FILE

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of	DOCKET NO. A89-646
LILIUOKALANI TRUST	LILIUOKALANI TRUST
To Amend the Land Use District Boundary to Reclassify Approximately 1,135 Acres of land from the Agricultural and the Conservation Districts to the Urban District at Keahuolu, North Kona, Hawaii, State of Hawaii, Tax Map Key No.: 7-4-08: Portion of 2 and Portion of 12	

This is to certify that this is a true and correct copy of the document on file in the office of the State Land Use Commission, Honolulu, Hawaii.

DEC 11 1990 by _____
Date Executive Officer

LAND USE COMMISSION STATE OF HAWAII
DEC 11 7 55 AM '90

FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER ACCEPTING AN ENVIRONMENTAL IMPACT STATEMENT FOR A STATE LAND USE DISTRICT BOUNDARY AMENDMENT

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FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER ACCEPTING AN ENVIRONMENTAL IMPACT STATEMENT FOR A STATE LAND USE DISTRICT BOUNDARY AMENDMENT

The Land Use Commission (hereinafter "Commission"), having examined the Final Environmental Impact Statement ("FEIS"), filed by Philip Ching, Trustee of the Liliuokalani Trust (hereinafter "Petitioner") on August 4, 1990, hereby makes the following Findings of Fact, Conclusions of Law and Decision and Order:

FINDINGS OF FACT

DESCRIPTION OF AFFECTED PROPERTY AND PROPOSED DEVELOPMENT

1. The subject property consists of approximately 1,135 acres of land located at Keahuolu, North Kona, Island of Hawaii, Tax Map Key Number: 7-4-08: portion of 2 and portion of 12 (hereinafter the "Property"). The subject property extends east from the Old Kona Airport Park, mauka to Palani Road, and north from the intersection of Palani Road and Queen Kaahumanu Highway to the Kealakehe Landfill.

2. The Property ranges in elevation from below 10 feet at the makai boundary to approximately 780 feet at the mauka end. The terrain is an undulating surface of a'a and pahoehoe lava with little soil cover. The slope of the makai portion of the property below Queen Kaahumanu Highway ranges from 0-5 percent. The slope of the mauka portion of the property above Queen Kaahumanu Highway ranges from 5-10 percent with an average slope of 6.5 percent.

3. The property is presently undeveloped lava fields with scattered trees and grasses and dense stands of kiawe at the mauka end of the property.

4. Petitioner proposes to reclassify approximately 1,135 acres from the Agricultural District and the Conservation District to the Urban District to develop the property for urban expansion, a residential community, a business expansion area, and a regional transportation network.

5. The project as proposed is low-density in nature, featuring low-rise buildings, pedestrian oriented spaces and courtyards to accommodate a growing community.

PROCEDURAL MATTERS

6. On August 4, 1989, Petitioner submitted its petition to amend the district boundary of the Property from the Conservation and Agricultural Districts to the Urban District. The petition included an environmental assessment as required by Section 343-5(a)(7), Hawaii Revised Statutes ("HRS"), as amended.

7. On August 24, 1989 and by Order filed on September 13, 1989, the Commission required Petitioner to prepare an environmental impact statement, pursuant to Chapter 343, HRS.

8. A FEIS was prepared by Petitioner and submitted to the Commission on October 19, 1990.

CONTENTS REQUIREMENTS

9. The FEIS contains the required summary sheet, description of the project, description of the environmental setting, information regarding the relationship of the proposed action to land use plans, policies, and controls for the affected area; information of the proposed action on the environment; information on adverse environmental effects that cannot be avoided; offsetting considerations of governmental policies; alternatives to the proposed action; information regarding the relationship between local shorter-term uses of the environment and the maintenance and enhancement of long-term productivity; mitigation measures; identification of any irreversible and irretrievable commitment of resources; a list of the organizations and persons consulted; and a list of necessary approvals.

RESPONSE TO COMMENTS

10. The Petitioner responded to timely comments received during the review process. Comments and responses have been appended to the FEIS.

CONCLUSIONS OF LAW

Pursuant to Chapter 343, Hawaii Revised Statutes, as amended, and Chapter 200 of Title 11, Hawaii Administrative Rules, entitled "Environmental Impact Statement Rules," the Commission concludes that Petitioner has satisfied the criteria and procedures for acceptance of a Final Environmental Impact Statement and the requirements of Section 11-200-23 of Hawaii Administrative Rules.

ORDER

IT IS HEREBY ORDERED that the Final Environmental Impact Statement submitted by Philip Ching, Trustee of Liliuokalani Trust under Docket No. A89-646 be and the same is hereby accepted pursuant to Chapter 343, Hawaii Revised Statutes, and Chapter 200 of Title 11, Hawaii Administrative Rules.

IT IS FURTHER ORDERED that the subject petition under Docket No. A89-646/Liliuokalani Trust is accepted for filing as of November 15, 1990.

Done this 11th day of December 1990, per motion of November 15, 1990 at Kapaa, Kauai.

LAND USE COMMISSION
STATE OF HAWAII

By RENTON L.K. NIP
Chairman and Commissioner

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of LILIUOKALANI TRUST To Amend the Land Use District Boundary to Reclassify Approximately 1,135 Acres of land from the Conservation and the Agricultural Districts to the Urban District at Keahuolu, North Kona, Hawaii, State of Hawaii, Tax Map Key Nos.: 7-4-08: Portion of 2 and Portion of 12	DOCKET NO. A89-646 LILIUOKALANI TRUST

CERTIFICATE OF SERVICE

I hereby certify that a copy of the Findings of Fact, Conclusions of Law, and Decision and Order Accepting an Environmental Impact Statement for a State Land Use District Boundary Amendment was served upon the following by either hand delivery or depositing the same in the U. S. Postal Service by certified mail:

HAROLD S. MASUMOTO, Director
Office of State Planning
State Capitol, Room 410
Honolulu, Hawaii 96813

CERT. NORMAN HAYASHI, Planning Director
Planning Department, County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

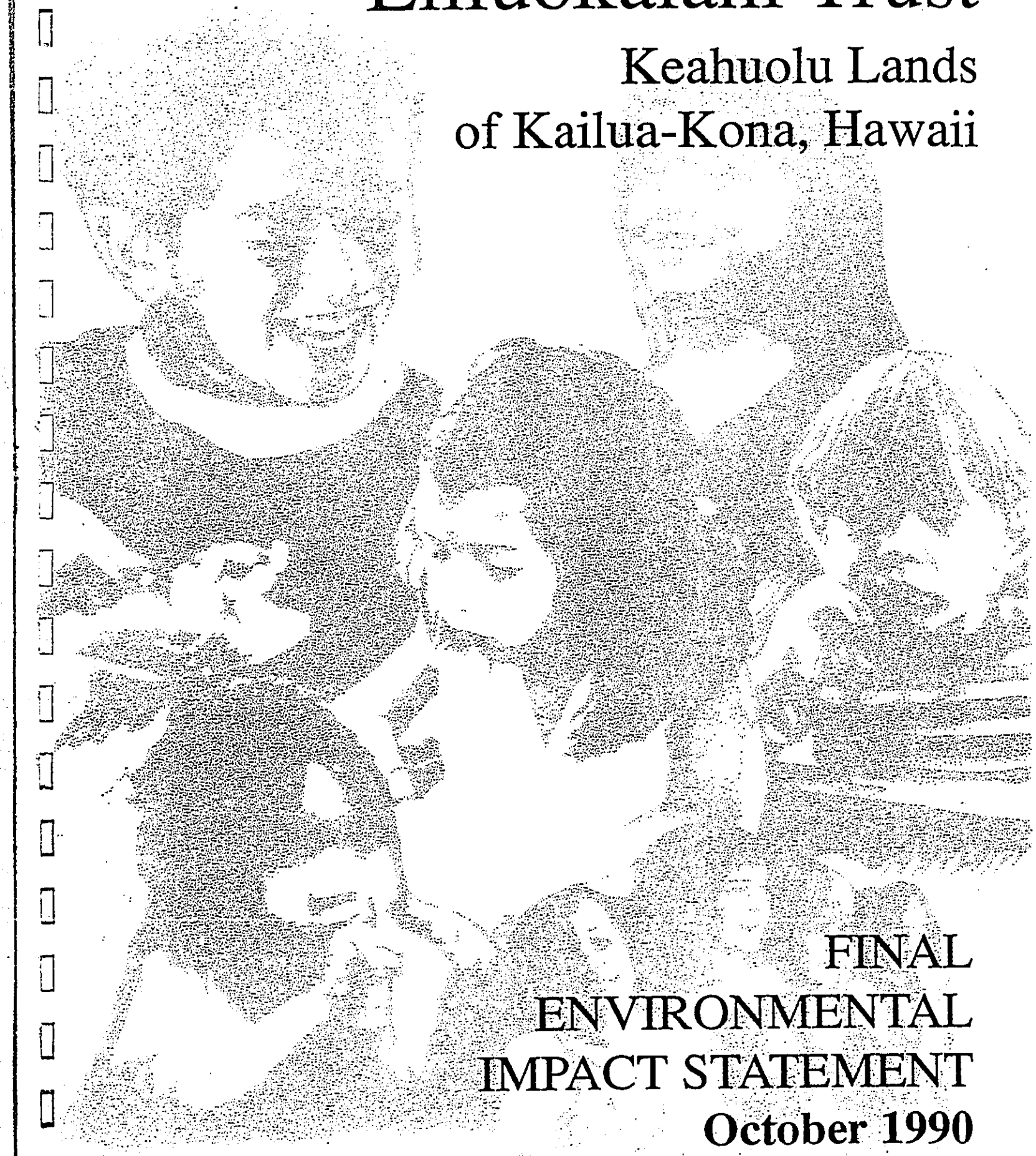
CERT. BENJAMIN KUDO, ESQ., Attorney for Petitioner
Watanabe, Ing & Kawashima
745 Fort Street, 5th Floor
Honolulu, Hawaii 96813

DATED: Honolulu, Hawaii, this 11th day of December 1990.

ESTHER UEDA
Executive Officer

Liliuokalani Trust

Keahuolu Lands
of Kailua-Kona, Hawaii



FINAL
ENVIRONMENTAL
IMPACT STATEMENT
October 1990

Keahuolu Lands of Kailua-Kona

FINAL
ENVIRONMENTAL IMPACT STATEMENT

This document is prepared pursuant to Chapter 343, Hawaii Revised Statutes, for submission to the State Land Use Commission

Petitioner:

Liliuokalani Trust
161 South King Street, 18th Floor
Honolulu, Hawaii 96813

Prepared by:

Belt Collins & Associates
Honolulu, Hawaii
October 1990

SUBMITTED BY:

Philip Ching, Trustee
Liliuokalani Trust

OCTOBER 23, 1990
Date

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Chapter One

CHAPTER I
INTRODUCTION AND SUMMARY

1. APPLICANT AND BRIEF PROJECT SUMMARY

The applicant is the Liliuokalani Trust Estate (herein after called "the Trust"), a non-profit public benefit organization. The Trust is proposing to lease for development 1,135 acres of its land immediately north of Kailua town. This land is part of a 4,000-acre ocean to mountain top ahupua'a left to the Trust by Queen Liliuokalani in her will for the purpose of assisting orphaned Hawaiian children.

The proposed project consists of the four principal elements, an Urban Expansion Area, a Residential Community, a Business Expansion Area, and a Regional Transportation Network. The Trust intends to retain ownership of the Urban Expansion Area and the Business Expansion Area, sell the Residential Development Area to the State of Hawaii, and participate with the State, County, and other land owners in the construction and dedication of regional infrastructure, including the Regional Transportation Network. For those areas retained by the Trust, developers will be selected to construct the individual projects according to specifications established by the Trust. Restrictive covenants will be established to guide the development, operation and maintenance of buildings and facilities developed on Trust property. Lease rents derived from the various projects will provide the Trust with a major source of new revenue to support its beneficiaries.

2. PROPOSED GOVERNMENT ACTION

This environmental impact statement is prepared in accordance with Chapter 343, Hawaii Revised Statutes and the rules and regulations of the Office of Environmental Quality Control. It has been determined that the environmental impact statement is required pursuant to Chapter 200 of Title 11, Department of Health, Administrative Rules, Subchapter 5(b). This document is being prepared to accompany a Petition for Boundary Reclassification from Conservation and Agriculture to Urban which was filed with the State Land Use Commission on August 4, 1989 and is identified as Petition No. A89-646.

3. PURPOSE OF THIS DOCUMENT

The purpose of this document is to identify and assess environmental and social impacts that could result from the development of the Keahuolu Lands. Preparation of an Environmental

Impact Statement requires a detailed analysis of the subject property and the proposed action. This process enables the applicant to identify weaknesses or inconsistencies in the project plan, propose mitigation measures designed to address potentially significant adverse impacts, respond to critical public and private review of the project, and ultimately create a well-planned project that is sensitive to the physical, natural and social environment within which it is proposed.

4. STATEMENT OF OBJECTIVES

The development proposal envisions a new urban expansion for the West Hawaii area surrounded up slope by a series of residential villages. The urban expansion incorporates land uses which are vital to a growing community and creates an activity core for the region. In realizing this development concept, the Trust hopes to achieve several major objectives:

- Preserve the character and lifestyle of the historic Kailua Village area.
- Improve existing and future traffic circulation in the Kailua area.
- Assist in Implementing the State and County's growth polices.
- Increase the income earned by the Trust to better serve the growing needs of its beneficiaries.
- Balance private and public benefits derived from the various project components.
- Preserve significant historic sites on the property and regulate development in a manner that will enhance the traditional Hawaiian character and culture of the area.
- Separate industrial and commercial land uses in a manner that will benefit both.
- Maximize pedestrian access to facilities and amenities in the project.
- Encourage development consistent with a low-rise, open space character of the existing community.
- Create an attractive landscaped environment with many shade trees to promote pedestrian-oriented activity.

5. PROJECT DESCRIPTION

5.1 PROJECT SETTING

The proposed project consists of an approximately 1,135 acre portion of the Keahuolu ahupua'a in North Kona and is identified as Tax Map Key Numbers of the Third District: 7-4-08: portion 2 and 7-4-08: portion 12. The project area extends east from the Old Kona Airport Park mauka to Palani Road in the vicinity of Queen Liliuokalani Village, a distance of about two and a half miles, and north from the intersection of Palani Road and Queen Kaahumanu Highway to the Kealakehe Landfill, a distance of just over a mile. An 865-acre parcel makai of Queen Kaahumanu Highway, which contains the Pawai Bay Beach and family recreation area, is part of the original ahupua'a but is not included in this environmental impact statement or the proposed development plan.

Resort growth proposed in South Kohala and North Kona over the next twenty or more years is expected to result in a significant expansion of Kailua-Kona's population, creating an increasing demand for the expansion of existing urban areas to provide office, commercial, light industrial land uses, as well as new residential opportunities. As West Hawaii's existing regional center, Kailua-Kona is the focus of planning efforts by the State, County and private land owners.

5.2 PROPOSED DEVELOPMENT

As discussed above, the proposed project consists of the four principal elements, an Urban Expansion Area, a Residential Community, a Business Expansion Area, and a Regional Transportation Network.

The 465-acre Urban Expansion Area is proposed as the central element of urban expansion in the North Kona region. It will provide a variety of land uses which combine to create a new region-serving activity center for Kailua. Included in this area are the following proposed uses: a 145-acre Regional Shopping Center; a 20-acre Financial Plaza; a 35-acre Regional Hospital; a 25-acre Professional Plaza including medical offices; a 20-acre Business Hotel; a 30-acre Civic and Cultural Center; as well as 65 additional acres of commerical land, 95 acres for Office expansion, and 30 acres of Open Space, Park, and an Historic Reserve which contains numerous archaeological sites.

A 450-acre area including all of that portion of the project mauka of the center line of a planned Mid-Level Roadway, which creates the eastern boundary of the Urban Expansion Area, is proposed for sale to the State of Hawaii. The land uses for this mauka area will, subsequently, be determined by the State of Hawaii rather than by the Trustees. A number of alternative uses have been considered including affordable and market housing, a West Hawaii university campus, and a regional sports facility. However, it is anticipated for the purposes of this study that the entire 450 acres will be developed as a residential community.

The third component consists of approximately 229 acres of land located makai of Queen Kaahumanu Highway between the Trust's Conservation district land and the Kona Industrial Subdivision 100-acre expansion area. This parcel is proposed for long-term development as a mixed-use expansion area for retail, commercial and wholesale businesses, and recreational uses. It includes the Kona Children's Center which presently occupies a small parcel within the proposed expansion area and has leased an adjoining parcel to a privately-owned aquaculture project. Because the Business Expansion Area is proposed for development in a later phase of the project, the activities of the Kona Children's Center will not be disrupted in the foreseeable future.

Finally, the Trust proposes a Regional Transportation Network be implemented in coordination with development projects proposed by landowners throughout the area. The Regional Transportation Network is designed to relieve major traffic problems, especially in the area of Palani Road and Queen Kaahumanu Highway. The components of this system include the following:

1) A 300-foot wide setback for Queen Kaahumanu Highway to provide space for the eventual expansion of Queen Kaahumanu Highway and/or a frontage road along the mauka side of the highway.

2) A new mauka-makai roadway extending through the subject property, tentatively called the Queen Liliuokalani Boulevard. It will consist of a 120-foot right-of-way and provide access to the proposed project including the proposed Regional Shopping Center and help to reduce traffic congestion on Palani Road.

3) A Mid-Level Roadway separating the proposed urban expansion from the proposed Residential Development on the 450 acres to be purchased by the State. This roadway would consist of a 120 foot right-of-way with two lanes generally paralleling Queen Kaahumanu Highway.

4) A secondary roadway (Road "A") consisting of a 60 foot right-of-way linking the northern portion of the urban expansion to Queen Liliuokalani Boulevard.

5) Waena Drive, a 60-foot right-of-way depicted by the HFDC in its Kealakehe Planned Community Concept Plan and by the County of Hawaii in its Keahole to Kailua Development Plan. It provides a link from Palani Road to the proposed Kealakehe development.

5.3 PROPOSED INFRASTRUCTURE

5.3.1 Water

At full buildout, total daily demand for water will reach 2.88 million gallons. The water will be provided by wells to be developed above the 1,600-foot elevation at sites along Mamalahoa Highway on Trust property. At full development, a total storage of about 4 million gallons (MG) will be required for the project and will be distributed among three reservoirs. The system will also include all the necessary transmission lines to residential and non-residential land uses as well as complete fire-protection hydrant system.

5.3.2 Wastewater

The entire project will be linked to the Kealakehe Sewage Treatment Plant, now under construction on the makai Kealakehe parcel. The project will generate approximately 2.98 million gallons per day of wastewater.

5.3.3 Drainage

Drainage for the entire project will be handled by drywells to be situated within road right-of-ways wherever possible.

5.3.4 Electrical Energy

At full build out, the proposed development will require over 50 megawatts. This is based upon an analysis of watts per square foot of development at maximum density. The actual electrical energy demand is expected to be considerably lower, however, since the project is envisioned at relatively low densities. This will result in the need for the development of one or more new substation transformers and a new region-serving 69 KV transmission line. Major transmission lines will be located along primary arterial roadways.

6. SUMMARY OF IMPACTS

Impacts to the physical and social environment will result from the development of the proposed project. Adverse impacts will be mitigated where possible and offset by benefits resulting from the project.

6.1 SHORT-TERM CONSTRUCTION PERIOD IMPACTS

- Increases in air-borne particulate matter (fugitive dust) and exhaust emissions from on-site construction equipment.
- Increased construction vehicle traffic, vehicle emissions and traffic noise.
- Increase in surface water run-off and drainage.

6.2 LONG-TERM IMPACTS

- Permanent changes to the topography of the area due to grading and site improvements.

- Increases in storm run-off.
- Changed visual character of the site.
- Loss of existing flora due to grading.
- Changed air quality due to exhaust emissions from increases in vehicular traffic.
- Increase in vehicular traffic noise.
- Loss of some archaeological sites.
- Increase in resident population, employment opportunities, and housing units.
- Increase in vehicular traffic.
- Increase in direct sales and rental income, as well as public revenues.
- Increase in demand for public utilities, including water service, wastewater treatment, solid waste disposal, storm water drainage, and electrical energy.
- Increase in demand for public facilities and services, including recreational opportunities, public education, public health care services, and protective services.

7. SUMMARY OF PROPOSED MITIGATION MEASURES

Mitigation measures to reduce adverse environmental and social impacts address both short-term and long-term impacts. Short-term mitigation measures include performing construction activities (clearing, grading and grubbing) in compliance with applicable air and noise quality regulations to minimize potential fugitive dust and noise impacts on adjacent developed areas. To ensure compliance with state regulations, a dust control plan must be implemented. Watering will be used to control construction-generated dust and open-bodied trucks will be covered when transporting dirt or dust producing materials. In addition, all construction will be subject to all relevant county and state permit procedures and reviews.

Major mitigation measures to address long-term impacts include:

- Design and construction of a drainage infrastructure system to accommodate increases in run-off and drainage.
- Adherence to appropriate building codes and standards and the inclusion of evacuation routes and a civil defense warning system to address natural hazard concerns.
- Use of native plants in landscaping and retention of natural area wherever practicable.

- Compliance with applicable federal, state and county archaeological, historical and cultural features preservation laws, rules and regulations, and the recommendations of consulting archaeologists.

- Creation of an Historic Reserve to preserve unique archaeological features.

- Inclusion of a Regional Transportation Network including a new mauka-makai roadway, setbacks from Queen Kaahumanu Highway, and a new Mid-Level Roadway.

- Promote transportation alternatives such as bus service, car pooling, and staggered work hours to help reduce vehicle emissions (These mitigative measures are beyond the control of a single developer).

- Development of water infrastructure to serve the project including new source wells and a transmission system.

- Development of waste water infrastructure in full compliance with applicable federal, state, and county regulations.

8. SUMMARY OF ALTERNATIVES CONSIDERED

In addition to the "no action" alternative, five alternative uses of the subject property were considered, including development of the lands for agricultural purposes, park uses, resource extraction, residential development and resort development. In general, none of the alternatives evaluated provide the degree of satisfaction of meeting the project objectives as well as the preferred alternative. They have greater adverse environmental impacts or have higher on-site and off-site infrastructural costs. Further, the alternatives would not allow the state and county overall goals and objectives regarding the project area to be met as well as the preferred alternative.

9. SUMMARY OF UNRESOLVED ISSUES

The Trust is aware of many questions and public concerns at this time regarding the proposed project. The Trust has been and will continue to work with the various state and county agencies, residents and business persons of the area, as well as elected officials to assure the final development plans meet the Trust's objectives and satisfactorily address concerns that have been raised to date.

10. SUMMARY OF COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The proposed project is generally consistent with the applicable Hawaii State Plan and various Functional Plans, the County General Plan and various Community Plan goals, policies

and standards relating to the future growth and development of the West Hawaii/Kailua-Kona area.

11. NECESSARY APPROVALS AND PERMITS

Following is a list of major approvals and permits required for the implementation of the proposed project. Additional permits and approvals may be necessary. In addition to State Land Use Commission approval for redesignation of land use districts, the Trust will seek necessary State and County approvals for the development of the project.

Permit or Approval	Authority
Land Use Boundary Amendment	State Land Use Commission
General Plan Amendment	Hawaii County Council
Well Construction Permit	State Commission on Water Resource Management
Pump Installation Permit	State Commission on Water Resource Management
Potable Water System Approval	State Department of Health
Underground Injection Control Line Approval	State Department of Health
Water Master Plan Approval	Hawaii County Board of Water Supply
Drainage Master Plan Approval	Hawaii County Department of Public Works
Change of Zoning	Hawaii County Council
Special Management Area Permit	Hawaii County Planning Commission
Subdivision Approval	Hawaii County Planning Department
Building and Grading Permits	Hawaii County Planning Department

Chapter Two

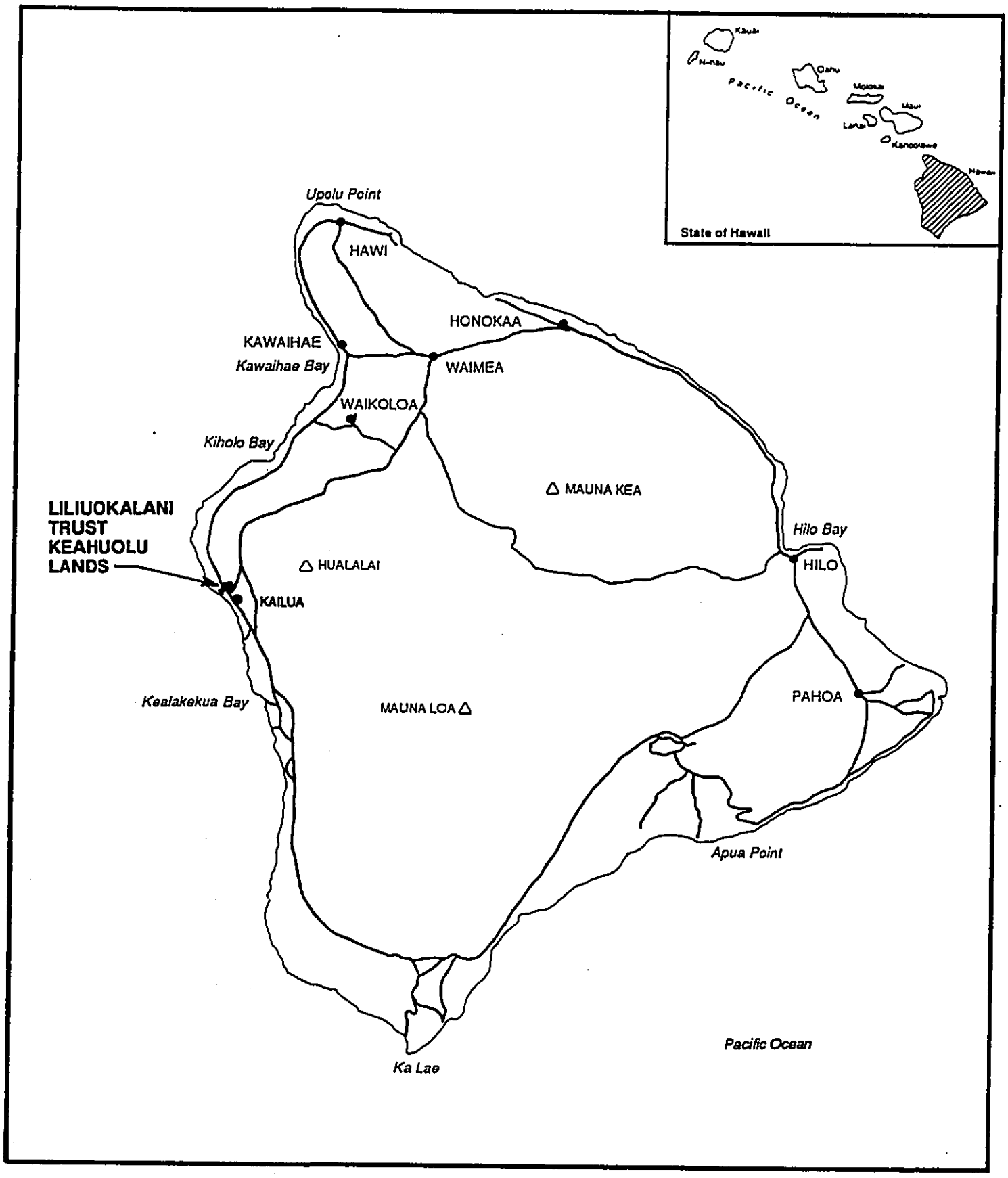
CHAPTER II
DESCRIPTION OF THE PROPOSED PROJECT

1. REGIONAL SETTING

The proposed project is located in the district of North Kona on the western side of the Island of Hawaii immediately north of and adjacent to the town of Kailua, as depicted in Figure II-1. The district of North Kona includes coastal and inland areas situated between Nenue Point to the south and Anaeho'omalu Bay to the north, a portion of the northwestern slope of Mauna Loa extending to its summit, and Hualalai mountain. Urban settlements in the district include the principal town of Kailua and the villages or settlements of Pu'uanahulu, Puu Waawaa Ranch, Huehue Ranch, Kalaoa, Honokohau, Holualoa, Kahalu'u, Honalo, Kainaliu, and Kealakekua, as well as a number of smaller communities and residential subdivisions. Major transportation facilities in the district include the Queen Kaahumanu Highway linking Kailua to Kawaihae, the Hawaii Belt Road (Mamalahoa Highway), the Keahole Regional Airport, and the Honokohau small boat harbor.

Kailua is the population, economic, and activity center of the western side of the Island of Hawaii and is intersected by the region's three principal arterial roadways; Queen Kaahumanu Highway, Palani Road, and Kuakini Highway. In July, 1987, North Kona had a population of 20,500, an increase of 49% over its population of 13,748 in 1980. The town is situated along the shoreline of Kailua Bay and extends eastward to the intersection of Palani Road and Queen Kaahumanu Highway and then south along the lower slopes of Hualalai. Historically, the town and its surrounding communities depended upon agriculture as their major source of employment and income. However, since the rapid growth of the State's visitor industry, beginning in the mid-1960's, Kailua has become an important visitor destination. With the development of the King Kamehameha Hotel and Kona Hilton in the Historic Kailua Village area and the opening of the Keauhou resort area on the coast five miles to the south, Kailua has become a rapidly growing visitor center.

In addition to visitor oriented developments in the immediate vicinity of Kailua, the development of the South Kohala coastline between Kawaihae and Anaeho'omalu as a major visitor destination area has increased the importance of Kailua as an economic center. These developments have contributed to increased resident and visitor populations, traffic congestion, the demand for goods and services, and a host of new commercial developments. In the course of twenty years, Kailua has been transformed from a sleepy little village noted for its proximity to excellent deep-sea fishing grounds to a bustling center of commercial tourism.



Prepared By: BELT COLLINS AND ASSOCIATES • AUGUST 1990

Figure II-1
ISLAND OF HAWAII

2. PROJECT BACKGROUND

In 1911, Queen Liliuokalani placed in trust over 11,000 acres of her land. The Queen's intent was that income derived from the sale or lease of these lands was to be used to assist orphaned Hawaiian children. Included in these lands was an *ahupua'a* of approximately 4,000 acres just north of Kailua. This property extends along the ocean from Kuka'ilimoku Point to Kaiwi Point and inland to the 3,600 foot elevation.

The Liliuokalani Trust Estate (herein after called "the Trust") is a non-profit organization. It is administered by three lifetime trustees who are approved by the First Circuit Court. The current Trustees are: Monsignor Charles Kekumano, David Peters, and First Hawaiian Bank. The mission of the Liliuokalani Trust Estate is to assist orphaned Hawaiian children by assuring that each is provided a permanent, safe and nurturing home. Its income, after expenses, is used for these beneficiaries. This is carried out through the Queen Lili'uokalani Children's Center, a social service agency. The Children's Center is staffed by over one hundred people, including almost sixty professionally trained child welfare social workers. This staff operates from nine offices on the five major islands; four on Oahu, two on Hawaii, and one each on Maui, Kauai and Molokai. Among the services provided to beneficiaries by the staff professionals are: finding a suitable home, assisting the child and its new parents in adjusting to one another, developing education plans, arranging for psychological counseling where needed, providing for foster care or adoption if needed, and extending financial assistance.

The Trust has been assisting orphaned children and other eligible destitute children of Hawaiian ancestry from its Kona Center since 1979 and from Hilo since 1972. In all, there have been over 13,000 Big Island children served as beneficiaries. The Kona Children's Center is located approximately one mile north of Kailua between Queen Kaahumanu Highway and the Old Kona Airport beach.

3. DEVELOPMENT CONCEPT

The project area is proposed for reclassification from the State Land Use Agriculture and Conservation Districts to the State Land Use Urban District to accommodate some of the urban growth and development projected for West Hawaii. The Trust believes that its properties immediately adjacent and contiguous to the existing urban area of Kailua provide an appropriate location for some of this growth.

Population growth and urban expansion in the North Kona region is resulting, in part,

from planning decisions made by the State over thirty years ago to redirect growth from Oahu to the Neighbor Islands. However, this growth and the changes it will bring are viewed by many as a mixed blessing. While economic growth means new jobs and new opportunities for area residents, the rural character and values of the Kona community can be easily jeopardized by inappropriate development. Although new residential growth can mean exciting opportunities for home ownership, Kona's traditional sense of community could be disrupted by the steady arrival of new residents.

The development concept for the proposed project is based upon the Trust's commitment to preserve the most vital element of the Kona community; its sense of self. The name "Kona", which is used to loosely describe the North and South Kona coastline, is much more than a geographic description. It captures a feeling of a relaxed and friendly lifestyle that is strongly rural in character and oriented to the ocean as well as the land. The "Kona" lifestyle immediately brings to mind warm lazy days, the sparkling blue ocean, and friendly gatherings of neighbors and family. The Trust recognizes that above all, the "Kona" community must be preserved. To do so will require the careful integration of new growth into the community. It will require a look, a feel, and a texture to new development that is consistent with historic Kona and its lifestyle.

The proposed project includes approximately 1,135 acres and is intended to accommodate growth for 20 years or more. While the actual development of the Trust property will be phased to meet the needs of the region and respond to market demand, it is essential to master plan the entire area to assure its orderly and timely development. Master planning will provide the community and its decision makers adequate lead time to plan and implement the infrastructure required to accommodate growth and to minimize undesirable impacts of new development.

The proposed project is low-density in nature. It features low-rise buildings, pedestrian-oriented spaces, courtyards, mauka-makai oriented view corridors and breezeways, ample open space, and extensive landscaped setbacks and buffer zones. The character of the proposed development is intended to reinforce and extend the existing character of Kailua.

4. STATEMENT OF OBJECTIVES

The development proposal envisions a new urban expansion for the West Hawaii area surrounded up slope by a series of residential villages. The urban expansion incorporates land uses which are vital to a growing community and creates an activity core for the region. In realizing this development concept, the Trust hopes to achieve several major objectives:

- Preserve the character and lifestyle of the historic Kailua Village area.
- Improve existing and future traffic circulation in the Kailua area.
- Assist in Implementing the State and County's growth polices.
- Increase the income earned by the Trust to better serve the growing needs of its beneficiaries.
- Balance private and public benefits derived from the various project components.
- Preserve significant historic sites on the property and regulate development in a manner that will enhance the traditional Hawaiian character and culture of the area.
- Separate industrial and commercial land uses in a manner that will benefit both.
- Maximize pedestrian access to facilities and amenities in the project.
- Encourage development consistent with a low-rise, open space character of the existing community.
- Create an attractive landscaped environment with many shade trees to promote pedestrian-oriented activity.

5. NEED FOR THE PROJECT

A Market Study conducted specifically for the proposed project concludes that economic growth for the County of Hawaii in general and West Hawaii in particular are tied directly to the forecasted growth of the visitor industry. Visitor industry growth will create jobs and economic opportunity to sustain an expanded resident population which, in turn, will require housing, retail, light industries, as well as institutional, recreational, and public service facilities.

Recent trends confirm these projects. Not only has West Hawaii's visitor industry grown rapidly, but its resident population has expanded as well. The Kona and South Kohala areas have replaced Hilo as the tourist center for the County of Hawaii and West Hawaii's resident population accounted for 40,200 persons, or 34.2 percent of the County total in 1988. Projections indicate that this figure will increase to 144,200 persons, or 54.7 percent of the County total by 2020. Overall, the Island of Hawaii should have a very healthy economy.

The expanding economy of West Hawaii will, in turn, require a concentrated planning effort to coordinate the development of new infrastructure, new residential areas, expanded commercial and industrial areas, and the careful integration of all these elements to preserve the best attributes of the Kona area. The existing business district of Kailua is a confusion of mixed-uses and cross-purposes. Historic Kailua Village has grown into a high-activity visitor center, yet contains a number of resident-oriented businesses and services, e.g. film processing, which are increasingly difficult to access during peak business hours. Continuing demand for new commercial space has converted the Kona Industrial Subdivision into a mix of industrial and commercial uses. Finally, a rapidly expanding population has increased the demand for vital services including a regional hospital, schools and government services, and waste disposal. The sum impact of these changes is a region that is rapidly outgrowing its business district. What is needed is a large urban expansion area, carefully planned to absorb new regional growth while redistributing existing uses in a more functional and esthetically pleasing design.

6. PROJECT DESCRIPTION

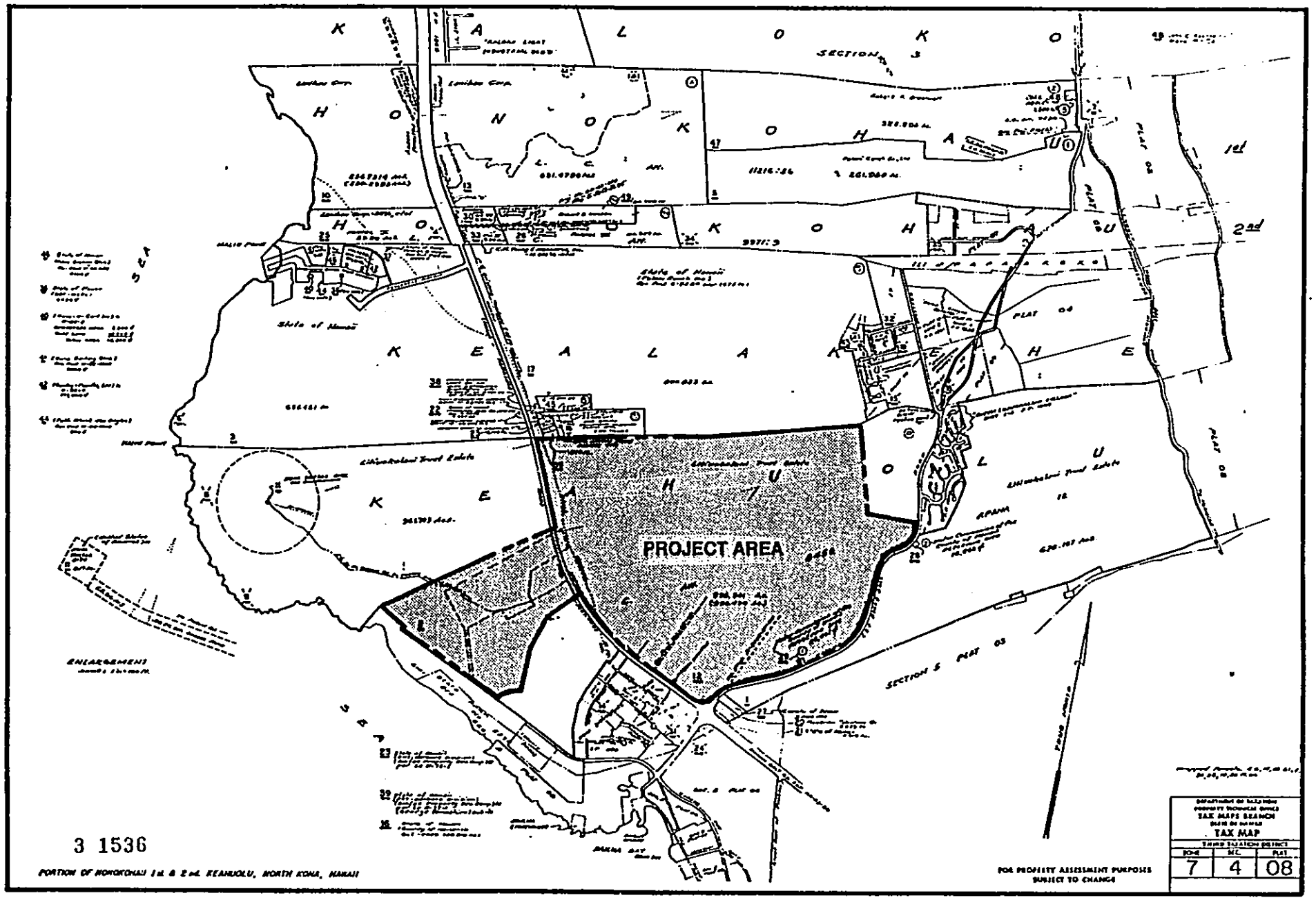
The proposed project consists of an approximately 1,135 acre portion of the Keahuolu *ahupua'a* in North Kona and is identified as Tax Map Key Numbers of the Third District: 7-4-08: portion 2 and 7-4-08: portion 12 (see Figure II-2). The project area extends east from the Old Kona Airport Park mauka to Palani Road in the vicinity of Queen Liliuokalani Village, a distance of about two and a half miles, and north from the intersection of Palani Road and Queen Kaahumanu Highway to the Kealakehe Landfill, a distance of just over a mile. It contains two primary land areas; a generally triangular shaped area north of Palani Road consisting of approximately 917 acres extending mauka from Queen Kaahumanu Highway to the intersection of Palani Road and Kealakaa Street, and wedge of approximately 229 acres located between Queen Kaahumanu Highway and the Old Kona Airport Park and bordered on the south by the 100 acre Kona Industrial Subdivision expansion area, and on the north by the Conservation district lands owned by the Trust (see Figure II-3).

The proposed project consists of the four principal elements, an Urban Expansion Area, a Residential Community, a Business Expansion Area, and the Regional Transportation Network. A summary of the land uses in each element is presented in Table II-1.

TABLE II-1: LAND USE SUMMARY

Element	Code	Designation	Acreage
URBAN EXPANSION AREA (LILIUOKALANI TRUST)			
Commercial:	C1	Regional Shopping Center	145
	C2	West Commercial	40
	C3	Central Commercial	20
	C4	Civic Center Commercial	5
Office:	O1	Financial Plaza	20
	O2	Professional Plaza	25
	O3	Office Square	15
	O4	Mauka Office	45
	O5	Office Expansion	35
Hotel:	H	Business Hotel	20
Public Facilities:	PF1	Civic and Cultural Center	30
	PF2	Regional Hospital	35
Parks/Open Space:	P1	Central Open Space	10
	P2	Historic Reserve	20
		Subtotal:	**465**
RESIDENTIAL COMMUNITY (STATE OF HAWAII)			
Residential:	R1	Kealakehe Villages	53
	R2	North Residential	186
	R3	South Residential	93
Commercial:	NC	Neighborhood Commercial	3
Park:	NP	Neighborhood Park	4
		Subtotal:	**339**
BUSINESS EXPANSION AREA (LILIUOKALANI TRUST)			
Office:	O6	QLT Children's Center (existing)	5
	O7	Makai Business Expansion Area	224
		Subtotal:	**229**
REGIONAL TRANSPORTATION NETWORK (STATE, COUNTY, QLT)			
Streets and Roads:	S1	Mid-Level Roadway (120' R.O.W.)	16
	S2	Queen Liliuokalani Boulevard (120' R.O.W.)	18
	S3	Road "A" (60' R.O.W.)	6
	S4	Waena Drive (60' R.O.W.)	5
	S5	Queen Kaahumanu Highway 200' Setback	46
		Minor Streets	11
		Subtotal:	**102**
		TOTAL:	**1,135**

Note: Total portion of project area (360 acres) proposed for sale to the State includes Residential Development area (339) plus upper portion of Queen Liliuokalani Boulevard (8 acres), upper half of Mid-Level Roadway (8 acres) and Waena Drive (5 acres).



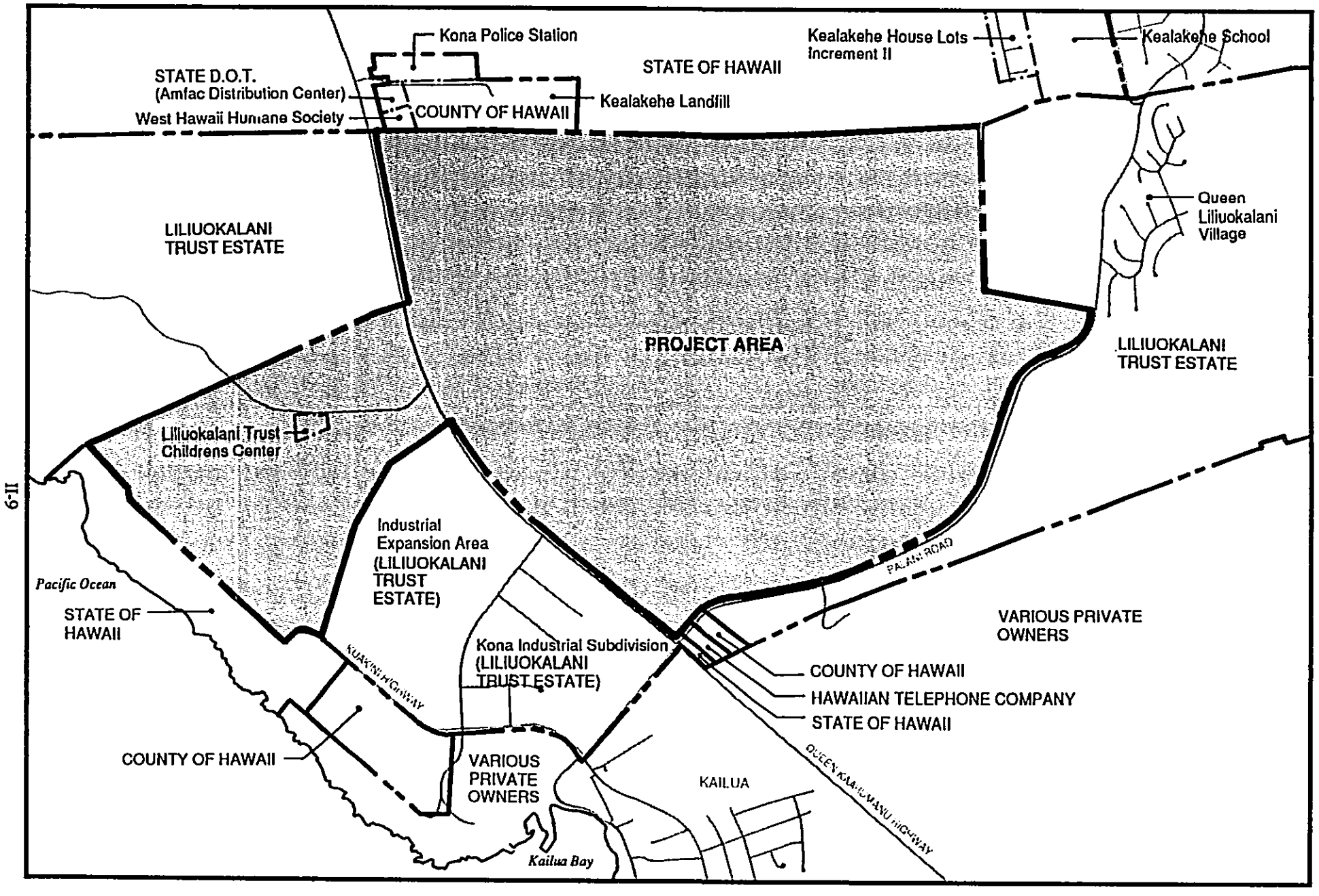
LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

0 1000 2000 4000
SCALE IN FEET

NORTH

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure II-2
TAX MAP 7-4-8



LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

0 400 800 1600
SCALE IN FEET

NORTH

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure II-3
PROJECT AREA

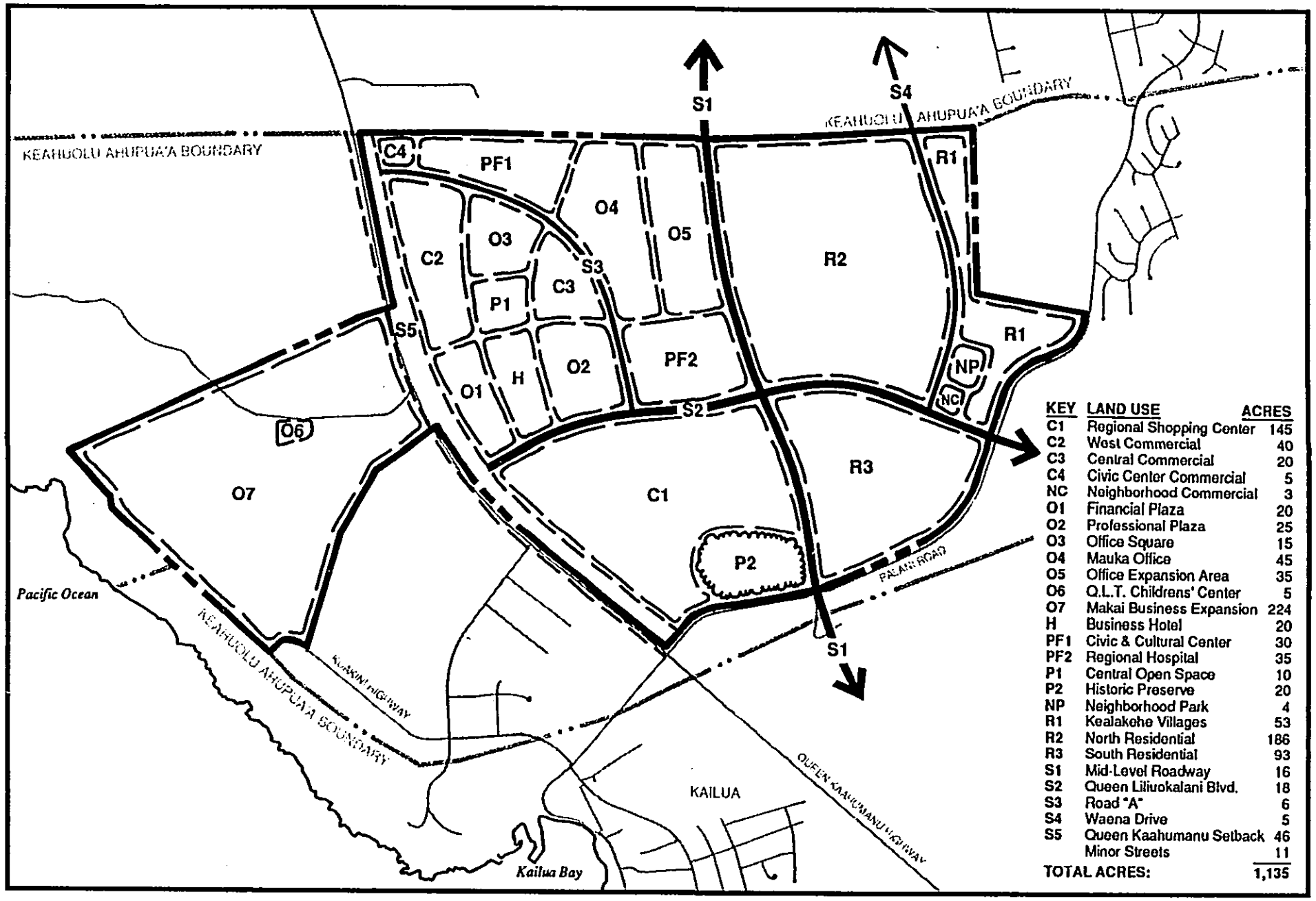
It is intended that the Trust will retain ownership of the Urban Expansion Area and the Business Expansion Area, sell the Residential Development Area to the State of Hawaii, and participate with the State, County, and other land owners in the construction and dedication of regional infrastructure. For those areas retained by the Trust, developers will be selected to construct the individual projects according to specifications established by the Trust concerning Floor Area Ratio (F.A.R.), landscaping, open space, setbacks and building heights. Restrictive covenants will be established to guide the development, operation and maintenance of buildings and facilities developed on Trust property. Lease rents derived from the various projects will provide the Trust with a major source of new revenue to support its beneficiaries.

6.1 URBAN EXPANSION AREA

This 465 acre component of the project is proposed as the central element of urban expansion in the North Kona region. It will provide a variety of land uses which combine to create a new region-serving activity center for Kailua. Following is a description of each of the individual elements proposed for the urban expansion. An index number identifying each element correlates with the Concept Plan presented in Figure II-4.

Regional Shopping Center (C1): This facility is proposed as the first phase of the urban expansion and will ultimately provide over one million square feet of gross leasable area with approximately 58 acres of parking. It is envisioned as a spacious, low density and generously landscaped facility containing several major department stores and anchor tenants and a variety of smaller shops and stores. Located on a 145 acre parcel near the intersection of Palani Road and Queen Kaahumanu Highway, the shopping center will have excellent visibility and access. The facility is proposed to attract residents and is not intended to provide direct competition with or replace existing shops and outlets in Historic Kailua Town. At ultimate buildout, the shopping center could employ up to 3,700 persons.

Historic Reserve (P2): Although there are a number of historic sites scattered throughout the proposed project area, a large concentration of them have been identified near a remnant of Kuakini Wall just north of Palani Road. The number and diversity of these sites are a valuable cultural asset to the Kailua community as well as to the entire West Hawaii region. In recognition of their cultural and educational significance it is proposed that these sites be set aside for preservation as an Historic Reserve. Interpretive development for the sites within the 20 acre (approximately) area would include a self-guided pathway and signage. Preservation of the sites would be conducted in full cooperation with the State's Historic Sites Office and local civic and cultural organizations to ensure that the proposed preservation is appropriate.



KEY	LAND USE	ACRES
C1	Regional Shopping Center	145
C2	West Commercial	40
C3	Central Commercial	20
C4	Civic Center Commercial	5
NC	Neighborhood Commercial	3
O1	Financial Plaza	20
O2	Professional Plaza	25
O3	Office Square	15
O4	Mauka Office	45
O5	Office Expansion Area	35
O6	Q.L.T. Childrens' Center	5
O7	Makai Business Expansion	224
H	Business Hotel	20
PF1	Civic & Cultural Center	30
PF2	Regional Hospital	35
P1	Central Open Space	10
P2	Historic Preserve	20
NP	Neighborhood Park	4
R1	Kealakehe Villages	53
R2	North Residential	186
R3	South Residential	93
S1	Mid-Level Roadway	16
S2	Queen Liliuokalani Blvd.	18
S3	Road "A"	6
S4	Waena Drive	5
S5	Queen Kaahumanu Setback	46
	Minor Streets	11
TOTAL ACRES:		1,135

LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

0 400 800 1600
SCALE IN FEET

NORTH

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure II-4
CONCEPT PLAN

Financial Plaza (O1): Situated at an intersection of Queen Kaahumanu Highway and a new mauka-makai roadway, the Financial Plaza will be located on a 20 acre parcel across from the Regional Shopping Center. It is intended to provide up to 175,000 feet of gross leasable area and will include a spacious tree-lined pedestrian mall linking the various financial institutions, banks, real estate offices and insurance companies in a campus like setting. In keeping with the low density character proposed for the entire development project, the Financial Plaza will be landscaped with a variety of large canopy trees and palms and individual buildings will be sited to preserve view corridors. With a distinctive pedestrian orientation, the plaza will be designed to eventually become the financial center of West Hawaii.

Business Hotel (H): Located mauka of the Financial Plaza on a 20 acre parcel, this facility is proposed to provide the business traveler with strategically located accommodations within the urban expansion. The hotel is proposed to contain about 250 rooms and will be designed as a low-rise facility allowing its low profile to blend in with the landscaped surroundings. It is intended that the hotel would target the business traveler.

Regional Hospital (PF2): Proposed to contain up to 120 beds, this facility will be sited on a 35 acre parcel of land at the intersection of a new Mid-Level roadway and a new mauka-makai roadway. This location will afford convenient vehicular access from the region's major highways and will be within ten minutes traveling time from the Keahole Airport. Also, the proposed site is large enough to accommodate a helipad should it be deemed necessary. In addition to the hospital itself, the site is intended to include an emergency clinic and all necessary support services.

Professional Plaza (O2): Situated between the Regional Hospital and the Business Hotel, this facility would serve as a major office complex for the region. Located on 25 acres of land, the plaza is intended to contain over 200,000 square feet of gross leasable area at full build out. Designed with the same concern for open space and density as the Financial Plaza, this plaza will provide a similar campus setting. Its proximity to the Regional Hospital will make it ideal for private medical and dental offices, medical laboratories, and out-patient services.

Community Shopping Center (C2): Unlike the Regional Shopping Center, this facility will be anchored by one or more major supermarkets and drug stores, together with a mix of restaurants and businesses designed to serve the regional commuter as well as the community resident. With over 340,000 square feet of gross leasable area, the Community Shopping Center is intended to eventually employ over 1,000 persons. The facility will provide ample parking for its employees as well as clientele with over 1,100 parking stalls proposed. The 40-acre parcel is proposed to include a series of single-story structures set back from the Queen Kaahumanu Highway and

buffered with landscaping to reduce its visual impact from the makai side of the highway.

Civic and Cultural Center (PF1): Envisioned to become part of West Hawaii's government center, the center is intended to accommodate County, State and Federal offices, including the State and County administrative and judicial offices, courtrooms and legislative offices, as well as Federal offices including a postal facility and Federal office building. Also provided in the 30 acre Center could be a number of the cultural facilities including an auditorium or theater for the performing arts and a museum. Specific development sites within the Civic and Cultural Center project area are intended to be made available to appropriate government agencies as the need arises.

Civic Center Commercial (C4): This 5 acre area located at the makai end of the Civic and Cultural Center will provide a variety of retail outlets to serve the surrounding land uses.

Office Square (O3): Located across a principal thoroughfare from the Civic and Cultural Center, this 15 acre parcel is intended to provide office space for lawyers and other professionals and businesses. Taking advantage of the gently sloping land, the site will provide space for a series of low-rise office buildings situated to maximize views of the ocean. At build out, the site is intended to provide over 130,000 square feet of gross leasable area. The Office Square site will be a cornerstone of the proposed project due to its proximity to the Civic Center and its prime frontage on the Central Open Space area discussed below.

Central Open Space (P1): Centrally located between the Business Hotel, Financial Plaza, Professional Plaza and Office Square, this 10 acre area will be set aside to provide open space amenities for the entire business district in the form of a shady park area or festive pedestrian mall.

Central Commercial (C3): Located just up slope from the Office Square and Downtown Open Space and adjacent to the Professional Plaza, the 20 acre site is intended to provide over 140,000 square feet of gross leasable area and a variety of restaurants and shops to serve both the daytime business community and the weekend shopper. It is intended to include over four acres of parking and will be developed in a spacious low-density character similar to the other principal elements of the proposed project.

Mauka Office Complex (O4): This complex consists of a 45 acre parcel located on a slope overlooking the Civic and Cultural Center. With over 380,000 square feet of gross leasable area proposed, the Mauka Office Complex will provide general office space to a variety of businesses serving the West Hawaii region as well as the neighboring Kealakehe and Kailua communities.

Office Expansion Area (O5): This 35 acre parcel is included as an expansion area for the Mauka Office parcel as well as the proposed Regional Hospital. Its proximity to the Mid-Level Roadway, Hospital and neighboring residential areas was a determining factor in the choice of its location.

6.2 RESIDENTIAL DEVELOPMENT AREA

Lands to be Purchased by the State (R1,R2 and R3): The proposed project involves a unique set of circumstances concerning residential development on the project site. A 450-acre area including all of that portion of the project mauka of the center line of a planned mid-level roadway is proposed for sale to the State of Hawaii. The land uses for this mauka area will, subsequently, be determined by the State of Hawaii rather than by the Trustees. A number of alternative uses have been considered including affordable and market housing, a West Hawaii university campus, and a regional sports facility. However, because the property will be purchased by the State through its Division of Land Management, it will be initially controlled by the Department of Land and Natural Resources (DLNR). Any other State agency desiring to use the land would first need an approval for its transfer and sale by the DLNR.

It should be noted that the proposed purchase area includes 90 acres of Trust land that was previously designated Urban by the State Land Use Commission and which is not part of the land area included in the Trust's current Petition before the State Land Use Commission. This 90 acre area is situated between the existing Kealakehe School and Palani Road. Consequently, only a portion, approximately 360 acres, of the proposed 450 acre purchase area is included for evaluation in this document.

To date, the only firm commitment for a portion of the property rests with the Housing Finance and Development Corporation (HFDC) which is developing the 840 acre tract of land north of Keahuolu for affordable housing. The HFDC's project, Kealakehe Planned Community, includes a 195-acre public golf course just mauka of the Queen Kaahumanu Highway. To offset the land devoted to the golf course, which is proposed to be developed by the County of Hawaii, the HFDC is planning to include at least 150 acres of the Trust's land in its Kealakehe project. The 150-acre portion of the Trust's property includes the 90-acre Urban area discussed above and the 60-acre portion designated R1, NP and NC (residential, neighborhood park, and neighborhood commercial) on the Trust's Concept Plan. These uses reflect the HFDC's present land use plan for the area. The State's intended use of the remaining 300 acres of land proposed for sale is unknown at this time.

