Tubes head off to the east and west. It is very difficult to get out of this cave, since the drop is so abrupt.

There is a possible alignment inside the tube and east of the entrance and roof fall. This feature runs north-south and contains about 12 boulders. Boulders are not placed end to end, but with spaces in between each stone. There is also a possible clearing pile, c. 15.00 m east of the entrance and roof fall. This pile is placed at the entrance of another tube continuing east. No feature designations were assigned at this time.

This site is located c. 30.00 m at 346° to Site 15300 and from the site to Site 15283 point A is 156°. No portable remains or cultural deposits were observed on the surface of the feature.

STATE NO.: 15285 **PHRI TNO.:** 1298-35
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Rolling pahoehoe flows with scattered outcrops. Located on a high outcrop with a view in all directions
VEGETATION: Fountain grass, sparse *koa-haole*, *'ilima*, and *pua-pilo*.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of one enclosure (Feature A) and one cupboard (Feature B). The overall site dimensions are c. 12.00 m (north-south) by 9.50 m (east-west).

FEATURE A: Enclosure
ADJACENT TERRAIN: Rolling pahoehoe flows with scattered outcrops. There is a view in all directions. Features A and B are located on a high outcrop. The major aa flow (toe) is c. 200.00 m at 22°.
FUNCTION: Habitation
DIMENSIONS: 10.00 m by 8.00 m by 1.61 m

CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: This is a square enclosure surrounding interior space. It is constructed on top of a large pahoehoe outcrop. A small cupboard (Feature B) is in the northeast corner. Construction material is pahoehoe cobbles and boulders (c. 0.08-0.62 m). The interior walls are constructed with stacked and faced pahoehoe slabs ranging from two to six courses high. These inner walls (as constructed) would have made an interior space of c. 4.00 m north-south by 3.60 m east-west. It appears that there may have been an entrance into the enclosure in the west wall near the northwest corner. There is an alignment of two or three vertical slabs placed at right angles to the structure wall, with another possible alignment of one or two stones parallel to the first alignment. Distance between the alignments is c. 0.70 m. Pahoehoe slabs have been stacked up to three courses high in the entrance to block it.

The interior of the structure is fairly level, although portions of the wall appear to have fallen in on it. The natural collapse has reduced wall height on all four walls. A single branch coral was found outside on eastern wall near southeast corner.

FEATURE B: Cupboard
ADJACENT TERRAIN: Rolling pahoehoe flows with scattered outcrops.
VEGETATION: Dense fountain grass, *wilelaiki*, sparse *noni*, *'ilima*, *koa-haole*, and *'a'ali'i*.
FUNCTION: Storage
DIMENSIONS: 0.46 m by 0.44 m by 0.68 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This is a small (0.46 m by 0.44 m by 0.68 deep) cupboard constructed in the corner of the interior of the enclosure (Feature A). The east wall and the north wall are those of Feature A, with the west wall constructed perpendicular to the north. The west wall is constructed of both vertical and horizontal pahoehoe slabs (c. 0.45 m maximum) that are stacked two courses high and up to c. 0.70 m above the floor. A large pahoehoe slab (c. 0.42 m by 0.35 m by 0.17 m) is placed vertically on top of the cupboard. There are other cobbles piled in the northern part away from the opening. The floor is roughly paved with flat pahoehoe. No portable remains or cultural deposits were noted at this feature.

STATE NO.: 15286 **PHRI TNO.:** 1298-37
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Undulating pahoehoe flows gently sloping downward to the west
VEGETATION: Dense fountain grass and *koa-haole*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of one modified outcrop (Feature A), one alignment (Feature B), one midden (Feature C), and one water catchment (Feature D). The overall site dimensions are c: 12.00 m (east-west) by 5.00 m (north-south).

FEATURE A: Modified outcrop
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west
VEGETATION: Fountain grass.
FUNCTION: Indeterminate
DIMENSIONS: 2.40 m (east-west) by 1.80 m by 0.27 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A modified outcrop placed on top of a pahoehoe outcrop running east-west. This consists of about eight subangular, pahoehoe boulders c. 0.32-0.63 m in diameter. This structure is amorphous in shape. All boulders are one course high. This structure is c. 0.50-2.00 m south of the cave entrance. No portable remains or cultural deposits were noted at this feature.

FEATURE B: Alignment
ADJACENT TERRAIN: Located inside of a lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 6.00 m (northwest-southeast) by 0.40 m by 0.37 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: A one course high alignment beginning east of the roof fall at the wall and running northwest for c. 6.00 m. This structure is constructed with 16 subangular, pahoehoe boulders c. 0.23-0.37 m in diameter. It runs along the wall. The boulders have space between them and are not placed end to end. No portable remains or cultural deposits were observed on the surface on this feature.

FEATURE C: Midden
ADJACENT TERRAIN: Located inside a lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.10 m by 0.10 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A circular ash deposit c. 0.10 m by 0.10 m in diameter, with grey and white ash. This is at the south wall, near the cave entrance, and west of the roof fall. Charcoal is also found within it, and encompassing the deposit is soil. The ash deposit is c. 0.08 m thick.

FEATURE D: Other (water catchment)
ADJACENT TERRAIN: Located inside lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.32 m (east-west) by 0.25 m by 0.18 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: About 5.00 m west of the entrance along the south wall is a one course-high structure consisting of three cobbles. The subangular, basalt stones are c. 0.11-0.18 m in diameter. No portable remains or cultural deposits were observed on the surface of this feature.

STATE NO.: 15287 **PHRI TNO.:** 1298-38
SITE TYPE: Petroglyph
TOPOGRAPHY: Rolling pahoehoe flows with aa lava flow c. 0.75 m south. With pressure ridges and collapsed tunnels
VEGETATION: Dense fountain grass, *'ilima*, *'inikoa*, SIFA and *koa-haole* nearby.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Recreation
DESCRIPTION: This feature appears to consist of c. 150 holes (15 x 10) which have been pecked into scoriaceous pahoehoe in mostly parallel rows. Distance between the holes averages c. 0.04 m, but is also up to 0.05 m. Maximum depth of the holes is c. 0.01 m, but could have been somewhat deeper when the surrounding matrix was present. No other rock art was noted in the immediate area, but a short semicircular alignment of seven cobbles and boulders (c. 0.17-0.36 m) was noted sitting atop the pahoehoe c. 8.00 m at 137°. Both of these features are probably associated with Site 15264, a probable prehistoric habitation site just to the north. The petroglyph is constructed on pahoehoe.

No portable remains or cultural deposits were noted at this site.

STATE NO.: 15288 **PHRI TNO.:** 1298-39
SITE TYPE: Cairn
TOPOGRAPHY: Rolling pahoehoe flows with occasional hilltops and ridges. Large aa flow is south.
VEGETATION: Dense fountain grass, *'ilima*, *'inikoa*, *'oka-kilika*, *'a'ali'i*, and *koa-haole* nearby.
CONDITION: Poor
INTEGRITY: Altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Marker
DESCRIPTION: This altered cairn is now amorphous in shape, but may have originally been square or roughly circular. The remaining portion is dome shaped and is constructed atop a pahoehoe flow. Construction materials are pahoehoe cobbles and boulders (c. 0.06-0.85 m) with the larger materials around the base and smaller materials on the inside. Sides of the feature are: The south side is vertical; the west side gradually sloping; the north gently sloping; the east steeply sloping. The surface is mostly flat, although several boulders (c. 0.10-0.30 m) are sitting on top.

It was possibly taller originally, then was partially dismantled and the upper stones placed to the southeast. This site is c. 120.00 m at 159° from Site 15287 and c. 80.00-90.00 m *mauka* of *makai* project line on low hill located on Sweep 36.

No portable remains or cultural deposits were noted at this site.

STATE NO.: 15289 **PHRI TNO.:** 1298-40
SITE TYPE: Enclosure
TOPOGRAPHY: Located on a pahoehoe flow running 310° with a large aa flow c. 20.00 m north.
VEGETATION: *Wilelaiki*, *koa-haole*, fountain grass.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DESCRIPTION: The enclosure is mostly oval and constructed atop a pahoehoe flow. It appears the walls have been built around a large pahoehoe slab on the south. This slab is sitting at an approximate angle of 45°. The remaining walls of the structure are composed of flat pahoehoe slabs (size range is c. 0.05 to 0.70 m). In some areas, these slabs are piled up to three courses high, others are placed atop a higher level of pahoehoe and are only one course high. Three large boulders are on the floor of the structure.

STATE NO.: 15290 **PHRI TNO.:** 1298-41
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Undulating pahoehoe flow gently sloping to the west.
VEGETATION: *Wilelaiki*, *koa-haole*, *'a'ali'i*, *'ilima*, fountain grass, *'oka-kilika*, and lantana.
SITE ELEVATION: About 360 ft AMSL
CONDITION: Excellent
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of one alignment (Feature A), one platform (Feature B), one enclosure (Feature C), and one mound (Feature D). The overall site dimensions are c. 19.00 m (north-south) by 12.00 m by (east-west).

FEATURE A: Alignment
ADJACENT TERRAIN: Undulating pahoehoe flow gently sloping downward to the west.
VEGETATION: *Wilelaiki*, *koa-haole*, *'a'ali'i*, *'ilima*, fountain grass, lantana, and *noni*.
FUNCTION: Indeterminate
DIMENSIONS: 3.60 m by 2.25 m by 0.61 m

CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: Feature A is composed of seven large, flat pahoehoe boulders (size range 0.20 to 0.45 m) aligned in an L-shape. These boulders are placed on their sides and are sitting upon the edge of a pahoehoe flow. Several small pahoehoe cobbles are placed one course high north and east of the alignment. The L-shape may have served as a retaining wall for the small cobbles. Two other large boulders on the south have fallen to the west. A thin soil layer was observed south and west.

FEATURE B: Platform
ADJACENT TERRAIN: Rolling pahoehoe with a gentle slope west.
VEGETATION: *Wilelaiki*, *koa-haole*, *'a'ali'i*, *'ilima*, fountain grass, lantana, and *noni*.
FUNCTION: Habitation
DIMENSIONS: 4.50 m by 3.20 m by 0.60 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a quadrangular platform structure approximately 4.5 m long. Although the feature was not tested, it appears to be constructed on top of an undulating pahoehoe flow with a slight slope southwest. This feature is constructed with pahoehoe gravel, cobbles, and boulders. The northern perimeter of the feature is constructed with large (c. 0.60 m diameter) boulders. Construction on the east and the west sides is similar. On the south, the feature abuts the (Feature C) enclosure. Here, the east and the west walls continue south, then turn to meet and enclose a small area (Feature C). The south wall (of Feature B) slopes gradually (into Feature C) between the two walls. The interior of Feature B is dome-shaped and is paved with pahoehoe gravels, cobbles, and small boulders. No bedrock was exposed in the interior. One possible upright is near the *makai* side. The upright appears to be a part of the construction, however, and does not rise above the top of the platform.

FEATURE C: Enclosure
ADJACENT TERRAIN: Westward sloping pahoehoe.
VEGETATION: Fountain grass, *wilelaiki*, *koa-haole*, *'a'ali'i*, *'ilima*, lantana, and *noni*.
FUNCTION: Habitation
DIMENSIONS: 5.50 m by 4.50 m by 0.36 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a small enclosure that is a part of the Feature B platform. This feature is also constructed on pahoehoe. It is composed of circular low walls of piled pahoehoe cobbles and small boulders (size range 0.10 to 0.40 m) abutting the south end of Feature B. There is no stacking evident. The southwest corner has small to medium-size boulders and one pahoehoe slab that may have been upright. There are several small trees that could have pushed the slab. There is no opening into the enclosure. The southwest portion is composed mainly of medium-sized cobbles with few boulders. The interior of the structure is loosely paved with small to medium pahoehoe cobbles.

FEATURE D: Mound
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west.
VEGETATION: *Wilelaiki*, *koa-haole*, *'a'ali'i*, *'ilima*, fountain grass, lantana, and *noni*.
FUNCTION: Agriculture
DIMENSIONS: 0.62 m by 0.34 m by 0.17
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature D is a small oval mound built one to two courses high. It is constructed of small pahoehoe cobbles (average c. 0.20 m in diameter) that are piled together. The feature is surrounded by modified outcrops.

STATE NO.: 15291 **PHRI TNO.:** 1298-42
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Undulating pahoehoe flows gently sweeping downward to the west.

VEGETATION: *Wilelaiki, koa-haole, 'a'ali'i, 'ilima*, fountain grass, and silk or silver oak.
SITE ELEVATION: About 545 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DESCRIPTION: The site complex consists of one enclosure (Feature A) and one wall (Feature B). The overall site dimensions are c. 19.00 m by 8.00 m.

FEATURE A: Enclosure
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west.
VEGETATION: *'A'ali'i, wilelaiki, kolomona*, and fountain grass.
FUNCTION: Indeterminate
DIMENSIONS: 10.50 m by 7.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature A is an enclosure with three stacked walls. One runs northwest to southeast, one runs northeast to southwest, and the other runs northwest to southeast. There is an opening to the southeast. The walls of the structure are piled one to two courses high with boulders 0.25 to 0.80 m in diameter. The walls are constructed of flat, subangular, pahoehoe slabs with no particular orientation. There do not appear to be any upright slabs within the construction. The interior of the feature appears to be boulder-filled and may have resulted from the inward collapse of the walls. There is a small lava tube opening in the southeast corner of the feature. Site 15291 (Feature B) is c. 4.00 m southeast. The area contains many large lava tubes that may have been used for storage.

FEATURE B: Wall
ADJACENT TERRAIN: Undulating pahoehoe flows gently sloping downward to the west.
VEGETATION: *'A'ali'i, wilelaiki*, and fountain grass.
FUNCTION: Indeterminate
DIMENSIONS: 7.00 m by 6.50 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a rough C-shape alignment with the opening to the southwest. One to two courses of large pahoehoe cobbles (0.10 to 0.25 m in diameter) are piled upon a pahoehoe outcrop. There is a possible pahoehoe excavation and another alignment in the northeast interior. This inside alignment connects to the northwest wall, becoming a circular alignment within the C-shape. There are modified outcrops around the feature. Site 15291 (Feature A) is c. 4.00 m northwest. The area contains many large lava tubes that may have served as storage.

STATE NO.: 15292 **PHRI TNO.:** 1298-43
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Rolling pahoehoe flows with a slight slope west.
VEGETATION: Fountain grass, *noni, hapu'u-'i'i*, and possible *kuawa*.
SITE ELEVATION: About 590 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION:
DESCRIPTION: The site complex consists of one enclosure (Feature A), three terraces (Features B, D, and G), one wall (Feature C), one cleared area (Feature E), one pavement (Feature F), and one excavation (Feature H). The overall site dimensions are c. 11.50 m by 5.70 m.

FEATURE A: Enclosure
ADJACENT TERRAIN: Within lava tube cave
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 4.40 m by 2.25 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature A is a double enclosure. Pahoehoe roof fall material was excavated from the interior, and then used to construct the sides. The cobbles and boulders used range from c. 0.20 to 0.70 m in diameter. The enclosure area has been divided into two chambers (long axis is northeast-southwest) by a rough alignment of six large boulders (c. 0.25 to 0.50 m in diameter). The shape of the resulting area is a rough oval. Feature C is within Feature A (in the northeast corner), and Feature D forms the south wall of Feature A. The northeast portion of Feature A touches the east wall of the tube. There is a collapsed sink, with features in the lava tube southeast (*mauka*). Inside the cave is a skylight with a large *noni* plant, and another smaller tube branching off the northwest.

FEATURE B: Terrace
ADJACENT TERRAIN: Within lava tube, exterior of the cave is a westward sloping pahoehoe field.
VEGETATION: No vegetation
FUNCTION: Multiple
DIMENSIONS: 1.10 m by 0.60 m by 0.47
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature B is a terrace constructed of medium pahoehoe cobbles to small boulders, creating a level, paved surface. This terrace includes both upper and lower levels, separated by large boulders.

The upper terrace abuts the tube wall on the west, and rubble from the collapsed tube is on the east. The lower terrace is also paved with small to medium pahoehoe cobbles. It is separated from Feature A (on the southeast) by several large boulders that make up the walls of Feature A. The lower terrace also abuts the western tube wall. There is a collapsed sink, with features in the lava tube southeast (*mauka*). Within the cave, there is a skylight with a large *noni* plant, and another smaller tube branching off the northwest.

FEATURE C: Wall
ADJACENT TERRAIN: Outside lava tube. There are undulating pahoehoe flows gently sloping downward to the west.
VEGETATION: No vegetation
FUNCTION: Multiple
DIMENSIONS: 0.92 m by 0.78 m 0.20-0.92 m high
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a small U-shaped wall in the northeast corner of Feature A. The two walls making up the U-shaped wall run west off of the cave wall for 0.78 m and are 0.20 to 0.92 m high. The south wall is much shorter, since the north wall is the Feature A structural wall. The north wall is stacked five courses high, and the south wall is piled one to three courses high. The interior of the feature is flat pahoehoe bedrock. The stones are basalt cobbles to boulders (c. 0.10 to 0.80 m in diameter). There is a collapsed sink, with features in the lava tube southeast (*mauka*). Within the cave, there is a skylight with a large *noni* plant, and another smaller tube branching off the northwest.

FEATURE D: Terrace
ADJACENT TERRAIN: Within lava tube, directly under skylight.
VEGETATION: *Noni*.
FUNCTION: Indeterminate/Possible Burial
DIMENSIONS: 4.50 m by 2.50 m by 1.70 m
CONDITION: Good
INTEGRITY: Unaltered

DESCRIPTION: Feature D is a terrace within the lava tube located directly under the skylight. This roof fall area has been leveled off using small to medium-sized cobbles. The top slopes slightly north. The terrace abuts the east wall of the tube on the east, with the other sides slightly raised by terracing of the roof material. The interior of the terraces appears to be filled with the small to medium cobbles. The terrace possibly contains a human burial based on structural morphology.

There is a collapsed sink, with features in the lava tube southeast (*mauka*). Within the cave, there is a skylight with a large *noni* plant, and another smaller tube branching off the northwest.

FEATURE E: Cleared area
ADJACENT TERRAIN: Within lava tube cave
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 1.70 m by 1.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A circular area along the east edge of cave that has been cleared of large roof fall materials. Roof fall material surrounds the cleared area. Within the cleared area the surface is level and is paved with small to large cobbles. With the roof fall and the caves edge the feature is roughly three-fourths enclosed. A large upright slab (roof fall) is along the east edge, (c. 0.95 m by 0.95 m by 0.32 m). It is unknown if the slab was moved, placed, or naturally fell into place. Judging from its size, it probably fell.

Bedrock, or large rocks are exposed on the surface of the cleared area. The cleared area is c. 1.00 m above the cave floor. A narrow (c. 0.40 m) pathway heads toward Feature D along the east edge of the cave. Pebbles and medium cobbles cover the pathway. Feature E is within the cave near the east boundary and c. 1.30 m from Feature D (terrace) along the east cave edge. Portable remains include mouse skeletons and owl droppings. No testing was done on this feature.

FEATURE F: Pavement
ADJACENT TERRAIN: This feature is on the side of a collapsed portion of a lava tube. The terrain on the lip of the sinkhole is smooth pahoehoe. The bottom of the sinkhole is filled with large pahoehoe chunks fallen from the sides.
VEGETATION: *Wilelaiki*, *lama*, and dense fountain grass on the rim above cave.
FUNCTION: Transportation
DIMENSIONS: 5.10 m by 0.55 m
ORIENTATION: 159°-339°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A path has been made from the top of the rim of the sinkhole (on the west) down to the entrance of a cave leading off the sinkhole. This cave is constructed of large slabs of pahoehoe that have broken off and slid down along the side of the sinkhole. These slabs fell c. 0.40-0.50 m away from the side of the sinkhole. The gap between these slabs has been filled with pahoehoe cobbles and large boulders (c. 0.17-0.51 m maximum diameter). This area was probably not filled in with rocks carried any appreciable distance, but rocks were probably rolled or pushed from the top of the slabs into the gap. This served two purposes: it cleared the top of the slabs, which was used as a path, and filled the gap between the path and the side of the sinkhole, preventing people from falling into the cracks.

The path consists of two boulders (c. 0.90 m) serving as steps down to the slabs that act as a ramp (c. 2.00 m slope to south) to a series of boulders (c. 1.60 m) that create three steps down to the cave. The entire pavement is c. 5.10 m long and c. 0.55 m wide, and the filled gaps are c. 0.40-0.90 m wide. The pavement is c. 1.80 m above the sinkhole floor at the north end, c. 0.72 m above the floor at the slab section, c. 1.04 m below the sinkhole rim at the slab section, and c. 1.70 m below the sinkhole rim at the south end.

No portable remains or cultural deposits were noted at this feature.

FEATURE G: Terrace
ADJACENT TERRAIN: Within collapsed blister and lava tube
VEGETATION: Fountain grass.
FUNCTION: Indeterminate
DIMENSIONS: 3.90 m by 1.40 m by 1.30 m
ORIENTATION: 114°-294°
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: A crudely constructed rectangular terrace. The north and east walls abut the large slabs associated with collapsed the blister. The blister's edge is immediately behind these naturally placed slabs. The south wall of the terrace is constructed of pahoehoe boulders crudely stacked four to five courses high. The largest boulders (c. 0.85 m by 0.65 m by 0.65 m) are along the base. The west side of the terrace is collapsed. The terrace surface has cobbles and small boulders forming an uneven surface. This feature is c. 5.80 m at 226° to the north edge of Feature B. No portable remains or cultural deposits were noted at this feature. No testing was done.

FEATURE H: Excavation
ADJACENT TERRAIN: The floor of the collapsed tube is filled with rock fill (loose pahoehoe subangular cobbles and boulders up to c. 0.55 m in maximum diameter.
VEGETATION: Sparse fountain grass and *wilelaiki*.
FUNCTION: Indeterminate
DIMENSIONS: 1.68 m by 0.69 m by 0.18
ORIENTATION: 94°-274°
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: This small enclosed area was created when pahoehoe cobbles and boulders from the pile of rock fall at the bottom of the collapsed tube were moved. This created a depressed area completely surrounded by rock fall which has probably not been moved or modified.

The enclosed area is c. 1.68 m long and c. 0.69 m wide. It is depressed below the level of the rock fall c. 0.62 m on the east side, c. 0.48 m on the south side, and on the west side (below the level of Feature F). This feature is at the bottom of a collapsed tube east of Feature F. No portable remains or cultural deposits were observed at this feature.

STATE NO.: 15293 **PHRI TNO.:** 1298-45
SITE TYPE: Platform
TOPOGRAPHY: Rolling pahoehoe lava with low outcrops and tubes
VEGETATION: *Wilelaiki*, *'a'ali'i*, fountain grass, *lama*, *'oka-kilika* and *lauki* in distance.
SITE ELEVATION: About 550 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This feature is roughly square with mostly flat top. It appears to be constructed on bare pahoehoe bedrock. Construction materials are pahoehoe cobbles and small boulders (range c. 0.07-0.50 m). Larger stones are placed around the outside perimeters, and the smaller stones form a level paved area in the interior, especially in the south half. Materials appear piled with gradually sloping sides. There is a possible interior alignment running *mauka-makai* of the paved area. More stones forming the south edge slope down to the ground level of the paved area. The north half of the platform is not level, but slopes slightly north.

STATE NO.: 15294 **PHRI TNO.:** 1298-46
SITE TYPE: Enclosure

TOPOGRAPHY: Rolling pahoehoe lava with low outcrops and tubes
VEGETATION: *Wilelaiki*, *'a'ali'i*, fountain grass, *lama*, *'oka-kilika* and *lauki* in distance
SITE ELEVATION: C. 550' AMSL
CONDITION: Fair
INTEGRITY: Altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DESCRIPTION: This site consists of a small circular alignment enclosure of large (c. 0.80 m average) pahoehoe slabs (c. 90.25 m thick) that had been placed. All are sitting at angles on pahoehoe bedrock. These stones are obtained here. The bedrock continues on to the west, where others appears to have been set up vertically. These pieces are also quite large (range c. 0.60-0.90 m) and form a rough alignment. Just north of this alignment, a low spot or depression in the bedrock appears to have been filled with gravels, cobbles, and small boulders (range c. 0.03-025 m). These are roughly placed to form a mostly level surface.

This site is located c. 40.00 m at 357° from Site 15287 on Sweep 38 and a large aa flow is c. 12.00 m north. No portable remains or cultural deposits were noted on the surface of the site.

STATE NO.: 15295 **PHRI TNO.:** 1298-47
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Undulating broken bare pahoehoe - general surface area has slight slope to west-southwest
VEGETATION: Dense fountain grass, *lama*, and *wilelaiki*
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This site complex consists of one platform (Feature A), two terraces (Feature B and E), and two enclosures (Feature C and D). The overall site dimensions are c. 68.00 (36°-216°) by 26.00 m (126°-306°).

FEATURE A: Platform
ADJACENT TERRAIN: Undulating bare pahoehoe south, slight slope to west-southwest
VEGETATION: Dense fountain grass and *wilelaiki*
FUNCTION: Habitation - Possible Burial
DIMENSIONS: 4.00 m by 3.60 m by 0.04-0.56 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: The feature is a rectangular terrace constructed on top of bare pahoehoe bedrock. It is constructed of an interior fill of pahoehoe gravel and cobbles (range from 0.05-0.25 m in maximum diameter but 90% of material are cobbles of rather uniform size c. 0.10-0.15 m in diameter). The perimeter of the feature is outlined with aa cobbles and boulders c. 0.18-0.44 m placed or stacked two courses high to the level or slightly above the level of the interior fill. Since the ground slopes slightly to the west-southwest the northeast corner is elevated only c. 0.04 m above the bedrock surface, while the southwest corner is elevated c. 0.44 m above the ground surface. The surface of the terrace is flat, regular and was leveled. The northwest corner of the platform is rather amorphous. An ear-like extension has been built partially over the northwest corner and extending out from the corner. Some of the perimeter stones on the northwest corner can still seen under this extension, so obviously a perfectly rectangular platform was constructed first,and the extension was built later. Unlike the rest of the platform, extension is constructed of piled pahoehoe cobbles and boulders (c. 0.15-0.55 m maximum diameter) with no smooth level interior fill and nor perimeter stones. The extension in fact is rather dome shaped in appearance with the top c. 0.30 m above an exposed perimeter stone of the original northwest corner. Form the southwest corner of this platform to the water tank is at 96°. No portable remains were noted at this feature. There may be buried cultural deposits under the rocks. Possible burial in the northwest corner.

FEATURE B: Terrace
ADJACENT TERRAIN: Undulating broken pahoehoe with slight slope to west-southwest
VEGETATION: Dense fountain grass
FUNCTION: Indeterminate
DIMENSIONS: 1.29 m (60°-186°) by 0.87 m by 0.10-0.39 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: A small rectangular terrace has been constructed against the northwest slope of a low bedrock outcrop. The terrace is flush with the top of the outcrop as the south and the east sides are elevated c. 0.10-0.39 m above the ground surface (at the base of the outcrop) on the north and west sides. The interior of the terrace and the south and east sides are composed of pahoehoe gravel and small cobbles (up to c. 0.14 m in diameter). The north and the west sides are bordered by one-two courses of pahoehoe cobbles and boulders (c. 0.10-0.40 m in maximum diameter). The surface of the terrace is fairly regular and flat but slopes slightly to the northwest (parallel to slope of outcrop). This feature is located in the middle of the site between Feature A and Feature C. No portable remains were observed on the surface of this feature.

This terrace might be constructed on top of an excavated portion of the outcrop and this may have a depth greater than the height (c. 0.39) of the terrace itself.

FEATURE C: Enclosure
ADJACENT TERRAIN: Westward sloping pahoehoe field
VEGETATION: Fountain grass and *wilelaiki*
FUNCTION: Habitation
DIMENSIONS: 5.50 m (north-south) by 4.10 (east-west) by 0.24-0.38 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Circular shaped enclosure constructed of subangular pahoehoe large cobbles and boulders (largest boulder c. 0.50 m by 0.30 m by 0.26; average boulder c. 0.25-0.30 m in diameter). No stacking is evident, however, all sides appears to be collapsed. Interior dimensions are c. 2.50 m (east-west) by 1.88 m (north-south). The feature is constructed on pahoehoe bedrock, the interior of the feature is fairly flat pahoehoe. A narrow opening (c. 0.68 m) is present on the western edge of the feature and faces 294°.

To the north of feature is a pahoehoe outcrop with boulders scattered throughout. The boulders are scattered to the northern edge of the enclosure. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE D: Enclosure
ADJACENT TERRAIN: Westward sloping pahoehoe fields
VEGETATION: Fountain grass, *wilelaiki*, silk oak, and *mamane*
FUNCTION: Habitation
DIMENSIONS: 5.40 m (290°-110°) by 4.86 m by 0.65 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: U-shaped enclosure constructed of pahoehoe cobbles and boulders piled and stacked. Stacking only evident in the northeast corner. Largest boulder is c. 0.48 m diameter, average stone is c. 0.20-0.35 m. The sides width average c. 1.10 m, the opening facing at 290° west and is c. 2.40 m wide. Interior back wall is c. 2.40 m, interior length is c. 3.10 m. The interior is covered with pahoehoe outcrop near front and the back interior is covered with loose and only placed cobbles. Roughly two third (2/3) of interior is covered by loose cobbles and soil. Possible that some interior stones were placed on edge. The feature is collapsed around all sides.

Pahoehoe bedrock is visible westward. Numerous excavations and modified outcrops are present. It is c. 33.00 m at 16° from the northeast corner of the enclosure to datum of Feature A. No portable remains were noted on the surface of this feature. No testing was done, however, at least a c. 0.08 m thick deposit was present.

FEATURE E: Terrace
ADJACENT TERRAIN: Westward sloping pahoehoe field
VEGETATION: Fountain grass
FUNCTION: Indeterminate
DIMENSIONS: 1.78 m by 1.71 m by 0.58-0.80 m
ORIENTATION: 38°-218°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A square terrace constructed against a pahoehoe bedrock outcrop. The interior is constructed of pahoehoe cobbles of a fairly uniform size (c. 0.05-0.13 m maximum diameter). The interior surface is smooth, flat and level. The perimeter of the terrace or the southeast, northeast, and northwest sides are outlined with pahoehoe boulders or slabs (c. 0.25-0.35 m maximum diameter). On the southeast side these boulders are placed one course high (c. 0.58 m high) and on the northwest side up to four courses high (c. 0.80 m high). These sides are not really faced since the basalt boulders extend out from a vertical line with the top boulders. One large upright boulder (c. 0.45 m high) has been incorporated into the west corner of the feature. The interior cobble fill abuts the top of the outcrop on the southwest side. There are no perimeter stones.

STATE NO.: 15296 **PHRI TNO.:** 1298-52
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Rolling pahoehoe flows with widely scattered pahoehoe outcrops and undercut by lava tubes
VEGETATION: Dense fountain grass, with scattered *lama*, *'a'ali'i*, *wilelaiki*, lantana, *koa-haole*, and *noni*
SITE ELEVATION: About 570 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This site complex consists of one steppingstone trail (Feature A), one terrace (Feature B), three enclosures (Feature C, H, and I), one excavation (Feature D), one cupboard (Feature E), one alignment (Feature F). The overall site dimensions are c. 108.00 m (northwest-southeast) by 10.00 m.

FEATURE A: Steppingstone trail
ADJACENT TERRAIN: Inside lava tube. All basalt, pahoehoe and aa materials. Outside lava tube is flat pahoehoe flows.
VEGETATION: Fountain grass, *wilelaiki*, and lantana
FUNCTION: Transportation
DIMENSIONS: 9.00 m (southeast-northwest) by 1.30 m by 0.08-0.31 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: Inside the lava tube and the southeast of the entrance is a steppingstone trail that takes off to the southeast, past the roof fall. The trail follows a 143° angle and consists of fifteen plus (15+) flat pahoehoe basalt boulders placed on the rough aa floor. The boulders range in size from c. 0.16-0.48 m in diameter. No cultural material is found in lava tube. The datum is at the northeast corner of the feature at the mouth of the cave. Feature B is c. 26.60 m at 259° away.

FEATURE B: Terrace
ADJACENT TERRAIN: Flat undulating pahoehoe flows
VEGETATION: Thick fountain grass and moderate *wilelaiki* and *koa-haole*.
FUNCTION: Habitation
DIMENSIONS: 5.00 m by 3.00 m by 0.02-0.32 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: An oval shaped terrace running east-west with small cobbles to small boulders piled one-two courses high. Most of the structure is built with small cobbles and approximately eighteen (18) small boulders amorphously placed in

the center of the structure. Some of these boulders are excellent to sit on and the surface of structure is flat and level. None of the four sides of the structure is raised. The c. 5.00 m by 3.00 m area is basically paved with small cobbles.

Feature A is c. 26.60 m at 79° away and Feature C is c. 20.40 m at 284°. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE C: Enclosure
ADJACENT TERRAIN: Flat, undulating pahoehoe flows
VEGETATION: Thick fountain grass with moderate growth of *'a'ali'i*
FUNCTION: Habitation
DIMENSIONS: 5.60 m (north-south) by 5.60 m by 0.08-0.47 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A square enclosure with the entrance/exit opening to the east. This structure is piled two-four courses high with ends/corners have tumbled over both sides. The walls are c. 1.30 m wide. The interior of the enclosure is c. 2.70 m by 2.70 m. The corners of the feature are in excellent condition with carefully lined stones placed upright and on their sides to form a 90° corners.

The feature is composed of subangular basalt, pahoehoe cobbles to boulders ranging in size from c. 0.08-0.50 m in diameter. It appears that the enclosure is built upon bedrock outcropping. Feature B is c. 20.40 m at 104°, Feature I is c. 10.00 m at 68°, and Feature D is c. 20.00 m at 250° away from this feature. No portable remains or cultural deposits were noted at this feature.

FEATURE D: Excavation
ADJACENT TERRAIN: Rolling pahoehoe flows with slope to west. There are widely scattered tubes and caves.
VEGETATION: Dense fountain grass, *wilelaiki*, *'a'ali'i* just to west, *noni* and *lama* sparsely to the south.
FUNCTION: Storage
DIMENSIONS: 0.93 m (north-south) by 0.84 m (east-west) by 0.77 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature D is an excavation into pahoehoe bedrock. It appears to have been constructed around a natural *puka* in the bedrock. This natural hole looks to be a rough U-shape with the opening to the west-southwest at 250°. A large boulder (c. 0.30 m long) has been placed over the top with other large (0.35-0.46 m) pahoehoe boulders placed circularly around the opening on top of the pahoehoe bedrock. The boulders are placed one course high and serve to ring the opening. Feature C to this feature is c. 23.50 m at 269°, and Site 15297 is c. 22.00 m at 262°. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE E: Cupboard
ADJACENT TERRAIN: Flat undulating pahoehoe flows outside lava tube
VEGETATION: Thick fountain grass, moderate growth of *wilelaiki*, and *'a'ali'i* outside the lava tube. No vegetation inside the lava tube.
FUNCTION: Storage
DIMENSIONS: 2.70 m (at 44°) by 0.80 m by 0.80
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Just inside and to the right of the entrance of lava tube is an opening which continues back c. 2.70 m. Several small boulders have been placed in the area and appears as if they were used to block the opening.

These boulders range in size of c. 0.11-0.35 m in diameter and composed of subangular, pahoehoe, basalt materials. Northing is more than one course high. Further back in the cave, c. 20.00 m, is an *ipu* gourd holder. Feature I is c. 12.00 m at 220°, Feature F is c. 15.00 m at 330° away.

FEATURE F: Alignment
ADJACENT TERRAIN: Undulating pahoehoe flow in a flat area. C. 30.00 m to the west, the terrain slopes downward.
VEGETATION: Thick fountain grass and moderate growth of *'a'ali'i*
FUNCTION: Habitation
DIMENSIONS: 7.70 m (east-west) by 1.70 m by 0.08-0.29 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A linear alignment running east-west with approximately twenty two (22) small boulders, one course high. The boulders are placed so the ends overlap touch end to end, and are slightly apart. The structure is built on top of a linear pahoehoe outcrop.

The boulders ranging in size of c. 0.23-0.31 m in diameter and composed of subangular basalt pahoehoe material.

Feature E is c. 15.00 m at 150° away. No portable remains or cultural deposits were noted at this feature.

FEATURE H: Enclosure
ADJACENT TERRAIN: Rolling pahoehoe with scattered outcrops and lava tube caves.
VEGETATION: *Koa-haole* and dense fountain grass inside feature, and fountain grass, *'a'ali'i*, and *koa-haole* surrounding the feature.
FUNCTION: Habitation
DIMENSIONS: 4.60 m (north-south) by 4.20 m by 0.80 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature H is a slightly rectangular structure with a possible entrance on the north-northeast. It appears to be constructed on the ground surface which consists of pahoehoe bedrock. Materials used in construction are pahoehoe gravels to ropy pahoehoe boulders and slabs (size c. 0.05-0.63 m). Along the north wall (interior) a large pahoehoe slab (c. 0.65 by 0.30 m) is placed vertically, then four to five courses of large pahoehoe slabs are stacked on top. Further to the east, an area consisting of two smaller (c. 0.40 m) boulders are sitting horizontally with pahoehoe stacked above. Just before the northeast corner, another slab (c. 0.53 m by 0.34 m) is vertical with only a single slab on top. This is the best preserved interior wall, although an area in the southeast corner has three large vertical slabs with two or so courses on top. It looks as though the interior wall was faced all around, but slumping has occurred to disrupt. The walls are generally c. 0.80 m wide and probably were faced outside as well as inside. The entrance is c. 0.70 m wide and appears paved with flat pahoehoe slabs. Maximum wall height is c. 0.80 m in the northeast. No portable remains were noted on the surface of the feature. It is not tested, but appears to be organic atop pahoehoe bedrock.

FEATURE I: Enclosure
ADJACENT TERRAIN: Rolling pahoehoe with scattered outcrops and lava tube caves
VEGETATION: Fountain grass, *wilelaiki*, *'a'ali'i*, *koa-haole*, and *lama*
FUNCTION: Habitation
DIMENSIONS: 4.40 m (east-west) by 4.40 m (north-south) by 0.14-0.40 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature I is a rectangular enclosure that is constructed on top of pahoehoe bedrock. All sides of the enclosure are raised, and an entrance with a large (c. 0.77 m by 0.54 m by 0.14 m) flat pahoehoe slab. The structure is c. 5.00 m at 226° from the small cave entrance at Feature E and slightly higher. The proposed entrance to this feature faces *makai* at c. 275°. Bearing of walls are 100°-280° and 15°-195°. Materials used in construction are pahoehoe cobbles to boulders (range 0.07-0.64 m). These are stacked usually two rough courses high, although three to four (very rough) are found in the northwesterly corner. The northern wall is roughly faced along the bottom course, collapse outward has occurred in the upper courses. The eastern wall is slightly bowed out, but again may be the result of collapse. The south wall appears also to have collapsed out, but the interior appears roughly faced. There are small (c. 0.06-0.17 m) pahoehoe pieces sitting on the floor. Width of the walls are generally c. 1.00 m wide and probably were constructed by facing the inside and outside,

then stacking additional pahoehoe stones to height. This feature is located c. 12.80 m at 320° from the datum at Feature B. No portable remains or cultural deposits were noted at this feature.

STATE NO.: 15297 **PHRI TNO.:** 1298-57
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Set in undulating pahoehoe with downslope to the west-northwest
VEGETATION: *Lama* and fountain grass
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of one pavement (Feature A) and three terraces (Feature B-D). The overall site dimensions are c. 11.00 m (103°-283°) by 7.50 m (13°-193°).

FEATURE A: Pavement
ADJACENT TERRAIN: Descending rubble and the ground surface is undulating pahoehoe, which downslopes to the west
VEGETATION: Fountain grass
FUNCTION: Habitation
DIMENSIONS: 1.50 m (0°-180°) by 0.70 m by 0.15 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a set of three pahoehoe slabs set on/in the rubble which descends (south to west) into a lava tube cave. They range from c. 0.30 m by 0.30 m to 0.50 m by 0.40 m in size and are roughly c. 0.04-0.15 m thick.