However, in an effort to evaluate potential impacts, it is assumed for the purposes of this

environmental impact statement that the entire parcel to be sold to the State will eventually be developed with a variety of affordable housing opportunities at an overall density of 6 units per acre. This would result in a total of approximately 2,700 units with a total population of up to 7,300 persons. In addition, the HFDC has proposed the siting of a Neighborhood Park and a Neighborhood Commercial area with the 450 acre parcel.

The 4-acre Neighborhood Park and the 3-acre Neighborhood Commercial area included in the State's proposal are all proposed as support services for the 150-acre area. According to HFDC plans, the 150-acre area would ultimately consist of three separate Villages, each to be part of the overall phased development of the project.

6.3 BUSINESS EXPANSION AREA

Makai Keahuolu Lands (O7): The third component of the proposed project consists of a 229-acre (approximately) parcel of land located makai of Queen Kaahumanu Highway between the Trust's Conservation district land and the Kona Industrial Subdivision 100-acre expansion area. It is just *mauka of the Old* Kona Airport Park. This parcel is proposed for long-term development as a mixed-use expansion area for retail, commercial and wholesale businesses.

Kona Children's Center (O6): The Kona Children's Center presently occupies a small parcel within the proposed expansion area and, in addition, has leased an adjoining parcel to a privately-owned aquaculture project. The Children's Center consists of a single building containing a number of administrative offices. Because the Business Expansion Area is proposed for development in a later phase of the project, neither the activities of the Kona Children's Center nor the aquaculture facility will be disrupted in the foreseeable future.

6.4 REGIONAL TRANSPORTATION NETWORK

Implementation of the proposed project according to the Development Concept and Objectives discussed earlier demands that the proposed facilities and uses be carefully integrated into the existing community with minimum disruption and careful attention to the region's existing problems, concerns, and needs.

The greatest concern expressed by residents is traffic congestion in the area and the potential negative impact of new growth and development. As an active resident and member of the West Hawaii community, the Trust shares this concern and proposes a Regional Transportation Network designed to relieve major traffic problems, especially in the area of Palani Road and the

Queen Kaahumanu Highway. The components of this system are discussed below.

Queen Kaahumanu Highway (S5): The Trust proposes that a 300 foot wide corridor be designated for Queen Kaahumanu Highway fronting the project site. This corridor is included in the Concept Plan. For much of the frontage, additions to the existing corridor would be located mainly on the mauka side of the highway, due to the existing development associated with the Kona Industrial Subdivision located makai of Queen Kaahumanu Highway. At the northern boundary of the Business Expansion Area, makai of the highway, the setback shifts slightly makai to bring it into conformance with a similar corridor proposed for the adjoining Kealakehe property.

The proposed corridor accomplishes three objectives. First, it provides space for an expansion of Queen Kaahumanu Highway should the State deem this necessary. Second, it provides sufficient room for a frontage road along the mauka side of the highway. Third, it ensures the preservation of the portion of Mamalahoa Trail left intact after the construction of the Queen Kaahumanu Highway. The trail would lie within the proposed corridor.

Queen Liliuokalani Boulevard (S2): The Kailua community is unanimous in its agreement that Palani Road presents the greatest traffic problem to the residents of North Kona. However, there is no consensus about how to resolve the problem. Palani Road is a major arterial roadway linking Kailua to the Hawaii Belt Highway (Mamalahoa) despite its narrow lanes and dangerous curves. Improvements to Palani Road, including widening, straightening, and adding stacking lanes at key intersections will bring long-term relief, but will increase congestion in the short-term, especially during construction periods.

The Trust believes that while Palani Road will always serve as a regional connector, its importance as a primary access roadway to Kailua can be greatly reduced with the provision of alternative roadways to serve as relievers to the over-used road. It is therefore recommended that a new mauka-makai roadway be developed on the Trust's property linking the Old Kona Airport Park to Palani Road at a point near the Queen Liliuokalani Village. This roadway, tentatively called the Queen Liliuokalani Boulevard, will provide an alternate route and access to the proposed project including the proposed Regional Shopping Center and help to reduce traffic congestion on Palani Road.

Mid-Level Roadway (S1): In conjunction with the proposed mauka-makai road, a Mid-Level Roadway separating the proposed urban expansion from the proposed Residential Development is proposed. This roadway would consist of a 120 foot right-of-way with two lanes generally paralleling Queen Kaahumanu Highway. Development of the Mid-Level Roadway would be

coordinated with the phased development of the overall project. Intersecting Palani Road at a point just over a third of mile mauka of the Palani Road-Queen Kaahumanu Highway intersection, the Mid-Level Roadway is envisioned as major arterial route linking the mauka residential communities proposed for development by the HFDC to the proposed urban expansion and existing Kailua area.

Road "A" (S3): A secondary roadway consisting of a 60 foot right-of-way is also included in the Concept Plan. This roadway links the northern portion of the urban expansion to Queen Liliuokalani Boulevard.

Waena Drive (S4): A 60-foot right-of-way, depicted by the HFDC in its Kealakehe Planned Community Concept Plan, and by the County of Hawaii in its Keahole to Kailua Development Plan is included in the Trust's Concept Plan. It provides a link from Palani Road to the proposed Kealakehe development.

Minor Roadways: Finally, eleven acres of land within the Trust's urban expansion are set aside for minor collector roadways. Although not shown on the Concept Plan, they will generally correspond with the spaces between the various land uses presented.

6.5 *PHASING*

The project is proposed to be master planned by the Trust and implemented by a single developer or group of developers, in coordination with infrastructure development by the State and County. Full build out of the project is projected in 20 or more years, depending upon market demand and the timely participation of government in the funding and construction of public facilities and services.

Construction of the Regional Shopping Center is planned as the first phase of the project, together with construction of the portions of the Mid-Level Roadway and Mauka-Makai Roadway bordering the shopping center site. The second phase of the project will include development of other facilities within the urban expansion area. The third development phase will involve the development of the Business Expansion Area makai of Queen Kaahumanu Highway. At this point, it is unknown what the schedule will be for the implementation of the Kealakehe Planned Community on the land purchased from the Trust by the State of Hawaii.

6.6 INFRASTRUCTURE

The proposed project will require major improvements to the existing infrastructure to accommodate the planned urban expansion and residential development. Proposed improvements to the infrastructure are discussed below.

6.6.1 Water

6.6.1.1 Source

At full buildout, the total water demand of the proposed project will be approximately 2.88 million gallons per day (mgd). A map of the infrastructure required to provide water to the project site is presented in Figure II-5. Water to meet projected demand will be provided by a series of three wells to be located on Trust property above the 1,600-foot elevation along Mamalahuoa Highway. Previous well drilling activities in the region have demonstrated this to be the elevation above which potable quality water can be obtained. Domestic drinking water supply wells at or above 1,600 feet mean sea level (MSL) have been successfully developed by Huihui Ranch and the Nansay Corporation. Due to varying geological formations throughout the region, rainfall percolation rates and ground water migration patterns may vary from one area to another. However, the long term sustained yield from any particular well is considered to be indefinite, insofar as over pumping or siting another well in close proximity such that it withdraws water from the same subsurface source is avoided. Well pumping rates and spacing are established by on-site field-testing and operational experience from other area wells. For the project area, a yield of 700 to 1000 gpm per well can be anticipated. The spacing between the wells should be from 1,200 to 1,500 linear feet. The proposed wells will be located mauka of the Department of Health's Underground Injection Control (UIC) line, and therefore, will be designed and constructed to prevent the possibility of groundwater contamination. The specific location of proposed wells will be coordinated through DOWALD and DWS. The joint development of potable water resources with neighboring property owners will provide the additional potable water needed to satisfy the maximum daily demand of the project (see Table II-2).

The basis for the determining the capacity of the project's water transmission system is the DWS' "Water Systems Standards", 1985. Area water demands were determined based on the size of the proposed land use areas and are presented in Table II-2. The DWS' domestic consumption guideline for average daily demand and demand factors was used to determine pipeline flows to the various areas. Pipelines were aligned to conform to major area right-of-ways.

Three reservoir elevations were considered in the analysis of required infrastructure, based on the established DWS pressure zones; the 325 foot zone which serves an area from 0 to 225 feet MSL, the 595 foot zone which serves an area from 225 to 495 feet MSL, and the 935 foot zone serving an area from 495 to 835 feet MSL. However, it should be noted that because none of the proposed development is located within the 935-foot zone, the project's upper reservoir is proposed to be located at the 1,600 foot elevation along Mamalahoa Highway and will serve as a general supply tank for the middle reservoir at 595 feet. The 595-foot reservoir is located at the eastern tip of the project area, adjacent to Palani Road. The site for a 325-foot elevation reservoir is centrally located within the project area near the intersection of Mid-Level Roadway and the proposed Queen Liliuokalani Boulevard.

6.6.1.2 Transmission System

The construction of a water transmission system will be phased to coincide with the development of the proposed project as discussed in section 6.5 above. At full development, a total storage of about 4.0 million gallons (mg) will be required for the project. This storage will be distributed among the three reservoirs discussed above; a 1.0 mg facility at the 1,600 foot elevation, a 1.0 mg facility at the 595 foot elevation, and a 2.0 mg facility at the 325 foot elevation. The residential portion of the project will be developed by the state and served by the 595 foot elevation reservoir. The urban expansion proposed for development by the Trust will be served by the 325 foot elevation reservoir. The 1,600 foot elevation reservoir will serve as a general storage facility for the project. The upper reservoir will be linked to the 595 foot reservoir by a 16-inch water main extending north along Mamalahoa Highway and then west down Palani Road. A pressure reduction valve will be required to complete the linkage.

The 595-foot zone was analyzed based on having a single supply line from the reservoir with no connection to other lines. Based on this consideration, a 16-inch transmission line will be required as indicated in Figure II-5. It will extend from the reservoir downslope to Waena Drive and then south to Queen Liliuokalani Boulevard. A 12-inch water line will extend north along Waena Drive from the northern end of the 16 inch line, with a second 12-inch line extending west along the entire lenght of Queen Liliuokalani Boulevard.

The 325 foot zone was also analyzed based on have a single supply line from the 2.0 MG reservoir. A 6-inch water line will extend along the entire length of the Mid-Level Roadway that crosses the project site. The remainder of the project site will be served by a series of 12-inch, 8-inch and 6-inch lines.

All transmission lines must receive final approval from the County DWS before they can be constructed.

TABLE II-2: SUMMARY OF PROJECT WATER DEMAND

Land Use	Total Daily Demand (gallons)	Average Daily Flow Rate (gal/min)	Maximum Day Demand (gallons)	Peak Hour Flow Rate (gal/min)
C1 - Regional Shopping Center	435,000	302	652,500	1,510
C2 - West Commercial	120,000	83	180,000	417
C3 - Central Commercial	60,000	42	90,000	208
C4 - Civic Commercial	15,000	10	22,500	52
NC - Neighborhood Commercial	9,000	6	13,500	31
O1 - Financial Plaza	60,000	42	90,000	208
O2 - Professional Plaza	75,000	52	112,500	260
O3 - Office Square	45,000	31	67,500	156
O4 - Mauka Office	135,000	94	202,500	469
O5 - Office Expansion Area	105,000	73	157,500	365
O6 - QLT Childrens' Center	15,000	10	22,500	52
O7 - Makai Business Expansion Area	672,000	467	1,008,000	2,333
H - Business Hotel	107,200	74	160,800	372
PF1 - Civic and Cultural Center	90,000	63	135,000	313
PF2 - Regional Hospital	105,000	73	157,500	365
P1 - Central Open Space	18,000	13	27,000	63
P3 - Neighborhood Park	20,000	14	30,000	69
R1 - East Residential	108,000	75	162,000	375
R2 - North Residential	448,800	312	673,000	1,558
R3 - South Residential	240,000	167	360,000	833
DEVELOPMENT TOTALS	2,883,000	2,002	4,324,500	10,010
MAXIMUM FIRE DEMAND	3000 GPM X 60 MIN/HR = 540,000 GALS			

(a) Average Daily Water Demand = 3000 gallons/acre
(b) Average Daily Water Demand = 4000 gallons/acre
(c) Average Daily Water Demand = 400 gallons/unit
Notes: Demands = DWS standards. Maximum Day = 1.5 x avg.day. Peak Hour = 5 x avg.day

KEY	LAND USE	ACRES
C1	Regional Shopping Center	145
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C4	Civic Center Commercial	5
NC	Neighborhood Commercial	3
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O6	O.L.T. Childrens' Center	5
O7	Makai Business Expansion	224
H	Business Hotel	20
PF1	Civic & Cultural Center	30
PF2	Regional Hospital	35
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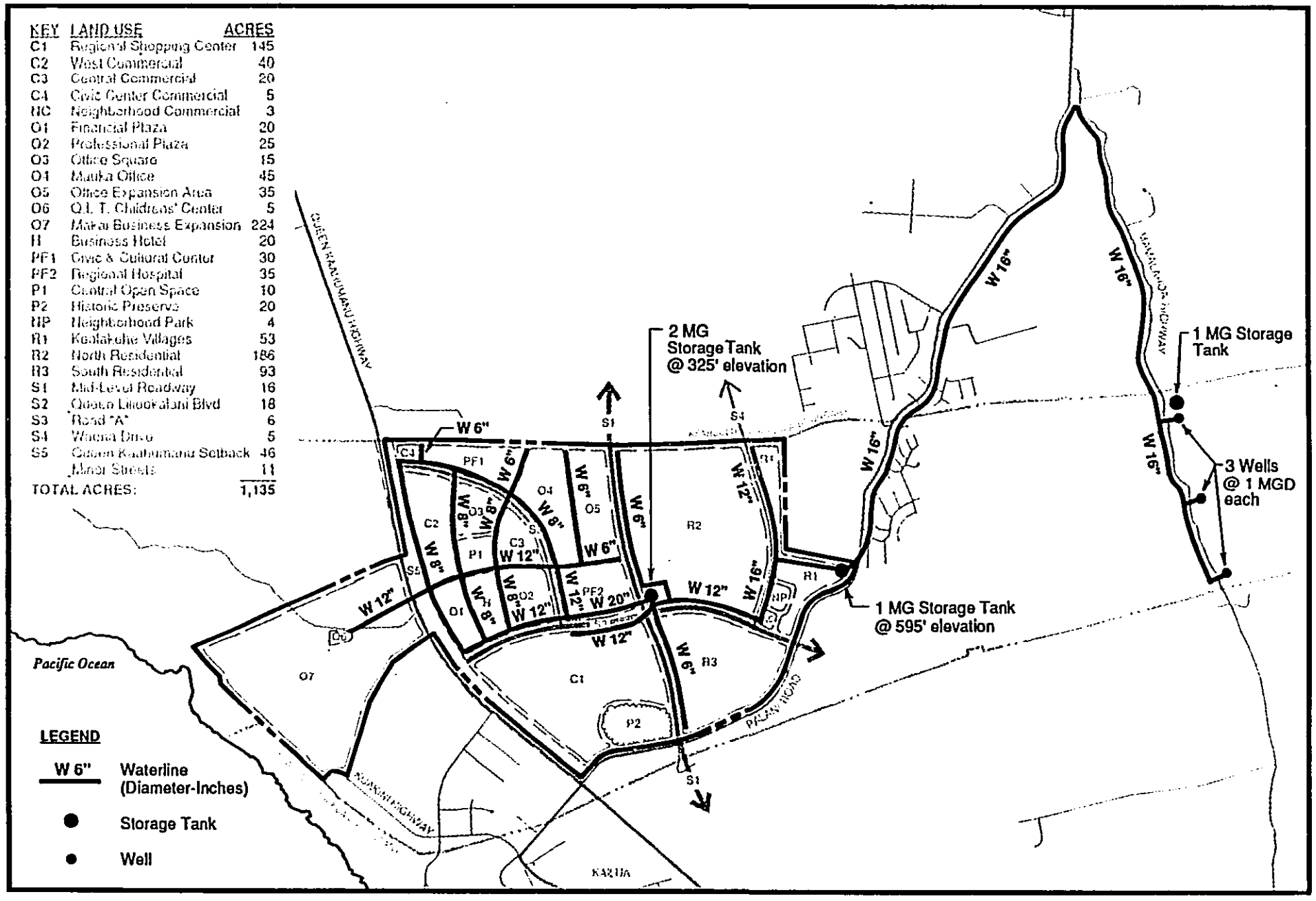
NP	Neighborhood Park	4
R1	Kealakolu Villages	53
R2	North Residential	186
R3	South Residential	93
S1	Mid-Level Roadway	16
S2	Queen Liliuokalani Blvd	18
S3	Road "A"	6
S4	Waiona Drive	5
S5	Queen Kaahumanu Setback	46
	Minor Streets	11
TOTAL ACRES:		1,135



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LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure II-5
PROPOSED WATER INFRASTRUCTURE PLAN

6.6.2 Wastewater

The proposed project will generate approximately 2.9 mgd of wastewater. About 77% of the wastewater generated is attributable to non-residential uses, with the remaining 23% being generated by the residential areas included in the property to be sold to the State of Hawaii.

Wastewater generated by the project will be treated at the proposed Kealakehe STP presently under construction to the north of the project area. The proposed configuration of wastewater transmission lines is presented in Figure II-6. Gravity mains from the proposed Regional Shopping Center (C1), a portion of the Residential Development (R3), the Business Hotel (H), and the Financial Plaza (O1) will all feed into a sewage pump station to be located along Queen Kaahumanu Highway. Wastewater will be pumped from the station via an 8-inch force main to the 24-inch gravity main at the northwestern corner of the project site which is linked to the Kealakehe STP. The remainder of the project site will be served by gravity mains leading directly to the Kealakehe STP.

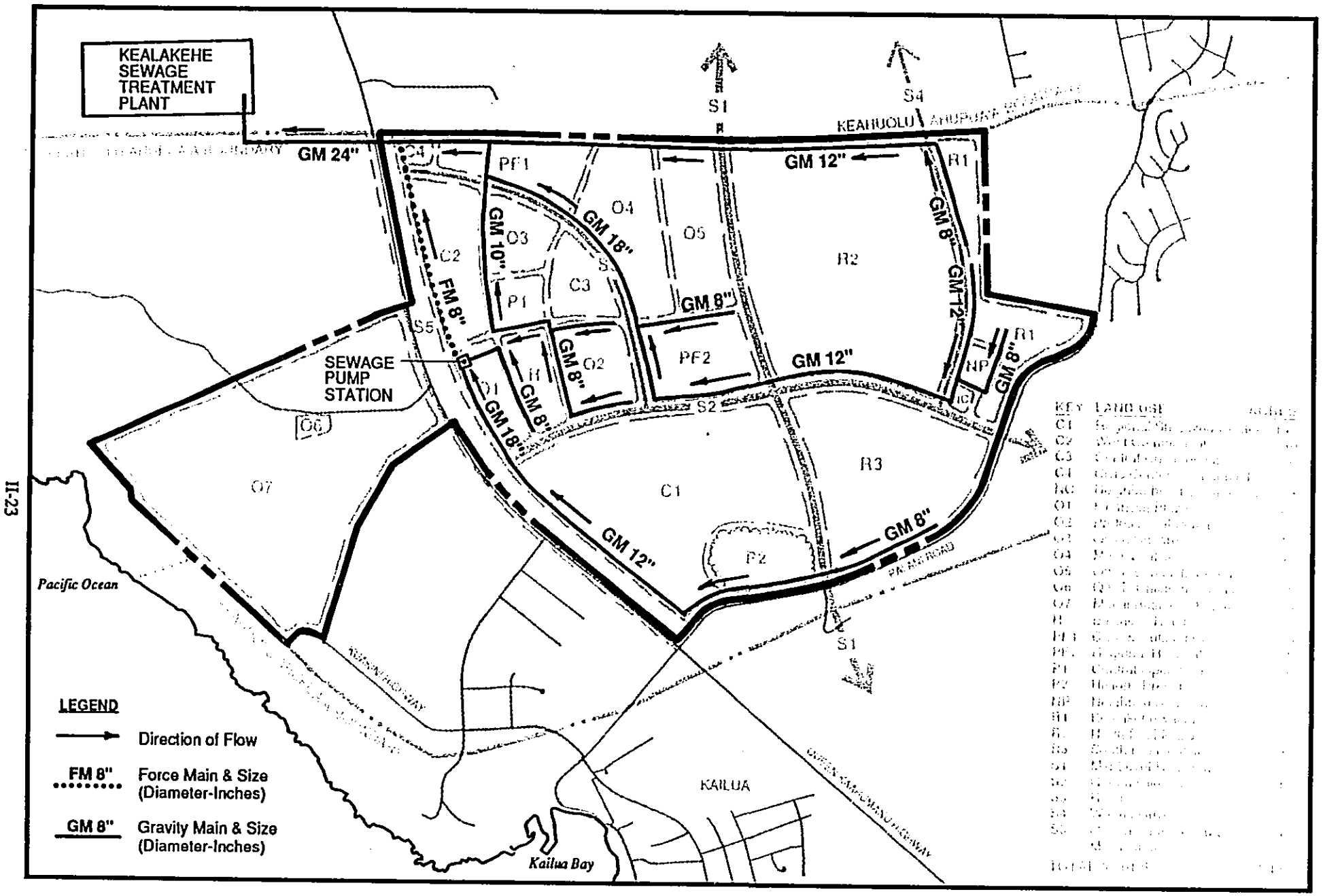
The transmission system will include a 12-inch gravity main extending along the northern property boundary and linking to the 24-inch sewer main makai of Queen Kaahumanu Highway. A second 12-inch gravity main will follow the alignment of Queen Liliuokalani Boulevard and link to a third 12-inch gravity main following the alignment of Queen Kaahumanu Highway. An 18-inch gravity main follows the proposed alignment of "Road A" through the center of the urban expansion area receiving wastewater from smaller lines feeding into it.

6.6.3 Drainage

Drywells will be constructed in conjunction with each proposed land use on the subject property to accommdate increased drainage from surface runoff. They will typically be located with road right-of-ways wherever possible.

6.6.4 Solid Waste

At full build out, the proposed project will generate approximately 96 tons of solid waste per day. This is equivalent to 250 cubic yards per day. Solid waste generated by the project will be disposed of at a new County landfill which is anticipated to be operational by the time that construction begins on the proposed project.



II-23

LILIUOKALANI TRUST
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Date: AUGUST 1990

Figure II-6
WASTEWATER MASTER PLAN

6.6.4 Project Costs

The total cost of off-site infrastructure for the proposed project is approximately $130 million. This cost does not reflect survey, design, master planning, land and other non-construction related costs. Costs are based on 1990 constant dollars.

Chapter Three

CHAPTER III

ALTERNATIVES CONSIDERED

1. INTRODUCTION

The proposed project has been designed to accommodate some of the urban growth and development projected, over the next 20 years or more, for West Hawaii. While actual development of the property will be phased to meet the short-term needs of the region and respond to market demand, the entire 1,135 acre area has been master planned to assure orderly and timely development over the long-term. The proposed project consists of four principal elements: an Urban Expansion Area; a Residential Community; a Business Expansion Area; and the Regional Transportation Network (see Chapter II, Section 6). The various facilities within the project would be designed to be low-density, featuring low-rise buildings, pedestrian oriented spaces, courtyards, mauka-makai oriented view corridors and breezeways, ample open space and extensive landscaped setbacks and buffer zones. The character of the development has been planned to reinforce and extend the existing character of Kailua.

In compliance with the provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), the "known feasible" alternatives to the proposed project are discussed in this chapter. Those alternatives which could "feasibly" attain the objectives of the project are described and evaluated. An exploration and evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid or reduce some or all of the adverse environmental impacts, cost and risks, is included in order not to prematurely foreclose options which might enhance environmental quality or have less detrimental effects. In each case, the analyses have been sufficiently detailed to allow the comparative evaluation of the environmental benefits, costs and risks of the proposed action and each reasonable alternative. Also, in compliance with the applicable rules, the alternatives have been evaluated relative to their capability to meet the proposed project objectives as stated in Chapter II, Section 4. In addition to the preferred alternative (proposed project), the alternatives of no-action, alternative configurations and sizes of the project elements and alternative uses of the project site property were evaluated.

2. EVALUATION OF ALTERNATIVES

2.1 PROPOSED ACTION

The proposed project (Figure II-4) has been designed to provide an Urban Expansion Area consisting of a regional shopping center, historic preserve, financial plaza, business hotel, regional hospital, professional plaza, community shopping center, civic and cultural center, civic center commercial area, office square, central open space, central commercial and mauka office complex. The central open space would be a 10-acre area located between the business hotel, financial plaza, professional plaza and office square. The open space would serve as a shady park area or festive pedestrian mall. The residential development area involves 450 acres of land that will be purchased by the State. The land to be purchased is all of that portion of the project mauka of the center line of a planned mid-level roadway (see Figure II-4). The land uses for this mauka area will subsequently be determined by the State of Hawaii rather than the Trustees. Numerous alternative uses have been considered, including affordable and market housing, a West Hawaii university campus and a regional sports facility. The project will also include the necessary roadway system to serve the project site; potable water supply, storage, transmission and distribution system; on-site wastewater collection, transmission, treatment and disposal systems; on-site electrical and communications distribution systems; on- and off-site surface water drainage system; and tsunami and civil defense warning system. A complete description of the proposed project is included in Chapter II, Section 6.

The proposed project will have both positive and negative environmental impacts, as described in Chapter IV. The positive impacts include socioeconomic impacts through the provision of increased residential, public facilities, commercial and recreational opportunities for West Hawaii residents and visitors; preservation of historical and cultural features; and improved infrastructure systems. Potential negative impacts include increased urbanization of the project area and attendant increased traffic, noise and air quality conditions. Increased landscaping for the proposed facilities will add to the overall vegetation of the area but will also entail the removal of the present native and introduced scrub-grassland vegetation. Consequently, some wildlife habitat will be lost, but it will be replaced by an urbanized landscape.

The analysis of alternative configurations and sizes of project elements took into consideration several elements. This included the number and types of individual components that could be efficiently and economically located within the project boundaries, the opportunities and constraints of the site and governmental agency input regarding the proposed project. Following the evaluation of all of the various elements, the preferred alternative (proposed project) was selected as the alternative that could best meet the objectives of the project; provides for the best internal and regional traffic flows and patterns; provides the greatest flexibility in phasing of construction; provides the most amenities and services forecast to be required over the development period; and allows the state and county overall goals and objectives regarding the development of a West Hawaii regional center to be met in the most expeditious manner. Development of the master planned project as described in this EIS will have definite positive social and economic benefits. The majority of the alternative configurations and sizes of project elements investigated would have the same or more onerous physical and natural environmental impacts as the proposed project. therefore, given the positive social and economic advantages of the proposed project, adoption of an alternative configuration or sizing of the project elements does not appear economically feasible, prudent or reasonable.

2.2 "NO-ACTION" ALTERNATIVE

The "no-action" or "no-project" alternative would retain the present status of the project lands. This alternative would not allow the Trust to generate any income from the project lands for the benefit of the Trust's beneficiaries. To receive any direct monetary benefit, the Trust would have to sell the land to either private or public buyers. To that end, the Trust is proposing to sell approximately 450 acres of land to the state, 360 acres of which is included in the proposed project area (the remaining 90 acres are already classified Urban and are, therefore, not included in the petition area). It is expected that these lands (360 acres) will be developed in residential use by the state, although at this time the state has only committed to developing 150 acres of the 450 acre parcel in residential use. While the sale of the property will generate income, it will not provide a substantive source of long-term income. Because of this, the Trust does not view the sale of the remaining 775 acres as a viable alternative, i.e., it does not meet the objectives of the proposed project and is not consistent with Trust land policies.

Leaving the property undeveloped will result in the loss of a timely opportunity to expand commercial, industrial and public services and facilities in an area contiguous to the existing community. Development of these activities in an area other than Keahuolu will likely result in increased infrastructure costs to the general public and a slower development schedule due to the lack of an existing population base or economic market. Leaving the property undeveloped will also result in the loss of potential revenue to the state and county governments.

2.3 ALTERNATIVE USE OF THE SITE

In addition to the preferred alternative configuration for the proposed project, five other site uses were examined. The five alternative uses included development of the lands for agricultural purposes, park uses, resource extraction, residential development and resort development.

Due to the poor quality of the soils (classified as "E" by the Land Study Bureau) and rockiness of the land, it is not presently suitable for large-scale mechanical cultivation. While the property historically supported agricultural activities (small-scale plot cultivation), these activities were limited to dry-land taro and similar crops that no longer enjoy the demand they once did. Further, the costs to make the lands suitable for agricultural purposes would be prohibitive and even if they could be overcome, the availability of water and the costs to develop the sources further denigrate the property's value for crop type agriculture. The use of the lands for grazing or similar non-cultivation type agricultural activities is considered incompatible with the character of the neighboring urban area. Lastly, this alternative use is inconsistent with the Hawaii County General Plan designations for the area.

Development of all or a part of the project lands for public park purposes implies its acquisition by the state or county, actions that appear unlikely. Development of the area as a private park cannot be justified in economic terms when considering the extent of investment that would be required to convert the lava fields to usable park land versus the return on investment. Similarly, a park development would not provide the level of long-term income needed to meet the needs of the Trust's beneficiaries. Similarly, retaining the land in open space as a passive park does not fulfill the Trust's responsibilities to its beneficiaries.

Chapter Four

CHAPTER IV

DESCRIPTION OF THE AFFECTED ENVIRONMENT, ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

1. INTRODUCTION

The general and/or specific physical, natural and social environmental characteristics, archaeological and cultural resources and infrastructure and public facilities serving the proposed project site and area are described in the following sections of this chapter. The analyses presented herein are generally based on an assumed "worst case" situation that would include the full development of the proposed project (as described in Chapter II), within the project boundaries. Should the proposed project be reduced in scale and/or types or numbers of facilities and services provided, it is presumed that potential impacts would be less for most environmental resource issue areas. Additionally, to the degree possible at this time, the information contained herein covers both the on- and off-site infrastructural components that will serve the proposed project. For ease of review and evaluation, information and analyses of the impacts of the proposed project are provided from the standpoint of *existing conditions*, *probable* impacts and mitigation measures that would be required to minimize potential adverse impacts. The criteria against which the significance of potential impacts are measured are also stated.

The information contained in this chapter has been developed from: (1) specific field and/or office environmental, engineering or planning studies conducted specifically for this project and this EIS; (2) the input, advice, guidance and information provided prior to and during the development and review of this EIS by public agencies, private groups, organizations and residents in the project area; and (3) comparisons and evaluations by specialty consultants (see Chapter 1, Section 13) of the proposed project relative to similar planned or existing housing projects.

2. PHYSICAL ENVIRONMENT

2.1 GEOLOGY, PHYSIOGRAPHY, SOILS AND AGRICULTURAL POTENTIAL

2.1.1 Existing Conditions

2.1.1.1 Geology and Physiography

The project area consists of approximately 1,135 acres extending from the Old Kona Airport Park to Palani Highway in the vicinity of Queen Liliuokalani Village, a distance of about 2.5 miles. The topography of the area is gently sloping (0 to 5 percent) from the park to Queen Kaahumanu Highway (Figure IV-1). From the highway, the elevation rises gradually to a height of about 780 feet above sea level at Palani Road (the eastern and mauka property boundary). The slope of this portion of the property varies from 5 to 10 percent with the average slope being about 6.5 percent (Figure IV-2).

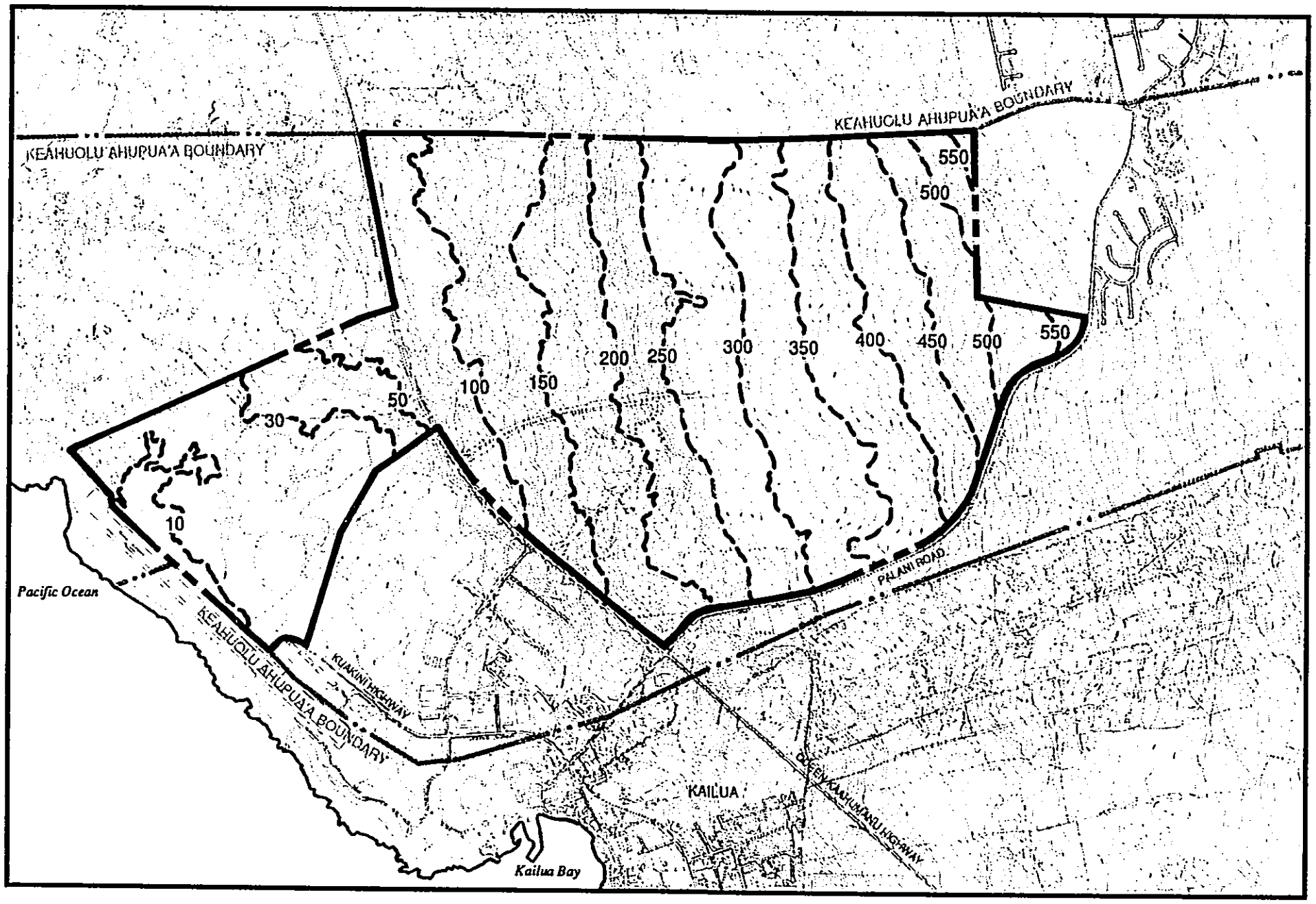
The project area is situated on the western slope of Hualalai volcano and is composed of prehistoric lava flows estimated to be from 3,000 to 5,000 years old.

2.1.1.2 Soils and Agricultural Potential

Four soil types, as described below, have been identified on the project lands by the U.S. Department of Agriculture Soil Conservation Service (SCS) (December, 1973) in a comprehensive soil survey of the Island of Hawaii (Figure IV-3). None of the four soil types are particularly agriculturally significant.

In general, lava flows (a'a and pahoehoe) have been mapped as miscellaneous soil types, while the Punaluu and Kaimu series (Punaluu extremely rocky peat and Kaimu) consist of well-drained, thin organic soils over pahoehoe lava bedrock. These soils are located in gently sloping to moderately steep topography and are on uplands at an elevation ranging from near sea level to 1,000 feet. These soils receive from 60 to 90 inches of rainfall annually.

(1) A'a Lava Flows (rLV). A'a lava has practically no soil cover and is generally bare of vegetation except for mosses, lichens, ferns and a few small ohia trees. The surfaces of a'a flows are masses of clinkery, hard, sharp pieces piled in tumbled heaps that are difficult



IV-3

LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

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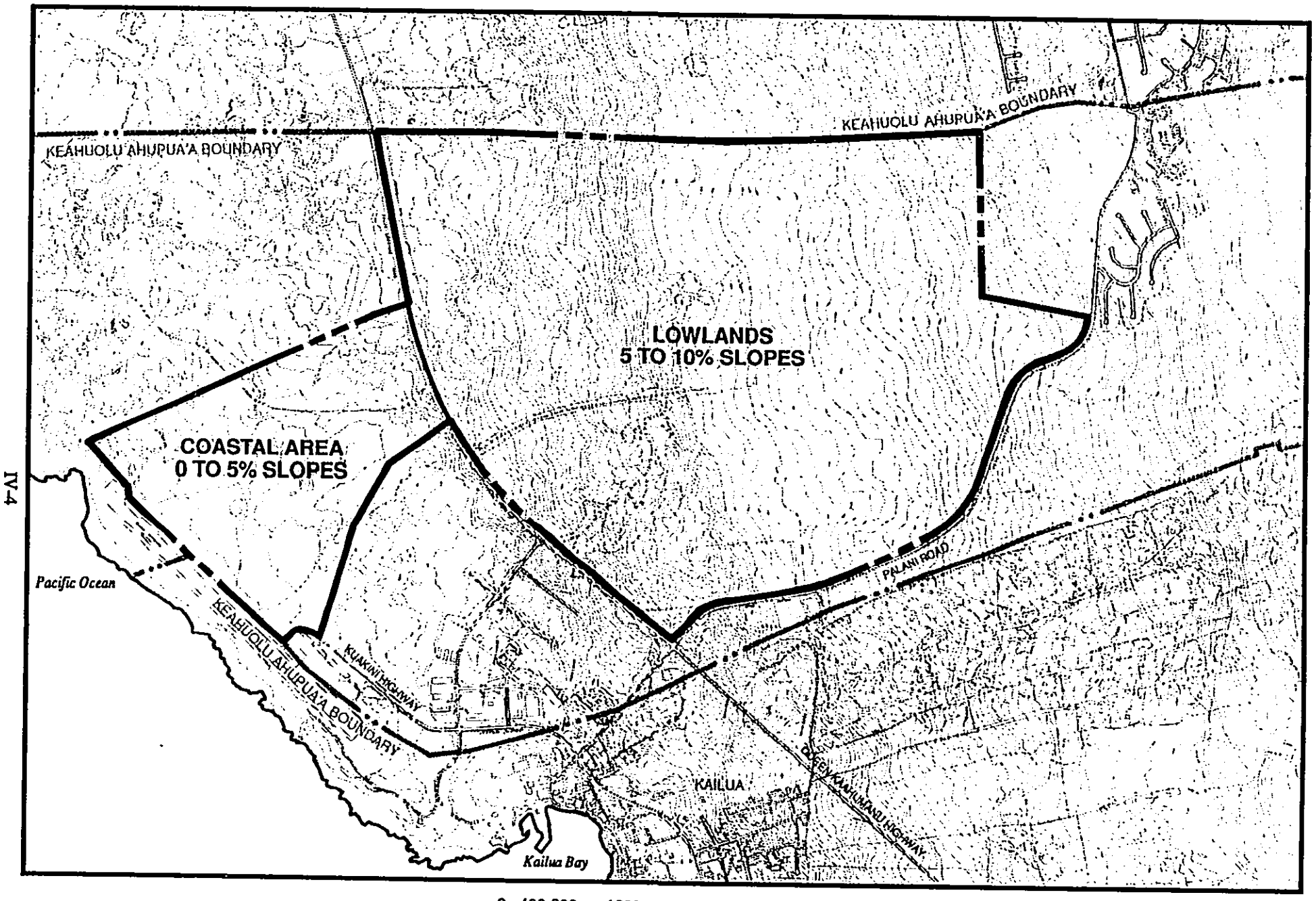
Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure IV-1
PROJECT SITE TOPOGRAPHY



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KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

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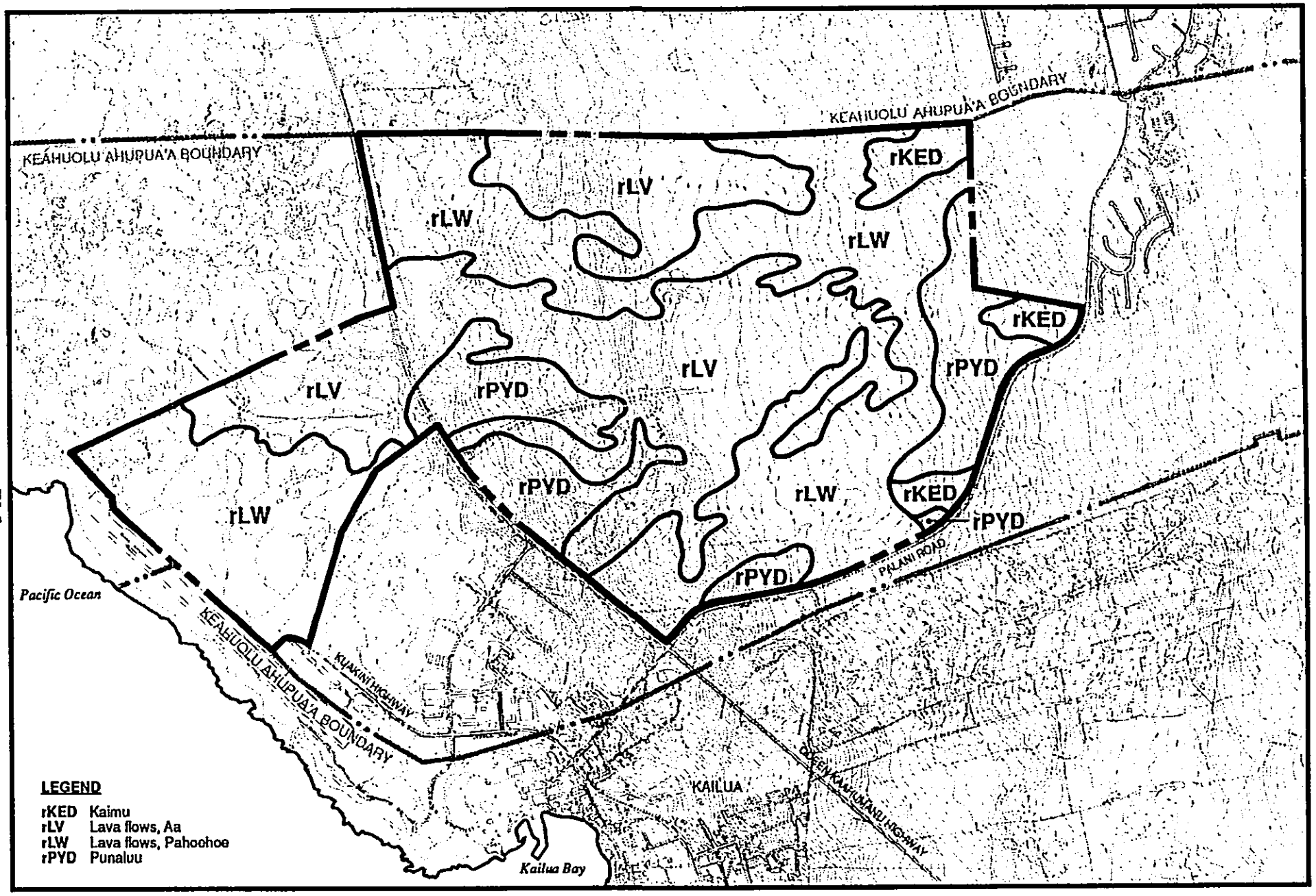
Figure IV-2
GENERALIZED SLOPE MAP



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Date: AUGUST 1990

Figure IV-3
SOIL CLASSIFICATION

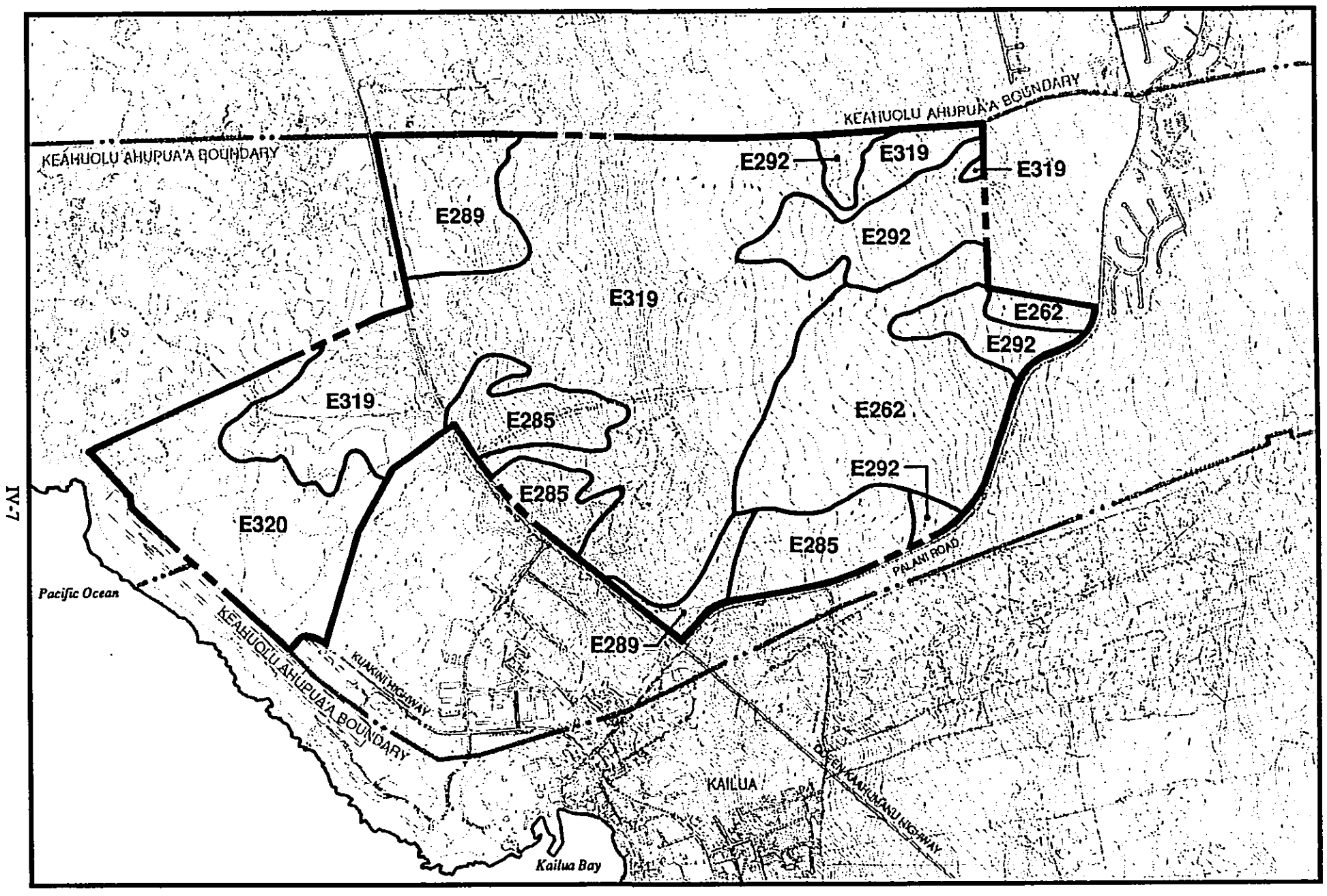
to traverse on foot. It has been demonstrated that the clinkery a'a surface can be easily moved and crushed by bulldozers into relatively smooth surface cobbles one to 4 inches in size. In areas of higher rainfall the a'a surface contributes substantially to the underground water supply and is used for watershed.

(2) Pahoehoe Lava Flows (RLW). Pahoehoe lava flows, similar to the a'a flows, are also a miscellaneous soil type. This lava has a billowy, glassy surface that is relatively smooth. In some areas the surface is rough and broken and with hummocks and pressure domes. Pahoehoe lava generally has no soil cover and is typically bare of vegetation except for mosses and lichens. Soil is, however, found in cracks and depressions, that have been transported there by wind and storm runoff. In areas of higher rainfall, this lava contributes to the groundwater supply through percolation.

(3) Punaluu extremely rocky peat (rPYD). This soil type is found on the lower leeward side of Mauna Loa. Rock outcrops occupy 40 to 50 percent of the surface. In a representative profile the surface layer is black peat about 4 inches thick and underlain by pahoehoe lava bedrock. This soil type is medium acid. The peat is rapidly permeable while the pahoehoe lava is very slowly permeable, although water moves rapidly through the cracks. Runoff is slow and the erosion hazard is slight. This soil is used for pasture land.

(4) Kaimu (rKED). This soil type is generally found on the lower slopes of Mauna Loa. In a representative profile the surface layer is very dark brown extremely stony peat about 3 inches thick. It is underlain by fragmental a'a lava and the soil is neutral in reaction. Permeability is rapid, runoff is slow and the erosion hazard is slight. This soil is not suitable for cultivation and most of it is in native woodland. Small areas are used for pasture, macadamia nuts, papaya and citrus fruit farming.

Agriculturally, the Detailed Land Classification, Island of Hawaii (University of Hawaii, Land Study Bureau, 1972), classifies the project lands as "E" or very poorly suited for agricultural productivity (Figure IV-4). Except for two small areas (approximately 30 acres) at the upper elevations of the property just makai of Palani Road, none of the land within the proposed project boundaries is classified in the Agricultural Lands of Importance to the State of Hawaii (ALISH) system. The approximately 30 acres that are included in the ALISH system are classified as Other Important Agricultural Land, indicating statewide or local importance for agriculture. About 945 acres of the project site is located in lands that are presently designated



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LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

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Date: AUGUST 1990

Figure IV-4
DETAILED LAND CLASSIFICATION

Agriculture by the State Land Use Commission for possible future agricultural use. There are no present agricultural uses of the project lands.

2.1.2 Probable Impacts

Impacts to the geology and physiography of the project lands could occur as a result of extensive excavation and reshaping of the existing topography. Impacts to the soils and agricultural potential of the project lands could occur as a result of disruptions to existing or future agricultural activities; and large-scale alterations to or removal of the soils. The degree of impact significance to the geology, physiography, soils and agricultural potential has been assessed on the basis of alteration to existing conditions or effects on potential future conditions.

Development of the project lands as a regional center for West Hawaii will impact the physical character of the land. Because the property is relatively level, site development will be generally limited to crushing of the lava flows and site grading in the area makai of Queen Kaahumanu Highway. In the area mauka of the highway, development of the property for project purposes will require cut and fill as well as grading due to the increased slope of the area.

Because the project lands are not currently used for agricultural activities the proposed project will not have any impact on existing agricultural activities. Development of the project would essentially preclude future use of the lands for agricultural activities. However, given that less than 20 percent of the state's land dedicated to agriculture is cultivated (Ramsour, 1990), it does not appear that the loss of the project lands for future agricultural activities would result in a significant adverse impact. The soils of the project site are relatively thin and would be used on site for grading and landscaping purposes. It is likely that additional soils for landscaping purposes will need to be imported from other areas on the island. Overall, potential impacts to the soils and agricultural potential of the project site would be insignificant.

2.1.3 Mitigation Measures

Because of the lack of adverse impacts to the geology, physiography, soils and agricultural potential of the project lands, mitigation measures to minimize potential adverse impact are not warranted. Construction activities (clearing, grading and grubbing) would be performed in compliance with applicable air and noise quality regulations to minimize potential

fugitive dust and noise impacts on adjacent developed areas and will be subject to all relevant county permit procedures and reviews.

2.2 GROUNDWATER, HYDROLOGY, SURFACE WATER AND DRAINAGE

2.2.1 Existing Conditions

2.2.1.1 Groundwater and Hydrology

The general character of Kona's regional water resources is classified in three distinct reserve types: basal groundwater, brackish basal groundwater and dike-impounded perched groundwater (Figure IV-5). The region's rainfall pattern is responsible for the recharge of the basal aquifer that extends from the upper slopes of Hualalai to the shoreline. Seawater intrusion at the shoreline results in the creation of brackish water. The extent of brackish water inland is highly variable within the Kona region and depends on the character of rainfall, specific terrain and geologic formations. Dike-impounded perched groundwater may exist at higher elevations on Hualalai. The specific configuration of groundwater resources in the project area is unknown. However, it is believed that the groundwater resources below the project lands are not sufficient or suitable for potable or non-potable water resource development. Additional information relative to the amounts of potable and non-potable water that will be required for the proposed project is provided in Section 6.2 of this chapter.

2.2.1.2 Surface Water and Drainage

There are no perennial streams in the project area and no well-defined drainageways have been identified, due in part to the high permeability of the soil types. No floodways or flood zones have been identified in the project area. In general, because of the high permeability of the soil types on the project lands, drainage of surface waters is relatively rapid.

2.2.2 Probable Impacts

Impacts to the groundwater, hydrology, surface water and drainage characteristics of the project lands could result from the introduction of pollutants into the groundwater stream, interruption of the groundwater stream and alterations to existing surface water drainage patterns or quantities. Impacts to the groundwater stream could also occur as a result of the application

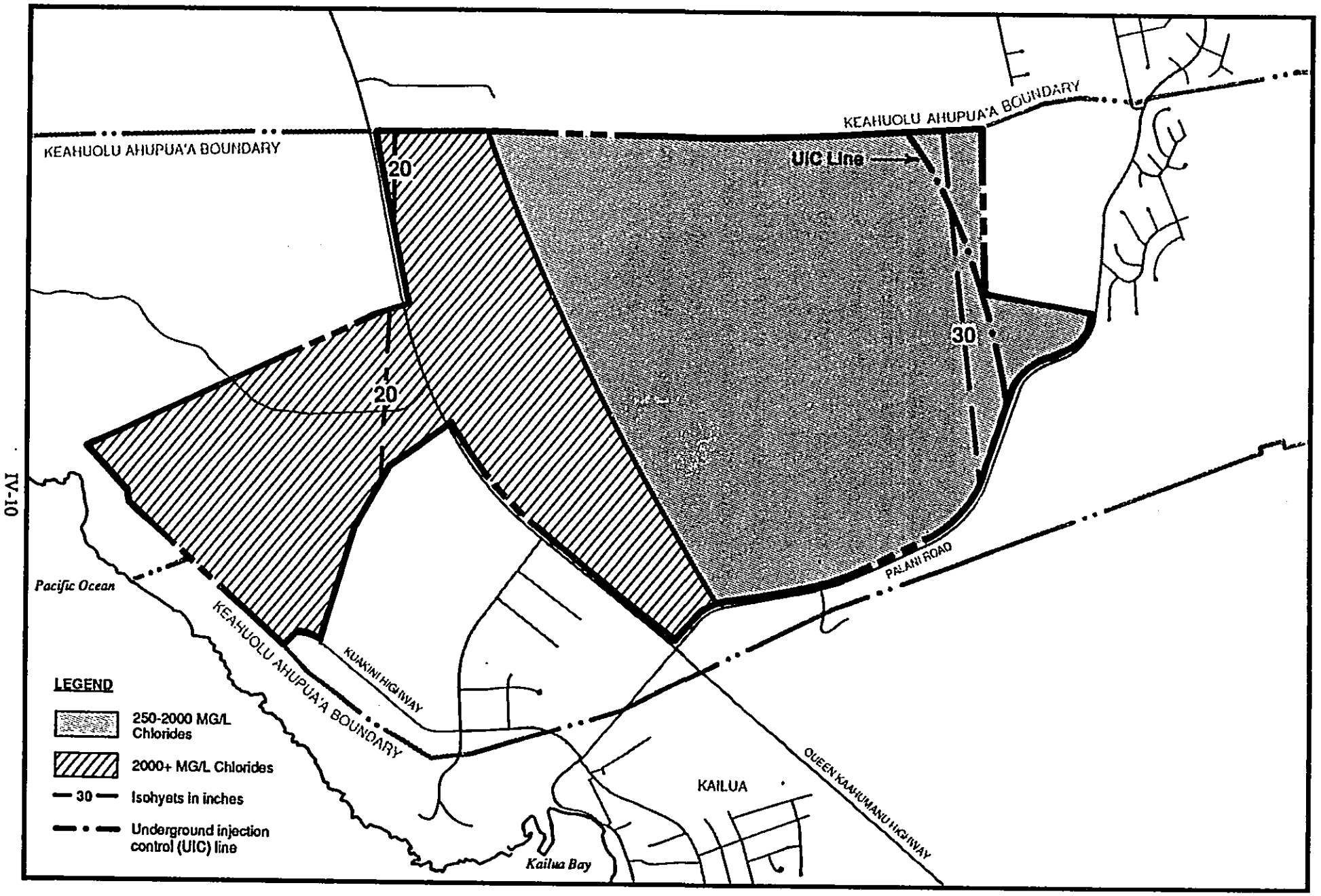

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Figure IV-5
GROUNDWATER CHARACTERISTICS

of fertilizers and biocides on landscaped areas. The significance of these potential impacts has been assessed on the basis of the degree of alteration to existing conditions that might occur as a result of the proposed project.

Surface water runoff and drainage from the property will increase due to an increase in impermeable runoff surfaces, such as roofs and roadways. The increased surface water runoff from roadways could carry petrochemical residues (oil and gasoline) and rubber substances from tire wear that could enter the groundwater stream if allowed to percolate through the underlying lavas.

Because no well-defined drainageways have been identified in the project area, significant alterations to existing surface water runoff patterns are not expected to occur. A storm drainage system will be master planned, designed and constructed as part of individual project components. Storm water will be disposed of in a manner acceptable to the County Department of Public Works and State Department of Health.

2.2.3 Mitigation Measures

Potential adverse impacts to the groundwater resources, hydrological characteristics, surface waters and drainage of the project site and area would be mitigated through the design and construction of a drainage infrastructure system in compliance with County Department of Public Works and State Department of Health (DOH) standards; the use of slow, time release or rapid uptake fertilizers; and the use of U.S. Environmental Protection Agency (US EPA) and State DOH approved biocides applied by or under the direction of state-certified applicators.

If drywells are used to dispose of surface water runoff, all would require a UIC permit, under State DOH rules and regulations, and would be located at least one-quarter mile away from any potable drinking water well (see Section 6.2 below). Consequently, the project is expected to result in positive impacts to the surface water and drainage characteristics of the project site.

As noted previously, it is likely that soils would be imported for landscaping purposes, given the lack of suitable soils on the project site. These soils would tend to promote plant absorption of fertilizers, thereby decreasing the potential for the fertilizers passing through the soil layer into the underlying lavas and into the groundwater stream. Slow, time-release or rapid

uptake fertilizers would be used and all biocides would be those approved for use by the US EPA and State DOH. Further, all chemicals would be applied per manufacturer's label instructions and would be applied by or under the direction of state-certified applicators. In general, scientific studies in Hawaii and on the mainland United States have indicated that there are no adverse impacts to groundwater supplies resulting from the proper use of fertilizers and biocides on landscaped areas. As such, the proposed project landscaping maintenance activities are not expected to have a significant impact on the groundwaters of the project site or area.

2.3 NATURAL HAZARDS

2.3.1 Existing Conditions

The potential natural hazards to which the project property could be subjected include earthquakes, volcanic eruptions and tsunamis. Because of the nature of the land and soil types, floods due to rainwater surface runoff are unlikely to occur.

Volcanic hazards in the area have been studied in detail (Mullineaux, *et al*, 1987). The last volcanic eruption of Hualalai that affected the project lands occurred in 1800-1801. Lavas emerged from 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 Mamalahoa Highway) creating a flow that entered the ocean north of Keahole Point. Mullineaux, *et al* (1987), indicate that the project lands are in lava flow hazard Zone 4. Less than 15 percent of the land in this zone has been covered with lava in the last 750 years. Although lava flows on Hualalai have typically covered large areas, the rift zones of the volcano do not seem to have a distinctly higher degree of hazard than do its flanks. As such, lava flow hazards for the project site are relatively low.

In addition to lava-flow hazard zones, hazard zones for tephra falls (ashfall) have also been defined for Hawaii (Mullineaux, *et al*, 1987). The project lands are located in ashfall-hazard Zone 2, which indicates that tephra falls from lava fountains could be frequent but thin.

The project area is not included in the United States Geological Survey (USGS) hazard zone for pyroclastic surges. The single pyroclastic surge hazard zone on the island surrounds the Kilauea caldera, in Puna District, and extends to a distance of about 6 miles from its center. The project site is more than 45 miles (direct distance) northwest of the Kilauea caldera.

Hazard zones for volcanic gases are the same as hazard zones for tephra, i.e., Hazard Zone 2. The project lands are outside hazard zones for ground fracture and subsidence. However, a review of historical data indicates earthquakes, associated with underground magmatic movement at Hualalai have been recorded. Based on this historical data, earthquakes of a level of 6.4 Richter Scale Magnitude occur on an average of once every 62 years.

Historically the lower, makai portion of the project lands have been subject to tsunami wave runup of about 8 feet. The base flood level is 6 feet.

2.3.2 Probable Impacts

The proposed project is not expected to have any impacts on the natural hazards to which the project lands are subjected. However, natural hazards could impact the proposed project. As noted above, the project lands have been subjected to lava flows from Hualalai, volcanically related earthquakes and tsunami inundation. The significance of these potential impacts has been assessed relative to the likelihood of occurrence of the events individually and concurrently.

Based on the information developed by Mullineaux, *et al* (1987), the likelihood of a volcanic eruption of Hualalai resulting in impacts to the project lands appears small. However, the project lands are impacted by earthquakes, most of which are relatively small and do no damage. Should Hualalai erupt, it is likely that the eruption would be accompanied by an earthquake. The concurrent event of an eruption and earthquake could cause significant impacts to the project lands.

The lower portions of the makai parcel could be impacted by tsunamis with wave runups greater than about 8 to 10 feet. Should a tsunami of this height occur, potential impacts to project related facilities could occur. The frequency of occurrence of tsunamis cannot be predicted. Appropriate mitigation measures can considerably reduce the level of significance.

2.3.3 Mitigation Measures

Mitigation measures to reduce the significance and/or impacts of volcanic eruptions and/or earthquake events include adherence to appropriate building codes and standards, as established by the County of Hawaii; the inclusion of evacuation routes within the project and the inclusion of a civil defense warning system within the project. These latter two measures would be

included in the proposed project and all buildings and structures would be designed and constructed in compliance with applicable building codes and standards.

2.4 VISUAL ATTRIBUTES

2.4.1 Existing Conditions

The present visual character of the project lands from Queen Kaahumanu Highway looking makai, is best described as a mix of open lava field with scattered trees and grasses adjacent to a light industrial subdivision. Looking mauka the view may be characterized as gently upward sloping land, lava fields with dense stands of kiawe (*Prosopis pallida*), stands of various grasses and a backdrop of Hualalai and residential uses bordering the project lands. The view makai across the project lands from the upper elevations at Palani Road adjacent to the upper (eastern) boundary of the project lands is similar to the mauka view, with the exception that the Pacific Ocean and Kailua town form the backdrop.

2.4.2 Probable Impacts

The proposed project will result in visual impacts in the form of a changed character of the site; from vacant open land sparsely utilized by man, to an urban, built-up character. The significance of impacts to the visual attributes of the site have been evaluated relative to the ability to mitigate the loss of the present open space character of the site.

The general nature of the proposed development is intended to be relatively low in density and consistent with the desired character and lifestyle of Kailua-Kona. To that end, buildings will be designed with large setbacks from roadways, extensive landscaped areas and open breezeways to take advantage of the climate in the area. The visual impact of the proposed development will be an extensive, yet spacious, low-rise development area makai of the County's proposed mid-level bypass highway. Development mauka of the bypass roadway will replace vacant slopes with a residential community. The visual impact will be that of a relatively low density community consisting of single and multifamily dwellings. The degree of significance of the changes in the visual character of the site is highly subjective. However, there will be significant changes in the visual character of the site, as indicated above.

2.4.3 Mitigation Measures

To the degree possible, potential impacts to the visual character of the site will be mitigated through the use of special design features, extensive landscaping and open breezeways. These measures are expected to ease the transition of the present visual character of the site to its future visual character and blending with the existing urban Kailua-Kona area and the open space character of lands north and east of the project site. Other mitigation measures will include the adoption of special design standards for all facilities and the maintenance of as much open space as possible while providing the level of services and facilities required for economic viability.

3. NATURAL ENVIRONMENT

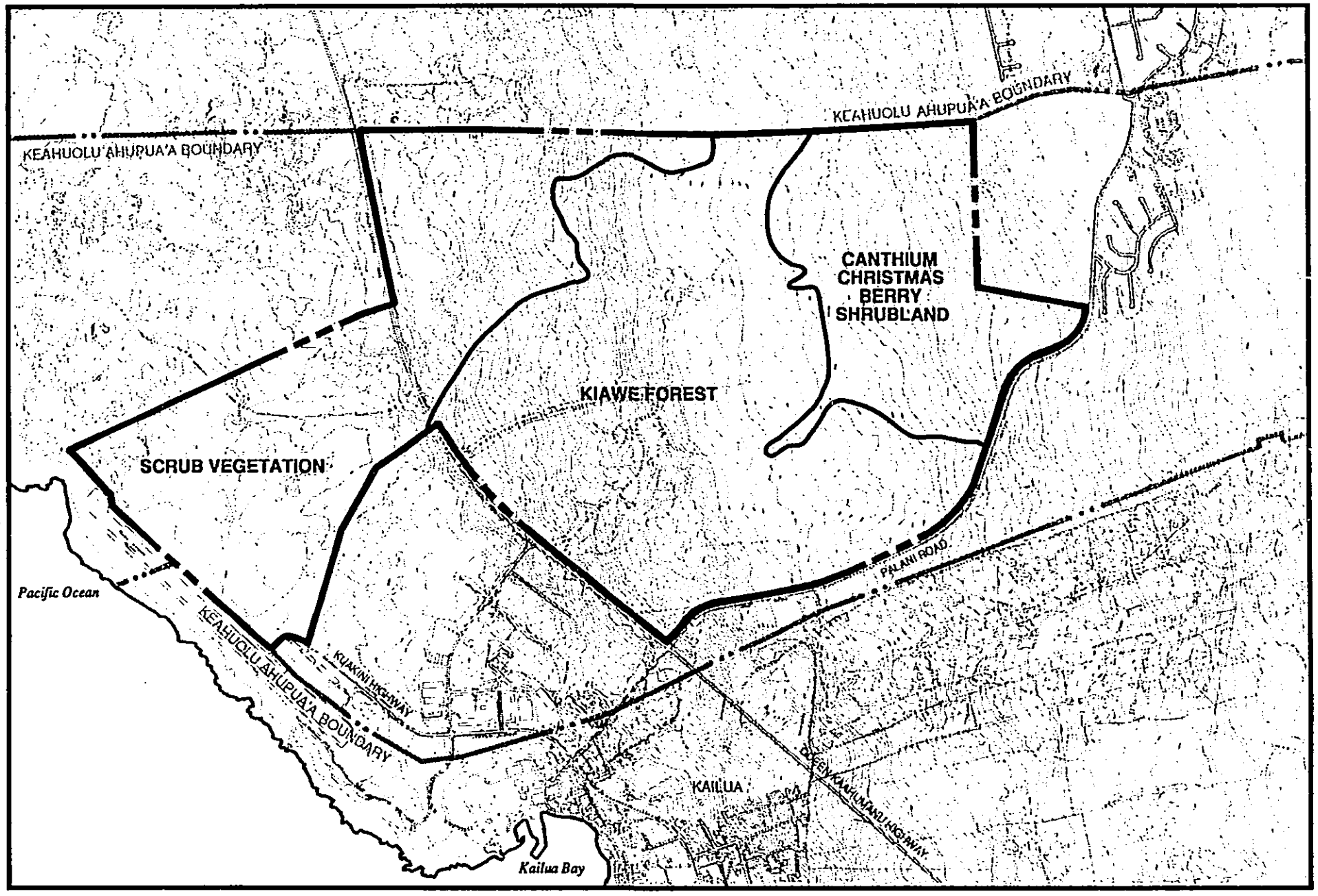
3.1 TERRESTRIAL FLORA

3.1.1 Existing Conditions

The terrestrial flora of the project lands have been surveyed (Appendix B) by experienced, qualified botanists through a pedestrian survey of the entire parcel and a literature search of pertinent references regarding the project site and adjacent areas. Areas most likely to harbor native species, such as *Canthium*/Christmas berry shrubland, were more intensively examined.

The vegetation on the project site (Figure IV-6) is dominated by introduced or alien species. The makai portion of the project lands below Queen Kaahumanu Highway is generally covered with the introduced fountaingrass (*Pennisetum setaceum*) along with scattered trees and shrubs of various species and open scrub. On the lands mauka of Queen Kaahumanu Highway, kiawe forest with dense fountaingrass and ground cover dominate one-half of the parcel with the remainder occupied equally by scrub vegetation and *Canthium*/Christmas berry shrubland. In the *Canthium*/Christmas berry shrubland vegetation, *Canthium ordoratum*, an indigenous native species, is codominant with the introduced Christmas berry (*Schinus terebinthifolius*). This shrubland also supports a number of other native elements not found elsewhere on the site. A list of all vascular plant species inventoried during the field survey is presented in Appendix B. The following are brief descriptions of the three major vegetation types.

- Scrub Vegetation - This vegetation type covers all of the makai portion of the project lands and approximately 100 acres of the mauka lands, adjacent to Queen Kaahumanu Highway and the



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NORTH

LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure IV-6
SITE VEGETATION MAP

Kealakehe County Sanitary Landfill. Fountaingrass with scattered shrubs and kiawe trees typify this vegetation type. Fountaingrass cover may vary from 40 to as much as 80 percent and is particularly dense in the area mauka of the highway. Kiawe trees from 9 to 20 feet tall occur as scattered individuals or as small stands of trees. Christmas berry, koa-haole (*Leucaena leucocephala*) and klu (*Acacia farnesiana*) shrubs are often associated with these small stands of trees. In some low-lying areas, koa-haole may form dense thickets from 6 to 12 feet tall. Various densities of smaller shrubs in the scrub vegetation include 'ilima (*Sida fallax*), 'uhaloa (*Waltheria indica*), maiapilo (*Capparis sandwichiana*), lantana (*Lantana camara*) and noni (*Morinda citrifolia*). Other grass species are minor components in this vegetation type, although, in places, Natal redtop (*Rhynchelytrum repens*) may be locally abundant.

Minor variations of the scrub vegetation may occur where there are differences in substrate types, past disturbances and drainage patterns. For example, scattered throughout the scrub are large pahoehoe knolls which are usually barren except for a few plants of hairy sword fern (*Nephrolepis multiflora*) and kumu-niu (*Doryopteris decora*). Areas containing relatively young a'a lava flows as well as areas that have been recently disturbed (bulldozed) support sparser vegetation, usually weedy annuals.

- Kiawe Forest - The lowland, coastal vegetation of all main Hawaiian islands is often characterized by kiawe (*Prosopis pallida*) forests. This vegetation type is usually species poor and consists of almost exclusively of species introduced to Hawaii in the 19th century.

The kiawe forests on the project site occupy a large portion of the mauka parcel, from Queen Kaahumanu Highway up to the 400-foot elevation, and occur on old, broken pahoehoe and older a'a lava flows. The canopy cover varies from open (less than 60 percent) to closed (more than 60 percent), with the open canopy condition being most common. Trees vary from 15 to 25 feet in height, although some large trees, 30 to 40 feet tall, are found along the old quarry road area. Koa-haole shrubs may form a subcanopy layer. Other trees and larger shrubs found scattered through this vegetation type include Christmas berry, pluchea (*Pluchea symphytifolia*), 'opiuma (*Pithecellobium dulce*), klu, and a few plants of the endemic wiliwili (*Erythrina sandwicensis*).

Fountaingrass is very dense in the kiawe forest vegetation type, even where the forest cover is closed, thus there are few other species. Most of the smaller shrubs, grasses and herbaceous

material occur along roadsides, bulldozed areas and the old quarry where the fountaingrass cover has been disturbed. Some of the more frequently encountered plants in these areas include Florida beggerweed (*Desmodium tortuosum*), Natal redtop, 'uhaloa, 'ihi (*Portulaca pilosa*), red-flowered boerhavia (*Boerhavia coccinea*), partridge pea (*Chamaecrista nicitans*), virgate mimosa (*Desmanthus virgatus*) and love grass (*Eragrostis tenella*). At the Palani Road/Queen Kaahumanu Highway intersection (near the runaway truck ramp), Guinea grass (*Panicum maximum*) is locally abundant under the kiawe forest, displacing the fountaingrass.

- *Canthium*/Christmas Berry Shrubland - This vegetation type generally occurs above the 400-foot elevation on the mauka parcel, although smaller areas of shrubland may extend down into the kiawe forest. this portion of the mauka parcel receives between 30 to 40 inches of rain per year. *Canthium*/Christmas berry shrubland occurs on very rocky substrates consisting primarily of geologically younger a'a lava flows or, in places, on rough, broken pahoehoe lava flows with numerous rocky outcrops.

  Canthium ordoratum or alahe'e and Christmas berry are of equal dominance in this vegetation type. These two species form a dense thicket, from 12 to 18 feet tall. Ground cover is about 40 percent with the rugged a'a lava largely bare. Unlike the other two vegetation types on the project site, fountaingrass is rare in the shrubland. Low-lying areas accumulate slightly more runoff and debris, supporting a dense growth of mixed species, usually weedy; these include lantana, Natal redtop, molassesgrass (*Melinis minutiflora*), guava (*Psidium guajava*) and air plant (*Kalanchoë pinnata*).

  Many native species are associated with this vegetation type, including 'ohe (*Reynoldsia sandwicensis*), mamane (*Sophora chrysophylla*), lama (*Diospyros sandwicensis*), uhiuhi (*Senna gaudichaudii*), huehue (*Cocculus trilobus*), 'ala'ala-wai-nui (*Peperomia leptostachya*), 'ulei (*Osteomeles anthyllidifolia*), maiapilo (*Capparis sandwichiana*), 'ilima, and a'ali'i (*Dodonaea viscosa*). The last three species noted occur throughout the site but are most abundant in the shrubland vegetation type.

No officially listed, proposed or candidate threatened or endangered plants were encountered during the botanical survey of the project lands.

3.1.2 Probable Impacts

Impacts to the existing flora of the project site could be caused by the grading and clearing that will be necessary to construct the proposed project elements. Similarly, impacts could be caused by the introduction of additional alien plants that might out-compete existing species. As such, the significance of potential impacts has been evaluated based on the extent of loss of existing vegetation, the potential for introduction of additional hardy, highly competitive species and the potential for loss of endangered or threatened species.

The impacts that would be experienced to the existing flora can be considered significant from the standpoint of loss of existing vegetation. That is, development of the proposed project will require clearing portions of the site, which will include areas in each vegetation type. It is unlikely, however, that additional species would be introduced that would out-compete existing species. There are no endangered or threatened species on the site, and, therefore, no impacts to these species.

While none of the native species on the site are considered rare or depleted, continued development within lower elevation habitats islandwide will eventually cause these lowland populations to be uncommon or rare in some cases.

3.1.3 Mitigation Measures

To mitigate the loss of native vegetation, native plants would be used in the landscaping for the project facilities. These plants have adapted to the climatic conditions of the site and would require less maintenance than introduced ornamental species. Several species, including wiliwili, mamane, uhiuhi, 'ohe, maiapilo and alahe'e would be suitable for landscaping purposes and will be incorporated into the landscaping plans. In addition, only those areas that require clearing and/or alteration would be cleared, thereby retaining significant portions of the site in its present "natural" condition.

3.2 TERRESTRIAL FAUNA

3.2.1 Existing Conditions

The terrestrial fauna of the project lands was surveyed by a qualified biologist in late June to early July 1989. The results of that survey are included in Appendix C. The following summarizes the information contained in Appendix C.

- Resident Endemic (Native) Land and Water Birds - No endemic species were recorded during the site survey. The Short-eared Owl or Pueo (*Asio flammeus sandwichensis*) might be expected to occasionally occur within the project boundaries. The species is relatively common on the Big Island, particularly at higher elevations. This species is listed, by the State Department of Land and Natural Resources, but not the US Fish and Wildlife Service, as endangered on Oahu but not on other Hawaiian Islands. Although not recorded during the project survey, Pueo have been found in similar habitat elsewhere in West Hawaii. No other endemic birds would be expected at the project site given the location and nature of the habitats available. The small, coastal anchialine ponds makai of the project property may provide occasional foraging opportunities for the endemic and endangered Black-necked Stilt or Ae'o (*Himantopus mexicanus knudseni*).

- Migratory Indigenous (Native) Birds - Migratory shorebirds winter in Hawaii between the months of August through May. Of all the shorebird species that winter in Hawaii, the Pacific Golden Plover (*Pluvialis fulva*) is the most abundant. This species prefers open areas such as mud flats, lawns, pastures, plowed fields and roadsides. The birds are site-faithful and many establish foraging territories that are defended vigorously. The populations tend to remain fairly stable over many years. No plover were recorded during the project survey, probably due to the time of the year and the lack of suitable habitat on the site. Two migratory species, Ruddy Turnstone (*Arenaria interpres*) and Wandering Tattler (*Heteroscelus incanus*) were recorded along the shoreline makai of the project property.

- Resident Indigenous (Native) Birds and Seabirds - No indigenous species were recorded nor would any be expected at the site given the nature of the habitat available. Black-crowned Night Heron (*Nycticorax nycticorax*) probably forage infrequently in the off-site

anchialine ponds. No seabirds were seen on the project site. Some native seabirds nest and roost in barren lava flows in Hawaii, but at a much higher elevation than the project property.

- Exotic (Introduced) Birds - A total of 17 species of exotic (introduced) species were recorded on the project site during the survey. A listing of the species, their relative abundance and general habitat preferences is included in Table 1 of Appendix C. In summary, the most abundant species were the Japanese White-eye (*Zosterops japonica*), Nutmeg Mannikin (*Lonchura punctulata*) and Zebra Dove (*Geopelia striata*). Black and Gray Francolin (*Francolinus francolinus* and *F. pondicerianus* respectively) were also common on the project site. The following exotic bird species may also occur on or near the project property: Erckel's Francolin (*Francolinus erckelii*), California Quail (*Callipepla californica*), Japanese Quail (*Coturnix japonica*) and Northern Mockingbird (*Mimus polyglottos*). Unexpected species sightings on the project site included the Lavender Waxbill (*Estrilda caerulescens*) and a parrot (*Psittacula sp.*??) that was too far away to positively identify.

- Feral Mammals - A total of 18 Small Indian Mongoose (*Herpestes auropunctatus*) were seen during the survey. Two cats were also recorded along with the skeletal remains of pigs and cows. Evidence of rats and mice were also found. No individuals of the endemic and endangered Hawaiian Hoary Bat (*Lasiurus cinerus semotus*) were observed during the survey, despite attempts to sight the species. This species roosts solitarily in trees and has been sighted in West Hawaii.

3.2.2 Probable Impacts

The present habitat provides a limited range of living spaces that are utilized by the typical array of exotic species of birds that would be expected to occur at the project site. Potential impacts to the bird and mammal species that occur or might occur on the project site have been evaluated in terms of increasing or decreasing population levels, loss of available habitat and potential impacts to endangered or threatened species.

The proposed development will create a more urban-like environment that might increase the abundance of some species such as the Common Myna (*Acridotheres tristis*) and House Sparrow (*Passer domesticus*). The significance of these potential population increases is somewhat subjective, depending on the reviewer's like or dislike of these particular species. The

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population levels of these species is not particularly threatened. However, any increase in population levels is not expected to positively or adversely affect either the population levels of other species or the nature of the proposed project. Other species populations, such as Japanese White-eye, Warbling Silverbill (*Lonchura malabarica*) and some game birds like Black Francolin, may decline as a result of the project. This could be seen by some as an adverse impact. However, other habitat opportunities are available on the island and in the West Hawaii area. As such, in this instance, the impact is viewed as insignificant. As noted above, no endangered or threatened species of birds or mammals were observed on the site. No impacts to these species would occur as a result of the project.

3.2.3 Mitigation Measures

Given the lack of adverse impacts, mitigation measures to minimize potential adverse impacts do not appear warranted. Project landscaping will replace some of the natural habitat to be lost while increased human activities will reduce some species populations. The majority of the bird and mammal life to be impacted is exotic species, for which other habitat opportunities in West Hawaii exist.

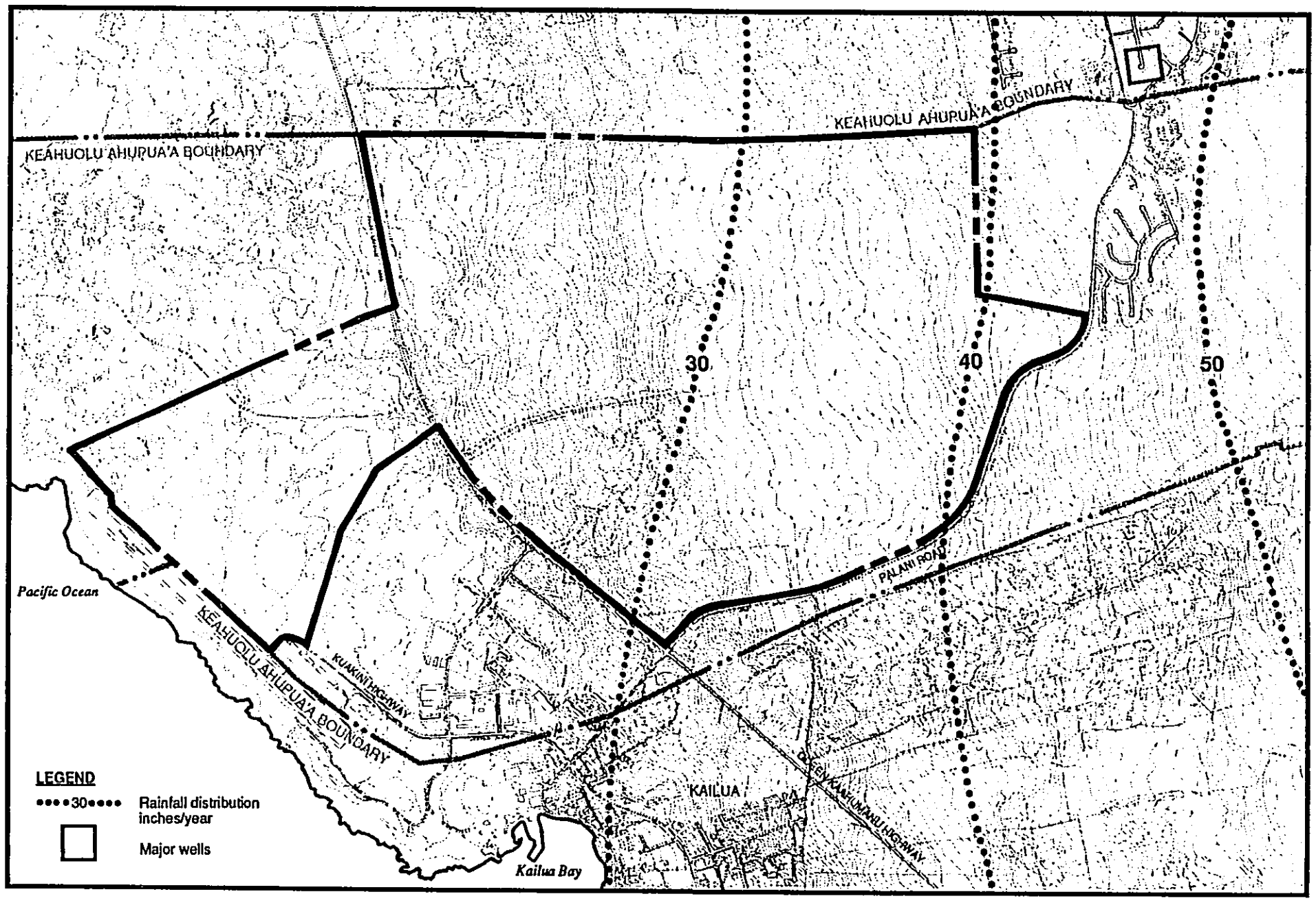
3.3 CLIMATE, METEOROLOGY AND AIR QUALITY

3.3.1 Climate and Meteorology

3.3.1.1 Existing Conditions

The climate of the project lands is generally mild with a mean annual temperature of 75 degrees (F) with relatively small daily and seasonal variations, although because of the range of elevations in the project site, lower temperatures would be expected at the higher elevations.

At the coastline, daytime temperatures above 88 degrees F. or nighttime temperatures below 63 degrees F. are rare. The average rainfall for the project property ranges from between 20 inches at the coastline to 40 inches per year in the Queen Liliuokalani Village area (Figure IV-7). The frequency of rainfall is related to elevation; the upper slopes of Hualalai are prone to a higher incidence of rainfall than the coastal areas. Winds are generally light to moderate and are predominantly from the southwest as a result of seabreezes and Kona (southerly) storms.



LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure IV-7
RAINFALL DISTRIBUTION

3.3.1.2 Probable Impacts

The proposed project is not expected to have any impact on the climatological or meteorological characteristics of the project site or area. Potential impacts to the air quality aspects of the project site and area are discussed and evaluated in the next subsection.

3.3.1.3 Mitigation Measures

Because no impacts have been identified, mitigation measures are not warranted.

3.3.2 Air Quality

3.3.2.1 Air Quality Standards

National Ambient Air Quality Standards (AAQS) and State of Hawaii AAQS are summarized in Table IV-1. AAQS have been established for six pollutants including particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead.

National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety." National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant."

In contrast to the national AAQS, state AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality." State AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the state one-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

TABLE IV-1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS (AAQS)

POLLUTANT (Units)	AVERAGING TIME	MAXIMUM ALLOWABLE CONCENTRATION		
		NATIONAL PRIMARY	NATIONAL SECONDARY	STATE OF HAWAII
Suspended Particulate Matter ($\mu g/m^3$)	Annual	--	--	60[a]
	24 Hours	--	--	150[b]
Particulate Matter[c] ($\mu g/m^3$)	Annual	50	50	--
	24 Hours	150[b]	150[b]	--
Sulfur Dioxide ($\mu g/m^3$)	Annual	80	--	80
	24 Hours	365[b]	--	365[b]
	3 Hours	--	1,300[b]	1,300[b]
Nitrogen Dioxide ($\mu g/m^3$)	Annual	100	100	70
Carbon Monoxide (mg/m^3)	8 Hours	10[b]	--	5[b]
	1 Hour	40[b]	--	10[b]
Ozone ($\mu g/m^3$)	1 Hour	235[b]	235[b]	100[b]
Lead ($\mu g/m^3$)	Calendar Quarter	1.5	1.5	1.5

[a] Geometric Mean
[b] Not to be exceeded more than once per year
[c] Particles less than or equal to 10 microns aerodynamic diameter

3.3.2.2 Existing Conditions

An air quality study for the project has been prepared and is included as Appendix D. The purpose of the study was to describe existing air quality in the project area and to make a preliminary assessment of the potential short- and long-term direct and indirect air quality impacts that could result from the proposed project. Measures to mitigate potential impacts are suggested where possible and appropriate.

The Trust lands and proposed project elements are classified as an "indirect source" of air pollution as defined in the Federal Clean Air Act of 1977 because their primary association with air pollution would be due to the inherent generation of mobile source, i.e., motor vehicle activity.

The present air quality in the project area is mostly affected by air pollutants from natural, industrial, agricultural and/or vehicular sources. Natural sources that may affect the project area, but cannot be accurately quantified, include the ocean (salt spray), plants (aero-allergens), wind-blown dust and volcanoes. Of these natural sources, volcanoes are the most significant, especially since the latest eruption phase of Kilauea Volcano which began in 1983 and is continuing. Air pollution emissions from the volcano consist primarily of sulfur dioxide and are carried to the project area by prevailing winds. The volcanic emissions are seen in the form of a volcanic haze (vog) which persistently hangs over a majority of the West Hawaii area. the American Lung Association is studying the character and concentrations of volcanic air pollution in the area, but to date no results are available.

the major industrial sources of air pollutants in the project area include the Keahole Power Plant, operated by Hawaii Electric Light Company (HELCO) and the Kailua Landfill, operated by the county. Air pollution from the power plant consists mostly of sulfur dioxide and oxides of nitrogen. Emissions from the landfill consists mostly of fugitive dust and noxious fumes from underground fires.

Vehicular sulfur dioxide and particulate emissions, as measured about 12 miles from the project site by the State Department of Health (DOH) during 1985 and 1986 (the latest data available) indicated consistently low 24-hour average concentrations, with mean sulfur dioxide values ranging from less than 5 to 12 $\mu g/m^3$. No exceedances of the state/national 24-hour

AAQS for sulfur dioxide were recorded. Twenty-four hour average particulate concentrations ranged from 4 to 28 $\mu g/m^3$ with no violations of state AAQS recorded.

3.3.2.3 Probable Impacts

To ascertain the significance of potential long-term direct and indirect air quality impacts of the proposed project, estimates of air pollution emissions associated with the proposed project and occurring in the project vicinity were prepared for comparison to the "significant" emission rates as defined by the State DOH. If emissions are below the significant levels, it is very unlikely that any significant impacts on air quality would occur. If emissions exceed the significant levels, it does not necessarily mean that there would be significant impacts, but it does suggest that a more detailed analysis is required.

3.3.2.4 Long-Term Impacts

Following construction of the various elements of the proposed project there will be an increase in vehicular traffic in and around the project site. This increase will potentially cause long-term impacts on ambient air quality. Based on the air quality computer modeling that has been performed (see Appendix D), 1990 1-hour carbon monoxide (CO) concentration in the project area during the afternoon peak traffic hour are 17.4 mg/m^3, at the Kuakini Highway/ Palani Road intersection. The worst case 1990 1-hour afternoon peak traffic hour CO concentrations at the Queen Kaahumanu Highway/Palani Road intersection was estimated to be 16.4 mg/m^3.

In the year 2010 without the proposed project, a worst case 1-hour afternoon peak traffic hour concentration at the Kuakini Highway/Palani Road intersection was estimated to be 16.2 mg/m^3. At the Queen Kaahumanu Highway/Palani Road intersection, the 1-hour 1990 afternoon peak traffic hour CO concentration was estimated to be 15.8 mg/m^3. The estimated concentrations are based on a set of assumptions regarding roadway configurations and improvements or lack of them to present roadway conditions (see Appendix D).

Analysis of air quality under three different roadway improvement concept scenarios implemented in conjunction with the proposed project indicate that for all scenarios the estimated worst-case 1-hour CO concentrations would be well within the federal AAQS of 40 mg/m^3 in the year 2010. However, it appears likely, based on the modeling performed, that existing

concentrations of CO, either with or without the proposed project, may exceed state 1-hour AAQS of 10 mg/m^3 on occasion at several locations in the project area. With two of the roadway improvement concepts (Concepts 2 and 3), the state AAQS may be achieved along Queen Kaahumanu Highway at Liliuokalani Boulevard and at Palani Road. Tables IV-2 and IV-3 indicate 1-hour and 8-hour estimate worst-case CO concentrations in the project area both with and without the proposed project.

The proposed project will also cause long-term air quality impacts due to electrical generation required to support the proposed project. Estimates of the emissions resulting from the generation of electricity to serve the project amount to about a 25 percent increase in total emissions from the Keahole Power Plant. Recent expansion of the Keahole plant required State DOH permits and demonstration that state and federal air quality standards would be met.

Occasional impacts may also occur from natural, agricultural and/or vehicular sources as well as the disposal of solid wastes. Natural sources of air pollution emissions which could affect the project area include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and volcanic activity in the Puna District (vog). These potential minor emissions do not represent significant air quality impacts. Emissions from solid waste disposal would be primarily linked to exhaust fumes from refuse trucks and heavy equipment used to place the refuse in a landfill, fugitive dust and potential contaminants from burning either at a landfill or municipal incinerator. It is likely that the solid waste refuse generated at the project site would be hauled to the new county landfill site as described in Section 6.4 below.

3.3.2.5 Short-Term Impacts

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

TABLE IV-2

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KEAHUOLU LANDS DEVELOPMENT PROJECT DURING AFTERNOON PEAK TRAFFIC HOUR

[milligrams per cubic meter (mg/m^3)]

ROADWAY/ INTERSECTION	YEAR /SCENARIO				
	1990/ PRESENT	2010/WITHOUT PROJECT	2010/WITH PROJECT CONCEPT 1	2010/WITH PROJECT CONCEPT 2	2010/WITH PROJECT CONCEPT 3
Queen Kaahumanu Hwy/Liliuokalani Blvd.[a]	—	—	11.7	7.6	8.9
Queen Kaahumanu Hwy/Palani Rd.	16.4	15.8[b]	11.5	9.4	9.4
Mid-Level Rd/ Palani Rd.	1.5[c]	2.3[c]	11.2	—	—
Mid-Level Rd./ Liliuokalani Blvd.[a]	—	—	12.2	—	—
Kuakini Hwy./ Palani Rd	17.4	16.2	18.6	—	—

Source: Appendix D, Neal & Associates. 1990.

Notes:

[a] In 1990 and 2010 without project scenarios, intersection does not or will not exist.

[b] Assumes intersection with three northbound and three southbound through lanes, two eastbound and two westbound through lanes and two left-turn and one right-turn lanes on all approaches.

[c] Assumes through traffic only.

State AAQS = 10 mg/m^3
Federal AAQS = 40 mg/m^3

TABLE IV-3

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KEAHUOLU LANDS DEVELOPMENT PROJECT DURING AFTERNOON PEAK TRAFFIC HOUR

[milligrams per cubic meter (mg/m^3)]

ROADWAY/ INTERSECTION	YEAR /SCENARIO				
	1990/ PRESENT	2010/WITHOUT PROJECT	2010/WITH PROJECT CONCEPT 1	2010/WITH PROJECT CONCEPT 2	2010/WITH PROJECT CONCEPT 3
Queen Kaahumanu Hwy/Liliuokalani Blvd.[a]	---	---	5.8	3.8	4.4
Queen Kaahumanu Hwy/Palani Rd.	8.2	7.9[b]	5.2	4.7	4.7
Mid-Level Rd/ Palani Rd.	0.8[c]	1.2[c]	5.6	---	---
Mid-Level Rd./ Liliuokalani Blvd.[a]	---	---	6.1	---	---
Kuakini Hwy./ Palani Rd	8.7	8.1	9.3	---	---

Source: Appendix D, Neal & Associates. 1990.

Notes:

[a] In 1990 and 2010 without project scenarios, intersection does not or will not exist.

[b] Assumes intersection with three northbound and three southbound through lanes, two eastbound and two westbound through lanes and two left-turn and one right-turn lanes on all approaches.

[c] Assumes through traffic only.

State AAQS = 10 mg/m^3
Federal AAQS = 40 mg/m^3

Fugitive dust emissions may arise from grading and dirt-moving activities within the project sites. The emission rate for fugitive dust is nearly impossible to estimate accurately because of its elusive nature and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The US EPA has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity. Uncontrolled fugitive dust emissions in the project area would probably be somewhere near this level. State of Hawaii Air Pollution Control Regulations require that visible emissions of fugitive dust from construction activity be essentially nil. Adherence to those regulations as recommended in Section 3.3.2.6 will serve to mitigate any potentially significant short-term fugitive dust air quality impacts.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emission from diesel engines, on the other hand, are very low and should be relatively insignificant. Adherence to the below measures can mitigate these impacts to an insignificant level.

3.3.2.6 Mitigation Measures

Options available to mitigate long-term vehicular traffic-related air pollution are to improve roadways, reduce traffic or reduce individual vehicular emissions. As indicated in Section 6.1 below, major roadway improvements as part of and separate from the proposed project are planned. These improvements will aid in the reduction of vehicular generated air emissions. Vehicular generated emissions could also be reduced by the establishment of a mass transit system on the island. However, this measure is beyond the scope of the proposed project. A reduction in traffic levels could, however, be achieved by the use of staggered hours for schools and work places and the active encouragement of car/van pooling.

Indirect emissions from electrical power generation could be mitigated somewhat by utilizing solar energy design features to the maximum extent possible. As indicated in Section 6.5 below, the Trust will incorporate, to the maximum extent practical, the most energy saving

technologies, including the use of energy saving lighting and use of solar power for water heating and air conditioning purposes, in the design of the Trust facilities to minimize future electrical power generation requirements and the costs of energy.

Short-term air quality impacts are foreseen as a result of project construction, creating fugitive dust emissions from site grading and other construction activities, and fumes emitted from gasoline and diesel-powered construction equipment. Short-term emissions can be minimized by the following:

- Strict adherence to state air pollution control standards.
- Use of a frequent watering program to limit bare-dirt surfaces from becoming significant dust generators;
- Requirements that all open-bodied trucks be covered when transporting dirt or dust producing materials;
- The paving of parking areas and the establishment of landscaping early in the construction process to limit areas of possible dust production.

3.4 NOISE QUALITY

3.4.1 Existing Conditions

The existing noise quality of the proposed project site is limited to three principal sources: motor vehicle traffic; natural factors including wind moving through vegetation; and fixed source noise. Fixed source noise is primarily associated with activities at the Kailua Landfill and light industrial activities associated with the existing light industrial subdivision. None of these noise generators are presently considered to be a significant source of noise. Traffic noise is associated with the area's roadway system, including Queen Kaahumanu Highway, Palani Road, the Old Airport Road and industrial subdivision roads. Traffic noise tends to dominate all other noise sources in the project area.

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (L_{dn}). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. Sound levels

that occur during the nighttime hours of 10:00 pm to 7:00 am are increased by 10 decibels (Db) prior to computing the 24-hour average by the L_{dn} descriptor.

Table IV-4 indicates the current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in Figure IV-8. In general, noise levels of 55 L_{dn} or less occur in rural areas, or in areas that are removed from high volume roadways. In urbanized areas shielded from high volume streets, L_{dn} levels generally range from 55 to 65 L_{dn} and are usually controlled or driven by motor vehicle traffic noise. Residences that front major roadways are generally exposed to levels of 65 L_{dn}, and as high as 75 L_{dn} when the roadway is a high speed freeway. In the North Kona project area, noise levels at lots that front Queen Kaahumanu Highway and Palani Road are typically above 60 L_{dn}. Noise shielding by intervening structures lowers noise levels 3 to 10 L_{dn} in interior lots.

For the purpose of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 L_{dn} or lower is considered acceptable. This standard is applied nationally, including Hawaii. However, because of the predominance of open-living conditions and naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by naturally ventilated structures, an exterior noise level of 65 L_{dn} does not eliminate all risks of noise impacts. Because of these factors, a lower level of 55 L_{dn} is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. Relatively high exterior noise levels of 65 to 80 L_{dn} are considered to be "Compatible" or "Marginally Compatible" for commercial land uses and hospitals are considered compatible in areas with exterior noise levels as high as 75 L_{dn}, as long as sound attenuation measures, such as, total closure and air conditioning, are provided to reduce interior noise levels to acceptable levels.

To quantify existing noise conditions for comparison with expected future noise conditions, field measurements were taken at the locations shown on Figure IV-9 in June 1989. The complete results and analysis of those measurements are included in Appendix E and summarized below.

The existing traffic noise levels in the project area are in the "Significant Exposure", Normally Unacceptable category at 50-foot distance from the centerline of Queen Kaahumanu Highway and Palani Road. Traffic noise levels along the right-of-way of a roadway generally

TABLE IV-4

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

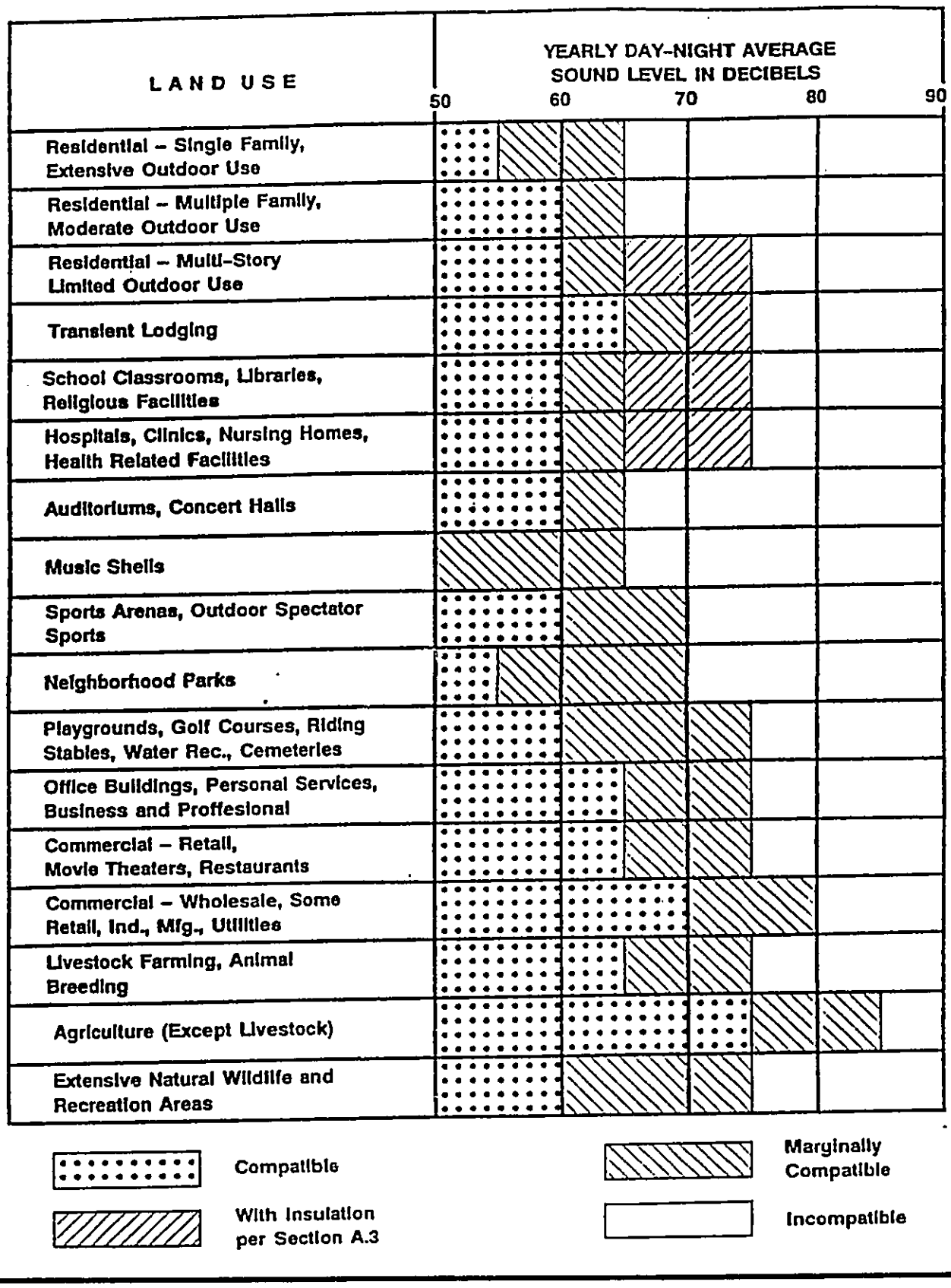
NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL STANDARD[1]
MINIMAL EXPOSURE	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
MODERATE EXPOSURE	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable[2]
SIGNIFICANT EXPOSURE	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
SEVERE EXPOSURE	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Source: Guidelines for Considering Noise in Land Use Planning and Control. Federal Interagency Committee on Urban Noise. June 1980.

Notes:

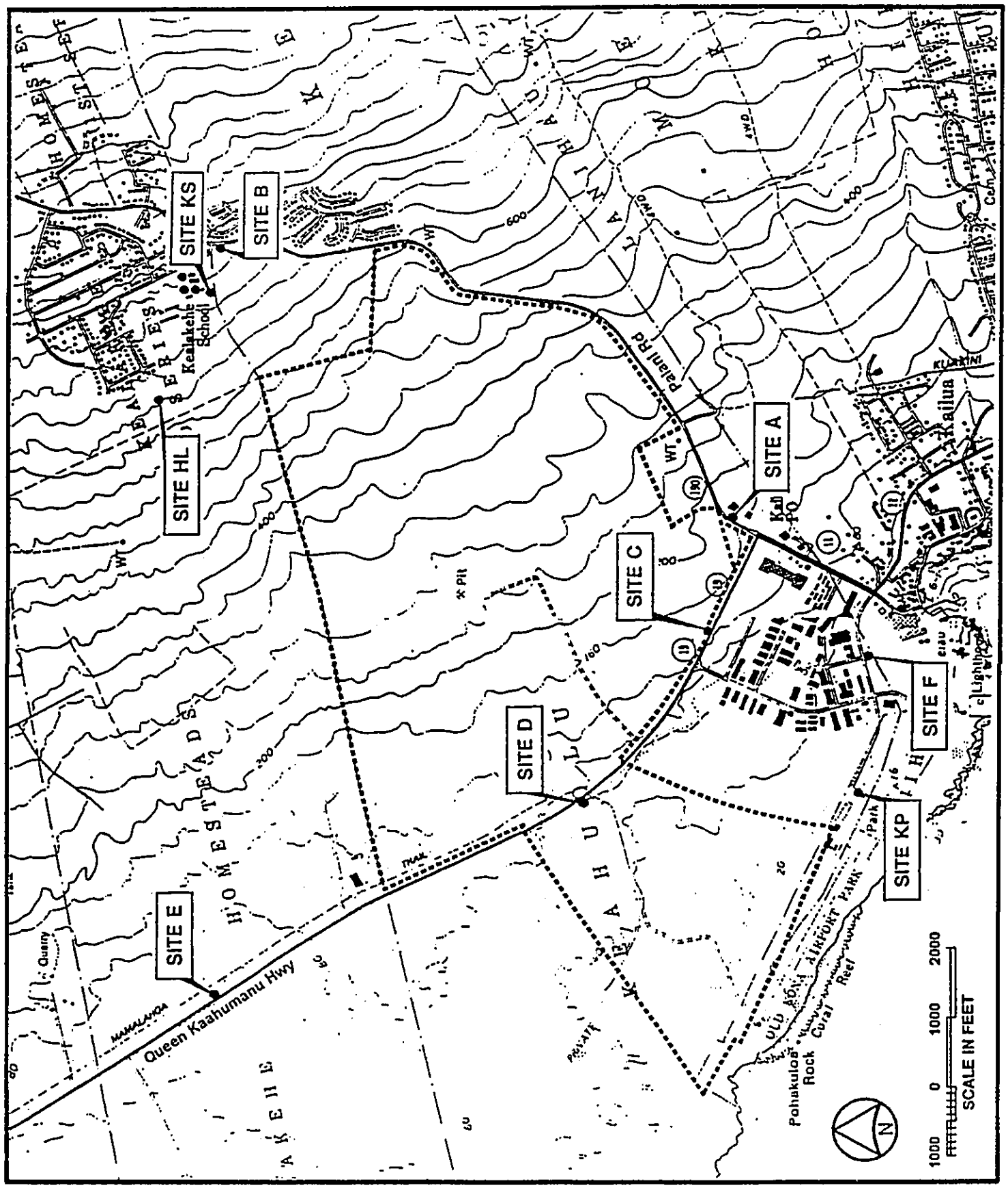
[1] Federal Housing Administration, Veterans Administration, Department of Defense and Department of Transportation.

[2] FHWA uses the L_{eq} instead of L_{dn} descriptor. For planning purposes, both are equivalent if (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours and (b) traffic between 10:00 pm and 7:00 am does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 L_{eq}.



Source: Y. EBISU & ASSOCIATES
NOISE STUDY, JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES • AUGUST 1990

Figure IV-8
LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL



Source: Y. EBISU & ASSOCIATES
NOISE STUDY, JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES • AUGUST 1990

Figure IV-9
LOCATIONS OF NOISE MEASUREMENT SITES

represent the worst case levels due to the proximity of the right-of-way to the noise sources. At greater setback distances of approximately 75 to 100 feet, traffic noise along Queen Kaahumanu Highway decreases to the "Moderate Exposure", "Acceptable" category. Setback distances of approximately 45 to 80 feet are required from the centerline of Palani Road to be in the "Moderate Exposure", "Acceptable" noise exposure category.

Calculations of the existing traffic noise levels during the peak pm traffic hour were made as were the existing setback distances from the roadways' centerlines to their associated 60, 65 and 70 L_{dn} contours. The contour line distances, as shown in Table IV-5, do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. The existing setback distances to the 65 L_{dn} contour lines are relatively large along Queen Kaahumanu Highway and the makai (or west) section of Palani Road. Along the mauka (or east) section of Palani Road and along Kuakini Highway, the setback distances to the 65 L_{dn} contour lines are relatively small (see Table IV-5).

Existing traffic noise levels at the mauka (inland) portions of the project site are very low (less than 60 L_{dn}) due to their large setback distances from Queen Kaahumanu Highway.

3.4.2 Probable Impacts

Noise quality impacts resulting from the proposed project have been evaluated based on comparisons with existing noise conditions and relation to generally accepted noise levels as specified by federal lending institutions for residential properties (HUD/FHA/VA).

Predictions of future traffic noise levels were made using the traffic volume assignments included in Appendix E for calendar year (CY) 2010, both with and without the proposed project. The major project roadways, for which traffic noise levels were calculated, are shown in Figure II-4. As will be indicated below in Section 6.1.1 (Highways and Public Access), by CY 2010 traffic conditions on all existing roadways will worsen and major improvements to the roadway network will be required with or without the proposed project. If these roadway improvements are implemented to accommodate the projected future traffic volumes, traffic noise levels will increase significantly (by 5.5 to 7.4 L_{dn}) above existing levels. If the required roadway improvements are not implemented to maintain current levels of service, future traffic noise level increases will be less than those calculated (see Table 3, Appendix E) due to increased congestion and reduced average vehicle speeds.

TABLE IV-5

EXISTING AND CY 2010 DISTANCES TO
60, 65 AND 70 L_{dn} CONTOURS

STREET SECTION	60 L_{dn} SETBACK (Ft) EXISTING	60 L_{dn} SETBACK (Ft) CY 2010	65 L_{dn} SETBACK (Ft) EXISTING	65 L_{dn} SETBACK (Ft) CY 2010	70 L_{dn} SETBACK (Ft) EXISTING	70 L_{dn} SETBACK (Ft) CY 2010
Queen Kaahumanu Hwy. (North)	160	479	74	222	34	103
Queen Kaahumanu Hwy. (Front)	232	601	108	279	50	130
Queen Kaahumanu Hwy. (South)	202	632	94	293	44	136
Palani Road (North)	96	229	45	106	21	49
Palani Road (South)	175	299	81	139	38	64
Kuakini Highway	131	155	61	72	28	33
Mid-Level Roadway	N/A	210	N/A	183	N/A	85
Liliuokalani Blvd. (North)	N/A	210	N/A	97	N/A	45
Liliuokalani Blvd. (South)	N/A	303	N/A	140	N/A	65

Source: Appendix E

Notes:

1. All setback distances are from the roadways' centerlines.
2. See Table 3 (Appendix I) for traffic volume, speed and mix assumptions.
3. L_{dn} assumed to be equal to pm peak hour L_{eq} along all roadways.
4. Setback distances are for unobstructed line-of-sight conditions.
5. Soft ground conditions assumed along all roadways.

The predicted increases in traffic noise levels associated with non-project traffic by CY 2010, and as measured by the L_{dn} descriptor system are shown in Table IV-6. As indicated in the table, the increases in traffic noise along Queen Kaahumanu Highway due to project traffic are relatively small when compared to those increases expected from non-project traffic. Similar conclusions apply along Palani Road. Project traffic noise increases are expected to be greatest relative to non-project traffic along Kuakini Highway, where existing and future land uses are not considered sensitive.

As a result of the construction of the Mid-Level roadway and Liliuokalani Boulevard, traffic noise levels are expected to increase significantly at the inland areas mauka of Queen Kaahumanu Highway. By CY 2010, following the construction of these new roadways, traffic noise levels at the future residential area mauka of the Mid-Level roadway are expected to increase (or decreases) to the levels indicated in Table IV-6. Setback distances of approximately 183 feet from the centerlines of the Mid-Level roadway will be required to meet FHA/HUD noise standard of 65 L_{dn} under unobstructed line-of-sight conditions. Setback distances of 97 to 106 feet from the centerlines of Palani Road and Liliuokalani Boulevard will be required to meet the same standard. It is noted that the primary cause of these relatively large setback distances is the forecast non-project traffic.

Relatively large increases in traffic noise levels along the improved Palani Road are expected to occur as a result of project and non-project related traffic. By CY 2010, non-project traffic is expected to increase noise levels along Palani Road by 3.6 to 5.3 L_{dn}, with project related traffic adding 0.0 to 0.3 L_{dn} to the non-project noise levels. Setback distances of 106 to 139 feet from Palani Road's centerline will be required to meet FHA/HUD noise standards under unobstructed line-of-sight conditions between the roadway and noise sensitive receptors.

Potential noise impacts along the improved Palani Road are possible, both in respect to existing and planned noise sensitive receptors along the roadway. Existing residences along the road may be impacted by the added traffic noise as well as by future roadway improvements if noise mitigation measures are not included with the construction of the roadway improvements.

TABLE IV-6

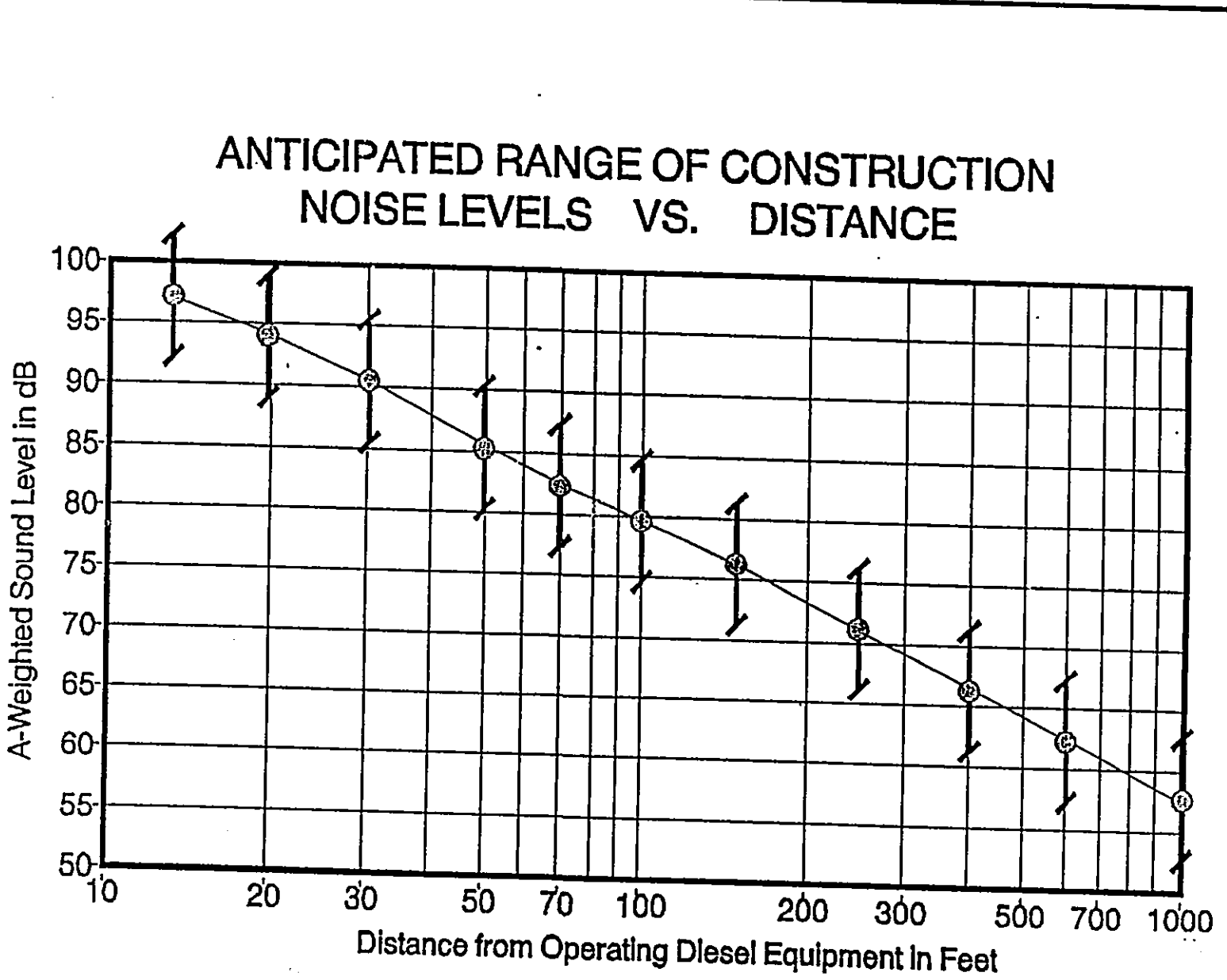
CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2010)

STREET SECTION	NOISE LEVEL INCREASES (L_{dn}) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Queen Kaahumanu Hwy. (North)	6.3	0.9
Queen Kaahumanu Hwy. (Front)	5.4	0.8
Queen Kaahumanu Hwy. (South)	7.0	0.5
Palani Road (North)	5.3	0.3
Palani Road (South)	3.6	-0.1
Kuakini Highway	-0.7	1.8
Mid-Level Road	73.3	0.2
Liliuokalani Blvd. (North)	0.0	69.3
Liliuokalani Blvd. (South)	0.0	71.7

Source: Appendix E.

Audible construction noise will be unavoidable during the entire project construction period. However, actual length of exposure to construction noise at any one receptor location will be less than the entire construction period as construction moves from one site to another. Typical construction activity noise levels (excluding pile driving activity) are shown in Figure IV-10. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in Figure IV-10, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure.

Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation.



Source: Y. EBISU & ASSOCIATES
NOISE STUDY, JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES - AUGUST 1990

CONSTRUCTION NOISE LEVEL VS. DISTANCE

Figure IV-10

3.4.3 Mitigation Measures

The increases in traffic noise levels attributable to the proposed project from the present to CY 2010 are predicted to range from 0.5 to 0.9 L_{dn} along Queen Kaahumanu Highway, where traffic noise levels are expected to remain above 65 L_{dn} along the highway right-of-way. This degree of noise increase will be difficult to perceive over a 20-year period and is not considered to be significant. The proposed residential areas of the project would be located beyond a half-mile from Queen Kaahumanu Highway. Existing and planned uses along the highway are primarily commercial and light industrial. Therefore, traffic noise impacts along the highway resulting from the proposed project are not considered to be serious.

At 45 feet or greater setback distance from the centerline of the mauka sections of Palani Road, traffic noise levels from this lower volume roadway are less than 65 L_{dn}. For these reasons, the existing levels of roadway traffic noise at the proposed residential portions of the project are not expected to exceed current FHA/HUD noise standards or cause noise impacts on future residents.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50-foot distance), and due to the exterior nature of the work. The use of properly muffled equipment would be required on the project. Similarly, all construction noise limits and curfew times, as specified by the State DOH rules and regulations, would be followed during construction.

4. HISTORICAL AND ARCHAEOLOGICAL RESOURCES

4.1 EXISTING CONDITIONS

To determine the archaeological and historical resources of the proposed project site, a surface and limited subsurface archaeological inventory survey of the entire project parcel has been conducted and is included as Appendix F to this EIS. The survey report has been forwarded to the State Department of Land and Natural Resources, Historic Preservation Program/State Historic Preservation Office (DLNR/HPP/SHPO) for review and confirmation of preliminary assessments regarding the significance of sites and measures required to mitigate potential impacts to those sites. The following is a summary of the information contained in Appendix F.