This feature is located near (c. 0.30 m) the northwest area of the edge of a collapsed lava tube (forming a sinkhole). Feature is c. 1.70 m to the southeast. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE B: Terrace
ADJACENT TERRAIN: Undulating pahoehoe
VEGETATION: Fountain grass and medium size *lama*
FUNCTION: Habitation
DIMENSIONS: 4.50 m (east-southeast to west-northwest at 150°-330°) by 2.20 m (west-southwest to east-northeast) by 0.90 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is an angled (bent) terrace composed of subangular pahoehoe boulders and cobbles (c. 0.15-0.50 m in diameter) stacked two-three courses high. The south-southwest facing wall extends c. 3.90 m into the cave at 288° northwest. This wall comes to an abrupt end on the surface of the cave in a small room. The surface of this wall is irregular and is sloped northwest. The connecting terrace wall at the entrance of the cave faces west. The surface is irregular and is sloped west. At the connecting point, the terrace makes a 90° turn into the cave. This feature is located on the western side of a sinkhole/collapsed lava tube. Portable remains include charcoal, urchin spine and *kukui* nut fragments. C. 1.00 m southeast of the southwest corner there is a deposit of dark brown, silty, loam clay (c. 0.80 m by 0.80 m in diameter).

FEATURE C: Terrace
ADJACENT TERRAIN: Inside a collapsed blister on a flat area of undulating pahoehoe flows.
VEGETATION: Sparse fountain grass and *lama*
FUNCTION: Habitation
DIMENSIONS: 3.80 m (northwest-southeast) by 1.60 m by 1.20 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: An L-shaped terrace with the longer part running northwest-southeast. This feature is two-three courses high and constructed with small to large boulders. The boulders range in size from c. 0.20-0.85 m in diameter and

composed of subangular, basalt, pahoehoe materials. The western edge is elevated to meet the ground of the eastern end. The terrace was probably faced at one time, but areas of it have tumbled over. It is constructed on bedrock. The surface of feature is irregular. This feature is inside a collapsed blister c. 18.00 m east-west by 12.00 m. Collapsed blister is on a flat area of undulating pahoehoe flows. C. 20.00 m to the west, the terrain sloped downward. Feature B is c. 3.00 m at 276°, Feature A is c. 2.00 m at 350°, Feature D is c. 0.80 m at 98°, and entrance to cave is c. 3.25 m at 276°. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE D: Terrace
ADJACENT TERRAIN: Within the sinkhole
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 2.07 m (35°-215°) by 0.70 m (125°-305°) by 0.60 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: Feature D is a linear terrace built against the southeastern wall of the sinkhole. The north-northeast side is a facing wall with subangular pahoehoe boulders and cobbles (c. 0.20-0.40 m in diameter) stacked three-four courses high. The top is filled with small cobbles and gravel (c. 0.03-0.15 m in diameter). This filled area is sloped to the north-northeast. This feature is located southeastern side of sinkhole c. 1.00 m northwest of Feature C. No portable remains or cultural deposits were observed on the surface of the feature.

STATE NO.: 15298 **PHRI TNO.:** 1298-65
SITE TYPE: Complex (165+ Features)
TOPOGRAPHY: Rolling pahoehoe flows with lava tubes. The site line itself appears to be marked with a number of outcrops and sinkholes
VEGETATION: Dense fountain grass, *'a'ali'i*, *koa-haole*, *noni*, *'ilima*, and pluchea
SITE ELEVATION: About 400-490 ft AMSL
CONDITION: Good
INTEGRITY: Altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple
DESCRIPTION: The site complex consists of three pavements (A, BC, and BJ), five modified outcrops (Feature B, BZ, BBA, BBL, and BBW), six mounds (Feature C, F-2, BD, BBC3, and BBD), nine terraces (Feature D, H2, H3, K, BA, BG, BW, BBC1, and BCD), three cupboards (Feature E, H4, and BBC2), eleven others - stacked rocks (Feature G, BU, BY-6, BBG-2, and BBM), six enclosures (Feature H1, BL, BP-2, BBO, and BBQ), seven petroglyphs (Feature I1-4, I2-2, and I3), two pecked stones (Feature I4-2), one excavation (Feature J), ninety middens (Feature BE, BF, BK, BN, BR, BS, BBE-77, BBI, BBJ, BBR, BBT, BBV, BBX, and BCC), nine walls (Feature BB, BH, BI, BM, BO, BBF, BBN, BBZ, and BCB), five alignments (Feature BQ, BT, BBB, BBK, and BBP), one platform (Feature BV), one steppingstone - six sections (Feature BBH), one cairn (Feature BBS), one cleared area (Feature BBY), one modified depression (Feature BCA), and one modified lava tube (Feature BCE).

Note: Feature A-K and BA are all surface or sink features associated with lava tubes. Feature BB-BCE are subsurface feature located in the lava tubes.

FEATURE A: Pavement
ADJACENT TERRAIN: Gently undulating pahoehoe flows sloping gently to the west.
VEGETATION: Fountain grass, *'a'ali'i*, *koa-haole*, and *lama*.
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 3.20 m by 2.40 m by 0.20 m
CONDITION: Good
INTEGRITY: Unaltered

DESCRIPTION: Feature A is a pavement with a shape that is slightly rectangular. It is constructed of rough pahoehoe on the northern edge of the large tube line running *mauka/makai*.

It is located c. 20.00 m *mauka* of Feature B, a modified outcrop and about the same distance from the main entrance to Site 1298-65. Materials used with pavement are mostly pahoehoe cobbles and small boulders. Generally all sizes are mixed together. The material is roughly placed on the pahoehoe outcrop although some piling has occurred in low spots of bedrock. The surface is irregular with a slight slope to the west.

FEATURE B: Modified Outcrop
ADJACENT TERRAIN: Gently undulating pahoehoe flows sloping gently to the west.
VEGETATION: Fountain grass, *'a'ali'i*, *koa-haole*, and *lama*.
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 6.00 m by 4.60 m by 0.81 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature B is modified outcrop of a rather amorphous shape located between a large upthrust pahoehoe boulder on the south and a natural break in the pahoehoe bedrock on the north. It is composed of pahoehoe small cobbles to large boulders, placed one to two courses high on the pahoehoe bedrock between the two. Size range is c. 0.03 to 0.54 m, and sizes are pretty well intermixed. At both the southwest corner (near the large upthrust) and the northwest are larger boulders that are stacked two to three courses high to form short walls off of the upthrust bedrock. The wall on the southwest is c. 1.00 m by 0.55 m, on the northwest is c. 1.00 m by 0.45 m. Also on the north is an alignment of large boulders (c. 0.40 maximum diameter) placed as a retaining wall for the modified outcrop. Surface of the feature is gently undulating as is underlying bedrock.

FEATURE C: Mound
ADJACENT TERRAIN: Westward sloping undulating pahoehoe flow.
VEGETATION: Fountain grass.
FUNCTIONAL INTERPRETATION: Multiple
DIMENSIONS: 5.40 m by 3.60 m by 0.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature C is a linear mound of angular and subangular pahoehoe cobbles to small boulders (c. 0.05 to 0.24 m). Surface is covered with small cobbles (c. 0.10 m diameters). North eastern edge are pahoehoe ropy slabs are upright (c. 0.45 by 0.50 by 0.10-0.35) small slabs present on the eastern edge toppled. Approximately midpoint along the northern wall a small stone feature (c. 0.25 m interior diameter) present. An opening present inside this square is stacked construction. This could have functioned as a post holder. Larger slab-like rocks are present along other edges, but definitely more on the eastern half of feature and most are upright.

FEATURE D: Terrace
ADJACENT TERRAIN: Westward sloping undulating pahoehoe flow.
VEGETATION: Fountain grass and lantana.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 5.40 m by 4.30 m by 0.39 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a rectangular terrace constructed of angular to subangular to small boulders (0.05 m to 0.16 m). There are slabs of pahoehoe c. 0.06 to 0.07 m thick and c. 0.15 to 0.30 m long and 0.15 m wide present throughout, mainly along outer edges. The terrace abuts the ridge on two sides. No formal stacking is evident. Rocks appear to be simply piled and the surface is relatively flat. One piece of waterworn coral present near the northeast corner where the terrace abuts pahoehoe outcrop. Smaller cobbles (c. 0.05-0.10 m diameter) are the majority on the terrace surface.

FEATURE E: Cupboard
ADJACENT TERRAIN: Westward sloping undulating pahoehoe flow.
VEGETATION: Fountain grass and lantana.
FUNCTIONAL INTERPRETATION: Storage
DIMENSIONS: 4.40 m by 2.80 m 0.70 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature E is a cupboard formed around a *puka* on the eastern side of a pahoehoe floor. There are pahoehoe slabs placed vertically to form a small enclosure or C-shape around the opening. A large pahoehoe slab is sealing off the cupboard with large cobbles (c. 0.10 to 0.25 m diameter), placed between the covering slabs and the outside slabs to hold it tight. Nothing appears to be inside the cupboard.

There is a small circular enclosure located on the opposite or *makai* end of the terrace c. 2.00-5.00 m away. This circular alignment is constructed by placing pahoehoe slabs around a break at the edge of the outcrop. Size range of these stones is c. 0.20-0.47 m and the enclosed area is c. 1.10 m by 0.50 m by 0.45 m with the long axis running east-west.

FEATURE F: Mound (2)
ADJACENT TERRAIN: Undulating pahoehoe, with a slight slope to the west
VEGETATION: Fountain grass and *koa-haole*
FUNCTION: Agriculture
DIMENSIONS: 13.80 m (110°-290°) by 6.00 m by 0.15 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: This feature is a set of two low mound c. 4.00 m apart. These two sub-features have been combined into one feature letter, but were sub-designated into F1 and F2. F1 is amorphously shaped, and is roughly c. 5.00 m northeast-southwest by 5.00 m northwest-southeast. In the northeast portion of the feature a small low overhang is present. This feature is piled one-three courses and is of subangular pahoehoe c. 0.05-0.30 m in size. F2 is also amorphous, and is roughly c. 6.00 m north-northwest to south-southeast by 3.00 m north-northeast to south-southwest. A short linear area of bedrock outcrop is present in the middle of F2. This is also constructed of subangular pahoehoe c. 0.05-0.25 m in size and one-three course high.

This feature is located c. 48.40 m west from the eastern (or *mauka*) entrance of the long lava tube of the site and it is c. 8.00 m west of Feature C. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE G: Other (entryway)
ADJACENT TERRAIN: Collapsed lava tube is situated in undulating pahoehoe
VEGETATION: Fountain grass
FUNCTION: Transportation
DIMENSIONS: 3.00 m (east-southeast to west-northwest at 110°-290° by 1.40 m (20°-200°) by 1.40 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is inclined down east-southeast to west-northwest and is stacked six-eight courses high (c. 42° slope). This feature is constructed of mainly slab pahoehoe basalt ranging roughly from c. 0.16 m by 0.10 m by 0.04 m to 0.60 m 0.50 m by 0.12 m. This feature "fills" up a rock in the lava tube (collapsed) wall which runs east-southeast to west-northwest, and is on the west-northwest end of the crack.

This feature is set on the southeast edge of the (upslope) entrance to this site (lava tube cave and associated surface features) and is on the southwest end of the collapsed tube which continues upslope to the northeast. The feature provides access to the collapsed tube and the tube line beyond. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE H1: Enclosure
ADJACENT TERRAIN: Within sinkhole with westerly sloping pahoehoe field
VEGETATION: Fountain grass
FUNCTION: Multiple
DIMENSIONS: 9.00 m by 8.50 m by 2.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: H1 (enclosure) is c. 4.30 m north-south by 3.55 m east-west). The enclosure is half oval in shape and the northern and western sides are the sink walls. The area is overhang by the sink c. 2.00 m. The entrance is in the southern wall which is constructed of large boulders (c. 1.14 m by 0.70 m by 0.45 m) and a large slab (c. 1.50 by 1.10 m by 0.26 m). The slab forms the southeast corner of the enclosure. The eastern wall of the enclosure is formed by H2 (terrace). This wall is c. 0.78-1.10 m high, highest where is abuts the sink wall. This wall is slightly concave. A pahoehoe slab (c. 0.65 m by 0.38 m by 0.10 m) is embedded along the southwest interior corner of the enclosure.

A possible crudely piled wall (c. 1.00 m by 0.30 m by 0.35 m high) projects westward. Behind the slab are numerous basalt cobbles filling a space beneath a large basalt boulders. The enclosure floor is littered with overhang roof fall slabs. A waterworn basalt (c. 0.23 m by 0.16 m by 0.65 m) is present near the center of the enclosure and under the overhang. In the northeast interior corner of the enclosure, in a small hole (*puka*) within the overhang is a concentration of *kukui* nut fragment and a small charred stick. Beneath the overhang/roof fall slabs a possible pavement of basalt cobbles (c. 0.08-0.14 m in diameter) can be seen.

FEATURE H2: Terrace
ADJACENT TERRAIN: Within sinkhole with westerly sloping pahoehoe field
VEGETATION: Fountain grass
FUNCTION: Multiple
DIMENSIONS: 9.00 m by 8.50 m by
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: H2 (two tiered terrace) as a whole is triangular shaped and measured c. 5.95 m along base (southern edge) and c. 7.00 m from the base to the apex. The last c. 2.00 m of the apex is under the overhang along the northern sink wall. The upper tier is constructed of larger rocks than the lower tier. The upper tier (triangular shaped) has two levels. The upper tier is constructed of large basalt slabs (c. 0.30 m by 0.25 m by 0.15 m to 0.80 m by 0.45 m by 0.12 m) and equally large boulders, stacked to form the outer walls of the upper tier. Slabs are both upright and laying flat. The western wall of the terrace delineates the eastern interior of the enclosure (H1). The surface of the upper tier is of medium sized cobbles to slabs slightly larger than the smaller slabs used in the terrace walls. These slabs are laying flat, the upper and lower levels of the upper terrace are separated by an upright slab (c. 0.69 m by 0.60 m by 0.10 m). The upper level is c. 0.40 m higher than the lower lever. Neither surface of the upper tier as very smooth. The lower tier of H2 (terrace) is immediate east of the upper tier. The lower tier is c. 0.40-0.80 m lower than the upper tier. The southern edge of the lower tier is collapsed. The surface of the lower tier is generally composed of c. 0.08-0.14 m diameter cobbles and is fairly level, where as the upper tier slopes slightly southward. Near the center and along the retaining wall for the upper tier, the remains of a stacked wall are visible (c. 0.50 m by 0.30 m by 0.40 m high). To the immediate north of the wall (two-three courses high, one course wide) is a large red slab (c. 0.53 m by 0.52 m by unknown thickness). The red is natural coloring of the basalt. Other scattered rocks lay around the slab, possible remnant of a wall (forming a small enclosure around the slab). The slab could not be moved. The southern edge of the lower tier is constructed of large boulders stacked along the edge. The east and north edges of the lower tier are formed by the sink wall. One waterworn basalt cobble (c. 0.18 m in diameter) was noted near the southwest corner of the lower tier. Due to the construction and morphology of H2 (terrace), it may have served as ceremonial.

FEATURE H3: Terrace
ADJACENT TERRAIN: Within sinkhole with westerly sloping pahoehoe field
VEGETATION: Fountain grass
FUNCTION: Multiple

DIMENSIONS: 9.00 m by 8.50 m by
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: H3 (terrace) is located c. 0.80 m south of H1 (large slab forming southeast corner) and H2 (terrace). Between H3 and the other features a probable walkway is present. An upright basalt slabs and boulders define the southern edge. The walkway trends (110°-290°) and terminates at the cave entrance (just inside drip line). A step (c. 0.50 m high) is formed by crudely stacked boulders and slabs. The slabs may be a result of overhang fall. In the opposite direction the walkway can be followed until it disappears into the tall thick fountain grass. Total length is c. 4.00 m. To the immediate south of the walkway crudely piled/stacked boulders form the crude terrace (H3). The crude terrace is c. 3.00 m (110°-190°) by 1.80 m slabs from the overhang are on the terrace. The *papamu* board (Feature I3) is present on the overhang over this terrace. The slabs and boulder of H3 are under lain by cobbles generally c. 0.08-0.12 m diameter. A fractured waterworn basalt rock (possible pecking present) lays on western edge of H3. The upright slab on the southern edge measure c. 0.65 m by 0.45 m by 0.14 m and is embedded into the terrace/walkway. The southern edge and part of the western edge are bounded by the sink walls. Numerous urchin body shell fragment and some *kukui* nut fragments are present along the western terrace's edge and sink wall.

FEATURE H4: Cupboard
ADJACENT TERRAIN: Within sinkhole with westerly sloping pahoehoe field
VEGETATION: Fountain grass
FUNCTION: Storage
DIMENSIONS: 1.00 m by 0.90 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: H4 (cupboard) is situated within the western retaining wall of H2. A possible second cache is also present. Both caches would open into the enclosure. The cache is formed by space between the upright slabs of the retaining wall and the ceiling is of the crudely stacked/piled terrace floor. An opening c. 0.45 m high and c. 0.70 m deep and c. 0.30 m wide is present. A urchin body shell and several *kukui* nut fragment are within the cave. Other slabs are toppled over in front of cache. The possible cache is a small opening (c. 0.45 m by 0.20 m by 0.30 m high) is formed between an upright slab and boulder. A slab is over the top. No cultural material within cache. Slabs are also laying about nearby.

FEATURE I1: Petroglyph (4)
ADJACENT TERRAIN: Undulating pahoehoe flows with a large (c. 40.00 m east-west by 15.00 m (north-south) depression just to the north
VEGETATION: Moderate growth of fountain grass
FUNCTION: Communication
DIMENSIONS: 0.75 m by 0.50 m
CONDITION: Good-excellent
INTEGRITY: Unaltered
DESCRIPTION: A flat pahoehoe flow contains a small area of three-four different petroglyphs in a c. 0.60-0.75 m circle. All petroglyphs are human in form. One petroglyph is complete with a triangular center and two petroglyphs are incomplete. Feature I2 is c. 6.20 m at 100°. This feature is east of *konane* cave entrance, on a flat ridge of pahoehoe flow. Feature H is at 325° at c. 15.00 m. The *mauka konane* cave entrance is at 50° and c. 20.00 m.

FEATURE I2: Petroglyph (2)
ADJACENT TERRAIN: Undulating pahoehoe flows with a large (c. 40.00 m east-west by 15.00 m (north-south) depression just to the north
VEGETATION: Moderate growth of fountain grass
FUNCTION: Communication
DIMENSIONS: 0.70 m by 0.40 m
CONDITION: Good-excellent
INTEGRITY: Unaltered

DESCRIPTION: A flat pahoehoe flow contains a small area of two different petroglyphs. One petroglyph is a pecking of c. 0.60 m small circles in an amorphous arrangement. The other petroglyph is of a human figure. The dimensions are c. 0.75 m east-west by 0.40 m north-south.

This feature is east of *konane* cave entrance, on a flat ridge of pahoehoe flow. Feature H is at 325° at c. 15.00 m. The *mauka konane* cave is at 50° and c. 20.00 m.

FEATURE I3: Petroglyph
ADJACENT TERRAIN: Undulating pahoehoe flows with a large (c. 40.00 m east-west by 15.00 m (north-south) depression just to the north
VEGETATION: Moderate growth of fountain grass
FUNCTION: Recreation
DIMENSIONS: 0.60 m by 0.60 m
CONDITION: Good-excellent
INTEGRITY: Unaltered
DESCRIPTION: This feature consists of a *papamu* board. It is found on the west edge of a large depression, on the upper pahoehoe flow ridge. This board contains approximately one hundred (100) small circles aligned in eleven (11) lines north-south and ten (10) lines east-west. The size of the board is c. 0.60 m by 0.60 m square. Feature I2 is c. 7.00 m at 152°. The circles of game board are for the most part c. 0.05 m apart from each other.

This feature is east of *konane* cave entrance, on a flat ridge of pahoehoe flow. Feature H is at 325° at c. 15.00 m. The *mauka konane* cave is at 50° and c. 20.00 m.

FEATURE I4: Pecked stone (2)
ADJACENT TERRAIN: Undulating pahoehoe flows with a large (c. 40.00 m east-west by 15.00 m (north-south) depression just to the north
VEGETATION: Moderate growth of fountain grass
FUNCTION: Recreation
DIMENSIONS: 0.94 m by 0.42 m
CONDITION: Good-excellent
INTEGRITY: Unaltered
DESCRIPTION: A flat pahoehoe flow containing two small areas of pecking. The dimension of entire area is c. 0.94 m east-west by 0.42 m north-south. It is located c. 4.20 m at 11°. This feature is east of *konane* cave entrance, on a flat ridge of pahoehoe flow. Feature H is at 325° at c. 15.00 m. The *mauka konane* cave is at 50° and c. 20.00 m.

FEATURE J: Excavation
ADJACENT TERRAIN: Undulating pahoehoe flows. There is a relatively flat area with three sinks to the east.
VEGETATION: Fountain grass.
FUNCTIONAL INTERPRETATION: Quarry
DIMENSIONS: 8.00 m by 5.00 m by 0.67 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature J is a large linear depression which appears to be a pahoehoe excavation with the remaining stones shaped as a C-shape around the surface of the ridge. The opening of the C-shape faces east. The stones removed from the depression and placed around and on top of the surface are one course high and composed of subangular, pahoehoe basalt materials. These stones are small to large boulders ranging in size of c. 0.24 to 0.75 m in diameter. There is an opening at the western end of the depression which is 0.41 m high and 0.83 m wide and continues back underground to the west. This tube is too small to investigate.

FEATURE K: Terrace
ADJACENT TERRAIN: It is surrounded by undulating pahoehoe flows.
VEGETATION: Fountain grass.

FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 8.00 m by 3.00 m by 0.70 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A rectangular terrace with the southern edge built up to meet the northern edge of bedrock. The surface is relatively level and flat. The terrace is constructed with small cobbles to large boulders. The stones range in size from c. 0.20 to 0.55 m in diameter and are composed of subangular, basalt, pahoehoe material. The southern end is at the bottom of the sink and the northern edge is three quarters of the way up.

FEATURE BA: Terrace
ADJACENT TERRAIN: Undulating pahoehoe flows. Cave entrance is in a large depression.
VEGETATION: Fountain grass, vervain, and *'ilima*.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.50 m by 1.10 m by 1.21 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature BA is a terrace built around the entrance of the cave. The cave entrance opens to the east below ground level. The boulders are stacked 1 to 2 courses high to meet the ground surface c. 1.10 m east of the entrance. This produces a level area and a step into the cave. These boulders consist of pahoehoe, basalt subangular material and range in size of c. 0.30 m to 0.75 m in diameter. An upright is placed in the center of the terrace at 0.55 m from the east and west edges of terrace. This upright is triangular in shape and is c. 0.39 m high and 0.35 m wide with a 0.06 m thickness. Within the cave entrance the terrace turns into an alignment. This is 1-2 courses high, stacked boulder material, and same material as the terrace. This alignment runs east-west at c. 1.6 m and is 0.75 m north to south. The terrace and alignment this slopes downward to the floor of the cave.

FEATURE BB: Wall
ADJACENT TERRAIN: The entrance to the cave is composed of loose aa cobbles and boulders.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.40 m by 0.75 m by 0.95 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The entrance to the cave consists of loose aa cobbles and boulders which slope from the entrance north for c. 5.00 m to a bare level cave floor. On the western edge of this talus, aa boulders c. 0.45 to 0.55 m have been stacked on top of the northern edge of the talus to create a retaining wall.

This wall is c. 1.85 m and 0.95 m high on the north side from the top of the wall to the cave floor. This side is comprised of two loose boulders stacked against the talus and one large boulder stacked on top of the talus (c. 0.30 m high). On the western side the wall abuts the side of the cave on the eastern side it abuts the natural talus slope. The top of the wall is c. 0.65 m below the cave ceiling. From the eastern end a second wall extends northeast c. 2.40 m. The southern end of the wall is comprised of nine large boulders (eight aa boulders and one pahoehoe slab) stacked two courses high above the cave floor. These boulders extend to within c. 0.45 m of the talus slope. From this point the wall is comprised of aa cobbles. The wall widens from c. 0.40 to 1.20 m. This section probably consists of slight modification to a portion of the natural talus slope. The north end of this wall is c. 1.40 m from the western side of the cave. This creates an enclosed area on three sides defined by the first wall on the south. The cave wall on the west and the second wall which is oriented fairly parallel to the cave wall on the east. The interior of this enclosed area is fairly level but is still covered with scattered aa cobbles. One large pahoehoe slab placed convex side up was noted adjacent to the base of the southern wall. This enclosed area is c. 2.60 m by 1.40 m by 2.50 m high. Behind the south wall the talus slopes west to the cave's west side, leaving a slightly open cave. A crew member climbed back as far as possible in this area, but no burials were seen and it could not be determined if this talus blocked a smaller tube.

FEATURE BC: Pavement
ADJACENT TERRAIN: Inside cave surrounded by pahoehoe basalt material. The location is under a sky light.
VEGETATION: Very dense *laua'e*.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 5.10 m by 4.10 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a one course high pavement constructed with large cobbles (0.03 - 0.07 m) and boulders (c. 0.25 by 0.47 m) made of pahoehoe basalt. Subangular material. The pavement runs north to south for c. 5.10 m and hits the southern wall of cave. The pavement continues west for c. 3.10 m and thins out to an alignment with larger boulders c. 0.30 by 0.45 m. The surface is flat. Two large roof fall boulders c. 2.00 by 2.75 m are near the paving. One of the roof fall boulders is Feature BF.

FEATURE BD: Mound
ADJACENT TERRAIN: The mound is built on top of the cave floor. The western edge abuts, partially, the east blocked tube between the western and middle chamber. The northern end abuts the north cave wall.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 1.05 m by 0.80 m by 0.30 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The mound is constructed of aa cobble boulders (c. 0.15 x 0.30 m). The rocks are loosely piled in a rough oval two to three courses high.

The rocks are very loosely packed, so that the cave floor can be seen through the feature in several places. The center of the feature is piled up less than the perimeter rocks so the feature appears more as a rock ring than a classic mound. This indicates the feature may have been used as a hearth. However there was no charcoal, ash, ecofactual material or soil on the feature interior.

FEATURE BE: Midden
ADJACENT TERRAIN: Inside cave. All pahoehoe basalt material
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.00 x 0.80
CONDITION: Excellent
DESCRIPTION: An oval-shaped ash deposition the floor of the cave with fourteen (14) cobbles and boulders placed one course high in an amorphous shape around ash deposit. The ash is white and gray colored and the stones are c. 0.05 by 0.35 m in diameter with basalt, pahoehoe subangular material.

Another hearth or fire ring is found c. 2.30 m to the southwest and exhibits better construction than the one above. The latter one does not contain any ash or charcoal. It measures c. 1.60 m by 0.80 m and has stones placed around a deposit of bone, *kukui* nut and *Echinoid* sp.. The stones are large cobbles to small boulders ranging in size from c. 0.04-0.38 m.

FEATURE BF: Midden
ADJACENT TERRAIN: Lava boulder is located on top of roof fall or the cave floor.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.20 m by 2.10 m by 0.60 m
CONDITION: Good
INTEGRITY: Unaltered

DESCRIPTION: A loose roughly triangular aa rock is located on the cave floor. The sides of the triangle are c. 2.20 m by 1.80 m by 2.10 m. It is c. 0.43-0.60 m high. The ceiling is c. 3.50 m above the cave floor at this point. The surface of the boulder is irregular with depressions.

The depressed areas contain a thin deposit of ashy soil with burnt and unburnt *kukui* nut, *Echinoid* sp. fragments and bone fragments. The northeast to southwest side has a midden concentration c. 0.72 m x 0.50 m. Adjacent and southwest of the concentration is a protuberance. On this protuberance is a goat mandible half (R) a cowry shell lure and a basalt abrader. On top of the northwest corner is a concentration of ash (no soil) 0.40 m by 0.23 m. A complete mouse skeleton was also noted in this area. A small concentration c. 0.10 m of ashy soil was also noted in the northwest-southwest side.

FEATURE BG: Terrace
ADJACENT TERRAIN: The eastern end of the middle chamber is filled with roof fall of aa cobbles and boulders.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.30 m by 1.10 m by 1.85 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The aa boulders (c. 0.25-0.40 maximum diameter) and aa slabs c. 0.20 by 0.40 by 0.07 m have been stacked against and on top of the edge of a natural rock fall pile. The rocks have been stacked three to four courses high extending from the south wall of the cave to a large aa boulder. This boulder constitutes of c. 1.10 m of the height above the case floor. The western side is elevated c. 1.70 m above the bare cave floor, it abuts the cave wall on the south side and is level with the top of the roof fall on the north and east sides. The west side is not faced. On the cave floor at the base of the west side there is a scatter of soil ecofactual material. A bone needle was noted on a shelf near the base. The surface of the terrace is composed of aa pebbles and cobbles. A rectangular area c. 1.30 by 1.10 m adjacent to the east of the elevated side is fairly level. This area abuts an aa boulder on the east, part of Feature BT. The feature probably functioned as a retaining wall for a living area below the terrace. The surface of the feature is too small to be usable for a living surface.

FEATURE BH: Wall
ADJACENT TERRAIN: All pahoehoe and basalt material inside cave.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 4.10 m by 1.50 m by 1.05 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A two to six course high linear wall constructed with small cobbles to large boulders. Most of the wall is stacked and faced on both sides. The wall is constructed on the flat floor of the cave up onto the large roof fall. There is a small tube running northeast-southwest, but it is not completely closed off on the sides. The wall is constructed from the floor up to where the sides are open on the lava tube to close the tube off. There is an exit and entrance to the cave. The top of the wall is level. The stones range in size of c. 0.02 by 1.05 m and are pahoehoe, basalt subangular and flat stones.

FEATURE BI: Wall
ADJACENT TERRAIN: Location is inside cave. All are pahoehoe and basalt materials.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 3.93 m by 1.71 m by 1.46 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A linear wall constructed two to six courses high with medium size cobbles to large boulders. This wall is built on top of a smooth cave floor and runs northeast to southwest and abuts Feature BH.

This wall continues the blockage of a lava tube described in Feature BH notes. This wall extends the tubes entrance farther northeast. Also this wall constructs a narrow c. 0.90 m passageway between Feature BV and this feature. A goat skeleton is at the northern end of the wall and inside the lava tubes entrance. The stones range in size from c. 0.05 by 1.46 m and are pahoehoe basalt subangular material. The wall is stacked and faced on both sides. Two large boulders sit alone as uprights to finish the extension of the wall. The two large boulders range in size c. 0.75 by 0.57 m and 0.50 m by 0.49 m.

FEATURE BJ: Pavement
ADJACENT TERRAIN: Inside cave, with all pahoehoe and basalt material.
VEGETATION: None except at the skylight which contains *laua'e*.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.80 m by 2.20 m by 0.26 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A linear pavement running north-south for c. 2.8 m. This feature is one to two courses high with a level surface. It is constructed with small cobbles to small boulders. The stones are basalt, pahoehoe subangular materials and range in size from c. 0.04–0.34 m. There is no particular arrangement to the placement of the stones.

A small circular ash deposit c. 0.10 by 0.10 m is found within the pavement at the southern end. This deposit also contains charcoal. The *kukui* nuts are found adjacent to the feature at the southeast end. A dog bone is placed in the center of the feature.

FEATURE BK: Midden
ADJACENT TERRAIN: The ash concentration is on the cave floor and the north end of the middle chamber.
VEGETATION: *Laua'e*
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 7.20 m by 1.86 m
CONDITION: Good
INTEGRITY: Altered
DESCRIPTION: This feature consists of ash and ashy soil over the cave floor. It extends to within c. 1.20 m of the southern wall of the cave on the south side to natural piles of rock fall on the west. There is an alignment of boulders on the north and to a sudden drop in the cave floor (modified into a terrace Feature BG) on the south. The cave floor slopes to the west so the deepest part of the concentration (c. 0.04–0.05 m) is adjacent and extends into the rock fall to the west. This area may have been cleared at one point, but is now covered with scattered aa cobbles and boulders. It looks like the large boulders have been cleared away and placed close to the eastern cave wall. The wall consists of an alignment of two aa slabs on the edge and one boulder from the cave wall to the rock fall pile. The midden extends under Burial No.1.

On top of a large boulder (part of the rock pile) near the northwest corner of the feature someone has recently collected several ecofacts and artifacts. These were probably collected from the midden surface (therefore the feature is altered). These include a dog and pigs upper canine, an *opihi* shell, and oval basalt abrader, a razor coral abrader, three bone needles, one fish spine, two scoria abraders an *Echinoid* sp. abrader, and a basalt abrader. The ash concentration consists of burnt and unburnt *kukui* nut shell, marine shell, cowrie fragments, bone and *Echinoid* sp. fragments. A gourd fragment was noted by Burial No.1. Three possible bone needles and a dog mandible were found on a rock near the southwest corner of the feature. The midden extends on top of the lone boulders in some places.

FEATURE BL: Enclosure
ADJACENT TERRAIN: The feature is constructed on the cave floor. There is a great deal of roof fall in this area. The ceiling is c. 3.10 m above the cave floor at this point.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 1.05 m by 1.00 m by 0.70 m
CONDITION: Good

INTEGRITY: Unaltered
DESCRIPTION: A square enclosure has been constructed by stacking aa boulders (c. 0.25 to 0.60 m) between two large aa boulders. The boulder on the east side is c. 1.40 m by 0.90 m by 0.80 m. The western edge is oriented at roughly 165°-345°. The western boulders are c. 2.75 m by 1.85 m. These boulders are probably in the natural position. The southern side of the enclosure is composed of aa boulders stacked three-four courses (c. 0.60 m) high on the cave floor between and perpendicular to the two boulders.

This wall is c. 1.08 m by 0.70 m. The northern wall is c. 1.12 m by 0.70 m by 0.90 m. It is composed of large aa boulders on the bottom and aa slabs stacked 3 to 4 courses high between the large aa boulders. The enclosed space is c. 1.05 m by 1.00 m. The floor of this enclosure is fairly clear of scattered aa rock. The midden is fairly thin here. There are some bird eggs at the bottom. A large aa slab c. 1.04 m by 0.02 m by 0.18 m is partially upright at the north corner of the enclosure. There are scattered aa boulders and slabs on top of the two large aa boulders. It is possible that this feature represents a burial crypt that has been opened. This would mean that the upright slab was a capstone.

FEATURE BM: Wall
ADJACENT TERRAIN: This location inside of the cave which composed of pahoehoe basalt materials.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.00 m by 1.00 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A semi-circular wall abuts natural roof fall and Feature BL. This feature is constructed with small cobbles to small boulders, stacked two to four courses high. Between the wall and the roof fall, small cobbles are placed on the floor to make it level.
These small cobbles contain pahoehoe, basalt, subangular materials and range in size from c. 0.02-0.05 m in diameter. The wall is constructed with larger stones made of the same material and ranging in size of c. 0.05-0.36 m . The opening would face the south, but natural roof fall is enclosing the wall. The feature appear as a possible storage area.

FEATURE BN: Midden
ADJACENT TERRAIN: Inside cave with pahoehoe basalt materials.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.20 m by 0.60 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This is an area with burnt *kukui* nut concentration c. 0.06 m deep and mixed with soil. This concentration is oval shaped and contains one *hua hala* (pandanus seed) at the northeast edge of the scatter. Two large roof fall boulders c. 0.50 m by 0.75 m sit upon scatter and are not associated with the scatter. This scatter sits upon roof fall and abuts large natural roof fall (c. 6.40 m by 6.10 m in diameter).

FEATURE BO: Wall
ADJACENT TERRAIN: Location in cave interior
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.90 m by 1.70 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A C-shape wall is stacked one-three courses high. It is constructed with large cobbles to small boulders with the opening facing west. A large roof fall boulder (c. 1.10 m by 1.10 m) is blocking the opening of the C-shape and makes the feature appear to be a small enclosure. The stones range in size from c. 0.05-0.61 m and made of pahoehoe basalt subangular material.

The inside of the C-shape is constructed with a small cobbles and one large boulder. The C-shape wall is constructed with large stones. The C-shape slopes downward to the north.

FEATURE BP: Enclosures (2)
ADJACENT TERRAIN: Cave floor slopes steep to the west of this area. North of the feature the cave floor is bare.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.00 m by 1.00 m by 1.00 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Two small enclosed areas (No.1 and No.2) were created by piling rocks between large aa boulders (roof fall). The two enclosures share a common wall, No.1's north wall and No.2's south wall. Enclosure No.1 is composed of natural roof fall as the southeast corner. Aa cobbles have been piled two-three courses high to create a eastern, north and west wall.

The south wall is composed of a large boulder at the end and aa slabs at the other. This created a rectangular enclosed space c. 0.84 m by 0.40 by 0.55 m. There is some ash and midden in this area. Enclosure No.2 - the south and east side are formed by a large boulder, this north side of the wall shared with No.1 and the east side to Feature BM which is c. 0.20 m above the cave floor at this point. This created a rectangular enclosed area c. 0.73 m by 0.65 m by 0.76 m oriented at 42°-222°. This enclosed area has roof fall aa pebbles and small cobbles and a thin deposit of soil.

FEATURE BQ: Alignment
ADJACENT TERRAIN: Cave floor slopes gradually to the west to entrance of the east lava tube.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.40 m by 0.34 m by 0.65 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The northern edge of a large aa boulder (c. 1.46 m by 1.70 m by 0.62 m) which is part of the natural roof fall pile in the center of the chamber, defines the southern boulder of the feature. A naturally placed large boulder (c. 1.60 m by 1.50 m by 1.50 m) defines the western side of the feature. An alignment of aa boulders extends from the north edge of this boulder. The alignment is oriented parallel to the first large boulder. This results in a U-shaped enclosed space c. 2.07 m by 0.95 m (130°-310°) with the eastern side open. This enclosed area contains ash and ashy soil (c. 0.01-0.04 m thick) charcoal flecks ecofacts (*Echinoid* sp., bone, marine shell [*opihi* and cowrie], and *kukui* nut shells) in the east half and filled with small aa pebbles and cobbles in the west half. The alignment is composed of large aa boulders or aa slabs placed on edge. The alignment is not continuous, but this may be due to collapse rather than the original condition.

FEATURE BR: Midden
ADJACENT TERRAIN: The midden is on a level cave floor along the eastern wall of the cave floor.
VEGETATION: *'Iwa'iwa* and *uluhe* near the SE corner of midden.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 8.00 m by 8.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The midden consist of ash and ashy soil c. 0.01-0.05 m thick on the cave floor. There are scattered aa cobbles and boulders on the cave floor, but it appears that most of these have been cleared away and piled on the south corner near the alignment that separates this feature from Feature BK. The cave wall is c. 1.00 m from the roof fall pile at the south end. The cave widens from the roof fall towards the middle. The cave narrows again at the north end so that the ash is located in a semicircle. About eight aa slabs are placed horizontally on the cave floor in this semi-circle. Above the slabs, the ceiling gets lower to the east and higher to the west. Among those slabs is the dental portion of a left mandible

of a pig. The slabs would have made good sitting places. A collection of *'ili 'ili* stones is located at the north end. This was designated Feature BS.

The midden continues under the edge of the rock fall pile toward the center of the chamber and down the north wall of the cave to the eastern lava tube.

FEATURE BS: Midden
ADJACENT TERRAIN: The feature is located on a level bare section of the cave floor against the north wall of chamber.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.07 m by 1.01 m by 0.03 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The midden concentration is located within Feature BR (a midden concentration which covers the northeast corner of the central chamber). It was treated as a separate feature because of its unique contents. Except for these contents there is no clear dividing line between these two concentrations. Feature BR contains soil, ash, *kukui*, *Echinoid* sp., fish bones, and marine shell. The ash, marine shell present in this feature is cowry halves and an occasional large *opihi* shell. Feature BS also contains soil, ash, *kukui*, *Echinoid* sp., fish bones and marine shells. However the species represented is quite different. There were no cowry shells, there were only a few Nerita picea, *Drupa* sp. and *opihi* shells on the surface. Charcoal flakes were very noticeable on the surface. In addition there were about nine white waterworn pebbles and three black waterworn pebbles (*'ili 'ili*). These pebbles were c. 2.50 m in diameter. Most of the stones are clustered near the northern cave wall. The stones are rather uniform in size and may be *konane* game pieces. At the eastern end of the feature is a horizontal aa slab with a rough surface. On the slab is pencil urchin spine, modified so that the distal end is a sharp point (the spine was not used for abrasion), and six small red stones. The stones are soft and may be some type ochre. In the other tube cave are bird bones and many fish bones and urchin remains.

FEATURE BT: Alignment
ADJACENT TERRAIN: Cave floor is covered with rock fell of aa cobbles and boulders.
VEGETATION: None
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.10 m by 0.45 m by 0.32 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: About ten-fifteen (10-15) aa boulders and slabs (c. 0.50 m maximum diameter) have been roughly placed in a line across a large aa boulder. The alignment abuts the cave wall on the south side. This aa boulder is broken on the east side leaving hollow area under the rock. An area c. 1.20 m by 0.90 m east of the boulder is depressed c. 0.30 m below the surface of the rest of the rock fall. This oval depressed area may represent a fire pit with the alignment constituting the western border. There was no ash, soil or ecofactual material in the interior of the depressed area. There were a few aa slabs on a shelf south of the feature which may be rocks removed to make the depressed area.