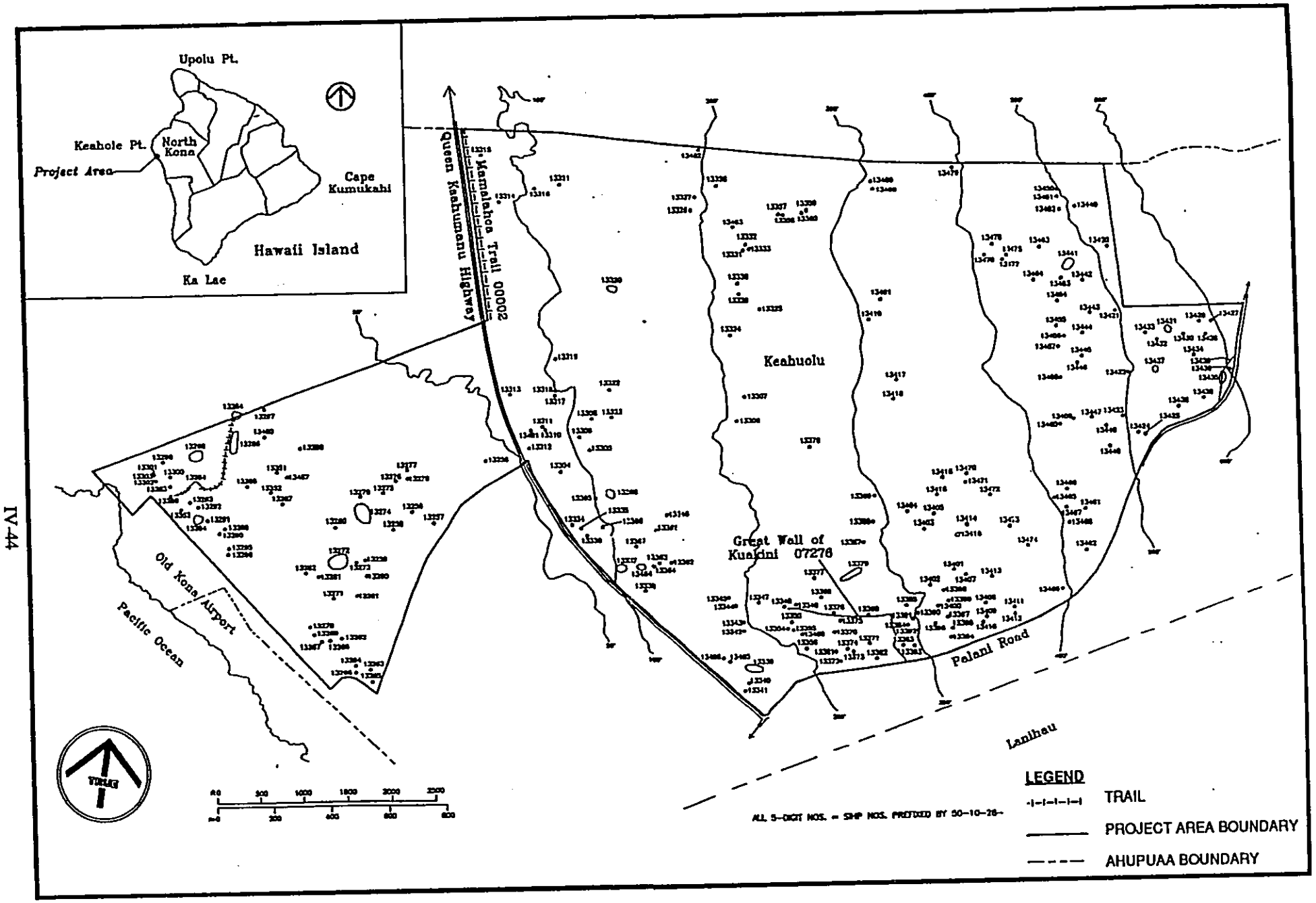
The area of North Kona between Kailua Bay and Keauhou Bay is generally recognized as the population core and fertile agricultural district of North Kona. To the north of Kailua Bay, beginning at Honokohau, is the relatively dry Kekaha district of North Kona. Keahuolu, the project site, is situated in the transition zone between these two contrasting environmental districts.

The Keahuolu area, along the shoreline, has been recorded as the site of various habitation and agricultural activities. However, there is little historic information regarding the traditional Hawaiian land use for the inland portion of the project area and no *kuleana* grants were awarded there. It is apparent from the archaeological record observed at Keahuolu, Kealakehe and Honokohau 2nd, that agricultural activities (apparently prehistoric, i.e., pre-western contact) were relatively intensive in the area historically designated as grazing land.

During the inventory survey conducted for the project, 239 sites consisting of 1,810+ component features were identified within the project area. The approximate locations of the sites is shown on Figure IV-10. State Inventory of Historic Places (SIHP) site numbers were assigned to 237 sites. Two sites, Mamalahoa Trail (Site 00002) and Kuakini Wall (Site 07276) had been previously assigned SHIP numbers.

Within the project area there are four relatively distinct clusters of sites. These occur at the northwestern end of the project area between 9 and 20 feet above mean sea level (AMSL); along the east side of Queen Kaahumanu Highway between 50 and 150 feet AMSL; along the north side of Palani road between 200 and 400 feet AMSL; and at the eastern end of the project area between 450 and 600 feet AMSL. The patterning of these clusters is such that they are in non-overlapping elevation ranges that encompass the overall elevation range of the project area.

The distribution of sites in general shows no marked tendency toward higher densities at specific elevations. To examine patterning of features by elevation, the consulting archaeologists selected three general intervals: less than 200 feet (101 sites in approximately 580 acres or 53 percent of the total surface area); 200 to 300 feet (117 sites in approximately 380 acres or 34 percent of the total surface area); and 400 feet or more (51 sites in approximately 140 acres or 13 percent of the total surface area). These three elevation intervals approximate three annual rainfall zones of 20 to 30 inches, 30 to 40 inches and 40 to 50 inches.



LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

Source: PAUL H. ROSENDAHL, Ph.D., INC., MAY 1990
Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure IV-11
ARCHAEOLOGICAL SITES

A breakdown of formal feature types by elevation interval (Table IV-7) indicates that, overall, feature density is greater in the upper interval (400 feet or more). In this interval, 26.4 percent of all features occur in 13 percent of the total surface area. This equals approximately 3.4 features per acre. In the lower elevation interval (less than 200 feet), the feature occurrence rate is approximately 1.3 features per acre, and in the 200 to 399-foot elevation interval, there are approximately 1.5 features per acre.

Twenty-six formal types are represented among the identified features. These include those listed in Table IV-7 plus five types with less than three occurrences that are listed as "other" in Table IV-7. These five types included two roadbed sections, a cupboard, a loading ramp, two modified poles and two uprights. Predominant among the formal types are pahoehoe excavations, three varieties of rock mounds and modified blisters and outcrops.

The clear majority of these features, which together comprise 76 percent of all features, reflect agricultural activities. Agricultural activities are also represented by enclosures, terraces, rubble walls and low platforms. Overall, approximately 90 percent of all features are associated with agricultural functions.

4.2 PROBABLE IMPACTS

The basic purpose of an archaeological inventory survey is to identify, i.e. to discover and locate on available maps, all sites and features of potential archaeological significance present within a specified project area. An inventory survey constitutes an initial level of archaeological investigation. It is extensive rather than intensive in scope and is conducted primarily to determine the presence or absence of archaeological resources. This level of survey indicated both the general nature and variety of archaeological remains present, and the general distribution and density of such remains. It permits a general significance assessment of the archaeological resources and facilitate formulation of realistic recommendations and estimates for any subsequent mitigation work as might be appropriate or necessary. Such mitigative work could include further data collection involving detailed recording of sites and features and limited test excavations; mitigation could also include more extensive and intensive data recovery excavations, construction monitoring, interpretive planning and development and/or observation of sites and features with significant scientific research, interpretive and/or cultural values.

TABLE IV-7

ARCHAEOLOGICAL FEATURE COUNTS BY FORMAL TYPE AND ELEVATION INTERVAL

FORMAL TYPE	<200 FT N	<200 FT %	200 TO 399 FT N	200 TO 399 FT %	400 FT + N	400 FT + %	TOTAL	%
Alignment	16	51.6	8	25.8	7	22.6	31	1.7
Cairn	10	25.0	13	32.2	17	42.5	40	2.2
Cave	9	18.0	24	48.0	17	34.0	50	2.8
C-Shape	2	40.0	1	20.0	2	40.0	5	0.3
Enclosure	8	18.6	17	39.5	18	41.9	43	2.3
Faced Mound	--	--	2	15.4	11	84.6	13	0.7
Filled Crevice	4	80.0	--	--	1	20.0	5	0.3
Linear Mound	4	22.2	13	72.2	1	5.6	18	1.0
Midden Scatter	3	100.0	--	--	--	--	3	0.2
Modified Blister	12	19.0	17	27.0	34	54.0	63	3.5
Modified Outcrop	136	74.3	20	10.9	27	14.8	183	10.1
Mound	46	22.4	20	9.7	139	67.8	205	11.3
Overhang	9	90.0	--	--	1	10.0	10	0.6
Phh. Excavation	392	43.9	368	41.3	132	14.8	892	49.3
Pavement	5	31.3	2	12.5	9	56.2	16	0.8
Petroglyph	13	72.2	2	11.1	3	16.7	18	1.0
Platform	8	18.2	22	50.0	14	31.8	44	2.4
Rock Concentration	17	100.0	--	--	--	--	17	0.9
Terrace	27	32.5	27	32.5	29	34.9	83	4.6
Trail	7	53.8	--	--	6	46.2	13	0.7
Wall (bifaced)	1	12.5	6	75.0	1	12.5	8	0.4
Wall	11	26.8	23	56.1	7	17.1	41	2.3
Other	5	55.6	2	22.2	2	22.2	9	0.5
TOTAL	745	41.2	587	32.4	478	26.4	1,810	99.9

Source: Appendix F.

Based on the preceding, significance categories used in the site evaluation process are based on the National Register criteria for evaluation. Both the federal and state governments use these criteria for evaluating cultural resources. Sites determined to be potentially significant for informational 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 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 with potential cultural significance are evaluated under guidelines prepared by the Advisory Council on Historic Preservation. 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 facilitate management decisions regarding the subsequent treatment of resources, the general significance of the archaeological resources identified during the inventory survey were also evaluated in terms of potential scientific research, interpretive and/or cultural values.

Based on the criteria cited above, 207 of the 238 sites identified during the archaeological inventory survey for the project are assessed as significant solely for information content. No further work is recommended for 84 of the 207 sites. These 84 sites are generally isolated agricultural features which lack cultural deposits and portable remains; they have been measured, mapped, described, photographed, plotted and selected samples have been excavated. Data collected from them during the survey is considered sufficient; their preservation is not essential, although perhaps they could be considered for inclusion into development landscaping. Further data collection is recommended for the remaining 123 of the 207 sites. After further data collection is completed, if warranted, a data recovery plan should be prepared and implemented for sites not recommended for preservation or interpretation.

Twenty-three of the 238 recorded sites are assessed as significant under National Register Criteria C and D. The majority of these sites are habitation/agriculture complexes located within

a distinct concentration at the northern end of Kuakini Wall, along Palani Road. The spatial concentration within a "district-like" area greatly enhances their integrity and Criterion C significance. It is the intention of the landowners to establish an "Historic Reserve" for these sites, i.e., an area that would be set aside with the archaeological features preserved "as-is" with interpretive signage describing the sites and their interrelationships. As a group, these sites also exhibit a high cultural value, which cannot be attributed to them on an individual basis. One site ((13441 - complex) is not located within the preserve district. This complex includes a number of unique and exemplary agricultural and habitation features and is contained within a relatively well-preserved enclosure. The formal attributes of the features at this site are not repetitive of the features within the preserve district and it is likely that a different time period, social group or agricultural pattern is represented.

Eight of the sites within the preserve district with Criteria C or D significance are individually assessed as having provisional cultural value, in addition to high interpretive and information values. These sites include features which potentially contain human interments. Presence or absence of the burials can only be determined through subsurface testing. If, however, the features are preserved for their interpretive value within the context of the surrounding area, there would be no need to disturb the features or potential interments.

Seven of the 238 total identified sites are assessed as significant under Criterion D and as having high cultural value, due to the presence of human remains. These sites consist of cave shelters with exposed human interments that are generally in poor preservation and disturbed. It has been recommended that the remains be preserved "as is" in the location of the original interment, with stabilization of the disturbed burial features and documentation of the nature (i.e., disposition prior to stabilization) and the location of the remains. If the burials are not preserved "as is", the procedures of Section 43 of Chapter 6E (Historic Preservation, HRS, as amended) would be followed. A mitigation plan would be developed and agreed to by DLNR/HPP/SHPO and a plan for final disposition of the remains developed in accordance with Chapter 6E.

Two sites, Mamalahoa Trail and Kuakini Wall, are assessed as significant under Criteria C and D as well as having high cultural value. Preservation with interpretive development of the portions of the sites within the project area has been recommended.

4.3 MITIGATION MEASURES

In compliance with applicable federal, state and county archaeological, historical and cultural features preservation laws, rules and regulations, the recommendations of the consulting archaeologist will be followed. That is, sites will be preserved as required under the various significance criteria and preservation methods for those criteria. A mitigation plan is being developed by the consulting archaeologist and that plan will undergo review and approval of DLNR/HSS/SHPO prior to implementation. Further, appropriate mitigation measures would be taken prior to the initiation of construction activities that might disturb any sites recommended for preservation. The creation of an Historic Reserve to protect the concentration of sites at the northern end of the Kuakini Wall near Palani Road constitutes an additional mitigation measure.

5. SOCIOECONOMIC FACTORS

5.1 EXISTING SOCIOECONOMIC CONDITIONS

5.1.1 Overview of Existing Conditions

A Socioeconomic Impact Assessment of the proposed project has been completed and is included as Appendix G. Additionally, a Public Revenue - Cost and Economic Impact Analysis has been performed and is included as Appendix H. The following summarizes those studies.

Existing socioeconomic conditions have been analyzed in terms of (1) historic and geographic factors; (2) economic base and employment; (3) population; (4) housing patterns; and (5) lifestyle and values.

5.1.1.1 Historic and Geographic Factors

North and South Kona: Kailua-Kona was one of the centers of government for all of Hawaii during the rule of the Kamehameha dynasty. In the later years of the Hawaiian Kingdom, it receded in importance and became a small fishing village again. With the emergence of the sugar industry, Hilo (in East Hawaii) became the predominant population and political center for the island of Hawaii.

Unlike many other rural parts of Hawaii, Kona's social and economic systems did not depend on a few large employers. During much of this century, economic activity in the Kona area centered around small-scale ranching and coffee farming. In the 1960's, Kailua-Kona began to emerge as a new economic and population center as the visitor industry developed along the West Hawaii coast. While the first major luxury hotel, the Mauna Kea, was in South Kohala, North Kona soon became the most developed site of hotels and resort condominiums on the Big Island. In the 1980's, new hotel development shifted from North Kona to South Kohala, but condominium construction continued in Kona. Consequently, there has been more recent population growth in the coastal resort areas of Kailua and neighboring Keauhou.

South Kona has remained relatively undeveloped, with little in the way of direct resort activity. The indirect effects of North Kona's visitor industry growth have produced more population in South Kona villages, but many residents are still involved in farming or fishing.

South Kohala: The Kohala Mountains divide both South and North Kohala into a "dry side" and a "wet side." For much of the past century, the majority of South Kohala's sparse population lived in or around the cool mauka town of Waimea (also called Kamuela), which straddles the South Kohala wet side/dry side boundary.

Until the mid-1960's, South Kohala's economy centered on truck farming and ranching, particularly the sprawling Parker Ranch headquartered in Waimea. In 1965, tourism began to bring economic prominence to the dry coastal region with the opening of the 310-room Mauna Kea Beach Hotel. The 1970's saw construction of the Queen Kaahumanu Highway to Kona; development of the Lalamilo water system; expansion of the Waikoloa resort/residential subdivision south of Waimea; and the establishment of numerous second homes and an observatory base camp in Waimea.

The 1980's brought new resort hotel operations to South Kohala including the Sheraton Royal Waikoloa (now the Royal Waikoloan), the Mauna Lani Bay Hotel and the Hyatt Regency Waikoloa opened in late 1988. In addition, there was continued population growth in the Waikoloa residential area mauka of Waikoloa Resort, as well as some growth in the non-resort coastal communities of Puako and Kawaihae.

North Kohala: This district is a peninsula formed by the Kohala Mountains. Until very recently during historic times, the western, "dry side" mountain slopes and coast have been

almost unpopulated, except by a few cattle ranch employees. Human settlement has been concentrated in villages located in the "wet side," on the northeastern part of the peninsula. The road comes to an end at Pololu Valley, which marks the beginning of a series of steep cliffs and valleys that render the rest of the eastern coast basically uninhabitable for significant numbers of people. Thus, the settled parts of North Kohala have historically been isolated from the rest of the island.

In the 1980's, there was modest growth in the population of subdivisions located in the "dry side" between Hawi and Kawaihae, as well as a few new mauka "wet side" subdivisions.

5.1.1.2 Current Economic Base and Employment

Major Industries: The current principal economic activities in West Hawaii are the visitor industry, construction, diversified agriculture and ranching, and high technology activities in astronomy and ocean science. The visitor industry is the most important of these, in economic terms.

Labor Force and Employment: West Hawaii employers report a labor shortage, particularly among skilled construction workers and entry level service workers for restaurant, retail, and resort operations.

The most recent available unemployment and workforce estimates from the Department of Labor and Industrial Relations (DLIR) are shown below in Table IV-8.

The most recent detailed analysis of occupational patterns is provided by the 1980 Census. Table IV-8 shows selected data from the 1980 and 1970 Censuses. Some important conclusions from this table:

- Compared to workers countywide or statewide, employed residents of North Kona, North Kohala and South Kohala were much more likely to be in tourism-related occupations or industries in 1980.

- In North Kohala, there was a dramatic 1970-80 shift from agriculture to tourism-related work, due to the phaseout of sugar cultivation. Many such tourism jobs were located outside North Kohala, as indicated by high average commute times.

TABLE IV-8

SELECTED HAWAII COUNTY UNEMPLOYMENT
AND WORKFORCE ESTIMATES

AREA	1988 ANNUAL AVERAGE CIVILIAN LABOR FORCE	1988 ANNUAL AVERAGE UNEMP. RATE (%)	AUGUST 1989 CIVILIAN LABOR FORCE	AUGUST 1989 UNEMP. RATE (%)
North Kona	9,776	3.7	10,645	2.1
South Kona	3,778	4.0	4,108	2.4
North Kohala	1,795	6.6	1,929	3.9
South Kohala	2,819	4.4	3,060	2.6
West Hawaii	18,168	4.3	19,742	2.4
Hawaii County	54,676	5.0	59,206	2.9

(NOTE: DLIR estimates for sub-county areas are based on 1980 census shares, hence usually under-estimate numbers for high-growth areas like West Hawaii. Based on actual population and labor force participation rates, CRI would estimate West Hawaii's 1988 civilian labor force as about 19,100 -- a figure to be used later in this section for forecasting purposes.)

- South Kona's workforce was more involved in agricultural occupations and industries than was the case elsewhere in West Hawaii or the rest of the county, on average.

- South Kona and North Kohala had relatively low proportions of managerial/professional workers.

Continuing West Hawaii resort development would suggest even more concentration in tourism today, as well as more intensive use of available workers. Preliminary results of the 1988 "Tourism Impact Management System" (TIMS) survey by the Department of Business and Economic Development (1989) indicate:

- The percentage of employed workers who consider themselves "in the visitor industry" was around 40 percent in Kona and 35 percent in Kohala, compared to an islandwide figure of just 25 percent.

- North Kona's civilian labor force participation rate is now close to 80 percent -- i.e., four out of every five potential workers aged 15 or above now holds a job or is actively seeking one.

- West Hawaii workers (particularly those in North Kona) are more likely than those in East Hawaii to work more than 48 hours a week and to work standard evening and/or weekend hours.

5.1.1.3 Population Levels and Composition

West Hawaii has been one of the fastest growing areas in the State of Hawaii. As shown in Table IV-9, its population nearly tripled from 1970 to 1988 (from 14,500 to 40,700). The growth rates have been particularly high in North Kona and South Kohala, sites of major resort development in the 1970's and 1980's. Growth in South Kona has essentially just matched the islandwide rate. In North Kohala, there was no growth from 1970 to 1980 and only modest estimated population increases since 1980.

As of 1980, North Kona was the only district in Hawaii County where a majority of the population consisted of Caucasians. (See Census data in Table 2-C, Appendix G.) Nearly a quarter of North Kona's population at that time had been living on the Mainland five years previously, and 40 percent had been Mainland-born -- much larger percentages than for the county as a whole.

Substantial in-migration from the Mainland is also apparent in the 1980 Census data for South Kohala. South Kona and North Kohala had a more ethnically mixed population, including more people born in Hawaii (more than 70 percent each) than North Kona and South Kohala.

Although there have been anecdotal reports of a surge of retirees moving to West Hawaii in the 1980's, the earlier Census data indicate that North Kona and South Kohala had relatively few senior citizens in 1980. The more youthful North Kona/South Kohala population was better educated, on average, than populations elsewhere on the Big Island. By contrast, the aging North Kohala population had lower than average educational levels.

5.1.1.4 Housing Stock

Housing in West Hawaii (with the possible exception of North Kohala) is now considered to be in very short supply, leading to crowding and to high rentals and sales costs.

TABLE IV-9

POPULATION TRENDS, STATE OF HAWAII, COUNTY OF HAWAII, AND STUDY AREA, 1970 - 1988

AREA	APRIL 1, 1970	APRIL 1,1980	JULY 1, 1988
North Kona District	4,832	13,748	21,600
South Kona District	4,004	5,914	7,500
South Kohala District	2,310	4,607	7,900
North Kohala District	3,326	3,249	3,700
Total West Hawaii Study Area	14,472	27,518	40,700
County of Hawaii	63,468	92,053	117,500
State of Hawaii	769,913	964,691	1,098,200
	AVERAGE ANNUAL RATE OF GROWTH (%)		
North Kona District	11.0	5.6	8.6
South Kona District	4.0	2.9	3.5
South Kohala District	7.1	6.8	7.0
North Kohala District	-0.2	1.6	0.6
Total West Hawaii Study Area	6.6	4.9	5.8
County of Hawaii	3.8	3.0	3.4
State of Hawaii	2.3	1.6	2.0

Source: Hawaii State Department of Business and Economic Development, Data Book, November 1989.

During the 1980's, the West Hawaii housing inventory grew more slowly than the resident population, meaning that more people must share living quarters. From 1980 to 1988, population increased by more than 48 percent. However, County figures, as shown in Table IV-10 (from Appendix G), indicate that, even by March 1989, the total West Hawaii housing unit inventory had increased by only 26 percent. Moreover, over 40 percent of the new units were visitor units. In the rest of Hawaii County, proportionate growth in housing units more closely matched growth in population.

Furthermore, Hawaii Visitors Bureau data indicate that nearly 2,000 of the 16,000 West Hawaii housing units are actually condominiums for visitor use. (Condominiums in resort areas may be made available for visitor use during peak travel years, then revert to long-term residential rentals when tourism declines.) An unknown number of West Hawaii single-family homes may also now be reserved for visitor rentals or second homes.

In 1988, the average resale price for a single-family home was about $160,000 in West Hawaii, but less than $95,000 in the rest of the county. Of all Hawaii County single-family homes sold for $175,000 or more in 1988, 89 percent were in West Hawaii (Neighbor Island Multiple Service Data Base). Table 2-E, Appendix G, contains additional descriptive information from past Censuses.

5.1.1.5 Lifestyle and Values

Historically, the Kona Coast has been populated by highly independent and individualistic people. By contrast, neighboring South Kohala was historically a much more close-knit community, following establishment of the Parker Ranch in the 1800's. In the manner of the times, Ranch managers exercised paternalistic control over many aspects of employees' lives, including provision of housing and health care.

In the past several decades, the transition from an agricultural to a service-based economy -- along with substantial in-migration and demographic shifts -- has modified these patterns. South Kohala's social fabric has become more diverse and independent, while Kona residents now are somewhat more likely to belong to some common social or economic institutions (e.g., labor unions at major hotels).

TABLE IV-10

HOUSING UNIT INVENTORY, COUNTY OF HAWAII AND WEST HAWAII DISTRICTS, 1980 AND 1989

AREA/HOUSING TYPE		1980	1989	% CHANGE 1980 TO 1989
WEST HAWAII	Single Family	4,105	5,322	29.6
	Duplex	122	146	19.7
	Multi Family	2,934	4,109	40.0
	Other	379	N/A	____
DISTRICT TOTAL - ALL UNITS		7,540	9,577	27.0
SOUTH KONA	Single Family	1,631	1,974	21.0
	Duplex	28	34	21.4
	Multi Family	48	88	83.3
	Other	15	N/A	____
DISTRICT TOTAL - ALL UNITS		1,722	2,096	21.7
NORTH KOHALA	Single Family	1,092	1,235	13.1
	Duplex	12	14	16.7
	Multi Family	7	7	0.0
	Other	11	N/A	____
DISTRICT TOTAL - ALL UNITS		1,122	1,256	11.9
SOUTH KOHALA	Single Family	1,692	2,236	32.2
	Duplex	10	84	740.0
	Multi Family	511	653	27.8
	Other	5	N/A	____
DISTRICT TOTAL - ALL UNITS		2,218	2,973	34.0
TOTAL STUDY AREA	Single Family	8,520	10,767	26.4
	Duplex	172	278	61.6
	Multi Family	3,500	4,857	38.8
	Other	5	N/A	____
DISTRICT TOTAL - ALL UNITS		12,602	15,902	26.2
REST OF COUNTY	TOTAL - ALL UNITS	22,370	26,287	17.5
HAWAII COUNTY	TOTAL - ALL UNITS	34,972	42,189	20.6

NOTE: "N/A" Category no longer used by county.
SOURCE: Data File, Land Use Inventory, County of Hawaii Planning Department, March 1989.

Nevertheless, Kona residents are still regarded as very different in lifestyle and values from the more populous East Hawaii area, where plantation life has left a legacy of more communal values.

Some quantified indications of lifestyle and values are provided by preliminary results of a 1988 State survey with separate samples for North Kona, Kohala, South Kona/Ka'u, and other Big Island areas. Asked why they chose to live in their part of the island, North Kona residents were much more likely than other Big Island residents to talk about "convenient location," "climate," or Kona's "outdoor character" -- much less likely to refer to family or other longtime "roots" (Table IV-11).

TABLE IV-11

REASONS FOR CHOOSING TO LIVE IN VARIOUS PARTS OF THE BIG ISLAND

Question: "Why did you choose to live in THIS PART of the island?"

(Answers were given in respondents' own words, then later coded into categories. Percentages sum to more than 100 percent because more than one answer could be given.)

	North Kona (%)	N. & S. Kohala (%)	S. Kona Ka'u (%)	Hawaii County (%)
Convenient/close to jobs, schools, shopping, etc.	34	27	22	27
Climate/health	31	25	13	16
Family/roots in area	21	39	37	32
Lack of congestion, traffic	20	24	27	24
Outdoor character of area	15	23	8	10
Social character of area	12	8	3	6
(No sense of choice)	8	5	10	9
Housing value/affordability	5	3	3	11
Like neighborhood character	1	1	2	1
Non-replies	2	1	1	3
Survey Base:	168	152	155	789

SOURCE: Hawaii State Department of Business and Economic Development, Tourism Branch, 1989. (Preliminary Results).

5.1.2 Forces For Change

The discussion below is a review of future changes expected to occur with or without the proposed project.

5.1.2.1 Quantitative Projections

Countywide: The State of Hawaii's official "M-K Series" forecast for the period through year 2010 (as shown in Table 2-G, Appendix G) indicate substantial economic and population growth for Hawaii County:

- Resident population increasing by 75 percent over the estimated 1988 figure of 117,500, to reach 180,800 persons by the year 2005 and 206,100 by year 2010;
- The average daily visitor count more than tripling, to reach 36,900 in 2010;
- An ongoing shift in the distribution of jobs, with fewer people working in agriculture and more in tourism (hotels, eating and drinking);
- Per capita personal income increasing by 40 percent from 1990 to 2010, to an average of $13,600 (1982 dollars).

West Hawaii: Projected massive growth in West Hawaii's visitor industry is expected to produce major increases in employment and population. For example, the West Hawaii Regional Plan (Office of State Planning, 1989) estimated current West Hawaii "resort units" (hotel plus condominiums) at 7,429 -- a figure which would increase to 39,009 if all planned and proposed resort developments were to build out. (The report assumes the actual build-out figure by the year 2005 would be just 25,279 units, which is still nearly three and a half times the existing inventory.)

Unpublished projections made by the Hawaii County Planning Department in April 1989 assumed only slightly slower growth -- a total of about 26,000 visitor units (13,600 hotel rooms plus 12,400 resort condominiums) by the year 2010. More than 60 percent of these are assumed to be located in North Kona; most of the rest in South Kohala; and only a handful in South Kona or North Kohala.

In terms of population and employment, the State's M-K projections apply only to the county level. However, several other documents (all roughly compatible with the M-K projections at the countywide level) provide forecasts for West Hawaii in particular. These include:

(1) The Hawaii County Planning Department's General Plan contains three series of population and visitor industry projections. The lowest of these ("Series A," the current basis for County infrastructure planning) indicates a year 2005 countywide population of 173,000, slightly lower than the M-K figure of 180,800.

Additionally, the County Planning Department's unpublished April 1989 projections anticipate that about 53 percent of the island's employment will be located in West Hawaii (primarily North Kona and South Kohala) by the year 2010.

(2) The Office of State Planning's West Hawaii Regional Plan also extends to the year 2005. It projects a year 2005 countywide population of 170,400 and a West Hawaii population of 79,000 -- figures highly compatible with the General Plan "Series A" and preliminary draft M-K forecasts. The plan also assumes 25,900 new countywide jobs resulting from West Hawaii resort development, but does not attempt to predict what portion of these jobs will be in West Hawaii.

(3) The market assessment for the project (Natelson, Levander, Whitney, Inc., 1989) is based on the final M-K projections, extrapolated to the year 2020, with additional assumptions and projections for West Hawaii. It projects a slightly higher year 2005 West Hawaii resident population (87,005) than do the West Hawaii Regional Plan or the County Series A projections, but is otherwise consistent with them. That is, all three assume the West Hawaii population will, roughly, double by 2005. Table 2-H (Appendix G) contains a summary of key assumptions and results from this market assessment. Based primarily on Table 2-H (Appendix G) and the M-K projections, as well as current employment estimates, Community Resources Inc. (CRI) has developed some additional projections of future West Hawaii jobs and labor supply, for the years 2005 and 2020. These are shown in Table 2-I, Appendix G.

The CRI analysis results in a total projected West Hawaii jobcount of 37,500 for the year 2005 and 65,200 for 2020. New labor supply resulting from natural increase (excess of births over deaths) in the existing West Hawaii population -- as measured by two separate methods

producing highly similar results -- would be able to fill only about 13 percent of the new jobs from now until 2005 and a little under 12 percent of the projected new jobs from 2006 to 2020. If there is no increase in commuting from East Hawaii, the remaining 88 percent of the new jobs would have to be filled by net in-migration (that is, more people moving into West Hawaii than moving away).

As the table (Table 2-1, Appendix G) notes, however, the actual proportion of jobs going to net in-migrants may be somewhat lower, perhaps only 60 percent by 2005. That is because the analysis is based primarily on M-K assumptions for Hawaii County, and these assumptions include very low rates of labor force participation compared to other counties. If existing residents and their children absorb more jobs, fewer in-migrants will be needed.

The analysis deals with a long period, and does not distinguish recent in-migrants from ones who have lived in the area for decades. If in-migrants come to take West Hawaii jobs at a constant pace, recent in-migrants, who have lived 5 years or less in West Hawaii, would account for about 16 percent of the 2005 workforce, and 10 percent of the 2020 workforce.

5.1.2.2 Qualitative Changes in West Hawaii

The social impacts of the preceding quantitative changes will depend in large part on (1) geographical distribution of growth; (2) location and timeliness of development of infrastructure (including housing); and (3) characteristics of in-migrant workers. All three topics are discussed in detail in Appendix G. In brief, geographical distribution and growth are still being determined through the government land use process. Indications of broad policies have been provided by the County and the market assessment prepared for the project (Appendix G), the West Hawaii Regional Plan and the Hawaii County Planning Department's Draft Keahole to Kailua Development Plan.

5.1.3 Community Issues and Concerns

The most recent community survey shedding light on major issues in West Hawaii was the State Tourism Impact Management System (TIMS) study conducted in later 1988. Preliminary results, as shown in Table 3-A, Appendix G, indicate that:

- Lack of affordable housing was the top issue throughout the island, but was ranked even more highly in West Hawaii -- and particularly in North Kona, where 76 percent said it was a "big problem" for that part of the island.

- Cost of food/clothing and traffic congestion were the next most important North Kona issues, rated as "big problems" by nearly 60 percent.

  For virtually all the issues on the list (except lack of jobs or urban amenities), North Kona residents were more likely than people elsewhere on the island to feel there was a serious problem. However, the gap was particularly large for traffic. The proportion of North Kona residents saying this was a "big problem" was twice as much as the rate for the island as a whole.

- Lack of sports/recreation facilities was also counted as a major problem by more than 50 percent of both North Kona and South Kona/Ka'u residents. This was of much less concern in areas such as Kohala or East Hawaii, where plantations and large ranches built gymnasiums and playing fields in earlier years.

- Environmental and/or crowding concerns (rapid population growth, crowded parks, destruction of natural beauty, pollution) were counted as "big problems" by more than a third of North Kona residents -- higher than in most other parts of the island.

- Overall quality of life was felt to have grown worse over the past five years by about a third of North Kona residents -- compared to only 18 percent islandwide. (However, 36 percent of North Kona residents felt it had grown better. Statewide, North Kona was the only heavily resort-impacted area in which a few more people felt life had grown "better" rather than "worse." By comparison, in West Maui 63 percent said "worse" vs. just 16 percent "better.")

- Negative attitudes toward further tourism growth were prevalent throughout the island (and the state), but even more so in West Hawaii than elsewhere in Hawaii County. Statewide preliminary TIMS results indicate such attitudes largely reflect growth-related problems.

Both the TIMS survey and a recent study by the University of Hawaii School of Social Work (Matsuoka et. al., 1988) found that most Kona respondents thought tourism impacts to date had been, on balance, very positive because of the economic benefits. There were, however, strong concerns about continued growth.

Surveys such as the TIMS study indicate broad background issues for entire populations. Specific controversies may involve a more limited group of people not necessarily representative of the entire population, but these individualized issues are often related to the more general themes.

A review of major Big Island publications (particularly the newspapers West Hawaii Today and the Hawaii Tribune-Herald) indicate a great variety of such issues and controversies relating to the North Kona area. A sampling from the latter part of 1989 would include:

- Plans for a commercial rocket launching facility in Ka'u produced strong public reaction in Kona. Some residents expressed concern with impacts on air quality, and consequently health, plant life, and the visitor industry. Another issue was the possibility of the island becoming a military target.

- A proposal to build a gymnasium on the State-managed part of the Old Airport Park and the subsequent decision by the County to build it on the County-leased section of the park were debated. Many thought that accessible sports facilities are much needed, and the Old Airport Park is a good site for these. Others thought the Park should remain dedicated to passive uses.

- The police in the Kona Station have complained that fumes from the adjacent dump enter the station and affect their health. (Community interviewees cited this as an example of poor government planning in Kona. See Appendix G, Sections 3.2.2 and 3.3.)

- The County review of the ohana zoning law responded to complaints in Kona that developers were creating double density, residential condominiums. Residents were concerned that developers are able to sell many extra units, straining the infrastructure.

5.1.4 Information from Community Interviews for This Study

Community interviews for this study included questions about issues and concerns independent of (although potentially related to) the proposed project. The major issues emerging from these interviews were all generally linked to rapid growth and its control or management. They can be classified into the three broad categories listed below and discussed in detail in Appendix G:

- Physical planning and infrastructure;
- Social infrastructure; and
- Socio-political concerns.

5.1.5 Community Issues and Concerns With Regard to The Project

Table 3-B, Appendix G, summarizes the issues raised in the interviews. The following provides a general overview of individual issues and concerns.

5.1.5.1 Overview and Context for Evaluation

The preceding discussion of "Background Issues" provides the broad context in which interviewees responded to the Keahuolu Lands proposal. However, three particular issues seemed critical for people: Kona's rapid growth, its infrastructure problems, and the need for more recreational opportunities.

5.1.5.2 Specific Concerns

The specific concerns mentioned in the interviews fall into five broad sets of issues. These are listed in Table 3-B, Appendix G, in order of frequency -- the topics listed near the beginning of the table were discussed by more informants than the topics listed near the end. (Within each section, views expressed by informants are also grouped by order of frequency.)

The five sets of issues (and various sub-issues) were:

- The Project as a Planned Development
- The Makai Keahuolu Property
- Reactions to Specific Proposed Components
- Anticipated Impacts on Adjacent Uses
- Liliuokalani Trust/Children's Center

5.1.5.3 Interest Groups with Distinctive Concerns

Most concerns were shared by nearly all those interviewed. However, merchants and real estate professionals showed more interest than others in the project's possible impact on retail and industrial areas. Members of the Hawaiian community and several other community leaders were most likely to mention concerns about use of the makai parcel and the activities of the Trust. Hawaiian respondents were also more likely than others to express concern over potential historic sites on the property.

5.1.6 Overview of Existing Market Conditions and Potentials

The economic growth potential for the County of Hawaii in general and West Hawaii in particular are intrinsically linked with the visitor industry. The tourist industry creates the potential for growth for local resident population with its own set of housing, retail, light industrial, institutional, recreational and public service requirements. Recent trends show growth for the West Hawaii area not only in the visitor industry but also in the resident population. The resident population of West Hawaii is projected by 2020 to increase to 144,200 persons, or 54.7 percent of the county total. Overall, the county should have a growing economy due to the expanding tourist industry. The following identifies the market potentials for several categories of functions that could be supported on the project property. A complete analysis of these potential is presented in Appendix A. The key element of the analyses that have been conducted is that all of the functions and elements of the proposed project appear to be economically and socially supportable.

5.1.6.1 Residential Market Potentials

The demand for residential development on the project property has been determined through a review of regional market forces in the county as well as local trends within the immediate Kailua-Kona area. As noted previously, at present there is a shortage of affordable housing, not only in Hawaii County, but throughout the state. However, in Hawaii County, this shortage is highlighted in the West Hawaii area, particularly in North Kona and South Kohala. It is estimated (Appendix A) that the cumulative demand for new housing in West Hawaii is about 41,500 units over the next 32 years. It is further estimated that the proposed project could reasonably be expected to capture approximately 15 percent of this demand, or over 6,200 units, the majority of which could be single family units.

5.1.6.2 Commercial Retail Potentials

The market potential for retail goods and supportable retail space is primarily a function of the market area population, personal income and that proportion of personal income that is expended on various retail goods. In 1988 the total capturable sales in West Hawaii was estimated to be about $245 million. This is expected to increase to about $1.1 billion by 2020 as measured in constant 1988 dollars. It has been estimated (Appendix A) that the project property has the potential to capture about 35 percent of the increase in retail demand in West Hawaii. At this capture rate, approximately 960,000 additional square feet of retail gross leasable area will be supportable within the project by 2020. This translates to four major retail centers: (1) a regional shopping center with two to three major department stores; (2) two community/ neighborhood centers; and (3) a heavy commercial/automobile-related center.

5.1.6.3 Office Space Potentials

The demand for office space within the proposed project has been determined through an examination of current and future market forces as well as a review of the current supply of office space in North Kona. The project site has an excellent potential to provide office space for the area because it is located near employee generating areas such as Keahole Airport, the Kona Industrial Subdivision and the Kona Central Business District. There is also the opportunity to work with the county to provide a West Hawaii Civic Center/Government facility. It is estimated that by 2020 the project property should be able to support about 490,000 square feet of office space.

5.1.6.4 Industrial Market Potentials

The potential for development of major industrial activities in the county in the immediate future appear limited. West Hawaii is not expected to emerge as a major industrial/ manufacturing center. However, there is a mix of activities that could engender a substantial demand for industrial land. Those businesses that could require industrial land include automobile-oriented activities; wholesalers serving retail, restaurant and hotel operators, cottage industries such as traditional handicrafts, sports equipment and apparel manufacturing; businesses providing services and supplies to the building industry; contract construction storage yards and other storage facilities, including public storage; and local consumer oriented businesses.

5.1.6.5 Hotel Market Potentials

Hotel development on the project property is limited due to its location off the waterfront and the likelihood that the surrounding development would have a commercial/industrial character. However, there could be a need for a business-related traveler hotel with moderate prices, access to a golf course, meeting/conference rooms and other special services to business travelers. Such a hotel could be expected to capture between 1.5 and 2.0 percent of the West Hawaii demand for visitor accommodations. This translates to between about 130 and 170 rooms by 2005 and between about 200 and 270 rooms by 2020, assuming an occupancy rate of 80 percent annually.

5.1.6.6 Public and Institutional Lands Potentials

Because of the location of the project property and the existing businesses and land uses and the expected surrounding land uses, such as the state's Kealakehe project, the potential for the establishment of a new West Hawaii count and/or state governmental center exists. Such a center could house various offices for general administrative functions, social services, police and fire stations, a regional library, district and family courts, etc. Additionally, the location offers the potential to house a regional sports complex, a golf course oriented to local residents and neighborhood parks, at least one of which could be sited with an elementary school. All of these facilities are in short supply in the North Kona area.

5.2 PROBABLE SOCIOECONOMIC IMPACTS

Based on the interviews and socioeconomic impact assessment research performed for the proposed project, a consultant assessment of both quantifiable changes (e.g., employment and residential population) as well as more qualitative (social) impacts associated with the proposed project was developed. The analyses conducted to determine probable impacts also considered the market potentials as described in the preceding section.

Many of the impacts or effects associated with the project are positive. However, as appropriate, the section also includes some discussion of ways to mitigate negative effects and/or enhance positive ones.

5.2.1 Concept of "Impact" as Applied to The Proposed Project

In a socioeconomic impact assessment, an "impact" is usually not defined as the difference between existing conditions and the future with the proposed project. Rather, it is defined as the difference between two possible futures: future conditions which will occur even without the project and future conditions with the project.

Projected West Hawaii future conditions expected to occur whether or not the project is developed are discussed in Section 5.1.3. That future included:

- An expected boom in visitor industry construction, with the West Hawaii resort unit inventory at least quadrupling by the year 2005.
- Resident population roughly doubling by the year 2005, then nearly doubling again by 2020.
- Major in-migration of workers (as well as full-time resort residents and hotel visitors), resulting in substantial socio-political change.

The latter effects are all consequences of the first point, the expected rapid growth of West Hawaii tourism. A few other activities may generate some employment and population growth -- ocean science, agriculture, retirees -- but their impacts are expected to be very minor compared to tourism growth.

Similarly, the project will be, for the most part, a consequence of tourism growth, not something independent of it. The project's commercial, office and housing components will all be responses to growth, not causes of growth.

If it is assumed that the employment and population growth outlined in Section 2.2 will definitely occur, then commercial, office and residential housing support development is needed to support the new population. The "impact" of the project development is a matter of where such development takes place in West Hawaii, not whether it takes place. If the support activity does not take place at the project site, it must occur at other locations.

Preventing support activities could prevent tourism growth by interfering with labor supply. Few workers might move to West Hawaii without places to live or shop. However, many of the resorts already have their approvals and can be expected to proceed with

development even if it is necessary to attract workers with makeshift solutions (e.g., dormitories). Building new resorts without providing support services for new population would produce extreme negative impacts on cost of living and quality of life for existing residents.

Therefore, the major socio-economic impacts of the project (and particularly of the Regional Center) will involve location: effects of concentrating future retail and commercial activities in such a way as to expand and re-organize the existing Kailua Village.

The alternative future, for comparison's purpose, could generally be an unplanned and dispersed development of such urban support activities. As noted in Chapter III, alternative commercial, office and light industrial zoned lands do exist in other West Hawaii locations. Depending on the effectiveness of marketing and development decisions, it is possible that the project could capture less than its anticipated share of development. However, this scenario is just another version of the "dispersed development" future. Impact assessments are expected to consider maximal effects of project approval. The maximal socio-economic effects of the project will occur if it builds out rapidly, in such a way as to create a new Regional Center for West Hawaii.

5.2.2 *Quantitative Effects*

Given the preceding discussion, it could be argued that the project will have no real "impact" on West Hawaii jobs, population growth, or housing. That is, the various jobs which may be sited within the project would be located somewhere else, if the project does not take place. However, with implementation of the project there would be a significant increase in the number of jobs available in the West Hawaii region, as is noted below.

To permit full understanding of project implications, the following have been analyzed and described in detail in Appendix G and are briefly described below.

- Employment associated with the project;
- Population supported by these jobs, plus on-site population;
- Housing units occupied by employees and dependents.

5.2.2.1 Employment

Broad estimates of the phasing of development at the project site can be derived from the market assessment (Appendix A). That study identifies markets for various project elements in the period ending in 2005, and in the period ending in 2020. Remaining project elements are expected to be built in a third period, beginning in 2021. That period is likely to be longer than the preceding periods and its exact length cannot be specified.

As shown in Table 4-A of Appendix G, over half the project area could likely be developed in the first period. Development would continue in the remaining periods. Consequently, both construction and operational jobs will be generated on-site in each period.

Construction Employment: Construction activity in the 15- year period 1991-2005 is expected to generate over 8,600 jobs (see Table 4-B, Appendix G). The annual average number of construction jobs for the project in that period is under 600 jobs. (The annual average figure provides only a rough estimate of the actual construction workforce at any point in the period. The pace of construction will likely vary during each period. Also, the number of workers involved in any construction project changes during the course of the project. Furthermore, the number of workers on-site is smaller than the total number of workers employed in construction on a project, as some construction activities are performed off-site.)

In the second period, construction work is expected to generate nearly 5,000 jobs, yielding an annual average jobcount over 300. In the last period, the total construction jobcount would rise to over 17,000 jobs (no annual average jobcount can be estimated).

Operational Employment: By the end of the first period, over 2,700 jobs are likely to be created on-site. By the end of the second period, an additional 2,800 jobs would be created. By the final buildout of the project, the total operational workforce on-site would reach nearly 15,000 persons. In each period, the leading source of new operational jobs is commercial operations. Offices on-site are projected as employing about a third of the total operational labor force.

Operation employee income, on an annual basis at buildout, is forecast to be about $106 million in direct wages and the project will generate an average direct sales and rental income of about $3,582 million per year, in constant 1990 dollars.

Indirect and Induced Employment: As noted above, the project is responsive to anticipated growth in West Hawaii, rather than a major cause of growth. The jobs created on-site are hence largely indirect and induced employment impacts of income brought to Hawaii by new resorts. The State's West Hawaii Regional Plan estimates that nearly 26,000 new jobs will be created in Hawaii County by 2005. The construction and operational jobs projected as existing on-site by 2005 amount to about 12 percent of those new jobs.

Indirect and induced employment effects of the project can be estimated. Tables 4-C and 4-D of Appendix G provide information on direct, indirect, and induced employment associated with the project. (Direct employment consists of work on the construction of a project, and operational work on-site at the project. Indirect employment consists of jobs created as establishments that receive income from a project as a result of the purchase of goods and services in Hawaii. Induced employment consists of jobs created as the employees of a project spend their wages and pay their taxes, and hence support both private sector and government jobs.)

Combining the analyses of construction and operational employment in Tables 4-C and 4-D (Appendix G), the direct, indirect and induced employment effects of the project are estimated to be, for the following points in time:

	2005	2020	Buildout
Direct Employment	3,300	5,800	14,900
Indirect and Induced Employment, On-Island	800	1,900	3,900
Total Indirect and Induced	2,500	3,400	9,000

5.2.2.2 Population

The size of two population groups associated with the project can be calculated:

- People staying on-site; and
- People living in the area who depend on jobs at the project.

Most of the population living on-site at the project will consist of Hawaii residents. In addition, visitors at the proposed hotel and patients staying in the proposed hospital are part of the continuing on-site population.

Table IV-12 shows the population staying on-site for three points in time. Project residents are expected to number about 6,500 by 2005, approximately 8 percent of the West Hawaii population at that time (Office of State Planning, 1989). Over time, the project population will amount to a smaller fraction of the regional population, as little further residential construction is slated for the project site after 2005.

A few visitors would be on-site by 2005, at the business hotel located in the project. They would form a very small part of the visitor population in West Hawaii.

Employees of the project and project construction workers will support a population estimated to number about 8,400 in 2005, as shown in Table IV-13. The population supported by employment at the project is forecast as growing to 14,600 by 2020. Eventually, it could reach over 36,000.

5.2.2.3 Housing

The residential portion of this project consists of two components: an elderly retirement village of about 35 acres, and a 352-acre residential community. The latter is comprised entirely of land to be sold to the state and potentially developed by the state's Housing and Finance Development Corporation (HFDC). While the HFDC is only committed to developing 150 acres of the total 352 acre parcel at this time, for purposes of this study it is assumed that the state will ultimately develop all 352 acres in housing. The proposed project would complement the HFDC Kealakehe project by providing additional housing opportunities for the residents of West Hawaii.

TABLE IV-12

PROJECTED RESIDENT AND VISITOR POPULATION AT THE KEAHUOLU LANDS PROJECT

POPULATION GROUP	TIME PERIOD 2005	2020	BY BUILDOUT
RESIDENTS IN:			
Single Family Units[1]	6,120	5,910	5,910
Elderly Units[2]	360	510	510
TOTAL RESIDENT POPULATION	6,480	6,420	6,420
Average Daily Visitors in Hotel Units[3]	240	400	400
Average Daily Patients in Regional Hospital[4]	90	90	90

NOTES:

For phasing of construction of residential areas, hotel and hospital, see Table 4-A, Appendix G.

[1] Household size assumed to be 2.9 persons/unit in 2005, then 2.8 persons/unit in 2020 and subsequently, based on historic trends in Hawaii County.

[2] Household size assumed to be 1.5 persons/unit.

[3] Party size assumed to be 1.85 persons. Occupancy rates assumed to be 80 percent.

[4] Occupancy assumed to average 72 percent, based on West Hawaii Health Conference Task Force Report (1989).

TABLE IV-13

PROJECTED HOUSEHOLD POPULATION SUPPORTED BY PROJECT EMPLOYMENT, KEAHUOLU LANDS PROJECT

POPULATION GROUPS	TIME PERIOD 2005	2020	AT BUILDOUT
CONSTRUCTION:			
Annual Average Jobs[1]	580	330	0
Workers	580	330	0
Dependents[2]	1,100	630	0
Total in all construction Worker Households	1,680	960	0
OPERATIONS:			
Total Operations Jobs[1]	2,730	5,500	14,940
Workers	2,730	5,500	14,940
Dependents[2]	3,990	8,112	21,835
Total in all Operations Worker Households	6,720	13,662	36,775
BOTH GROUPS:			
Total in All Households	8,400	14,622	36,775

NOTES:

[1] From Table 4-B, Appendix G.

[2] Household size projected at 2.9 in 2005 and 2.8 in 2020 based on historical Hawaii County experience. Number of workers per household estimated as 1.3 (affecting number of dependents per worker.

[3] Construction workforce is based on an average over the periods ending in 2005 and 2020, while operational employment is calculated on the basis of the number of jobs created on-site by those points, so the combined figure is necessarily inexact.

At build-out, the project will include approximately 2,112 single-family housing units (at a density of 6 units per acre) and 340 residential units for the elderly. In light of current and anticipated demand for housing in the study area, all of these except 100 units for the elderly are projected to be built by 2005, as shown in Table 4-A, Appendix G.

Project employees (operational and construction) are expected to need about 2,100 housing units in 2005 (see Table 4-G, Appendix G). Many or most will already have homes in the area, and will not need new housing. Still, the project will provide housing equivalent to all the demand generated by employees in 2005, and about half the demand associated with project employment in 2020.

When the project is viewed along with the State's Kealakehe project, to be built on adjacent land, the net result of new development in the area is an increase of housing well beyond that needed by the on-site workforce in the next three decades.

5.2.3 Impacts on Liliuokalani Trust Operations and Programs

The project's impact on the Trust is expected to be positive, as the project will provide a new source of revenue:

- Increased revenue will support existing programs of the Trust statewide; and
- The Trust will be able to develop new programs. Plans for these are now under review by the Trust. The Trust is likely to enter new ventures cautiously in the coming years, "building on small successes based on community needs".

At this time, the Trust has made no definitive commitments to particular new programs. New initiatives under study include day care programs, after school programs with an emphasis on cultural education and a family life education program.

As few details of the project have been announced, many Kona residents are concerned that the project would negatively affect existing Trust programs in Kona, notably the existing Children's Center and the family campground. However, the Trust is committed to maintaining its Kona operations, and the development of the makai section of the project will be compatible with continuing activity at the Children's Center (situated in that section) and the campground (outside the project site).

With or without the project, a major influx of non-Hawaiians from Oahu and the Mainland United States will occur in West Hawaii. Under the circumstances, some Hawaiians are likely to be concerned that major social changes provide them with little beyond inconvenience. The project, by assuring funding for Trust programs, will be able to stand out as a development that is of benefit to the Hawaiian children and families in West Hawaii.

5.2.4 Impacts on the West Hawaii Region

Regional growth, of which this project will be an important, but limited, component, must be taken as a baseline condition in assessing impacts of the project. The project is not a motor for growth but an opportunity to organize development and to plan for future developments, on-site and off-site. Impacts of a planned development, rather than unplanned growth, include:

- Creation of a regional center on the project lands will complement present services and facilities found in Kailua town, thereby assisting in maintaining the vitality of Kailua and providing new services and facilities that will meet both resident and visitor needs.

- West Hawaii's settlement pattern was one of widely separated villages in the recent past. Kailua-Kona has increasingly served residents as a center, but to a limited extent. With the creation of a planned regional center:

  - The region's villages will be increasingly viewed as satellites to Kailua, rather than independent urban areas;

  -Residents will be increasingly likely to shop and socialize in major public areas, rather than in village centers; and

  - Specialized small businesses in West Hawaii villages will be at a disadvantage due to location, and may lose customers.

- The project will provide a home for more government services in a single place than now is found in West Hawaii. The region's status in the County is likely to increase as both demands for services and the delivery of services are centralized.

- By concentrating services to residents at the site, the project will encourage residents and visitors to patronize separate areas;

- The project, as part of a larger planning effort in which the State and County are involved, will lead to more coherent development of Kailua region lands, and hence to less likelihood that growth will bring problems of infrastructure capacity;

- Conversely, the centralization of functions at one site makes the need to solve local infrastructural problems -- notably, traffic congestion at the intersection of Palani Road and Queen Kaahumanu Highway -- all the more acute; and

- The development of a planned urban center will counter the trend towards strip development along the major roads in the Kona area.

Historically, politics in Kona was dominated by the mauka villages. Kailua-Kona has gained in importance in recent years. The project will tend to concentrate power further in the Kailua-Kona area.

5.2.5 Impacts on Nearby Areas

The project will tend to mitigate the impacts of growth for the Kailua area. It will make it possible for other nearby areas to be integrated into a larger urban system.

5.2.5.1 Impacts on Kailua Village

Over the long term, the project promises to complement Kailua Village as the major urban area of West Hawaii. Kailua would retain importance and activity, and would continue to function as both a seaside town with an ambience attractive to residents and visitors and as a center where all sorts of business are done. The proposed project would provide an additional area in which government and private services could be located, and perhaps consolidated. Particular impacts that seem likely as the project is developed include:

- With residents' urban functions largely met upland, in the project site and elsewhere, Kailua Village can be gradually redeveloped as a center for visitor activities, much as Lahaina has developed as a town appealing to the visitors staying along a coastal area; and

- Redirection of traffic upland will help to develop a "walker-friendly" village atmosphere in Kailua Village and along Alii Drive.

5.2.5.2 Other Residential Areas

The project site is near the Queen Liliuokalani Village residential area and the State's proposed Kealakehe housing area. Further upland along Palani Drive are several subdivisions. Likely impacts of the project include:

- For nearby residents, convenient services, entertainment, and (in many cases) work; and
- With improved facilities in the area, the desirability and value of nearby residential tracts will increase.

These upland areas will increasingly be seen as part of a Kailua urban area as the project develops, rather than as subdivisions dispersed in the landscape.

5.2.5.3 Industrial/Commercial Areas

The makai portion of the project adjoins the existing Trust industrial area. Other areas considered in assessing potential impacts of the project were the Kaloko industrial area, Lanihau Center and the North Kona Coast Shopping Center on Palani Road. Likely impacts include:

- Development of urban center will provide more customers for nearby businesses, and will hence have a positive effect on tenants of existing industrial and commercial areas;
- Mix of uses in the nearby industrial area has been changing from industrial to commercial; with the (eventual) development of the commercial area in the project, the existing area may be less competitive as a site for the operations its operators now seek;
- With increased traffic on Queen Kaahumanu Highway, the Kaiwi Street intersection, already considered hazardous by many, will become more difficult to use. Hence the project could aggravate the problem of access to the Trust industrial area. (Road improvements are included in the project plans. Setbacks along Queen Kaahumanu Highway may improve passage along the road and turns into the side street.)

5.2.5.4 Recreational Areas

The project is contiguous with Old Kona Airport State Recreation Area, although no development of land adjoining the park is planned for the next few decades. On Trust land to the north, the Trust has developed a camping area at Papawai. Over the long term, project impacts will likely include:

- Need for increased maintenance of both areas due to increased population in the immediate area;
- Need for increasing security at Papawai, as others will also use its access road;
- Noise and light from the project site could be noticeable in at least part of the camping area.

The project's timeframe extends for decades, and no changes in land use near existing recreational areas is planned to occur in this century. Commercial, not residential or resort, uses are indicated for the land nearest the camping area. Consequently, the foreseeable impacts of development near recreational areas are small. However, the market potential analysis conducted for the proposed project (Appendix A) notes that the project site could potentially support a 100-acre sports complex; a 150-acre public golf course oriented to local residents; and two five-acre neighborhood parks, one of which could be sited with an elementary school. The extent of recreational facility development on the site is unclear at this time, but would be coordinated with appropriate state and county agencies to avoid duplication of facilities and misuse of project lands.

5.3 IMPACTS OF SPECIFIC PROJECT COMPONENTS

5.3.1 Residential

Demand for housing in the Kona area is great. The proposed project and the State's proposed Kealakehe development will significantly assist in meeting that demand. However, neither project will totally satisfy the demand for affordable housing in West Hawaii, nor are either project designed to accomplish that purpose. Other state, county and private projects will be required to fully meet the affordable housing needs of the area. The proposed project will supply about 13 percent of the new housing units estimated as needed by residents in West Hawaii by the year 2005 and 6 percent of the units needed by 2020 (according to estimates by

Natelson, Levander, Whitney, Inc., shown in Table 2-H. Appendix G.) The state's Kealakehe project will supply an unknown, at this time, percentage of the affordable units needed over the next 30 years.

5.3.2 Commercial

The project will greatly increase the commercial and office space available in Kona. Developers of commercial and office segments of the project will implement the project plans over a period of decades, so no abrupt changes in the amount of commercial space are likely. Orderly development of commercial space at the project will encourage development of a more segmented market for commercial space in the Kona area, with less mingling of specialized retail, general retail and other businesses. As a result, commercial/industrial areas will aim increasingly at distinct market niches. This process should help businesses and landholders to plan commercial development economically.

5.3.3 Hotel

The hotel proposed for the project site is intended to attract business travelers, a small segment of the existing West Hawaii hotel market. Its location will bar the hotel from competing with coastal and resort hotels for the bulk of the visitor market. The hotel is accordingly expected to have little or no impact on other hotels.

5.3.4 Hospital

The development of a community hospital at the project site would pre-empt other sites now under consideration. Other sites are viewed as presently more accessible to the South Kohala community and to the airport. However, the project will allocate some 35 acres to the hospital, which will provide room for expansion, if needed. Also, development of a hospital at the project site, near professional offices, will facilitate use of the hospital by private medical practitioners. Further, the project site is relatively close to the airport (approximately 3 miles northward), would be served by developed and improved infrastructural components (roads, water and sewer) and would have relatively easy access from all directions.

5.3.5 Civic Uses

The development of a government office complex is expected to improve the delivery of services to West Hawaii's citizens by centralizing facilities that are presently dispersed throughout the Kona area. Again, access to government offices is likely to become easier and more convenient. The development of new government offices will free up space in existing sites. That space could then be allocated to programs still based in existing offices.

5.4 GENERAL ECONOMIC IMPACTS/PUBLIC REVENUE/COST ANALYSIS

5.4.1 Public Revenue/Cost Analysis

Based on the present mix of facilities to be provided in the proposed project, the cumulative discounted public revenues are estimated to be $382.5 million in constant 1990 dollars. The cumulative discounted public costs associated with the proposed project are estimated to be $39.4 million in constant 1990 dollars. This represents a revenue/cost ration of 9.7 to 1.0. That is, an additional $9.70 in public revenue benefits would accrue to the state and county for every dollar of public cost caused by the proposed project. Table IV-14 indicates the sources of the estimated revenues and government support cost categories.