FEATURE BU: Other (water catchment)
ADJACENT TERRAIN: Cave interior mostly of pahoehoe, and some aa roof fall.
VEGETATION: *'Iwa'iwa* and *noni* under skylight.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 1.13 m by 0.90 m by 0.30 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Feature BU is a modified outcrop placed near the cave wall. It is situated on a sloping ledge and consists of medium pahoehoe boulders (c. 0.40 m average diameter) placed one or two courses high in a rough circular alignment (c. 0.20 m by 0.30 m) on all but the western sides. The interior is directly under a drip and would have been a suitable place for an *ipu* gourd.

FEATURE BV: Platform
ADJACENT TERRAIN: The south end of the feature is constructed at the base of the middle chamber. The cave floor slopes downward abruptly from the middle chamber to the east tube. There is a great deal of rock fall at the south end of the feature.
VEGETATION: No vegetation
FUNCTION: Multiple
DIMENSIONS: 5.00 m by 3.20 m by 0.30-1.50 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: The feature is a two-tiered rectangular platform, with a linear terrace (No.1) adjacent to and below the south side of the platform and a semi-circular terrace (No.2) constructed on top of the southeast corner of the platform.

The platform is constructed against the east wall of the cave. Therefore, the north and west sides are free-standing, the south wall is elevated slightly above terrace No.1, and the east side abuts the cave wall.

The upper tier of the platform is c. 1.50 m long on the west side, c. 2.10 m on the south side, c. 1.10 m on the east side, and c. 1.05 m on the north side. The north and west sides are simply extensions of the north and west sides of the tube lower tier. The east and south sides are free-standing and are elevated c. 0.38-0.50 m above the surface of the lower tier. The east side of the tier does not abut the east cave wall. There is a space c. 0.83 m wide between the east side and the cave wall.

This tier is constructed of aa cobbles and boulders and aa and pahoehoe slabs (c. 0.15-0.45 m in maximum diameter). The east wall is composed of aa boulders stacked two to three courses high. The exact construction of the north side cannot be discerned since it is obscured by one course of aa slabs that have been placed vertically against the side. The north and west wall are extensions of the lower tiers and will be discussed later. The perimeter stones of the tier are slightly elevated (c. 0.10 m) above the interior fill, which is composed mainly of aa cobbles and small boulders (c. 0.15-0.30 m in maximum diameter). A few aa and pahoehoe slabs are placed horizontally on the surface, but no attempt was made to make the interior particularly level or smooth.

The north wall of the lower tier is c. 1.65 m long at the top of the platform (top of upper tier) and c. 3.40 m long at the base. This is the result of the platform being constructed against the east wall of the cave. Since the ceiling height decreases towards the east, the base is much longer than the top. The northeast corner of the terrace has collapsed, and there is a scatter of loose aa boulders north of the platform. There seem to be more boulders in this area than can be accounted for by the collapse, however. The north side is slightly convex. From northeast corner to northwest corner, the sides are oriented at 130°-310°.

The wall is c. 4.30 m long at the top, and c. 4.00 m long at the base. Both the north and west walls are built over the base-level cave floor of the east tube. The north wall is c. 1.40-1.50 m high from cave floor to the top of the upper tier. The west wall is c. 1.50 m high at the northwest corner (from cave floor to top of the upper tier) to c. 1.10 m high (from cave floor to top of lower tier) to c. 1.10 m on the southwest corner (cave floor to top of lower tier). Both sides are constructed in the same way. However, the upper tier is present along the west side only from the northwest corner to c. 2.00 m south (this makes up the west wall of the upper tier). Both sides were constructed of aa boulders stacked three to six courses high at the base. An aa slab was thus placed vertically, obscuring these courses (courses were counted in the collapsed northeast corner where the aa slab had fallen). This constituted c. 1.10 m of the height as the north wall and the north portion of the west wall. Above the boulders, aa and pahoehoe slabs were stacked horizontally three to five courses high (c. 0.30-0.40 m of the height). These slabs were c. 0.35-0.50 m in maximum diameter and c. 0.05-0.10 m thick. There was no attempt to stack the slabs so the ends aligned. At the south end of the west wall, aa boulders were stacked two to three courses at the base with two to three horizontal slabs on top. The top of the basalt boulders at the northwest corner (base of upper tier) is level with the top of the southwest corner (surface of lower tier) including the basalt boulders and the horizontal slabs. This is evidence that the upper tier was not built at a later date, since the construction technique is the same, although the height varies. The west wall is oriented at 10°-190°. Both the north and west walls were faced. The east end of the lower terrace abuts the cave wall. It is c. 3.30 m long and oriented at 25°-345°. Only a portion of the south wall can be observed, since it is obscured by construction of the two terraces. The top of the south wall from the

southwest corner to c. 1.64 m northeast (the wall is oriented at 84°-264°) is composed of one course of horizontal pahoehoe and aa slabs above the level of terrace No.2. It is probable that the terrace extends to the base of the cave floor, but the courses are obscured by terrace No.2. The east half is covered by terrace No.2. However, if the south wall extended to the east cave wall at the same orientation, it would be c. 3.40 m long.

Terrace No.1 is a triangular terrace which was constructed on top of the southeast corner and extends south and east to abut the base of the cave floor of the middle chamber. The cave floor at the north end of the middle chamber drops abruptly c. 1.40 m north and west. The north end of terrace No.1 is constructed on top of the platform, and the east wall of the terrace abuts the middle chamber cave. The west side of the terrace No.1 is built partially over terrace No.2 and partially over the platform. The terrace is c. 3.40 m long (24°-244°) and c. 1.76 m wide. The east side abuts the side of the cave floor, the north side is elevated c. 0.30 m above the platform, and the west side is elevated c. 0.34 m above terrace No.2. There were perimeter stones along the west side (two to three courses high of aa cobbles and boulders). The rocks range from c. 0.22-0.57 m in maximum diameter.

Terrace No.2 extends between terrace No.1 and the cave floor south. It abuts Feature BI on the west end. It was constructed of aa cobbles and small boulders. There is a steppingstone trail of pahoehoe slabs partially obscured by roof fall, which parallels the south side of the platform and extends just around the southwest corner. There is a goat skeleton mixed in with the rocks. The south side of terrace No.2 is oriented at 136°-316°.

This feature is at the south end of the east tube along the east wall of the tube. No portable remains were noted on the surface of this feature. There may be buried cultural deposits under the terrace at the south side of the feature.

FEATURE BW: Terrace
ADJACENT TERRAIN: In middle chamber inside the cave.
VEGETATION: Moderate amount of *laua'e*.
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 3.50 m by 2.60 m by 0.86 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This is a semi-circular terrace built against the north edge of roof fall from the skylight above. The north edge is built up c. 0.50 to 0.86 m above ground surface and meets the roof fall to become a level surface. This feature is constructed with large, subangular pahoehoe boulders ranging from c. 0.30-0.80 m in diameter. The edge of the terrace is stacked two to four courses high and is faced.

FEATURE BY: Other (6) lamp holder
ADJACENT TERRAIN: Inside cave. All pahoehoe materials.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Other (lamp holder)
DIMENSIONS: 0.60 m by 0.30 m by 0.26 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: These features vary in orientation and size. They range from c. 0.30 m by 0.30 m to 0.60 m by 0.40 m in size. They usually resemble cairns (at least two courses high) and generally contain charcoal/burned *kukui*. Three of the six features are constructed on the floor of the cave (on bare bedrock), with one feature on unelevated roof fall boulder near the east end of Area No.3.

These features are in a large lava tube cave. They begin in Area No.1, near the east-northeast end (c. 14.00 m), and end at the northeast of Area No.4. Marine shell and burned *kukui* fragments were observed on these features as well as in the general area.

FEATURE BZ: Modified outcrop
ADJACENT TERRAIN: Location inside of the cave.

VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 3.60 m by 2.00 m by 0.45 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature sits upon a bedrock cave surface. The feature is c. 1.00 m north of the south wall and continues north for c. 2.6 m. The feature consists of six large boulders placed in a alignment c. 0.75 m apart from each other. The alignment runs basically north to south. These subangular, pahoehoe boulders range from c. 0.35 to 0.67 m in diameter. A crescent-shaped scoria fragment is c. 1.90 m at 245° from the south end of the feature.

FEATURE BBA: Modified outcrop
ADJACENT TERRAIN: Inside cave with pahoehoe materials.
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 1.00 m by 1.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature sits upon bedrock on the floor of the cave. It is c. 1.10 m at 334° (north-northwest) from the south-southeast cave wall. The feature consists of four placed stones within a c. 1.00 m by 1.00 m area. There are three small subangular, pahoehoe boulders measuring c. 0.16 m by 0.17 m, and c. 0.28 m by 0.20 m, and one large boulder measuring c. 0.64 m by 0.27 m.

FEATURE BBB: Alignment
ADJACENT TERRAIN: Within lava tube (running *mauka* from *konane* sink)
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 0.30 m by 0.20 m by 0.22 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This is a circular arrangement of subangular to subrounded cobbles (c. 1.00 m by 1.00 m by 0.80 m) one course high. Several burned pieces of *kukui* nut and charcoal are present around the outside of the feature. A small deposit of charcoal and ash is present c. 0.50 m at 20°. The feature is on the lava tube floor near the northwest edge of a cleared area and mound (Feature BBD).

FEATURE BBC1: Terrace
ADJACENT TERRAIN: Within lava tube (running *mauka* from *konane* sink)
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 5.00 m by 3.00 m by 1.00 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature BBC-1 is a higher area that appears paved. A crudely stacked wall is present along the west edge. The east edge slopes gently down to the cleared area immediately west of Feature BBD (linear mound). The north edge of the feature is bordered by a low mound (c. 4.80 m by 2.40 m by 0.68 m) mentioned with Feature BBD. The south edge of the feature is covered with large roof fall slabs. The feature appears to be on an area of roof fall that has been smoothed by removal of larger rocks and by paving with angular to subangular slab material (c. 0.10 m by 0.10 m by 0.25 m to 0.35 m by 0.35 m by 0.45 m). Rounded rocks are present also (c. 0.10 m by 0.10 m). On the sloping east edge, a smooth section of roof fall and a possible placement of pahoehoe slabs (roof fall) are present. Along the west edge of the feature, a crude stacked wall with a cupboard is present. The terrace wall c. 1.8 m by 0.91 m abuts an extremely large boulder on the northwest end, while the southwest end of the wall abuts the roof fall along the south edge of the feature. The wall is constructed of crudely stacked large cobbles and small to large boulders. A cupboard (Feature BBC-2) is present near the middle of the terrace wall. The cupboard measures c. 1.10 m by 0.50 m by 0.26 m. Two levels are present within the

feature. The upper area measures c. 0.65 m by 0.50 m by 0.26 m. A very large boulder is present on the bottom. The lower area measures c. 0.45 m by 0.40 m by 0.86 m. The bottom is covered with loose cobbles. Immediately south of the cache laying on the terrace surface is a large pahoehoe slab c. 0.92 m by 0.35 m by 0.40 m. The slab could easily be moved by two people. It would be somewhat awkward for one. The main terraced area is c. 4.2 m by 2.5 m. At the northwest corner of the feature, a small lava tube leads down to a lower chamber. The extremely large boulder roof fall partially blocks the entrance to this lower chamber. The terrace provides an easy path to the small lava tube leading to the lower chamber as well as to Features BBD and BBB.

FEATURE BBC2: Cupboard
ADJACENT TERRAIN: Within lava tube
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 1.10 m by 0.50 m by 0.26 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The cupboard is along the western edge of the terrace (Feature BBC1). Immediately south of the cupboard (cache), laying on the terrace surface, is a large pahoehoe slab c. 0.92 m by 0.35 m by 0.40 m. The slab could easily be moved by two people.

FEATURE BBC3: Mound
ADJACENT TERRAIN: Within lava tube
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 4.80 m by 2.40 m by 0.68 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This mound is along the north edge of the terrace and against the shelf that leads the tube's outside entrance. The mound is a linear pile of angular to subangular pahoehoe, generally slabs, probably resulting from leveling off the terrace.

FEATURE BBD: Mound
ADJACENT TERRAIN: Within lava tube (running *mauka* from *konane* sink)
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Boundary
DIMENSIONS: 4.54 m by 2.30 m by 1.10 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A linear mound constructed of angular to subangular pahoehoe cobbles and boulders (c. 0.08 m by 0.07 m by 0.05 m to c. 0.96 m by 0.75 m by 0.30 m). The mound appears to have been constructed of piled roof fall. No stacking is evident. Slabs are present throughout. Several larger slabs are along the west edge. Two of these slabs have been turned on the edge and are leaning against the mound's side.

A cleared area is immediately west of the mound. It appears this was the source for the construction material. The vast majority of the surface remains are located within the cleared area. Only a few small urchin shell body fragments and a few *kukui* nut fragments are on the east side of the mound. The mound is roughly perpendicular to the long axis of the lava tube. The north end abuts a shelf, which leads to the opening. Feature BBY is on this shelf. The south end of the mound terminates under the overhanging roof. There is little space (c. 0.28 m) between the mound and the roof. The mound here slopes down to the edge of the cave and appears to stop c. 0.55 m from the cave wall. About 1.50 m northwest is another possible mound. The mound is constructed of piled rock debris. This mound is roughly parallel with the long axis of the lava tube. A relatively cleared area is south of the mound and leads to a mostly flat area, (possibly paved) and Feature BBB, Feature BBC, Feature BBZ, and the entrance to the lower chamber. An ash-like deposit is near the northwest corner. The function of the mound appears to be a boundary or divider. The mound does divide the lava tube, and east of the mound

no archaeological features are present. The west edge of the mound appears better constructed (upright slabs). It is also possible that human remains could be covered by the mound, but this is unlikely.

FEATURE BBE: Midden (77)
ADJACENT TERRAIN: Inside cave
VEGETATION: Fair-good
FUNCTION: Habitation
DIMENSIONS: 0.35 m by 0.03 m by 0.02
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: These 77 deposits vary in orientation and size, and are scattered through Areas No.3 amd No.4 of the large lava tube cave (Site 15998). In Area No.3 (the possible refuge), they are randomly scattered, while in Area No.4, they seem to be aligned in direct association with the slab-lined trail (Feature BBH), especially sections No.3, No.4, and No.5 of the trail. These deposits are usually located on the cave floor. However, these deposits are also found on elevated, raised ledges as well as on fallen boulder rubble.

Based on the distribution of the numerous BBE features, it is likely that they represent small, single episode fires used to illuminate the tube. These charcoal piles are generally located in the most easily traveled routes through the tube (i.e. the center of the tube, in areas with the least amount of roof fall, etc.). The charcoal piles range from 0.03-0.04 m in diameter, to as much as c. 0.30 m in diameter. As illustrated on the base map of the site (Figure XX), there does appear to be an association between the charcoal piles and the steppingstone trail, with the charcoal piles located along the trail.

Although much of the floor of the tube (Area No.3, possible refuge cave) contains scattered faunal bone, marine shell, and *kukui* nut, only occasional burned *kukui* nut fragments were observed in these deposits.

FEATURE BBF: Wall
ADJACENT TERRAIN: This portion of the cave contain large amounts of roof fall and has a bumpy floor surface
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 2.00 m (northwest-southeast at 130°-310°) by 0.60 m (northeast-southwest) by 0.85 m
CONDITION: Good
INTEGRITY: Habitation (refuge)
DESCRIPTION: This feature is a slightly triangular-shaped wall section which partially constricts a tube section (running east-northeast to west-southwest) that opens up into a large, slightly oval chamber. This feature is set in the west-southwest back wall of this larger chamber. It is three courses high and is constructed of roof fall slabs (basalt) c. 0.10-0.10 m in diameter.

This feature is in Area No.2 of a large tube cave. Feature BBG is c. 1.50 m northeast. Portable remains include marine shell, *Echinoid* sp., as well as charcoal scattered on the floor northeast of this feature. No cultural deposits were observed on the surface of this feature.

FEATURE BBG: Other (2) water catchment
ADJACENT TERRAIN: Rough aa and pahoehoe floor of lava tube system. Large amount of roof fall near these features
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: Area No.2 = 0.40 m by 0.40 m, Area No.3 = 0.40 m by 0.20 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: One feature is circular and one feature is oval. They are constructed underneath present condensation drips or existing mineralized stalactites (indicating past "drips"). They range from one to three courses (piled/stacked) and are composed of basalt roof fall materials.

These features are in a large lava tube cave, roughly situated in the middle area of Areas No.2 and No.3. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE BBH: Steppingstone trail (6 sections)
ADJACENT TERRAIN: Rough aa and pahoehoe floor of subterranean lava tube.
VEGETATION: No vegetation
FUNCTION: Transportation
DIMENSIONS: 2.70 m by 0.30 m by 0.15 m (approximately)
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a discontinuous, single alignment of pahoehoe roof fall and is generally composed of slab basalt. The slabs are generally placed in the most easily travelled routes through the tube (i.e. the center of the cave, in areas with the least amount of roof fall, etc.) These placed, slab-like to subangular stones average roughly c. 0.07 m to 0.30 m in diameter. The feature has possible direct association with Feature BBE (charcoal deposits - probable hearths) Feature BBE possibly lit the way for the trail. Six separate sections are in this cave, from Area No.2 to Area No.4. It is interesting to note that only a short section (c. 5.00 m long) is in the feature-dense Area No.3 (possible refuge cave).

FEATURE BBI: Midden
ADJACENT TERRAIN: On a large boulder resting directly on the floor surface of a lava tube cave with a slightly undulating (bumpy) surface. An elevated natural shelf southeast is c. 1.80 m high.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 1.17 m (east-west at 90°-270°) by 0.78 m by 0.10 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a charcoal concentration set on a large boulder (c. 2.40 m by 1.40 m by 0.25 m high), with three large cobbles/small boulders (c. 0.15-0.30 m in diameter) of roof fall basalt resting on the north-northeast side.

The charcoal concentration is c. 0.01 m deep, and is oval. The rock is in an area c. 0.50 m by 0.30 m, while the ash/charcoal is c. 0.35 m (east-west) by 0.30 m (north-south).

This feature is c. 2.00 m west of a cluster of a four charcoal concentrations (Feature BBE), and Feature BBJ is c. 12.00 m east-northeast from this feature. Feature BBI is the nearest structure to the west entrance of Area No.3, and is c. 17.00 m north-northeast from this narrow aperture. It is c. 0.20-0.40 m from the tube wall to the northwest. Portable remains include *kukui* and charcoal, within close proximity to this feature. These remains are scattered through most of this chamber, both on the cave floor and on elevated natural shelves/ledges.

FEATURE BBJ: Midden
ADJACENT TERRAIN: Set in the floor of a lava tube cave with an undulating surface.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.90 m (east-west) by 0.50 m by 0.06 m deep
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a linear, oblong charcoal deposit oriented east-west, situated on the slightly rough (bumpy) floor surface of a c. 447 m (long axis) lava tube cave. Because of the undulating of the floor, this feature has no real height above the floor surface and apparently has varying depth. This feature is in a feature-dense portion of the cave, tentatively assessed as (possible) refuge area. This feature is set roughly in the middle of the (lower) tube floor. It is also c. 2.60 m west-southwest of Feature BBK. A group of four charcoal concentrations (Feature BBE) begins c. 5.00 m southwest of Feature BBJ. A charcoal sample was collected near the middle of this feature. *Kukui* and charcoal are scattered throughout the tube cave, on the surface and elevated natural shelves/ledges.

FEATURE BBK: Alignment
ADJACENT TERRAIN: Set on the floor surface of lava tube cave with a slightly undulating (bumpy) surface.
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 2.60 m (northeast-southwest) by 0.80 m (northwest to southeast) by 0.25 m.
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This is a five small boulder (one course) alignment oriented northeast-southwest. The two boulders at the extreme end of the alignment are c. 0.60 m in diameter, while the three middle boulders range from c. 0.30-0.40 m in length/diameter. The material comprising the feature is apparently transported (basalt lava tube) roof fall. This feature is located in a feature-dense portion of the cave, tentatively assessed as a (possible) refuge area. This portion is designated as Area No.3. This feature is partially encircled by three (small size) charcoal concentrations (Feature BBE). These are c. 1.00-1.40 m northeast, north-northeast and southwest from the feature. Prehistoric cultural remains (*kukui* and charcoal) lie close to this feature, and are scattered throughout most of the chamber of this lava tube cave, both on the floor and elevated natural ledges/shelves.

FEATURE BBL: Modified outcrop
ADJACENT TERRAIN: Set on the bumpy floor surface of a linear portion of the chamber
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 1.00 m (east-west) by 0.60 m (north-south) by 0.25 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a short, wall-like modification resting on and against a large (c. 1.80 m north-south by 1.20 m east-west) roof fall boulder on the north side. One to two courses of smaller roof fall basalt, cobbles and small boulders, c. 0.13-0.42 m in diameter, are stacked. This feature is located in the west portion of Area No.3, c. 12.00 m east of Feature BBK, and within a large lava tube cave.

FEATURE BBM: Other (water catchment)
ADJACENT TERRAIN: This feature is in a tube cave with a ledge beginning against the north wall
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.80 m (north-south) by 0.60 m (east-west) by 0.45 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This gourd holder is oriented north-south and is triangular-shaped with the apex pointing northward. It is constructed of roof fall slabs. The smaller slabs average roughly c. 0.25 m by 0.50 m, and the larger average roughly c. 0.55 m by 0.40 m in size. This feature is constructed of five courses (observable) and is c. 0.20 m from the tube wall to the south.

Feature BBM is c. 10.20 m at 115° from Feature BBL in Area No.3 of the lava tube. Section No.2 of the pahoehoe slab trail (Feature BBH) is c. 4.00 m north. This feature is near the south wall, and is in the central portion of chamber. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE BBN: Wall
ADJACENT TERRAIN: Within a lava tube cave
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 10.40 m (east-west) by 2.40 m (north-south) by 0.30 m
CONDITION: Good
INTEGRITY: Unaltered

DESCRIPTION: This is a linear wall lying on and parallel to an elevated ledge (c. 1.10 m high) oriented roughly east-west. In the middle portion of the feature, two shorter connecting alignments angle perpendicular to the long axis and back toward the cave wall. This creates a compartment effect, with a charcoal concentration (Feature BBE) in the east corner area. In the center of the compartment's south wall is a large (c. 1.80 m by 0.60 m) linear flat boulder with Feature BBE. At the west end of the feature, a third feature is found. This feature is constructed of basalt roof fall cobbles and small boulders (c. 0.15-0.35 m in diameter), and is one to two courses high and one to two courses wide.

This feature is in the central, east portion of Area No.3 in a lava tube. It is on an elevated ledge on the north side of the lava tube. Below to the south, starting at c. 2.00 m, Feature BBQ and Feature BB lie on the cave floor. Portable remains include bone (fish and mammal) scattered throughout this feature on the ledge. A dog tooth was located and plotted on the site map (east end). No subsurface cultural deposit was observed at this feature, as it rests on a bare bedrock ledge.

FEATURE BBO: Enclosure
ADJACENT TERRAIN: This feature is built on the lower floor surface of the cave, with elevated natural ledges against both sides of the tube (north and south).
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 2.60 m (north-south) by 2.00 m (east-west) by 0.70 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: This feature is roughly rectangular and is oriented north-south. The east wall (running north-south) is c. 1.00 m longer than the west wall, creating a widening of the enclosure to the east. This east wall is composed of four cobbles (c. 0.20 m by 0.20 m), forming a slightly discontinuous alignment. The north, west, and the south walls are created by piling and stacking (one to three courses high) roof fall slabs c. 0.20-0.40 m in length/diameter. The middle of the west wall has a jutting/elevated outcrop extending from the floor of the cave. A section of coral abrader was observed and plotted (not collected) on this outcrop. Clinker stones (thin roof fall fragments) lie in the middle of this feature. The southeast corner abuts the central portion of the west wall of enclosure Feature BBQ.

This feature is set in the middle of the tube floor and is at 83° and c. 26.00 m from Feature BBM. This feature is located in the central east portion of Area No .3. A *Cypraea* sp., octopus lure, was observed c. 2.00 m south, also on a raised outcrop.

FEATURE BBP: Alignment
ADJACENT TERRAIN: On a raised ledge on the south-southeast side of the tube (running roughly west).
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 2.60 m (east-northeast to west-southwest at 68°) by 0.40 m by 0.25 m
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: This feature is one course wide, one course high, and is oriented east-northeast to west-southwest. This feature is composed of cobbles and small boulder c. 0.15-0.40 m in length/diameter. It rests roughly c. 0.60 m south-southeast from a westward-running ledge (c. 2.00 m wide) jutting from the south-southeast (upper) back tube wall. This feature is located in the central, east portion of Area No.3. It is on and runs parallel to an elevated ledge. This feature is c. 1.20 m above and south of Feature BBQ. No portable surface remains were observed directly with this feature. However, dog bone (mandible, etc.) was located c. 1.00 m the south of the west-southwest end of the alignment.

FEATURE BBQ: Enclosure
ADJACENT TERRAIN: An elevated ledge (with Feature BBN) is to the north-northwest on the opposite side tube wall, while an elevated ledge serves as the south wall of the structure. The feature is built on the floor of the cave.
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 6.80 m (east-west at 80°) by 2.80 m (north-south) by 0.50 m
CONDITION: Fair-good

INTEGRITY: Unaltered
DESCRIPTION: This feature is a linear rectangle, and is oriented roughly north-south. The north wall is constructed of small boulders and boulder-size slabs from c. 0.30 m by 0.30 m to 0.80 m by 0.50 m in length/diameter. The west and east wall are shorter, and run south, where they meet and stop at the elevated ledge (c. 0.20 m wide) projecting from the back south-southeast wall of the cave. This creates the "southern wall" of the enclosure, and is c. 1.20 m high. This feature is stacked and piled one to three courses high.

This feature is immediately adjacent (east-southeast) to Feature BBO. Feature BBO's southeast corner abuts the outside middle of this feature's west wall. This feature is in Area No.3, in the central east portion of a chamber. No surface remains were identified. No subsurface cultural deposits existed, since this feature rests upon bare bedrock and roof fall.

FEATURE BBR: Midden
ADJACENT TERRAIN: Below the ledge is the lower, flat cave floor (c. 5.00 m wide) with a second raised ledge north, where Feature BBN lies
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.40 m by 0.40 m by 0.14 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is circular and is located on a raised ledge (c. 1.20 m high) up against the back south-southeast wall of the tube. It is c. 0.01 m thick.

This feature is in the central east portion of Area No.3 in a lava tube. It is on an elevated ledge on the south-southeast side of the tube. It is c. 1.00 m east-southeast of Feature BBP on the same ledge. This feature is c. 36.00 m from the rubble at the east end of Area No.3 (which demarcates area). Marine shell remains were observed as a light scatter throughout this feature.

FEATURE BBS: Cairn
ADJACENT TERRAIN:
VEGETATION: No vegetation
FUNCTION: Marker
DIMENSIONS: 1.10 m by 0.90 m by 0.16 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is oriented roughly north-south, and is constructed of basalt roof fall from c. 0.05-0.40 m in diameter/length. It is stacked two courses high and is c. 1.60 m north of the south wall. This feature, as is burial B3, is on a raised ledge c. 11.00 m by 3.00 m, oriented north-northeast, and is c. 2.80 high above the lower cave surface.

This feature is in a large lava tube cave, in designated Area No.3. It is c. 23.00 m from the east end of this chamber. It is c. 0.60 m northwest from Burial B3. Charcoal fragments are scattered around this feature throughout most of the ledge.

FEATURE BBT: Midden
ADJACENT TERRAIN: This is a tube section with no ledges
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.80 m (90°-270°) by 0.80 m by 0.03 m
CONDITION: Poor
INTEGRITY: Unaltered
DESCRIPTION: A deteriorated dog skeleton is lying on the cave floor in the middle of the tube. The mandible of the dog is easily distinguishable and is diagnostic. The bone has disintegrated into many small fragments, is c. 0.03 m deep, and a spherical shape.

This feature is in the middle of a lava tube cave, near (c. 12.00 m east-southeast) the roof fall demarcating Area No.3. A charcoal concentration (Feature BBE) is c. 0.60 m west. No other remains (besides the dog bone) were observed at this feature. No subsurface cultural deposit is at this feature.

FEATURE BBU: Modified lava tube
ADJACENT TERRAIN: Large amount of roof fall immediately southeast
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 3.80 m (east-southeast to west-northwest at 120°-300°) by 3.00 m (east-northeast to west-southwest) by 1.10 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is set at the southeast end of a narrow tube/aperture area between Areas No.3 and No.4. Up against the southwest wall of this narrow passageway, basalt roof fall cobbles, small boulders, slabs from c. 0.06 m by 0.06 m to 0.50 by 0.75 m in size are piled in a linear shape three to four courses high. In addition, at the southeast end of the linear structure, a natural ledge runs (perpendicular) to the tube and creates a step down into the larger chamber where Feature BBV is located. This ledge is also somewhat modified one to two courses in places. This feature creates a "tunnel" effect into the larger chamber.

This feature is set in a lava tube cave in designated Area No.2. It is at the extreme northwest end of this area, and is c. 0.80 m to the west from Feature BBY. It is c. 12.00 m southeast from the roof fall separating Area No.3 from Area No.4. No portable remains or cultural deposits were observed at feature. This feature is constructed on bare tube floor bedrock.

FEATURE BBV: Midden
ADJACENT TERRAIN: Large amount of roof fall on the southwest portion of the tube cave
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 0.60 m by 0.60 m by 0.04 m
CONDITION: Poor
INTEGRITY: Unaltered
DESCRIPTION: This feature is roughly circular and lies on a slightly raised, (relatively) smooth ledge near the northeast wall. It is also near the northwest "corner" of the cave. This faunal bone scatter is extremely deteriorated, with transparent mineral encrustations.

This feature is in Area No.4, in a large lava tube cave. It is c. 12.00 m east-southeast from the roof fall/aperture dividing Area No.3 from Area No.4. This feature is west c. 1.00 m from Feature BBV. No other surface remains were observed with this feature, however, down the chamber to the east-southeast is a lamp holder (Feature BY), numerous charcoal concentrations (Feature BBE), and a slab trail (Feature BBH).

FEATURE BBW: Modified outcrop
ADJACENT TERRAIN: Inside cave with pahoehoe materials
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 1.00 m (90°) by 0.92 m by 0.29 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature sits upon the bedrock cave floor. It consists of three large boulders placed in a triangle, with c. 0.50 m spacing in between the rocks. The subangular, pahoehoe boulders range from c. 0.24-0.52 m in diameter. The feature is c. 2.00 m north of the south wall.

This feature is between chamber No.2 and No.3, Burial No.2 is c. 3.50 m at 230°, Feature BZ is c. 4.40 m at 94°, and Feature BV is c. 8.00 m at 240°. Portable remains were limited to *kukui* nut fragments. No cultural deposits were observed on the surface of this feature.

FEATURE BBX: Midden
ADJACENT TERRAIN: Slope to the west in cave
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 1.85 m by 0.94 m by 0.10 m
ORIENTATION: 17°-185°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a semi-circular concentration of ash. It is surrounded by a midden concentration (Feature BR) on the east. The demarcation between these two features is not a sharp line, but can be discerned. Feature BR is a grey to brown ash/soil mixture c. 0.01-0.04 m deep. It contains many ecofacts, including shell, bone, *Echinoid* sp. and *kukui* nut shell.

Feature BBX is a white ash concentration c. 0.03-0.10 m thick, with no noticeable ecofactual remains.

The ash concentration abuts a pile of roof fall on the north, west, and south side. One large upright slab (c. 1.04 m by 0.61 m by 0.11 m) on the south side may have been placed here to complete the semi-circle. The other cobbles and boulders seem to be in their original position.

No portable remains were noted on the surface of this feature.

FEATURE BBY: Cleared area
ADJACENT TERRAIN: Within lava tube (running *mauka* from *konane* sink)
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 2.83 m by 1.80 m by 1.43 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A rectangular area that has been cleared of rocks. The lava tube floor is exposed over the vast majority of the area. Several small to medium boulders are present. These boulders appear to have fallen in from the west edge of Feature BBC. Small cobbles are scattered throughout the area. Along the south edge of the cleared area is a linear mound. This mound is probably the result of clearing. The dimensions of the linear mound are c. 4.6 m by 2.00 m by 0.70 m high. The mound is in an area of low ceiling height. Ceiling height over the cleared area varies from c. 1.43 m to 1.80 m.

FEATURE BBZ: Wall
ADJACENT TERRAIN: Within lava tube (running *mauka* from *konane* sink)
VEGETATION: No vegetation
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 1.70 m by 0.30 m by 0.23 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A short L-shaped wall constructed of cobbles and small boulders (c. 0.17 by 0.14 by 0.06 m) crudely stacked two to three courses high. The generally north-south arm is c. 1.14 m long and abuts the north lava tube wall. The generally east-west arm is c. 0.60 m long and is parallel to the north lava tube wall. Several rocks are present within the L-shaped area (small cobbles to small boulders).

This area is possibly paved with the small cobbles. This area is fairly flat, measuring c. 1.07 m (north-south) by 1.34 m (east-west). A small hole is immediately south, and is partially filled with cobbles. The wall is one course wide. Sunlight lights this area fairly well. The shelf is c. 1.70 m by 4.00 m.

FEATURE BCA: Modified depression
ADJACENT TERRAIN: Large amount of roof fall lies immediately northwest.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 1.80 m by 1.80 m by 0.65 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This is an oval depression in the cave floor, oriented roughly east-west, with modification on the north and south sides, creating a circular shape. The modification is piled three to four courses high, of basalt roof fall. This basalt roof fall is of small boulders and cobbles c. 0.20-0.45 m in length/diameter. The majority of this piled material is on the south side of the depression. The depression sinks to c. 0.42 m below the cave floor.

This feature is located in Area No.4 c. 50.00 m east-southeast from the roof fall separating Area No.3 and Area No.4, in a large lava tube cave. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE BCB: Wall
ADJACENT TERRAIN:
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 1.00 m by 0.80 m by 0.50 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Feature BCB is composed of stacked pahoehoe slabs (range c. 0.21-0.50 m) three to four courses high to the roof of the cave. A vertical slab is placed at the south end to form a narrow crawl space between it and the opposite cave wall. The feature is at right angles to the main tube, and is built upon large pahoehoe boulders. It appears to have served to restrict access beyond to a single person at a time (as does the Feature BBF restriction c. 0.15 m *makai*). This feature is in Area No.2 of the lava tube cave. No portable remains or cultural deposits were observed.

FEATURE BCC: Midden (2 sections)
ADJACENT TERRAIN: This feature is set on and near the end of a tube/sloping roof fall area (down toward west-southwest) which begins under the *makai* (western) entrance of the large lava tube cave.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 4.40 m (30°-210°) by 2.00 m by 0.66 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: This feature consists of two separated areas of ash/charcoal (BCC1 and BCC2). BCC1 is a small, circular (c. 0.40 m diameter) ashy area c. 4.00 m south-southwest from the *makai* entrance. BCC2 is a layer of ashy area beginning c. 1.00 m to the southwest. It is also circular, and is roughly c. 2.00 m in diameter. BCC2 is in elevated roof fall (large cobbles, boulders) while BCC1 is set flush with the sloping roof fall. This feature is roughly located c. 4.00 m south-southwest from the eastern (*makai*) entrance of the large lava tube cave. This is at the end of Area No.4. Ecofactual remains include charcoal fragments, rat bone, and *Echinoid* sp. Cultural deposits in BCC1 consist of a thin black layer (c. 0.01 m deep) that overlies a white/grey ashy deposit c. 0.14 m in depth (a carbon dating sample was collected from here). This *makai* ash deposit (BCC2) contains less charcoal fragments.

FEATURE BCD: Terrace
ADJACENT TERRAIN: Elevated ledges on both sides of the tube (east-northeast to west-southwest). A lower channel begins c. 3.40 m northwest.

VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 3.00 m (110°-290°) by 2.20 m (20°-200°) by 0.65 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is a slightly triangular-shaped terrace with a boulder facing wall and smaller paving-like material to the east narrowing and creating the apex of the triangle. The front facing wall is oriented north-northeast, while the triangular paved area is oriented roughly east. The three boulders in the facing wall are c. 0.60 m by 0.40 m to 0.80 m by 0.80 m, and are elevated 0.32-0.40 m above the paved area (which is to the east). The paved area's material components are c. 0.10 m by 0.10 m to 0.30 m by 0.30 m in length/diameter, which creates a fairly flat surface. Large boulder roof fall forms the margins of the feature to the north, the east, and the south.

This feature is in a large lava tube cave in designated Area No.4. This terrace is c. 20.00 m west from the *mauka* entrance of the tube. Feature BBE is c. 4.00 m north-northwest on a raised ledge. Charcoal and *kukui* nut fragments were found just east of the boulder facing wall.

FEATURE BCE: Modified lava tube
ADJACENT TERRAIN: This main tube floor is to the south, with a lower lava channel in the middle of the tube.
VEGETATION: No vegetation
FUNCTION: Habitation (refuge)
DIMENSIONS: 7.00 m (110° 0 290°) by 2.00 m by 1.80 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature is shaped somewhat like a long, thin rectangle. The short axis of the rectangle extends south from the tube cave wall and turns and runs parallel with the elevated leg on the farthest south edge. From the west-southwest end c. 2.00 m, a short wall section runs across the short axis of the structure. Within this smaller compartment, a small charcoal deposit (Feature BBE, one of 77) is situated in the west-southwest interior corner. The east end of the compartment is c. 4.00 m by 1.80 m and contains an upright (c. 0.70 m high) in the "eastern" corner up against the tube cave wall.

This feature is in the large lava tube cave, on an elevated ledge on the north side of the lava tube (Area No.4). Feature BCD is c. 4.00 m to the south-southeast. Charcoal, *kukui*, and *Echinoid* sp. fragments were observed within this enclosure.

STATE NO.: 15299 **PHRI TNO.:** 1298-66
SITE TYPE: Modified outcrop
TOPOGRAPHY: Rolling pahoehoe flows with outcrops and lava tubes. Aa lava flows to north-northeast c. 50.00-60.00 m.
VEGETATION: Dense fountain grass, and scattered *koa-haole* and *'a'ali'i*
SITE ELEVATION: About 485 ft AMSL
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: This site is a collapsed blister which was cleared on the south side, then a small, stacked, curved alignment of rocks (range c. 0.22-0.32 m) was placed one to two courses high to form a small (c. 1.50 m by 1.20 m) enclosure. Just south of this enclosure a small blister (c. 1.60 m deep by 0.22 m high) goes back to the south. The floor of this enclosed area appears to be pahoehoe bedrock with a thin covering of organic material. North of this area, the rest of the blister appears to have been covered by rocks placed in rough alignments going back. The north alignment uses large slabs (c. 0.20-0.43 m) that are sitting on an angle (two wide) on top of the bedrock.

No portable remains were observed on the surface of this feature. There is c. 0.02-0.03 m of organic material in the blister overhang.

STATE NO.: 15300 **PHRI TNO.:** 1298-71
SITE TYPE: Utilized lava tube
TOPOGRAPHY: Undulating pahoehoe with some collapsed lava tube
VEGETATION: Fountain grass, *'ilima*, and *koa-haole*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: A large tube collapsed along its length so that a small overhang was formed with a side entrance facing north. The slab that collapsed rests on its side. It has left an opening c. 1.90 m long and c. 0.54 m high. Inside this opening, there is an area under the leaning slab that is c. 1.90 m long by 0.60 m by 0.94 m high. This section of the cave floor is covered with a thin (c. 0.01-0.03 m) soil layer, with some scattered burnt and broken *kukui* nut fragments intermixed. The other overhang areas slope and would not be good habitation areas.

Located on Sweep 61, 340° to Site 15262, 164° to Site 15283 point A, c. 25.00 m north of flag line No.2, and 297° and c. 25.00-30.00 m to Site 15301.

STATE NO.: 15302 **PHRI TNO.:** 1298-74
SITE TYPE: Complex (31+ Features)
TOPOGRAPHY: Rolling pahoehoe flows with lava tubes
VEGETATION: *Noni*, *hapu'u-'i'i*, and *pua-pilo*.
SITE ELEVATION: About 390 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Multiple
DESCRIPTION: This site complex consists of ten other - stacked rocks (Features BA-3, BD-BF, BO-BQ, and BBB), two alignments (Features BB and BBA), five enclosures (Features BC, BH-2, and BM-2), three walls (Features BG, BJ, and BL), one cairn (Feature BI), eight middens Feature BN-8), one modified depression (Feature BY), and one terrace (Feature BZ). The overall site dimensions are c. 136.00 m (72°-252°) by 29.00 m (162°-392°).

FEATURE BA: Other (3) water catchment and lamp holder
ADJACENT TERRAIN: Within lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 3.17 m by 0.94 m by 0.30 m
CONDITION: Fair
INTEGRITY: Unaltered
DESCRIPTION: Three separate crudely stacked rock features along the north wall of lava tube. The east and west features are constructed of large cobbles to small boulders (c. 0.12-0.30 m in diameter). The one further east has a flat rock near the top, while the westernmost one forms a small circle (c. 0.23 m in diameter). The center one is constructed of small to medium boulders (c. 0.30-0.55 m in diameter) abutting the tube wall. A small circle (c. 0.21 m in diameter) is against the lava tube wall. Charcoal is scattered among the rocks of this one. The east feature measures c. 0.67 m by 0.41 m by 0.28 m and is stacked/piled three to four courses high, the central feature measures c. 1.15 m by 0.94 m by 0.30 m and is stacked/piled two courses high, and the west feature measures c. 0.65 m by 0.44 m of aligned rocks. Portable remains are limited to charcoal.

FEATURE BB: Alignment
ADJACENT TERRAIN: Within lava tube on lower shelf
VEGETATION: No vegetation
FUNCTION: Transportation

DIMENSIONS: 1.96 m (east-west) by 1.10 m
CONDITION: Poor-fair
INTEGRITY: Unaltered
DESCRIPTION: Single course-wide alignment of seven small angular to subangular boulders (c. 0.27 m in diameter) along the outside (south edge) of shelf. Feature is buried by roof fall. The north edge of the shelf is formed by an upper shelf. The shelf is c. 1.80 m wide. The area between the alignment and upper shelf is c. 0.90-1.10 m wide.

The roof fall extends for c. 5.00 m, with no sign of the alignment under the roof fall or at the other end. Charcoal flecks in area.

This feature is along the north wall on the shelf, c. 2.00 m west of Feature BA, with a lava tube on the lower shelf.

FEATURE BC: Enclosure
ADJACENT TERRAIN: Within lava tube, c. 28.00 m east of skylight
VEGETATION: *Noni* and *laua'e* at skylight, no vegetation at feature.
FUNCTION: Indeterminate
DIMENSIONS: 4.20 m by 1.15 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: Rectangular enclosure constructed along the southern lava tube wall. An alignment of cobbles and small boulders goes along a narrow ledge (c. 0.21-0.67 m). The north and east sides of the enclosure are formed by massive roof fall. Some rocks appear placed at the east end. The west end is constructed of crudely stacked boulders (c. 0.25-0.60 m in diameter). One boulder is upright. The floor of the enclosure is rough aa, and several rocks are present. These rocks are probably the result of collapse. The stacked west end is c. 0.70 m high, and the east end is c. 1.50 m high. A pig tusk is c. 5.00 m west. This feature is c. 28.00 m east of the skylight. Partially burned wood was also observed on the feature.

FEATURE BD: Other (water catchment)
ADJACENT TERRAIN: Within lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.00 m by 0.67 m by 0.80 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A crudely stacked rock pile (seven to eight courses high and one to four courses wide) against the northern wall and resting on a narrow ledge (c. 0.17 m wide). The top of the feature is a C-shape (c. 0.27 m by 0.15 m by 0.19 m). The interior of the C-shape incorporates a narrow ledge (0.02-0.03 m wide) and flatter rocks to form fairly flat surface. Water is currently dripping into the C-shape area. This feature is c. 18.00 m east of the skylight along the northern lava tube wall and c. 1.50 m east of Feature BH. Marine shells are scattered east and south. *Kukui* nut shells are on the south. The waterworn cobbles are on the narrow ledge which supports the feature.

FEATURE BE: Other (lamp holder)
ADJACENT TERRAIN: Within lava tube
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.20 m by 0.18 m by 0.33 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A crudely stacked pile of basalt cobbles with a smooth, circular cobble on top. The circular cobble (c. 0.13 m in diameter and c. 0.04 m thick) appears to be natural. About 3.00 m east, a *kukui* nut concentration (about 25-30) is present. Some are burned.

This feature is c. 19.00 m east of the skylight and along the north wall, and c. 1.00 m east of Feature BD. Portable remains include charcoal, *kukui* fragments, urchin shell body fragments, *opihi*, and bivalves.

FEATURE BF: Other (water catchment)
ADJACENT TERRAIN: Inside lava tube. All pahoehoe materials
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS:
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: This feature consists of two stacked rock piles. The first pile is built of 13 small boulders stacked six courses high.

The stones lean against a wall and are stacked in a way that would catch water if a gourd were in place. These small, subangular pahoehoe boulders range from c. 0.23-0.43 m in diameter. The dimensions are c. 1.13 m (east-west) by 0.50 m (north-south) by 0.52 m high.

The second stacked rock pile consists of four small boulders and one large cobble stacked two courses high. The stones are placed near the wall, and water is in the center of the feature where a gourd was probably placed. These subangular, pahoehoe stones range from c. 0.17-0.34 m in diameter. The dimensions are c. 0.74 m (east-west) by 0.36 m (north-south) by 0.16 m high. The distance between the two stacked rock piles is c. 0.87 m.

This feature is on the south shelf c. 10.00 m east of a large skylight. The beginning of Feature BG is on the same shelf c. 0.70 m north. Feature BH is at 316° and c. 6.00 m and Feature BC is c. 12.20 m at 78°. No portable remains or cultural deposits were observed on the surface of this feature.

FEATURE BG: Wall
ADJACENT TERRAIN: Inside lava tube. All pahoehoe materials
VEGETATION: Some fern around skylight area.
FUNCTION: Transportation
DIMENSIONS: 1.00 m by
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A c. 40.00 m long linear short wall runs east-west along a shelf. Most of the wall has collapsed on both sides, with c. 15% remaining stacked. The wall is constructed with small cobbles to large boulders stacked and placed one to four courses high. These subangular, pahoehoe stones are from c. 0.03-0.75 m in diameter.

In the central area of the wall and just north is a skylight and the entrance to the lower tube. Some of the roof fall from the skylight has fallen over the wall, and disturbed c. 4.50 m of it.

From the edge of the cave wall to the feature, the cleared area ranges from c. 1.11-1.63 m wide. From the edge of the shelf to the feature, the cleared space ranges from c. 0.92-01.08 m wide.

This feature is on the south shelf with Feature BE. Feature BF is c. 0.62 m at 190° from the east end of Feature G. At west end where the lower lava tube begins, Feature BBA is c. 12.00 north.

Marine shells were at the west end of the feature. No cultural deposits were noted.

FEATURE BH: Enclosure (2)
ADJACENT TERRAIN: Within lava tube c. 10.00 m east of skylight
VEGETATION: Ferns.
FUNCTION: Ceremonial

DIMENSIONS: 6.84 m (east-west) by 2.75 m (north-south)
CONDITION: Good
INTEGRITY: Altered
DESCRIPTION: A rectangular enclosure built on the floor of the tube, utilizing the steep sides of the tube channel (north and south sides of enclosure). There are two sections defined within the enclosure. The east section has a boulder wall. Boulders range from c. 0.30 m diameter to c. 0.92 m by 0.70 m by 0.22 m. Three of the boulders are upright. Several medium to large cobbles are along the base and between the boulders of the wall, providing support.

A waterworn cobble (c. 0.15 m by 0.09 m by 0.07 m) is present near the exterior northeast corner. Near the center of this wall is a probable cache area. Several flat slabs are covering part of a depression and several boulders and cobbles are scattered eastward. The depression in the aa floor measures c. 0.60 m (east-west) by 0.50 m (north-south). One bivalve shell fragment is within the depression, but boulders prevent further investigation. This wall is c. 2.75 m wide and c. 0.40-0.75 m high. The wall is one to two courses high and one course wide. Within the wall are several scattered boulders and one amorphously-shaped upright boulder (c. 1.15 m by 0.92 m by 0.53 m) against the north wall of the tube. The floor of the eastern area is roughly paved with gravel to small boulders. The floor is fairly level. Along the north wall, a narrow lip is present on the tube wall. Several small boulders and one c. 0.60 m by 0.40 m by 0.30 m pebble are scattered along the lip. A narrow lip (c. 0.20 m) is also present along the south wall of the tube within the enclosure. A charcoal deposit (very wet) is present c. 0.80 m from the southeast corner of the east wall. Several small cobbles and mice bones are within the charcoal. The eastern section is c. 3.62 m long east-west and varies from c. 2.56-2.75 m wide. The feature narrows westward due to the shape of the tube channel.

The west section of the enclosure is defined by the west wall (c. 2.56 m wide) of the east section, and the low, crudely stacked wall along the west edge. The dividing wall is constructed of boulders stacked one to three courses high and one to two courses wide. Boulders are from c. 0.29 m in diameter to a large upright slab, c. 0.90 m by 0.40 m by 0.20 m. Several other boulder slabs are upright. Again, cobbles are used as fill to support the wall. The westernmost wall is crudely constructed of gravels to boulder-size rocks. The largest boulder is c. 0.75 m by 0.62 m by 0.30 m. No uprights are present. The wall is c. 2.10 m long and c. 0.90 m wide and c. 0.32 m high. The floor is level and paved with gravels to large cobbles and is c. 0.20-0.25 m higher than the floor in the east section. Several small boulders are scattered throughout floor. Near the central floor is a possible cache area (0.40 m by 0.40 m by 0.30 m deep). Boulders are present along the floor surrounding the cache area. Several other small boulders are adjacent to the hole (*puka*) and appear as if they were removed from the hole. Additional hollow areas are visible in the floor. Slabs are present on the floor over some of these areas. The area within this section is c. 1.70 m (east-west) and varies from c. 2.56-2.10 m wide (westernmost wall). The east section appears to have two levels. The section is split into an east and west half near the center. The narrow lip present in the east section is also present in the west section, providing a good seat.

This feature is c. 10.00 m east of the skylight. Waterworn pebbles (2), mice bones, goat bones, cowry shell fragments, pencil urchin spines, and charcoal are present. The marine ecofacts and *kukui* nuts are scattered outside of the enclosure, eastward near Feature BD and Feature BE. No testing was done at this feature.

FEATURE BI: Cairn
ADJACENT TERRAIN: Inside lava tube. All pahoehoe material.
VEGETATION: Some fern growth on the east side of the cairn.
FUNCTION: Marker
DIMENSIONS: 5.80 m (east-west) by 2.06 m by 0.21-1.42 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A large cairn is associated with an adjacent wall on the northern shelf. The cairn is c. 1.55 m (north-south) by 1.21 m (east-west) by 1.42 m high. It is constructed with large, subangular, pahoehoe boulders ranging from c. 0.31-0.55 m in diameter. With the light coming from the skylight to the east, the cairn produces a large shadow to the west. It is seven to nine courses high. A linear wall continues west from the cairn for c. 4.25 m. The stones are stacked one to three courses high and appear in better shape than Feature BG. This wall is constructed along the edge of the shelf. The stones are small subangular, pahoehoe cobbles to large boulders ranging from c. 0.04-0.39 m in diameter. There

is c. 1.00 m cleared space between the cave wall and the feature. Then from the feature, it drops straight down into the lower tube for c. 2.70 m.

This feature is on the northern shelf. The lower tube entrance is directly south. The skylight is east at c. 3.00 m. Feature BBA is directly south, across the lower tube entrance and on another shelf. Feature BK (same shelf as this feature) is c. 3.00 m at 267°. The cairn is not constructed tightly, and the center can be seen between stones.

Marine shells were present at this feature. No cultural deposits were visible on the surface of this feature.

FEATURE BJ: Wall
ADJACENT TERRAIN: The cave floor is level but very rough. The lower tube is c. 2.80 m below the upper tube at this point.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 2.90 m by 2.55 m by 0.50-0.60 m
ORIENTATION: 0°-180°
CONDITION: Fair
INTEGRITY: Altered
DESCRIPTION: The wall is constructed perpendicular to the west side of a narrow tube. The wall abuts the north wall of the tube on the north end and a large (c. 1.50 m by 0.60 m by 1.40 m) aa boulder (probably roof fall) on the south end. The wall is c. 8.60 m long (0°-180°) by 0.42 m wide. It is constructed of aa cobbles and boulders (c. 0.30-0.40 m maximum diameter) stacked three to five courses high over the cave floor. The wall is now c. 0.50-0.60 m high, but it is evident that the top has collapsed and it was once higher.

On the south side of the boulder is pavement extending c. 1.15 m east of the southeast corner of the boulder, adjacent to the lava tube wall and extending c. 1.40 m west of the southeast corner. The pavement is thus c. 2.55 m long (76°-256°) by 1.01 m wide. It extends from a series of boulders (steps), as the east side that leads to the upper tube is elevated c. 0.10-0.20 above the loose rock fall of the cave floor on the east and north side, and is flush with the south tube wall on the south side. It spans the distance between the south end of the boulder and the south lava tube wall and extends c. 0.80 m past (west) the boulder. It becomes gradually higher (like a ramp) on the east side, and then abruptly drops c. 0.25 m on the west side of the boulder. Several aa slabs make up the surface. Since the pavement is thicker between the boulder and the south lava tube side, perhaps the wall once extended all the way across the tube and blocked it off. Later, the south section of the wall collapsed or was dismantled and was altered into a pavement, so the block could be easily surpassed.

This feature is located at the entrance (east end) of the lower tube of the east tube of the cave complex.

Some marine gastropods (*Cypraea* sp., *kukui* nuts were noted at this feature. No soil or cultural deposits were noted.

FEATURE BK: Terrace
ADJACENT TERRAIN: Inside lava tube. All basalt materials
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 4.82 m (east-west) by 1.29 m by 0.18-0.45 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: A terrace built on the edge of the shelf, overlooking the entrance to the lower tube. The south and west edges of the terrace are built up two to three courses high to meet the bedrock to the north and east. This feature is constructed with small cobbles to small boulders and is one to three courses high. The subangular, pahoehoe stones range from c. 0.18-0.45 m in diameter. There is a cleared area to the west which may be where the stone was obtained. The feature drops straight down c. 6.50 m from the south edge.

This feature is on the northern shelf at the west end of the lava tube, upper tube. Feature BI is c. 3.00 m at 87° and Feature BL is c. 2.61 m at 264°. Feature BG is south on the southern shelf. Goat bones were underneath the feature. No cultural deposits were noted.

FEATURE BL: Wall
ADJACENT TERRAIN: The cave floor is fairly rough at this point, but relatively clear of rubble. The cave floor slopes east (to the entrance to the lower tube) in a series of steps. The surface of the steps is level.
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 3.70 m by 1.10 m by 0.36-0.38 m
ORIENTATION: 0°-180°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A wall has been constructed from the north wall of the tube (which is oriented roughly east-west) to within c. 1.70 m of the south wall of the upper tube. The wall is just perpendicular to the east-west opening of the lower tube. It is constructed of large aa boulders (c. 0.40-0.50 m maximum diameter) placed one course high, smaller boulders (c. 0.25-0.40 m) stacked two courses high, or aa slabs (c. 0.30-0.40 m) stacked horizontally up to four courses high. The wall is shaped like a dog's leg. The south half of the wall abuts a higher ridge of the cave floor on the west. This results in a small, triangular enclosed area. The interior of the enclosed area is cleared of rubble, and is level, but rough. A thin deposit of midden (c. 0.01-0.02 m thick) consisting of silt with charcoal flecks and shell (cowrie) was observed in the northeast corner of this enclosed area. This corner may be a fire pit.

The south "leg" is c. 2.43 m long (24°-204°) by 0.20-0.60 m wide by 0.20-0.58 m high. The east-west wall is c. 1.20 m (124°-304°) by 0.22-0.33 m wide by 0.32-0.50 m high. The north wall is c. 1.40 m long (20°-200°) by 0.32-0.40 m wide by 0.40-0.45 m high. The triangular enclosed space is c. 2.50 m by 1.10 m. The wall is c. 1.60 m west of the opening to the lower tube. The ceiling is c. 2.10 m above the floor of the enclosed space.

This feature is in the upper chamber of the western tube, at the west end of the opening to the lower tube. It is c. 2.40 m west of Feature BK and c. 1.30 m northeast of Feature BM.

FEATURE BM: Enclosure (2)
ADJACENT TERRAIN: Within lava tube at front of rear chamber
VEGETATION: No vegetation
FUNCTION: Multiple
DIMENSIONS: 7.00 m (east-west) by 1.06 (north-south)
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A circular enclosure utilizing the southern cave wall and massive roof fall boulders along the north edges as walls. The east and west walls are crudely stacked cobbles and boulders and slabs. The largest boulders are c. 0.65 m by 0.65 m by 0.17 m. One boulder is against the south wall, holding up an exfoliating slab. A large leaning slab (c. 0.90 m by 0.80 m by 0.10 m) is against the interior west wall.

A large, upright slab (c. 1.30 m by 1.03 m by 0.45 m), amorphous in shape, is standing within roof fall at the northern edge of the enclosure. The slab is facing north/south, the narrow side towards the enclosure. The area with the enclosure is c. 2.30 m (east-west) by 1.80 m (north-south). The floor is cleared of rubble. Immediately south is small enclosure, c. 1.40 m (east-west) by 1.40 (north-south). The south wall of the main enclosure is one wall. The north wall is composed of two boulders (one upright c. 0.82 m by 0.42 m by 0.30 m). The east edge is defined by a low (c. 0.25 m) aa ridge. Several medium to large cobbles are scattered on the floor. The main enclosure ceiling is c. 1.74-3.00 m high. A cleared area (c. 3.60 m by 1.60 m) is immediately west of the main enclosure. Several small boulders (probably recent roof fall) is present.

Crustacean fragments, several small pieces of wood (several appeared extremely burnt), two pencil urchin spines (not used), and two bones were present. The bones are unidentifiable other than large mammal. They are deteriorated spiral fractured long bone fragments.

This feature is c. 40.00-50.00 m west of the skylight, along the south wall. The lower tube is c. 10.00-15.00 east, and Feature BL is immediately northeast.

FEATURE BN: Midden (8)
ADJACENT TERRAIN: Undulating pahoehoe and aa flow
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.35 m by 0.35 m by 0.15 m deep (average)
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: These features are circular. They are on elevated roof fall as well as resting in/on the cave floor. They consist of fine fragments/ash of larger pieces (c. 0.005-0.01 m) that are obviously twigs/small branches of unidentified wood. In addition, occasional burnt *kukui* nut fragments are interspersed in a charcoal/ash matrix as well as isolated burnt pieces. These features seem associated with gourd holders (BBQ) as they are usually in close proximity. In addition, they seem to be placed in semi-linear intervals throughout portions of the tube, possibly serving a lighting function.

These features are in the lower secondary tube below the main tube. The tube is designated as Area No.5, and runs roughly west-southwest from the west end of the main tube. These eight features are c. 15.00-123.00 m from the entrance to this tube. Charcoal/ash and burned *kukui* nut to a maximum depth of c. 1.50 m was present at this feature. The horizontal and vertical extents varied.

FEATURE BO: Other (water catchment/indeterminate)
ADJACENT TERRAIN: Inside lava tube. All pahoehoe and aa materials. This tube has a mostly aa floor.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.70 m (east-west) by 0.60 m by 0.14 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A small, circular one to two course high pile of stones. One flat pahoehoe boulder (c. 0.34 m by 0.30 m by 0.09) is in the center (where a gourd would have been placed), and five angular aa cobbles are placed around it, only one course high.

This feature is in the lava tube c. 11.00 m west of Feature BJ, near the southern wall. A large roof fall pile of boulders is the west for c. 2.30 m.

FEATURE BP: Other (water catchment)
ADJACENT TERRAIN: Slightly undulating tube floor bedrock. Surface is pahoehoe and aa.
VEGETATION: No vegetation
FUNCTION: Habitation
DIMENSIONS: 0.70 m (east-southeast) by 0.55 m by 0.15-0.30 m
ORIENTATION: 128°-308°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: The feature consists of a flat boulder (c. 0.60 m by 0.40 m by 0.30 m high) that is propped up by three other roof fall rocks that are c. 0.15 m in diameter. On top of the boulders, four rocks are set in a rectangular shape. These are c. 0.10 m in size, and this rectangular form is c. 0.25 m in diameter.

This feature is in the lower tube cave below the main chamber. This tube is designated as area No.5, and is c. 24.00 m west-southwest from the entrance.

Charcoal and *kukui* nut fragments were observed on the flat boulders.

FEATURE BQ: Other (water catchment)
ADJACENT TERRAIN: Slightly undulating tube floor bedrock. Surface is undulating pahoehoe and aa.
VEGETATION: No vegetation

FUNCTION: Habitation
DIMENSIONS: 1.60 m by 1.00 m by 0.30
CONDITION: Fair-good
INTEGRITY: Unaltered
DESCRIPTION: These features are roughly circular/rectangular. They range from one to three courses high, and are mainly piled, with occasional stacking. They seem to be located beneath vertical ledges extending downward from the ceiling, as well as below small mineralized stalactites with water still dripping from them. These features are in the lower, secondary tube below a main tube. This tube is designated as area No.5, and runs west-southwest from near the west end of the main tube. These nine feature are c. 42.00-70.00 m west-southwest from the entrance.

No surface remains were currently identified with these feature.

FEATURE BX: Modified lava tube
ADJACENT TERRAIN: Inside lava tube. All pahoehoe materials
VEGETATION: No vegetation
FUNCTION: Indeterminate
DIMENSIONS: 2.00 m (east-west) by 1.11 m high
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: There are two modifications at the entrance. One modification on the north side consists of several horizontal boulders stacked five to eight courses high. At the base of the feature, there are two large boulders (c. 1.13 m by 0.90 m by 0.11 m and 0.90 m by 0.72 m by 0.13 m) which hold all the horizontal boulders in place. The entire feature is c. 2.00 m (east-west) by 1.11 m high. The flat, subangular pahoehoe boulders range from 0.39-0.87 m in diameter.

The other modification is south of the entrance and consists of boulders stacked three to four courses high. The subangular, pahoehoe boulders range from c. 0.23-0.44 m in diameter. This modification measures c. 1.10 m by 0.60 m by 0.57 m.

Also, there are two large boulders that appear to be large steppingstones which lead into the cave.

Feature BA is c. 6.00 m at 304°, Feature BY is c. 7.10 m at 232°, and Feature BB is c. 10.00 m at 262°. No portable remains or cultural deposits were noted on the surface of this feature.

FEATURE BY: Modified depression
ADJACENT TERRAIN: Within lava tube, rubble west of the feature, with other areas clear.
VEGETATION: No vegetation
FUNCTION: Storage
DIMENSIONS: 0.90 m (east-west) by 0.65 m by 1.54 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A small hole (c. 0.90 m by 0.65 m) with a crude, possible alignment along the east edge. The west edge is covered/blocked with massive roof fall. The hole has a low (c. 0.10-0.15 m) space north and east. Nothing besides a goat skeleton is in the hole. Water is dripping into hole. The floor is bedrock. The alignment is constructed of large cobbles and small boulders (c. 0.65 m by 0.40 m).

This feature is near the main entrance, in the center of the lava tube, and c. 3.00-4.00 m southwest of Feature BB.

Portable remains were limited to goat bones.

FEATURE BZ: Terrace
ADJACENT TERRAIN: The feature is on top of a high pile of natural rock fall
VEGETATION: No vegetation
FUNCTION: Habitation

DIMENSIONS: 4.54 m by 2.40 m by 0.75 m
ORIENTATION: 105°-285°
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: This feature consists of three adjacent terraces. All three are at slightly different levels with various construction methods, so these were probably not all built at the same time. All three are constructed on top of a high pile of rock fall and are adjacent to a large boulder which probably could not have been moved. The resulting feature as a whole has a U-shape appearance, with the large boulder occupying the open end of the "U".

The largest terrace (No. 1) is on the west side of the boulder. It is roughly rectangular. The surface of this terrace is composed of aa cobbles, boulders and slabs (0.18-0.50 m maximum diameter). This surface represents the surface of the rock pile which has been modified to create a very level surface. The west side is c. 2.40 m (10°-190°), the south side is c. 2.50 m (105°-185°), the east side is c. 2.10 m (1.72°-352°), and the north side is c. 1.65 m (100°-280°). The perimeter is elevated c. 0.10-0.20 m above the interior surface. In the southeast corner, a pointed slab is on edge. An area c. 0.60 m by 0.60 m north of this slab is depressed (c. 0.10 m) below the terrace surface. This may have functioned as a hearth or cupboard.

The southeast terrace (No.2) extends from the southeast corner of the west terrace No. 1. The south wall is even with and oriented the same direction as the south wall of the west terrace No. 1, and is elevated c. 0.65 m above the south side of the rock pile. The east side is flush with the surface of the rock pile, and the north side abuts the large rock fall boulders. The terrace is perfectly rectangular, and is c. 2.04 m by 1.30 m. It differs in construction from terrace No.1 in that the entire surface of the terrace is level (perimeter stones are not elevated above interior surface), the interior stones are regular sized aa cobbles (c. 0.10-0.20 m in diameter), not slabs, and the perimeter stones are slabs (not boulders). The interior of this terrace is even with the interior of the west terrace No.1.

The northeast corner of the west terrace No.1 is the southwest corner of the northeast terrace No.3. This terrace is flush with the cave wall on the north side, flush with the roof fall pile on the east side, abuts the large boulders on the south side, and is elevated c. 0.70 m above terrace No.1 on the west side. Terrace No.3 is roughly square. It is constructed of aa pebbles and small cobbles (less than c. 0.10 m diameter) that fill the space between the south sloping cave wall and rock fall next to the boulders. There are no perimeter stones. This terrace is c. 1.15 m (78°-258°) by 0.90 m.

The feature is near the west end of the east chamber (main chamber). No portable remains were observed on the surface of this feature. Cultural material may be present under the rock. No soil or midden was observed.

FEATURE BBA: Alignment
ADJACENT TERRAIN: Inside lava tube. All basalt materials.
VEGETATION: Tiny amount of fern growth.
FUNCTION: Indeterminate
DIMENSIONS: 1.30 m (east-west) by 0.71 m by 0.06-0.24 m
CONDITION: Good
INTEGRITY: Unaltered
DESCRIPTION: A small, circular alignment consisting of approximately nine small boulders placed in a circle, and approximately five small boulders east of the circle. The small subangular, pahoehoe boulders range from 0.23-0.34 m in diameter. This feature is on the edge of shelf at the entrance to lower tube. Also feature is c. one course high.

It is near the western end of the lava tube. The skylight is at 56° c. 6.00 m. The entrance to the lower lava tube is directly north. Feature BG (west half) is directly south at c. 0.12 m. This feature sits at the edge of the shelf.

Marine shells and *kukui* nut fragments are present on the surface. No cultural deposits were noted.

FEATURE BBB: Other (water catchment)
ADJACENT TERRAIN: Inside a small lava tube against the north wall
VEGETATION: No vegetation

FUNCTION: Habitation
DIMENSIONS: 0.85 m (north-south) by 0.45 m by 0.18 m
CONDITION: Excellent
INTEGRITY: Unaltered
DESCRIPTION: This feature is constructed of stacked and piled small boulders (c. 0.30 m by 0.20 m by 0.05 m - 0.45 m by 0.30 m by 0.15 m). The largest boulder is leaning against the smaller boulders, forming a pocket (c. 0.20 m by 0.15 m by 0.18 m deep) against a shelf. The feature is resting on a narrow (c. 0.25 m) shelf and leans against a higher, narrow (c. 0.30 m) shelf. Charcoal is present at this feature. No cultural deposits were noted.

STATE NO.: 15303 **PHRI TNO.:** 1298-75
SITE TYPE: Modified lava tube
TOPOGRAPHY: Undulating pahoehoe with many outcrops and collapsed tubes
VEGETATION: Fountain grass, *'ilima*, and *koa-haole*.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: An alignment of about ten pahoehoe boulders (c. 0.25-0.50 m maximum diameter) have been placed at an angle to the length of a tube. South of the alignment, an area c. 0.50 m by 0.50 m has been cleared of all rock fall. The ceiling height is c. 0.70 m. This area, therefore, would have made an excellent sitting spot under the overhang, in a position to get a good breeze. Site 15302 (*mauka* entrance) is northwest at 324° and c. 25.00 m from this site, Site 15262 is northwest at 348° and c. 100.00 m away, and Pine Tree Beach is at 210° from this site. No portable remains or cultural deposits were noted on the surface of this feature.

STATE NO.: 15304 **PHRI TNO.:** 1298-76
SITE TYPE: Petroglyph
TOPOGRAPHY: Rolling pahoehoe flow with aa flow c. 100 m north.
VEGETATION: Dense fountain grass, scattered *koa-haole*, and sparse *'a'ali'i*.
SITE ELEVATION: About 390 ft AMSL
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Communication
DESCRIPTION: A single "X" or crossed petroglyph of flat pahoehoe bedrock. The design appears pecked into stone. Arms are pointing at 338-158° and 72-252°. This petroglyph is c. 200.00 m south of road along northern boundary at 350° to northwest corner stake. No portable remains or cultural deposits were noted at this feature.

STATE NO.: 15305 **PHRI TNO.:** 1298-78
SITE TYPE: Cairn
TOPOGRAPHY: Broken bare pahoehoe with moderate slope west-southwest
VEGETATION: Dense fountain grass.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Marker
DESCRIPTION: A square cairn has been constructed of stacked pahoehoe cobbles (c. 0.18-0.28 m) and boulders (c. 0.25-0.43 m) and slabs (0.25-0.37 m maximum diameter).

The top stones on the south side have fallen off, and the basalt stones for the north side have rolled out. This leaves only the east and west sides intact. These sides are stacked and roughly faced with rock three to four courses high, with one

slab at the apex of the cairn (the center is probably five courses high). The north side of the cairn is constructed on top of fractured pahoehoe bedrock and this may be where the material to build this cairn was obtained.
This feature is on Sweep 22, one-third of the way south to the phone line, at 87° to the stake (yellow flagging) on *mauka* boundaries, 277° to the map point A of Site 15283, 100° to the water tank, and 220° to Pine Trees Beach. No portable remains or cultural deposits were noted at this site.

STATE NO.: 15306 **PHRI TNO.:** 1298-79
SITE TYPE: Cupboard
TOPOGRAPHY: Broken undulating pahoehoe with slope west-southwest
VEGETATION: Dense fountain grass, *lama*, *koa-haole*, *wilelaiki*, *kolomoa*, honeysuckle vine.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Storage
DESCRIPTION: A bedrock outcrop c. 1.45 m wide is c. 0.60 m above the ground surface, but it slopes down gradually at the northeast end to become level with the ground surface. It is on this northeast slope that a cupboard has been constructed. Pahoehoe cobbles, boulders and about four large slabs have been loosely stacked on top of the apex, down the slope, and adjacent to the base of the outcrop to make a rock ring with a bare interior (c. 0.65 m by 0.60 m in diameter). Only one course has been piled on the top of the outcrop and the sides, but two courses are piled up at the base. Although the top of the rock ring is not level, it slopes parallel to the slope of the outcrop, and the interior depth of the ring is uniform on all sides. The size of the material ranges from c. 0.08-0.65 m maximum diameter, with most of the cobbles used on the lower course, and most of the loose boulders and slabs used in the second course.

The interior is depressed c. 0.20-0.25 m below the level of the perimeter rocks. The exterior outline and interior space are both rather square in plan view. Rocks on the northeast side of the cupboard have fallen and rolled downhill.

STATE NO.: 15307 **PHRI TNO.:** 1298-80
SITE TYPE: Enclosure
TOPOGRAPHY: Broken undulating pahoehoe with slope west-southwest
VEGETATION: Dense fountain grass, *wilelaiki*, and low *'a'ali'i*.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: A low, dome-like pahoehoe outcrop has been modified. The top of the outcrop has been either naturally or artificially fractured so that a top layer of slabs has been removed. This area was partially, to completely cleared at one time. Pahoehoe slabs were then placed on edge to form a boxed C-shape around this fractured, cleared area, enclosing it with these slabs on three sides. The west side is open. These slabs range from c. 0.31-0.46 m in maximum diameter. The resulting cleared space is c. 2.00 m (176°-256°) by 1.92 m (along north wall). The south wall is somewhat shorter (c. 1.27 m). The north and south walls are generally perpendicular to the east wall, but both the north and east walls are somewhat convex. The northwest corner consists of one slab placed perpendicular to the rest of the north wall. This might be the only remains of a fourth (west) wall that once connected the north and south walls. There are many slabs scattered west of the ends of the north and south wall that might represent the remains of the wall, but there is no pattern to their scatter. If there was once a west wall, it has been purposefully dismantled and the rocks scattered. The scattered rocks do not represent natural collapse. The slabs are supported on their edge placement by pahoehoe gravel, cobbles, and boulders tightly piled around the exterior. These rocks range from c. 0.04-0.35 m maximum diameter. The rocks are stacked one to four courses high, with the gravel and smaller cobbles against the slabs, and the larger cobbles and boulders on the outside. This retaining wall is c. 0.43-0.73 m thick on the south and east sides, only c. 0.10-0.25 m thick on the north side, and c. 0.50 m thick west of the northwest corner. It is c. 0.10-0.35 m high and built up within c. 0.07-0.12 m of the top of the slabs.

An alignment of pahoehoe slabs, convex side up, extends from the southwest corner to the middle of the north wall. Some of these may be portions of the original outcrop surface that were not moved. To the west of this alignment of slabs, concave rocks are present from the southwest corner to the middle of the north wall. These alignments could once have subdivided the enclosure into two areas. The slabs range from 0.18-0.35 m high.

Note: The size of this enclosure is directly related to the level bedrock outcrop on which it is constructed. The outcrop edges drop off abruptly c. 0.30 m south of the swell, c. 0.70 m north of the north wall, and c. 0.25 m west of the west end of the enclosure.

This site is at 240° and c. 40.00 m to Site 15280, at 271° to a high outcrop, at 282° to the water tank, and c. 50.00 m at 62° to Site 15305. No portable remains or cultural deposits were observed on the surface of this feature.

APPENDIX B

HISTORICAL DOCUMENTARY RESEARCH

by Lehua Kalima, B.A. and Kepa Maly

Introduction

The present project area is within the *ahupua'a* of Hale'ohi'u, Hamanamana, Makaula, Kalaoa 1-5, and 'O'oma 1 and 2 in the North Kona District of the Island of Hawaii (Figure B-1). Information on these lands is extremely limited. For this reason, information on the North Kona district in general is included in this report. Legends, early historic accounts, settlement patterns, oral history interviews, and land use information is presented here.

Pukui et al. (1974:75) state that the name Kalaoa translates literally as "the choker," referring to a stick used for catching eels.

The entire portion of North Kona between Honokohau (sometimes referred to as Honokahau) and Kapalaoa was once known as Kekaha (Soehren 1963:1). These *ahupua'a* in Kekaha were often treated as a unit. Kekaha (where food does not grow) (ibid.) was a waterless land often ravaged by Pele. The Hawaiians who lived there often gave such epithets as "Kekaha wekaweka" (black Kekaha) and "Kekaha wai 'ole" (waterless Kekaha) to these barren lava fields (ibid.).

Hannah Springer, an authority on this area, writes that Kekaha (barren, desolate) was the name given to that section of North Kona from Honokohau, north of Kailua, to Napu'u (The Hills), meaning Pu'uwaa'awa'a and Pu'uanahulu, and along the coast to Anaeho'omalu, the boundary of South Kohala (Springer 1985:2). The main resources from Kekaha were obtained from exploitation of the ocean and from the dryland forest. The hardwood *'uhi'uhi* (*Mezoneuron kauaiense*), for example, was used for the runners of *holua* sleds (ibid.).

Concerning the climate of these Kekaha lands, Hannah Springer writes:

> Located on the leeward side of Hawai'i, Kekaha is less affected by the northeast tradewinds, which are distorted, if not blocked by the masses of Mauna Kea, Mauna Loa, and Hualalai, than are the regions of the windward side of the island. The land-sea breezes and other regional winds play an important part in determining the climate of, and affecting activities in Kekaha (Springer 1985:4-5).

Springer also notes that Robert Keakealani of Pu'uanahulu has described the winds of Kekaha as he learned them: The 'Eka wind is the "Waimea wind," the prevailing wind; the Kaumoku is the wind from Kona; the wind from Maui is called Ho'lua (Hoolua); and the Kuhonua is the wind from *mauka*.

Eliza Maguire, a resident of Huehue at the turn of the century and a translator of Hawaiian legends, describes the terrain of this area:

> One readily sees the great lava stretches of country, as one travels along the road. It is no wonder that the simple fisherfolks living along the seacoast personified the volcano as a dreadful being with supernatural powers whose wrath bore down on them so much destruction, laying waste their gardens, and filling their fish-ponds with rocks, leaving them on a narrow strip of beach, the ocean on one side, and the lava fields on the other (Maguire 1966:5).

Hamanamana is not listed in *Place Names of Hawaii* (Pukui et al. 1974) nor in *'Olelo No'eau* (Pukui 1983), two books that discuss place names in detail. The name itself cannot be translated without a great deal of speculation, as Hamanamana does not appear as a single word in the *Hawaiian Dictionary* (Pukui and Elbert 1971).

Information relevant to the present project area was found in a number of archaeological reports. A passage concerning the ancient chief Umi-a-Liloa, found in Schilt (1984), refers to the numerous caves in the general vicinity of the project area, and indicates that a number of them were used as places of refuge:

> In Kona, 'Umi was said to have established craft and professional separations...This division of labor probably came at a time of rapid population increase and was aimed at increasing production and work efficiency. However, 'Umi's descendants apparently struggled without definitive success to maintain political control over the island. In fact, traditions dating probably from the 1500s to the mid-1700s tell of the stresses and battles between opposing district chiefs of Hawaii island, and Maui and the chiefs of leeward Hawaii. It was

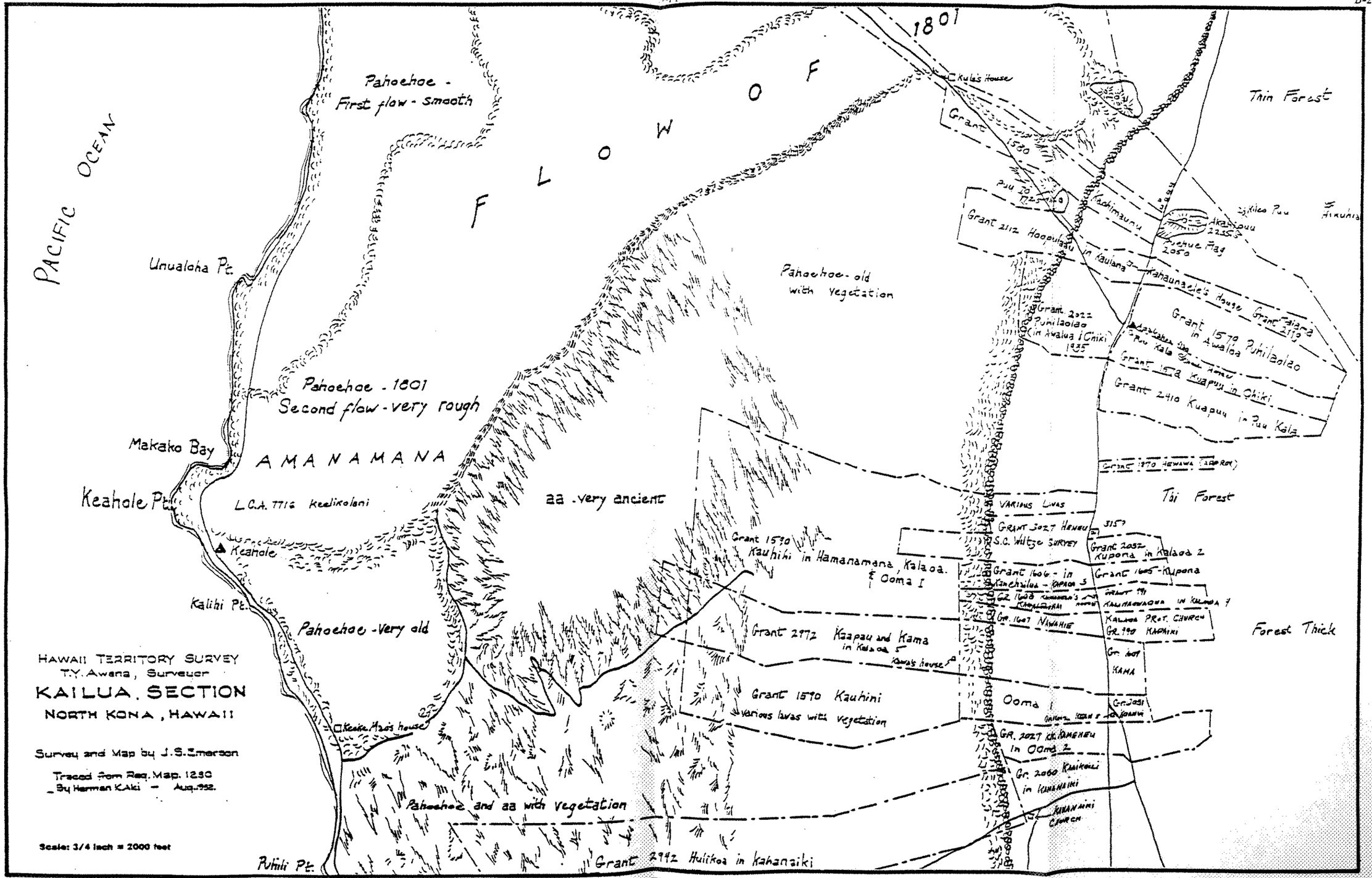

Figure B-1.
1952 J.S. Emerson Map of Kailua Section, North Kona, Hawaii
State Survey Office, Reg. Map No. 1280

probably during this time that many caves in leeward Hawaii Island were extensively modified to become underground places of refuge (Schilt 1984:22).