In general, a revenue/cost ration greater than 4.0 to 1.0 is considered high. The unusually high revenue/cost ratio of 9.7 to 1.0 for the proposed project is attributable to the proposed mix of commercial and business economic activities that tend to generate large tax revenues and require relatively little public support. For example, the shopping centers will generate nearly $140 million in tax revenues annually by the year 2020. However, they do not require educational support and only minimal fire and police services.

The revenue/cost analyses have been conducted by distributing a set of financial impact variables, listed below, over the 1995 to 2020 time period. The values attached to each of the variables were calculated in a manner closely approximating the actual valuation approach. Each of the variables were estimated in terms of constant 1990 dollars. To evaluate the flow of dollars over time, standard present value analyses were used. Once all of the calculations were completed for the cash flows for each year, the results were summed to represent the cumulative effects of the project over time. The revenue variables were added together as well as the cost variables. Then the ratio of the total revenues to the total costs was calculated.

TABLE IV-14

SUMMARY OF REVENUES AND COSTS

TAX REVENUE CATEGORIES	STATE REVENUE (NPV)[1]	COUNTY REVENUE (NPV)	TOTAL REVENUE (NPV)
General Excise Tax - Construction	$ 6,893,174		$ 6,893,174
General Excise Tax - Operations	$307,640,569		$307,640,569
Corporate Income Tax	$ 34,544,072		$ 34,544,072
Personal Income Tax	$ 19,127,260		$ 19,127,260
Property Tax		$14,167,599	$ 14,167,599
Hotel Room Tax	$ 155,523		$ 155,523
TOTAL REVENUE	$368,360,598	$14,167,599	$328,528,197
GOVERNMENT SUPPORT COSTS	**STATE COSTS (NPV)**	**COUNTY COSTS (NPV)**	**TOTAL COSTS (NPV)**
Lower Education	$ 9,702,101		$ 9,702,101
Higher Education	$ 1,151,214		$ 1,151,214
Health Services	$ 2,014,148		$ 2,014,148
Transportation Services		$ 35,327	$ 35,327
Fire Services		$ 3,367,491	$ 3,367,491
Police Services		$ 4,136,339	$ 4,136,339
Public Facilities	$14,218,022	$ 4,739,520	$ 18,958,078
TOTAL COSTS	$27,086,022	$12,278,677	$39,364,698
REVENUE TO COST RATIO	13.60	1.15	9.72

[1] NPV = Net Present Value.

Source: Appendix H.

The following lists the various variables the revenue/cost analysis assessed in detail to produce the financial impacts on public sector revenues and costs:

1. Public Revenue Variables

- General Excise Tax/Construction
- General Excise Tax/Gross Revenues
- Corporate Income Tax
- Personal Income Tax
- Property Tax
- Hotel Room Tax
- County Excise Tax

2. Public Cost Variables

- Lower Education
- Higher Education
- Health Services
- Transportation Services
- Police Services
- Fire Services
- Public Facilities

A complete description of the above listed variables and the assumptions used for each factor in the calculations is included in Appendix H. As noted above and as shown in Table IV-10, the results of the revenue/cost analysis indicate a ratio of 9.7 to 1.0.

5.4.2 Economic Impact Analysis

As with any economic activity, the injection of dollars into the economy will result in direct impacts through the purchase of goods and services from other industries and businesses. The additional purchases made will cause these industries and businesses to purchase more goods and services from others, resulting in a "multiplier" effect produced by the original increase in purchases.

There are three effects that are relevant in the economic impact analysis: (1) direct effects; (2) indirect effects; and (3) induced effects. The direct effect is the immediate and primary impact of the project. The indirect effect is the secondary impact that would be experienced within the economy and the induced effect is the subsequent rounds of changes in the economy, such as increased purchases of goods and services as a result of increased buying by primary or secondary purchasers of goods and services.

The direct effects or impacts represent the changes that could occur to the Gross State Product, i.e., the effect on the total value of the goods and services produced within the state's economy. For the proposed project, it is estimated that the project will generate an average direct sales and rental income of $3,582 million per year, in constant 1990 dollars, form the operation of the shopping centers, office complexes and other income generating activities within the project. It is further estimated that the project would generate an average direct personal income of $106 million per year in constant 1990 dollars and 5,600 jobs per year.

The indirect and induced effects of the project can be measured in terms of enhanced employment opportunities outside the proposed project. Utilizing the state's Input-Output Model, it is estimated that a new job is created for every $120,000 in construction. The proposed project is expected to create up to 5,300 construction jobs, averaging 210 per year over the life of the project construction period. Further, it is estimated, based on the state's Input-Output Model, that an additional 0.6 jobs are created for every job created through retail sales to out-of-state visitors. Based on this assumption, the commercial enterprises proposed for the project will generate 540 jobs in addition to the 2,240 direct employees. Lastly, the state Input-Output Model projects that approximately 0.9 jobs are created in the state economy for every direct job in the hotel industry, assuming that all customers will be out-of-state visitors. Based on this assumption, the project will generate an additional 200 jobs in addition to the 240 direct jobs in the business hotel planned for the project. It is noted that the assumption that all of the

customers would be out-of-state visitors is probably unrealistic in this case, because the business hotel would probably cater primarily to in-state business travellers. However, the project would have a positive impact by inducing the creation of additional jobs outside the project.

6. INFRASTRUCTURE AND PUBLIC FACILITIES

6.1 TRANSPORTATION FACILITIES

6.1.1 Highways and Public Access

6.1.1.1 Existing Conditions

The project property is presently served by two primary roads: Queen Kaahumanu Highway, a state highway, that links Kailua-Kona to Kawaihae; and Palani Road linking Kailua-Kona to Mamalahoa Highway, the Hawaii Belt Road. Mamalahoa Highway provides a linkage from Kailua and other North Kona coastal areas and the Waimea-Hilo area. Mamalahoa Highway also provides and alternative through traffic link to the south, bypassing kailua and rejoining the Hawaii Belt Road at Honalo, approximately 10 miles south of Kailua. Figure II-2 depicts the major roadways in and around the project site.

The West Hawaii project area is in the midst of rapid development which includes resorts, commercial, housing and supporting industrial types of development. The proposed project will provide a focal point for the rapidly growing area with the planned regional shopping center, civic and cultural center, business and financial centers, affordable and market-priced housing, recreational facilities and a health care center. The magnitude of the project, in conjunction with the neighboring state Kealakehe project will add significant amounts of traffic to the area's already heavily utilized roadways, necessitating major improvements to regional transportation linkages.

Between 1976 and 1984, 24-hour traffic volumes, for the section of Queen Kaahumanu Highway south of Keahole Airport, increased from 3,175 vehicles to just over 7,000 vehicles. During the same period, the 24-hour accumulate traffic volumes on Palani Road increased from 4,073 vehicles to 9,437 vehicles.

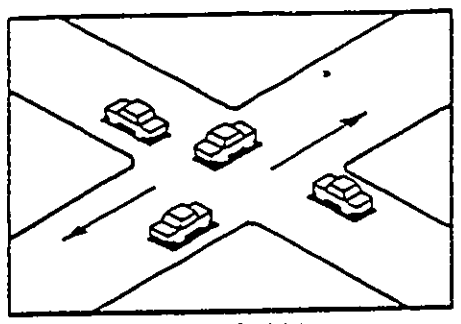
Traffic congestion along these primary roadways is considered to be a major problem by residents of the region, as noted in the previous section. Continued population growth in the area will require substantial improvements to the existing arterial roadways and the addition of a mauka-makai roadway between Queen Kaahumanu Highway and Palani Road to relieve congestion on Palani Road. Although Queen Kaahumanu Highway is proposed for expansion by the State Department of Transportation, it is likely that a new roadway paralleling the highway further inland will be needed. This "mid-level" roadway would provide an alternate route linking Kailua-Kona to the Keahole region, including the Kona Palisades area. A precise determination of how roadways will be funded has not been made. However, it is likely that the mauka-makai roadway would be part of the State's Kealakehe housing project.

A traffic study, to determine the impacts of project related and generated traffic on existing roadways has been made and is included as Appendix I. The following summarizes the results of that study.

Of the key intersections analyzed for the proposed project, two (Queen Kaahumanu Highway at Palani Road and Palani Road at Kuakini Highway) are controlled by signals, while the others are stop sign controlled.

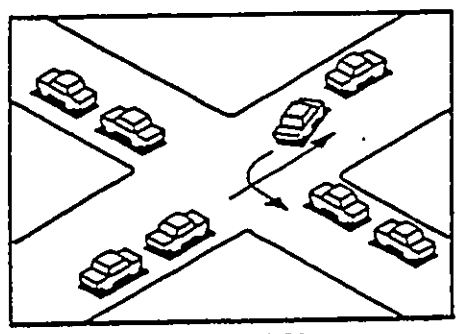
Volume/capacity (V/C) and level of service (LOS) analyses for pm peak hour traffic conditions were drawn from other studies (see References, Appendix I) or calculated specifically for the proposed project. Figure IV-12 depicts the LOS concept for intersections and Figure IV-13 indicates existing average weekday traffic volumes in the vicinity of the project site. The intersection of Queen Kaahumanu Highway and Palani Road has been determined to be currently operating at LOS "D", indicating substantial delays to traffic. Side street traffic at the stop sign controlled Queen Kaahumanu/Kealakehe Parkway intersection is also subject to LOS "D" conditions, while Kaiwi Road traffic at Queen Kaahumanu Highway has been determined to operate at LOS "F" (unacceptably long delays) under present conditions. The Palani Road/Kuakini Highway intersection is also estimated to operate at LOS "F". Table IV-15 summarizes traffic controls and existing LOS at the key intersections in the project area.

LEVEL OF SERVICE "A" - V/C = 0 TO 0.60
Describes operations with very low delay, i.e., less than 5 seconds per vehicle. This occurs when signal progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all.



LOS 'A'

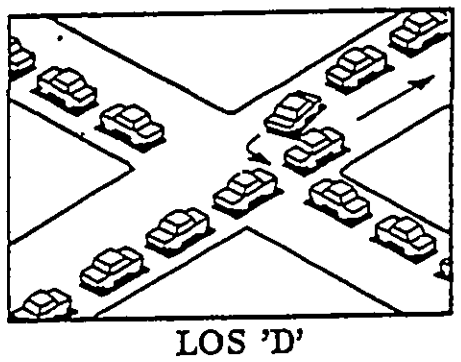
LEVEL OF SERVICE "B" - V/C = 0.61 TO 0.70
Describes operations with delays in the range of 5 to 15 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS "A", causing higher levels of average delay.



LOS 'C'

LEVEL OF SERVICE "C" - V/C = 0.71 TO 0.80
Describes operation with delay in the range of 15 to 25 seconds per vehicle. Occasionally vehicles may wait more than one red signal phase. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

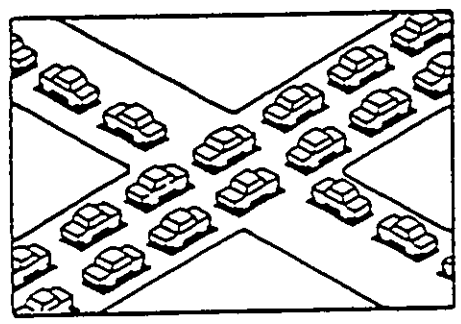
LEVEL OF SERVICE "D" - V/C = 0.81 TO 0.90
Describes operations with delay in the range of 25 to 40 seconds per vehicle. At LOS "D", the influence of congestion becomes more noticeable. Many vehicles stop, and the proportion of vehicles not stopping declines. Noticeable numbers of vehicles fail to clear signal during the first green phase.



LOS 'D'

LEVEL OF SERVICE "E" - V/C = 0.91 TO 1.00
Describes operations with delay in the range of 40 to 60 seconds per vehicle. These high delay values generally indicate poor progression, long cycle lengths, and high V/C ratios. Vehicles frequently fail to clear the signal during the first green phase.

LEVEL OF SERVICE "F" - V/C GREATER THAN 1.00
Describes operations with delay in excess of 60 seconds per vehicle. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection.

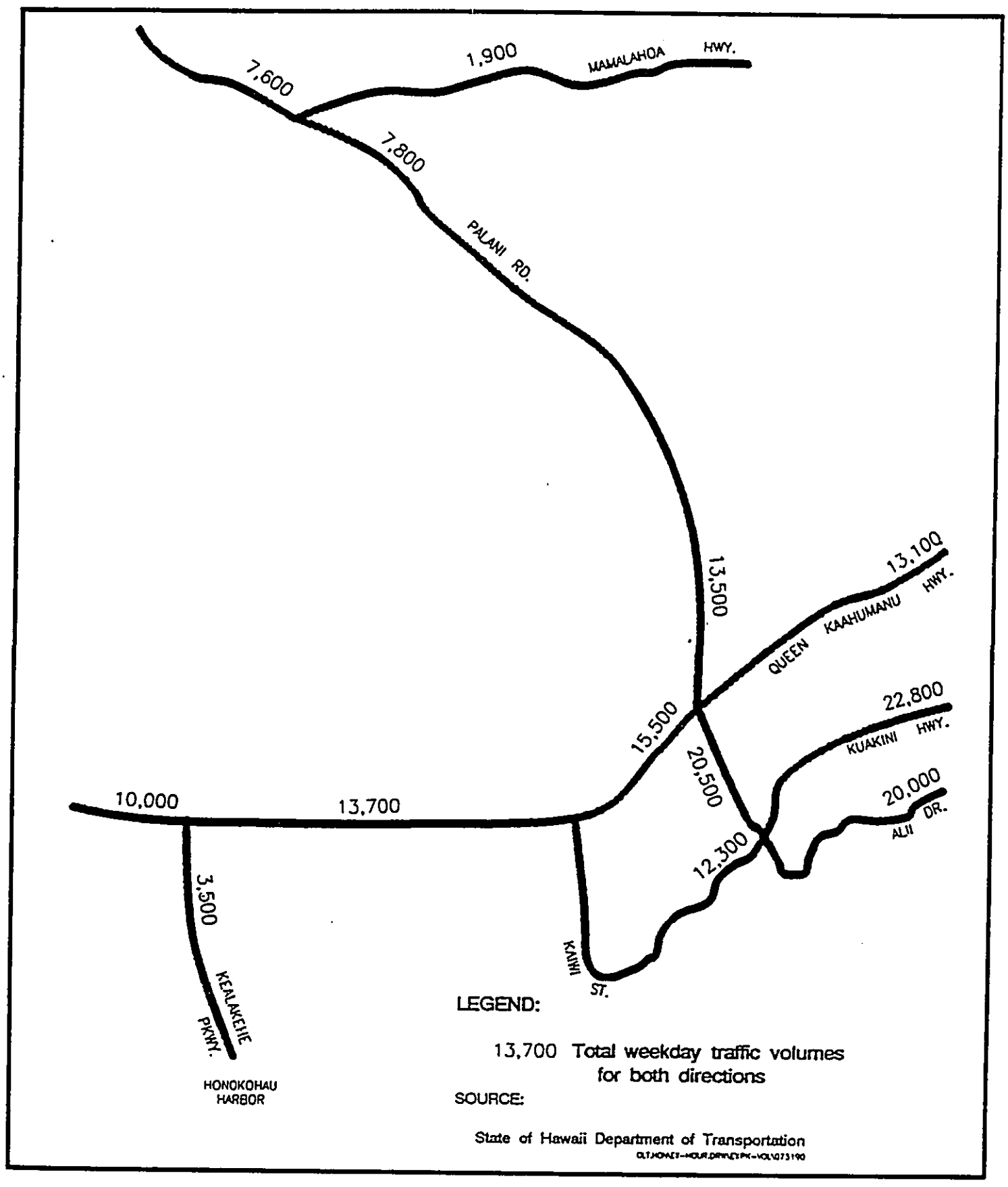


LOS 'F'

SOURCE: Highway Capacity Manual, 1985.

Source: WILBUR SMITH ASSOCIATES
KEAHUOLU LANDS TRANSPORTATION ANALYSIS, MAY 1990
Prepared by: BELT COLLINS & ASSOCIATES • AUGUST 1990

Figure IV-12
INTERSECTION LEVEL OF SERVICE CONCEPTS



Source: WILBUR SMITH ASSOCIATES
KEAHUOLU LANDS TRANSPORTATION ANALYSIS, MAY 1990
Prepared by: BELT COLLINS & ASSOCIATES • AUGUST 1990

Figure IV-13
EXISTING AVERAGE WEEKDAY TRAFFIC VOLUMES

TABLE IV-15

EXISTING TRAFFIC CONTROLS AND PM PEAK
LEVELS OF SERVICE

LOCATION	TRAFFIC CONTROL	VOLUME/ CAPACITY RATIO	LEVEL OF SERVICE
Queen Kaahumanu Hwy./ Kealakehe Pkwy.	Stop Sign	N/A	D
Queen Kaahumanu Hwy./ Palani Road	Signal	0.86	D
Queen Kaahumanu Hwy./ Kaiwi Street	Stop Sign	N/A	F
Palani Road/ Kuakini Hwy.	Signal	0.84	D

Source: Appendix I.

Note: V/C ratio not relevant (not applicable) for stop sign controlled intersection.

6.1.1.2 Probable Impacts

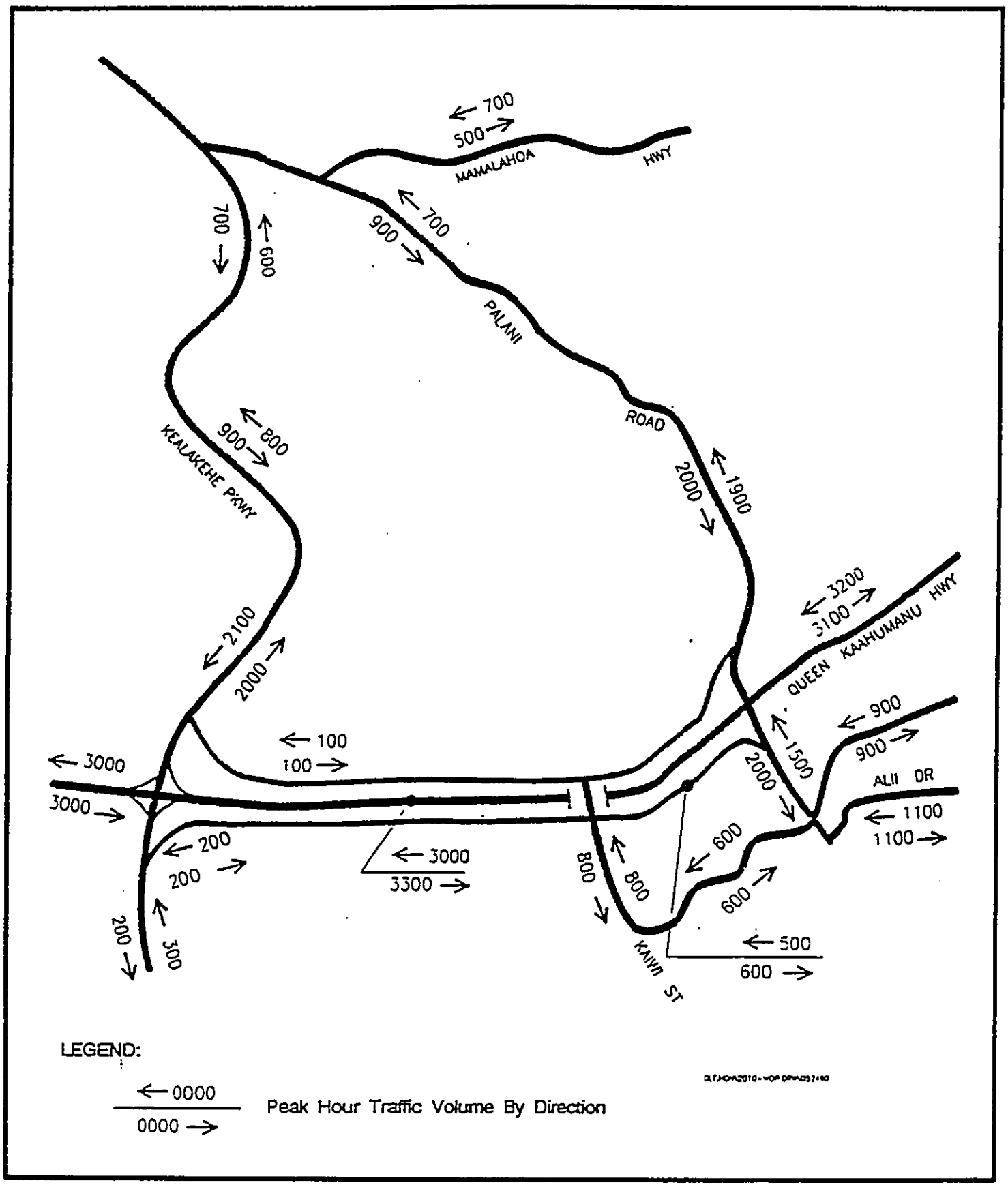
The determination of potential traffic impacts resulting from the proposed project was analyzed using the following three-stem modeling approach:

1. Trip generation of future land uses was projected based on historic trip generation studies for respective uses.

2. Trip distribution of future traffic was estimated based on a gravitational model.

3. Projected traffic was assigned to logical paths for assumed future roadway networks, based on time and distance considerations.

A horizon year of 2010 was assumed for the purposes of determining future conditions, i.e., traffic impacts. This is consistent with other traffic and roadway planning efforts underway in Hawaii County. Figure IV-14 indicates year 2010 pm peak hour traffic without the proposed project.



Source: WILBUR SMITH ASSOCIATES
KEAHUOLU LANDS TRANSPORTATION ANALYSIS, MAY 1990
Prepared by: BELT COLLINS & ASSOCIATES • AUGUST 1990

Figure IV-14
YEAR 2010 PM PEAK HOUR TRAFFIC WITHOUT PROPOSED PROJECT

The basic future roadway network modeled, to determine traffic conditions without the proposed project, for the year 2010, included assumptions of several improvements to the areawide highway network, independent of those planned to serve the project itself. These improvements included the following and are the same as those included in the Draft Keahole to Kailua (K to K) Development Plan:

- Upgrading Queen Kaahumanu Highway to a full control of access status, with an interchange at Kealakehe Parkway. An interchange at Palani Road and frontage roads on both sides of the highway were also built into the model, although the configuration of these improvements are uncertain at this time. An overcrossing at Kaiwi Street was also included in the network.

- Extension of Kealakehe Parkway from Queen Kaahumanu Highway to Mamalahoa Highway at a point north of the existing Palani Road/Mamalahoa Highway intersection.

- Extension of Kealakehe Parkway southward from the Honokohau Boat Harbor to connect with kuakini Highway at Kaiwi Street.

- A new mid-level north-south roadway located approximately one mile mauka of Queen Kaahumanu Highway passing through the project site.

- A new Alii Highway paralleling Alii Drive from the Keauhou area to connect with Kuakini Highway south of downtown Kailua.

Volume/capacity calculations were performed for three key intersections for the year 2010 conditions without the project; (1) Palani Road at Mid-Level Road; (2) Palani Road at Queen Kaahumanu Highway; and (3) Palani Road at Kuakini Highway. The results of this analysis are shown in Table IV-15.

The modeling efforts did not assume a freeway interchange at Queen Kaahumanu Highway and Palani Road. Volume/capacity analysis for year 2010 were performed with an at-grade intersection, with an array of different through and turning lane assumptions. The analysis indicated that five to seven approach lanes, including turn lanes would be required at each of the intersection approaches to accommodate forecast volumes. If an intersection is provided, a minimum of two through lanes in each direction would be required for Queen Kaahumanu Highway. Actual lane requirements for Palani Road would depend on the ramp configuration of the interchange.

TABLE IV-16

VOLUME/CAPACITY RATIOS AND LEVELS OF SERVICE
YEAR 2010 WITHOUT THE PROPOSED PROJECT

INTERSECTION	V/C RATIO	LOS
Palani Road at Mid-Level Roadway	2.16	F
Palani Road at Queen Kaahumanu Highway	2.13	F
Palani Road at Kuakini Highway	1.92	F

Source: Appendix I.

Palani Road mauka of the Mid-Level Road would require a minimum four-lane cross section, as would Kealakehe Parkway between the Mid-level Road and Queen Kaahumanu Highway. The Mid-Level Road would warrant a six-lane cross section in the vicinity of Palani Road and a four lane cross section for the remaining segments between the Kealakehe Parkway and its junction with the Queen Kaahumanu Highway extension.

As indicated in Table IV-15 and the above discussion, significant improvements to the area roadway network will be required without the proposed project if traffic is to move in a safe and efficient manner.

The analysis of traffic impacts resulting in the year 2010 with the project assumed the following areawide roadway network improvements that are independent of those serving the project itself:

- A Queen Kaahumanu/Palani Road interchange, along with a frontage road along both sides of Queen Kaahumanu Highway from Kealakehe Parkway to Palani Road.

- Liliuokalani Boulevard would serve as a mauka-makai roadway extending from Palani Road to the Queen Kaahumanu Highway frontage road in the vicinity of the Kaiwi Street overcrossing.

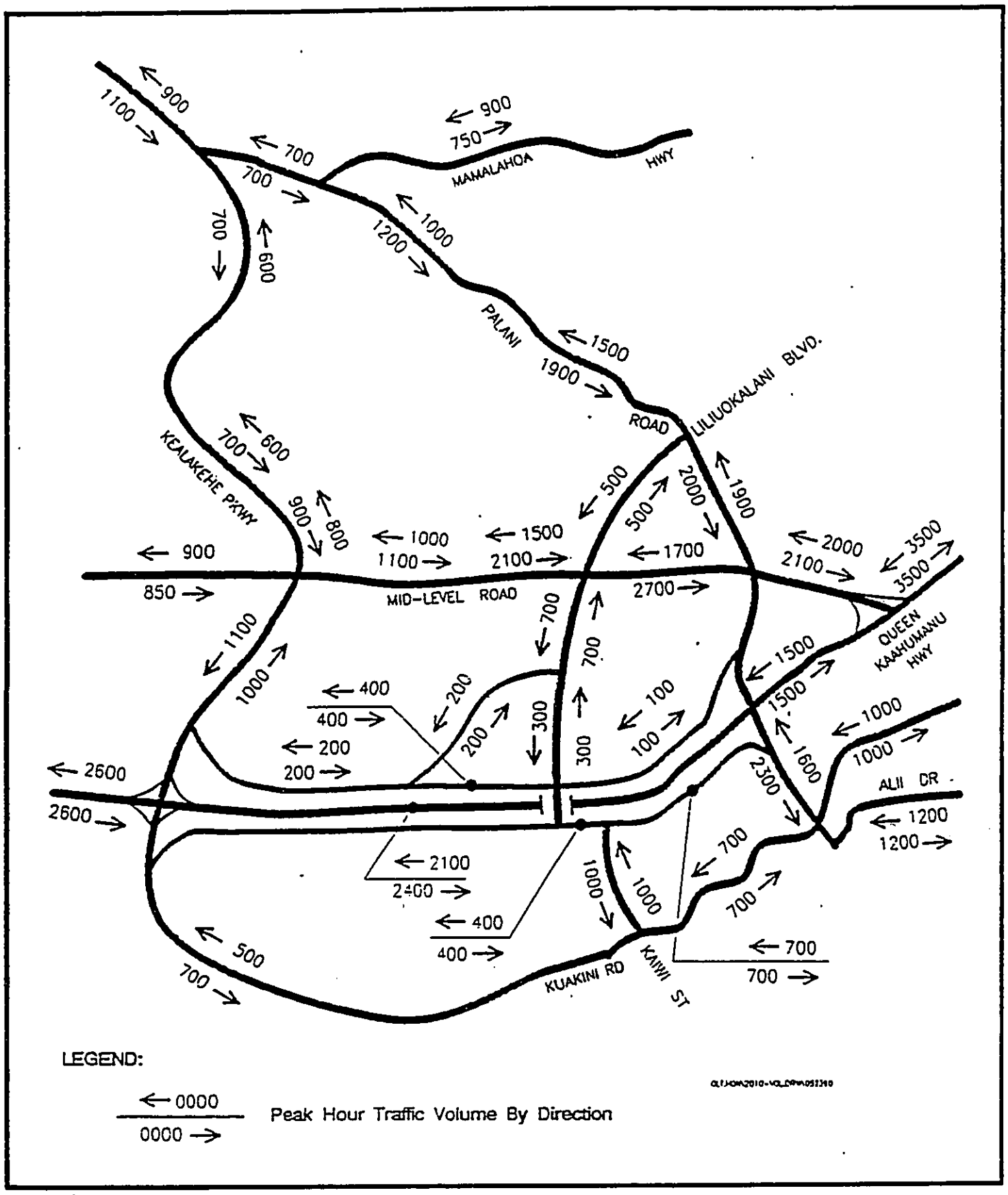
With the proposed project, overall pm peak hour traffic is projected to grow by approximately 3,500 to 3,800 trips in each direction south of Palani Road in the Queen Kaahumanu-Kuakini-Alii corridor, and by approximately 2,800 to 3,000 in each direction north of the project site in the Queen Kaahumanu-Mid-Level Road corridor (Figure IV-15). Highest volumes for a single roadway are projected at approximately 3,500 in each direction on the Queen Kaahumanu Highway extension south of the point where Queen Kaahumanu Highway and the Mid-Level Road merge. Peak loads for the Mid-Level Road are projected just north of Palani Road, with approximately 2,700 vehicles using this segment in the southbound direction during the pm peak hour.

Major intersection impacts of the project will occur at the Palani Road/Mid-Level Road intersection, where the project will add approximately 600 new pm peak trips. Similarly, at the Palani Road/Queen Kaahumanu Highway interchange, the project is projected to contribute approximately 800 new pm peak trips.

Measures to minimize potential traffic impacts resulting from the proposed project are discussed below. Assuming that these measures are taken, volume/capacity ratios were calculated for key intersections in the vicinity of the project. The results of this analysis are shown in Table IV-16. The intersections of Mid-Level Road at Liliuokalani Boulevard, Mid-Level Road at Palani Road and Liliuokalani Boulevard with Queen Kaahumanu Highway northbound on-ramps would all operate at LOS "D" during the pm peak period under year 2010 conditions. The intersection of Liliuokalani Boulevard with Queen kaahumanu Highway northbound off-ramps is projected to operate at LOS "C". Assuming no improvements to the existing geometrics at the intersection of Palani Road and Kuakini Highway, this intersection would operate at LOS "F" during the pm peak hour in the year 2010.

6.1.1.3 Mitigation Measures

Because of substantial traffic impacts the proposed project and other projects will have on Palani Road and the junction of Palani Road with Queen Kaahumanu Highway, an alternative network concept was developed that featured freeway interchanges at both Queen Kaahumanu Highway and the new Liliuokalani Boulevard serving the project area. This concept was designed to minimize the traffic impacts resulting from both the proposed project as well as others, e.g., the state's Kealakehe project. The addition of the Liliuokalani Boulevard interchange would reduce traffic on the Mid-Level Road and Palani Road and increase traffic on



Source: WILBUR SMITH ASSOCIATES
KEAHUOLU LANDS TRANSPORTATION ANALYSIS, MAY 1990
Prepared by: BELT COLLINS & ASSOCIATES • AUGUST 1990

Figure IV-15
YEAR 2010 PM PEAK HOUR TRAFFIC WITH PROPOSED PROJECT

TABLE IV-17

YEAR 2010 LEVELS OF SERVICE
WITH PROPOSED PROJECT AND RECOMMENDED IMPROVEMENTS

LOCATION	VOLUME/CAPACITY RATIO	LEVEL OF SERVICE
Queen Kaahumanu Highway NB Ramps/ Liliuokalani Blvd.	0.86	D
Queen Kaahumanu Highway SB Ramps/ Liliuokalani Blvd.	0.67	B
Liliuokalani Blvd./ Mid-Level Road	0.83	D
Mid-Level Road/Palani Road	0.89	D
Palani Road/Kuakini Highway	2.13	F

Source: Appendix I.

Queen Kaahumanu Highway in the vicinity of the project site. The section of Palani Road between the Mid-Level Road and Queen Kaahumanu Highway would have approximately 1,200 fewer vehicles in the pm peak hour. Volumes on Queen Kaahumanu Highway north of Kealakehe Parkway and south of the Queen Kaahumanu Highway/Mid-Level Road juncture are not projected to be changed significantly with the addition of the Liliuokalani Boulevard interchange.

Traffic impacts resulting from the proposed project can be minimized to a certain extent with a continuation of the regional planning underway by both the state and county. However, with increased numbers of residents, businesses, public facilities and recreational facilities in the vicinity of the project area, there will be some traffic impacts for which mitigation measures would not be available.

6.1.2 Air Transportation Facilities

6.1.2.1 Existing Conditions

The air transportation needs of the proposed project site and all of West Hawaii are provided by Keahole Airport, located approximately 5 miles northwest of the project site. Keahole Airport had over 56,000 operations (aircraft arrival or departure) in 1988 (the latest year for which statistics are available), of which almost 21,000 were air carrier operations. Over 159,000 overseas passengers and over 1.6 million interisland passengers were processed through Keahole Airport in 1988. In addition, over 16,000 pounds of cargo and mail passed through the airport in 1988. As a result of existing increasing aircraft operations and passenger levels, as well as planned resort, residential and commercial developments in West Hawaii, aircraft operations, passenger and cargo levels are forecast to significantly increase in the future. Present planning and construction at the airport by the State Department of Transportation includes expansion of the airport facilities, including extension of the runway, to accommodate the forecast aircraft operations, passenger and cargo increases and direct mainland US flights by wide-bodied aircraft.

6.1.2.2 Probable Impacts

As noted in Section 5.2.1, the proposed project is expected to be a consequence of continued tourism growth in West Hawaii, not something independent of that growth. As such, the project, in and of itself, is not expected to significantly affect air passenger and/or cargo levels at Keahole or any of the other state airports on the island. However, interisland passengers (residents and visitors) utilizing some of the services to be provided within the project will pass through the airport. Because the project is being planned to primarily serve the needs of the residents of the Kailua-Kona area, the project is not expected to significantly affect Keahole Airport service or facilities requirements.

6.1.2.3 Mitigation Measures

Because of the lack of expected significant impacts attributable to the project, mitigation measures to minimize potential adverse impacts are not warranted. The Liliuokalani Trust would continue to cooperate with the State Department of Transportation in the planning of the airports serving the project.

6.1.3 Harbors

6.1.3.1 Existing Conditions

The three principal harbors possibly serving the project are Kailua-Kona Harbor, Honokohau Harbor and Kawaihae Harbor. The former two are primarily recreational vessel harbors, while the latter is the only deep draft harbor serving West Hawaii. Kawaihae Harbor is located approximately 28 miles north of the project site and is primarily used by interisland barges. Over 870,000 short tons of cargo passed through the harbor in 1987. Cargo transiting through the harbor includes building materials, consumer goods, large equipment and machinery, as well as provisions and supplies to service the resort industry in West Hawaii.

6.1.3.2 Probable Impacts

As noted above, the project is being designed and planned to serve the residents of serve the needs of the residents of the Kailua-Kona area, the project is not expected to significantly affect commercial or recreational harbor service or facilities requirements. It is likely that a major portion of the construction materials required for the project will transit through Kawaihae Harbor. Similarly, it is likely that supplies and goods utilized within the project following completion will pass through the harbor. However, given the existing capabilities of the harbor, the transiting of these commodities through Kawaihae Harbor is not expected to significantly affect harbor operations or facilities requirements.

6.1.3.3 Mitigation Measures

Because of the lack of expected significant impacts attributable to the project, mitigation measures to minimize potential adverse impacts are not warranted. The Liliuokalani Trust would continue to cooperate with the State Department of Transportation in the planning and use of the harbors serving the project.

6.2 WATER SUPPLY

6.2.1 Existing Conditions

Existing potable water wells in the Kailua-Kona area include the Kahalu'u Wells A, B, C and D. These wells have a safe yield capacity of 4.5 million gallons per day (mgd). The aquifer's maximum yield has been calculated to be about 10 mgd. The existing hydrogeological characteristics of the project site and area have been discussed in Section 2.2 of this chapter.

Existing transmission facilities in the project area include three reservoirs with booster pumps on Palani Road; a 300,000 gallon reservoir at the 325-foot elevation; a 100,000 gallon tank at the 590-foot elevation; and a 50,000 gallon tank at the 935-foot elevation, all of which are linked by an 8-inch main.

6.2.2. Probable Impacts

The proposed project will include substantial improvements and additions to the existing potable water system. New piping will include 6- to 20-inch transmission lines with appropriate valves and filters. Two new 1.0 million gallon supply tanks will also be constructed. In addition, new supply wells will be required. The new wells may be located on Trust lands mauka of the project site. Because each new well would serve 25 or more individuals at least 60 days per year or have a minimum of 15 service connections, the use of each well will require compliance with the State's Potable Water Systems Regulations, Chapter 20, Title 11, Administrative Rules, Potable Water Systems. Section 11-20-29 of Chapter 20 requires that any new source of potable water serving a public water system be approved by the Director of Health prior to its use. Similarly, new potable water system improvements would be designed and constructed in compliance with the County Department of Water Supply requirements and all new potable water well system improvements would be in compliance with State Water Resource Management Commission requirements. Development of new sources of water mauka of the project site is not expected to have a significant effect on existing sources, given that the aquifer presently has excess capacity.

The majority of the project site mauka of Queen Kaahumanu Highway lies above the Underground Injection Control (UIC) line. Land areas above the UIC are considered by the Department of Health to contain underground sources of drinking water. These areas would,

therefore, be protected against all sources of groundwater contamination (see Section 2.2 regarding groundwater). As such, the proposed new wells will be designed and constructed so that they do not in themselves contribute to groundwater contamination. The wells would be designed with concrete pads to prevent seepage or flood waters migrating down the well shafts.

6.2.3 Mitigation Measures

The primary mitigation measures to be employed with regard to the potable water system will be the application of all appropriate state and county rules and regulations. These include proper location, design and operation of potable water wells, storage facilities and transmission lines. As noted above, this includes compliance with State DOH Chapter 20 requirements, Water Resource Management Commission and County Department of Water Supply rules and regulations.

6.3 WASTEWATER COLLECTION, TREATMENT AND DISPOSAL

6.3.1 Existing Conditions

There is no public wastewater collection system presently serving the proposed project site. A wastewater treatment plant is located within the Kona Industrial Subdivision. This is a secondary, activated sludge treatment plant with a design capacity of 1.0 mgd. The entire capacity of the plant is committed to units within the existing service area. Existing mauka residential areas are served by individual septic tank or cesspool systems.

6.3.2 Probable Impacts

A new wastewater treatment plant with associated collection system is being constructed to serve the existing Kailua-Kona area. This plant is being designed with an initial capacity of 2.8 mgd. As part of the proposed project, three additional 1.0 mgd expansions will be required for the Kealakehe plant. In addition, new sewage pump stations would be required along with new transmission lines. All new wastewater collection, treatment and disposal system facilities serving the proposed project would be planned, designed and constructed in compliance with appropriate state and county rules and regulations.

6.3.3 Mitigation Measures

The primary mitigation measures to be employed with regard to the wastewater collection, treatment and disposal system will be the application of all appropriate state and county rules and regulations. These include proper location, design and operation of the collection and treatment facilities.

6.4 SOLID WASTE COLLECTION AND DISPOSAL

6.4.1 Existing Conditions

The project site is situated adjacent to the Kealakehe Landfill and Transfer Station.. Because the landfill is rapidly nearing capacity, it is scheduled for closure in the near future and the County of Hawaii is actively engaged in identifying a location for a new facility. Once closed, the landfill site will be mined for recyclable material before becoming available for redevelopment. The closure schedule, including mining, is projected to be completed in approximately ten years. A new 177-acre landfill site has been proposed by the county and is expected to be in operation by August 1991. The new site is located in the Puu Waawaa area close to Puu Anahulu in North Kona. The new landfill will be able to accommodate initial solid waste volumes of 46,300 tons per year and more as the population in the area increases.

6.4.2 Probable Impacts

Because the exact numbers of the various types of facilities that would be located within the project boundaries has not been determined, it is not possible to determine the exact quantity of waste products that would be produced. However, the proposed project is expected to generate a significant volume of solid waste, of all types. As such, timely development of a new solid waste disposal facility for the region is critical. In addition to residential waste products, offices within the proposed project can be expected to generate paper waste products,; commercial facilities would generate a variety of waste products and medical facilities would generate medical waste products. To the extent practical and possible, all facilities and uses within the project would be encouraged to practice recycling and it is possible that a regional recycling center could be established within the project boundaries. In addition, present tenants of the Kona Industrial Subdivision would be encouraged to practice recycling to the maximum extent possible.

6.4.3 Mitigation Measures

To mitigate potential impacts resulting from the generation of expected significant quantities of solid wastes, all facilities and types of uses within the project would be encouraged to practice recycling measures to the maximum extent possible. In addition, the Trust would continue to cooperate with the County Department of Public Works with the siting of a new regional solid waste disposal facility.

6.5 ELECTRICAL POWER AND COMMUNICATIONS

6.5.1 Existing Conditions

Electrical power for the project area is provided by Hawaii Electric Light Company (HELCO) facilities. HELCO's available generating capacity is approximately 150 megawatts (MW) with a present peak demand of about 130 MW. To meet the increasing future demands of the region, HELCO is planning to construct additional petroleum or coal fired power plants. The utility has forecast the need to generate an additional 200 MW of power by the year 2007.

The present electrical power transmission and distribution system in the vicinity of the project site consists of overhead lines along the Palani Road right-of-way and along Queen Kaahumanu Highway in the vicinity of the project site. Service from these lines would provide electrical power to the project.

Telephone service to the project area is provided by Hawaiian Telephone Company via their Kailua-Kona facilities.

Cable television (CATV) is provided to the project area via a private cable company system serving the Kona and Waimea areas.

6.5.2 Probable Impacts

The electrical power delivery system that would serve the proposed project will require upgrading and expansion to meet the needs of the project. At least one, and possibly more, electrical substations would be required. Present planning calls for all distribution lines within the project boundaries to be underground for aesthetic reasons. Presumably, with existing and

forecast generating capacity, the project would not significantly impact the electrical power system of the region. Transmission, distribution and service equipment would be located and designed in consultation with HELCO and in compliance with applicable public utilities commission rules and regulations and building codes and standards.

In addition, the Trust will incorporate the most energy saving technologies in the design of Trust facilities so as to minimize future generation requirements and the cost of energy and encourage developers of other facilities to utilize similar technologies. This will include the use of active and passive solar systems, the use of heat pumps for heating and cooling and the use of energy efficient light fixtures and systems.

Telephone service to the project area will also require upgrading the system to serve the project. Telephone lines would also be located underground and services through a system of underground duct lines and handholes. Increased telephone service to the project is not expected to significantly affect Hawaiian Telephone Company capabilities or overall system.

The CATV system would be expanded as requested and required to serve the project area. The CATV system would also be located within the underground duct and handhole system.

6.5.3 Mitigation Measures

Because the project is not expected to result in significant impacts to either the electrical or telephone systems of the project area, measures to mitigate potential adverse effects are not warranted. The Trust will continue to work with both utilities in the location, design and construction of the required facilities to assure compatibility of those facilities with existing systems. Further, expansion of the utilities serving the project site would be accomplished in compliance with public utilities commission rules and regulations and building codes and standards.

6.6 POLICE AND FIRE PROTECTION SERVICES

6.6.1 Existing Conditions

. The project area police and fire services are provided by facilities located within and around Kailua-Kona town. At present, these facilities are adequate to serve existing

requirements. However, both police and fire department facilities and services will require upgrading and expansion to meet the requirements of the proposed project as well as the state's proposed Kealakehe project.

6.6.2 Probable Impacts

Because the project, as well as other planned private and public projects, will require expansion of both police and fire department services and facilities to serve the area, the project is expected to result in positive impacts to these services. It is likely that fire department facilities would be located near the project area and that existing police department facilities would be expanded to meet the needs of the growing population or relocated to larger quarters. The Trust would continue to work with the county and state in determining the extent of expansion required and how to best meet future requirements.

6.6.3 Mitigation Measures

Because the project is expected to result in positive impacts to the police and fire services of the project area, mitigation measures are not warranted.

6.7 HEALTH CARE FACILITIES

6.7.1 Existing Conditions

The Island of Hawaii has five hospitals that provide a range of medical services. Kona Hospital is a "full-service" health care facility serving the Kailua-Kona area. The Kohala area is served by two state-operated hospitals, the Kohala Hospital located in Kapaau in North Kohala and the Honokaa Hospital and, in Waimea, the Lucy Henriques Medical Center provides out-patient health services. All of the public sector health care facilities serving the West Hawaii area require upgrading and are being handled as such by the State Department of Health and private operators.

6.7.2 Probable Impacts

As indicated in Chapter II, Section 6, Project Description, the proposed project includes the development of a new regional hospital. The new hospital would contain up to 120 beds and

would be sited on a 35 acre parcel of land at the intersection of the new mid-level roadway and the new mauka-makai roadway. This location would afford convenient vehicular access from the region's major highways and would be within ten minutes of Keahole Airport. The proposed site is also large enough to accommodate a helipad is required. The hospital would include an emergency clinic and all necessary support facilities and services. In addition, the project includes the development of a Professional Plaza that would serve as a major medical office complex for the region. It is expected that the Professional Plaza would be an ideal location for private medical and dental offices, medical laboratories and out-patient services.

Because the project includes the new hospital and professional plaza, impacts to the health care facilities and services of the area would be increased and upgraded at private expense. This is expected to result in positive impacts to both the quality and quantity of services available to the population and reduced public monies expenditure requirements.

6.7.3 Mitigation Measures

The proposed project is expected to result in significant positive impacts to the availability, quantity and quality of health care facilities serving the West Hawaii area. As such, mitigation measures to minimize potential adverse impacts are not warranted.

6.8 SCHOOLS AND EDUCATION FACILITIES

6.8.1 Existing Conditions

The West Hawaii area is served by eleven public schools located in North and South Kohala and North and South Kona. Those in the immediate vicinity of the project site include Konawaena Elementary and Konawaena Intermediate and High School and Kealakehe Elementary and Kealakehe Intermediate School. Present enrollment (1988-1989 school year) for the public schools serving the project area was about 3,700 students. Private lower and upper schools serving the project area include the Hawaii Preparatory Academy and Parker School.

6.8.2 Probable Impacts

Due to unparalleled growth in West Hawaii, the formulation of accurate enrollment projections has become problematic. Although the proposed project is not expected to be a

growth inducing project, but is being planned to accommodate present and future growth of the West Hawaii region, the project, in and of itself, is not expected to cause a significant increase in student enrollments. However, working in conjunction with the state's Kealakehe project, it is expected that a significant number of new students would be generated. Some of these may be relocations from other Big Island areas and some may be new to the area. However, until the state's Kealakehe plans are developed further, and the numbers and types of housing units to be developed are known, it is not possible to estimate increased school facility requirements. The state's Kealakehe project does, however, include one new, ten-acre elementary school site. Based on other state projects on Oahu and Maui, it is possible that two school sites will be required in the final analysis. Space for these facilities would be made available within the project and/or Kealakehe project boundaries.

6.8.3 Mitigation Measures

New schools and improved and increased facilities at existing schools would be required to minimize potential adverse impacts to existing public education facilities. The Trust would continue to work with the State Department of Education to assure that adequate public school services are provided.

6.9 RECREATIONAL FACILITIES

6.9.1 Existing Conditions

The West Hawaii region in general, and specifically the project area, are served by numerous public and private recreational facilities. The primary public facilities serving the project area include the Old Kona Airport State Recreation Area, Pahoehoe Beach Park, White Sands Beach Park Kahaluu Beach Park and the recreational facilities at Konawaena and Kealakehe schools. In addition Honokohau small boat harbor provides public recreational opportunities.

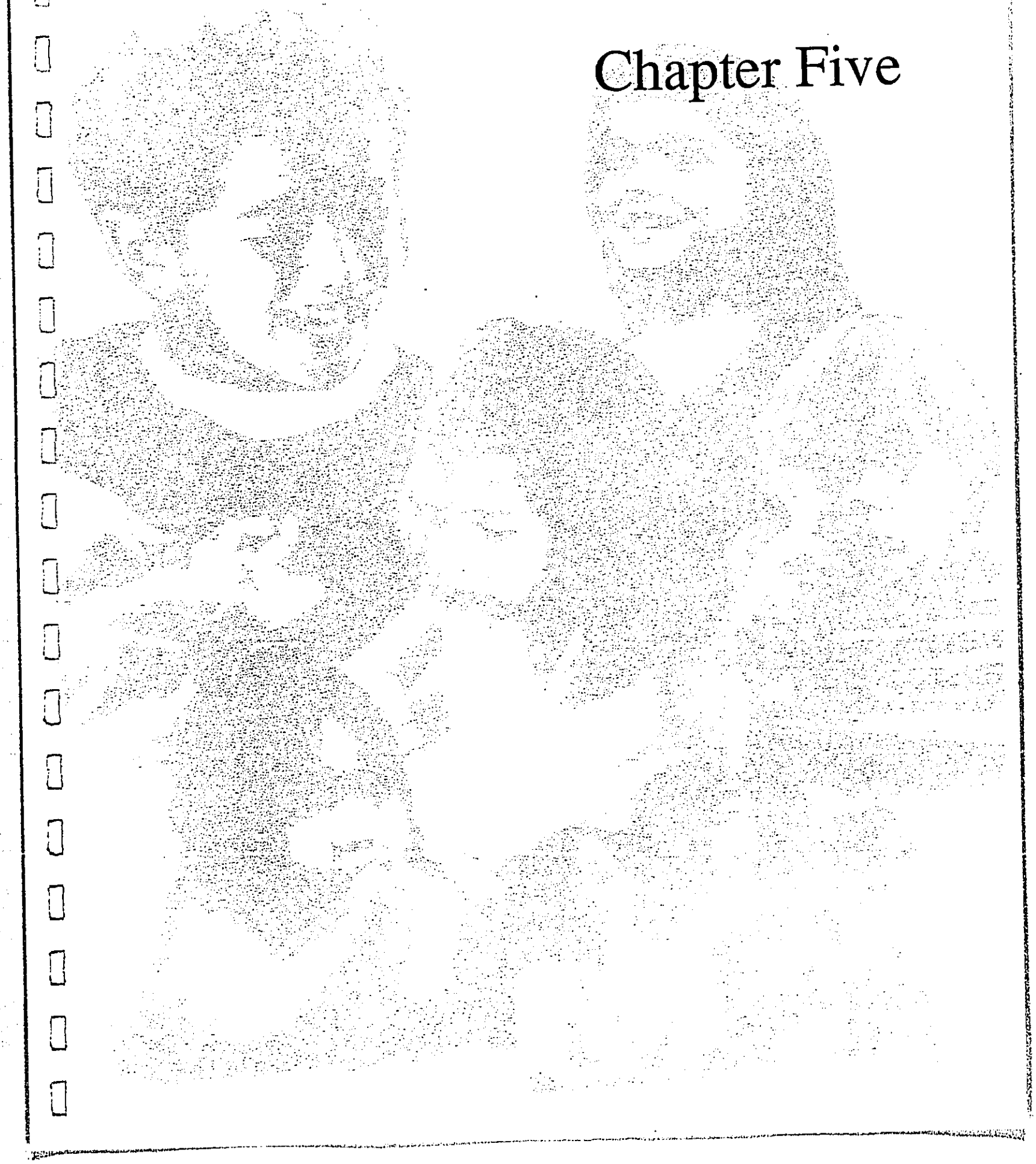
6.9.2 Probable Impacts

As noted in Chapter II, Section 6, Project Description, the proposed project includes the establishment of a historic preserve, and, in conjunction with the state's Kealakehe project, a new neighborhood park and elementary school would be developed. These facilities would add to the recreational opportunities of the project area. As such, the project is expected to result in positive impacts to the recreational opportunities for the existing and future population of the project area.

6.9.3 Mitigation Measures

The proposed project will improve the recreational facilities and amenities of the area. As such, mitigation measures are not warranted.

Chapter Five



CHAPTER V

RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

1. HAWAII STATE PLANS AND CONTROLS

All lands in the State have been placed in one of four land use districts (Urban, Agriculture, Conservation, or Rural) by the State Land Use Commission (SLUC). State Land Use District Boundary Reviews are undertaken by the State Land Use Commission to update its Land Use District Maps. Besides this SLUC-initated review, provisions for applicant-initiated amendments to the district boundaries have been established in Section 205-4 of the Hawaii Revised Statutes (HRS), and further promulgated in Chapter 15-15, Hawaii Administrative Rules entitled Hawaii Land Use Commission Rules (September 3, 1986, as amended).

1.1 EXISTING AND PROPOSED DISTRICT BOUNDARIES

The existing State Land Use District boundaries are shown in Figure V-1. The proposed project area contains two State Land Use District classifications: approximately 945 acres are designated Agriculture; and approximately 190 acres are designated Conservation, General subzone. The Trust is currently requesting amendments to the State Land Use District boundaries to change these two areas to an Urban designation. Figure V-2 shows the proposed District boundary amendments.

1.2 REQUIREMENTS FOR BOUNDARY AMENDMENTS

Section 205-17, Hawaii Revised Statutes (HRS), sets forth the following decision making criteria for reclassification of District boundaries by the State Land Use Commission:

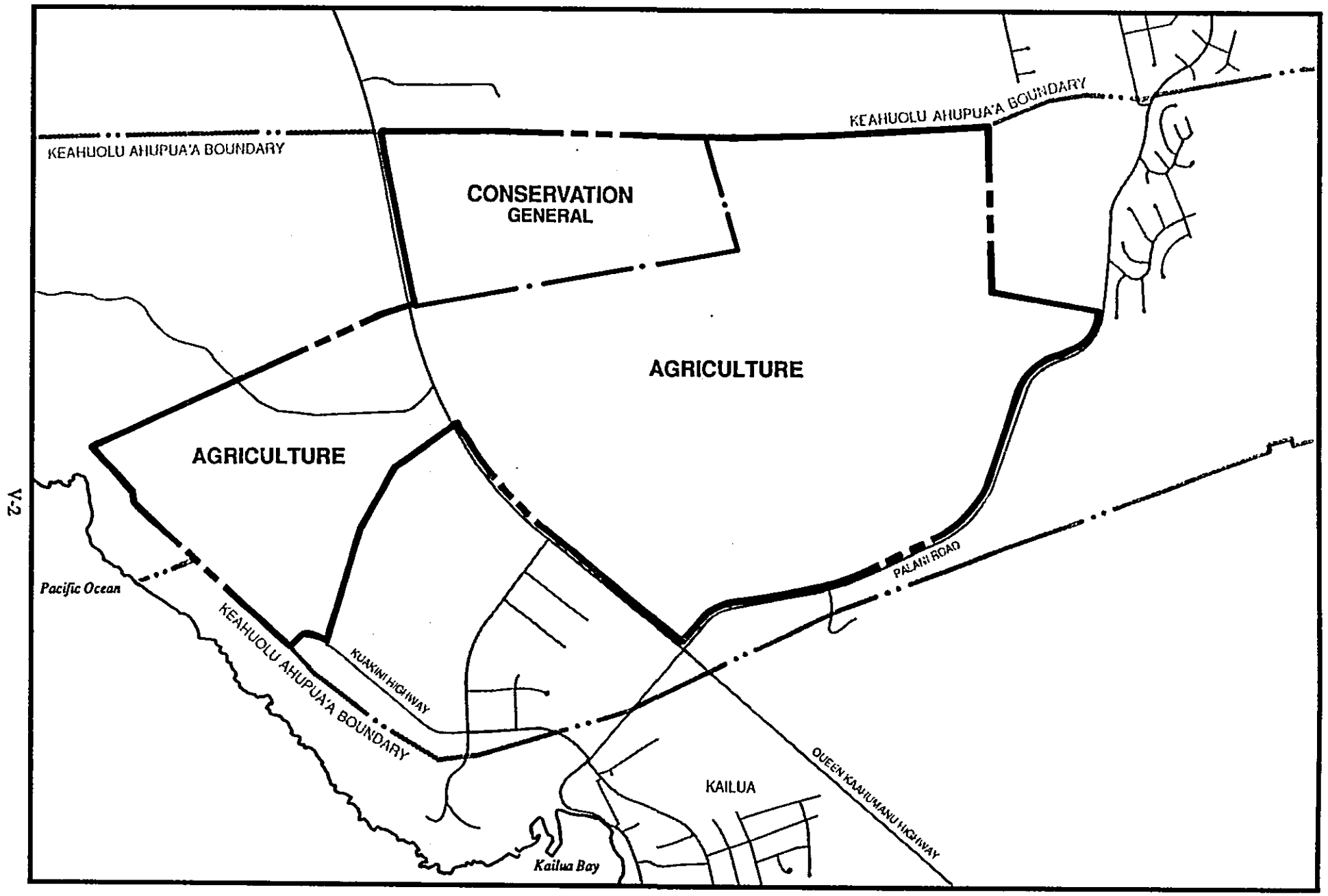
(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawaii state plan and related to the applicable priority guidelines of the Hawaii state plan and the adopted functional plans;

(2) The extent to which the proposed reclassification conforms to the applicable district standards; and

(3) The impact of the proposed reclassification on the following areas of state concern:

(A) Preservation or maintenance of important natural systems or habitats;

(B) Maintenance of valued cultural, historical, or natural resources;



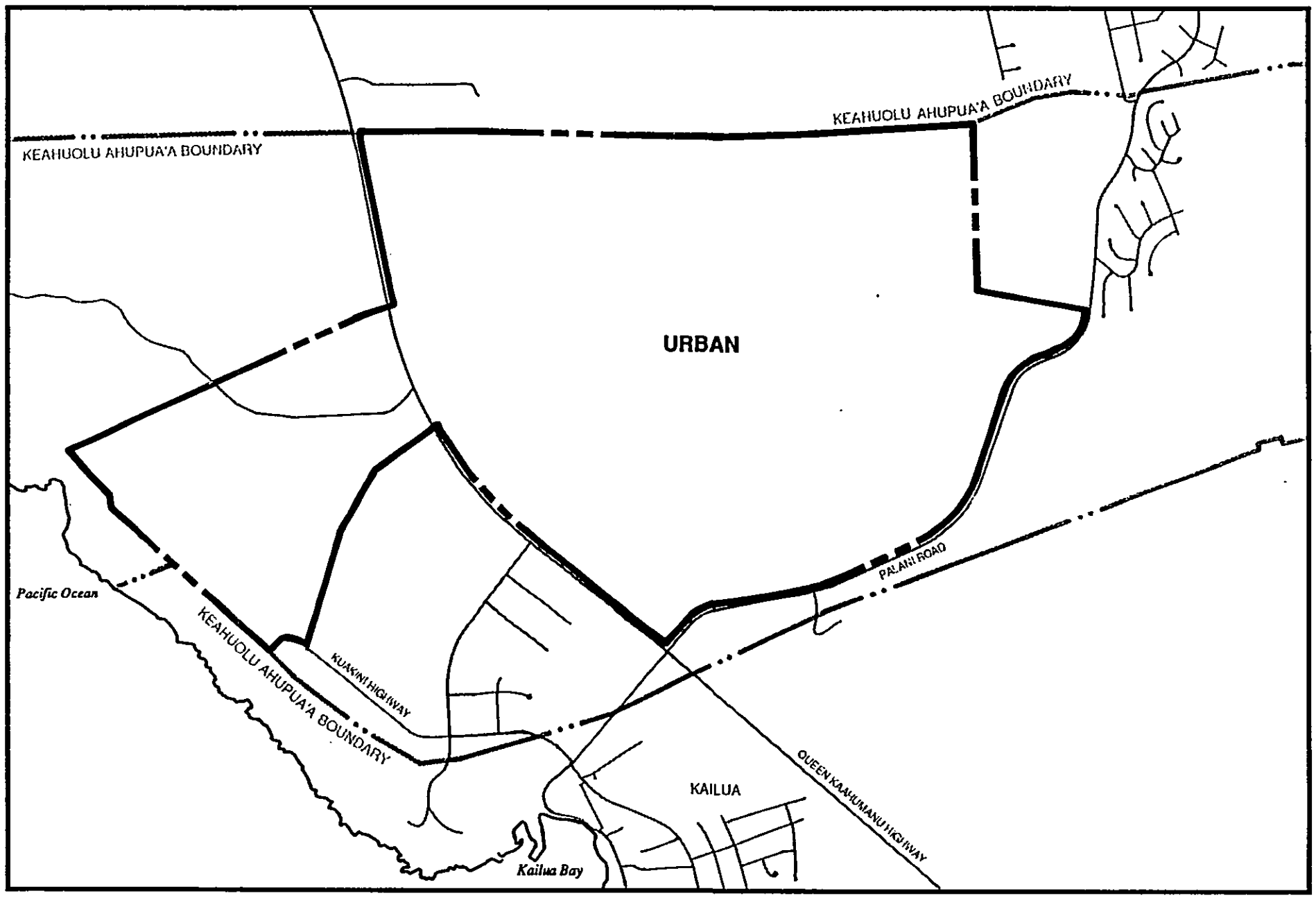
LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

0 400 800 1600
SCALE IN FEET

NORTH

Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure V-1
EXISTING LAND USE DISTRICT BOUNDARIES



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NORTH

LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

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Figure V-2
PROPOSED LAND USE DISTRICT BOUNDARIES

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

(D) Commitment of state funds and resources;

(E) Provision for employment opportunities and economic development; and

(F) Provision for housing opportunities for all income groups, and gap groups.