Myths and Legendary References

Two legends relevant to this part of Kona were found. One legend concerning the North Kona district mentions the god Lono, who was associated with life-giving resources such as rainfall: "...the story of the origin of the Makahiki rain and harvest festival...was to bring Lono from Kahiki, whither he returns," (Handy and Handy 1972:522-523). Another legend, included in Maguire's *Kona Legends* (1966), concerns a shoreline pool, *makai* of the project area. This tale tells of a sea creature with the power to change his form into a young man who seduces young girls at a pond named Wawaloli near the coast of Kalaoa (Maguire 1966).

One saying about this area concerns the life-sustaining qualities of the sea off Kekaha:

Ola akula ka 'aina Kaha, ua pua ka lehua i kai.

Life has come to the *Kaha* lands for the *Lehua* blooms are seen at sea.

"Kaha Lands" refers to Kekaha, Kona, Hawaii. When the season for deep-sea fishing arrived, the canoes of the expert fishermen were seen going and coming (Pukui 1983:271).

Kekaha was, and is, famous for its offshore fishing grounds. The Hawaiian historian, Samuel Kamakau, writes about the High Chief Umi-a-Liloa fishing for *aku* off the coast of Makaula during the 15th century (Kamakau 1961:20). During the later years of his life (c. 1810), Kamehameha frequently enjoyed fishing expeditions along the shores of Kekaha (ibid:203).

John Papa I'i, a Hawaiian historian and member of Kamehameha II's court, notes the abundance of fish, and the trading done off the coast of Kekaha:

The next day the ship arrived outside of Kaelehuluhulu, where the fleet for *aku* fishing had been since the early morning hours. The sustenance of those lands was fish...Soon the fishing canoes from Kawaihai, 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* lay silvery-hued on the deck (I'i 1959:109).

The fishpond of Paaiea was a large pond extending along the coast from Kaelehululu in Mahaiula to Wawaloli on the southern boundary of 'O'oma, a distance of about three miles. This pond was not far from Keahole Point, and the fishermen going to Kailua and further south often took a short cut by taking their canoes across the pond, "thus saving time and the hard labor of paddling against the Eka, a strong sea breeze from the south, and also against the strong current from Keahole" (Maguire 1966).

Three poetic sayings referring to the 'Eka wind are found in Pukui's *'Olelo No'eau*:

Ka makani kukulu pe'a nui, he 'Eka.
The 'Eka, the wind that sets up the big sails.
When the 'Eka wind blew in Kona, Hawaii, the fishermen sailed out to the fishing grounds (Pukui 1983:159).

Ke 'Eka, makani ho'olale wa'a o na Kona.
The 'Eka breeze of Kona that calls to the canoe-men to sally forth to fish.
Refers to Kona, Hawaii (ibid:182).

Makani 'Eka aheahe o Makalawena.
The gentle breeze of Makalawena (ibid:228).

According to tradition, Kekaha was a region "valued by ruling chiefs, inhabited by attendant chiefs, and upon occasion abused by warring chiefs" (Kalakaua 1973:31). It was the object of contention during the late 16th century when Kamalalawalu, ruling chief of Maui, was at war with Lonoikamakahiki, ruling chief of Hawaii (Kamakau 1961:56).

When the chiefess Keakealani was ruler of Kohala and Kona (c. the mid-17th century) (Kalakaua 1973:31), the Mahi clan were her war leaders and in charge of the wars between the chiefs of Hilo and Kona. The Hilo chiefs were evidently always victorious and "after they won the battle of Hu`ehu`e, the secret places and burial caves in Kona were broken open" (Kamakau 1961:63).

During the early 18th century, when Alapa'inui was at war with Kekaulike of Maui, the latter "abused the country people of Kekaha," cut down "the trees throughout the land of Kona," and "at Kawaihae he cut down all the coconut trees" (ibid:66). These acts of war were of no small consequence, for "to fell trees of such usefulness was considered truly inhuman" (Springer 1985:23).

During the reign of Kalani'opu'u, the lands of Kekaha belonged to the twins Kame'eiamoku and Kamanawa, half-

brothers of Ke'eaumoku. Kame'eiamoku was a very important and powerful chief (Kame'eiamoku and his twin are reported as being the two men present on the Great Seal of the state of Hawaii [ibid.]). In the 1780s and early 1790s, Kame'eiamoku had his home in Kekaha.

Early Historical Accounts

The earliest historical account of this part of the North Kona area is that of Archibald Menzies, who traveled with Captain George Vancouver in 1792. He wrote, "barren and rugged with volcanic dregs and fragments of black lava...in consequence of which the inhabitants were obliged to have recourse to fishing for their sustenance" (1920:99). It is assumed that Menzies never ventured beyond the coastline to the upland area where the project area is located.

John Papa I'i recorded a description of Kalaoa as he sailed past, "The gentle Eka sea breeze of the land was blowing when the ship sailed past the lands of the Mahaiulas, Awalua, Haleohiu, Kalaoas, Hoona, on to 'O'omas, Kohanaiki, Kaloko, Honokohaus, and Kealakehe...."(1959:110).

While touring the island of Hawaii in 1823, William Ellis noted the destruction caused by the 1801 Huehue Flow from Hualalai. He wrote of the flow:

> ... [it] inundated several villages, destroyed a number of plantations and extensive fish-ponds, filled up a deep bay twenty miles in length and formed the present coast...Stone walls, trees, and houses, all gave way before it; even large masses or rocks of hard ancient lava, when surrounded by the fiery stream, soon split into small fragments, and falling into the burning mass, appeared to melt again, as borne by it down the mountain's side" (Ellis 1963:30-31).

In 1840 Wilkes, an explorer with the American Expedition, also made a few observations about this area:

> ...a considerable trade is kept up between the south and north end of this district. The inhabitants of the barren portion of the latter are principally occupied in fishing and the manufacture of salt, which articles are bartered with those who live in the more fertile regions of the south, for food and clothing (Wilkes 1845:91).

Evidence of this salt manufacture is still seen along the coast in the numerous basalt and concrete salt pans.

In 1880, George Bowser traveled through the inland area where the project area is located:

> From Kiholo the road southwards is rough and laborious. Perpetual travelling over lava is very hard upon our horses, and it is impossible to travel faster than the slowest walk. On the road we met with some awful chasms of unknown depth and numberless cracks and fissures in the lava (Bowser 1880:93).

Bowser also recorded the business operations in various areas of the islands. Here he relates his impressions of North Kona and mentions some of the crops he saw growing:

> Presently I reached the ridge of the mountain, and had a fine view of the surrounding country. Fronting the sea for many miles in North Kona there is a rich tract of bottom land which might be turned to good account. Large areas of the mountain land might also be cultivated for coffee. It is a shame to see so many hundred square miles of country lying waste for want of enterprise on the part of its owners.
>
> I was astonished to see in this district how bananas, mangoes, oranges, pineapples, in short, all the fruits belonging to these islands grow in profusion and yield splendid crops upon the bare lava. Ferns it is not so surprising to see, for they will grow in all sorts of rocky situations, but the luxuriance of their growth is wonderful. In many places you may see them growing to the height of five-and-twenty feet. The ferns, except the variety which yields the pulu, are only food to look at, for if there is an edible fern here, as in New Zealand, the natives have had too many other more tempting fruits of the soil at hand to think of turning it to account. But the fruits I have just alluded to ought to be worth something if any one would but try to utilize them. They are so fine in quality and grow in such profusion that I feel sure some enterprising person will yet make a fortune by being the first to turn them to account (ibid.).

Land Tenure

In 1848, during the reign of Kamehameha III, the traditional Hawaiian land ownership system was replaced with a more Western-style system. This radical restructuring was called the Great Mahele (division). The Great Mahele separated and defined the undivided land interests of the king

and the high-ranking chiefs, and the *konohiki*, who were originally those in charge of tracts of land on behalf of the king or a chief (Chinen 1958:vii and Chinen 1961:13). More than 240 of the highest-ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division. The first *mahele* was signed on January 27, 1848 by Kamehameha III and Princess Victoria Kamamalu, and by her guardians Mataio Kekuanaoa and Ione Ii. The last *mahele* was signed by the King and E. Enoka on March 7, 1848 (Chinen 1958:16).

The *mahele* did not convey title to any land. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands quitclaimed to them by Kamehameha III. They were also required to pay commutations to the government in order to receive royal patents on their awards. Until an award was issued, title remained with the government. The lands awarded to the chiefs and *konohiki* became known as Konohiki Lands. Because there were few surveyors in Hawaii at the time of the *mahele*, the lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This expedited the work of the Land Commission and speeded the transfers (Chinen 1961:13).

During this process all land was placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and Konohiki Lands. These were all "subject to the rights of native tenants," (Laws of Hawaii, 1848:22). Native tenants were the common Hawaiian people who lived on the land and worked it for their subsistence. Questions concerning the nature of these rights began to arise as the king, the government, and *konohiki* began selling parcels of land. On December 21, 1849 the Privy Council attempted to clarify the situation by adopting four resolutions intended to protect the rights of native tenants referred to in the 1848 law (Chinen 1958:29).

These resolutions authorized the Land Commission to award fee simple title to all native tenants who occupied and improved any portion of Crown, Government, or Konohiki lands. These awards were to be free of commutation except for house lots located in the districts of Honolulu, Lahaina, and Hilo (ibid.).

Before receiving their awards from the Land Commission, the native tenants were required to prove that they cultivated the land for a living. They were not permitted to acquire wastelands or lands which they cultivated "with the seeming intention of enlarging their lots" (ibid:30). According to Chinen, once a claim was confirmed, a survey was required before the Land Commission was authorized to issue any award. These lands became known as "Kuleana Lands." Until its dissolution on March 31, 1855, the Land Commission issued thousands of awards to the native tenants for their *kuleana*; even so, less than 30,000 acres of land were awarded to the native tenants as Kuleana Lands.

The entire *ahupua'a* of Hamanamana was awarded to Princess Ruth Keelikolani in the Great Mahele of 1848 (Board of Commissioners 1929). No other claimants are listed for land in the area, thus no Land Commission *kuleana* awards are located within the project area.

Hamanamana is shown as "Amanamana" on a 1952 map-tracing of the Kailua Section of North Kona. The only feature of importance to appear on this map of the project area shows LCA 7716 to Keelikolani. The outline of the 1801 lava flow labeled as "Pahoehoe 1801 Second flow very rough" is shown near the coast with "aa very ancient" shown inland (Figure A-1).

Kalaoa 4 became part of the land set aside for the government (Board of Commissioners 1929). This land as well as Kalaoa 1-3 were the lands of King Kamehameha III, which he passed to government control. Most of the land between the 1000 ft and 2400 ft elevation was soon sold, and a series of grants was issued in these *ahupua'a* from 1852-1864. Typically sold in lots of c. 50 acres, most of them were agricultural parcels (Cordy 1985:6 and Soehren 1982:3).

'O'oma is best known for the fact that Kauikeaouli (Kamehameha III) was raised there by his guardian Kaikioewa during the years 1841 to 1819. This suggests that Kaikioewa had principal interest in 'O'oma. During the *mahele*, the lands of 'O'oma were designated Government Lands. Since 'O'oma 1 and 2 were not *ahupua'a* that were commutated by other chiefs, it is likely that they were the personal holdings of Kauikeaouli, which he passed on to the government (Cordy 1985:35).

With its classification as Government Land, parcels were sold as grants throughout the year, primarily for homestead purposes. A letter from H.N. Greenwell to the Minister of Interior (c. 1878-1880) informed the minister that Greenwell's *konohiki*, Kekoanui, collected thirty dollars from Kama, a leasee for lands at Kalaoa and 'O'oma. John Avery Maguire, who started Huehue Ranch, leased some 302 acres in the vicinity, c. 1902. This suggests some ranching (Jean Greenwell, pers. comm. 5 July 1990). Most commonly, land in the *ahupua'a* was used for fishing and homesteading.

Makaula was also listed as Government Land at the time of the Great Mahele. Hale'ohi'u was designated as Crown lands in the *mahele*, remaining as the personal property of the king.

Agriculture

Agriculture has changed drastically in the Kona area, as it has throughout the Hawaiian chain, with the introduction of foreign plants and animals. Handy tells us that in the Kona area, where the rain for taro planting is seasonal, dry taro was planted in individual holes filled with mulch. Clearing the upland forest for this type of planting was termed *umoki* (Handy 1940:47-48). Handy records a detailed account of these planting methods, by Kepelino, a native of Kona (ibid:48). In 1794, Captain Vancouver introduced goats and cattle to the Kona area, and after an initial 10-year *kapu*, they were for many years the mainstay of industry.

The 1850s saw the development of large-scale commercial ranching and agriculture, after the Mahele and after an 1850 law permitting foreigners to own land. Coffee, grazing-land, and for a time, sugar cane, gradually replaced traditional subsistence crops such as taro and *'uala*. Chinese and Hawaiian labor was utilized on coffee plantations, located in the fertile belt above the 800 ft elevation. At elevations of 500 to 3,000 ft tobacco was grown commercially, from this time until about 1930 (Schilt 1984:24).

In the 1890s rising prices produced a boom in coffee-growing in North Kona. Contributing to the boom were the introduction of the ladybird beetle, from Australia, to combat white scale, and the opening of former Crown lands for leasing under the Provisional Government (1894). Although coffee prices fell in the late 1890s and sugar cane plantations expanded with U.S. annexation in 1898, coffee-growing persisted in Kona because coffee could be grown on land that was too rocky for sugar cane (Schilt 1984:25).

Land Use and Settlement Patterns

The Kalaoa area has been arid and hot as least since the time of the first Western visitors. In most of the Kekaha lands, the population was concentrated on the coast, and most fields were in the upland forest. Trails (with associated shelters) connected the two areas (Cordy 1985:5). Cordy dates the beginning of permanent settlement in 'O'oma 2 to the years 1400-1450 (1985:37-38). The 1801 lava flow wiped out the coastal settlements in Kalaoa. Schmitt cites the population decrease between 1778 and 1819 as 52%, from 300,000 to 145,000 (Schmitt 1977:25).

Cordy also sums up the various conflicting views concerning the population in the general vicinity of the project area. Cordy indicates that Reinecke (n.d.) thought there was once a population in the hundreds, and that the "scarcity of remains" was the result of destruction by man, cattle, and storms, or else any remains left were in sandy areas and were not discernible or were a short distance inland. Ching (1971) agrees, citing legends suggesting "[a] large population for the lands above the study area" (North Kona). He believes the trails in the Kalaoa area pointed to inland permanent settlement there. He also argues that fishponds and fishing grounds, and the large number of archaeological sites, refuge caves, and *holua* slides in the North Kona area suggest that Kalaoa was a productive land of great value (ibid.). Cordy emphasizes the harsh environmental setting and argues that the population was always low, containing only small villages of fishermen. Thus he feels that the number of sites is not unusual for 400 years of occupation. Cordy used counts of permanent house sites to create population estimates (Cordy 1987:244-5) that suggested that the population of `O`oma 1 and 2 and Kalaoa 4 and 5 together was never more than 102 people, and was at a maximum between c. 1750 and 1780.

According to Schmitt (1977:13), the population of North Kona declined to 1,753 in 1890 and then increased to 3,819 in 1900. By 1866 most of the land flanking the Mamalahoa Highway had been sold (Soehren 1985). All the early grants had frontage on the "alaloa mauka" or upper belt road, now known as the Mamalahoa Highway, which lies at about the 1700-ft elevation. Another road, at about the 1100-ft elevation, Alanui Kauila, served the lower ends of these grants (ibid.). Soehren notes that these arterial roads "connected the upland farm lots of the various *ahupua`a* with one another, with the port and urban center at Kailua and with the rest of the island" (ibid.). Portions of the Alanui Kauila are now part of Kauila Street in Kona Coast View subdivision, while Ahiahi Street in Kona Palisades follows approximately the route of Alanui Kama, a lower branch of Alanui Kauila (ibid.).

Communication between different elevations within the *ahupua'a* was provided by *mauka-makai* trails such as the Alanui Kauhini (probably Ka-'uhini, "grasshopper" [ibid.]). One of the trails in Kalaoa mentioned by Ching (1971) could very well be the Alanui Kauhini. It is a trail that runs *mauka-makai*. It is shown on Map No. 6 by J.S. Emerson, dated January 1889, Homestead lots, Akahipuu Section, N. Kona, Hawaii, and was in existence before the government subdivided the Kalaoa lands and began selling lots in 1852 (Soehren 1985). A portion of the trail is shown well above the Mamalahoa Highway, but much of it has been omitted from the 1889 map (ibid.). In the report on their survey of Kalaoa 4, Telea and Rosendahl (1987) state that the trail was once used for the transportation of people and produce between the upland agricultural zone and the coastal habitation zone.

Shortly after World War II, a jeep trail was bulldozed from Mamalahoa Highway to the shore near Keahole Point (Soehren 1985). The upper portion of this road followed the Alanui Kauhini, past private farm lands to the state land below (ibid.). Over the years the trail was maintained by periodic bulldozing until the Queen Ka'ahumanu Highway provided easier access to the shore (ibid.).

Today the upper forest zone of the Kalaoa area is well-populated, with the Kona Palisades Subdivision occupying much of the area. The intermediate zone is slowly being developed as part of the industrial and residential areas expanding out of Kailua. No permanent human habitation was ever reestablished on the coast after the 1801 lava flow inundated much of the area. The coastal area is now home to the Keahole Airport and OTEC, the Natural Energy Laboratory of Hawaii. OTEC uses the temperature difference between the warm water of the ocean surface and cold water from the depths to generate electricity, which may provide an alternative energy source for the rapidly increasing Kona population (Clark 1985:115).

Informant Interview

Margaret Spinney, a resident of Kalaoa, was interviewed by Larry Kimura in 1980 for an oral history. The part of their conversation reproduced below focuses on families in Kalaoa and the activities that took place c. the 1920s. The following is reprinted from Walker and Rosendahl (1989:11-12).

LK: In those days, the house that you folks had down at the beach, well, to get there was no real road, was there?

MS: There was only a footpath....Of course in those days the land was clear. There was not all of these bushes and plants that you see now covering the landscape. The vegetation was so low, very low; you could see all the way down to Kailua. Now, when you look, you can't see Kailua; it's all blocked with this dense growth of vegetation.

MS: My mother...planted several acres with *lau hala*. This would be the *lau hala kokala'ole*.

LK: And was that just below here? (Below the present site where Margaret Spinney is now living, approximately in the Kona Palisades area.)

MS: Yes. And so when the *lau hala* trees grew to maturity, she had a lot of *lau hala* to use for her own weaving. Most of the people of Kalaoa would go to these fields that my mother planted to get their *lau hala* to use.

LK: Who were some old people who lived in this area, some old time people? Are you familiar with the name Kawaimaka Ha'o?

MS: Yes, I've heard of that family. Some are in Pu'uanahulu.

LK: Because this name of your mother, Kalua and...

MS: Yes, that Kalua Pimoe makahi.

LK: What about this Mahi family? Isn't this a big family here? I think one of this Mahis is from Hamakua District, but another Mahi family is from this area.

MS: Yes, there is a Joe Mahi here in Kalaoa. His father is Mitchell Mahi.

LK: Isn't that the one from Hamakua?

MS: No, no, there is another Mahi, this Pelika Mahi.

LK: What was the major race that lived here during your time? What was the majority race?

MS: They were Hawaiian people. Later, Japanese came and lived together with the Hawaiians that were living here.

On October 14, 1991, PHRI historical researcher, Lehua Kalima interviewed Mr. Karin Haleamau, a resident of the Kalaoa area. Mr. Haleamau's grandmother was raised in this area, and when he was a young boy, he worked in the fields near the project area. He recalled that the project area vicinity was farm land, even before the time of his birth, and it was once cultivated in taro. He also remembered coffee and avocados being grown there. Mr. Haleamau reported that clearing in the area was done by hand, in order to preserve the soil. When this was done, the rocks that were cleared away were piled into neat mounds, which may account for the numerous rock piles still present. Mr. Haleamau knew of no burials or graves in the area (pers. comm.).

Additional Information from Ka Hoku o Hawai'i

The Legend of Kamiki has been recently translated from the Hawaiian language newspaper *Ka Hoku o Hawai'i* (Maly,

in prep). The legend is set in the time of Pili-a-Ka'aiea (Pili), who was sovereign chief of all Kona c. the 13th century. The tale concerns two supernatural brothers who travel around the island of Hawaii, vanquishing evil *'olohe* (skilled fighters) and priests whose conduct offended the gods. Contained in the text are descriptions of traditional life in ancient Hawai'i, and the text specifically mentions three of the project area *ahupua'a*—Kalaoa, Hale'ohi'u, and Awalua (the land north of Kau).

The district of Kona, Hawai'i is one of the six major districts of Hawai'i Island. The boundaries of Kona, and its various subdivisions are described in the Legend of Ka-Miki (*Ka Hoku o Hawai'i* 9/13/1917):

> *Mai Ke-ahu-a-Lono i ke 'a o Kani-ku, a ho'ea i ka 'ulei kolo o Manuka i Kaulanamauna e pili aku i Ka'u*
>
> [Kona] extends from Keahualono on the rocky expanse of Kaniku, to Kaulanamauna next to the crawling (tangled growth of) 'ulei bushes at Manuka, where it clings to Ka'u.

The Kona district was divided into two major regions—Kona 'akau (North Kona, which contains the current project area) and Kona hema (South Kona). Kona 'akau was further divided into two areas. The first was generally known as Kona kai 'opua, and it extended from the lands in the Kailua area to Pu'uohau. Kona kai 'opua can be interpretively translated as Kona of the Distant Horizon Clouds Above the Ocean. The other subdivision of Kona 'akau was Kekaha (The Place or Shore), which was also called Kekaha-wai-'ole (The waterless place). Here are three interpretive translations for the project area *ahupua'a*: Hamanamana (Many branches or segments), Ka-u (The moisture or damp place), Makaula (Prophet or seer).

According to the Legend of Ka-Miki, Kekaha extends northward from Keahuolu to the boundary between Kona and Kohala at Keahualono:

> *O Hikuhia i ka uka o Na-pu'u a me Kekahawai'ole, mai Ke-ahu-a-Lono i ke 'a o Kaniku a ho'ea i ke kula o Kanoenoe i ka pu'u o Pu'u-o-Kaloa.*
>
> [Kekaha extends from] the uplands of Hikuhia, which is above Napu'u and the waterless Kekaha; Kekaha reaches from Keahualono on the rocky plain of Kaniku, to the hill of Pu'uokaloa, [at Keahuolu]. (10/18/1917)

To a contemporary visitor, the project area lands, and Kekaha in general, appear barren and desolate. It is difficult to believe that many people could have lived in the area without modern conveniences, but traditional accounts of this area describe numerous settlements, extensive agricultural fields and fishponds, and well-defined trails. Accounts also contain much praise for the rich fishing grounds of the region.

Awalua (Two Harbors)

> Subject: An account of Ka loko o Pa'aiea. **Kaloa** is the ocean that fronts Awalua and **Kaloahale** is named as a *ko'a 'opelu* (*'opelu* fisherman's station) at Awalua
>
> While Ka-Miki was competing at 'Iwa'awa'a, Maka-'iole was at Ka'aipapa'a, Kaloko (a compound of Pohaku-o-Kane). Maka-'iole compared the rising voices of those watching the contest to the sounds of the murmuring ocean of Awalua, a sound that was carried upon the winds:
>
> *Wa ku'i ka pihe hanehane a ke kai la*
> *Kai Kaloa e nu nei i Awalua*
> *Ke hone ala i uka o Kalama'ula...*
>
> Shouting is heard like the distant murmuring of the ocean
> It is the sea of Kaloa that rumbles at Awalua
> A murmuring that rises gently to the uplands of Kalama'ula...(5/21/1914)

After fighting in the ocean with Kanahaha, a warrior who threatened Pili's kingdom, Ka-Miki left Kanahaha bound in the ocean as a *ko'a* (fishing station) off of Hale'ohi'u. Ka-Miki then swam and landed at Awalua, which was also a *makaha* (sluice gate) of the great fishpond Pa'aiea (11/29 and 12/6, 1917).

In *Ka Hoku o Hawai'i*, Hawaiian historian J.W.H.I. Kihe presents an account of Ka loko o Pa'aiea, the pond of Pa'aiea (2/5-19, 1914). According to the account, "To avoid the strong currents between Ho'ona and Keahole, canoes traveling to and from Kailua entered the pond of Pa'aiea and traveled via the inland waters. Awalua formed the northern makaha used by canoes" (and Puhili was the southern gate).

Also from *Ka Hoku o Hawai'i* comes the account of Ka Mo'olelo o Ka'elemakule, by J. Ka'elemakule. Hawaiian educator and businessman The account describes the people of Kekaha, Kona and their activities, customs, and fishing

grounds. The narrative documents use of an "*awa pae wa'a*" (canoe landing) at Awalua (7/3/28); and reveals that Kaloa-hale (House [in the sea of] Kaloa) was a *ko'a 'opelu* (*'opelu* [Decapterus pinnulatus] fishermen's dedicated station or grounds. (3/5/29)

Hale'ohi'u (House made with a thatching shuttle)

Subject: An account of Pao'o-a-Kanukuhale and its association with Kalaoa (Na Kalaoa wai'ole)

Kalua'olapa was the priest of the lands between Hale'ohi'u and Kamahoe, also referred to as Na-Kalaoa-wai'ole (The waterless Kalaoa [lands]). Kalua'olapa lived on the *'ilima*-covered plain of Maulukua. (4/30/1914)

While at Kalahiki (Kona), with Kualaka'i and his fishermen in the "halau wa'a" of Kuaokala, Ka-Miki described the fishing grounds of his home region with the following saying:

O Ka'elehuluhulu ka 'aina, o Hale'ohi'u ka ahupua'a, Kanahaha ke ko'a, o Keawehala ke awa pae

Ka'elehuluhulu is the name of the land, Hale'ohi'u is the sub-district, Kanahaha is the fishing ground, and Keawehala is the landing. (11/5/1914)

Pao'o-a-Kanukuhale (also called Pao'o or Kanukuhale) was a *ko'a hi-aku* (bonito fishing ground) between Hale'ohi'u and Ho'ona (Keahole-Kalaoa). When The canoes left Hale'ohi'u they were paddled till Manuahi (Palikapuokeoua at Ka'awaloa) could be seen, then the fishermen started fishing (10/4-11/1/1917).

Kalua'Olapa and Maulukua

Ka-lua-'olapa (The pit of flashing, or lightning) was the priest of Hale'ohi'u and Kamahoe (also called Na Kalaoa-wai-'ole), his dwelling place was upon Maulukua (interpretive translation: an area of plant growth), on the flats that stretched between Hale'ohi'u and Kalaoa, which were covered with wild *'ilima*. The priests' house site was called Kalua'olapa, and a crater of that name is identified on Map 2305 of North Kona.

While in Ka'u, Ka-Miki greeted the spirit-formed fisherwoman Kawelohea. Calling to her, he described the length of his journey and asked that she share her catch with a poor traveler who had come from Maulukua:

Noho mai nei keia i ka uka o Maulukua, a makapehu, a 'ono a'e la no ho'i i kahi limu 'o'olu, a me ka lipe'epe'e, ka pai'ea, a me kahi he'e pali, a 'oia ia i iho 'oko'a mai la e 'ike ia Kawelohea ka wahine alualu pai'ea o na makalae o Kalepeamoa.

Here is one who dwells in the uplands of Maulukua suffering from hunger, one who desires some of the *'o'olu* (*Champia* sp.) and *lipe'epe'e* (*Laurencia* sp.) seaweed, the hard-backed crabs, and cliff-base octopus. So here is this unfamiliar one, a stranger who has come down to see Kawelohea, the woman who gathers crabs from the shores of Kalepeamoa (6/317,1915).

Ho'ona (To Be Calm)

Ho'o-na is near the point of Keahole. The famous supernatural currents Ke-au-ka, (The Current That Strikes), Ke-au-kana'i (The Current Of Smooth Waters), and Ke-au-miki (The Current That Pulls Out to the Deep Sea) originate at Ho'ona. [These currents are identified as brothers of Pele ma in the lore of Pele's migration to Hawai'i.]

Ka-Miki was fishing off of the deep sea *ko'a* of Pao'o (between Ho'ona and Hale'ohi'u), when the *aku* began to strike at the canoe. Ka-Miki told his companions Uhalale ma to take the first caught and place it in a gourd container. After this the *aku* rose like biting dogs, tearing at the water, and Ka-Miki moved like a swift wind. In no time the canoe was filled with more than 400 *aku*.

An amazing thing is that although Pili's fishermen, and all the fishermen of the region, were fishing at Kaka'i, Kanahaha (Hale'ohi'u), and all the way from the fort (Ahu'ena) to Kahawai (Ka'upulehu), none of them caught any fish at all. [The locations of Kaka'i and Ahuloa in Kekahawai'ole, Kona could not be located on the maps or documents reviewed.]

After catching more than 400 *aku*, Ka-Miki landed the canoe at Na-Hono-'elua, now called Honokohau.

Ka-Miki divided the fish among the family of the sacred chiefess Paehala and people of those lands. (10/11/1917)

Kalaoa (The Choker)

Kalua'olapa was the priest of Hale'ohi'u and Kamahoe, which are also called Na Kalaoa-wai-'ole (The Waterless Kalaoa Districts). Kalua'olapa lived along the *'ilima*-covered upland flats of Maulukua, and his compound was called Kalua'olapa. (4/30/1914) [On the 1928 J.S. Emerson map of North Kona, Kalua'olapa is identified as a crater site near the upland border of Kalaoa and Hale'ohi'u.]

The chief of the Kalaoa lands was Kahouhale; his wife was Malumaluiki, and their son was named Kahokukahi. Following the dedication of Ka-Miki's compound at Ka'aipua'a (Kohana-iki), Kahokukahi was a competitor at 'Iwa'awa'a, the contest site of Pohaku-o-Kane, in the lands of Kohana-iki. During the contests, all competitors surrendered before Ka-Miki's superior skills. (5/7/1914)

When Ka-Miki and his brother were traveling through Hilo, they met with the chiefess-riddler Kalaoa (5/14/1916). The lands of Kalaoa, in Kona and Hilo, were named for Kalaoa, a master *'olohe* riddler. At one time she lived in the region of Hilo-pali-ku, with her husband Hapuna (Leina-Hapuna). All of Kalaoa's family practiced riddling, Kapalaoa was her sister and Halepaniho and Halepaiwi were their brothers. Kapalaoa married Kane-po-iki, and they had a son who was named Kalapana.

Halepaniho and Halepaiwi instructed Ka-lani-ali'i-loa, the riddling chief of Kaua'i (Wailua), in contest riddling. Later, Kane-po-iki was killed during a contest with Ka-lani-ali'i-loa. Kapalaoa sent Kalapana to learn riddling skills from Kalaoa, and he learned the skills so well that he killed Kalanaiali'iloa during a riddling contest on Kaua'i. Kalapana returned to Hawai'i and lived in the shade of the forest of Kali'u (see also: J.W.H.I. Kihe, *Ka Hoku o Hawai'i*, 10/21/1915 and Beckwith (1970:458459).

Kamahoe

Ka-mahoe (The twins) is given as an alternate name for the (na) lands of Kalaoa-wai-'ole. The priest who officiated over rituals of Hale'ohi'u and Kamahoe was Kalua'olapa. He dwelt upon the lands of Maulukua, the 'ilima-covered plain of these ahupua'a.

Keahole (the fish, Kuhlia sandwicensis)

A site near the point of Keahole is called Ho'o-na (To be calm). The famous supernatural currents, Ke-au-ka (The current that strikes), Ke-au-kana'i (The current of smooth waters), and Ke-au-miki (The current that pulls out to the deep sea) originate at Ho'ona.

Pa'aiea and Ka Loko o Pa'aiea (The fishpond of Pa'aiea)

This place name narrative was published by J.W.H.I. Kihe in the Hawaiian language newspaper *Ka Hoku o Hawai'i*. Kihe was a co-author of the legend of Ka-Miki. Though the texts primarily concern Ka'upulehu, this selection refers to the great fishpond that once extended across the project area lands. It is important to note that the presence of a major fishpond in this region is an indicator of Kekaha's substantial population and importance in supporting the larger "royal" community around the area now identified as Kailua.

While traveling in the form of an old woman, Pele visited the Kekaha region of Kona. Upon reaching the chiefs' fish pond of Pa'aiea, Pele inquired if she might have a few small fish to take home with her. Kepa'alani, overseer of the fish pond, refused Pele's request, so she departed and traveled to the uplands. It is said that the fish pond of Pa'aiea stretched across the lands of Kekaha from Awalua to Wawaloli, crossing Hale'ohi'u.

After departing from Pa'aiea, Pele went to the uplands of Ka'upulehu, near Ke-one-'eli (The Dug Sand, or Cinders) by the site now called Kepuhiapele (*'a'a* hills approximately 200 feet high, below the old Mcquire house). It was here, in a village (*kulanakauhale*) of many people, that Pele met with two girls, Kolomu'o and Pahinahina, who were broiling *'ulu* (breadfruit). All the other people of the village were away performing agricultural service (*po'aha*) for their chief.

Pele approached the two girls and inquired about their tasks. When she asked who would receive the first offerings of this *'ulu*, Kolomu'o said her goddess La'i would receive the offering for she was a

powerful deity. Kolomu'o did not acknowledge Pele, and Pahinahina replied that her goddess Pele-Honuamea would receive the first offering. Not knowing that the old woman was Pele, the girls responded to Pele's comments about the power of their goddesses. When their conversation was completed, Pele told Pahinahina, "Our 'ulu is cooked; let us eat." Pele then instructed Pahinahina to mark the boundary between her and her family's dwellings and the dwelling of Kolomu'o' with *lepa* (white *kapa* flags. She also told Pahinahina not to fear the events that would occur that night.

During the night, a white flash was seen to travel from Mauna Loa to Hualalai, and in a short time a red glow was seen at Ka-iwi-o-Pele. The people along the coast thought that it was the fire of the bird catchers at Hono-(manu)-'ua'u. The light dimmed and then appeared at (*pu'u*) Kileo where the shiny hills of black pahoehoe may be seen. Pele then went underground and appeared at Keone'eli where she caused deep fissures to open, and the kahe-'a-wai (fire rivers) to flow.

Kolomu'o ma were consumed by the lava, and the fishpond of Pa'aiea was completely covered by the lava as well. The lava flats below Kepuhiapele and a shoreward '*opelu* fishermen's *ko'a* (shrine) bear the name of Kolomu'o. The area where Pahinahina and her family lived was left untouched, and this open space bears the name of Pahinahina to this day. The name Ka-'ulu-pulehu (The Broiled Breadfruit), shortened to Ka'upulehu, also came about because of this event.

Kekahawai'ole (The Waterless Shore, or Place)

In He Mo'olelo no Makalei, another account of Ka'upulehu, written by J.W.H.I. Kihe (Ka Hoku o Hawai'i, 01/31 - 02/26, 1928), the author describes life in Kekaha:

Departing from O'ahu, Makalei and his family landed at Hale'uki, Ka'upulehu and were greeted by Ke'awalena, a chief and overseer of the Kekaha region. Ka'upulehu and all Kekaha were extensively cultivated at this time. Dependent on seasons, the uplands were used for residence and farming, and the coastal lands for residence and fishing. Pao wai (dug-out water catchments) were a means of water catchment on the pahoehoe and in upland fields. Crops grown here included taro, sweet potatoes, sugar cane, bananas, and 'awa. (1/31 - 4/10)

Having journeyed through Kona, Ka'u, Puna, Hilo, Hamakua, and Kohala, Ka-Miki, Maka-'iole, and their companion Keahialaka (of Puna) departed from Lanimaomao, Kohala (4/5/1917) and returned to Ka-uluhe-nui-hihi-kolo-i-uka, at Kalama'ula-Kaukahoku. The journey around Hawai'i-kuauli was completed, the *ala loa - ala hele* were safe, and the evil '*olohe* had either repented or been killed. The time when Ka-Miki ma returned to Kona and to their ancestress, Ka-uluhe, at Kalama'ula (Kaukahoku) is described with the saying 'olelo no'eau:

> *'Oia ka wa e ne'e ana ka la ia Kona, hele a malo 'o ka 'aina i ka 'ai kupakupa 'ia e ka la, a o na kanaka na li'i o Kona puhe'e aku la a noho i kahakai kahi o ka wai e ola ai na kanaka*
>
> It was the season when the sun moved slowly over Kona, drying the lands; it was the time when the chiefs and people moved and lived along the shores where water could be found to give life to the people. (4/5/1917)

In celebration of their return, Ka-uluhe caused rains and winds to roar; the ocean rumbled, the birds sang out in the lehua forests, and the mists covered the land from Kalama'ula through all Kona kai malino (Kona of the calm sea). The rains lasted for seven days. When the calm returned and the sun appeared, the *umauma* (breast) of Kona (i.e., Hualalai) was adorned with *liliko pua kanahele* (the blooming of flowers throughout the forest). The traditional beauty of the region was described in the following, excerpted from a chant:

> *Nani, kilakila a maika'i ka 'onohi o Kona i ka pohu, i ke anipeahi a Hualalai ae 'oia*
>
> Perfectly beautiful and majestic, the center [pride] of Kona, in the calm, Hualalai appears to gently nod; indeed it is so. (4/5/1917)

Summary

Legendary descriptions of this region depict communities and the various resources on which they depended for their survival. The legendary picture is so different from the way things are now that one must ask, what has so com-

pletely changed the face of Kekaha? The answer appears twofold: (a) the active volcanism of Hualalai and (b) changes in land-use practices over the last 150 years. Around the time of Western contact, Hualalai reclaimed much of the land used for settlements, agriculture, and fishponds. The flows also greatly reduced the forest on the mountain slopes, which undoubtedly caused rainfall to decrease. Subsequent ranching stripped the mountain slopes of even more forest, and as the forest disappeared, water catchment became unreliable. The famed water caves dried up, and the remaining *ki 'owai* (fresh water sources) on the shore became more brackish. As the water resources dried up and Western land-use practices replaced traditional methods, Hawaiian communities gradually disappeared.

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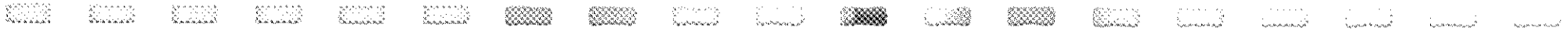


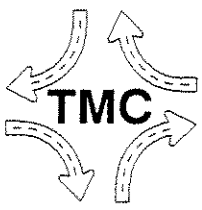
TRAFFIC ASSESSMENT FOR THE

WEST HAWAII BOUNDARY REVIEW OF STATE LANDS

PREPARED FOR

HELBER, HASTERT & FEE

FEBRUARY 26, 1993



PREPARED BY

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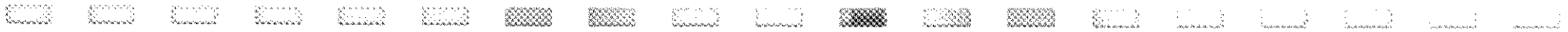

TRAFFIC ASSESSMENT
FOR THE
WEST HAWAII BOUNDARY REVIEW OF STATE LANDS

I. INTRODUCTION

A. Purpose of Study

The purpose of this study is to identify issues and opportunities relative to the traffic impacts resulting from the reclassification of State of Hawaii Lands in North Kona, Hawaii. The proposed reclassification of State Lands is part of the State Land Use District Boundary Review. Redesignation of the State Lands to urban uses is a broad measure intended to meet future population and economic needs on the island of Hawaii. Specific uses of these Lands have not ben identified, therefore the traffic impacts of the development of the State Lands cannot be analyzed.