The subject matters of these criteria are addressed in the following sections in this chapter and also in Chapter IV regarding probable impacts on the environment. Based upon these discussions, the proposed project meets the criteria contained in Section 205-17, HRS.

The SLUC District Regulations require that the application for a boundary amendment show that it is reasonable, not violative of Section 205-2 and consistent with Chapter 15-15, Hawaii Administrative Rules. The reasons for the requested changes in the State Land Use District Boundaries are discussed in Section 3-5, Chapter II of this document. The consistency of the proposed district designation with Section 205-2, HRS and Chapter 15-15, Hawaii Administrative Rules are discussed in the following sections. A discussion of how the proposed revisions meet the special requirements for petitions for urban classification then follows.

1.2.1 Chapter 15-15, State Land Use Commission Administrative Rules

The proposed amendments to the State Land Use District boundaries are consistent with the basic standards for determining boundaries that are set forth in Section 205-2, HRS and Chapter 15-15, Hawaii Administrative Rules. Relevant standards from the administrative rules are presented below and followed by a discussion of the proposed designations' consistency with each standard.

Urban District

"In determining the boundaries for the "U" urban districts, the following standards shall be used:

1. It shall include lands characterized by "city-like" concentrations 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 except where the development would generate new centers of trading and employment;
   B. Substantiation of economic feasibility of the petitioner;
   C. Proximity to basic services such as sewers, transportation systems, 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, unstable soil conditions, and other adverse environmental effects;
4. In determining urban growth for the next ten years, or in amending the boundary, land contiguous with existing urban areas shall be given more consideration than non-contiguous land, and particularly when indicated for future urban use on state or county general plans;
5. It shall 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 to not conform to the standards in paragraphs 1-5:
   A. When surrounded by or adjacent to existing urban development: and
   B. Only when those lands represent a minor portion of this district;
7. It shall not include lands, the urbanization of which will contribute toward 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 those lands are desirable and suitable for urban purposes and that official design and construction controls are adequate to protect the public health, welfare and safety, and the public's interests in the aesthetic quality of the landscape."

Discussion: An examination of the proposed project area to Urban redesignation in reference to each of the above-listed points follows.

1. The project area is adjacent to the regional center of population in West Hawaii.

2. The project area will serve as an extension of Kailua-Kona, which is West Hawaii's center of economic activity. Development of the project area will expand the existing center of trade and employment. As a private non-profit trust, the petitioner is committed to preserving the Trust and expanding its services to its beneficiaries. To that end, the Trust is committed to economic stability. A market analysis prepared for this project has concluded that the proposed project is feasible. The proposed project area is adjacent to basic services such as transportation systems, schools and police and fire protection. In addition, a new region-serving sewage treatment plant is being constructed adjacent to the project area. Potable water resources will be developed to serve the project area as part of the proposed development. Finally, the proposed project includes sufficient property to provide for urban expansion for the next 20 or more years.

3. The slope of the property is appropriate for urban development, and the property is not subject to adverse environmental conditions.

4. The project area is designated for Alternate Urban Expansion by the Hawaii County General Plan and is contiguous to an existing urban area.

5. The project area is appropriate for new urban concentration due to its close proximity to Kailua-Kona.

6. The proposed project area is consistent with paragraphs 1-5 of the urban standards.

7. Development of the proposed project will not result in scattered spot urban development. As a point of fact, the proposed project area is a logical extension of the existing community.

8. The project area does not contain lands in excess of ten percent slope.

1.3 HAWAII STATE PLAN

The Hawaii State Plan (State of Hawaii, Department of Planning and Economic Development, 1978, Revised 1989) consists of a series of broad goals, objectives and policies which are to serve as the guidelines for the growth and development of the State. The Plan is divided into three parts; Part I (Overall Theme, Goals, Objectives and Policies), Part II (Planning, Coordination and Implementation), and Part III (Priority Guidelines). Part II pertains to the administrative structure and implementation process for the State Plan. Because Part II is not relevant to the proposed action, it is not included in this analysis. Discussed below are the specific goals, objectives, policies, and priority actions contained in Part I and Part III of the State Plan which are thought to be most directly related to the proposed project.

1.3.1 Part I. Overall Theme, Goals, Objectives and Policies

The Hawaii State Plan lists three "Overall Themes": (1) Individual and family self-sufficiency; (2) Social and economic mobility; and (3) Community or social well being. These themes are considered to be "basic functions of society" and goals towards which government must strive. To guarantee the elements of choice and mobility embodied in the three themes, three goals are presented in the Plan:

SEC. 226-4 State goals. In order to guarantee, for present and future generations, those elements of choice and mobility that insure that individuals and groups may approach their desired levels of self-reliance and self-determination, it shall be the goals of the State to achieve:

(1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.

(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

(3) Physical, social, economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

Discussion: The Liliuokalani Trust's proposed Urban Expansion fully supports the three goals. The development of the proposed land use activities on the Keahuolu property is intended to accommodate major population growth that has been projected for the West Hawaii region. The Urban Expansion is proposed as a diverse mix of business and residential opportunities that will be needed to satisfy the growing demand for a full range of services and activities. The design of the Urban Expansion will be consistent with the existing and perceived character of the region and will be developed in a manner that is harmonious with the natural beauty of the area. The proposed residential area, together with the commercial and civic activities, will help to fulfill the needs of the area's existing and future residents by ensuring that their physical, social, and economic well-being are enhanced through a thoughtful urban design concept and efficient and timely implementation of long awaited facilities.

SEC. 226-5 Objective and policies for population.

Objective: It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic, and social objectives contained in this chapter.

Policies:

(2) Encourage an increase in economic activities and employment opportunities on the Neighbor Islands consistent with community needs and desires.

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

(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 project is proposed in direct response to the projected population growth in the West Hawaii region over the next 30 or more years. This population growth is being induced by significant resort expansion along the South Kohala coastline and in the district of North Kona. In the face of this growth, new employment and residential opportunities will be needed. The proposed project will provide commercial, office, recreational, and civic land uses; public facilities; and residential opportunities for the community. Construction of the project will be phased to meet demand as it arises. Infrastructure, including water, will be provided to ensure the new development is fully serviced and able to accommodate new growth.

SEC. 226-6 Objectives and policies for the economy--in general.

Objectives: (1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

(2) A steadily growing and diversified economic base that is not overly dependent on a few industries.

Policies:

(6) Strive to achieve a level of construction activity responsive to, and consistent with, State growth objectives.

(8) Encourage labor-intensive activities that are economically satisfying and which offer opportunities for upward mobility.

(9) Foster greater cooperation and coordination between the public and private sectors in developing Hawaii's employment and economic growth opportunities.

(10) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.

(14) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.

Discussion: A wide range of employment opportunities will be created by the proposed project. Planned uses include commercial and office space, a regional hospital, a business hotel, a civic and cultural center, and residential development. The proposed land uses will enable new businesses and activities to locate to the West Hawaii region, as well allow existing businesses in place to expand and prosper, resulting in the diversification of the region's economy. Phasing of the project over the next 30 or more years will help to ensure a stable level of construction activity. Implementation of the proposed project in accordance with State and County plans will facilitate a high level of cooperation with government agencies. Design of the various components of the project will be consistent with the existing and preferred character of the Kailua-Kona area and will strive to protect the scenic beauty and cultural and historic resources of the area.

SEC. 226-8 Objective and policies for the economy--visitor industry.

Objective: Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy.

Policies:

(3) Improve the quality of existing visitor destination areas.

(4) Encourage cooperation between the public and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities.

Discussion: Presently, the Kailua-Kona area contains two distinct visitor destination nodes, historic Kailua town and Keauhou. While population growth at Keauhou has been relatively

orderly, development in and around Kailua may be characterized by a distinct lack of commercial, retail and office space needed to serve the growing community. Infrastructure such as a new sewage treatment plant and roadway improvements have not kept pace with population growth. In addition, an expanding population has generated a critical need for expanded public facilities such as a regional hospital and government offices and services. The proposed project is intended to provide a new growth area which will allow the orderly and timely development and expansion of a central urban area. As such, it will also help to improve the visitor destination areas by providing new opportunities for the growth of visitor related support services and businesses as well as relocation opportunities for non-visitor oriented businesses that are presently located within the visitor destination nodes. This will, in turn, help to improve the visual character of the existing community by relieving traffic congestion in overcrowded Kailua town and the Kona Industrial subdivision, and segregate commercial and industrial uses.

SEC. 226-11 Objectives and policies for the physical environment--land-based, shoreline, and marine resources.

Objectives:

(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.

(2) Effective protection of Hawaii's unique and fragile environmental resources.

Policies:

(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

(3) Take into account the physical attributes of areas when planning and designing activities and facilities.

(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.

(8) Pursue compatible relationships among activities, facilities, and natural resources.

(9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.

Discussion: The proposed project is situated mauka of the Old Kona Airport Park and does not include any shoreline areas. The project area slopes up to the 700 foot elevation, approximately two miles inland. The project will be designed in a manner which will maximize view planes of the ocean and Hualalai mountain while preserving view corridors. Development of the various project elements will be sensitive to existing environmental conditions. Generous landscaping,

pedestrian walkways, low-density development and spacious open space areas will all contribute to a development character intended to be consistent with prevailing attitudes about quality of life in the existing community. No endangered species of plant or animal life have been identified on the project site. Endemic plants will be encouraged for use as landscape material wherever practicable. Development of the project site will greatly increase public access to the area. The project will be phased to correspond to future demand for commercial and office space. The subject property will be developed in a prudent manner consistent with the master plan resulting in orderly and timely development of infrastructure. Public open space areas devoted to passive recreational activities will be provided within the phased development.

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

Objective: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.

Policies:

(1) Promote the preservation and restoration of significant natural and historic resources.

(2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.

(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

(5) Encourage the design of developments and activities that complement the natural beauty of the islands.

Discussion: Over 230 historic sites, many consisting of multiple features, have been identified on the subject property. A detailed archaeological study of these sites has been conducted and treatment ranging from data collection to preservation has been recommended, depending upon the cultural and scientific value of individual sites. In recognition of the unique character of a large complex of sites near Palani Road, a 20 acre area has been recommended to be set aside as an Historic Preserve. Management of the Preserve will be consistent with procedures established by the State Historic Sites Office and accepted archaeological procedures. Sites recommended for preservation outside of the Preserve will be managed in the same manner. Scenic views of the ocean and Hualalai mountain will be preserve wherever possible. The low-density character of the proposed project's urban design will ensure the preservation of views, vistas, and the area's overall scenic beauty. Views of the subject property from Queen Kaahumanu Highway will be preserved. Views from Palani Road will be improved by the replacement of dense thickets of Kiawe and Haole Koa with landscaped areas. North-south view planes from Palani Road will be

created by the careful siting of structures.

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

Objective: (1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.

Policies: (2) Promote the proper management of Hawaii's land and water resources.

(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.

(4) Encourage actions to maintain or improve aural and air quality levels, to enhance the health and well-being of Hawaii's people.

(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.

(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

(7) Encourage urban developments in close proximity to existing services and facilities.

Discussion: The proposed project is located adjacent to North Kona's primary urban area and will be designed in a manner consistent with the desired character of the existing communities. Development of the project will ensure that threats to life and property from erosion and flooding are minimized through the engineering of drainageways to accommodate surface runoff. A small portion of the project area adjacent to the Old Kona Airport park is located within a tsunami inundation zone. No residential structures are planned for this area. Buildings located within the zone will be constructed to meet the County's current development standards. With regard to seismic activity, buildings will be constructed according to accepted engineering methods to minimize the potential damage from earthquakes. The last historical eruption of Hualalai occurred in 1801 resulting in a lava flow which reached the sea in the Keahole area. The potential for lava inundation of the project area is considered to be slight. Nevertheless, evacuation routes will be incorporated into the overall project design. The low-density character of the project will help to minimize aural impacts, as will the segregation of residential areas from the higher activity commercial district. While air quality may be impacted to some degree by the conversion of vacant agricultural land to more active uses, State and Federal air quality standards will be observed. The creation of pedestrian malls and an efficient transportation network will help to minimize the impact of automobile emissions upon air quality. There are no surface waters on the proposed project site. Impact upon ground waters will be minimized by adherence to accepted construction techniques and standards. No industrial activities are proposed for the development.

Consequently, noxious activities which might impact air and ground water quality are not expected to occur. Use of the property will be managed through the timely phasing of project elements in a manner that is compatible and beneficial to the environment as well as existing neighboring communities and the area's future population.

SEC. 226-14 Objective and policies for facility systems--in general.

Objective: Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

Policies:
(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with State and County plans.

(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.

Discussion: The key element of the proposed project is the design and implementation of facility systems which provide for the orderly and timely development of the project without placing undue strain on existing infrastructure. In fact, the roadway network included in the design proposal is specifically intended to assist in relieving existing traffic congestion on Palani Road and accommodating increased levels of traffic along Queen Kaahumanu Highway.

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

Objectives:
(1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.

(2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility and other areas.

Policy:
(1) Encourage the adequate development of sewerage facilities that complement planned growth.

Discussion: As a precursor to development in the Kailua region, the County of Hawaii is presently constructing the Kealakehe Sewage Treatment Plant just north of the Trust's proposed project. Discussions have been held with the County to ensure that expansion plans for the facility will include the Trust's project. With regard to solid waste, the County of Hawaii is presently proposing the development of a new land fill to serve the Kailua area at Puu-Waawaa in North Kona. The County has also proposed the closing of the Kealakehe landfill adjacent to the Trust's project, including the removal of metals and recyclable materials from the landfill. Solid and liquid

waste generated by the proposed project will be accommodated by these proposed facilities.

SEC. 226-16 Objective and policies for facility systems--water.

Objective: Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.

Policy: (1) Coordinate development of land use activities with existing and potential water supply.

Discussion: The master plan for the proposed project includes the phased development of potable water wells to serve the project area. Water wells will be developed either on Trust owned land or by a joint development agreement on neighboring properties. Development of water resources will be fully coordinated with State and County agencies.

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

Objective: (1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.

Policies: (6) Encourage transportation systems that serve to accommodate present and future development needs of communities.

(10) Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawaii's natural environment.

Discussion: Specific transportation elements included in the project include the provision of a 300 foot setback from Queen Kaahumanu Highway, the acquisition of Trust land by the County to facilitate the widening of Palani Road, a new mauka-makai roadway linking the Queen Kaahumanu Highway to Palani road, a grade-separated intersection at Queen Kaahumanu Highway, and a mid-level roadway across the project site linking Palani Road to the Kealakehe property. Also included within the proposed development are a series of pedestrian walkways linking project elements and providing an alternative to vehicular transportation.

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

Objective: (2) Increased energy self-sufficiency.

Policy: (3) Promote prudent use of power and fuel supplies through conservation measures including education and energy-efficient practices and technologies.

Discussion: The proposed project is intended to utilize the latest advancements in energy-efficient construction practices and alternate energy development technologies to facilitate the prudent use of power and fuel supplies. Conservation methods including the siting of buildings to take advantage of prevailing winds and the use of shade trees to help shelter buildings as a method of reducing reliance upon air-conditioning,

SEC.226-19 Objectives and policies for socio-cultural advancement--housing.

Objectives:
(1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, livable homes located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals.

(2) The orderly development of residential areas sensitive to community needs and other land uses.

Policies:
(1) Effectively accommodate the housing needs of Hawaii's people.

(2) Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households.

(3) Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.

(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.

Discussion: Included in the proposed project is the designation of approximately 450 acres of property for the development of affordable and market-priced housing. Approximately 450 acres of Trust land is planned for purchase by the State of Hawaii, 150 acres of which is proposed for inclusion in the Housing Finance and Development Corporation's proposed Kealakehe Planned Community (KPC). The KPC is intended to provide affordable housing opportunities to meet projected growth in West Hawaii. The remaining 300 acres being sold to the state are expected to be also be developed in housing by the HFDC. Together, the 450 acres proposed for housing fulfill the State's goals and objectives for new housing opportunities.

SEC. 226-20 Objectives and policies for socio-cultural advancement--health.

Objectives:
(1) Fulfillment of basic individual health needs of the general public.

(2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities.

Policies:
(1) Provide adequate and accessible services and facilities for prevention and treatment of physical and mental health problems, including substance abuse.

(5) Provide programs, services, and activities that ensure environmentally healthful and sanitary conditions.

Discussion: The master plan for the proposed project includes the designation of 35 acre site for the location of a new regional hospital for West Hawaii. This facility is intended to fulfill a critical need for expanded health services for the existing and growing population of the area. At present, studies conducted by advocacy groups indicate the need for a 120-bed facility. The proposed project includes a parcel of land of sufficient size to accommodate such a facility and allow for its expansion in the years to come. The siting of this facility within the proposed Regional Center will ensure the availability of health services to West Hawaii. The Trust's proposed development project will be designed and constructed in a manner that is sensitive to the environment and ensures healthful and sanitary conditions in the community.

SEC. 226-23 Objective and policies for socio-cultural advancement--leisure.

Objective: Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.

Policies:

(2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.

(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.

(6) Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.

(8) Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms.

Discussion: The Historic Preserve, the Civic and Cultural Center, and a variety of parks and open spaces included in the proposed development contribute to the goal and objectives of providing recreational and leisure activities to the existing and growing population of the area. In particular, the Civic and Cultural Center is proposed to provide a site for the development of cultural facilities including a museum and a theater of the performing arts, facilities which are not presently available to the residents of the Kailua area.

SEC. 226-25 Objective and policies for socio-cultural advancement--culture.

Objective: Planning for the State's socio-cultural advancement with regard to culture shall be

directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.

Policy: (1) Foster increased knowledge and understanding of Hawaii's ethnic and cultural heritages and the history of Hawaii.

Discussion: Preservation of historic sites within the subject property will provide a direct means of communicating to existing and future residents of the area, the cultural traditions and customs of the area's Hawaiian population.

1.3.2. Part III. Priority Guidelines

The purpose of this part of the State Plan is to establish overall priority guidelines to address areas of statewide concern. Section 226-102 of the Plan notes that the State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in five major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education. The priority guidelines applicable to the proposed project are discussed below.

SEC. 226-103 Economic priority guidelines.

(a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve and stable and diversified economy:

(1) Seek a variety of means to increase the availability of investment capital for new and expanding enterprises.

(8) Provide public incentives and encourage private initiative to develop and attract industries which promise long-term growth potentials and which have the following characteristics:

(B) A clean industry that would have minimal adverse effects on Hawaii's environment.

(b) Priority guidelines to promote the economic health and quality of the visitor industry:

(2) Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provides for adequate shoreline setbacks and beach access.

Discussion: The proposed Urban Expansion project would assist in meeting the above guidelines by allowing private investment in a wide variety of business activities, including

wholesale and retail commercial outlets, professional offices, business offices, a regional hospital, a business hotel, and a rental housing project targeted for the elderly. These activities will together serve an expanding economic market and promote the long-term economic stability of the region. The general types of businesses and services proposed are clean, non-polluting, low-impact activities that will have minimal adverse effects on the environment.

(e) Priority guidelines for water use and development:

(1) Maintain and improve water conservation programs to reduce the overall water consumption rate.

(f) Priority guidelines for energy use and development:

(2) Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy.

Discussion: The conservation of natural resources, especially water, is an important concern to the proposed development. While new water resources will be developed to support the projected growth in the region, the conservation of those resources is vital to long-term growth and stability. For this reason, the proposed project will seek to aid in the attainment of the water conservation guidelines. Energy conservation is equally important. Construction and design techniques can be utilized to ensure that new buildings are energy-efficient. Because transportation activities also have a significant impact on energy consumption, elements of the proposed project include a strong pedestrian orientation intended to help to minimize reliance upon automobiles. In this manner, the project will seek to assist in the attainment of energy conservation guidelines.

SEC. 226-104 Population growth and land resources priority guidelines.

(a) Priority guidelines to effect desired statewide growth and distribution:

(1) Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.

(3) Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.

(4) Encourage major State and Federal investments and services to promote economic development and private investment to the neighbor islands, as appropriate.

(b) Priority guidelines for regional growth distribution and land resource utilization:

(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable

public expenditures and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.

(2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

(9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized.

(12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.

Discussion: The proposed project is situated upon marginal agricultural land, adjacent to an existing urban area. The development of this land to support projected population growth in the region is consistent with population related priority guidelines. The development of infrastructure to support the proposed project, especially new transportation systems, sewage and solid waste disposal facilities, and water systems will ensure that the proposed development is implemented in an orderly and timely manner with adequate infrastructural capacities. The prudent investment of government funds in these facilities, especially in the area of waste disposal and transportation will help to alleviate current deficiencies. Finally, the proposed property is intended to be developed in a manner that is sensitive to the environment and protect valuable resources including archaeological sites and endemic plants. In this manner, the project will aid in the attainment of the above population related guidelines.

SEC. 226-106 Affordable housing. Priority guidelines for the provision of affordable housing:

(1) Seek to use marginal or non-essential agricultural land and public land to meet housing needs of low and moderate-income and gap-group households.

Discussion: The sale of 450 acres of marginal and non-essential agricultural land by the Trust to the State for the development of affordable housing is consistent with the guideline for the provision of affordable housing.

1.4 STATE FUNCTIONAL PLANS

The Hawaii State Plan sets forth in Section 2 that functional plans shall include "the policies, programs and projects designed to implement the objectives of a specific field of activity

when such activity or program is proposed, administered, or funded by any agency of the State". The twelve functional plans were examined to determine the relationship of the proposed project to each of their administrative areas of responsibility.

1.4.1 State Agricultural Functional Plan (1985)

The entire project area consists of barren or nearly barren a'a and pahoehoe lava flows. Although approximately 945 acres are designated as Agricultural land by the State Land Use Commission and a small portion (approximately 12 acres) near the eastern project boundary is identified as Other Important Agricultural Land under the State's ALISH (Agricultural Lands of Importance to the State of Hawaii) system, the general classification of these lands by the Land Study Bureau is E, indicating little intrinsic value as productive agricultural lands. Because these lands are not utilized for agricultural activities, the objectives, policies and implementing actions of the Agricultural Functional Plan are not relevant to the proposed project.

1.4.2 State Conservation Functional Plan (1984)

There are several objectives and policies in the State Conservation Functional Plan which pertain to the proposed project. These are identified below and followed by a discussion of how the proposal may assist in their implementation.

Objective: Effective protection and prudent use of Hawaii's unique, fragile, and significant environmental and natural resources.

Policy: (A1) Exercise an overall conservation ethic in the use of Hawaii's resources by protecting, preserving, and conserving the critical and significant natural resources of the State of Hawaii and controlling use of hazardous areas.

Objective: Effective protection and management of open space, watersheds, and natural areas.

Policy: (C3) Protect and manage the lands with historic or natural resources value.

Objective: Promote sound management and development of Hawaii land and marine resources for potential economic benefit.

Discussion: The conversion of Conservation District land to the Urban District for the implementation of the proposed project does not relieve the Trust of its responsibility to ensure that natural resources are preserved and protected. Phased development of the proposed project will ensure that development will occur in an orderly and timely manner with a minimal amount of negative impact upon the environment. Urban design of the project encourages low-density development that emphasizes the preservation of open space and encourages the use of endemic

plants for landscaping. Culturally significant historic and archaeological resources identified on the subject property will be preserved. The development of the property for economic benefit will be done in a manner that promotes environmental awareness and protection.

1.4.3 State Educational Functional Plan (1989)

The State Education Functional Plan reflects the Department of Education's strategies to address the goals, policies and priority guidelines of the Hawaii State Plan and the goals of the State Board of Education. All of the actions are to be undertaken by the State Department of Education. The specific objectives and policies of the functional plan are not directly applicable to the proposed development.

1.4.4 State Higher Educational Functional Plan (1984)

There are no objectives, policies or implementing actions in this functional plan that are directly applicable to the proposed project.

1.4.5 State Employment Functional Plan (1989)

The State Employment Function Plan contains objectives, policies and implementing actions directed four major areas: Education and Preparation Services for Employment; Job Placement; Quality of Work Life; and Employment Planning Information and Employment Coordination. The proposed project is intended to provide a wide variety of new employment opportunities to the existing and future residents of the West Hawaii region which will, in turn, have a direct impact upon improving the quality of life in the region. However, because the project is being master planned by the Trust, there is no direct involvement by the Trust in labor or employment practices associated with the project. Each project element site included in the master plan will be leased to a private developer who will be responsible for actual construction and/or operation. For this reason, although the proposed project will foster opportunities for increased employment and supports the intention of the plan, the specific provisions of the functional plan are not directly applicable.

1.4.6 State Energy Functional Plan (1984)

The State Energy Functional Plan's objective to promote energy efficiency through land use and support facility systems planning relates directly to the overall master planning of the proposed project as well as its implementation. The project will be master planned to promote energy

efficiency through the general siting of facilities to maximize access and minimize energy consumption. While specific building designs are not included in the master plan, the proposed project will adhere to energy conservation standards whenever possible. Specific elements of energy conservation such as the utilization of solar energy in building design for the purposes of water heating and air conditioning will be encouraged wherever practicable.

1.4.7 State Health Functional Plan (1989)

The State Health Functional Plan includes objectives and policies that relate directly to the proposed development. These are presented below followed by a discussion how the project will support their implementation.

Objective: To prevent degradation and enhance the quality of Hawaii's air, land and water.

Policy: (A1) Prevent and control the pollution of air, water and land through long-range planning, environmental impact assessments, interagency coordination, programs, regulations, and financial assistance to local governments.

Objective: Minimize the threat to public health from insanitary conditions by ensuring that facilities are built and maintained so that products and services are provided in a healthful manner.

Discussion: The proposed project intends to comply with all applicable Department of Health rules and regulations as well as those established by Hawaii County. Environmental impacts on air quality are fully addressed within this EIS document. Drainage and runoff from the project, both during construction and long-term maintenance of planned facilities will be minimized to ensure the protection of ground water quality and offshore ocean water quality. Infrastructure intended to accomodate the sewage and solid waste generated by the project will be master planned to ensure its timely development.

Objective: To reduce morbidity and mortality by assuring the availability and accessibility of the best possible emergency medical services throughout the State.

Discussion: The inclusion of a regional hospital in the proposed project will aid in the attainment of the above stated objective by ensuring that the West Hawaii region's activity center is adequately served by a health care facility of sufficient size to accommodate existing and project population increases.

1.4.8 State Historic Preservation Functional Plan (1984)

Objectives, policies and implementing actions in the Historic Preservation Functional Plan

are intended for implementation by the Department of Land and Natural Resources and affiliated State agencies. The project area has been extensively surveyed and a description of identified historic and archaeological sites is included in the EIS document. Recommendations are included for the dispostion of the sites, including preservation of those sites identified as significant for cultural, scientific or educational value. Implementation of the proposed project will included the preparation of an Historic Sites Mitigation Plan to ensure conformance with all applicable state, county and federal regulations concerning historic sites.

1.4.9 State Housing Functional Plan (1989)

The Housing Functional Plan includes objectives, policies which are applicable to the proposed project. These are presented below followed by a discussion of how the proposed project will assist in their implementation.

Objective: Homeownership for at least sixty percent, or roughly 248,500 households by the year 2000.

Policies:

(A1) Encourage increased private sector participation in the development of affordable for-sale housing units.

(A2) Form public/private partnerships and/or enter into public/private development agreements to develop affordable housing.

(A3) Ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable homeownership opportunities.

Discussion: The Trust and the State are working jointly to accomplish the development of affordable housing through an agreement by the Trust to sell 450 acres of its land to the State for inclusion of all or part of it in the State's Kealakehe Planned Community affordable housing project. The provision of this land for affordable housing satisfies the policy to provide a fair share amounty of affordable housing.

Objective: Sufficient amount of affordable rental housing units by the year 2000 so as to increase the State's rental vacancy rate to at least 3%.

Policy: (B2) Encourage increased private sector participation in the development of affordable rental housing.

Objective: Increased development of rental housing units for the elderly and other special need groups to afford them an equal access to housing.

(C7) Integrate special needs housing in new and existing neighborhoods.

Discussion: Sale of 450 acres of Trust land to the State for the development of a variety of home ownership and rental housing opportunities will assist in the implementation of the above objectives and policies for housing.

1.4.10 State Human Services Functional Plan (1989)

Objectives and polices of the Human Services Functional Plan are directed specifically to administration and implementation by State agencies including the Department of Human Services, the Department of Health, the Department of Education, the Department of Labor and Industrial Relations, and the State Office of Children and Youth and Executive Office on Aging. While the functional plan does not relate directly to the private sector, in the instance of the Trust, the issues raised in the functional plan are relevant and timely. The intent of the proposed project is to assist the beneficiaries of the Trust by increasing the income of the Trust, which will in turn be used to expand Trust programs and services.

1.4.11 State Recreation Functional Plan (1984)

A number of objectives and policies of the Recreation Functional Plan are applicable to the proposed project. These are presented below and followed by a discussion of how the project will assist in their implementation.

Objective: Achieve a pattern of land and water resource usage which is compatible with community values, physical resources, recreation potential, and recreation uses which support comprehensive public land use policies.

Policies: (A2) Ensure that intended uses for a site respect community values and are compatible with the area's physical resources and recreation potential.

(A3) Emphasize the scenic and open space qualities of physical resources and recreational areas.

Discussion: The proposed project is intended to provide sufficient area for the expansion of urban oriented activities in response to project population growth for the West Hawaii region. These activities include commerical and office space, public facilities, residential uses, and recreation uses. Included among the recreational uses are public parks and open space areas. The overall design of the proposed project will be consistent with the community's values and compatible with the area's physical resources. The project is proposed as a relatively low-density development which emphasizes open space.

Objective: Establish a system of maintaining natural and cultural resources for present and future generations, and of managing recreation and other uses in accordance with sound conservation practices.

Policy: (B1) Exercise an overall conservation ethic in the use of Hawaii's resources.

Discussion: The proposed project will include open space areas, an Historic Reserve, and public parks. Natural and cultural resources within the project area will be maintained and managed in accordance with sound conservation practices.

1.4.12 State Tourism Functional Plan (1984)

Although the proposed project does not directly involvement the expansion of existing visitor facilities or the development of new vistor-oriented facilities, it will contribute to the overall quality of the Kailua area by establishing a master planned area for population growth and development. This will promote the separation of land uses and the orderly and timely development of infrastructure to serve projected population growth, which will, in turn, help to improve the overall quality of life in the Kailua area and enhance its desirability as a visitor destination. Thus, while the objectives and policies of the Tourism Functional Plan do not directly relate to the proposed development, the project is consistent with and complimentary to the general intent of the functional plan.

1.4.13 State Transportation Functional Plan (1984)

The objectives and policies of the Transportation Functional Plan relate primarily to the administration and implementation of transportation policy by the State Department of Transportation. For this reason, the functional plan does not directly relate to the proposed project. However, because transportation is a crucial element of the proposed project, a variety of mitigation measures are recommended to assist in reducing the project's impacts upon existing and future traffic conditions in the area. Master planning of the proposed project is being undertaken by the Trust. Properties will be leased to private developers. Consequently, while transportation improvements will be master planned for the proposed project, their implementation will coincide with development of individual project elements. At the master planning stage, the Trust is working closely with the State Department of Transportation to ensure that transportation systems proposed for inclusion in the project are consistent and supportive of the DOT's agency objectives and polices.

1.4.14 State Water Resources Development Functional Plan (1984)

Objectives and policies of the Water Resources Development Functional Plan are directed primarily to State and County agencies responsible for the management of water resources and are not directly applicable to the proposed project. The proposed project includes the development of water resources to serve the planned development. Implementation of water infrastructure will be done in cooperation with the appropriate State and County agencies and in compliance with the State Commission on Water Resource Management.

1.5 COASTAL ZONE MANAGEMENT ACT (CHAPTER 205-A, HRS)

The objectives of the Hawaii Coastal Zone Management (CZM) Program, as set forth in Chapter 205A, Hawaii Revised Statutes, include protection and maintenance of valuable coastal resources. The proposed project does not directly impact the coastal area, in that, it is setback from the coastline and to a large extent, buffered by the Old Kona Airport Park. Nonetheless, that portion of the project located makai of the Queen Kaahumanu Highway is situated entirely within the Special Managment Area (see Figure V-3) and is therefore subject to evaluation under the CZM objectives. Following is a discussion of those CZM objectives relevant to the proposed project.

1.5.1 Recreational Resources

Objective

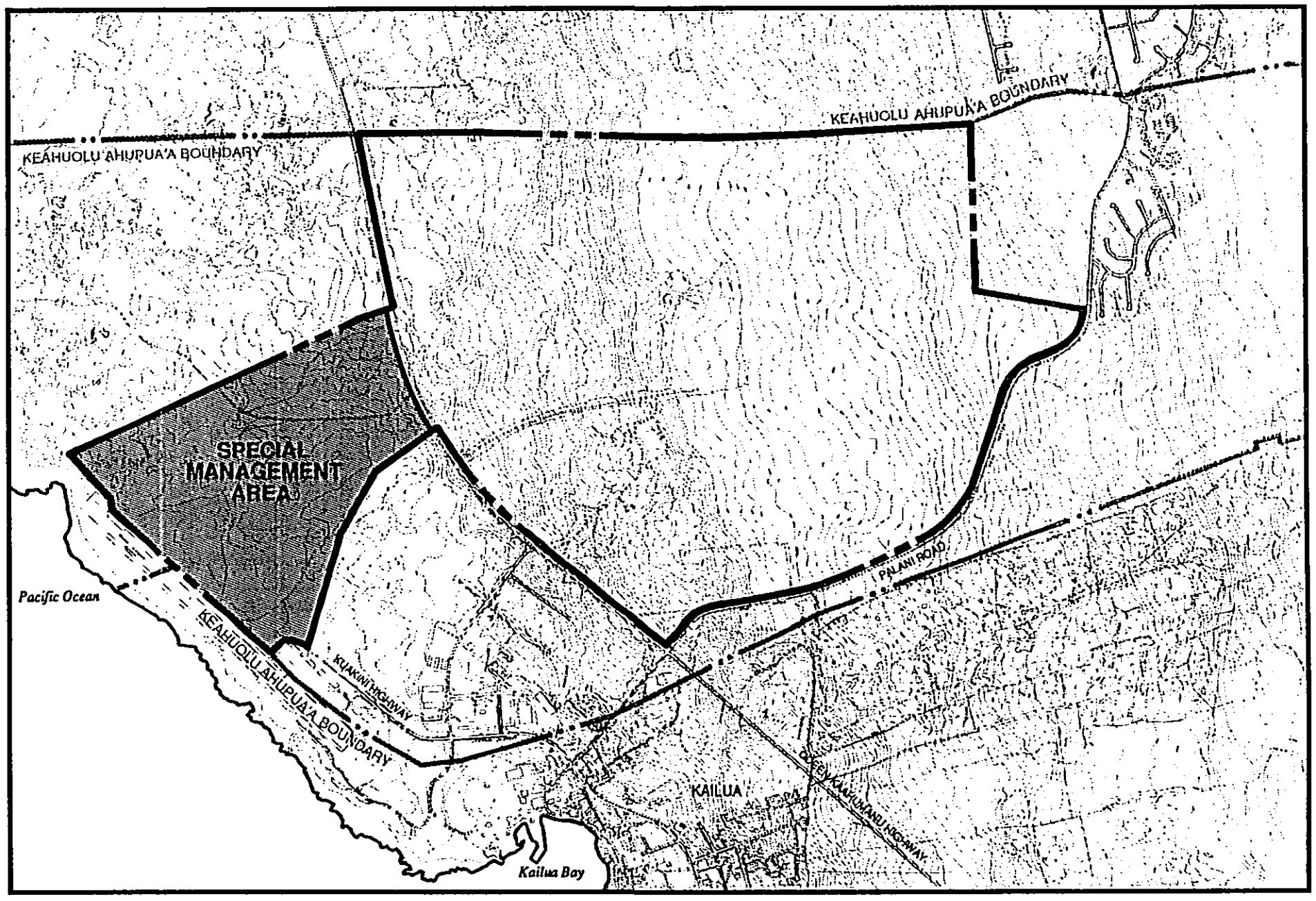
Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

Policies

2c) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

2f) Adopting water quality standards and regulating point and non-point sources of pollution to protect and where feasible, restore the recreational value of coastal waters;

Discussion: Development of the project area adjacent to the County and State park areas within the Old Kona Airport Park will include public accesses to the park as well as the shoreline where applicable. Point and non-point sources of pollution will be managed through the application of all appropriate County, State and Federal water standards. Runoff and drainage from the project site will be minimized.



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Date: AUGUST 1990

Figure V-3
SPECIAL MANAGEMENT AREA

1.5.2 Historic Resources

Objective

Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Polices

1) Identify and analyze significant archaeological resources;

2) Maximize information retention through preservation of remains and artifacts or salvage operations; and

3) Support State goals for protection, restoration, interpretation, and display of historic resources.

Discussion: An archaeological inventory survey has been conducted for the entire property and a general mitigation plan has been submitted to the State Historic Sites Office for approval. The inventory study and mitigation plan are both consistent with State goals for historic resources.

1.5.3 Scenic and Open Space Resources

Objective

Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policy

2) Insure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of the natural landforms and existing public views to and along the coastline;

Discussion: Development of the project will include design standards which emphasize coastal view planes and ensure that structures are compatible with the character of the surrounding area. The project is envisioned as a relatively low density development of commercial and office uses which will minimize impacts on coastal views.

1.5.4 Coastal Ecosystems

Objective

Protect valuable coastal ecosystems form disruption and minimize adverse impacts on all coastal ecosystems.

Discussion: The project will be located on barren and partially vegetated lava fields separated from the shoreline by an existing park development and is not located within the shoreline setback area. Biological studies have been conducted on the subject property and no significant or endangered biota has been identified. The project is not located within or abutting the coastal ecosystem and will have no direct impact upon the shoreline area. However, development of the project will increase the use of the adjacent park and shoreline area.

1.5.5 Economic Uses

Objective

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Discussion: The project is not coastal dependent. The portion of the project located within the CZM area is intended for long-range development and is not included in the project's initial phase. However, development of the overall project will contribute to the State's economy by providing new services and facilities to support the growing population of West Hawaii.

1.5.6 Coastal Hazards

Objective

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, and subsidence.

Policy

2) Control development in areas subject to storm wave, tsunami, flood, erosion, and subsidence hazard.

Discussion: A small portion of the project area is situated within the tsunami hazard zone. No residential development is planned for this area. Structures developed in this area will be constructed in a manner consistent with appropriate County, State and Federal standards.

1.5.7 Managing Development

Objective

Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies

1) Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development;

2) Facilitate timely processing of application for development permits and resolve overlapping or conflicting permit requirements; and

3) Communicate the potential short- and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the general public to facilitate public participation in the planning and review process.

Discussion: This EIS has been prepared in compliance with existing state and county environmental rules (Chapter 343, HRS). It will be used to apply for the required permits. The property owner has been meeting with appropriate County, State and Federal officials, as well as representatives of private organizations and the general public to solicit their comments and ensure that the project is understood and known to all whom may be impacted by it. The comments received during these meetings are being incorporated into this EIS. Public review of the Draft EIS will also provide public and governmental agency review of the project.

1.6 WEST HAWAII REGIONAL PLAN

Published in November, 1989 by the Office of State Planning, the West Hawaii Regional Plan "addresses critical topical issues which require State attention in order to most effectively meet the region's present and emerging needs". The plan identifies the subject property as contained within a subregional planning area and outlines a strategy to "concentrate future regional urbanization in designated Subregional Planning Areas and provide for their planning and future development in a manner which optimizes or mitigates subregional problems, issues and opportunities". The plan contains a number of goals which establish a "vision" for West Hawaii. Following is a summary of the relationship between these goals and the proposed project.

Goal:	Applicable	Supportive
Plan and maximize benefits for Hawaii's people.	Yes	Yes
Optimize the use of State owned lands.	No	
Promote a diversified economic base which maximizes job choice and opportunities.	Yes	Yes
Ensure access to and adquacy of health, education, job-training, and human service programs.	No	
Ensure provision and adequacy of affordable housing.	Yes	Yes
Minimize adverse impact of new development on local lifestyles, historic and cultural resources and community values.	Yes	Yes
Provide a wide range of outdoor recreational activities.	No	
Protect scenic areas, natural landmarks, open space and viewsheds.	Yes	Yes
Ensure that existing and proposed developments can be adequately accommodated.	Yes	Yes
Support urban developments that maintain the unique character of the West Hawaii region.	Yes	Yes
Protect State investments at the Natural Energy Laboratory of Hawaii, the Hawaii Ocean Science and Technology Park, Keahole Airport, and the Mauna Kea observatories.	No	
Ensure that new development does not adversely impact:		
agricultural resource activities	No	
aquacultural resource activities	Yes	Yes
the quality of the aquifer	Yes	Yes
the quality of nearshore waters	Yes	Yes
the quality of offshore and deep ocean waters	No	
the quality of the air	Yes	Yes
the watersheds	No	
Ensure that the servicing of resort development does not result in unnecessary in-migration.	No	
Ensure the clustering of resorts in order to minimze public service costs.	No	
Promote quality and diversity in future resort developments.	No	
Develop only within infrastructure capacities and constraints.	Yes	Yes
Maintain the diversity of the region's natural and cultural assets.	Yes	Yes
Maintain the diversity and character of existing communities	Yes	Yes
Ensure that development does not lead to deterioration in the quality of life.	Yes	Yes
Maintain opportunities for community participation during plan implementation.	Yes	Yes

2. HAWAII COUNTY PLANS AND CONTROLS

2.1 HAWAII COUNTY GENERAL PLAN

The Hawaii County General Plan is the policy document for the long-range comprehensive development of the island of Hawaii. The General Plan provides direction for balanced growth of the County. The Plan contains goal, policies, and standards concerning twelve functional areas as well as a series of land use maps referred to as General Plan Land Use Pattern Allocation Guide (LUPAG) Maps. The recently revised LUPAG map designations for the subject property identify

it generally as Alternate Urban Expansion with a portion near the intersection of Palani Road and Queen Kaahumanu Highway as High Density Urban, a portion near the Queen Liliuokalani Village as Low Density Urban, and an area mauka of Queen Kaahumanu Highway near the northern property boundary as Conservation and Industrial (see Figure V-4). With the exception of the Conservation designation, the proposed project is consistent with the General Plan designations. The proposed project is also consistent with the policies of the General Plan.

2.2 HAWAII COUNTY ZONING

The project area includes two zoning classifications: the area presently classified as Agricultural District by the State Land Use Commission is zoned Unplanned; and the area presently classified as Preservation District is zoned Open (see Figure V-5).

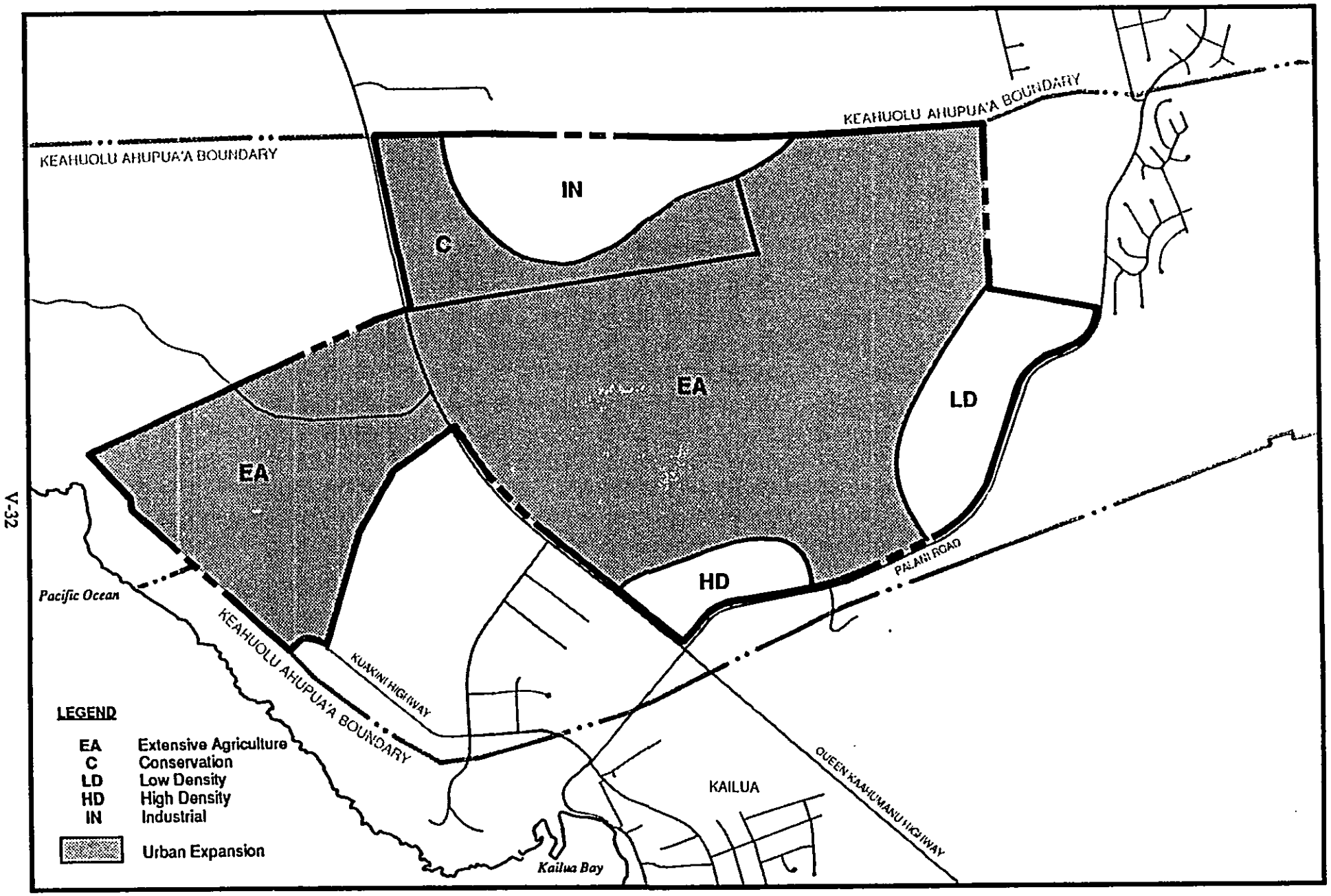
2.3 HAWAII COUNTY SPECIAL MANAGEMENT AREA

Approximately 229 acres of the proposed project is located within the County Special Management Area (see Figure V-3), and is therefore subject to the provisions of Chapter 205A, HRS and the County of Hawaii's Administrative Procedures Rule Number 9. This area consists of that portion of the subject property makai of the Queen Kaahumanu Highway. County objectives and policies for the SMA largely mirror the state objectives and policies discussed in Section 1.5 of this Chapter. County SMA guidelines relevant to the proposed project area as follows:

Guideline A4: (The planning director shall seek to minimize where reasonable) "Any development which would substantially interfere with or detract from the line of sight toward the sea from the State highway nearest the coast or from other scenic areas identified in the General Plan".

Discussion: The property makai of Queen Kaahumanu Highway is relatively flat extending from the ocean to the highway, a distance of about 4,400 feet. Due to the lack of slope and existing vegetation (albeit sparse) on the makai property, views of the ocean from the highway are constrained in some areas. Development of the makai property will impact views of the ocean from the highway. To migitate these impacts, it is recommended that development emphasize view corridors to the ocean wherever practicable.

Guidelines B1, B2 and B3: These guidelines seek to minimize potential adverse environmental impacts; assure that projects are consistent with state objectives and policies, and assure that projects are consistent with the County General Plan.



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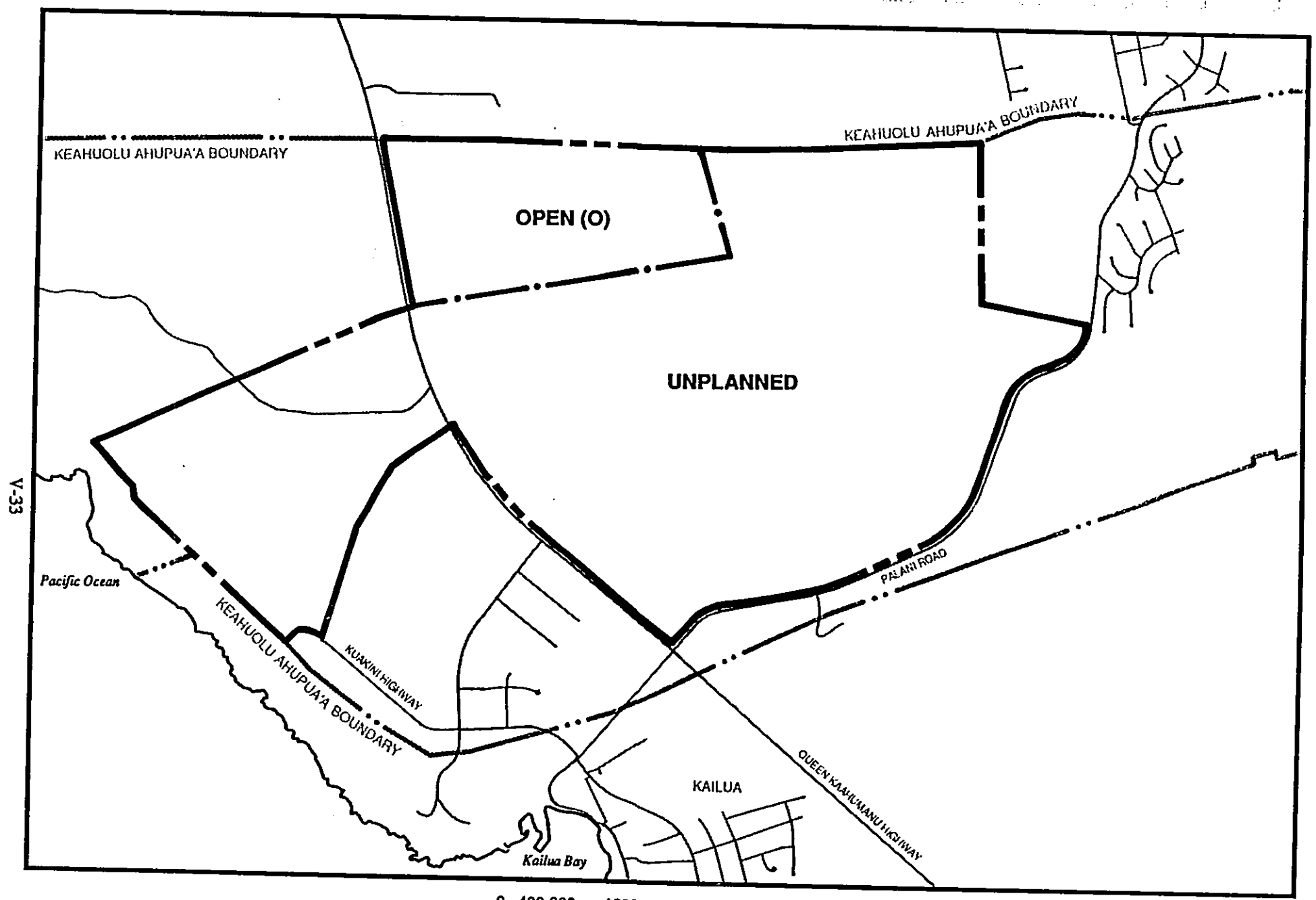
Date: AUGUST 1990

Figure V-4
HAWAII COUNTY GENERAL PLAN



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Date: AUGUST 1990

Figure V-5
HAWAII COUNTY ZONING

Discussion: As indicated in Chapter IV, the proposed project is not expected to result in any adverse impacts that cannot be mitigated. The project is consistent with applicable objectives and policies of the State's coastal zone management program.

Guidelines C1, C2, C3, C4: These guidelines pertain to the provision of adequate public access to publicly owned beaches, recreation areas and natural reserves; reserve areas and wildlife preserves; the provision of adequate sewage treatment facilities; minimizing adverse impacts to existing land forms and vegetation; and ensuring consistency with General Plan goals, policies and standards.

Discussion: The proposed project will include provisions for public access to the existing parks and coastal area. Liquid and solid wastes generated as a result of the proposed development will be treated, disposed of, and managed in compliance with all applicable rules and regulations. Finally, the proposed project is consistent with the General Plan.

2.4 KONA REGIONAL PLAN

The Kona Regional Plan is intended to serve as a guide for land use decisions by the public and private sectors rather than a regulatory document. To that end, it documents existing constraints as well as setting forth recommendations and growth policies. Since the original publication of the document in 1982, substantial growth and development has occurred in the Kona region necessitating updates to the plan. The County's present endeavor, the Draft Keahole to Kailua Development Plan, discussed below, represents the next logical step in the planning process to guide development in the Kona area. To that extent, the Kona Regional Plan is somewhat outdated. Nevertheless, it remains as a relevant guide for growth in the area.

The proposed project is consistent with the Regional Plan's policies and recommendations concerning infrastructure, residential and commercial development. While the plan also recommends industrial development for Trust lands within the current project area, it also recognizes the eventual need for conversion of these properties to commercial uses. The proposed project does not include any industrial uses out of recognition of the need to 1) meet the growing need for commercially zoned land in the region, and 2) separate commercial from industrial uses in order to promote orderly growth patterns.

2.5 DRAFT KEAHOLE TO KAILUA DEVELOPMENT PLAN

The Hawaii County Planning Department has recently developed a draft development plan to address future development in the area from Keahole Airport to Kailua. This plan has recently

been approved by the County Planning Commission and has been transmitted to the County Council for review and adoption. The current draft of the K-K Plan Land Use Map is presented in Figure V-6.

The Trust supports the intent and concept of the K-K Plan. The Plan is recognized as conceptual in nature and flexible in implementation. To that end, the Trust's proposal is relatively consistent with the K-K Plan. However, the present draft contains some elements that potentially conflict with the proposed project. A discussion of the relationship between the proposed project and the draft plan is presented below. It should be noted that as a Draft Plan, the K-K Plan is the source of continuing dialogue among the various landowners in the area and the County's Planning Department.

Regional Civic Center The K-K Plan depicts a Regional Civic Center located within the makai area of the state owned Kealakehe ahupuaa. In presentations to the Planning Commission by the County Planning Department, the 100 acre Civic Center has been referred to as a center of civic and public uses, and its location has been justified on the basis of the appropriateness of locating public uses on public property.

Discussion: The proposed project includes a Urban Expansion area located entirely upon Trust land which includes a regional shopping center, commercial, retail, office, civic, public and recreational uses. Thus the Trust's project contains a variety of lands uses beyond a "government center". The Trust's Urban Expansion area is situated in an area that is designated for Alternate Urban Expansion in the General Plan and is designated for Urban Expansion in the K-K Plan.

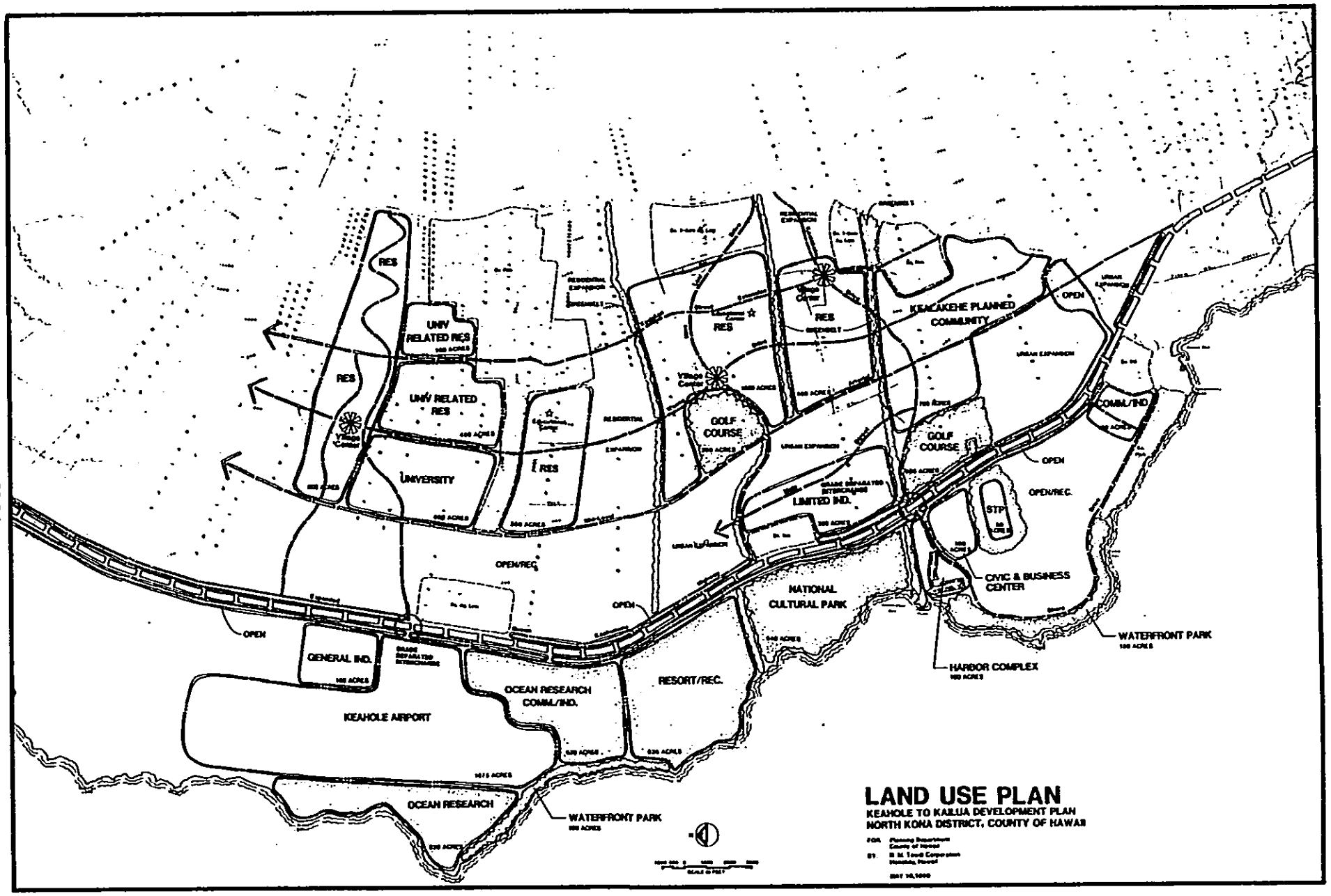
Residential Development: The K-K Plan establishes residential land uses on Trust land mauka of a new north-south arterial roadway.

Discussion: The Trust generally concurs with the proposal of limiting residential development mauka of the new proposed roadway and has included it in its Concept Plan.

Open Area The K-K Plan proposes that Trust land makai of the Queen Kaahumanu Highway be restricted to open space and recreational uses.

Discussion: The makai portion of the Trust's project is proposed for Business Expansion and is presently designated as Alternate Urban Expansion by the County General Plan. The Business Expansion area is not proposed for immediate development, but rather is intended for development in a later phase of the project, possibly after the year 2010.

Grade Separated Interchange The K-K Plan depicts two grade separated interchanges on Queen Kaahumanu Highway; one at Kealakehe Parkway and the other near the Keahole Airport.



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Source: R.M. TOWILL CORPORATION
HONOLULU, HAWAII
Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990

Figure V-6
KEAHOLE TO KAILUA
DRAFT DEVELOPMENT PLAN

Discussion: Development of the proposed plan may require a grade separated intersection at the location of the existing quarry road, approximately 4,000 feet north of the Palani Road intersection. Over the years, the State Department of Transportation has supported an intersection at this location. The Trust believes that this location will optimize access from the proposed project area to the existing industrial expansion area north of the Kona Industrial Subdivision. The Trust is also proposing a mauka-makai roadway linking this makai area to Palani Road. The Trust believes that the existing heavy use of the Palani intersection will necessitate the construction of a new grade separated facility somewhere other than the existing intersection. It proposes that a new Palani intersection actually be constructed about 1,200 feet south of the existing intersection so as to not further exacerbate existing traffic conditions during construction.

Mid level Roadway The K-K Plan proposes a mid-level arterial roadway paralleling Queen Kaahumanu Highway and crossing the Trust's project area. As proposed, this roadway consists of 120 foot right of way to be developed as a major arterial roadway.

Discussion: The Trust supports the mid-level roadway concept and has included it in the project Concept Plan.

Queen Kaahumanu Setback: The K-K Plan proposes expansion of the existing highway to 4-6 lanes by establishing a 300 foot right-of-way to accommodate the proposed construction.

Discussion: The Trust supports the expansion of the Queen Kaahumanu Highway and has included a 300 foot setback in its Concept Plan.

Makai Shoreline Roadway: The K-K Plan includes an extension of the Kealakehe Parkway following the shoreline across Kealakehe and Keahuolu property to the Old Kona Airport.

Discussion: The Trust is concerned about the impact of this proposed roadway upon the Trust's conservation lands that are not part of this land use proposal. The roadway will have a major impact upon existing recreational programs being conducted by the Trust at its shoreline camping areas.

2.6 KAILUA VILLAGE DESIGN PLAN

The 1988 Kailua Village Design (KVD) Plan does not specifically include the proposed project area. However, it is expected that the plan's jurisdiction will be expanded to include the proposed project should it be approved. To that end, the proposed project concept has been reviewed and has been found to be consistent with the intent of the KVD plan.

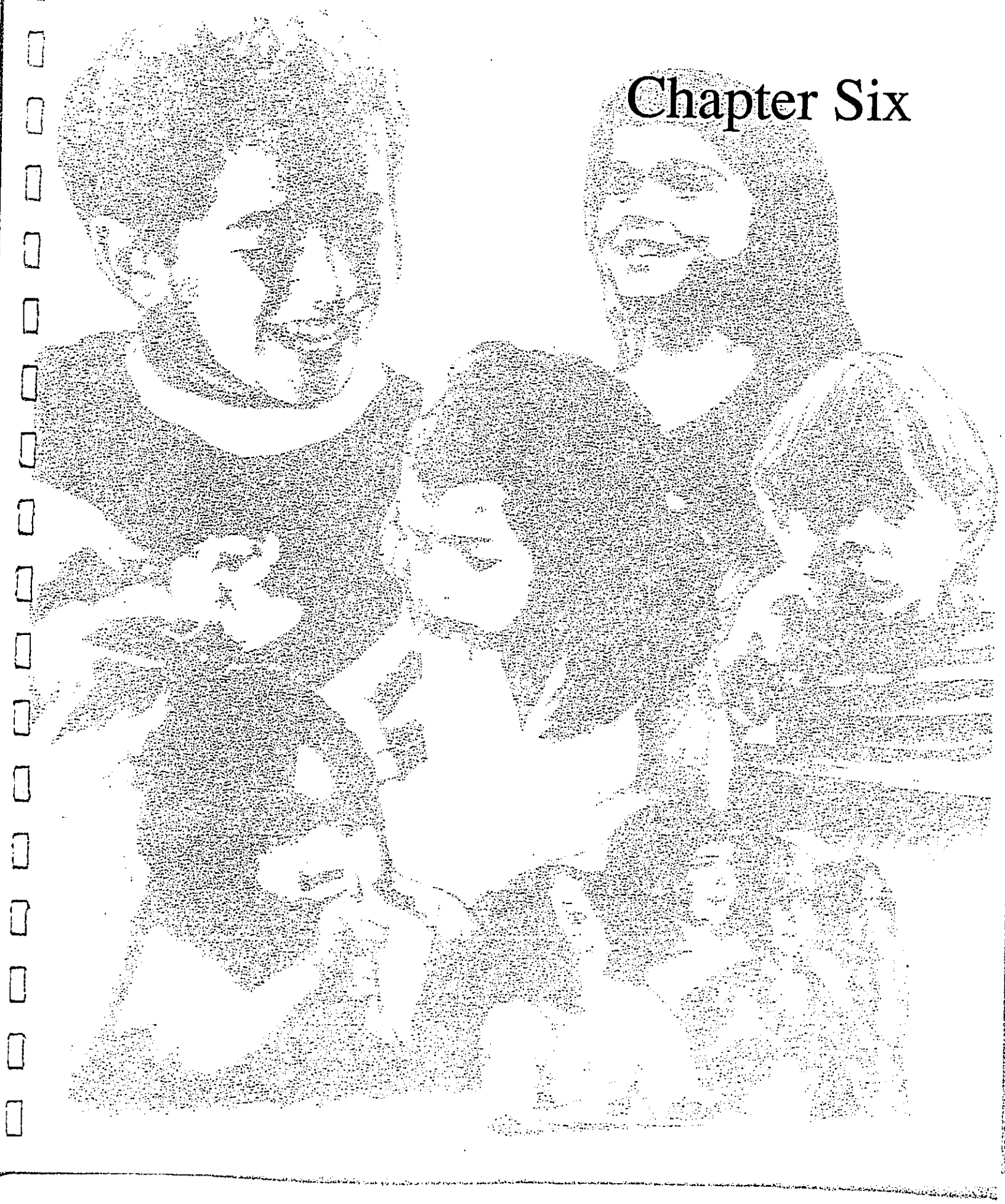
3. STATE ENVIRONMENTAL IMPACT STATEMENT REQUIREMENTS

3.1 CHAPTER 343, HRS

Section 343-5(a) of Chapter 343, HRS (revised) states that except as otherwise provided, an environmental assessment shall be required for actions that (2) "Propose any use within any land classified as conservation district by the state land use commission under Chapter 205". Accordingly, this Environmental Impact Statement for the proposed project has been prepared and is submitted pursuant to the provisions of Chapter 343.

Upon acceptance of this EIS and approval of the requested State Land Use Boundary Petition and subsequent county permitting requests,the proposed project would conform with relevant state and county land use regulations, as well as other appropriate regulations.

Chapter Six



CHAPTER VI

TOPICAL ISSUES

1. RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

Analyses of various on-site environmental features have found the Liliuokalani Trust property to possess physical attributes that are desirable both as amenities in a regional center development and for their own sake. These attributes include magnificent ocean and mountain views, relatively flat terrain and dry, warm climate. The studies performed (see Chapter I, Section 3.0) have also indicated that the proposed project is compatible with and will enhance the existing natural environment. The specific measures that will be employed to mitigate potential adverse environmental impacts, as discussed in Chapter I, Section 7.0 and Chapter IV, would be followed in the design, construction and operations phases of the project.

No short-term exploitation of resources that will have negative long-term consequences have been identified. The proposed regional center development as envisioned by the developer will be a high quality project, developed over a twenty-year period and will be designed to last for decades. The principal long-term benefits of the proposed project include the productive use of the property and the provision of needed medical, financial, commercial, light industrial and residential facilities that will serve West Hawaii residents and visitors alike. Increased economic opportunities for all socioeconomic levels would be provided along with increased community services and activities. The proposed project is a logical extension of the Kailua-Kona urban district. Open spaces surrounding the project site and vistas to the ocean and mountains would be retained for the long-term benefit of the immediate area residents and visitors to the area.

As noted in the discussion of Alternatives to the Proposed Project (Chapter III), one short-term use of the property would be to retain the present vacant status of the property. This would be less than optimum use of the property. As the regional center amenities are developed, significant socioeconomic benefits to the community will result, in the form of increased job opportunities and increased tax revenues. Direct, full-time employment opportunities and temporary construction employment will be generated by the project and

these in turn will have benefits that ripple through the regional and island economy. Similarly, indirect, induced employment will be generated in those industries and services that cater to the construction and service related businesses serving the proposed project. Public revenues from excise, personal and real property taxes are expected to more than offset any expenses associated with the expansion of public services to meet the requirements of the proposed project development and indirect population growth (see Chapter IV, Section 5.1).

2. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The development of the proposed project and resultant construction of medical, office, commercial, light industrial and residential facilities would result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Major resource commitments include the land on which the project is located and on which the facilities would be constructed, as well as money, construction materials, manpower and energy. The impacts of using these resources should be weighed against the expected positive socioeconomic benefits to be derived from the project versus the consequences of taking no action or adopting another less beneficial use of the property.

A portion of the property would remain as open space and views through and of the site enhanced. In addition, the project would include landscaping planted along and around the various facilities and along the streets, thereby adding to the aesthetic character of the area.

The commitment of resources required to accomplish the project includes building materials and labor, both of which are generally non-renewable and irretrievable. Construction of and resultant travel to/from the project by residents and visitors, would require the consumption of petroleum products and petroleum based electrical generation. This, too, represents an irretrievable commitment of resources.

The proposed project does not call for a substantial commitment of government supplied services or facilities that would not be required without the proposed project. The project would add to the cultural and recreational facilities available to the residents of the project and the West Hawaii area in general. Similarly, the project would add to the tax revenues of the county and state.

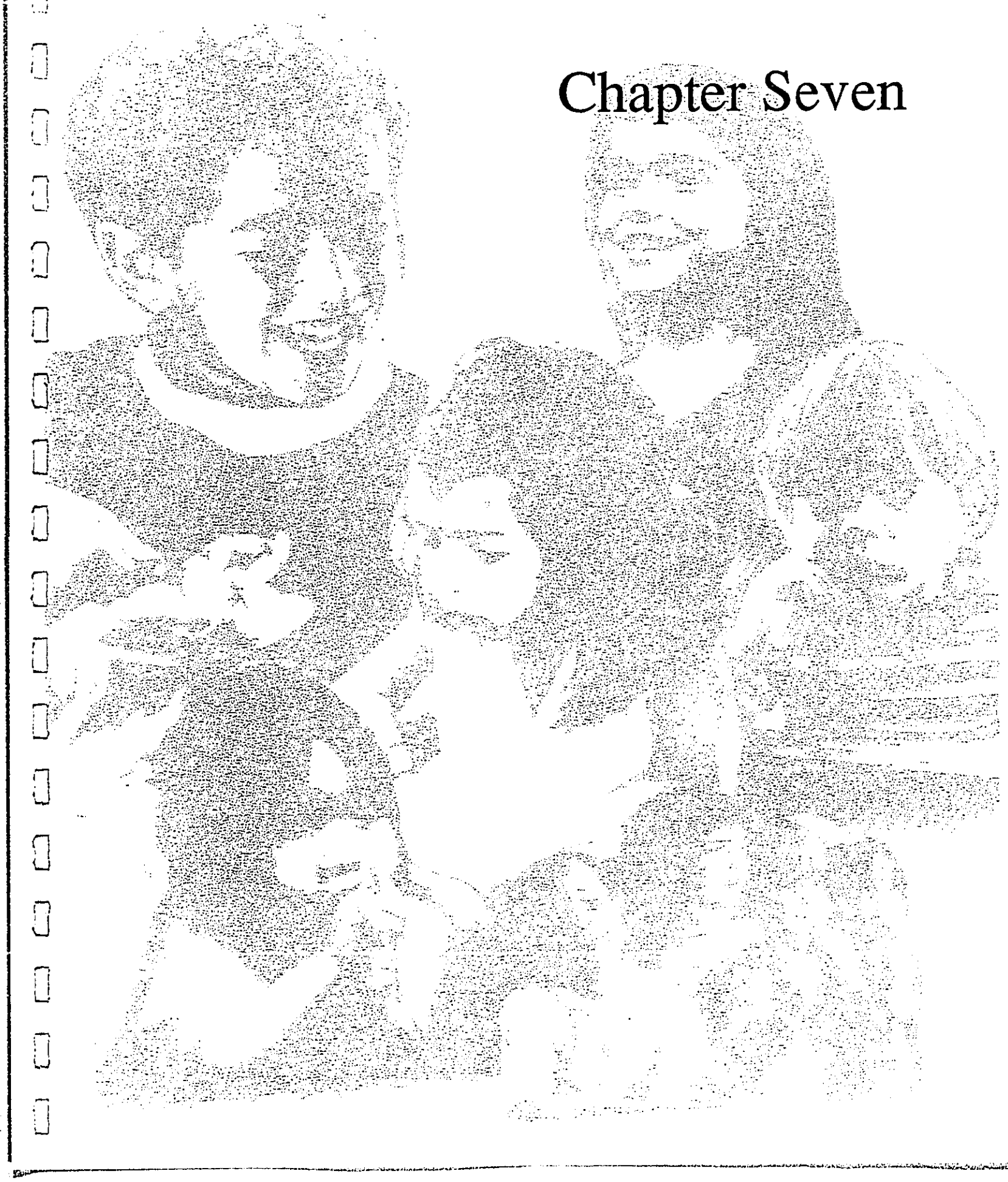
3. OFFSETTING CONSIDERATIONS OF GOVERNMENTAL POLICIES

By the very existence of a complex system of land use policies, plans, goals, objectives and controls at both the state and county levels of government, development proposals requiring land reclassification are often faced with inherent contradictions and conflicts within the land use regulatory system. As such, the project must be reconciled against those privately and publicly planned elements that may appear to conflict with the proposed project. As indicated in Chapter V, the proposed project is generally consistent with the applicable Hawaii State Plan and various Functional Plans, the County General Plan and various Community Plans goals, policies and standards relating to the future growth of the West Hawaii/Kailua-Kona area. Granting the requested land use boundary amendment would enable the project to meet the initial land use regulatory requirements. Future actions, including application for and acceptance of zoning and subdivision requests would enable the project to meet all land use regulatory requirements. Further, the analysis of public revenues versus public expenditures indicates an extremely favorable ratio of revenues to expenditures (see Chapter IV, Section 5).

4. UNRESOLVED ISSUES

The Trust is aware of many questions and public concerns at this time regarding the proposed project. The Trust has been and will continue to work with the various state and county agencies, residents and businessmen of the area, as well as elected officials to assure that the final development plans meet the developer's project objectives and satisfactorily address concerns that have been raised to date as well as those that may be raised during public review of this EIS.

Chapter Seven



CHAPTER VII
PARTIES CONSULTED AND THOSE WHO PARTICIPATED IN THE PREPARATION OF THE EIS

1. CONSULTED PARTIES

The notice of availability of the Environmental Assessment and EIS Preparation Notice for the Kealakehe Planned Community was published in the OEQC Bulletin by the Office of Environmental Quality Control on September 8, 1990. In addition, representatives of the Trust have personally met with a wide variety of public agencies, community organizations, elected officials and private citizens. The agencies, organizations and individuals consulted about the project are listed below. Those who commented on the environmental assessment in writing or requested status as a Consulted Party are identified with an asterisk (*) next to their names. Copies of the correspondence with them are reproduced in this chapter.

State Agencies

* Department of Land and Natural Resources
Department of Transportation
Office of State Planning
* State Health Planning Development Agency

State Legislators

Senator Andrew Levin
Senator Malama Solomon
Representative Harvey S. Tajiri
Representative Dwight Takamine
Representative Mike O'Kieffe
Senator Richard M. Matsuura
Representative Jerry L. Chang
Representative Wayne Metcalf
Representative Virginia Isbell

Hawaii County Agencies

* Department of Public Works
Office of Housing and Community Development
* Police Department
Planning Department

Hawaii County Elected Officials

Mayor Bernard Akana
Councilwoman Helene Hale
Councilman Stephen Yamashiro
Councilman Russel Kokubun
Councilman Harry Ruddle

Community Organizations

Hawaii Island Board of Realtors
Hawaii Leeward Planning Conference
Kona-Kohala Chamber of Commerce
* West Hawaii Bar Association

2. ORGANIZATIONS AND INDIVIDUALS WHO ASSISTED IN THE PREPARATION OF THIS EIS

This Environmental Impact Statement was prepared for the Queen Liliuokalani Trust by Belt Collins & Associates with input provided by subconsultants. The following were involved:

Belt Collins & Associates

James R. Bell	-	Principal in Charge
Lee William Sichter	-	Project Planner/Author of EIS
Cheryl Palesh	-	Civil Engineering
Thomas Nance	-	Hydrologist
Ken Hamilton	-	Printing Coordinator
Audrey Chun	-	Graphic Designer

Subconsultants

Archaeology	-	Paul H. Rosendahl, Ph.D. Inc.
Noise Impacts	-	Y. Ebisu & Associates
Flora	-	Char & Associates
Fauna	-	Phillip L. Bruner
Air Quality	-	Barry Neal
Fiscal Impacts	-	Environmental Capital Managers, Inc.
Market Analysis	-	Levander, Natelson and Whitney
Traffic	-	Pacific Planning & Engineering, Inc.
Social Impact	-	Community Resources, Inc.
Electrical	-	Ron Ho

3. COMMENTS RECEIVED DURING THE DRAFT EIS COMMENT PERIOD AND RESPONSES

An announcement of the availability of the Draft Environmental Impact Statement (DEIS) for the project was published in the OEQC Bulletin by the Office of Environmental Quality Control on August 23, 1990. The agencies, organizations, and individuals listed below were sent copies of the DEIS with a request for their comments on the project. Those believed to have an interest in the project or who requested consulted party status were mailed a copy of the report. Parties that replied are marked with an asterisk (*), and their letters together with the reponses to them are included in this chapter (following the comment letters pertaining to the environmental assessment discussed above).

Federal Agencies

* Soil Conservation Service, U.S. Department of Agriculture
* Fish and Wildlife Service, U.S. Department of the Interior
  National Park Service, U.S. Department of the Interior
  Geological Survey, Water Resources Division, U.S. Department of the Interior
  Regional Division, United States Environmental Protection Agency, Region IX
* Facilities Engineer, U.S. Army
* Facilities Engineer, U.S. Navy
  U.S. Coast Guard

State Agencies

* Department of Accounting and General Services
  Department of Agriculture
* Department of Business, Economic Development and Tourism
  Department of Business and Economic Development, Library
  Department of Budget and Finance
* Department of Defense
  Department of Education
  Department of Hawaiian Home Lands
* Department of Health
  Department of Land and Natural Resources
  Department of Land and Natural Resources, State Historic Preservation Officer
  Department of Transportation
* Housing Finance and Development Corporation
* Office of Environmental Quality Control
  Office of Hawaiian Affairs
  Office of State Planning
* Environmental Center, University of Hawaii at Manoa
  Water Resources Research Center, University of Hawaii at Manoa
  University of Hawaii at Hilo
  State Archives
  State Health Planning Agency
  State Energy Office

State Legislators

Senator Andrew Levin
Senator Malama Solomon
Representative Harvey S. Tajiri
Representative Dwight Takamine
Representative Mike O'Kieffe
Senator Richard M. Matsuura
Representative Jerry L. Chang
* Representative Wayne Metcalf
Representative Virginia Isbell

Hawaii County Agencies

Civil Defense Agency
* Department of Parks and Recreation
Department of Research and Development
Hawaii Redevelopment Agency
Office of Housing and Community Development
Fire Department
* Department of Public Works
Department of Water Supply
* Police Department
* Planning Department

Hawaii County Elected Officials

Mayor Larry Tanimoto
Councilman Takashi Domingo
Councilwoman Lorraine Inouye
Councilman Robert Makuakane
Councilman Spenser Schutte
Councilman Russel Kokubun
Councilwoman Helene Hale
Councilwoman Merle Lai
Councilman Harry Ruddle
Councilman Stephen Yamashiro

Public Utilities

Hawaiian Telephone Company
* Hawaii Electric Light Company, Inc.
The Gas Company, Hawaii Division

Community Organizations

Alu Like, Inc.
American Lung Association
Big Island Business Council
Hawaii Audubon Society
Hawaii Conference Foundation
Hawaii Hotel Association, Big Island Chapter
Hawaii Island Board of Realtors
Hawaii Island Chamber of Commerce
Hawaii Island Economic Development Board
Hawaii Island Portuguese Chamber of Commerce
Hawaii Leeward Planning Conference
Hawaii Visitor's Bureau, Big Island Chapter
Kona-Kohala Chamber of Commerce
Life of the Land, Big Island Chapter
Moku Loa Group, Sierra Club
Na Ala Hele
Native Hawaiian Legal Corporation
Sierra Club Legal Defense Fund
West Hawaii Bar Association

Libraries

University of Hawaii Library, Hawaiian Collection
Legislative Reference Bureau
Kaimuki Regional Library
Kaneohe Regional Library
Pearl City Regional Library
Hilo Regional Library
Wailuku Regional Library
Lihue Regional Library
Holualoa Library
Honokaa Library
Kailua-Kona Library

Media

Honolulu Advertiser
Sun Press
Hawaii Tribune Herald
West Hawaii Today

Individuals

* Mrs. Rose Akana Fujimori

WALLACE H. GALLUP, JR.
MARK VAN PERNIS

DUANE D. CHOY
VICTOR M. COX

GALLUP & VAN PERNIS

ATTORNEYS AT LAW, A LAW CORPORATION
SUITE C-210, HUALALAI CENTER
75-170 HUALALAI ROAD
P.O. BOX 1837
KAILUA-KONA, HAWAII 96745-1837

TELEPHONE:
AREA CODE 808
329-3551

September 1, 1989

Benjamin A. Kudo, Esq.
Kobayashi, Watanabe, Sugita,
Kawashima & Goda
Eighth Floor
Hawaii Building
745 Fort Street
Honolulu, Hawaii 96813

Dear Mr. Kudo,

I am contacting you in your capacity as a trustee of Queen Liliuokalani Trust. More specifically, this concerns the Trust's plans for future development of its large acreage in North Kona.

I'm sure you are aware that the Trust's North Kona land is within the Keahole to Kailua community development area for which the County of Hawaii is planning and intending future urban growth. I'm also sure you are aware that the State of Hawaii is going forward with master planning and development of its large acreage at Kealakehe, near or adjoining the Trust's property, and also within the Keahole to Kailua community development area of the County of Hawaii.

All of the plans of the County of Hawaii for the Keahole to Kailua urban expansion area, as well as the State's plan for Kealakehe, call for a governmental facilities area, i.e., a centralized civic center concept. This is something that is greatly needed and desired by the West Hawaii community. I also note that the Trust's plans provide for this civic center concept. It is assumed that the Trust and the State and the County are or will be all working together on this concept, as well as the overall Keahole to Kailua urban expansion area.

I am contacting you as a member of the West Hawaii Bar Association and its committee concerned with local judicial infrastructure, and as a member of a committee appointed by Chief Justice Herman Lum and chaired by Judge Joseph Florendo to investigate and report on judicial infrastructure in relation to the need for a separate judicial circuit for West Hawaii, (e.g.

9/6/89

ressurecting the old Fourth Circuit). I have also attended most public meetings the County has conducted regarding the Keahole to Kailua urbanization plans, attended the meetings conducted by the State regarding development of Kealakehe, met with key legislators concerning both the proposed new Kona Court facility which is already moving through the legislature and headed towards site selection and the West Hawaii community correctional facility which is in the same status, and I also have been in contact with the State personnel or consultants (Mr. Cedric Takamoto of DAGS and Ms. Janice Wolff of the Judiciary in regard to the Court facility, and consultant Jerry Winkler of WMFL Co in Spokane in regard to the correctional facility). My wife Kristi is also a member of the Keahole to Kailua Citizens Advisory Council appointed by the County's Planning Director. This letter is to ask you to have the Trust work with the County and State on the civic center concept and to allow the new Court facility, which is on the horizon already, to become the first "jewel in the crown" in the civic center, which can then be filled out with County, State and Federal offices and facilities, central police and fire facilities, hospital, library, correctional facility, etc.

Surely the Keahole to Kailua area, including the Trust land, will become the new urban center of West Hawaii. Centrally placing all of the big traffic generating governmental facilities, and then providing appropriately zoned and developed land around them for all of the big traffic generating professional and services offices and commercial support operations, will not only be convenient and efficient, it will also pull many of those sort of operations out of presently hopelessly clogged Kailua town and place them where new infrastructure can handle them, thus saving old Kailua for retail, restaurant and tourism uses. As an added benefit, the professions could then pay fair office rents, rather than compete with retail and tourist businesses in Kailua town as they do now, much as if your firm would be doing if your offices were in Waikiki.

The community supports this civic center concept, and I understand it is modern and good planning. We want to avoid a Courthouse in the wrong place, and ask the Trust cooperation in getting it into the future civic center now, even if the Trust's overall development is many years away. With the Trust's lands, like the State's, strategically located along Queen Kaahumanu Highway, the new Court could be effectively located there, north of old Kailua town, on Trust or State land, and the civic center site thus set.

I have sent copies of this letter to several key players in the Keahole to Kailua development matter, and you may wish to note their names and addresses stated below.

I believe that the proposed development of the Trust's property will be well received by the community if done in conjunction with the State at Kealakehe and the County in the overall Keahole to Kailua plan. However there are a few items you should seriously consider because community oposition will center around themn.

1) Stay off of Palani Road in terms of adding any traffic to this tremendously inadequate and problematic street which is already hopelessly overburdened.

2) The community and the University itself prefer and have chosen a better campus site on State land at Kalaoa, north of the Trust's property, (although it is still within the Keahole to Kailua area).

3) Keep the shore part of the property open, preferably adding it to the adjoining Old Airport Park, particularly the beach part.

Thank you for your time and attention. Please feel free to contact me if I can be of assistance.

Sincerely yours,

GALLUP & VAN PERNIS

By
MARK VAN PERNIS

MVP/lh.L6

cc: Jerry Winkler
WMFL Co.
West 244 Main Street
Spokane, Washington 99201

Cedric Takamoto
Planning Branch
Public Works Division
DAGS
1151 Punchbowl Street, Room 430
Honolulu, Hawaii 96813

Joseph Conant
Housing Finance Development Corp.
P.O. Box 17907
Honolulu, Hawaii 96817

"CONTINUED ON FOLLOWING PAGE"

Harold Masumoto
Office of State Planning
Hawaii State Capitol, Room 410
Honolulu, Hawaii 96813

Duane Kanuha, Director
County of Hawaii Planning Dept.
25 Aupuni Street
Hilo, Hawaii 96720.

Clyde W. Namuo
Chief Court Administrator
The Judiciary-State of Hawaii
P.O. Box 619
Honolulu, Hawaii 96809

Gerrie Rott & Assoc.
First Federal Plaza, Suite 207
Kailua-Kona, Hawaii 96740

Belt, Collins & Assoc.
606 Coral, 1st Floor
Honolulu, Hawaii 96813

Lionel Kutner, C.O.E.D.
P.O. Box 3210
Kailua-Kona, Hawaii 96745

BELT COLLINS
& ASSOCIATES

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Phone: (808) 521-5361, Telex: 811781 BELTCOL HNL, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

November 29, 1989
945.0101/89-2190

Mark Van Pernis, Esq.
Gallup & Van Pernis
Suite C-210, Hualalai Center
75-170 Hualalai Road
P.O. Box 1837
Kailua-Kona, Hawaii 96745-1837

Dear Mr. Van Pernis:

Environmental Assessment
Queen Liliuokalani Trust
Keahuolu Lands, Kailua-Kona, Hawaii

Thank you for your letter of September 1, 1989 concerning the Queen Liliuokalani Trust's proposal to develop approximately 1,135 acres of land north of Kailua-Kona. As you correctly stated, there is a need to coordinate the planning efforts of the Trust with those of the State of Hawaii and Hawaii County, and every effort is being made to do so.

The Trust is presently engaged in preparing a master plan for the 1,135 acre portion of its property that is being proposed for development. Once the master plan is completed, an environmental impact statement will be prepared, pursuant to the direction of the State Land Use Commission on September 5, 1989.

As indicated in our environmental assessment, the Trust is including a civic center in its land use proposal. We concur that a civic center will be an important element of the new urban center for West Hawaii and should be located in close proximity to a major arterial roadway such as Queen Kaahumanu Highway.

Following are responses to the additional points that you have raised in your letter.

1. While we understand your plea to "stay off Palani Road in terms of adding any traffic", we are unable to prevent future traffic from using this particular roadway. Consequently, we will be proposing an entire new roadway network within the project area to serve as a reliever to Palani Road. Our goal is to provide attractive alternative routes to those who traditionally use Palani Road. In that manner, we believe that traffic on Palani Road can be reduced despite the prospect of new growth in the area. In effect, with the implementation of a new traffic system, the importance of Palani Roadway as a major arterial roadway will be deemphasized and it will eventually become a typical mauka-makai collector street serving a large urban area.

2. The Trust and the State of Hawaii are presently negotiating the sale of 450 acres of Trust land to the State. In terms of our master plan, we are presently anticipating that it will be used for residential development. However, the final determination has yet to be made by the State. Hopefully, we will be kept informed by the State as to its development plans for the area.

3. The 1,135 acres included in our development proposal are located mauka of the Old Airport Park. Consequently, our master plan does not include the shoreline area and it is not part of State Land Use Boundary Petition.

Thank you for your comments and your willingness to participate in this land use process. We will be forwarding a copy of the Draft Environmental Impact Statement to you upon its completion. Should you have any questions on this or any related manner, please feel free to contact me.

Sincerely,

Lee William Sichter
Project Planner

Bernard K. Akaka
Mayor
Duane Kanuha
Director
William L. Moore
Deputy Director

Planning Department

25 Aupuni Street, Rm. 109 • Hilo, Hawaii 96720 • (808) 961-8288

October 30, 1989

Benjamin Kudo, Esq.
Kobayashi, Watanabe, Sugita,
Kawashima & Goda
Hawaii Building
745 Fort Street, 8th Floor
Honolulu, HI 96813

Dear Mr. Kudo:

State Land Use Boundary Amendment (A89-646)
Agricultural and Conservation to Urban
Liliuokalani Trust
TMK: 6-7-08:Portions of 2 and 12

For your information and appropriate action, we are transmitting comments received from the Department of Public Works relating to the above-described application.

Should you have any questions concerning this matter, please feel free to contact Connie Kiriu of this office.

Sincerely,

William L Moore

DUANE KANUHA
Planning Director

CRK:syw

Enclosure

Rec'd 11/1/89

DE RTMENT OF PUBLIC WORK
COUNTY OF HAWAII
HILO, HAWAII

DATE October 19, 1989

Memorandum

O : Planning Department

ROM : David Murahara for Robert K. Yanabu, Division Chief
Engineering Division

UBJECT: State Land Use Boundary Amendment (A89-646)
Applicant: Liliuokalani Trust
Location: N. Kona, HI
TMK: 7-4-8: por. of 2 & 12

We have reviewed the subject application and our comments are as follows:

BUILDING:

Buildings shall conform to all requirements of codes and statutes pertaining to building construction.

ROADWAYS:

1) Prepare a Traffic Impact Analysis Report (TIAR). The TIAR should address the effects of the traffic generated by the proposed development on County roads. It should also identify any mitigation measures necessary, including the possible need to improve nearby County roads and intersections.

2) Provide access to adjacent lands.

3) Roadways shall have curbs, gutters and sidewalks.

4) Plans must coincide with Keahole to Kailua Development plan.

DRAINAGE:

1) All development-generated runoff shall be disposed on site and shall not be directed toward adjacent properties.

2) Drainange report shall be done and shall contain the following:

   a) Hydrologic study with the watershed clearly delineated.

   b) Drainage quantities are to be based on expected future development of the watershed.

   c) Method of storm water disposal.

WASTEWATER:

Wastewater system needs to be expanded.

SOLID WASTE:

1) Solid Waste impacts of development needed to be thoroughly addressed. Volume generation, characteristics, etc.

2) The cost of hauling and landfilling of all construction wastes must be included in the cost of development.

3) Waste reduction program such as composting and/or recycling should be required. This would serve to reduce refuse volumes at the County landfill, renew resources, reduce refuse transportation costs and will be an enviromentally more acceptable means of solid disposal.

DHM:ama

BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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Hawaii • Singapore • Australia • Hong Kong • Saipan

November 29, 1989
945.0101/89-2191

Mr. Robert K. Yanabu
Division Chief, Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Yanabu:

Environmental Assessment
Queen Liliuokalani Trust
Keahuolu Lands, Kailua-Kona, Hawaii

Thank you for your memorandum of October 19, 1989 concerning the Queen Liliuokalani Trust's proposal to develop approximately 1,135 acres of land north of Kailua-Kona. It was transmitted to us by Mr. Duane Kanuha of the County Planning Department. Following are comments addressing your specific concerns.

Building

1. All buildings eventually constructed on the subject property will conform to all pertinent building codes and statutes.

Roadways

1. A Traffic Impact Analysis will be prepared as part of the Draft Environmental Impact Statement (DEIS) for the project. It will include mitigation measures necessary to address the impacts of proposed urban development in the area.

2. The roadway network proposed for the project will provide access to neighboring properties.

3. All dedicated roadways will conform to County standards.

4. We are working with both the State and the County to ensure that our proposed development is consistent with government planning efforts.

Drainage

1. All development generated runoff shall be disposed on site.

2. A drainage report will be prepared in conjunction with a zoning application, should the State Land Use Commission take favorable action upon our request. While we will be evaluating drainage considerations as part of the DEIS, a detailed drainage report cannot be prepared until specific building designs have been determined.

   A hydrology study will be included in the DEIS.

Drainage quantities will be based on expected future development of the watershed.

The method of storm water disposal will be discussed in the DEIS

Wastewater

1. Wastewater systems to serve the proposed project will be provided. A general discussion of the these systems will be included in the DEIS.

Solid Waste

1. Solid waste impacts of the development will be addressed in the DEIS.

2. The cost of hauling and landfilling of all construction wastes will be included in the cost of development.

3. A waste reduction program will be considered as part of the zoning application for the project. While a general discussion of such a program could appear in the DEIS, its specifics can not be determined until more detailed facility design occurs.

Thank you for your comments. We will be forwarding a copy of the Draft Environmental Impact Statement to you upon its completion. Should you have any questions on this or any related manner, please feel free to contact me.

Sincerely,

Lee William Sichter
Project Planner

Bernard K. Akana
Mayor
Duane Kanuha
Director
William L. Moore
Deputy Director

Planning Department

25 Aupuni Street, Rm. 109 • Hilo, Hawaii 96720 • (808) 961-8288

September 21, 1989

Mr. Benjamin Kudo
Kobayashi, Watanabe, Sugita,
Kawashima & Goda
Attorneys At Law
745 Fort St., 8th Fl. Hawaii Building
Honolulu, HI 96813

Dear Mr. Kudo:

State Land Use Boundary Amendment (A89-646)
Agricultural and Conservation to Urban
Liliuokalani Trust
TMK: 7-4-08:Portions of 2 & 12

For your information and appropriate action, we are transmitting comments received from the Police Department relating to the above-described application.

Should you have any questions concerning this matter, please feel free to contact the Planning Department.

Sincerely,

DUANE KANUHA
Planning Director

CRK:lv

Enclosure

9/25/89

V:

Way
Depu.

Police Department

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

August 30, 1989

TO : DUANE KANUHA, PLANNING DIRECTOR

FROM : VICTOR V. VIERRA, CHIEF OF POLICE

SUBJECT: LILIUOKALANI TRUST
STATE LAND USE BOUNDARY AMENDMENT (A89-646)
AGRICULTURAL AND CONSERVATION TO URBAN
TMK: 7-4-08:PORTIONS OF 2 & 12

This project is very large and consideration should be given to the following prior to approval:

A. Widen Queen Kaahumanu Highway to four lanes.

B. Improve Palani Road.

C. Complete Hinalani Street from Mamalahoa at Kona Heavens to the Kaloko Industrial lots.

D. A widening to four lanes beyond (north) of C.

E. An overpass at Queen Kaahumanu at bottom of C.

F. Develop another four-lane road mauka to makai between the top of Palani Road to the Honokohau Harbor entrance.

Submitted for your review and disposition.

VICTOR V. VIERRA
CHIEF OF POLICE

HJS:lli

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Telex: BELTH [illegible], Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

November 29, 1989
945.0101/89-2192

Victor V. Vierra, Chief of Police
County of Hawaii
349 Kapiolani Street
Hilo, Hawaii 96720

Dear Chief Vierra:

Environmental Assessment
Queen Liliuokalani Trust
Keahuolu Lands, Kailua-Kona, Hawaii

Thank you for your memorandum of August 30, 1989 concerning the Queen Liliuokalani Trust's proposal to develop approximately 1,135 acres of land north of Kailua-Kona. It was transmitted to us by Mr. Duane Kanuha of the County Planning Department. Following are comments addressing your specific concerns.

A. A master plan being developed for the proposed project will include additional right-of-way for that portion of Queen Kaahumanu Highway fronting the development project.

B. We have received a request from the County of Hawaii for a 20 foot right-of-way along Palani Road. This request is presently under consideration.

C. Hinalani Street is not included in the project area and is not part of the development proposal.

D. Improvements to Queen Kaahumanu Highway north of the project area are not included in the development proposal. These improvements would best be considered by the County in cooperation with adjacent land owners in the area.

E. Same as D.

F. We understand that the State of Hawaii owns the Kealakehe property and is planning to include a major mauka-makai roadway in its development plans. The Kealakehe property is not included in our development proposal.

Thank you for your comments. We will be forwarding a copy of the Draft Environmental Impact Statement to you upon its completion. Should you have any questions on this or any related manner, please feel free to contact me.

Sincerely,

Lee William Sichter
Project Planner

Bernard K. Akana
Mayor
Duane Kanuha
Director
William L. Moore
Deputy Director

Planning Department

25 Aupuni Street, Rm. 109 • Hilo, Hawaii 96720 • (808) 961-8288

November 3, 1989

Benjamin Kudo, Esq.
Kobayashi, Watanabe, Sugita,
Kawashima & Goda
Hawaii Building
745 Fort Street, 8th Floor
Honolulu, HI 96813

Dear Mr. Kudo:

State Land Use Boundary Amendment (A89-646)
Agricultural and Conservation to Urban
Liliuokalani Trust
TMK: 6-7-08:Portions of 2 and 12

For your information and appropriate action, we are transmitting comments received from the Department of Land and Natural Resources relating to the above-described application.

Should you have any questions concerning this matter, please feel free to contact Connie Kiriu of this office.

Sincerely,

William L. Moore

DUANE KANUHA
Planning Director

CRK:syw

Enclosure

RECEIVED
11/6/89

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

LIBERT K. LANDGRAF
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

REF:OCEA:SOR

OCT 30 1989

FILE NO.: 90-112
DOC. NO.: 6753E

The Honorable Duane Kanuha, Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Kanuha:

SUBJECT: Liliuokalani Trust State Land Use Boundary Amendment (A89-646), from Agricultural and Conservation to Urban, at Keahuolu, North Kona; TMK 7-4-08: Portions of 2 & 12

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.

Currently, we have no record of a complete archaeological survey of this project area, so we are unable to determine the proposed project's effect on significant historic sites. We understand that the Trust is having an archaeological survey done. We will be looking forward to reviewing the findings. However, as standard procedure in LUC petition reviews, we request that no decision should be made on the petition until we are able to review the survey report, to verify for the LUC the number and type of significant historic sites present (if any), and to verify that the proposed mitigation treatments are acceptable.

Thank you again for your cooperation in this matter. Please feel free to call me or Jay Lembeck at our Office of Conservation and Environmental Affairs, at 548-7837, if you have any questions.

Very truly yours,

WILLIAM W. PATY

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd. Suite 200 Honolulu, Hawaii 96813
Phone: 808 521-5361 Telex: 8817747 BELTH Fax: 808 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

November 29, 1989
945.0101/89-2193

Mr. William Paty, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

Environmental Assessment
Queen Liliuokalani Trust
Keahuolu Lands, Kailua-Kona, Hawaii

Thank you for your letter of October 30, 1989 concerning the Queen Liliuokalani Trust's proposal to develop approximately 1,135 acres of land north of Kailua-Kona. It was transmitted to us by Mr. Duane Kanuha of the County Planning Department.

A complete archaeological survey of the subject property is being prepared by Paul Rosendahl and will be included in the Draft Environmental Impact Statement for the project. The report will be transmitted to your office for review.

Thank you for your comments. We will be forwarding a copy of the Draft Environmental Impact Statement to you upon its completion. Should you have any questions on this or any related manner, please feel free to contact me.

Sincerely,

Lee William Sichter
Project Planner

KOBAYASHI, WATANABE, SUGITA, KAWASHIMA & GODA
ATTORNEYS AT LAW
HAWAII TOWER, 8th FLOOR
745 FORT STREET
HONOLULU, HAWAII 96813-3889

TELEPHONE (808) 544-8300

Facsimile: (808) 544-8399
Telex: 6502398585 MCI
MCI Mail: 2398585
ABA / Net: ABA2281

LS.

September 18, 1989

Mr. James Bell
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Re: Queen Liliuokalani Trust

Dear Jim:

I received a call from Reed Flickinger of West Hawaii Today requesting a copy of the draft EIS. His address is as follows:

Mr. Rick Flickinger
West Hawaii Today
P.O. Box 789
Kailua-Kona, Hawaii 96745

Should you have any questions concerning the above, please feel free to contact the undersigned.

Very truly yours,

BENJAMIN A. KUDO
for
KOBAYASHI, WATANABE,
SUGITA, KAWASHIMA & GODA

BAK:st

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Phone: 808-521-5361, Telex: BELTH [illegible], Fax [illegible] 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

November 29, 1989
945.0101/89-2200

Mr. Reed Flickenger
West Hawaii Today
P.O. Box 789
Kailua-Kona, Hawaii 96745

Dear Mr. Flickenger:

Environmental Assessment
Queen Liliuokalani Trust
Keahuolu Lands, Kailua-Kona, Hawaii

Thank you for your phone call of September 18, 1989 concerning the Queen Liliuokalani Trust's proposal to develop approximately 1,135 acres of land north of Kailua-Kona. We were advised of it by Mr. Ben Kudo.

We will be forwarding a copy of the Draft Environmental Impact Statement to you upon its completion. Should you have any questions on this or any related manner, please feel free to contact me.

Sincerely,

Lee William Sichter
Project Planner

Trustees of the

LILIUOKALANI TRUST

David M. Peters, Msgr. Charles A. Kekumano, First Hawaiian Bank
P. O. Box 3200, Honolulu, Hawaii 96801

March 14, 1990

Mr. Lee Sichiter
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

Dear Lee:

RE: KEAHUOLU PROJECT/DRAFT EIS

Please add the following as a recipient of the draft EIS:

Ms. Kinau Boyd Kamalii, Director
State Health Planning Development Agency
335 Merchant Street, #214E
Honolulu, HI 96813

This request was made by Ms. Linda Lee (phone 548-4050) at the Agency.

Thank you.

Sincerely,

FIRST HAWAIIAN BANK
MANAGING TRUSTEE

FRANK G. JAHRLING
Vice President & Trust Officer

FGJ:nmc
5357g

Comments to Draft EIS and Responses

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:

5090
Ser 00F2/2782
24 AUG 1990

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Sir:

LILIUOKALANI TRUST KEAHUOLU LANDS OF KAILUA-KONA

The Draft Environmental Impact Statement (DEIS) for Liliuokalani Trust Keahuolu Lands of Kailua-Kona, Hawaii, has been reviewed, and we have no comments to offer. Since we have no further use for the DEIS, it is being returned to the Office of Environmental Quality Control.

Thank you for the opportunity to review the draft.

Sincerely,

W.K. Liu

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
Liliuokalani Trust
Belt Collins and Associates
OEQC (w/DEIS)

BELT COLLINS
& ASSOCIATES
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October 16, 1990
945.0101/90-2145

Mr. W.K. Liu
Assistant Base Civil Engineer
Department of the Navy
Naval Base Pearl Harbor
P.O. Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Liu:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

HOUSE OF REPRESENTATIVES
THE FIFTEENTH LEGISLATURE

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

August 31, 1990

Lee William Sichter
Belt, Collins & Associates
680 Ala Moana blvd., Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

I acknowledge receipt of and thank you for sending the final two pages in Chapter IV of the Liliuokalani Trust, Keahuolu Lands of Kailua-Kona, Hawaii, Draft EIS.

I have no comments at this time, however, please be assured that I will contact you should a concern arise.

With warm personal regards.

Sincerely,

WAYNE METCALF
Hawaii State Representative
Third District

BELT COLLINS
& ASSOCIATES

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October 16, 1990
945.0101/90-2145

Honorable Wayne Metcalf
Hawaii State Representative, Third District
State of Hawaii
State Capitol
Honolulu, Hawaii 96813

Dear Representative Metcalf:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

Police Department
349 Kapiolani Street • Hilo, Hawaii 96720-3998 • (808) 961-2244 • FAX (808) 961-2702

Larry S. Tanimoto
Mayor
Victor V. Vierra
Chief of Police
Francis C. DeMorales
Deputy Chief of Police

August 31, 1990

Mr. Lee William Sichter
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Re: Liliuokalani Trust
Keahuolu Lands of Kailua-Kona, Hawaii
Draft Environmental Impact Statement

We reviewed the draft environmental impact statement of the development of the Keahuolu Lands. An increase in calls for assistance from the public is anticipated when the project is completed.

VICTOR V. VIERRA
CHIEF OF POLICE

JD:sk

cc: Kona Police

BELT COLLINS
& ASSOCIATES

Engineering • Planning
Landscape Architecture

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October 16, 1990
945.0101/90-2145

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

Dear Chief Vierra:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. We recognize that the proposed development will likely increase demand for police services. The proposed Civic and Cultural Center is located adjacent to the County owned parcel which includes the existing Kealakehe police station.

Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

September 8, 1990

Mr. Lee William Sichter
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

Dear Mr. Sichter:

Thank you very much for the opportunity to review the Draft Environmental Impact Statement for Liliuokalani Trust Keahuolu Lands of Kailua-Kona, Hawaii. I must say, that was quite a lot to read and I noticed and appreciate your cost in mailing it. I also received the final two pages of Chapter IV, which means that the Table of Contents must be corrected to add the subjects omitted.

On page I-3, Under 5.2 Proposed Development, 2nd Para.
I got confused with the 465 acre Urban Expansion. You mention, ...in this area are the following proposed uses...whatever you mentioned did not add up to 465 acres.

On page I-6, Under 6.2 Long-Term Impacts. Third Line.
Loss of existing flora due to grading. Please consider the plants...Although, I understand there are no endangered plants, the native plants mentioned need to be preserved, especially the maiapilo which is plentiful in the area but is hard to find in most places. Same page, Line 6. Loss of some archaeological sites. What does this mean? What sites?

On page III-4, Under 2.3 Alternative use of the site. 2nd para. Line 4. dry-land taro is a poor example of a crop that no longer enjoy the demand they once did. There is a severe taro shortage NOW!

On page IV-65, Under 5.1.6.3, Line 6. West hawaii Civic Center. H in hawaii should be capitalized.

On page IV-103, Under 6.8.1 Existing Conditions, Line 2. What do you mean by immediate vicinity? I don't consider Konawaena Elementary and Konawaena Intermediate and High School in the immediate vicinity of the project as existing conditions.

On page 8. I don't understand the mana'o on your part of a civic center complex including a mix of State and County functions. I serve on the University Advisory Board and it would be poor management on the University's part to purchase or lease QLT property when there are State lands of larger acreage available very close by.

On page 9. 1st line. I have some doubts that a hospital would be practical in that area. I just feel that it would be too crowded there and should be as close to the airport as possible.

Kind of skimmed over the archaeological portion because it started

to get confusing. Noticed on A-84 re. Feature C: Papamu. The papamu consists of 74 pecked holes, arranged in eight rows and nine columns. 8x9=72. what's this 74 pecked holes?

On page 2-13 Line 1. The "City of Refuge" National Park. I think it more proper as follows: Pu'uhonua o Honaunau National Historical Park (formerly City of Refuge National Park) was the site...I worked there for 10 years and instigated the change of its name to it's original name through the Kona Hawaiian Civic Club.

Same page Line 2. Kapu not Kapu's. Please do not add an s on a Hawaiian word.

Take this for what it's worth: (1) I personally think that your project will suffer because of the smell of the dumpsite which is located so close to your project site. Maybe you can have someone stake out that area and see how bad it is....that is, changing places throughout the area and for 24 hours a day for a period of time. Because if it is affecting your area, maybe it would be wise to spend some bucks and help the County of get rid of it as soon as possible. They are now talking about closing down the police station. (2) I wonder about the noise pollution regarding the airport. I don't remember reading anything about that. (3) You need to find some other alternatives for the use of the University site and also the hospital site in case it bombs out. (4) Electricity was one of my main concerns because of the power shortage we sometimes experience, but it looks like you have looked into that matter. (5) Liliuokalani Trust, in the past, has had very poor communications with the public. I know of only one time they have talked to the people when Mr. Kekumano and your man Jim Bell came to Kona. If not for this project they would never have come. Maybe they should call for public meetings maybe about two times a year at the Childrens' Center just for informational meetings. Otherwise, people guess and start terrible rumors...and you can't blame them because there is no one to turn to for information.

Again, I thank you for the opportunity to review your EIS and although it was a lot of reading to do, it was done so well that I enjoyed reading it as compared to others. I find most EIS reports hard to believe because they make things look better than it really is.

Aloha pumehana,

Mrs. Rose Akana Fujimori

Mrs. Rose Akana Fujimori
P. O. Box 14
Kealakekua, HI 96750
Phone: (808) 323-2797

BELT COLLINS
& ASSOCIATES
Engineering • Planning
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October 16, 1990
945.0101/90-2145

Mrs. Rose Akana Fujimori
P.O.Box 14
Kealakekua, Hawaii 96750

Dear Mrs. Fujimori:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Following are responses to your comments in the order they were presented in your letter.

The table of contents has been revised to include reference to the sections missing from the Draft EIS.

Page II-7 shows the correct distribution of land uses by acreage. The paragraph you cite on page I-3 contains two errors: the 68 acres of additional commercial land should be revised to 65 acres; and the 34 acres of Open Space, Park, and an Historic Preserve should be revised to 30 acres.

Page I-6 discusses the potential loss of existing flora and archaeological sites. It is inevitable that vegetation will be lost due to the need to grade the project site for the proposed development. However, as recommended on page IV-19, "to mitigate the loss of native vegetation, native plants would be used in the landscaping for the project facilities...Several species, including wiliwili, mamane, uhiuhi, 'ohe, maiapilo, and alahe'e wuold be suitable for landscaping purposes and will be incorporated into the landscaping plans." Thus, although some of these existing plants will be lost, they will be replaced to every exent possible during the landscaping phase of the proposed development.

With regard to archaeological sites, as discussed on page IV-47, 207 of the 238 sites identified on the project site are considered to be significant soley for their information content. These means that once an archaeologist has studied the sites and recorded all the useful information available from them, there is no further need to preserve the sites. The archaeologist's recommendation concerning which sites should be preserved and which may be destroyed once data recovery has been completed must be approved by the State's Historic Preservation Office before any further action can be taken.

The specific sites that are recommended for eventual destruction are listed in the Archaeologist's report in the appendix to the EIS and appear in that report's Table 8 (pages 35-37) as X (no further data collection necessary) on the left side of the table, and NFW (no further work of any kind necessary) on the right side of the table. For those sites identified as A and FDC, further data collection is necessary before they can be destroyed. However, the determination that the data collection is adequate must be made by the Historic Preservation Office. Those sites identified in the table as PID (preservation with interpretive development) and PAI (preservation as is) must be preserved.

The statement on page III-4 concerning dry-land taro refers to the historical use of the subject property. While demand for taro continues, it does not appear to be sufficient to generate a resurgence in the cultivation of dry-land taro in North Kona.

The typographical error on page IV-65 will be corrected.

The Department of Education West Hawaii school district extends from Kailua-Kona to Kawaihae. Given this extensive area, we believe it is correct to refer to Konawaena as in the immediate vicinity of the project area.

Page 8 of the Market Analysis lists public and institutional uses that are recommended for the subject property. The proposal to locate a Civic Center in the area and to include both State and County offices is in direct response to proposals from the State, the County, and residents of the Kailua-Kona area. The consolidation of public offices in a centralized area improves the community's access to government operations. From a planning perspective, it makes good sense to locate these facilities within walking distance. Because of the interrelationship among State and County agencies, we believe that locating them in close proximity to one another actually improves the overall function of government operations, and over the long term, helps to reduce costs. Government centers in Hilo, Wailuku and Honolulu all offer examples of this rationale.

We believe that a regional hospital should be located adjacent to the existing population center, in this case, Kailua-Kona. Because the proposed hospital site is situated within a 465 acre urban expansion area, we feel there is sufficent space for its facilities. The hospital is not proposed for location in a dense residential area, which we agree would be too crowded and incompatible with its day-to-day operations.

We can find no compelling reason why the hospital should be located near the airport. The cost of shipping medical supplies by air is not significantly reduced by moving the hospital closer to the airport. Operations involving emergency medical evacuation by helicopter usually involve the helicopter landing on a helipad at the hospital. Consequently, the hospital can be located anywhere. If emergency helicopters were restricted to land at airports, patients would have to be transferred to an ambulance for transport to the hospital, even if it were only a mile or two away, and precious time would be lost. It seems more appropriate to have the helicopter land right at the hospital to save valuable time, and if that is the case, it doesn't matter where the hospital is, so long as it is accessible by emergency helicopter. A further consideration is that emergency helicopter operations may actually interfere with routine airport operations if the hospital were located nearby. Thus, it might be more prudent to separate those operations to minimize potential interference.

Appendix A of the consulting archaeologist's report includes a detailed description of each archaeological feature identified on the subject property. We suspect that the papamu board described by the archaeologist includes the standard 8x9 grid with two extra pecked holes.

You are correct regarding the proper name for the Pu'uhonua O Honaunau National Historic Park and the grammatical use of Hawaiian words.

A detailed air quality analysis was conducted for the proposed project. Impacts from the Kealakehe Landfill were not identified as a problem. This is probably due to the fact that the winds in the project area are primarily on-shore and off-shore depending upon the time of day. Consequently, odors from the landfill tend to drift upslope and downslope from the landfill. Odors were not considered to be signficant south of the landfill site.

A detailed noise analysis was also conducted for the project. The subject property is located nearly five miles away from the airport and is, therefore, not subjected to airport noise.

The proposed land uses represent a "preferred" concept plan. The ultimate land uses will depend upon review and approval by a variety of State and County agencies, as well as considerable public input. Alternative uses for the property, as well as its individual land use components, have been considered and will be the subject of continuing discussions. However, at this stage of the land use permit process, the proposed project represents the Trust's preferred concept for its property.

As stated in the EIS, new electrical generating facilities will be required for the proposed project.

Your suggestion concerning public information meetings sponsored by the Trust has considerable merit. The publication of the EIS for the project represents the beginning of the project's land use permit process. There will be ample opportunities for the public to provide input and learn about the project in the course of the permit process.

Again, thank you for your comments. It is always a pleasure to know that our work has been subjected to such a detailed reading.

Very truly yours,

Lee William Sichter

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT
BELT, COLLINS & ASSOCIATES
JOHN WAIHEE
GOVERNOR
ROGER A. ULVELING
DIRECTOR
BARBARA KIM STANTON
DEPUTY DIRECTOR
LESLIE S. MATSUBARA
DEPUTY DIRECTOR
ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 FAX: (808) 531-5243 ENERGY HOTLINE: (808) 548-4080

90:0015M-056

September 19, 1990

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Commissioner:

Subject: DEIS Liliuokalani Trust
Keahuolu Lands of Kailua-Kona

We have received and reviewed the subject environmental impact statement. We would like to comment favorably on the statements on pages IV-101 and V-21 regarding energy:

"...the most energy saving technologies in the design of Trust facilities...will include the use of active and passive solar systems, the use of energy efficient light fixtures and systems," and "the proposed project will adhere to energy conservation standards whenever possible."

Thank you for the opportunity to review the document.

Sincerely,

MAURICE H. KAYA
Energy Program Administrator

MHK/MLT:dt

cc: Liliuokalani Trust
Mr. Lee Sichter ✓
Office of Environmental Quality Control

BELT COLLINS
& ASSOCIATES

Engineering • Planning
Landscape Architecture

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October 16, 1990
945.0101/90-2145

Mr. Maurice H. Kaya
Energy Program Administrator
Energy Division
Department of Business, Economic Development & Tourism
State of Hawaii
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Kaya:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

September 28, 1990

Planning Division

Mr. Renton Nip, Chairman
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Mr. Nip:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the Liliuokalani Trust Keahuolu Lands at Kailua-Kona, Hawaii. The following comments are offered:

a. The DEIS does not identify any streams or anchialine ponds within the project area. A Department of the Army permit is therefore not required.

b. According to the Flood Insurance Rate Map (Panel #1551660694C, dated September 16, 1988), the project site is located in Zone X, areas determined to be outside of the 500-year flood plain as designated by the Federal Emergency Management Agency. However, the DEIS states on page IV-13 that for the makai portion of the project lands, "The base flood level is 6 feet." The Final EIS should clarify this apparently conflicting information.

Sincerely,

/s/ C. Fujii

Kisuk Cheung
Director of Engineering

Copies Furnished:

Liliuokalani Trust
161 South King Street, 18th Floor
Honolulu, Hawaii 96813

BELT COLLINS
& ASSOCIATES
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Hawaii • Singapore • Australia • Hong Kong • Saipan

October 16, 1990
945.0101/90-2145

Mr. Kisuk Cheung
Director of Engineering
Department of the Army
U.S. Army Engineering District, Honolulu
Building 230
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. The analysis of base flood level discussed on Page IV-13 was based on information published by the County of Hawaii in its Kona Regional Plan. In view of the possible conflict among sources, we elected at the time of the analysis to take the most conservative position (the so-called "worst case") and base our discussion on the County document.

Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

OCT - 1 1990

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Re: Liliuokalani Trust Keahuolu Lands

Due to current staff limitations, the Pacific Islands Office, Fish and Wildlife Enhancement cannot devote the time to adequately evaluate potential impacts to important fish and wildlife resources from the proposed project. Please understand that this notification does not represent the Fish and Wildlife Service's approval of the proposed activity. We may review future actions related to this project should workload constraints be alleviated, or if significant adverse impacts to trustee fish and wildlife resources are identified.

Sincerely yours,

for Ernest Kosaka
Field Office Supervisor
Fish and Wildlife Enhancement

cc: Liliuokalani Trust
Belt Collins and Associates - Lee Sichter

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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October 16, 1990
945.0101/90-2145

Mr. Ernest Kosaka
Field Office Supervisor
Fish and Wildlife Enhancement
United States Department of the Interior
Fish and Wildlife Service, Pacific Islands Office
P.O.Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your letter concerning the above project. We will provide you with a copy of the final EIS for your files.

Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

P. O. BOX 50004
HONOLULU, HAWAII
96850

September 27, 1990

Mr. Rehton L.K. Nip
Chair-at-Large
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Mr. Nip:

Subject: Draft Environmental Impact Statement (DEIS) -
Liliuokalani Trust Keahuolu Lands, Kailua-Kona, Hawaii

We have reviewed the above-mentioned document and have no comments to offer at this time. We would appreciate the opportunity to review the final EIS.

Sincerely,

Warren M. Lee

WARREN M. LEE
State Conservationist

cc:
Liliuokani Trust, 161 South King Street, 18th Floor, Honolulu, HI 96813
Mr. Lee Sichter, c/o Belt Collins and Associates, 680 Ala Moana Blvd., Suite 200, Honolulu, HI 96813

BELT COLLINS
& ASSOCIATES

Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Telex: BELTH 7430474, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

October 16, 1990
945.0101/90-2145

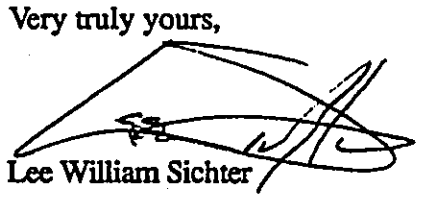
Mr. Warren M. Lee
State Conservationist
United States Department of Agriculture
Soil Conservation Service
P.O.Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. We will provide you with a copy of the final EIS. Should you require any additional information, please feel free to contact me.

Very truly yours,



Lee William Sichter

JOHN WAIHEE
GOVERNOR

DIRECTOR

TELEPHONE NO.
548-6915

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 SOUTH KING STREET, ROOM 104
HONOLULU, HAWAII 96813

September 25, 1990

The Honorable Esther Ueda
Executive Officer
State Land Use Commission
Old Federal Building, Room 104
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: Liliuokalani Trust, Keahuolu Lands of Kailua-Kona, Hawaii, Draft Environmental Impact Statement

Thank you for the opportunity to comment on the above referenced document. We have no comments at this time.