B. Scope of Study

The scope of this study includes:

1. Compile available traffic data in the vicinity of the State Lands.
2. Analyze the traffic data to establish the existing condition.
3. Describe the project environs, relative to proposed projects and related future and ongoing roadway improvements.
4. Discuss traffic issues and opportunities relative to the development of State Lands.

II. PROJECT DESCRIPTION

A. Location

The State Lands, proposed for reclassification, consists of approximately 2,640 acres in North Kona, Hawaii. The site is located on the mauka (east) side of Queen Kaahumanu Highway, opposite the Keahole Airport. Its northern

most boundaries is located approximately one mile north of the Keahole Airport Access Road. The State Lands extend southward, about two miles south of Keahole Airport Access Road. The State Lands frontage on Queen Kaahumanu Highway begins near the Keahole Airport Access Road and extends about one mile to the north. The State Lands frontage on Queen Kaahumanu Highway to the south begins about 0.85 miles south of the Keahole Airport Access Road and extends another mile and one half to the south. The State Lands extend up to 2.7 miles in the mauka direction. Figure 1 shows the location and limits of the State Lands.

B. Development Plan

The proposed plan for the State Lands has not been developed at this writing. In general, the proposed project would include urban activities including, but not limited to, residential, commercial, industrial, and institutional land uses. A West Hawaii University of Hawaii campus is also proposed within limits of the State Lands.

Preliminary communications with the State Department of Transportation indicate that access to the State Lands would be permitted at at-grade, traffic signalized intersections, as warranted. The at-grade access would ultimately be relocated to grade-separated interchanges or to a frontage road system, developed as part of the Queen Kaahumanu Highway improvement.

III. EXISTING TRAFFIC CONDITIONS

A. Area Roadway System

Queen Kaahumanu Highway is a two way, two lane, high quality arterial highway between Kailua-Kona and Kawaihae. Queen Kaahumanu Highway is the primary highway along the South Kohala and North Kona coasts. Exclusive left turn and right turn lanes are provided on Queen Kaahumanu Highway at key intersections, such as at Keahole Airport Access Road and at Kaimi Nani Drive. Left turn median storage lanes and right turn acceleration lanes are also provided at these intersections. These intersections are unsignalized at this writing.

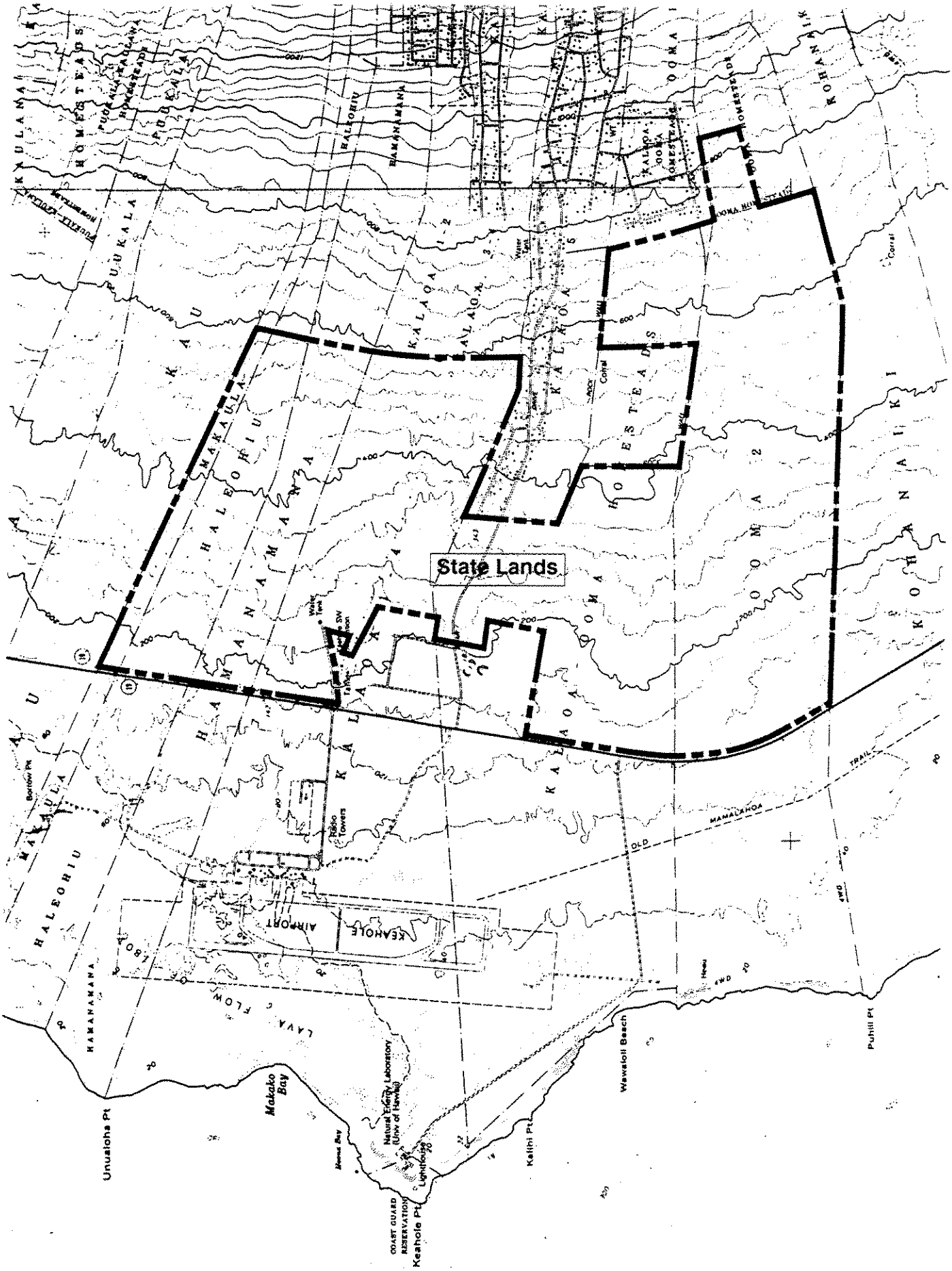

Figure 1 - Site Map

Mamalahoa Highway is a two lane, two way arterial highway that is a continuation of a "belt" road that circles the island of Hawaii. Mamalahoa Highway is located approximately 3.3 miles mauka of Queen Kaahumanu Highway. Mamalahoa Highway provides the primary route between Waimea and Kailua-Kona.

Kaimi Nani Drive is a two lane, two way collector roadway, connecting Queen Kaahumanu Highway and Mamalahoa Highway. Kaimi Nani Drive intersects Queen Kaahumanu Highway, about one half mile south of Keahole Airport Access Road. Kaimi Nani Drive is situated about midway through the project site in the mauka-makai direction. The mauka portion of Kaimi Nani Drive provide access to the Kona Palisades residential subdivision. Until the recent construction of Hina Lani Drive, Kaimi Nani Drive has been the only roadway connecting Queen Kaahumanu Highway and Mamalahoa Highway between Waikoloa Road to the north and Palani Road to the south.

Kamani Street/Hina Lani Drive has recently been extended from Mamalahoa Highway to Queen Kaahumanu Highway by the County of Hawaii. Kamani Street/Hina Lani Drive provides additional access between Queen Kaahumanu Highway and Mamalahoa Highway. This new roadway is expected to divert some of the traffic demand from Kaimi Nani Drive. The Kamani Street/Hina Lani Drive intersection with Queen Kaahumanu Highway is located approximately 3.2 miles south of the Keahole Airport Access Road intersection.

B. Traffic Volumes and Conditions

1. General

a. Traffic Data

Traffic count data were obtained from a previous field investigation, conducted in August 1992. The traffic survey was conducted between the hours of 6:00 AM and 8:00 AM in the morning, and between 3:00 PM and 5:00 PM in the afternoon at the intersections of Queen Kaahumanu Highway with Keahole Airport Access Road and Kaimi Nani Drive. Twenty-four hour traffic count data were obtained from the State Department of Transportation (DOT).

b. Capacity Analysis Methodology

The highway capacity analysis performed for this study is based upon procedures presented in the "Highway Capacity Manual" (HCM), Special Report 209, Transportation Research Board, 1985 and the "Highway Capacity Software", Federal Highways Administration.

Level of Service (LOS) is "defined as a qualitative measure describing operational conditions within a traffic stream". Several factors are included in determining LOS such as: speed, delay, vehicle density, freedom to maneuver, traffic interruptions, driver comfort, and safety. LOS "A", "B", and "C" are considered satisfactory levels of service. LOS "D" is generally considered a "desirable minimum" level of service. LOS "E" is an undesirable condition and LOS "F" is an unacceptable condition.

"Volume-to-capacity" (v/c) ratio is another measure indicating the relative traffic demand to the road's traffic carrying ability. A v/c ratio of 1.00 indicates that the roadway is operating at its capacity.

2. Existing Daily Traffic

The existing daily traffic count data were taken from DOT Traffic Count Station No. 8-P, Queen Kaahumanu Highway @ Keahole Airport Access Road; and Station No. 8-S, Queen Kaahumanu Highway between Kaimi Nani Drive and 94 Mile Post. The traffic data were taken on July 6-7, 1992 and June 1-2, 1992, respectively. A summary of the existing traffic count data is shown in Table 1.

Table 1. Existing Queen Kaahumanu Highway Traffic Analysis			
Period of Analysis		**North of Keahole Airport Road**	**South of Kaimi Nani Drive**
24 Hour Traffic	2-Way Volumes (vehicles per day)	7,824	12,327
AM Peak Hour	2-Way Volumes (vehicles per hour)	496	856
	LOS	B	C
	V/C	0.26	0.43
PM Peak Hour	2-Way Volumes (vehicles per hour)	681	763
	LOS	C	C
	V/C	0.34	0.39

3. Existing AM Peak Hour Traffic Analysis

The AM peak hour of traffic in the study area occurs between 6:45 AM and 7:45 AM. The existing AM peak hour traffic volumes and results of the capacity analysis are shown in Figure 2.

The intersection of Keahole Airport Access Road and Queen Kaahumanu Highway operates at acceptable Levels of Service during the AM peak hour of traffic. The left turn movement from Kaimi Nani Drive to southbound Queen Kaahumanu Highway operates at LOS "D" during the AM peak hour of traffic. The remaining movements at the intersection of Queen Kaahumanu Highway and Kaimi Nani Drive operate at acceptable LOS.

4. Existing PM Peak Hour Traffic Analysis

The PM peak hour of traffic in the study area occurs between 4:00 PM and 5:00 PM. The existing PM peak hour traffic volumes and capacity analysis are shown in Figure 3.

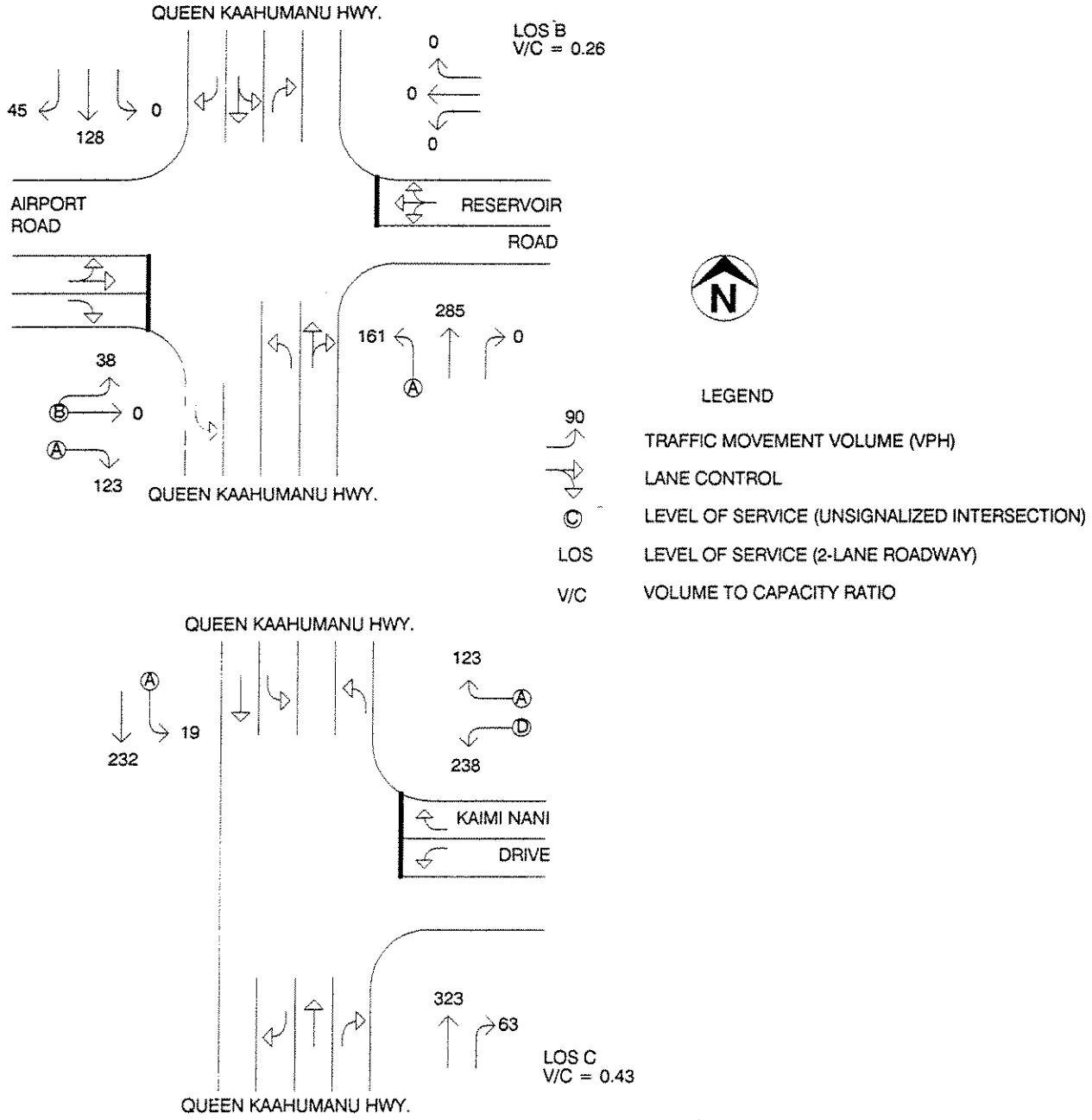

Figure 2 - Existing AM Peak Hour Traffic

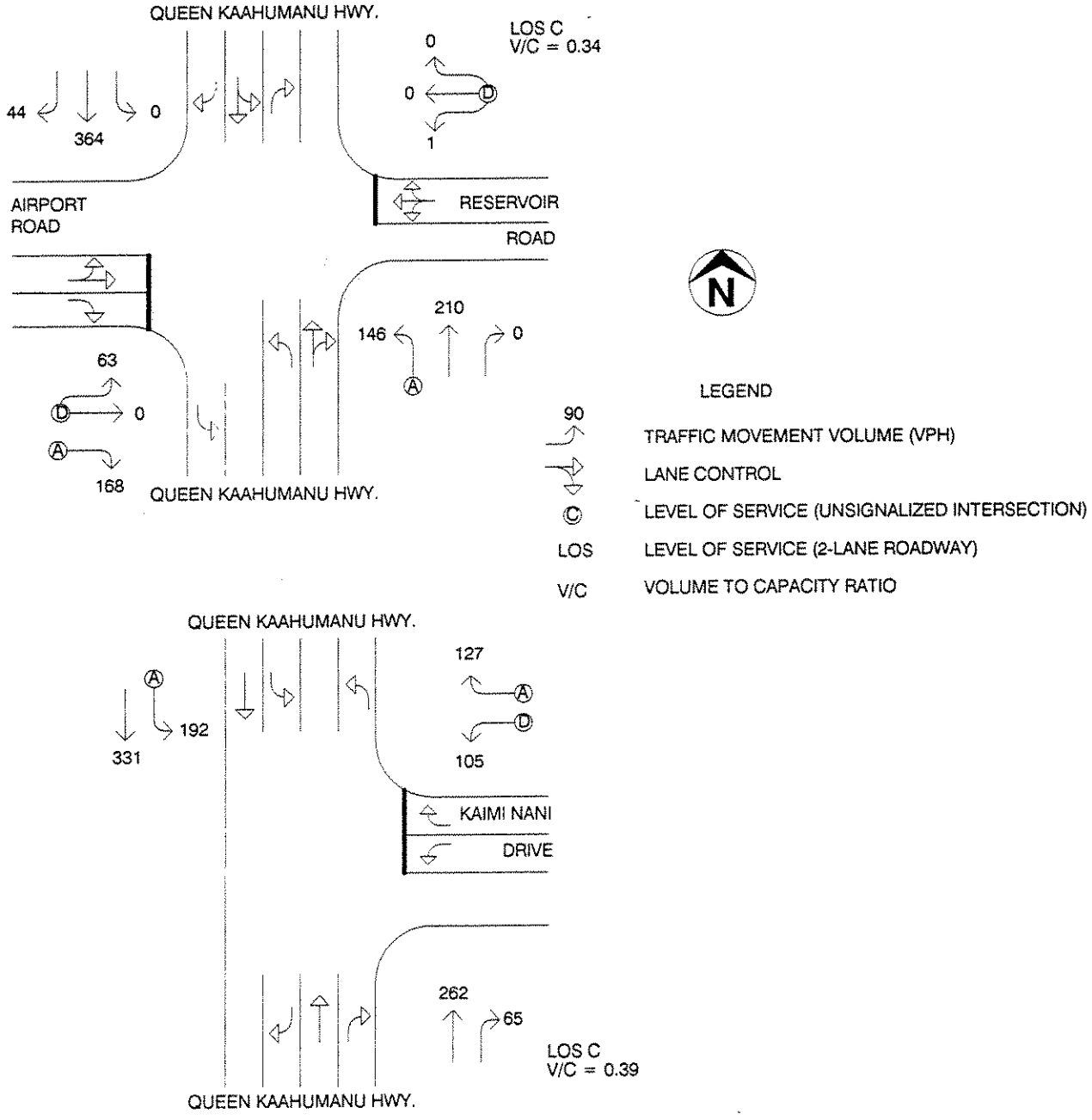

Figure 3 - Existing PM Peak Hour Traffic

The left turn movement from Keahole Airport Access Road to northbound Queen Kaahumanu Highway operates at LOS "D" during the PM peak hour of traffic. The remaining traffic movements at the intersection of Keahole Airport Access Road and Queen Kaahumanu Highway operate at satisfactory LOS.

The left turn movement from Kaimi Nani Drive to southbound Queen Kaahumanu Highway operates at LOS "D" during the PM peak hour of traffic. The remaining traffic movements operate at satisfactory LOS.

IV. PROJECTED TRAFFIC

A. Anticipated Future Development

1. Keahole Airport Expansion

The "Keahole Airport Traffic Circulation Plan", September 1990, was prepared by Pacific Planning and Engineering, Inc., as part of the development of the Keahole Airport Master Plan. By the Year 2005, the Keahole Airport is expected to generate 3,300 vehicles per hour (vph) during the airport peak hour of traffic. The airport traffic study recommends that access to Keahole Airport be provided by separate one-way roadways. Access onto Queen Kaahumanu Highway would be provided by grade-separated on- and off-ramps providing makai access only at each of the one-way roadways. The airport access recommendation has since been revised to provide for the expansion to a full service interchange that also would provide access to the State Lands. The Keahole Airport traffic study also recommends that interim access should be provided by signalizing the existing intersection.

2. Keahole Generating Station Expansion

The "Draft Traffic Impact Analysis Report for the Proposed Keahole Generating Station" was prepared by The Traffic Management Consultant (TMC), as part of the environmental assessment process for the proposed expansion of the Hawaii Electric Light Company (HELCO) generating station in Keahole. The Keahole Generating Station is expected to generate 14 vph and 12 vph during the AM and PM peak hours of traffic, respectively. The TMC study analyzes access off Kaimi Nani Drive as an alternative to the

existing access on Queen Kaahumanu Highway, opposite Keahole Airport Access Road. Traffic signalization and full channelization of the Queen Kaahumanu Highway intersections are proposed for either access alternative.

3. Kohanaiki Resort

The "Traffic Impact Analysis Update for the Kohanaiki Resort Development", September 27, 1990, was prepared by M&E Pacific, Inc. The proposed Kohanaiki Resort is located on the makai side of Queen Kaahumanu Highway, south of the State Lands. The proposed Kohanaiki Resort consists of 2,200 hotel rooms and resort condominium units, 210 single-family residential dwelling units, commercial village, and an 18-hole golf course. Access to Phase I (900 hotel and resort units) is proposed via an unsignalized at-grade intersection on Queen Kaahumanu Highway, located about 2.2 miles north of Keahole Airport Access Road. The Kohanaiki Resort project is expected to generate 1,320 vph during the PM peak hour of traffic. In it first phase, the M&E Report proposes a fully channelized, at-grade intersection at their project access.

4. O'oma II

The "Traffic Impact Analysis Report for the Proposed O'oma II", July 29, 1991, was prepared by The Traffic Management Consultant. O'oma II fronts Queen Kaahumanu Highway, opposite the southern portion of the State Lands. O'oma II is located on the makai side of Queen Kaahumanu Highway, opposite the southern portion of the State Lands proposed for reclassification. O'oma II consists of 600 visitor accommodations, 300 residential dwelling units, an 18-hole golf course, and marine recreational facilities. The O'oma project is expected to generate 724 vph and 1,156 vph during the AM and PM peak hours of traffic, respectively. Interim access is proposed via a fully channelized, at-grade signalized intersection on Queen Kaahumanu Highway, about 2 miles south of Keahole Airport Access Road.

5. Hawaii Ocean Science & Technology Park and Natural Energy Laboratory of Hawaii

The "Traffic Impact Study for a Natural Energy Laboratory of Hawaii Authority Project" (NELHA Study) in Kailua-Kona Hawaii, June 1992, was prepared by Barton-Aschman Associates, Inc. The NELHA Study analyzes

the traffic impacts resulting from the Hawaii Ocean Science & Technology (HOST) Park and Natural Energy Laboratory of Hawaii (NELH). The HOST and NELH projects are located immediately south of Keahole Airport, on the makai side of Queen Kaahumanu Highway, opposite the State Lands. The HOST/NELH project is expected to generate an additional 95 vph and 89 vph during the AM and PM peak hours of traffic, respectively. The NELHA study concludes that the projected 1997 peak hour traffic demands on Queen Kaahumanu Highway would exceed the existing two lane capacity. Project access is proposed at a fully channelized, at-grade signalized intersection. The NELHA traffic study indicates that at-grade signalized access would be feasible only if Queen Kaahumanu Highway is widened to four lanes to accommodate future through traffic.

6. Keahole to Kailua Development Plan

The "Keahole to Kailua Development Plan" (K-K Plan), April 1991, was prepared by R. M. Towill Corporation for the County of Hawaii Department of Planning. The K-K Plan is intended to guide the urbanization of the region between Keahole Airport and Kailua-Kona. The roadway plan, proposed in the K-K Plan, envisions three north-south collector/arterial roadways, two of which pass through the State Lands. Figure 4 shows the roadway plan for the K-K Plan.

The Mid-Level Arterial that would roughly run parallel to Queen Kaahumanu Highway, connecting to Palani Road. Subsequent planning of the Mid-Level Arterial includes extending it to Queen Kaahumanu Highway at Henry Street in Kailua Town. The Mid-Level Arterial is classified as a four-lane minor arterial with a 120-foot right-of-way.

Waena Drive is a proposed north-south collector roadway, located mauka of the Mid-Level Arterial. Waena Drive is proposed as a four lane, undivided roadway with an 80-foot right-of-way.

The K-K Plan also shows a mauka-makai roadway (University Drive) between Queen Kaahumanu Highway at Keahole Airport Access Road and Mamalahoa Highway. University Drive would extend Keahole Airport Access Road in the mauka direction to provide access to the State Lands and the mauka portion of the Lands of Ka'u project.

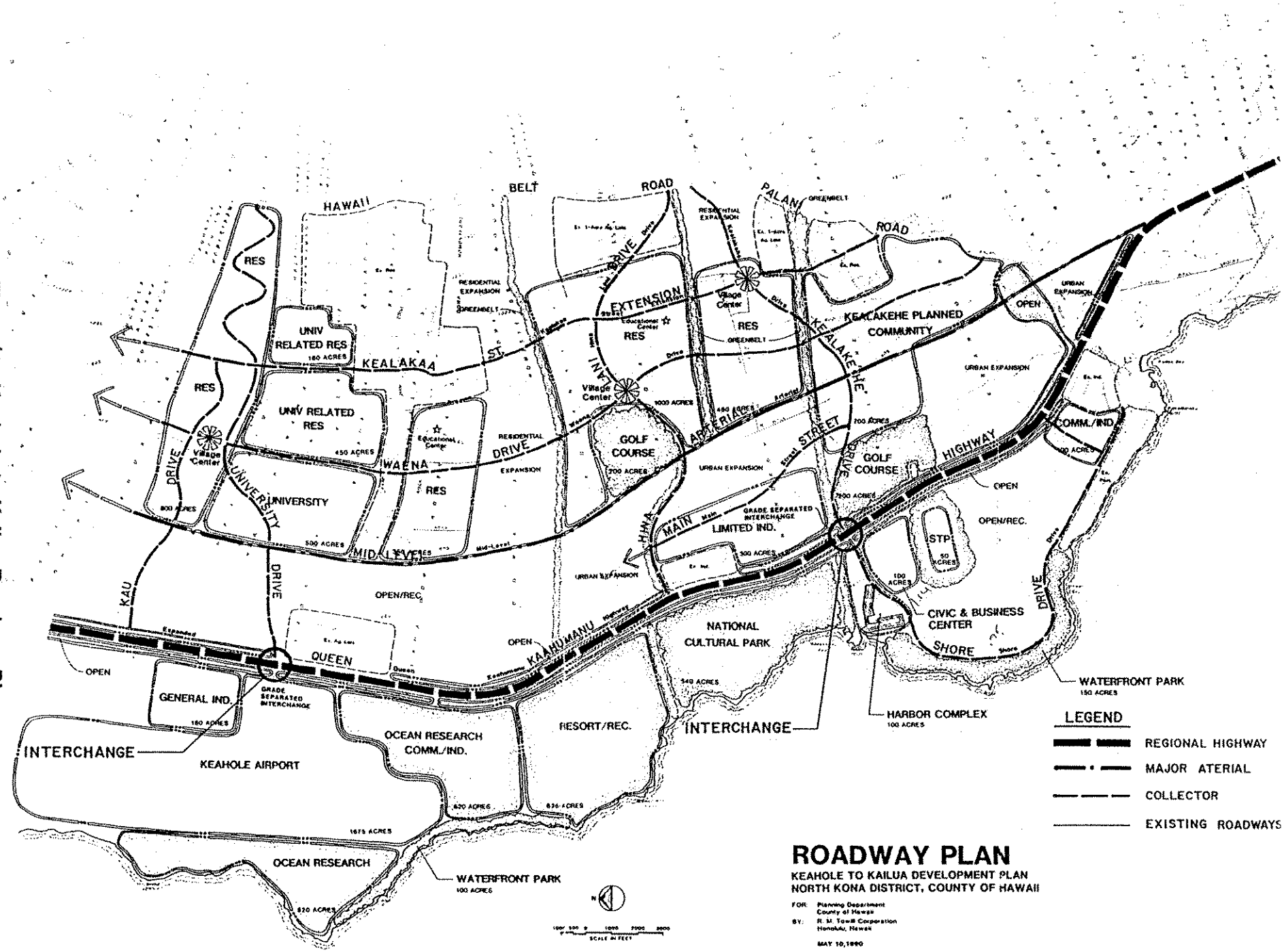

Figure 4 - Keahole to Kailua Roadway Plan

7. Lands of Ka'u

The Lands of Ka'u Project is located immediately north of the State Lands. At this writing, the proposed Lands of Ka'u Project is undergoing changes to its master plan. The project's major collector roadway is expected to become part of the planned University Drive between Queen Kaahumanu Highway and Mamalahoa Highway.

8. Queen Kaahumanu Highway Master Plan

The planning for the improvement of Queen Kaahumanu Highway is on-going at this writing. Queen Kaahumanu Highway would be widened to a four-lane, controlled-access freeway, with grade-separated interchanges at major intersections. Existing access on Queen Kaahumanu Highway would be relocated to a system of frontage roads on both sides of the highway, that would lead to the proposed interchanges. At this writing, two interchanges are approved between Keahole and Kailua. These interchanges are located about four and one half miles apart, at Keahole Airport Access Road and at Kealakehe Parkway.

The first phase of the Queen Kaahumanu Highway improvement is expected to include widening the two-lane highway to a four-lane, divided highway. Completion of Phase I of the Queen Kaahumanu Highway improvement is expected in 1996. Subsequent phase(s) would include extending the four-lane widening to Kawaihae, upgrading the highway to a controlled-access freeway, and the construction of grade-separated interchanges and a frontage road system to replace at-grade access along the highway.

The frontage road system would provide access for properties between interchange locations. The capacity of the frontage road is limited. The collector-distributor road system, between Queen Kaahumanu Highway and Mamalahoa Highway, would include the major north-south roadways, such as the Mid-Level Arterial and Waena Drive, and the major mauka-makai roadways, such as University Drive.

In addition to the interchange at the Keahole Airport Access Road and Kealekehe Interchange, other potential interchanges include an interchange at the recently completed Kamani Street/Hina Lani Drive, between Kealakehe and O'oma II/Kohanaiki areas, and an interchange near the

proposed O'oma II and Kohanaiki Resort developments. The latter interchange location could provide service to the southern portion of the State Lands proposed for reclassification.

9. Island of Hawaii Long Range Highway Plan

The "Island of Hawaii Long Range Highway Plan" (HLRHP), May 1991, was prepared by Parsons, Brinkerhoff, Quade and Douglas, Inc. for the State Department of Transportation and the County of Hawaii Departments of Planning and Public Works. The HLRHP estimates that the Year 2010 average daily traffic on Queen Kaahumanu Highway would increase to 32,900 vehicles per day between Keahole and Kealekehe. The Year 2010 traffic projection on Queen Kaahumanu Highway represents a 9.3% annual increase over 1992 conditions. In the HLRHP, the improvement of Queen Kaahumanu Highway, between Keahole Airport and Palani Road is rated with the highest priority for the island of Hawaii.

The HLRHP is being updated at this writing and is expected to be completed by the end of 1993. The updated highway plan would evaluate the regional highway needs, based upon updated Statewide population and employment forecasts and the development projects approved since the 1988 land use forecast. These recent projects are expected to include the State Housing Finance & Development Corporation housing project at Kealekehe, the development of the Queen Lilioukalani Trust Lands, and the State Lands proposed for reclassification, if approved by the State Land Use Commission.

V. FINDINGS

A. Site Accessibility

It is assumed that access to the State Lands would be provided at the proposed Keahole Interchange, via the proposed University Drive. Depending upon the ultimate development plan for the State Lands, the Keahole Interchange may not satisfy the State Lands access needs. The proposed Keahole Interchange would be located about 2.5 miles north of the southern boundary of the State Lands. The proposed Kealakehe Interchange would be located about 2.4 miles south of the State Lands' southern boundary. The proposed interchange, near the O'oma II and Kohanaiki Resort projects, presents an opportunity for additional access to Queen Kaahumanu Highway for the State Lands. If the

interchange is not located along State Lands frontage, then access could be provided by a frontage road along Queen Kaahumanu Highway, and the Mid-Level Arterial and Waena Drive, proposed in the K-K Plan.

Kaimi Nani Drive provides only limited potential for access between the State Lands and Queen Kaahumanu Highway. Because of its proximity to Keahole Airport Access Road, it is unlikely that an interchange would be located at Kaimi Nani Drive. Kaimi Nani Drive access would be relocated to a frontage road system leading to the Keahole Interchange and the nearest interchange to the south. Access between the State Lands and Mamalahoa Highway is limited. The upper portion of Kaimi Nani Drive is residential in nature, with driveways fronting Kaimi Nani Drive. The uncontrolled access along Kaimi Nani Drive limits its carrying capacity.

The proposed University Drive is an extension of Keahole Airport Access Road at the Keahole Interchange, from Queen Kaahumanu Highway to Mamalahoa Highway. The University Drive would provide access to the northern portion of the State Lands and to the Lands of Ka'u. The maximum allowable road grade for a collector road may be difficult to achieve as result of the steep terrain near Mamalahoa Highway.

The proposed Mid-Level Arterial and Waena Drive are expected to provide access between the State Lands and the Kealakehe region. These north-south roadways are expected to carry traffic with origins and destinations in neighboring communities. However regional access is expected to be provided by Queen Kaahumanu Highway and Mamalahoa Highway.

B. Future Traffic

The most recent available traffic forecast for the region is presented in the State/County 1991 HLRHP. The Year 2010 traffic forecast is based upon a land use forecast developed by the County of Hawaii, circa 1988. Several ongoing projects, such as O'oma II, Kohanaiki Resort, and Kealakehe Planned Community, have undergone changes. Other projects, such as the Queen Lilioukalani Trust Project, have received State Land Use Commission redesignation since the County land use forecast.

GROUNDWATER RESOURCES RELATIVE TO THE PETITION FOR STATE LAND USE RECLASSIFICATION AT KEAHOLE, NORTH KONA, HAWAII

Prepared for

Helber Hastert & Fee, Planners

Water Resource Associates

Honolulu, Hawaii
November 1992

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Map 2. Status of Groundwater Development, Keahole Area, North Kona, Oct. 1992

GROUNDWATER RESOURCES RELATIVE TO THE PETITION FOR STATE LAND USE RECLASSIFICATION AT KEAHOLE, NORTH KONA, HAWAII

INTRODUCTION

The Office of State Planning is seeking to petition for an Urban State Land Use Boundary Amendment for approximately 2,640 acres of State-owned land at Keahole, North Kona, Hawaii (see Figure 1). Because there are no potable water resources underlying the petition area, urban development of the petition area will require the development of potable water supply elsewhere in the region. The nearest existing sources of supply are the County Department of Water Supply's Holualoa well and Kahaluu shaft/well field located eight and ten miles, respectively, to the south. Eight to twenty-inch diameter pipelines currently transport water from these sources to Keahole Airport and mauka subdivisions at Kalaoa.

The purpose and scope of this report is to assess the groundwater resources of North Kona between Keahole and Kahaluu relative to the proposed land use reclassification. Also discussed are existing and future water use and development, and probable impacts of the urban development of the petition area on groundwater resources.

GEOLOGIC AND HYDROLOGIC SETTING

Climate

The Kona coast enjoys a land-and-sea circulation that has a distinct diurnal rhythm. In the afternoon and early evening, air moves inland on a sea breeze which at times can be brisk. Late at night and very early in the morning, the air drifts back from land to sea. This return drift is usually very gentle such that it can barely be felt. Kona's year-round equitable temperature conditions are moderated by Hawaii's mid-ocean location. Temperatures from season to season normally ranges between 15 and 20°F and averages about 75°.

The Kona coast has a unique seasonal rainfall pattern, compared to the normal tradewind regime of the State. The summers are wetter than the winters. This pattern is associated with the fact that Kona is well protected from the tradewinds, lying leeward of

the high mountains of Mauna Loa and Mauna Kea. There is a distinctive local circulation of air that yields fairly regular summer showers. During the winter, the cyclonic storms which produce most of the rainfall in other similar coastal areas of the State do not create such rainfall in Kona.

The climate at Keahole is dry. The median annual rainfall is less than 20 inches at the coast and increases to approximately 40 inches three to four miles inland (see Figure 1).

Geology

The petition area is located on the western slopes of Hualalai Volcano, mauka of Queen Kaahumanu Highway and Keahole Airport (see Figure 1). Hualalai Volcano is a dormant volcano which last erupted in 1801 along its northwest rift zone. An eruption at the 1500-foot elevation produced lava flows that spread out along the coast as far south as Keahole Airport. The northwest rift zone represents the major geologic structure in the area. Upwards of 100 cinder and spatter cones occur in the rift zone which is shown as a bold line in Figure 1.

The western slopes of Hualalai Volcano consist predominantly of alkalic olivine basalt flows that poured out of the northwest rift zone. Some of the flows, however, are gradational to Hawaiite (andesite). The basalt flows are typically thin-bedded, dip 10 to 15 degrees, and average 4 or 5 feet in thickness on the upper slopes (Macdonald and Abbott, 1970). These flows, however, probably average 10 feet in thickness on the more gentle (2°) slopes near the coast. The flows consist of both pahoehoe and aa types and belong to the prehistoric member (Holocene age) of the Hualalai volcanic series. Hualalai lavas extend as far south as Keauhou, some 7 miles away where they interfinger with lava flows from Mauna Loa Volcano. No surface evidence of geologic features such as cinder cones, dikes, or coastal caprock formations, which might affect the occurrence of ground water, occur in the area between Keahole and Kahaluu.

Basal Water Occurrence

Rainfall on the permeable volcanic slopes above an elevation of approximately 2,000 feet is the principal source of Kona's groundwater resources. This rainfall occurs in a four to five-mile wide belt which averages a peak of 75 inches a year (see Figure 1). However, most of it percolates quickly downward into the ground to become ground

formed the western slopes of Hualalai. No dikes, cinder cones, or coastal caprock formations occur in the coastal area and rainfall amounts to less than 40 inches a year. Consequently, the basal aquifer is unconfined, thin, and mostly brackish.

Based on the Kalaoa well (4360-01) located just mauka of the petition area (see Map 1), the basal lens in the mauka portion of the petition area has a head of 3.2 feet above sea level and a chloride content of 740 parts per million, barely suitable for landscape irrigation. In the seaward half of the petition area, the underlying basal aquifer probably has a chloride content of 1000 parts per million, or more. South of the petition area, the basal lens apparently is thinner and more brackish, based upon data from three wells (4160-01, 4160-02, and 4059-01). No wells have been drilled in the coastal area immediately north of the petition area to indicate hydrologic conditions there.

Northeast of the petition area near Mamalahoa Highway between Kalaoa and Huehue Ranch, the basal aquifer is potable, has a higher head of 7 to 10 feet above sea level, and probably occurs under semi-confined hydrogeologic conditions related to dike structures associated with the Hualalai Rift Zone. Although potable, the ground water is unusually high in hardness which is probably related to the proximity of the young rift zone and associated residual volcanic processes.

Hydrogeologic Boundary

The basal aquifer is known to have an inland hydrologic boundary with high-level ground water, based upon well data and a geophysical survey conducted in the Palani Junction area. The State-drilled Kalaoa Mauka well (4358-01) has a head of 238 feet above sea level, while a mile north the Nansay Hawaii-drilled Kau 2 well (4458-02) has a head of only 10.2 feet. In the Palani Junction area, located two miles south of Kalaoa, results of an electromagnetic geophysical survey (Blackhawk Geosciences, Inc., 1992) indicated a half to one-mile wide discontinuity between the known occurrence of basal water and high-level water. An interpretive hydrogeologic cross-section showing the discontinuity is shown in Figure 2.

Based on the well data and geophysical survey, the inferred location of the hydrogeologic boundary is shown on Map 1. The width, depth, and geologic nature of the low-permeability "dam" that confines ground water at high levels is not known. However, in the absence of adequate well data, it is believed that the confining geologic structure is more likely related to faults rather than to dikes. As shown on Map 1, the inferred hydrogeologic boundary coincides roughly with Mamalahoa Highway.

High-Level Water Occurrence

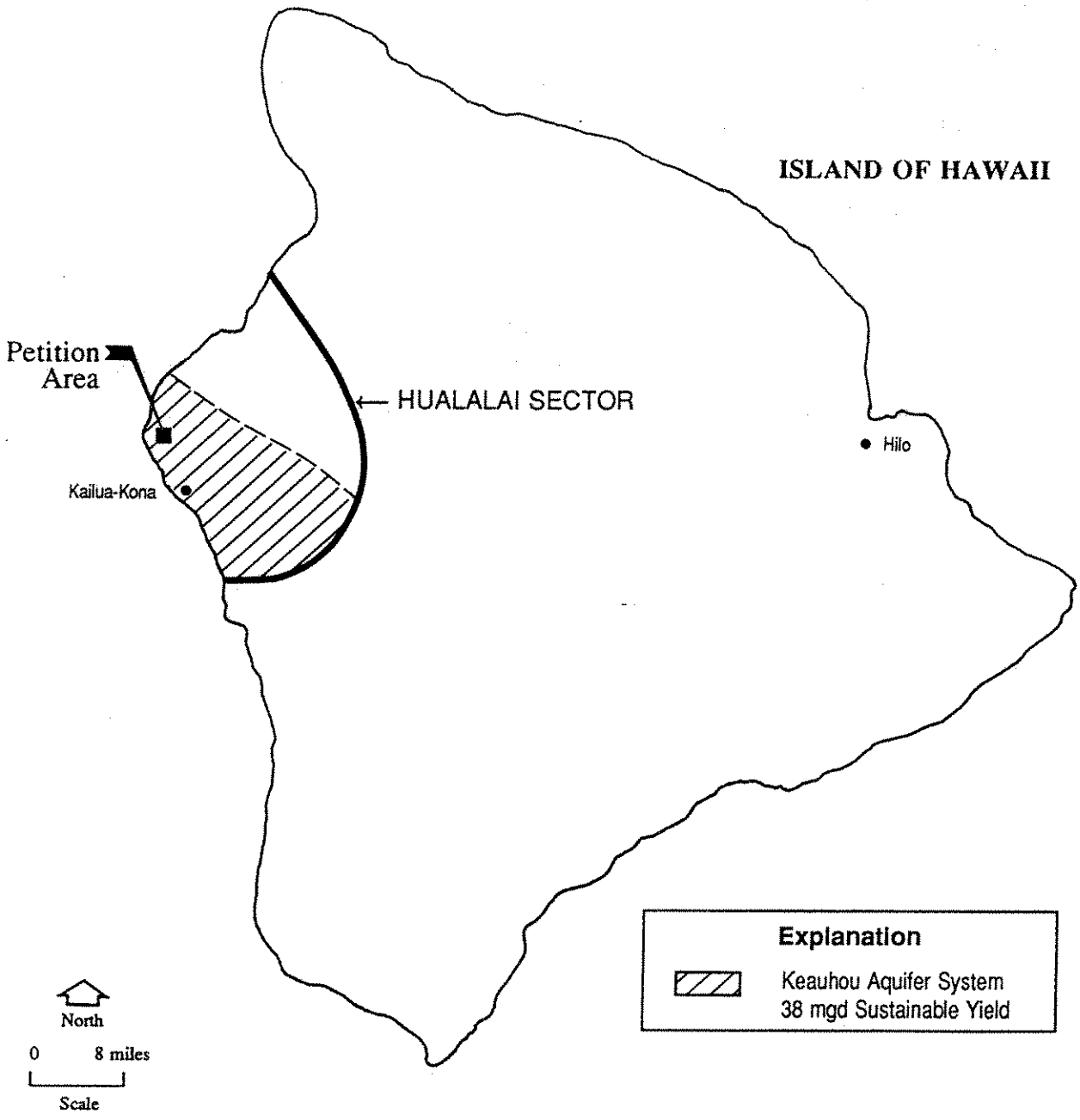
The occurrence of high-level ground water in the North Kona area between Keahole and Kahaluu was first discovered in 1990 by the State Division of Water and Land Development in the Kalaoa Mauka well, located 4.7 miles inland from the coast at Keahole. This discovery well (State Well No. 4358-01) is located mauka of Mamalahoa Highway at an elevation of 1800 feet (see Map 2, Well 7). The well was drilled to a depth of 50 feet below sea level and encountered ground water standing 238 feet above sea level and having a pristine chloride content of 10 parts per million.

Less than a year later in 1991, high-level ground water was also encountered in the County Department of Water Supply's Honokohau well (see Map 2, Well 11) located 2½ miles south of Kalaoa at an elevation of 1675 feet. This well was drilled to a depth of 60 feet below sea level and encountered ground water at an elevation of 109 feet above sea level. High-level ground water has been encountered in three other wells located between Honokohau and Waiaha, indicating that high-level ground water probably occurs more or less continuously mauka of Mamalahoa Highway along a 6-mile stretch of North Kona between Kalaoa and Waiaha.

The inland and lateral extent of this high-level water and the nature of the confining hydrogeologic structure are not well known at this time, although five other wells located south of Kahaluu have discovered high-level ground water as far south as Keei, some 14 miles south of Keahole. The hydrogeologic boundary between the basal water and inland high-level water apparently lies parallel to the coastline, approximately two miles or more inland. However, because different water levels ranging from 40 to 490 feet above sea level have been encountered, high-level groundwater probably occurs in separate or partially separate bodies.

Mauka of the petition area, the high-level water drops from an elevation of 238 feet in the Kalaoa Mauka well (4358-01) to 10 feet in the Kau 2 well (4458-02), located a mile north. This discontinuity in water levels may indicate the northern limit of the high-level water body above Keahole.

Prior to the 1990 discovery of high-level ground water, regional groundwater movement was assumed to be perpendicular to the coastline. Based upon this assumption, groundwater recharge and sustainable yield could be estimated on a coastal-mile basis. However, now that different levels of high-level ground water has been discovered in nine wells along some 20-miles of the Kona coast, the general assumption that high-level ground water movement occurs uniformly perpendicular to the coastline must be viewed with caution until more well data becomes available. However, basal



Source: Water Resources Protection Plan, 1990

Figure 3. KEAUHOU AQUIFER SYSTEM & SUSTAINABLE YIELD

basal aquifer exists and its utility must be protected, the sustainable yield of a particular coastal sector must take into account both the high-level and downgradient basal aquifers.

In any case, optimum development of North Kona's groundwater resources would consist of development of the high-level aquifers. An estimated 75% of the groundwater recharge to these aquifers is considered developable based upon experience with aquifer performance in Honolulu and Pearl Harbor on Oahu (Water Resources Protection Plan, 1990). Based upon this percentage, the sustainable yield of the 10-mile stretch of North Kona between Kalaoa and Kahaluu is an estimated 40 mgd (0.75 x 53 mgd).

EXISTING WATER SUPPLY AND WATER USE

Early Water Development

Prior to 1959, potable water requirements in the Kailua-Kona area were met almost entirely by rain catchment from galvanized corrugated rooftops. Two surface water springs located above Mamalahoa Highway at elevations 2,100 and 2,400 ft. in Waiaha Stream, however, supplied the former Kona Inn in Kailua-Kona. Exploration for groundwater supplies began in 1944 with the drilling of the Waiaha test hole located two miles southeast of Kailua-Kona at an elevation of 600 feet. Fourteen years later, in 1958, a full-size test well located along Palani Road at elevation 800 feet was drilled and pump tested by the State. The well was unsuccessful and a bit of a disappointment because it yielded very brackish water (2,800 ppm, chlorides) although the well was located two miles inland from the coast.

A year later, in 1959, the State drilled a second exploratory well located 1.1 miles inland at Kahaluu Bay at an elevation of 833 ft. It was highly successful in terms of yield and water quality. The well had a chloride content of only 8 ppm and was the freshest water well on the island at that time. Known as Kahaluu well A, it was put into production in 1967 with appurtenant tanks, pipelines, etc., to serve the Kailua-Kona area. Eventually, additional wells (B, C, and D) were drilled by the State and turned over to the Hawaii County Department of Water Supply (DWS). By 1971, the Kahaluu Well Field had a total pump capacity of 3.3 mgd.

To meet the growing demand for potable water in Kona, the State planned and constructed the Kahaluu Shaft which was placed into production by the County Department of Water Supply in 1975 with a pump capacity of 6 mgd.

Water Use

Potable water use in the Keahole-Kahaluu area of North Kona is provided by the Hawaii County Department of Water Supply from its North Kona Water System. The 1980-1990 record of the monthly pumpage of the Kahaluu Shaft and Kahaluu Well Field (Wells A,B,C,D), which are the major sources of water supply for the system, is shown in Figure 4. Total pumpage from the Kahaluu sources has increased steadily from about 4.5 mgd in 1980 to 7.5 mgd in 1990. Average annual pumpage at the Shaft peaked at about 5.5 mgd during 1986-87, but has been reduced to about 4.5 mgd to stabilize its chloride content at about 200 ppm. On the other hand, annual pumpage at the Well Field was increased from an average of 1.0 mgd to 3.5 mgd in order to meet a total pumpage of 7.5 mgd. This amount is about equal to the sustainable yield of the Kahaluu sources.

The Holualoa well was in production for less than a year when it experienced hardware problems. However, it was restored to service in 1991. The total system pumpage for the 1990-91 fiscal year as reported in the Hawaii County Water Use and Development Plan (Review Draft, February 1992) is as follows:

Table 2. 1990-91 AVERAGE WATER USE, NORTH KONA WATER SYSTEM

Source	1990-91 Average Water Use (mgd)
Kahaluu Well A	0.773
Kahaluu Well B	0.759
Kahaluu Well C	0.611
Kahaluu Well D	0.713
Kahaluu Shaft	4.868
Holualoa Well	0.618
TOTAL	8.342*

*Does not include Kalaoa Mauka Well which was not placed in service until 1992.

FUTURE WATER USE

Proposed State Projects

An assessment of future water use for proposed State projects in the Keahole-Kahaluu area of North Kona has been made in the draft report, *State Water Projects Plan, Hawaii Water Plan*, prepared for the State Commission on Water Resource Management (February 1992). The draft report has identified 13 State projects in the Keauhou Aquifer System (Keahole-Kahaluu sector of North Kona) with potentially significant impact on water resources and has estimated future water use for these projects, using the best available information. Not included in the report is a proposed West Hawaii Campus (University of Hawaii) in Kona. A total water requirement of 6.585 mgd is projected for the year 2010 for the 14 State Projects listed below.

Future Potable Water Use for Proposed State Projects
in the Keahole-Kahaluu Area of North Kona

Project Name	Department	2010 Projected Demand
Old Kona Airport Expansion	Land & Natural Resources	0.170
Honokohau Harbor Expansion	Transportation	0.130
Hawaii Ocean Science & Tech. Park	Business Economic Dev. & Tourism	0.390
Natural Energy Lab of Hawaii	" " " "	0.120
Keahole Airport	Transportation	0.330
Keahole Agricultural Park, Ph. I	Agriculture	0.325
Keahole Agricultural Park, Ph. II	"	0.570
Kealakehe Planned Community, Ph. I	Budget & Finance	0.270
Kealakehe Planned Comm. (Laiopua)	" "	3.500
Kealakehe High School	Education	0.120
Kealakehe II Elementary School	"	0.060
West Hawaii Detention Center	Public Safety	0.010
Kona Civic Center	Accounting & General Services	0.090
West Hawaii Campus	University of Hawaii	0.500
	Total	6.585
	Say,	7.0 mgd

Source of Data: State Water Projects Plan (Draft, February 1992)

The estimated recharge and sustainable yield of both high-level and basal groundwater resources in the Kalaoa-Kahaluu area is 53 mgd and 40 mgd, respectively. The current (1990-91 fiscal year) water use is 8.3 mgd and the estimated future use is 24.8 mgd, for a total of 33.1 mgd, projected to the year 2010. Thus, the estimated groundwater resources in the Kalaoa-Kahaluu area are expected to be adequate to meet the estimated future water needs (see Figure 5).

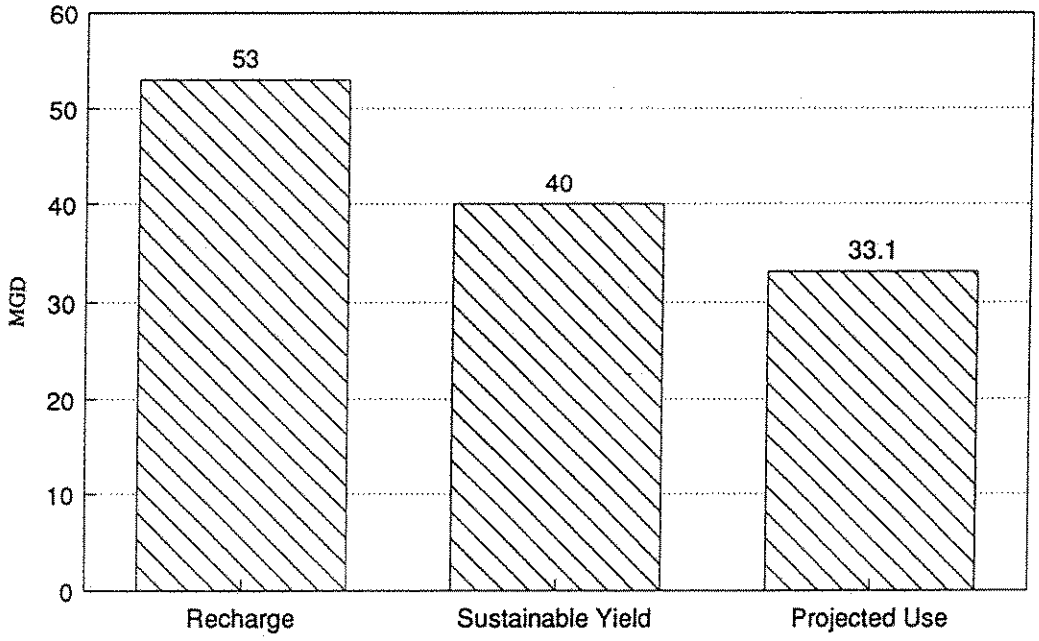


Figure 5. GROUNDWATER SUPPLY AND DEMAND, Kalaoa-Kahaluu Area

STATUS OF GROUNDWATER DEVELOPMENT

A total of 12 deep wells have been drilled in the Keahole area between Kailua-Kona and Kalaoa, eight of which are potable and four are brackish (600 to 2800 ppm, chlorides). These existing wells indicate that high-level water occurs mauka of Mamalahoa Highway above an elevation of approximately 1,600 feet, that potable basal water occurs makai of Mamalahoa Highway above an elevation of approximately

Table 3. PLANNED WATER DEVELOPMENTS
Kalaoa-Kahaluu Area, North Kona

Developer	Well Location	Well Status	Pump Cap. (mgd)
DWS	Honokohau	Drilled and tested	1.4
	Waiaha	Drilled	1.0
	Kealakehe	Permit applied for	1.0
	Keopu North	Planned	1.0
	Waiaha North	Planned	1.0
		Subtotal	5.4
State	Hualalai-DOWALD	Permit applied for	1.0
	Keopu-HFDC	Permit applied for	1.0
	Kaloko-HFDC	Planned	1.0
	Kaloko-HFDC	Planned	1.0
		Subtotal	4.0
Haseko	Keopu	Drilled	1.0
Lanihau Partners	Honokohau	Permitted	1.0
Nansay Hawaii	Kau 1	Drilled and tested	1.0
	Kau 2	Drilled and tested	1.0
	Kalaoa	Permit applied for	1.0
	Ooma Mauka	Permit applied for	1.0
	Waiaha North	Permit applied for	1.0
		Subtotal	5.0
QLT	Kealakehe South	Permit applied for	1.0
	Kealakehe South	Permit applied for	1.0
	Kealakehe South	Permit applied for	1.0
		Subtotal	3.0
		TOTAL	19.4

DWS - Hawaii County Department of Water Supply
QLT - Queen Liliuokalani Trust

Urban development of the petition area will require a potable water supply and the development of new potable water sources from the high-level aquifers located mauka of Mamalahoa Highway. Such water development is currently being coordinated by the Department of Land and Natural Resources' Division of Water and Land Development under a memorandum of understanding among State agencies and the County Department of Water Supply for source development and water system improvements to support State

Table 1. RECORD OF EXISTING WELLS IN THE KEAHOLE AREA

North Kona, Hawaii

Well Name	State Well No.	Owner	Year Drilled	Ground Elev. (ft.)	Csg. Dia. (in.)	Csg. Depth (ft.)	Well Depth (ft.)	Static Head (ft.)	Pump or Test Cap. (mgd)	Chloride (ppm)	Proposed Use
Honokohau	4158-02	Hawaii DWS	1991	1675	20	1735	1735	109.5	2.1	8	Domestic
Huehue Ranch 1	4559-01	Huehue Ranch	1985	1579	10	1609	1655	7.8	0.5	94-117	Domestic
Huehue Ranch 2	4459-01	Huehue Ranch	1991	1534	14	1566	1642	7.3	0.7	150	Domestic
Huehue Ranch 3	4558-01	Huehue Ranch	1991	1519	14	1545	1598	7.0	0.7	20	Domestic
Huehue Ranch 4	4459-02	Huehue Ranch	1991	1532	14	1565	1625	7.0	0.4	150	Domestic
Kaloko 1	4160-01	TSA International	1985	565	12	580	584	2.5	0.6	940	Irrigation
Kaloko 2	4160-02	TSA International	1985	542	12	561	561	1.5	0.6	880-955	Irrigation
Kalaoa Mauka	4358-01	Hawaii DWS	1990	1799	14	238	1850	238.0	0.7	10	Domestic
Kalaoa	4360-01	State of Hawaii	1968	680	10	638	702	3.2	0.2	600-740	Observation
Kau 1	4458-01	Nansay Hawaii	1990	1799	14	1842	1952	9.9	1.0	36	Domestic
Kau 2	4458-02	Nansay Hawaii	1991	1800	18	1850	1880	10.2	1.0	15	Domestic
Palani	4059-01	State of Hawaii	1958	800	12	835	853	1.6		2800	Sealed

Source of Data: Commission on Water Resource Management

STANDARD LAND USE COMMISSION PETITION CONDITIONS
Five-Year Boundary Review
Office of State Planning

1. The developer and/or landowner of the subject property shall fund and construct adequate civil defense measures as determined by the Country and State Civil Defense agencies.

2. The developer and/or landowner of the subject property shall contribute to the development, funding and/or construction of school facilities, on a pro-rata basis, as determined by and to the satisfaction of the Department of Education (DOE). Agreement by DOE on the level of funding and participation shall be obtained prior to the developer and/or landowner applying for county zoning or prior to the developer and/or landowner applying for county building permits if country rezoning is not required.

3. The developer and/or landowner of the subject property shall participate in the funding and construction of adequate wastewater transmission and disposal facilities, on a pro-rata basis, as determined by the State Department of Health and the County Department of Public Works.

4. The developer and/or landowner of the subject property shall provide affordable housing opportunities for low, low-moderate, and gap group income residents of the State of Hawaii to the satisfaction of the State Housing Finance and Development Corporation in accordance with the Affordable Housing Guidelines, adopted by the Housing Finance and Development Corporation, effective July 1, 1992, as periodically amended. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as my be mutually agreeable between the developer and/or landowner of the subject property and the State Housing Finance and Development Corporation and the County of Hawaii. Agreement by the HFDC on the provision of affordable housing shall be obtained prior to the developer and/or landowner applying for county zoning prior to the developer and/or landowner applying for county building permits if county rezoning is not required.

5. The developer and/or landowner of the subject property shall have an archaeological inventory survey conducted by a professional archaeologist prior to submitting an application to the County of Hawaii for rezoning prior to applying for a building permit if county rezoning is not required. The findings of this survey shall be submitted to the State's Historic Preservations Division in report format for adequacy review. The Division must verify that the survey report is acceptable, must approve significance evaluations, and must approve mitigation commitments for significant historic sites prior to the landowner and/or developer submitting an application to the county for rezoning prior to applying for a building permit if county rezoning is not required.

6. If significant historic sites are present, then the developer and/or landowner of the subject property shall agree to develop and execute a detailed historic preservation mitigation plan prior to any ground altering construction in the area. The State's Historic Preservation Division must approve this plan, and that Division must verify in writing to the Land Use Commission that the plan has been successfully executed. (note: This condition will be modified for the Urban Expansion State Lands Petition

12. The developer and/or landowner of the subject property shall fund the design and construction of drainage improvements required as a result of the development of the Property to the satisfaction of the appropriate State and County agencies.

13. The developer and/or landowner of the subject property shall not construct residential or condominium units within areas exposed to noise levels of 60 Ldn or grater.

14. The developer and/or landowner of the subject property shall grant to the State of Hawaii and avigation (right of flight) and noise easement in the form prescribed by the State Department of Transportation on any portion of the property subject to noise levels exceeding 55 Ldn.

15. The developer and/or landowner of the subject property shall attenuate the noise in guest (living) suites and other noise sensitive areas within commercial and hotel development areas exposed to exterior noise levels of 60 Ldn (day-night average sound level) by a minimum of 25 decibels (A-weighted).

16. The developer of the subject property shall petition the Land Use Commission to reclassify the lands actually developed for the marina waterways to the Conservation District within two years of completion of the marina. (for marinas only)

17. The developer and/or landowner of the subject property shall participate in an air quality monitoring program as specified by the State Department of Health.

18. The developer and/or landowner of the subject property shall cooperate with the State Department of Health and the County of Hawaii Department of Public Works to conform the program goals and objectives of the Integrated Solid Waste Management Act, Chapter 342G, Hawaii Statutes, and the County's approved integrated solid waste management plans in accordance with a schedule and timeframe satisfactory to the Department of Health.

19. The developer of the subject property shall maintain, to the extent required by the State Department of Health, on-site facilities to insure that the nearshore, offshore and deep ocean waters remain in pristine condition. The developer of the subject property shall also participate in a water quality monitoring program with the Natural Energy Laboratory of Hawaii and the Hawaii Ocean and Science Technology Park. This program shall be submitted for review to the State Department of Health.

20. The developer and/or landowner of the subject property shall, to the satisfaction of the State Department of Health, keep wastewater ponds holding effluent for irrigation of golf courses at a sufficient distance from residential areas to prevent odor and insect nuisances.

21. The developer of the subject property shall engage the services of a qualified golf course manager to oversee the irrigation of the golf course and application of fertilizers and pesticides to the golf course within the Property and who shall be qualified in the application of fertilizers and pesticides on those areas.

22. The developer and/or landowner of the subject property shall comply with the State Department of Health's conditions for new golf course developments.

23. The developer and/or landowner of the subject property shall be responsible for implementing sound attenuation measures to bring noise levels from vehicular traffic in the Petition Area down to levels acceptable to the State Department of Health and the State Department of Transportation.

24. The developer and/or landowner of the subject property shall notify all prospective buyers of property of the potential odor, noise, and dust pollution resulting from surrounding Agricultural District land.

25. The developer and/or landowner of the subject property shall notify all prospective buyers of property that the Hawaii Right-to-Farm Act, Chapter 165, Hawaii Revised Statutes, limited the circumstances under which pre-existing farming activities may b deemed a nuisance.

26. The developer of the subject property shall maintain the alignment for existing cane haul roads or shall provide alternate cane haul roads at its expense to insure uninterrupted agricultural operation of sugarcane cultivation areas. (only for projects affecting active plantation areas)

27. The developer and/or landowner of the subject property shall develop the Property in substantial compliance with the representations made to the Land Use Commission. Failure to so develop the property may result in reclassification of the Property to its former land use classification, or change to a more appropriate classification.

28. The developer and/or landowner of the subject property shall provide annual reports to the Land Use Commission, the Office of State Planning, and the County of Hawaii Planning Department in connection with the status of the subject project and the developer's and/or landowner's progress made in complying with the conditions imposed.

29. The Land Use Commission may fully or partially release these conditions as to all or any portion of the Property upon timely motion and upon the provision of adequate assurance of satisfaction of these conditions by the developer and/or landowner of the subject property.

30. Within 7 days of the issuance of the Commission's Decision and Order for the subject reclassification, the developer and/or landowner shall a) record with the Bureau of Conveyances a Statement to the effect that the Property is subject to conditions imposed by the Land Use Commission in the reclassification of the Property, and b) shall file a copy of such recorded statement with the Commission.

31. The developer and/or landowner of the subject property shall record the conditions imposed by the Commission with the Bureau of conveyances pursuant to Title 15, Chapter 15, Section 92, Hawaii Administrative Rules.

12. The developer and/or landowner of the subject property shall fund the design and construction of drainage improvements required as a result of the development of the Property to the satisfaction of the appropriate State and County agencies.

13. The developer and/or landowner of the subject property shall not construct residential or condominium units within areas exposed to noise levels of 60 Ldn or grater.

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17. The developer and/or landowner of the subject property shall participate in an air quality monitoring program as specified by the State Department of Health.

18. The developer and/or landowner of the subject property shall cooperate with the State Department of Health and the County of Hawaii Department of Public Works to conform the program goals and objectives of the Integrated Solid Waste Management Act, Chapter 342G, Hawaii Statutes, and the County's approved integrated solid waste management plans in accordance with a schedule and timeframe satisfactory to the Department of Health.

19. The developer of the subject property shall maintain, to the extent required by the State Department of Health, on-site facilities to insure that the nearshore, offshore and deep ocean waters remain in pristine condition. The developer of the subject property shall also participate in a water quality monitoring program with the Natural Energy Laboratory of Hawaii and the Hawaii Ocean and Science Technology Park. This program shall be submitted for review to the State Department of Health.

20. The developer and/or landowner of the subject property shall, to the satisfaction of the State Department of Health, keep wastewater ponds holding effluent for irrigation of golf courses at a sufficient distance from residential areas to prevent odor and insect nuisances.

21. The developer of the subject property shall engage the services of a qualified golf course manager to oversee the irrigation of the golf course and application of fertilizers and pesticides to the golf course within the Property and who shall be qualified in the application of fertilizers and pesticides on those areas.

22. The developer and/or landowner of the subject property shall comply with the State Department of Health's conditions for new golf course developments.

because an archaeological inventory survey has already been conducted from 500 acres of the petition area.)

7. Should any human burials or any historic sites such as artifacts, charcoal deposits, or stone platforms, pavings or walls be found, the developer and/or landowner of the subject property shall stop work in the immediate vicinity and contact the States Historic Preservation Division. The significance of these finds shall then be determined and approved by the Division, and an acceptable mitigation plan shall be approved by the Division (if needed). The Division must verify that the fieldwork portion of the mitigation plan has been successfully executed prior to work proceeding in the immediate vicinity of the find. Burials must be treated under specific provisions of Chapter 6E, Hawaii Revised Statutes.

8. The developer and/or landowner of the subject property shall conduct a flora and fauna survey and prepare and agree to execute a mitigation plan which meets the requirements of the Department of Land and Natural Resources prior to the developer and/or landowner applying for county zoning or prior to the developer and/or landwoner applying for county building permits if county rezoning is not required. The Department of Land and Natural Resources must approve the plan and a copy of the approved plan must be submitted to the Land Use Commission prior to the developer and/or landowner applying for county zoning or prior to the developer and/or landowner applying for county building permits if county rezoning is not required.

9. The developer and/or landowner of the subject property shall prepare a Traffic Impact Analysis Report prior to applying for county zoning or prior to the developer and/or landowner applying for county building permits if county rezoning is not required. The landowner and/or developer shall also participate in the funding and construction of local and regional transportation improvements and programs including dedication of rights-of-way as determined by the State Department of Transportation and the County Department of Public Works (Department of Transportation Services on Oahu). Agreement by the State Department of Transportation on the level of funding and participation shall be obtained prior to the developer and/or landowner applying for county zoning or prior to the developer and/or landowner applying for county building permits if county rezoning is not required.

10. The developer and/or landowner of the subject property shall monitor the traffic attributable to the proposed project at on-site and off-site locations and shall undertake subsequent mitigative measures that may be reasonably required. These activities shall be coordinated with and approved by DOT.

11. The developer and/or landowner of the subject property, at no cost to the State, shall appoint a permanent transportation manager whose function is the formulation, use, and continuation of alternative transportation opportunities that would optimize the use of existing and proposed transportation systems. In the alternative, the developer and/or landowner of the subject property may participate in a regional program for transportation management with other developers and/or landowners. This program shall address the transportation opportunities that would optimize the use of existing and proposed transportation systems. Either option will continue to be in effect unless otherwise directed by the State Department of Transportation prior to implementation. The transportation manager or developer and/or landowner of the subject property shall conduct periodic evaluations of the program's effectiveness and shall make reports of these evaluations available to the State Department of Transportation for review.

STANDARD LAND USE COMMISSION PETITION CONDITIONS
Five-Year Boundary Review
Office of State Planning

1. The developer and/or landowner of the subject property shall fund and construct adequate civil defense measures as determined by the Country and State Civil Defense agencies.

2. The developer and/or landowner of the subject property shall contribute to the development, funding and/or construction of school facilities, on a pro-rata basis, as determined by and to the satisfaction of the Department of Education (DOE). Agreement by DOE on the level of funding and participation shall be obtained prior to the developer and/or landowner applying for county zoning or prior to the developer and/or landowner applying for county building permits if country rezoning is not required.

3. The developer and/or landowner of the subject property shall participate in the funding and construction of adequate wastewater transmission and disposal facilities, on a pro-rata basis, as determined by the State Department of Health and the County Department of Public Works.

4. The developer and/or landowner of the subject property shall provide affordable housing opportunities for low, low-moderate, and gap group income residents of the State of Hawaii to the satisfaction of the State Housing Finance and Development Corporation in accordance with the Affordable Housing Guidelines, adopted by the Housing Finance and Development Corporation, effective July 1, 1992, as periodically amended. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as my be mutually agreeable between the developer and/or landowner of the subject property and the State Housing Finance and Development Corporation and the County of Hawaii. Agreement by the HFDC on the provision of affordable housing shall be obtained prior to the developer and/or landowner applying for county zoning prior to the developer and/or landowner applying for county building permits if county rezoning is not required.

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REFERENCES

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Table 1. RECORD OF EXISTING WELLS IN THE KEAHOLE AREA

North Kona, Hawaii

Well Name	State Well No.	Owner	Year Drilled	Ground Elev. (ft.)	Csg. Dia. (in.)	Csg. Depth (ft.)	Well Depth (ft.)	Static Head (ft.)	Pump or Test Cap. (mgd)	Chloride (ppm)	Proposed Use
Honokohau	4158-02	Hawaii DWS	1991	1675	20	1735	1735	109.5	2.1	8	Domestic
Huehue Ranch 1	4559-01	Huehue Ranch	1985	1579	10	1609	1655	7.8	0.5	94-117	Domestic
Huehue Ranch 2	4459-01	Huehue Ranch	1991	1534	14	1566	1642	7.3	0.7	150	Domestic
Huehue Ranch 3	4558-01	Huehue Ranch	1991	1519	14	1545	1598	7.0	0.7	20	Domestic
Huehue Ranch 4	4459-02	Huehue Ranch	1991	1532	14	1565	1625	7.0	0.4	150	Domestic
Kaloko 1	4160-01	TSA International	1985	565	12	580	584	2.5	0.6	940	Irrigation
Kaloko 2	4160-02	TSA International	1985	542	12	561	561	1.5	0.6	880-955	Irrigation
Kalaoa Mauka	4358-01	Hawaii DWS	1990	1799	14	238	1850	238.0	0.7	10	Domestic
Kalaoa	4360-01	State of Hawaii	1968	680	10	638	702	3.2	0.2	600-740	Observation
Kau 1	4458-01	Nansay Hawaii	1990	1799	14	1842	1952	9.9	1.0	36	Domestic
Kau 2	4458-02	Nansay Hawaii	1991	1800	18	1850	1880	10.2	1.0	15	Domestic
Palani	4059-01	State of Hawaii	1958	800	12	835	853	1.6		2800	Sealed

Source of Data: Commission on Water Resource Management

projects in North Kona. An initial 0.5 mgd of potable water requirement for a proposed West Hawaii Campus with possible location in the petition area has been included in the estimated total future water use for the Kalaoa-Kahaluu area (see page 15). Some additional water requirements may be needed for complete development of the petition area. However, as shown in Figure 5, page 17, the estimated sustainable yield in the Kalaoa to Kahaluu area of North Kona exceeds the estimated future water use needs in the area by 7 mgd (40–33 mgd).

Consequently, the proposed urban development of the petition area is not expected to have any significant adverse impact on the available potable groundwater resources in the Kalaoa-Kahaluu area of North Kona.

Table 3. PLANNED WATER DEVELOPMENTS
Kalaoa-Kahaluu Area, North Kona

Developer	Well Location	Well Status	Pump Cap. (mgd)
DWS	Honokohau	Drilled and tested	1.4
	Waiaha	Drilled	1.0
	Kealakehe	Permit applied for	1.0
	Keopu North	Planned	1.0
	Waiaha North	Planned	1.0
		Subtotal	5.4
State	Hualalai-DOWALD	Permit applied for	1.0
	Keopu-HFDC	Permit applied for	1.0
	Kaloko-HFDC	Planned	1.0
	Kaloko-HFDC	Planned	1.0
		Subtotal	4.0
Haseko	Keopu	Drilled	1.0
Lanihau Partners	Honokohau	Permitted	1.0
Nansay Hawaii	Kau 1	Drilled and tested	1.0
	Kau 2	Drilled and tested	1.0
	Kalaoa	Permit applied for	1.0
	Ooma Mauka	Permit applied for	1.0
	Waiaha North	Permit applied for	1.0
		Subtotal	5.0
QLT	Kealakehe South	Permit applied for	1.0
	Kealakehe South	Permit applied for	1.0
	Kealakehe South	Permit applied for	1.0
		Subtotal	3.0
		TOTAL	19.4

DWS - Hawaii County Department of Water Supply
QLT - Queen Liliuokalani Trust

Urban development of the petition area will require a potable water supply and the development of new potable water sources from the high-level aquifers located mauka of Mamalahoa Highway. Such water development is currently being coordinated by the Department of Land and Natural Resources' Division of Water and Land Development under a memorandum of understanding among State agencies and the County Department of Water Supply for source development and water system improvements to support State

1,400 feet north of Kalaoa, and that a limited amount of brackish water suitable for landscape/golf course irrigation occurs two to three miles inland from the coast above an elevation of approximately 700 feet. Eleven more deep wells, designed to tap high-level ground water, are under consideration for the Keahole area (see Map 2). Of the 11, a well construction permit has been issued for one (Lanihau Partners); applications for permits submitted for seven (Department of Water Supply, Nansay Hawaii, and Queen Liliuokalani Trust); and tentative plans made for three (Department of Water Supply and State-Housing Finance and Development Corp.). Presumably, all of these wells will eventually be added to the County's North Kona Water System.

Five more wells, located between Kailua-Kona and Kahaluu, also designed to tap high-level water are planned by the Department of Water Supply, Haseko, Nansay Hawaii, and State-HFDC. These wells also are expected to be incorporated into the County's North Kona Water System. Based upon an expected pump capacity of at least 1.0 mgd for each well, altogether 19.0 mgd of high-level groundwater development is being planned in the area between Kalaoa and Kahaluu by the County, State, and private developers. Presumably, all of this capacity will eventually be added to the 13.2 mgd existing capacity of the North Kona Water System. A summary of this planned water development is shown in Table 3.

IMPACT OF URBAN DEVELOPMENT OF PETITION AREA ON GROUNDWATER RESOURCES

The petition area is underlain by a nonpotable basal aquifer with low recharge and low sustainable yield. Based on hydrologic data from the Kalaoa well (4360-01) located at the mauka edge of the petition area, the brackish aquifer underlying the petition area has an estimated chloride content of approximately 700 to 1000 ppm (marginally suitable for normal landscape/golf course irrigation). The aquifer has a low estimated sustainable yield of approximately 1.0 mgd/coastal mile and is subject to potential contamination from residential developments located hydrologically upgradient of the petition area.

Urban development of the petition area will also subject the underlying aquifer to potential contamination; however, no significant adverse impact is expected to occur because of the existing limited utility of the nonpotable, thin basal aquifer.

The estimated recharge and sustainable yield of both high-level and basal groundwater resources in the Kalaoa-Kahaluu area is 53 mgd and 40 mgd, respectively. The current (1990-91 fiscal year) water use is 8.3 mgd and the estimated future use is 24.8 mgd, for a total of 33.1 mgd, projected to the year 2010. Thus, the estimated groundwater resources in the Kalaoa-Kahaluu area are expected to be adequate to meet the estimated future water needs (see Figure 5).

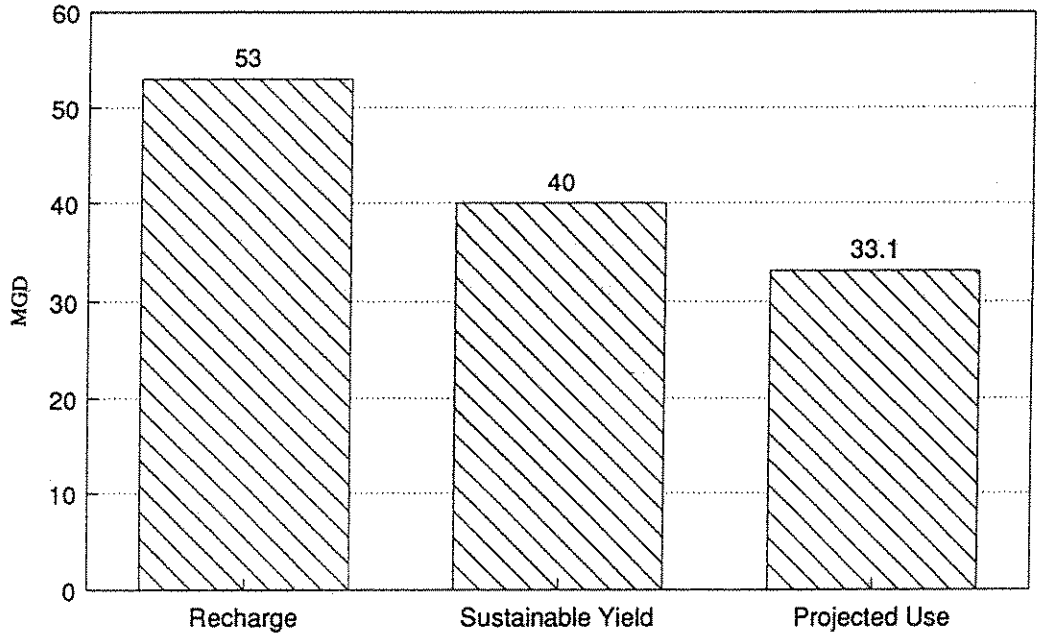


Figure 5. GROUNDWATER SUPPLY AND DEMAND, Kalaoa-Kahaluu Area

STATUS OF GROUNDWATER DEVELOPMENT

A total of 12 deep wells have been drilled in the Keahole area between Kailua-Kona and Kalaoa, eight of which are potable and four are brackish (600 to 2800 ppm, chlorides). These existing wells indicate that high-level water occurs mauka of Mamalahoa Highway above an elevation of approximately 1,600 feet, that potable basal water occurs makai of Mamalahoa Highway above an elevation of approximately

North Kona Water System

The estimated future water needs of the County's North Kona Water System is 24.8 mgd which includes 7.0 mgd for State projects (Hawaii County Water Use and Development Plan, Appendix C, Review Draft, February 1992). The 24.8 mgd estimate also includes estimated water needs for resort facilities south of Keahole, although some of the resorts may elect to have their own private system.

AVAILABILITY OF GROUND WATER

Ground water in the North Kona area between Keahole and Kahaluu occurs as basal water in an unconfined coastal aquifer and as high-level water confined behind a low permeability geologic damming structure of unknown origin that lies inland of the basal aquifer.

In general, the basal aquifer is thin with a low head and is mostly brackish between the coast and Mamalahoa Highway, except at Kahaluu where it is fresh within a mile of the coast. Indications are that recharge to the basal aquifer is low and probably non-uniform along the coast, based on data from the limited number of existing basal wells. The lack of uniformity in basal recharge along the coast plausibly relate to non-uniformity in permeability and physical dimensions of the geologic damming structure which coincidentally underlies Mamalahoa Highway. However, the exact location, width, and depth of this hydrogeologic dam are unknown at this time. Generally, groundwater recharge and sustainable yield per coastal mile decreases north of Kailua-Kona due to decreasing rainfall in the mauka rainbelt.

The high-level aquifers located inland of the hydrogeologic damming structure are protected from salt water intrusion and, therefore, represents the prime source of potable ground water in the study area. Potable water occurs in the inland portion of the basal aquifer, but due to its low recharge and sensitivity to salt water upconing under pumping conditions, the potential for basal water development is much more limited than for high-level water development. Consequently, it is expected that the bulk of future potable groundwater development will come from deep wells (1,500 feet or more) which tap the high-level aquifers located mauka of Mamalahoa Highway. However, it may be hydrologically feasible and economically advantageous to develop the high-level aquifer by means of a low-elevation (600± ft.), horizontal Lanai-type water development shaft.

FUTURE WATER USE

Proposed State Projects

An assessment of future water use for proposed State projects in the Keahole-Kahaluu area of North Kona has been made in the draft report, *State Water Projects Plan, Hawaii Water Plan*, prepared for the State Commission on Water Resource Management (February 1992). The draft report has identified 13 State projects in the Keauhou Aquifer System (Keahole-Kahaluu sector of North Kona) with potentially significant impact on water resources and has estimated future water use for these projects, using the best available information. Not included in the report is a proposed West Hawaii Campus (University of Hawaii) in Kona. A total water requirement of 6.585 mgd is projected for the year 2010 for the 14 State Projects listed below.

Future Potable Water Use for Proposed State Projects
in the Keahole-Kahaluu Area of North Kona

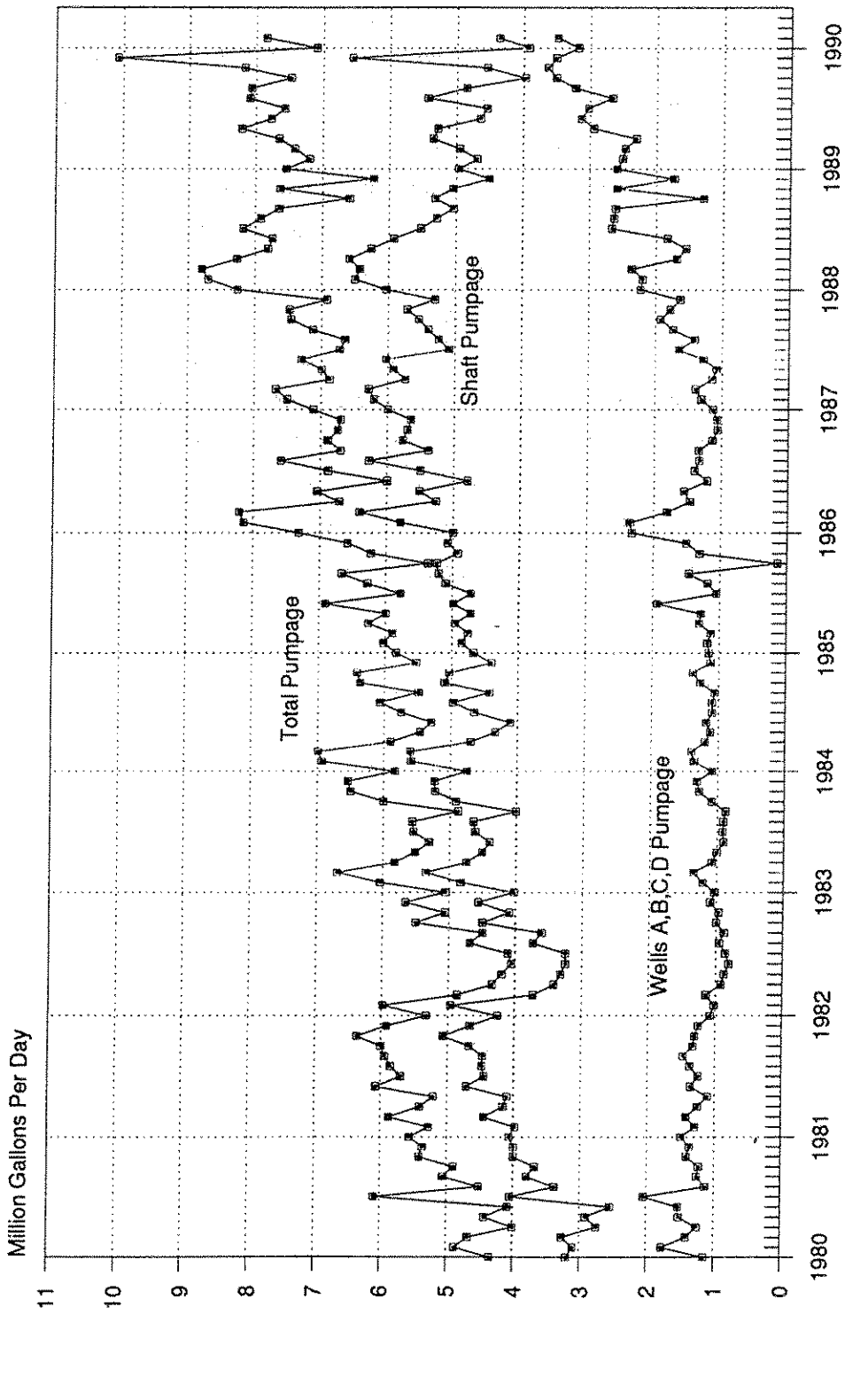
Project Name	Department	2010 Projected Demand
Old Kona Airport Expansion	Land & Natural Resources	0.170
Honokohau Harbor Expansion	Transportation	0.130
Hawaii Ocean Science & Tech. Park	Business Economic Dev. & Tourism	0.390
Natural Energy Lab of Hawaii	" " " "	0.120
Keahole Airport	Transportation	0.330
Keahole Agricultural Park, Ph. I	Agriculture	0.325
Keahole Agricultural Park, Ph. II	"	0.570
Kealakehe Planned Community, Ph. I	Budget & Finance	0.270
Kealakehe Planned Comm. (Laiopua)	" "	3.500
Kealakehe High School	Education	0.120
Kealakehe II Elementary School	"	0.060
West Hawaii Detention Center	Public Safety	0.010
Kona Civic Center	Accounting & General Services	0.090
West Hawaii Campus	University of Hawaii	0.500
	Total	6.585
	Say,	7.0 mgd

Source of Data: State Water Projects Plan (Draft, February 1992)

Figure 4. Monthly Pumpage

Kahaluu Shaft and Wells A,B,C,D

North Kona, Hawaii



Water Use

Potable water use in the Keahole-Kahaluu area of North Kona is provided by the Hawaii County Department of Water Supply from its North Kona Water System. The 1980-1990 record of the monthly pumpage of the Kahaluu Shaft and Kahaluu Well Field (Wells A,B,C,D), which are the major sources of water supply for the system, is shown in Figure 4. Total pumpage from the Kahaluu sources has increased steadily from about 4.5 mgd in 1980 to 7.5 mgd in 1990. Average annual pumpage at the Shaft peaked at about 5.5 mgd during 1986-87, but has been reduced to about 4.5 mgd to stabilize its chloride content at about 200 ppm. On the other hand, annual pumpage at the Well Field was increased from an average of 1.0 mgd to 3.5 mgd in order to meet a total pumpage of 7.5 mgd. This amount is about equal to the sustainable yield of the Kahaluu sources.

The Holualoa well was in production for less than a year when it experienced hardware problems. However, it was restored to service in 1991. The total system pumpage for the 1990-91 fiscal year as reported in the Hawaii County Water Use and Development Plan (Review Draft, February 1992) is as follows:

Table 2. 1990-91 AVERAGE WATER USE, NORTH KONA WATER SYSTEM

Source	1990-91 Average Water Use (mgd)
Kahaluu Well A	0.773
Kahaluu Well B	0.759
Kahaluu Well C	0.611
Kahaluu Well D	0.713
Kahaluu Shaft	4.868
Holualoa Well	0.618
TOTAL	8.342*

*Does not include Kalaoa Mauka Well which was not placed in service until 1992.

North Kona Water System

The Kahaluu Well Field and Water Development Shaft are the primary sources of supply for the North Kona Water System which serves the coastal areas from Kahaluu northward to Keahole Airport and the inland areas of Kalaoa. Water is transported from the Kahaluu sources through two major pipelines: one along Mamalahoa Highway to Kalaoa and another along Kuakini and Queen Kaahumanu Highways to Keahole Airport. The Mamalahoa route includes 12 and 8-inch diameter pipelines with appurtenant storage tanks and booster pumps, and the Kuakini/Queen Kaahumanu route, which starts at the Kahaluu Shaft, includes a 24-inch diameter pipeline that reduces to 20 inches 3½ miles south of Kailua-Kona, then to 16 inches at Kailua-Kona, and finally to 12 inches between Honokohau Harbor and Keahole Airport.

Only two new well sources have been added to the water system since the development of the Shaft in 1975. In 1983, the State drilled the Holualoa Well (3657-01) which was placed into production in 1986 (original one mgd pump capacity changed to 0.72 mgd in 1991) to help meet the growing water demand in the area. Seven years later, in 1990, the State drilled the Kalaoa Mauka Well (4358-01) and unexpectedly discovered a high-level groundwater source. This well was added to the North Kona Water System in 1992, providing a much needed 0.5 mgd additional water supply and providing a total pump capacity of 13.2 mgd for the North Kona Water System (see Table 1).

Table 1. PUMP CAPACITY, NORTH KONA WATER SYSTEM

Source	Pump Capacity (mgd)
Kahaluu A	1.0
Kahaluu B	1.0
Kahaluu C	1.0
Kahaluu D	1.0
Kahaluu Shaft	8.0
Holualoa	0.72
Kalaoa Mauka	0.5
TOTAL	13.22

basal aquifer exists and its utility must be protected, the sustainable yield of a particular coastal sector must take into account both the high-level and downgradient basal aquifers.

In any case, optimum development of North Kona's groundwater resources would consist of development of the high-level aquifers. An estimated 75% of the groundwater recharge to these aquifers is considered developable based upon experience with aquifer performance in Honolulu and Pearl Harbor on Oahu (Water Resources Protection Plan, 1990). Based upon this percentage, the sustainable yield of the 10-mile stretch of North Kona between Kalaoa and Kahaluu is an estimated 40 mgd (0.75 x 53 mgd).

EXISTING WATER SUPPLY AND WATER USE

Early Water Development

Prior to 1959, potable water requirements in the Kailua-Kona area were met almost entirely by rain catchment from galvanized corrugated rooftops. Two surface water springs located above Mamalahoa Highway at elevations 2,100 and 2,400 ft. in Waiaha Stream, however, supplied the former Kona Inn in Kailua-Kona. Exploration for groundwater supplies began in 1944 with the drilling of the Waiaha test hole located two miles southeast of Kailua-Kona at an elevation of 600 feet. Fourteen years later, in 1958, a full-size test well located along Palani Road at elevation 800 feet was drilled and pump tested by the State. The well was unsuccessful and a bit of a disappointment because it yielded very brackish water (2,800 ppm, chlorides) although the well was located two miles inland from the coast.

A year later, in 1959, the State drilled a second exploratory well located 1.1 miles inland at Kahaluu Bay at an elevation of 833 ft. It was highly successful in terms of yield and water quality. The well had a chloride content of only 8 ppm and was the freshest water well on the island at that time. Known as Kahaluu well A, it was put into production in 1967 with appurtenant tanks, pipelines, etc., to serve the Kailua-Kona area. Eventually, additional wells (B, C, and D) were drilled by the State and turned over to the Hawaii County Department of Water Supply (DWS). By 1971, the Kahaluu Well Field had a total pump capacity of 3.3 mgd.

To meet the growing demand for potable water in Kona, the State planned and constructed the Kahaluu Shaft which was placed into production by the County Department of Water Supply in 1975 with a pump capacity of 6 mgd.

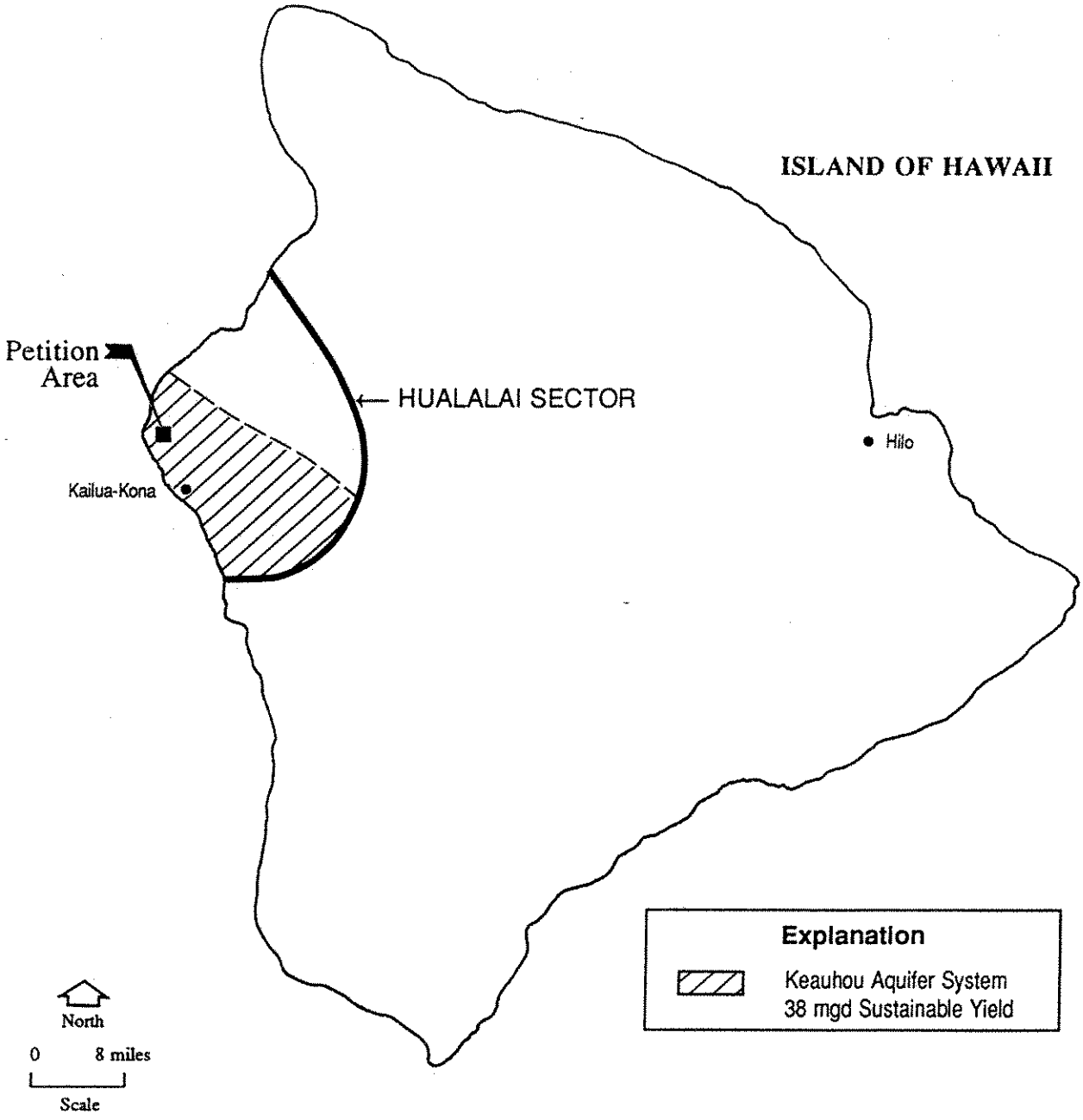
The volume of rainfall within the rainbelt described above was calculated for each coastal mile-wide sector between Kahaluu and Keahole. An average of 15 to 17 mgd of rainfall occurs per coastal mile between Kahaluu and Kailua-Kona. The volume of rainfall decreases to 12 mgd/coastal mile at Kealakehe and to 4 mgd/coastal mile at Kalaoa. In the 10-mile stretch between Kahaluu and Kalaoa, the volume of rainfall averages 135 mgd. With no reliable pan evaporation data, the recharge component of the water budget equation was estimated from the results of water budget studies done on Oahu where more complete hydrologic data is available.

Giambelluca (1983) made a detailed water budget study of the Pearl Harbor basin on Oahu using monthly data. His results showed that approximately 44% of total rainfall became groundwater recharge. Shade (1984) made a similar study for Moanalua Valley on Oahu and showed that approximately 43% of total rainfall became groundwater recharge. Eyre (1986) showed that groundwater recharge amounted to 25% of total rainfall in the Waialae area of Oahu, which is most comparable to the rainfall in North Kona. Adjusting Eyre's percentages to account for no runoff in Kona, a value of 39.5% is obtained as the percentage of total rainfall that becomes groundwater recharge. Thus, the estimated groundwater recharge or flux in the 10-mile stretch of North Kona between Kalaoa and Kahaluu is 53 mgd.

SUSTAINABLE YIELD

Of the estimated groundwater recharge to a basal lens floating on salt water, only a fraction can be developed on a sustained, long-term basis. This fractional amount is called the sustainable yield of an aquifer. Sustainable yield is the amount of ground water that can be developed without adversely affecting the long-term ability of a basal aquifer to produce acceptable quality water from existing and new sources. Adverse effects may relate to localized upconing of salt water caused by excessive pumping rates or to shrinking of the lens caused by excessive total pumpage over the long term. Sustainable yield of a basal aquifer is always less than its recharge.

The concept of sustainable yield for basal aquifers, however, is not completely applicable to the high-level aquifers of North Kona because they are not threatened by salt water intrusion. Assuming that the utility of any downgradient basal aquifer is not a factor, the "sustainable yield" of a high-level aquifer would be equal to its groundwater recharge, rather than to a fraction thereof. On the other hand, if a usable downgradient



Source: Water Resources Protection Plan, 1990

Figure 3. KEAUHOU AQUIFER SYSTEM & SUSTAINABLE YIELD

groundwater flow may reasonably be assumed to occur more or less perpendicular to the coast.

Keauhou Aquifer System and Sustainable Yield

The petition area is located within the Keauhou Aquifer System (State Commission on Water Resource Management, 1990). This aquifer system is a part of the Hualalai Hydrologic Sector (see Figure 3) and comprises the southern slopes of Hualalai Volcano. The boundaries of the Keauhou Aquifer System are defined by the northwest rift zone of Hualalai and the surface contact between Hualalai and Maunaloa lavas on the southern side of the rift zone. The Keauhou system includes the coastal stretch from Keauhou north to Kawili Pt. and covers an area of 167 square miles. The Keauhou Aquifer System includes basal and high-level aquifers and has an estimated sustainable yield of 38 mgd (Commission on Water Resource Management, 1990).

GROUNDWATER RECHARGE

One of the methods used to determine the availability of ground water in an area is to compute its water budget, based upon reasonable and logical assumptions of geology and hydrology. The objective of a water budget is to estimate the amount of recharge to an aquifer. The water budget method is especially useful in areas where insufficient well data is available and when long-term averages of rainfall, etc., are used to indicate long-term average (i.e., sustainable) conditions of an aquifer or groundwater body. The water budget method is based on average groundwater conditions. Groundwater recharge is the net amount of rainfall that percolates deep enough below the ground to escape evapotranspiration and is calculated from the following equation:

$$\text{Recharge} = \text{Rainfall} - \text{Evapotranspiration} - \text{Runoff}$$

The source of groundwater recharge in North Kona is the mauka belt of rainfall. In calculating the water budget, it is conservatively assumed that recharge is limited to the four-mile wide rainbelt between the 50-inch makai isohyet (line of equal rainfall) and the 40-inch mauka isohyet (see Map 1).

The rainfall component in the above equation was determined by using median annual rainfall data and planimetering isohyetal areas using a 1 inch = 1 mile scale map.

High-Level Water Occurrence

The occurrence of high-level ground water in the North Kona area between Keahole and Kahaluu was first discovered in 1990 by the State Division of Water and Land Development in the Kalaoa Mauka well, located 4.7 miles inland from the coast at Keahole. This discovery well (State Well No. 4358-01) is located mauka of Mamalahoa Highway at an elevation of 1800 feet (see Map 2, Well 7). The well was drilled to a depth of 50 feet below sea level and encountered ground water standing 238 feet above sea level and having a pristine chloride content of 10 parts per million.

Less than a year later in 1991, high-level ground water was also encountered in the County Department of Water Supply's Honokohau well (see Map 2, Well 11) located 2½ miles south of Kalaoa at an elevation of 1675 feet. This well was drilled to a depth of 60 feet below sea level and encountered ground water at an elevation of 109 feet above sea level. High-level ground water has been encountered in three other wells located between Honokohau and Waiaha, indicating that high-level ground water probably occurs more or less continuously mauka of Mamalahoa Highway along a 6-mile stretch of North Kona between Kalaoa and Waiaha.

The inland and lateral extent of this high-level water and the nature of the confining hydrogeologic structure are not well known at this time, although five other wells located south of Kahaluu have discovered high-level ground water as far south as Keei, some 14 miles south of Keahole. The hydrogeologic boundary between the basal water and inland high-level water apparently lies parallel to the coastline, approximately two miles or more inland. However, because different water levels ranging from 40 to 490 feet above sea level have been encountered, high-level groundwater probably occurs in separate or partially separate bodies.

Mauka of the petition area, the high-level water drops from an elevation of 238 feet in the Kalaoa Mauka well (4358-01) to 10 feet in the Kau 2 well (4458-02), located a mile north. This discontinuity in water levels may indicate the northern limit of the high-level water body above Keahole.

Prior to the 1990 discovery of high-level ground water, regional groundwater movement was assumed to be perpendicular to the coastline. Based upon this assumption, groundwater recharge and sustainable yield could be estimated on a coastal-mile basis. However, now that different levels of high-level ground water has been discovered in nine wells along some 20-miles of the Kona coast, the general assumption that high-level ground water movement occurs uniformly perpendicular to the coastline must be viewed with caution until more well data becomes available. However, basal

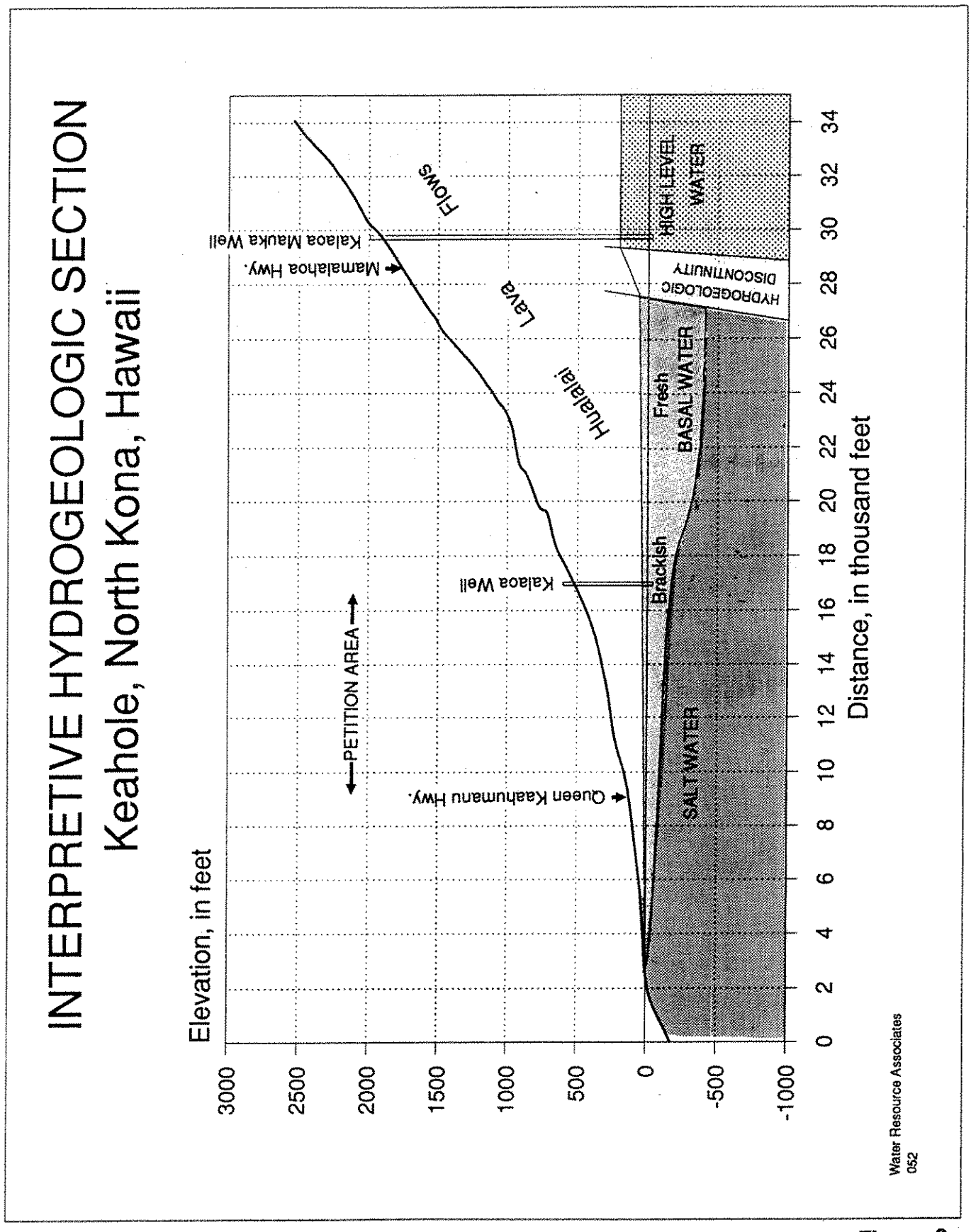

INTERPRETIVE HYDROGEOLOGIC SECTION
Keahole, North Kona, Hawaii
Elevation, in feet
3000
2500
2000
1500
1000
500
0
-500
-1000
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Distance, in thousand feet
PETITION AREA
Queen Kaahumanu Hwy.
Kaloa Well
Mamalahoa Hwy.
Kaloa Mauka Well
Hualalai
Lava
Flows
Brackish
Fresh
BASAL WATER
SALT WATER
HYDROGEOLOGIC
DISCONTINUITY
HIGH LEVEL
WATER
Water Resource Associates
052

Figure 2.

formed the western slopes of Hualalai. No dikes, cinder cones, or coastal caprock formations occur in the coastal area and rainfall amounts to less than 40 inches a year. Consequently, the basal aquifer is unconfined, thin, and mostly brackish.

Based on the Kalaoa well (4360-01) located just mauka of the petition area (see Map 1), the basal lens in the mauka portion of the petition area has a head of 3.2 feet above sea level and a chloride content of 740 parts per million, barely suitable for landscape irrigation. In the seaward half of the petition area, the underlying basal aquifer probably has a chloride content of 1000 parts per million, or more. South of the petition area, the basal lens apparently is thinner and more brackish, based upon data from three wells (4160-01, 4160-02, and 4059-01). No wells have been drilled in the coastal area immediately north of the petition area to indicate hydrologic conditions there.

Northeast of the petition area near Mamalahoa Highway between Kalaoa and Huehue Ranch, the basal aquifer is potable, has a higher head of 7 to 10 feet above sea level, and probably occurs under semi-confined hydrogeologic conditions related to dike structures associated with the Hualalai Rift Zone. Although potable, the ground water is unusually high in hardness which is probably related to the proximity of the young rift zone and associated residual volcanic processes.

Hydrogeologic Boundary

The basal aquifer is known to have an inland hydrologic boundary with high-level ground water, based upon well data and a geophysical survey conducted in the Palani Junction area. The State-drilled Kalaoa Mauka well (4358-01) has a head of 238 feet above sea level, while a mile north the Nansay Hawaii-drilled Kau 2 well (4458-02) has a head of only 10.2 feet. In the Palani Junction area, located two miles south of Kalaoa, results of an electromagnetic geophysical survey (Blackhawk Geosciences, Inc., 1992) indicated a half to one-mile wide discontinuity between the known occurrence of basal water and high-level water. An interpretive hydrogeologic cross-section showing the discontinuity is shown in Figure 2.

Based on the well data and geophysical survey, the inferred location of the hydrogeologic boundary is shown on Map 1. The width, depth, and geologic nature of the low-permeability "dam" that confines ground water at high levels is not known. However, in the absence of adequate well data, it is believed that the confining geologic structure is more likely related to faults rather than to dikes. As shown on Map 1, the inferred hydrogeologic boundary coincides roughly with Mamalahoa Highway.

water at depth, due to highly permeable, basaltic lava flows which are mostly unweathered and have little soil cover. There is little, if any, runoff to the sea even during times of heavy rainfall. Consequently, there are no perennial streams anywhere in North Kona. In the rainbelt, a few small springs, such as Waiaha Springs, may occur as groundwater issues from thin aquifers perched atop local ash beds. However, such springs are small and intermittent and suitable only for small or individual household needs.

Ground water in the coastal area between Keahole and Kahaluu occurs as a thin, unconfined basal lens of brackish to fresh water floating on salt water in very permeable Hualalai basalt lava flows. This thin basal aquifer is recharged principally by ground water discharging seaward from inland bodies of high-level ground water over and possibly through an, as yet, undefined hydrogeologic boundary that is located approximately two to four miles inland from the coast. Little recharge to the basal aquifer occurs from direct infiltration of overlying rainfall. The geographical distribution of rainfall undoubtedly influences the location, extent, quality, and thickness of the basal lens. However, the nature and extent of the implied low-permeability of the hydrogeologic boundary probably exerts a significant influence on the occurrence of basal water. A few anomalies to the expected occurrence of fresh water in the basal lens have been observed in existing wells and may be related to the hydrogeologic boundary or to local variations of permeability associated with dense lava flows, clinkery flows, and lava tubes.

At Kahaluu, a large quantity of fresh basal water occurs only a mile inland from the shoreline, the closest distance to shore that fresh water is known to occur along the entire Kona coast. It was fortuitously discovered 33 years ago, in 1959.

North of Kahaluu, the boundary between brackish and fresh basal water gradually shifts inland until the boundary occurs approximately two miles inland from shore at Kailua-Kona and approximately four miles inland from shore at Keahole. Less groundwater recharge and more permeable lava flows may account for the increased inland intrusion of salt water. These two factors tend to lower the seaward hydraulic gradient of an unconfined basal aquifer; and, in fact, the hydraulic gradient of the basal lens does decrease north of Kahaluu toward Keahole. Existing wells indicate a hydraulic gradient of 4.0 feet/mile at Kahaluu, 3.3 feet/mile at Holualoa, 2.4 feet/mile at Waiaha, 0.7 feet/mile at Kealakehe, and 0.9 feet/mile at Keahole.

Ground water in the Keahole area occurs as a thin, brackish basal aquifer in very permeable aa and pahoehoe lava flows that poured out of the northwest rift zone and

the high mountains of Mauna Loa and Mauna Kea. There is a distinctive local circulation of air that yields fairly regular summer showers. During the winter, the cyclonic storms which produce most of the rainfall in other similar coastal areas of the State do not create such rainfall in Kona.

The climate at Keahole is dry. The median annual rainfall is less than 20 inches at the coast and increases to approximately 40 inches three to four miles inland (see Figure 1).

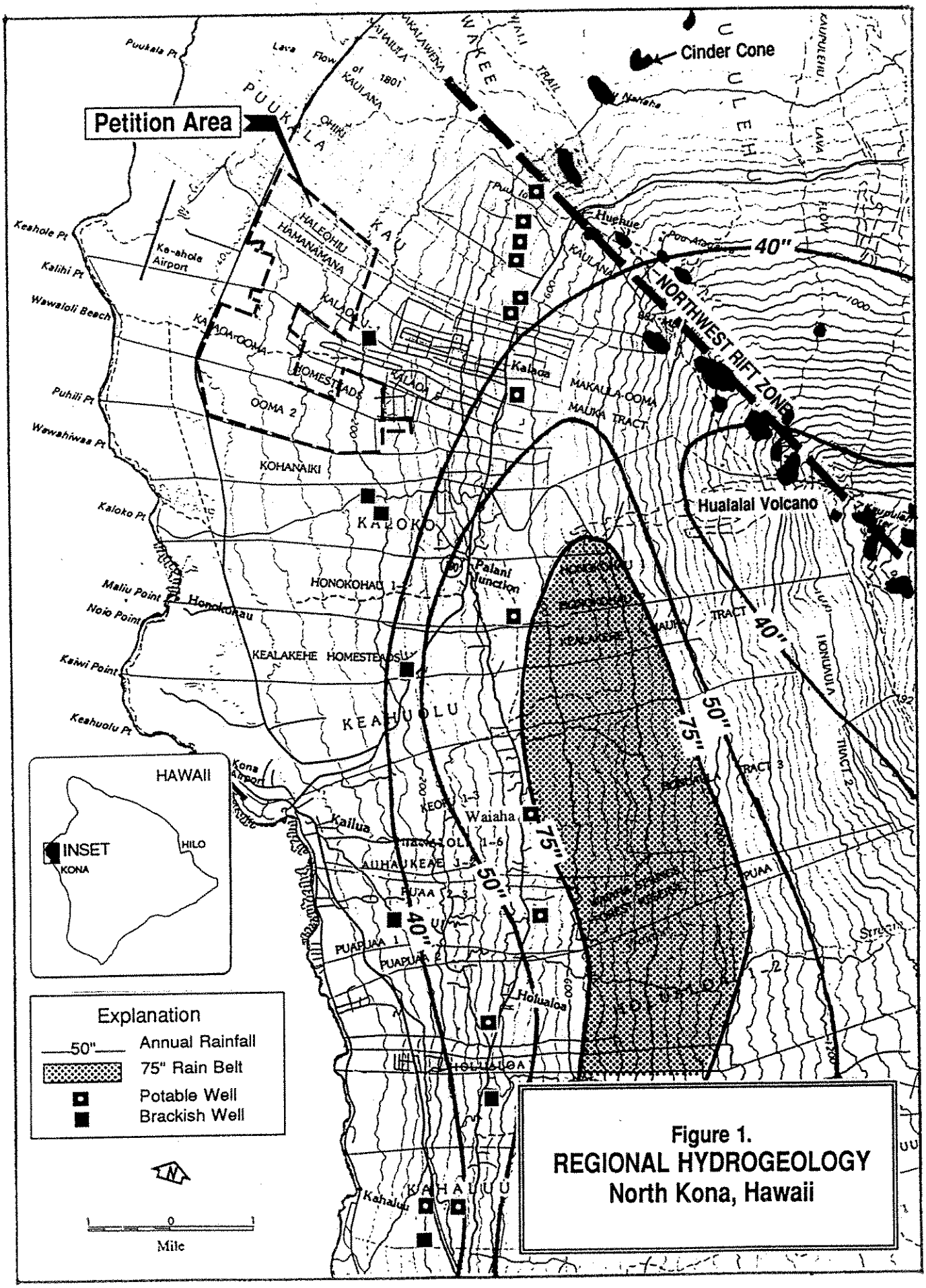
Geology

The petition area is located on the western slopes of Hualalai Volcano, mauka of Queen Kaahumanu Highway and Keahole Airport (see Figure 1). Hualalai Volcano is a dormant volcano which last erupted in 1801 along its northwest rift zone. An eruption at the 1500-foot elevation produced lava flows that spread out along the coast as far south as Keahole Airport. The northwest rift zone represents the major geologic structure in the area. Upwards of 100 cinder and spatter cones occur in the rift zone which is shown as a bold line in Figure 1.

The western slopes of Hualalai Volcano consist predominantly of alkalic olivine basalt flows that poured out of the northwest rift zone. Some of the flows, however, are gradational to Hawaiite (andesite). The basalt flows are typically thin-bedded, dip 10 to 15 degrees, and average 4 or 5 feet in thickness on the upper slopes (Macdonald and Abbott, 1970). These flows, however, probably average 10 feet in thickness on the more gentle (2°) slopes near the coast. The flows consist of both pahoehoe and aa types and belong to the prehistoric member (Holocene age) of the Hualalai volcanic series. Hualalai lavas extend as far south as Keauhou, some 7 miles away where they interfinger with lava flows from Mauna Loa Volcano. No surface evidence of geologic features such as cinder cones, dikes, or coastal caprock formations, which might affect the occurrence of ground water, occur in the area between Keahole and Kahaluu.

Basal Water Occurrence

Rainfall on the permeable volcanic slopes above an elevation of approximately 2,000 feet is the principal source of Kona's groundwater resources. This rainfall occurs in a four to five-mile wide belt which averages a peak of 75 inches a year (see Figure 1). However, most of it percolates quickly downward into the ground to become ground


Petition Area
Cinder Cone
Hualalai Volcano
NORTHWEST RIFT ZONE
40"
50"
75"
Explanation
50" Annual Rainfall
75" Rain Belt
Potable Well
Brackish Well
HAWAII
INSET
KONA
HILO
N
Mile
Figure 1.
REGIONAL HYDROGEOLOGY
North Kona, Hawaii

GROUNDWATER RESOURCES RELATIVE TO THE PETITION FOR STATE LAND USE RECLASSIFICATION AT KEAHOLE, NORTH KONA, HAWAII

INTRODUCTION

The Office of State Planning is seeking to petition for an Urban State Land Use Boundary Amendment for approximately 2,640 acres of State-owned land at Keahole, North Kona, Hawaii (see Figure 1). Because there are no potable water resources underlying the petition area, urban development of the petition area will require the development of potable water supply elsewhere in the region. The nearest existing sources of supply are the County Department of Water Supply's Holualoa well and Kahaluu shaft/well field located eight and ten miles, respectively, to the south. Eight to twenty-inch diameter pipelines currently transport water from these sources to Keahole Airport and mauka subdivisions at Kalaoa.

The purpose and scope of this report is to assess the groundwater resources of North Kona between Keahole and Kahaluu relative to the proposed land use reclassification. Also discussed are existing and future water use and development, and probable impacts of the urban development of the petition area on groundwater resources.

GEOLOGIC AND HYDROLOGIC SETTING

Climate

The Kona coast enjoys a land-and-sea circulation that has a distinct diurnal rhythm. In the afternoon and early evening, air moves inland on a sea breeze which at times can be brisk. Late at night and very early in the morning, the air drifts back from land to sea. This return drift is usually very gentle such that it can barely be felt. Kona's year-round equitable temperature conditions are moderated by Hawaii's mid-ocean location. Temperatures from season to season normally ranges between 15 and 20°F and averages about 75°.

The Kona coast has a unique seasonal rainfall pattern, compared to the normal tradewind regime of the State. The summers are wetter than the winters. This pattern is associated with the fact that Kona is well protected from the tradewinds, lying leeward of

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GROUNDWATER RESOURCES RELATIVE TO THE PETITION FOR STATE LAND USE RECLASSIFICATION AT KEAHOLE, NORTH KONA, HAWAII

Prepared for

Helber Hastert & Fee, Planners

Water Resource Associates

Honolulu, Hawaii
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An updated traffic forecast is being developed as part of the Queen Kaahumanu Highway Master Plan, however the figures are not available at this writing.

C. Future Highway Needs

The future highway needs are established by the HLRHP. The roadway master plan is defined in greater detail in the K-K Plan. All the studies reviewed in this assessment concur that the traffic demand on Queen Kaahumanu Highway would exceed the existing two-lane capacity before the Year 2000. Several issues, relative to the State Lands, need to be addressed by future and ongoing studies:

1. Number and locations of interchanges proposed on Queen Kaahumanu Highway, within the vicinity of the State Lands.
2. The configuration and operation of the frontage road system along Queen Kaahumanu Highway in the vicinity of the State Lands.
3. Implementation schedule of the proposed north-south arterial/collector roadways.
4. The traffic impacts and access requirements, based upon the development plan for the State Lands.

interchange is not located along State Lands frontage, then access could be provided by a frontage road along Queen Kaahumanu Highway, and the Mid-Level Arterial and Waena Drive, proposed in the K-K Plan.

Kaimi Nani Drive provides only limited potential for access between the State Lands and Queen Kaahumanu Highway. Because of its proximity to Keahole Airport Access Road, it is unlikely that an interchange would be located at Kaimi Nani Drive. Kaimi Nani Drive access would be relocated to a frontage road system leading to the Keahole Interchange and the nearest interchange to the south. Access between the State Lands and Mamalahoa Highway is limited. The upper portion of Kaimi Nani Drive is residential in nature, with driveways fronting Kaimi Nani Drive. The uncontrolled access along Kaimi Nani Drive limits its carrying capacity.

The proposed University Drive is an extension of Keahole Airport Access Road at the Keahole Interchange, from Queen Kaahumanu Highway to Mamalahoa Highway. The University Drive would provide access to the northern portion of the State Lands and to the Lands of Ka'u. The maximum allowable road grade for a collector road may be difficult to achieve as result of the steep terrain near Mamalahoa Highway.

The proposed Mid-Level Arterial and Waena Drive are expected to provide access between the State Lands and the Kealakehe region. These north-south roadways are expected to carry traffic with origins and destinations in neighboring communities. However regional access is expected to be provided by Queen Kaahumanu Highway and Mamalahoa Highway.

B. Future Traffic

The most recent available traffic forecast for the region is presented in the State/County 1991 HLRHP. The Year 2010 traffic forecast is based upon a land use forecast developed by the County of Hawaii, circa 1988. Several ongoing projects, such as O'oma II, Kohanaiki Resort, and Kealakehe Planned Community, have undergone changes. Other projects, such as the Queen Lilioukalani Trust Project, have received State Land Use Commission redesignation since the County land use forecast.