Sincerely,

for Bruce S. Anderson, Ph.D.
Acting Interim Director

cc: Benjamin A. Kudo, Esq., Liliuokalani Trust
Lee Sichter, Belt Collins and Associates

BELT COLLINS
& ASSOCIATES

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October 16, 1990
945.0101/90-2145

Dr. Bruce S. Anderson
Acting Interim Director
Office of Environmental Quality Control
State of Hawaii
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Anderson:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

Planning Department BELT, COLLINS & ASSOCIATES
25 Aupuni Street, Rm. 109 • Hilo, Hawaii 96720 • (808) 961-8288

October 4, 1990

State Land Use Commission
335 Merchant Street
Room 104
Honolulu, HI 96813

Gentlemen:

Liliuokalani Trust Kealuolu Lands
Draft Environmental Impact Statement

We have reviewed the draft EIS and have the following comments:

Water Source Development: The proposed well spacing and well capacities reflect a water draw rate considerably higher than is recommended by the consulting hydrologist for the Kealoha to Kailua Development Plan. His recommendations for potable water development show roughly half the capacity proposed by for the CLT lands. Please indicate the justification for assuming that this level of water development is possible.

The demands for water useage are not consistent with the Department of Water Supply standards which are based on maximum daily demand; i.e., 1.5 times the average daily demand. Please indicate how the remaining water needs will be met.

Sewer System: Is the proposed sewage generation incorporated as part of the Kealakehe STP capacity? If not, how does the applicant propose to deal with the additional sewage generated above the planned capacity of the system?

Drainage: Please indicate how drainage overflow areas will be handled. Drywells alone will not be adequate in all cases. Please indicate whether water draining through the mauka Kealuolu lands can cross the QK highway given the current County standards. Indicate any necessary mitigation measures.

Uhi Uhi: Based on the botanical survey for the Kealakehe Planned Community EIS, we were lead to believe that the Uhi Uhi plant is an endangered species that cannot be moved. The same botanist seems to be drawing different conclusions regarding the Uhi Uhi plants on the CLT Keahuolu lands. Please explain this discrepancy.

Traffic: Please clearly list the improvements that would be installed to meet the anticipated traffic demand, and indicate who would install them.

Thank you very much for the opportunity to comment on this draft EIS.

Sincerely,

DUANE KANUHA
Planning Director

KK:aet

cc: Liliuokalani Trust
Belt Collins and Associates
OEQC

BELT COLLINS
& ASSOCIATES
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October 16, 1990
945.0101/90-2145

Mr. Duane Kanuha
Hawaii County Planning Director
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Kanuha:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your letter on the above project. Following are responses to your comments in the order they were presented in your letter.

Water Source Development

Our staff hydrologist and engineers for the proposed project indicated as a result of their analysis that the proposed spacing of 1,200 to 1,500 feet was adequate for the potable wells and that a million gallon per day (mgd) output from each well was an appropriate estimate of capacity. The discussion on page II-18 of the EIS is based upon these conclusions. Although they may differ from the recommendations of the consulting hydrologist for the Keahole to Kailua Development Plan, we feel that they are valid.

There are a number of landowners in the North Kona area that are presently proposing development projects on their respective properties. We recognize the importance of coordinating these efforts into a regional water development program. The spacing of wells on the Liliuokalani Trust property indicates the ideal configuration from the Trust's point of view. Once other landowners' plans are known, a regional water development plan can be implemented that establishes a mutually agreed upon sustainable yield and coordinates the phasing of the various projects with the development of the necessary infrastructure. The Liliuokalani Trust is eager to participate in such a program.

Page II-20 of the EIS presents a summary table of project water demand that is consistent with the Department of Water Supply's standards for maximum daily yield, i.e. 1.5 times the average daily demand. The text on page II-18 has been amended to include the following statement:

> "The joint development of potable water resources with neighboring property owners will provide the additional potable water needed to satisfy the maximum daily demand of the project (see Table II-2)."

Sewer System

As stated on page IV-98, the Kealakehe Sewage Treatment Plant (STP) will need to be expanded to accommodate the proposed project.

Drainage

Drainage overflow in excess of the capacity of drywells will be directed to open space areas where emergency facilities can be easily accommodated. The 10-acre Open Space area (P1) offers an excellent location for such a facility. Centrally located with topography conducive to redirecting overflow, the 10-acre area can be designed to include an expanded drywell in the form of a large depression, pond, or similar landscape amenity. The system will be designed to minimize the potential for excess drainage to cross the Queen Kaahumanu Highway.

Uhi Uhi Plants

As stated on page IV-18 of the EIS, no endangered plants have been identified on the Keahuolu Lands.

Traffic

The EIS includes a detailed traffic study which presents a number of alternative highway improvements to accommodate population growth associated with the proposed project. We are unable to provide a specific list improvements beyond those discussed in the EIS. The ultimate configuration of the regional transportation system will be determined, to a great degree, by policy decisions of the State and the County of Hawaii, based upon the land use approvals actually granted to the region's landowners presently proposing development of the their respective properties. Most of the land use plans, including the County's, are presently in draft form and have not been finalized, nor approved by the State Land Use Commission and the County Council. Thus, it is difficult to commit to a definitive solution in the midst of a dynamic process. Nevertheless, the Trust is fully prepared to contribute its fair share to improvements deemed necessary by the State, County and surrounding landowners.

Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

HAWAII ELECTRIC LIGHT COMPANY,INC. PO BOX 1027 HILO,HAWAII 96721

October 5, 1990

Belt, Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Attention: Mr. Lee William Sichter

Subject: Environmental Impact Statement (EIS)
Liliuokalani Trust
Keahuolu Lands of Kailua-Kona, Hawaii

This is in response to the draft EIS for the proposed development by Liliuokalani Trust in the North Kona area. Due to the possible load of 50MW for the development, additional electrical transmission lines and facilities to service the area will be required. The developer should have his electrical consultant contact the engineering department at Hawaii Electric Light Company (HELCO) as soon as practicable to discuss the project schedule and necessary off-site and on-site electrical improvements.

We recommend that residential, commercial and industrial projects within this development take full advantage of waste heat recovery equipment to recycle and reuse the waste heat rejected by air conditioning and refrigeration equipment. If this equipment is incorporated in the development's original design, the amount of energy required will be substantially reduced. Attached are brochures which describe technology related to heat pumps.

In addition, we would also recommend that fluorescent lighting (equipped with high efficiency ballasts) be used throughout the project and that sodium lighting be specified for parking lots and roadways. Outdoor lighting fixtures should be carefully specified to insure that very little light is directed up into the night sky. This is important for efficiency reasons and also to minimize the stray light that might interfere with the operation of the astronomical observatories on the summit of Mauna Kea.

Again, we strongly urge that energy efficiency and conservation features suitable to reduce the peak electrical demand be a part of the development's plans and requirements. Our Director of Customer and Consumer Services, Tom Goya, is available to assist you on the Demand Side Planning concerns. He can be reached at 969-0131.

Very truly yours,

Clyde H. Nagata, Manager
Engineering Department

cc: T. Goya

BELT COLLINS
& ASSOCIATES

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October 16, 1990
945.0101/90-2145

Mr. Clyde H. Nagata, Manager
Engineering Department
Hawaii Electric Light Company, Inc.
P.O.Box 1027
Hilo, Hawaii 96721

Dear Mr. Nagata:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. The project project will require approval of the State Land Use Commission and rezoning of the property by the County of Hawaii, before development can begin. Discussion of electrical transmission requirements can not occur until approval from the Land Use Commission is received.

Energy conservation measures including waste heat recovery procedures and fluorescent lighting will be considered for inclusion into the project at the time detailed architectural design is undertaken. Facilities and outdoor lighting fixtures will be designed to minimize stray light.

Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
SEVEN WATERFRONT PLAZA, SUITE 300
500 ALA MOANA BOULEVARD
HONOLULU, HAWAII 96813
FAX (808) 543-6841

IN REPLY REFER TO:

90:PLNG/4794jt

October 8, 1990

TO: Ms. Esther Ueda, Executive Officer
State Land Use commission

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft Environmental Impact Statement for the Liliuokalani Trust Keahuolu Lands of Kailua-Kona, Hawaii

We have reviewed the subject draft EIS and offer the following comments.

The proposed commercial enterprises are estimated to generate 2,240 direct jobs and 540 indirect jobs. Additionally, the proposed hotel is estimated to generate 240 direct jobs and 200 indirect jobs. Policy B(3) of the State Housing Functional Plan seeks to ensure that projects which impact housing provide affordable rental opportunities for employees. We therefore believe that (1) an assessment of the impact of the proposed development on housing is needed and (2) that the developer should be held accountable to satisfy any need for affordable employee housing generated by the project.

Thank you for the opportunity to comment.

JT:eks

c: Liliuokalani Trust
Lee Sichter - Belt Collins and Associates
Office of Environmental Quality Control

BELT COLLINS
& ASSOCIATES
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October 16, 1990
945.0101/90-2145

Mr. Joseph K. Conant, Executive Director
Housing Finance and Development Corporation
State of Hawaii
7 Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Dear Mr. Conant:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. The Office of State Planning has confirmed that it will be recommending to the State Land Use Commission that the Liliuokalani Trust not be required by the State to provide any affordable housing so long as the Trust does not propose to develop its land for residential use.

Should you have any further comments regarding the project, please feel free to contact me.

Very truly yours,

Lee William Sichter

Department of Parks and Recreation
25 Aupuni Street, Rm. 210 • Hilo, Hawaii 96720 • (808) 961-8311

Larry S. Tanimoto
Mayor
George Yoshida
Director
Juliette M. Tulang
Deputy Director

October 8, 1990

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Subject: Liliuokalani Trust Keahuolu Lands, North Kona, HI
TMK: 7-4-08:02 and 12

The following comments are offered on the draft EIS for Liliuokalani Trust Keahuolu Lands:

1) Figure II-3

The County of Hawaii presently leases 34.8 acres of land for recreational uses from the State of Hawaii (map enclosed).

2) Figure II-4

The proposed Queen Liliuokalani Boulevard (S2) should extend makai to the Old Kona Airport Park, as noted on page II-16.

3) Figure V-6

The Keahole to Kailua Development Plan (draft) designates a "Shore Drive" beginning at the Honokohau Harbor and extending toward Kailua Village. The proposed Queen Liliuokalani Boulevard (mentioned in #2 above) could connect to the "Shore Drive".

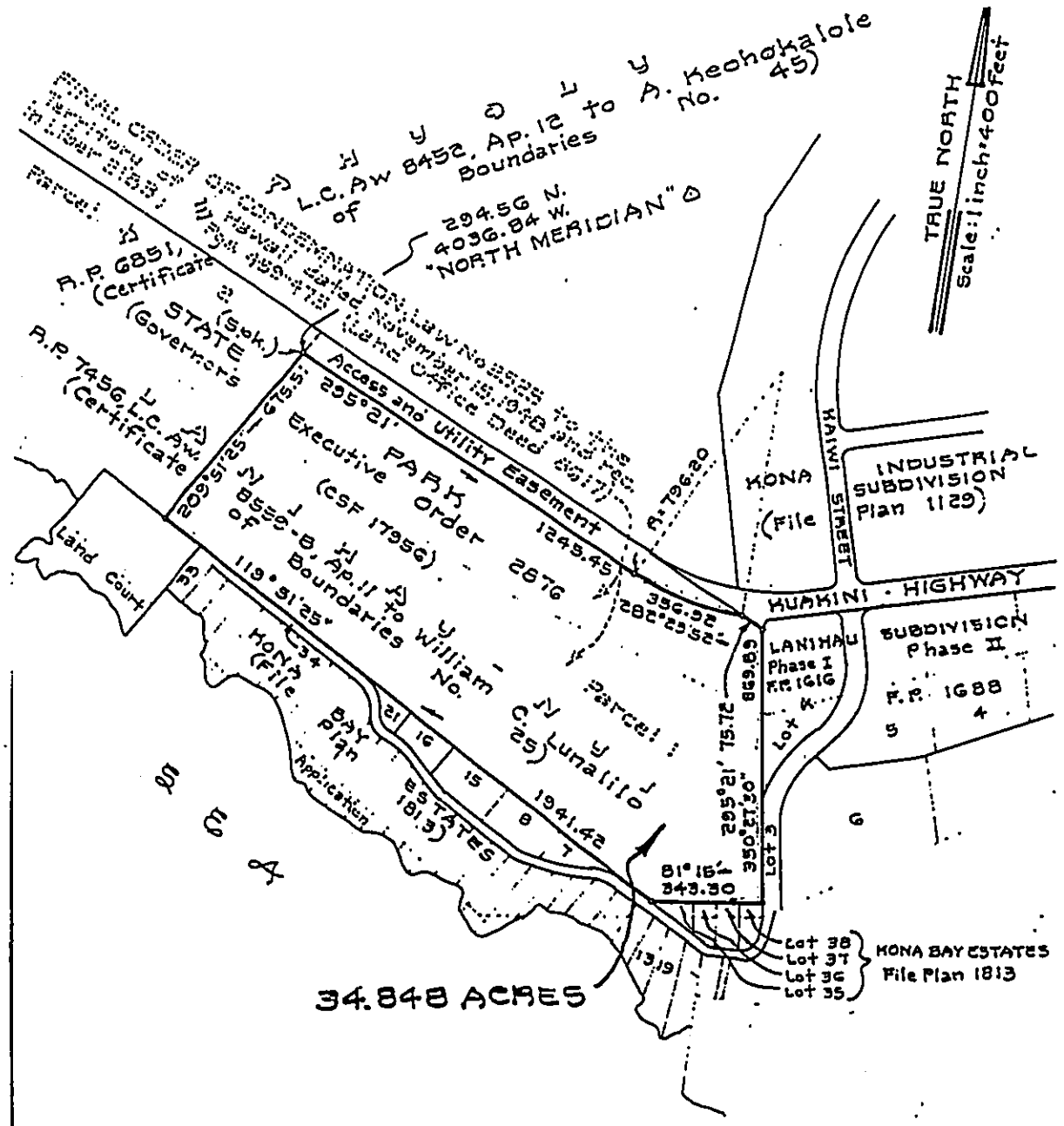
If any questions should arise relative to the above, please do not hesitate to contact this office.

Sincerely,

George Yoshida
Director

Encl.

cc: Liliuokalani Trust
✓ Belt Collins and Associates



COUNTY PARK SITE

Keahuolu and Lanihau-Nui, North Kona, Island of Hawaii, Hawaii

Scale: 1 inch = 400 feet

JOB H-101 (87)
C.BK T (RSN)

TAX MAP : T-5-05:83 por T	SURVEY DIVISION DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES	EXHIBIT "B"
C. S. F. No. 20,551	STATE OF HAWAII	R.S.N. May 5, 1987

BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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October 16, 1990
945.0101/90-2145

Mr. George Yoshida, Director
Department of Parks and Recreation
County of Hawaii
25 Aupuni Street, Room 210
Hilo, Hawaii 96720

Dear Mr. Yoshida:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Figure II-3 has been revised to depict the entire 34.8 acre parcel leased by the County from the State of Hawaii.

The possible extention of the proposed Queen Liliuokalani Boulevard across Queen Kaahumanu Highway must be approved by the State Department of Transportation as well as the County of Hawaii. The boulevard and the "Shore Drive" proposed by the State would both be elements of a new regional transportation network. Because there are no firm commitments by the State, County, or neighboring landowners concerning the ultimate configuration of the regional network, it would be premature to depict these elements in the Keahuolu Lands' EIS. However, please note that elements of a regional network are discussed in the project's traffic study which is included as an appendix to the EIS. The actual design and implementation of the regional network must depend upon negotiations among all affected parties. The Keahuolu Lands' EIS, therefore, presents a range of alternatives for its internal roadways as a means of facilitating the discussion and evaluating possible configurations. Once the specific design and configuration of a regional transporation network is agreed upon, the construction of individual elements will require additional environmental impact statements and will receive full public review.

Should you have any additional comments, please feel free to contact me.

Very truly yours,

Lee William Sichter

Larry S. Tanimoto
Mayor
Bruce C. McClure
Chief Engineer
Richard H. Nishimura
Deputy Chief Engineer

Department of Public Works

25 Aupuni Street, Rm. 202 • Hilo, Hawaii 96720 • (808) 961-8321 • Fax (808) 969-7138

September 18, 1990

STATE LAND USE COMMISSION
335 MERCHANT ST ROOM 104
HONOLULU HI 96813

SUBJECT: LILIUOKALANI TRUST KEAHUOLU LANDS - DEIS
N. Kona, HI
TMK: 7-4-8: 2 & 12

We have reviewed the draft EIS for the subject project and our comments are as follows:

A. SOLID WASTE

1. Contract to mine landfill has been terminated. Whether this project will be undertaken by others is highly questionable at this point in time.

2. The new landfill is presently designed to initially accept 60,800 tons/year.

3. Depending upon processing time of the landfill, the County may not be able to move operations until mid-1992 or possibly even later. Should this happen there will be severe impacts on solid waste operations.

4. Because of the limited space at the existing Kealakehe Landfill and the uncertainty in the development of the new West Hawaii Landfill, construction and occupancy must coincide with the opening of the new landfill. If this is not possible, an alternate means of disposing all wastes, including construction wastes, must be developed. Occupancy will not be granted until evidence is provided which shows that the existing Kealakehe Landfill will not be used.

5. The present Kailua Transfer Station is anticipated to have a maximum capacity of 200 tons/day based on the operation of the new West Hawaii Landfill and assuming a fairly regular flow of refuse and that each trailer will haul approximately 12 tons. Based on the 96 tons/day at build-out, the present design will no longer be adequate to accommodate the development. It is felt that this development, coupled with the new landfill, will probably require the development of a new regional type transfer station similar to the transfer stations found in Honolulu.

6. Commercially generated refuse must be disposed in a landfill. Use of transfer stations will not be allowed.

7. A waste reduction program such as composting and recycling centers should be planned for and implemented particularly with respect to commercial/business developments.

B. WASTEWATER

1. The proposed development should be consistent with the County's Keahole to Kailua Development Plan.

2. The new Kealakehe Wastewater Treatment Plant will have to be expanded to accommodate the wastewater flows. The cost will be passed on to all developers.

3. The existing wastewater treatment site land area may not be adequate and more land area will be required for the expansion.

4. Another issue that must be resolved is the effluent disposal capacity, which will be a critical factor.

C. TRAFFIC

We feel that some assumptions made in the Transportation Analysis are questionable.

1. Overcrossing at Kaiwi Street. The topography is too severe to construct this. Also, Kaiwi Street is built-up on both sides.

2. Frontage road along Queen Kaahumanu. If access is controlled and intersections are limited, why would frontage roads be necessary?

3. Kealakehe Parkway. Has anyone investigated the feasibility of connecting at Mamalahoa Highway?

4. Four-lane Queen Kaahumanu Highway. Is it realistic to assume this will be built by 2010?

5. Extension of Kealakehe Parkway to connect with Kuakini Highway. Is this a committed project? Will it be built by 2010?

Although this is a major development in a congested area with existing traffic problems, the traffic study does not have any conclusions or recommendations on 1) an access plan capable of providing safe and efficient ingress and egress from this development and 2) any external roadway improvements that this development will construct that is necessary to mitigate the traffic impacts identified in the study.

The location of the Shopping Center is contiguous to the existing commercial area which is good, except that the Queen Kaahumanu Highway will bisect the area. A primary arterial should not do this. The planning for the land use and the highway system in this area is not in sync.

The mid-level road seems to be a good candidate to be the primary arterial if it is extended to the Kuakini extension to the south and to the Kona Airport to the north. The intersection of the mid-level road and Palani Road should be grade-separated.

The proposed Kealakehe Parkway Road is being portrayed as a panacea for the ills of Palani Road. We feel that even if it can be built and even if it will be built and even if it is used, Palani Road would still need to be improved. Commuters to the south may still use Palani Road since it is a more direct route to Kailua. To the north is a planned road in close proximity to the mauka-makai road at the Mamalahoa Highway. Commuters traveling to the north would probably take this road instead of the proposed mauka-makai road.

Palani Road should be improved, along the frontage of this development, within a minimum 80' right-of-way with curbs, gutters and sidewalks and an improved horizontal alignment. The intersection of Palani Road and the Queen Kaahumanu Highway should also be improved.

The existing runaway truck ramp shall be reconstructed, as necessary, when the Palani Road is widened.

If the State allows the Queen Liliuokalani Boulevard connection to the Queen Kaahumanu Highway, then it should extend across Queen Kaahumanu Highway and eventually tie in to Kaiwi Street. The intersection of Kaiwi Street and Queen Kaahumanu Highway should then be deleted and the new access to the industrial area from Queen Kaahumanu Highway should be the Queen Liliuokalani Boulevard.

ROBERT K. YANABU, Division Chief
Engineering Division

DHM:sah

cc: Liliuokalani Trust
Lee Sichter, Belt Collins & Associates

BELT COLLINS
& ASSOCIATES
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October 16, 1990
945.0101/90-2145

Mr. Robert Yanabu, Division Chief
Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street, Room 202
Hilo, Hawaii 96720

Dear Mr. Yoshida:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your letter of September 18, 1990 concerning the above project. Following are responses to your comments in the order they are presented in your letter.

A. Solid Waste

We understand that construction and occupancy of the proposed project must coincide with the opening of a new landfill, and if this is not possible, an alternative means of disposing all wastes, including construction wastes must be developed. We also understand that development of a new regional type transfer station will probably be required in conjunction with a new landfill. Commercially generated waste from the project will be disposed of in a landfill as required by the County. Page IV-100 of the EIS discusses the use of recycling as a mitigation measure.

B. Wastewater

Page IV-98 of the EIS discusses the fact that the proposed project will require the expansion of the Kealakehe Sewage Treatment Plant presently under construction.

C. Traffic

We agree that an overcrossing at Kaiwi Street may be difficult due to the topography. However, this alternative was included in the analysis in order to evaluate its impact upon traffic conditions as a means of improving traffic circulation in the area. Frontage roads along Queen Kaahumanu Highway are being recommended by the Department of Transportation (DOT). We also understand that the Department of Transportation is presently conducting preliminary planning and engineering for the section of the proposed Kealakehe Parkway that would cross the Palani Ranch land and connect to Mamalahoa Highway. Widening of Queen Kaahumanu Highway will be initiated by the DOT. Projected population increases in the Kailua area by 2010 suggest that the widening will be necessary. The extension of the Kealakehe Parkway across the Trust's makai properties has been suggested by the DOT and is reflected in the Keahole to Kailua Draft Development Plan. However, we do not believe that the State legislature has funded this project to date.

The EIS presents alternative configurations for ingress and egress as well as external roadway improvements. Conclusions and recommendations on the best alternative will result from discussions with the State DOT and the County. The publication of the EIS signifies the beginning of these discussions, rather than their conclusion. Therefore, it would be premature and inappropriate to recommend a specific configuration without input from the State and the County.

The proposed shopping center is a regional land use which will require access from Queen Kaahumanu Highway. The shopping center should not be considered to be an extension of existing commercial activities makai of the highway. Planning for the shopping center and the roadway improvements necessary to provide access to it will be coordinated with the State DOT and the County.

We understand that the Keahole to Kailua Draft Development Plan was revised in March, 1990 to reflect an agreement between the State DOT and the County that the Mid-Level roadway will not be developed as a primary arterial roadway.

The Trust agrees that Palani Road will require improvements and has recently granted an easement to the County to permit the construction of truck passing lanes. However, it would seem that major improvements to Palani Road cannot occur until an alternate route is developed which will enable traffic to bypass the necessary construction activity. It may also be difficult to improve the intersection of Palani Road with Queen Kaahumanu Highway until this busy intersection can be bypassed in some manner.

We understand that the existing runaway truck ramp will be reconstructed, as necessary, when Palani Road is widened.

If the State allows the extension of Queen Liliuokalani Boulevard across the highway, it will become a major access route for traffic entering and leaving the Kona Industrial Subdivision and may eliminate the need for the Kaiwi Street intersection with Queen Kaahumanu Highway.

Should you have any additional comments, please feel free to contact me.

Very truly yours,

Lee William Sichter

Larry S. Tanimoto
Mayor
Bruce C. McClure
Chief Engineer
Richard H. Nishimura
Deputy Chief Engineer

Department of Public Works

25 Aupuni Street, Rm. 202 • Hilo, Hawaii 96720 • (808) 961-8321 • Fax (808) 969-7138

October 15, 1990

MR LEE SICHTER
BELT COLLINS AND ASSOCIATES
680 ALA MOANA BLVD SUITE 200
HONOLULU HI 96813

SUBJECT: DEIS - Liliuokalani Trust
Keahuolu Lands of Kailua-Kona
TMK: 7-4-8:4 por. 2 & por. 12

In addition to our previous comments on this application, we have the following comments:

1. Updates to the Traffic Study may be required as each phase is developed due to changes in traffic.

2. Funding for new roads and recommended traffic improvements need to be addressed. County funds are limited. What improvements will the Liliuokalani Trust commit to do?

for David Murakami
ROBERT K. YANABU, Division Chief
Engineering Division

DHM:lb

cc: Traffic Division
Planning Department

BELT COLLINS
& ASSOCIATES
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October 16, 1990
945.0101/90-2145

Mr. Robert Yanabu, Division Chief
Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street, Room 202
Hilo, Hawaii 96720

Dear Mr. Yoshida:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your additional comments on October 12, 1990 concerning the above project. We understand that updates of the Traffic Study may be required as each phase of the proposed project is developed. The Trust will bear its fair share of development costs for new roads and traffic improvements necessitated by the development of its lands.

Very truly yours,

Lee William Sichter

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

October 8, 1990
RE:0563

Ms. Ester Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawai'i 96813

Dear Ms. Ueda:

Draft Environmental Impact Statement (EIS)
Lili'uokalani Trust, Keahuolo Lands
Keahuolo, Kailua-Kona, Hawai'i

The above referenced document describes anticipated impacts associated with a 1,135 acre project which consists of 4 principle components: a 465 acre urban expansion area; a 450 acre area to be sold to the State of Hawai'i, the use of which is yet uncertain (for planning purposes the EIS assumes that the entire area will be developed as a residential community); a 229 acre business expansion area; and an improved regional transportation network.

Our review of the Draft EIS was prepared with the assistance of Michael Graves, Anthropology; Yu Si Fok and Henry Gee, Water Resources Research Center; Karl Kim, Urban and Regional Planning; and Robert Irwin, Environmental Center.

Long Range Planning Concerns

While the scope of this planning document (in its function as a preliminary master plan) is appropriately broad, our reviewers suggest that project descriptions at this point are too vague to afford specific impact assessment and mitigation plan formulation. Our reviewers recommend that a condition for the acceptance of the present EIS be that it serve only as a preliminary master plan for the several projects which it begins to describe. Draft Supplemental EIS(s) should be prepared for the residential and urban-commercial components of the project, as well as for the parcel to be acquired by the State. The proposing agency should be required to state clearly (in the Introduction section of the present Draft EIS) its intent to prepare draft supplemental EIS(s) for the major project components which are only briefly discussed in this preliminary document.

Requirement of these further planning documents will not only clarify what specific development is to take place on the Keahuolo lands (increasing impact assessment accuracy), but will also allow maximum public participation in the planning process, ensuring that the project is in keeping with the "character" of the landscape where it will be developed and the specific socioeconomic needs of the community presently residing there. The result of placing these conditions for approval on the present document should be a more enlightened planning process for everyone involved, and ultimately, a more desirable final project.

Archaeology

The archaeological inventory survey of the project property identified 239 sites (237 of which were newly discovered), containing over 1810 individual features. Our reviewers have several reasons for believing that features may have been missed during the survey for the Draft EIS, and that sites may have been missed or misdescribed.

First, the survey is described in the Summary (page ii, Appendix F) as "a 100%-coverage pedestrian survey". Yet, in the Introduction (page 1), the survey is described as a "Conduct variable-coverage (partial to 100%) variable-intensity (30-90 ft. intervals) ground survey".

A second problem is that, in some areas of the project lands, surface visibility is impeded by dense vegetation. Consequently, the report states that "further field work. . .may indicate that some sites are part of the same continuous complex" (page 13). In other words, some sites may have been segmented by the survey strategy into discontinuous sites, and some features may have been missed in the intervening areas.

Another related problem is that, as reported on page 13 of the report, not all features of large agricultural complexes were counted and inventoried. Nor were all features measured and described.

The likelihood that features were missed is suggested by the researchers themselves: "it is likely that there are additional rock mounds, pahoehoe excavations, and other minor agricultural features that were not observed during the sweeping or recording phases of field work" (page 13).

A number of larger problems arise as a result of these missing data. First, it is our general understanding that an archaeological inventory study is designed to detect all sites in a project area. At the very least, it is incumbent upon the archaeological consultant to provide a listing of those areas or sites which may contain additional features that were undetected by the initial survey. Second, it is not possible to make comprehensive well-informed recommendations about preservation and additional work without information about total site content. Third, the missing features raise questions about the accuracy of the Findings sections of the report. On page 15 the patterning of features in relation to elevation countours is examined. The fact that features for some sites have not yet been counted detracts from the accuracy and usefulness of this discussion. Further obscuring the findings is the fact that we do not yet

know if vegetation was thicker at some elevations (thus, obscuring more features). Nor is it reported whether larger agricultural complexes occurred at certain elevations (thus limiting the number of features which could be counted during the survey). That such factors have affected the findings is indicated by the following statement: "It is likely that additional features (not located during this survey) are present in the upper elevational interval, where visibility was extremely limited" (page 15). Our reviewers request further discussion and clarification of these important issues.

On page 34 of the inventory, the researchers suggest that a more intensive survey, including the clearing of vegetation in selected sample tracts, be performed. Our reviewers strongly concur with the researchers' suggestions here. However, this additional work should be carried out during the planning phase of the project rather than during the mitigation phase (after the issuance of a Final EIS) when decisions will already have been made about site significance and preservation. This further field work should be performed and discussed in a revised inventory prior to the acceptance of the Final EIS.

Water Supply

The discussion on page IV-97 makes no projections for water demands of the project at build out or at any other phase of development. Also missing is discussion of flow capacities for water supply sources to service the proposed developments.

Wastewater Disposal

The Draft EIS makes no mention of the ultimate disposal of wastewater effluent emanating from proposed project facilities. Is the wastewater system for this project compatible with the proposed wastewater reuse program for the Kealakehe sewage treatment plant? (see the Amendment to the Revised Environmental Impact Statement for the Kailua-Kona Sewerage System, Phase IV (Northern Zone), R. M. Towill Corporation, July 1990) Further discussion of this issue is necessary.

We thank you for this opportunity to have reviewed the Draft EIS.

Yours truly,

John T. Harrison, Ph.D.
Environmental Coordinator

cc: Lili'uokalani Trust
Belt Collins and Associates ✓
OEQC
Roger Fujioka
Michael Graves
Henry Gee
Yu Si Fok
Karl Kim
Robert Kai Irwin

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October 16, 1990
945.0101/90-2145

Mr. John T. Harrison, Ph.D.
Environmental Coordinator
Environmental Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Mr. Harrison:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your comments concerning the above project. Following are responses to your comments in the order they are presented in your letter.

Long Range Planning Concerns

The EIS for the above project was prepared to accompany the Trust's petition to the State Land Use Commission. By its very nature, the requested action is broad in scope and will require considerably more detailed planning and design for each project element. The County of Hawaii will determine whether a supplement to the EIS will required for each specific element of the project.

Archaeology

The parameters of the archaeological analysis conducted for the proposed project are consisted with the standards established by the State's Historic Preservation Office. It is virtually impossible to conduct an inventory to the degree suggested in your letter due to the cost and time involved. For this very reason, the State has developed the requirements for an acceptable report that will provide an adequate inventory of archaeological sites. As each individual component of the project is developed more intensive survey work is required. However, it is infeasible to conduct this level of analysis prior to receiving any land use approvals.

Water Supply

Water demands and flow capacities for the project at buildout will depend upon the specific design of the project elements. We are unable to project the ultimate demand without much more detailed infomration. This information will not be available until project elements are designed. The proposed project does not consist of designing specific project elements. Rather, it is proposing the urbanization of the property upon which project elements would be eventually constructed.

Wastewater Disposal

The EIS states on page IV-98 that the proposed project will utilize the Kealakehe Sewage

Treatment Plan presently under construction. The County of Hawaii has proposed that the effluent from the STP will be used to irrigate the proposed public golf course at Kealakehe. The same page also includes the statement that the wastewater disposal system for the proposed project will be planned, designed and constructed in compliance with appropriate state and county rules and regulations.

Should you require any further information concerning the project, please feel free to contact me.

Very truly yours,

Lee William Sichter

JOHN WAIHEE
GOVERNOR OF HAWAII

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH

FIVE WATERFRONT PLAZA
500 ALA MOANA BOULEVARD, S. 250
HONOLULU, HI 96813
FAX # (808) 548-7237

FACSIMILE REQUEST AND COVER SHEET
(Use Black or Blue Ink Only)

DATE: October 12, 1990

TO: Lee Sichter, Belt Collins & Assoc

OFFICE/PHONE NO.: 521-5361 FAX 538-7819

SUBJECT: Liliuokalani Trust DEIS

ORGANIZATION CODE/MAIL STOP: _____

FROM: Kelvin Sunada

OFFICE/PHONE: Env. Pln Office 543-8347

SIGNATURE OF SENDER: [signature]

No. of pages transmitted (Including Cover Sheet) 4

NOTE: If you did not receive all of the pages of this transmittal or if your pages are illegible, please call the office from which you received this material.

Rev. 1/5/90

Renton L.K. Nip, Chairman
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

STATE OF HAWAII
DEPARTMENT OF HEALTH
ENVIRONMENTAL MANAGEMENT DIVISION
FIVE WATERFRONT PLAZA, SUITE 250
500 ALA MOANA BOULEVARD
HONOLULU, HAWAII 96813

In reply, please refer to:
EMD-WWB

September 11, 1990

To: Planner, Staff Services Office

From: Chief, Wastewater Branch

Dear Mr. Nip:

Subject: Liliuokalani Trust Keahuolu Lands
Kailua-Kona, Hawaii ← Draft Environmental Impact Statement (DEIS)
TMK: 7-4-08:02 & 12

We have reviewed the ~~material on the~~ subject ~~project~~ DEIS and offer ~~submitted by your office. The following comments are offered:~~ Wastewater Disposal

1. A portion of the subject area (TMK: 7-04-08:12) is located in a proposed non()critical wastewater disposal area.

2. The remaining portion of the subject area (TMK: 7-4-08:02) is located in a proposed critical wastewater disposal area as determined by the Hawaii County Wastewater Advisory Committee. No cesspools will be allowed as a means of disposal in the subject area.

2. At this time, the details of wastewater treatment for the project and disposal are general in nature. Connection to the municipal sewer system is proposed, yet capacity for the additional flows from the project are not accounted for. Since section 11-62-06 (b) requires that projects within sewered areas connect to the public sewers, the use of a temporary wastewater systems which will eventually be integrated into the county system, would be acceptable if it is operated by the County of Hawaii.

3. The project developers must coordinate their efforts to build the planned community with the County of Hawaii. The County wastewater treatment facility must be expanded now rather than at some future unspecified date.

Drinking Water
SDW Branch comments

BSA

cc: Liliuokalani Trust
Mr. Lee Sichter c/o Belt Collins and Associates } See cover sheet for address
Chief Sanitarian, Hawaii

JOHN WAIHEE
VERNOR OF HAWAII

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

SEP 21 1990

September 20, 1990

In reply, please refer to:
EPHSD

MEMORANDUM

TO: Planner, Environmental Planning Office
ATTENTION: Kelvin Sunada

THROUGH: Chief, Safe Drinking Water Branch

FROM: Environmental Engineer, Safe Drinking Water Branch

SUBJECT: Draft Environmental Impact Statement
Liliuokalani Trust Keahuolu Lands
Kailua-Kona, Hawaii
TMK: 7-4-08: 02 and 12

Thank you for the opportunity to review and comment on the subject document. We have examined the draft environmental impact statement (DEIS) and have the following comments to offer:

Drinking Water

1. The DEIS correctly states that proposed supply wells must be approved by the Director of Health prior to its use. This is in accordance with the Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems." Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements set in Section 11-20-29.

2. Section 11-20-30 of Chapter 20 requires that new or substantially modified distribution systems for public water systems be approved by the Director. However, if the water system is under the jurisdiction of the County of Hawaii, the Department of Water Supply will be responsible for the review and approval of the plans.

3. According to the DEIS, the majority of the project site mauka of Queen Kaahumanu Highway lies above the Department's Underground Injection Control (UIC) line. Land areas located above the UIC line are generally considered to contain underground sources of drinking water. These areas should therefore be protected against all sources of groundwater contamination.

4. The DEIS states that project will utilize drywells for the disposal of surface water runoff. Since these drywells would be classified as injection wells, they must comply with the Department's Administrative Rules, Title 11, Chapter 23, "Underground Injection Control." Chapter 23 requires UIC permits for the construction and operation of all injection wells.

   The discussion of surface water and drainage on Page IV-11 of the DEIS is incorrect. All drywells used to dispose of surface water runoff, regardless of their location with respect to the UIC line, are required to obtain a UIC permit and must be located at least one-quarter mile away from any source of potable water.

If you should have any questions, please contact the Safe Drinking Water Branch at 543-8258.

Stuart Yamada
STUART YAMADA

SY:kt

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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October 16, 1990
945.0101/90-2145

Mr. Kelvin Sunada
Environmental Planning Office
Department of Health
State of Hawaii
Five Waterfront Plaza
500 Ala Moana Boulevard, Suite 250
Honolulu, Hawaii 96813

Dear Mr. Sunada:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your comments concerning the above project. Following are responses to your comments in the order they are presented in your letter.

Wastewater

The proposed project will utilize the Kealakehe Sewage Treatment Plant for wastewater disposal. Should Land Use Commission approval for the Trust's boundary petition be granted, coordination witht the County will begin immediately to facilitate the necessary expansion of the STP. The specific increase in capacity necessary will be determined once design work for individual project elements has commenced.

Drinking Water

The EIS has been revised to include your recommended correction concerning the need for UIC permits for all drywells developed on the subject property.

Should you have any further comments, please feel free to contact me.

Very truly yours,

Lee William Sichter

1990 October 8

State of Hawaii Land Use Commission
335 Merchant Street
Room 104
Honolulu, Hawaii 96813

COMMENTS ON DEIS FOR PROPOSED LILIUOKALANI TRUST ESTATE DEVELOPMENT OF KEAHUOLU LANDS OF KAILUA-KONA

1. Although the DEIS is dated August 1990, it makes no reference to compliance or non-compliance with the following:

a. The State of Hawaii Water Code (HRS 174C), adopted May 1987.
b. The State of Hawaii Water Plan (including the State Water Resources Protection Plan, the State Water Quality Plan, the State Water Projects Plan, and the County of Hawaii Water Use and Development Plan), adopted June 1990.

The Water Code requires that all new wells receive well construction and pump installation permits. It seems that the environmental impacts of project-related groundwater development cannot be adequately addressed until well construction permits have been granted and subsequent hydrological analyses, including pumping tests and core samples, have been performed.

2. Specifically, on page I-8, Section 11 (Necessary Approvals and Permits), Well Construction Permit and Pump Installation Permit (Both under the authority of the State of Hawaii Commission on Water Resource Management) should both be at the top of the list. Project work may also require Stream Channel Alteration Permits (also under the authority of the Water Commission).

3. Specifically, reference to the State of Hawaii Water Resources Development Functional Plan (p. V-25) is meaningless, since that document has been replaced by the State of Hawaii Water Plan. Objectives and policies of the State of Hawaii Water Plan ARE directly applicable to the proposed project (emphasis added), and must be evaluated in the final EIS.

Respectfully submitted,

David C. Penn

David C. Penn
P.O. Box 62072
Honolulu, HI 96839

cc: Liliuokalani Trust
Mr. Lee Sichter
OEQC

BELT COLLINS
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October 16, 1990
945.0101/90-2145

Mr. David C. Penn
P.O.Box 62072
Honolulu, Hawaii 96839

Dear Mr. Penn:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for your comments concerning the above project. We have revised pages I-8 and V-25 of the EIS to address your concerns. However, we do not agree that the Water Resources Development Functional Plan has been replaced by the State of Hawaii Water Plan. The Water Code specifically pertains to the administration of water resources, a function previously handled by the State Department of Land and Natural Resources and the County Board of Water Supply. While the enabling legislation is indeed new, the regulatory permit process is a consolidation and reorganization of existing administrative permit processes. Consequently, it is not singled out for analysis.

We agree that environmental impacts of project-related groundwater development must be addressed during the process of procuring the necessary well development permits and that detailed hydrological studies are a requirement of those permits. Page IV-97 of the EIS states that all new potable water well system improvements would be in compliance with the State Water Resource Management Commission requirements.

Very truly yours,

Lee William Sichter

JOHN WAIHEE
GOVERNOR

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

ALEXIS T. LUM
MAJOR GENERAL
ADJUTANT GENERAL

MYLES M. NAKATSU
COLONEL
DEPUTY ADJUTANT GENERAL

August 23, 1990

Engineering Office

State Land Use Commission
335 Merchant Street, Room 304
Honolulu, Hawaii 96813

Gentlemen:

Liliuokalani Trust Keahuolu Lands
Kailua-Kona, Hawaii

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting & Engineering Officer

cc: Liliuokalanai Trust
Belt Collins and Associates

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October 16, 1990
945.0101/90-2145

Lieutenant Colonel Jerry M. Matsuda
Contracting and Engineering Officer
Hawaii Air National Guard
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Lt. Colonel Matsuda:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

(P)1713.0

AUG 2 9 1990

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Gentlemen::

Subject: Liliuokalani Trust
Keahuolu Lands

Thank you for the cpportunity to review the subject document. We have no comments to offer.

Should there be any questions, please contact Mr. Ralph Yukumoto of the Planning Branch at 548-7192.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

RY:hc
cc: Liliuokalani Trust
Mr. Lee Sichter

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& ASSOCIATES
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October 16, 1990
945.0101/90-2145

Mr. Teuane Tominga
State Public Works Engineer
Division of Public Works
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Tominga:

Liliuokalani Trust Keahuolu Lands
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

Chapter Eight

CHAPTER VIII
REFERENCES

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Chapter Nine

CHAPTER IX
APPENDICES

The following subconsultant studies are included in this chapter and are listed in the order they appear:

A - Market Analysis
B - Botanic Analysis
C - Avifauna and Feral Mammal Analysis
D - Air Quality Analysis
E - Noise Analysis
F - Archaeological Analysis
G - Socio-Economic Impact Analysis
H - Fiscal Impact Analysis
I - Transportation Impact Analysis

Appendix A
Market Analysis

ANALYSIS OF MARKET POTENTIALS FOR SELECTED QUEEN LILIOUKALANI TRUST PROPERTIES LOCATED IN THE DISTRICT OF NORTH KONA, ISLAND OF HAWAII

Prepared for:

Belt Collins & Associates

November 1989

Prepared by:

Natelson·Levander·Whitney, Inc.
10960 Wilshire Boulevard, Suite 222
Los Angeles, California 90024
(213) 478-5016

TABLE OF CONTENTS

I. INTRODUCTION

The following report provides an analysis of the market potentials for 1,135 acres of land owned by Queen Lilioukalani Trust, hereinafter referred to as the QLT Property, located in the District of North Kona, County of Hawaii (Island of Hawaii), State of Hawaii. The property under investigation lies adjacent to existing urban development in the Kailua-Kona area, and straddles the Queen Kaahumanu Highway as delineated in Figure 1. The report focuses on a number of candidate land uses for this site, including both private and public sector activities. The private sector analysis includes examination of local residential, retail, office, light industrial, hotel, and visitor condominium activities. The public sector analysis includes examination of general governmental, health, education (schools and libraries), judicial, parks/recreation, police and fire service facilities requirements.

The primary products of this report are as follows:

(1) Projections of supportable space and/or land area requirements for each of the candidate land uses over the period 1990 to 2020; and
(2) Preliminary recommendations regarding feasible development approaches to the QLT Property.

As such, these investigations are intended to provide a constructive framework outlining the market opportunities and constraints which can influence land use planning and subsequent development of the property, and to aid in the preparation of public planning documents for submission to the State of Hawaii Land Use Commission and other interested agencies for reclassification of selected lands to Urban use designation.

The analysis, findings and recommendations have been developed from extensive market and related site physical research which has included:

(1) A review of socioeconomic and demographic trends both within the State of Hawaii and the County of Hawaii which impact development potentials on the property;

(2) Surveys of residential, commercial, light industrial, and resort properties throughout the County of Hawaii;

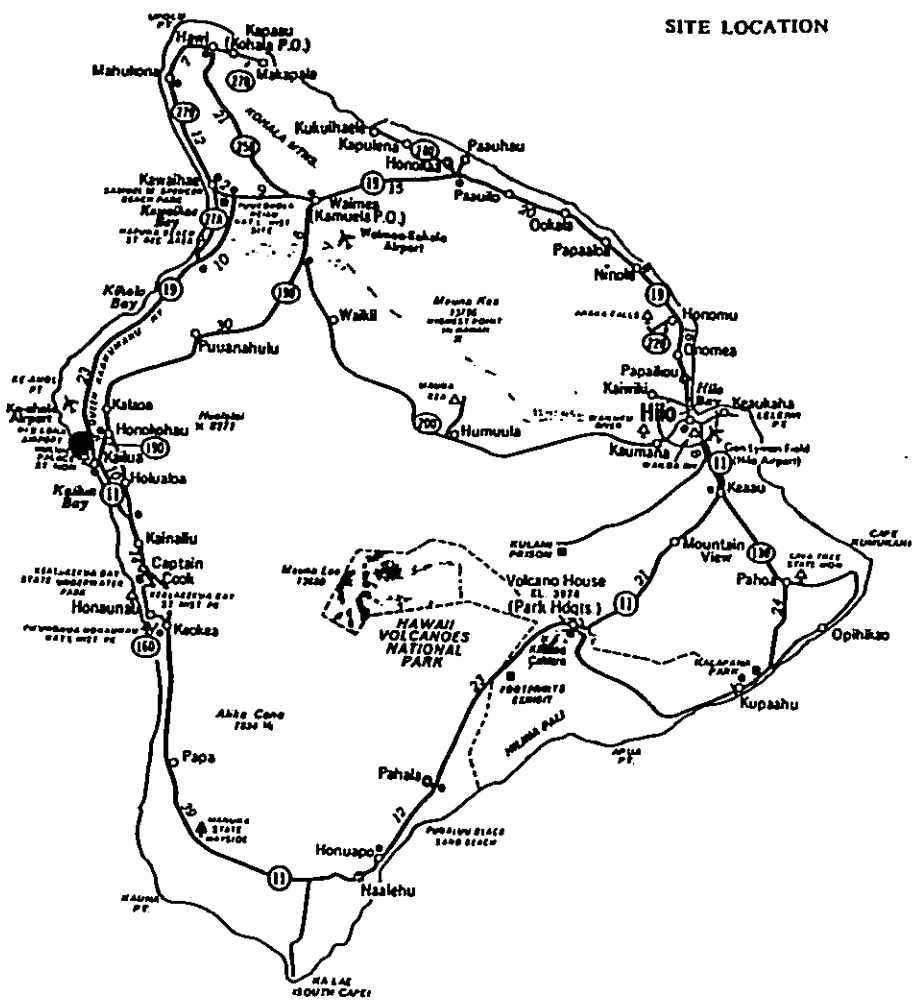
(3) Review of various public and private development plans for the County of Hawaii;

(4) Interviews with State and County officials, real estate brokers, developers, and public planning officials who are knowledgeable about development activity in the County of Hawaii, and involved with future planning of West Hawaii; and

(5) Assessment of the site's unique geographic location and physical characteristics within the Kailua-Kona market area and its major locational relationships with respect to the existing and proposed transportation network and urban development pattern.

FIGURE 1

SITE LOCATION



MAJOR DEVELOPMENT ISSUES

During the course of the study a number of development issues were identified which could impact the economic future facing the County of Hawaii in general and the QLT Property in particular. The rate of growth and success of new development in the County of Hawaii will depend to a large extent upon the successful resolution of the following issues:

1. Keahole Airport Expansion. The Keahole Airport expansion is a critical issue which faces the West Hawaii area. An expansion program must be initiated in the near future in order to support the increase in the number of travelers which will come to the Island of Hawaii as a result of the planned increase in the number of hotel and condominium facilities as well as local market-oriented commercial and industrial development.

   The Department of Transportation Airport Master Plan indicates that the Keahole Airport may be required to accommodate 4.16 million passenger emplanements and deplanements resulting from 159,000 aircraft operations by 2005. The Master Plan includes plans to design, construct, and improve airport facilities, including service/access roads, parking, aprons, runways, taxiways and utility infrastructure. The plan also calls for a 4,500 foot runway extension to allow for unrestricted service to wide body aircraft emanating from Japan and other overseas locations. There should also be greater coordination between the resorts and the major airline carriers to the Island of Hawaii. It is somewhat ironic that United Airlines chose to reduce its level of service between Kona and the west coast in the same month that the Hyatt Regency Waikoloa opened and more than doubled the number of hotel accommodations along the Kohala Coast.

2. Employee Housing. Affordable housing for the tourist-serving employee base is a critical issue facing West Hawaii, particularly since better quality hotels will be developed with relatively high employee per room service requirements. The comparatively low salaries paid to hotel and retail/restaurant service workers results in their having limited capacity to afford the diminishing supply of existing and available housing, engendering the need for programs which offer affordable (and in many cases, rental) housing which is near, but separate from, the resort areas. Failure to provide employee housing could delay hotel development, and this would result in a reduced demand for retail and other resident market-oriented convenience space.

3. Road System. An issue which should be addressed in the near future is the expansion of the Queen Kaahumanu Highway from two to four lanes. The highway is currently engineered for four lanes; delay in its widening could result in significant traffic congestion. In addition, the expansion of Palani Highway or creation of additional mauka-makai roadways should be addressed, as failure to do so could result in approval delays for that area as well as congestion during peak travel periods. Notwithstanding the expansion of the capacity of these two roadways near the site, consideration must also be given to the development of additional major regional roadways to serve the QLT Property.

REGIONAL ECONOMIC MODEL: AN OVERVIEW

The County of Hawaii exudes a dynamic economy which is undergoing such rapid transformation that it often defies reduction to a single set of numbers which accurately portray recent events. Given these conditions a great deal of attention was focused on the preparation of a regional economic model which could be used to analyze the economy and to trace the impact of rapid changes on the potential for development at the QLT Property. The basic structure of the model is portrayed in Figure 2. Following the logic of many regional economic models, the QLT Property economy will be driven by "exports" which in this case is represented by tourists coming to the area, and the subsequent sale of goods and services to these visitors. As noted in the model, tourists characteristically generate two types of demand which are important to trace for purposes of economic analysis: (1) a direct demand for hotels, residential units, retail services space and industrial activities; and, perhaps more significantly for the future of the QLT Property, (2) a direct employment component in the form of service workers, which in turn creates the potential for a local resident population with its own unique set of housing, retail, office, light industrial, institutional, recreation, and public services space requirements.

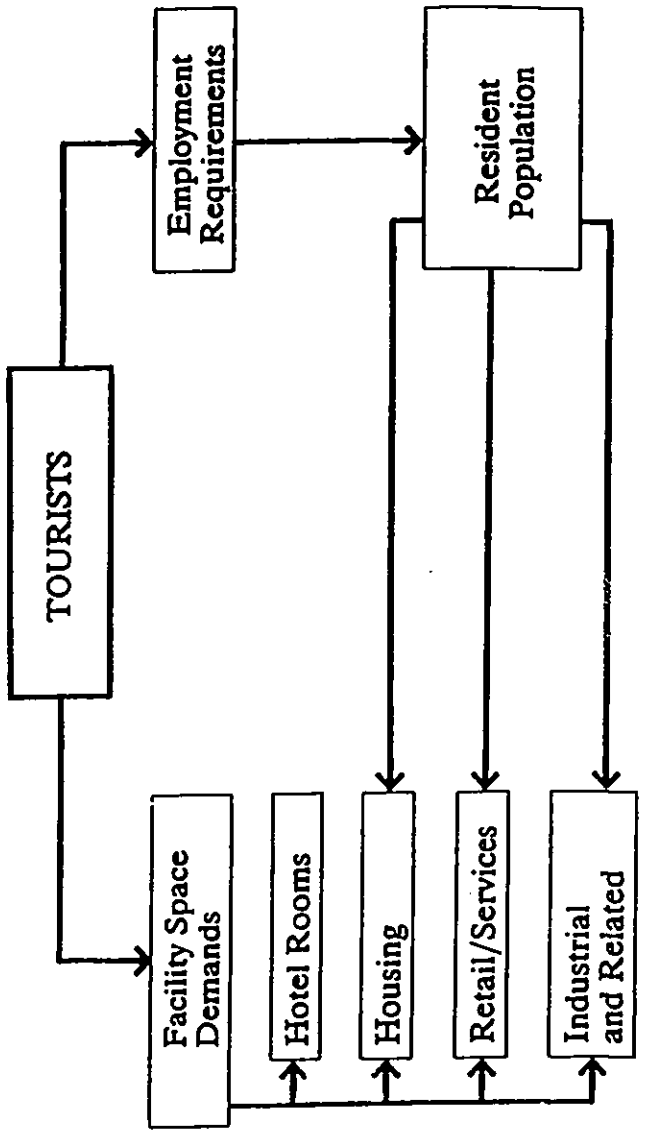
In the practical application of the model, a problem facing the analyst is in distinguishing resident from visitor demands, particularly as relates to the housing market. Baseline census data currently provide virtually no assistance in this regard, and published inventories of visitor-oriented condominium units are incomplete at best, and often understate the market share of housing which is utilized by visitors and other off-island owners. Moreover, the market is constantly in flux as units shift between serving resident and tourist needs. Consequently, the information and subsequent projections provided in this report of necessity reflect a substantial degree of professional judgement, and provide results that are felt to represent an accurate picture in the main while susceptible to further refinement as better data become available.

To further assist in the analysis, a computer-based model has been utilized which allows the interrelated projection of demand for private sector uses including local resident-oriented units, retail space, office space, light industrial space, resort hotel units, resort residential units, and resultant retail space requirements for the period 1990 to 2020. The model can provide the framework for continuous testing of future land potentials at the QLT Property under a range of optimistic and pessimistic "futures" for the County of Hawaii economy. In this fashion, it should also be possible to strengthen the forecasting process as new information is obtained regarding the local economy.

Public land use projections were determined primarily through interviews with State and County officials knowledgeable about future West Hawaii needs. When combined with socioeconomic and demographic trends, they provide the bases for the public land use forecasts presented in the report.

FIGURE 2

Diagram of Regional Economic Growth and Land Use Requirements



II. SUMMARY OF FINDINGS

The major findings regarding the market potentials for the QLT Property are as follows:

County of Hawaii and West Hawaii Economic Growth Potentials

Economic growth potential for the County of Hawaii in general and West Hawaii in particular are intrinsically linked with the visitor industry. Recent additions to the visitor plant inventory, such as the Hyatt Regency Waikoloa, as well as numerous planned projects for the County of Hawaii, suggest a positive economic future for the visitor industry. The tourist industry creates the potential for growth for a local resident population with its own set of housing, retail, light industrial, institutional, recreational, and public service space requirements.

Recent trends show rapid growth for the West Hawaii area not only in the visitor industry but also in the resident population. The Kona and South Kohala areas have replaced Hilo as the tourist center for the County of Hawaii. In 1988 West Hawaii's resident population accounted for 40.2 thousand persons, or 34.2 percent of the County total. The resident population of West Hawaii is projected by 2020 to increase to 144.2 thousand persons, or 54.7 percent of the County total. Overall, the Island of Hawaii should have a growing economy due to the expanding tourist industry. The rate of such growth in the County and in West Hawaii could be affected by how the following major development issues are resolved:

(1) Keahole Airport Expansion;
(2) Adequate supply of Employee Housing; and
(3) Expansion of existing Road System.

Residential Market Potentials

The demand for residential development on the QLT Property is determined through a review of regional market forces in the County of Hawaii as well as local trends within the immediate Kailua Kona area surrounding the property. The housing market for West Hawaii is somewhat unique as the demand for certain types of units is dominated by tourists, other short-term visitors, and part-time residents.

There is a shortage of affordable housing in the County of Hawaii. This shortage is highlighted in the West Hawaii area, particularly in North Kona and South Kohala. Given its location and amenities, the QLT has an opportunity to provide affordable housing.

Cumulative demand for new housing in West Hawaii is projected at 41,452 units over the next 32 years. An aggressive residential development program on the QLT Property can reasonably expect to capture approximately 15% of this demand or 6,247 units, by type as follows: 4,984 single-family units and 1,263 multiple-family units.

Commercial Retail Potentials

The market potential for retail goods and supportable retail space is primarily a function of market area population, personal income, and that proportion of income which is spent for various retail goods. Consideration was given to resident and

tourist generated demand. The Primary Market Area for the QLT Property was defined as the geographic area coterminous the North Kona Judicial District. The Secondary Market Area was defined as the combined area represented by the North Kohala, South Kohala, and South Kona Judicial Districts.

The 1988 total capturable sales in West Hawaii was estimated at $244.7 million. This figure is anticipated by 2020 to reach $1.1 billion annually as measured in 1988 constant dollars.

The QLT Property has the potential to capture 35 percent of the increase in retail demand in West Hawaii. At this capture rate an additional 959,979 square feet of gross leasable area will be supportable at the QLT Property by 2020.

The QLT Property should be able to support four major retail centers by 2020: 1) a regional shopping center with two to three major department stores providing a total of 400,000 to 500,000 square feet of gross leasable area; 2) two community/ neighborhood centers each offering a major drugstore and supermarket as anchor tenants ranging in size from 100,000 to 125,000 square feet; 3) a heavy commercial/ automobile-related center on 25 to 30 acres.

Office Space Potentials

The demand for office space was determined through an examination of current and future market forces as well as a review of the current supply of office space in North Kona. Given the recent and anticipated growth of the West Hawaii area, there exists a strong demand for office space in the area. The anticipated growth for the West Hawaii will undoubtedly require that governmental facilities be offered in the area.

The QLT Property has excellent potential to provide office space. The site is located near employee generating areas such as the Airport, the Kona Industrial subdivision, and the Kona Central Business district. There is also an opportunity to work with the County to provide a West Hawaii Civic Center/Government facility. By 2020 the QLT Property should be able to support 487 thousand square feet of office space.

Industrial Market Potentials

The potential for development of major industrial activities in the County of Hawaii in the immediate future appear to be limited. While West Hawaii is unlikely to emerge as major industrial manufacturing center there is a mix of activities which should engender a substantial demand for industrial land. Those businesses which should require industrial land in the future include:

- o Automobile-oriented activities servicing both local residents and visitors;
- o Wholesalers serving retail, restaurant and hotel operators who need warehousing facilities;

- o Cottage industries such as traditional handicrafts, sports equipment, and apparel manufacturing;
- o Businesses providing services and supplies to the building industry;
- o Contract construction storage yards and other storage facilities, including public storage; and
- o Local consumer-oriented businesses.

The QLT Property has a number of locational advantages which make it a desirable site for industrial activities. A total of 100 acres should be reserved for industrial uses on the property, with the phasing of development coordinated with the absorption of the second phase of the Kona Industrial Park.

Hotel Market Potentials

Hotel development potentials on the QLT Property are limited due to its lack of a waterfront location and the likelihood that the surrounding development would have a commercial/industrial character. Given these constraints the market focus for hotel facilities would be placed on business travelers and on Hawaiian residents seeking convenience and economy in their accommodations. A well-conceived project offering moderate prices, access to a golf course, meeting rooms/conference facilities, immediate proximity to Kailua-Kona business centers, and other special services to business persons should be able to capture the equivalent of 1.5% to 2.0% of West Hawaii demand for visitor accommodations. At an occupancy rate of 80% annually, this level of demand would support between 128 and 171 rooms by 2005 and between 201 and 268 rooms by the Year 2020. Land requirements for this use should range from 10 to 15 acres.

Public and Institutional Lands Analysis

The following public and institutional uses are recommended for the QLT Property:

- o A civic center complex of at least 20 acres which includes a mix of State and County functions. Important components of this complex would include the following:
  - Fire station;
  - Library;
  - District, circuit and family courts;
  - District attorney and related functions;
  - Police station and detention facilities if the present location proves unsuitable;
  - Various State offices for social services, welfare and other functions; and
  - County general administrative offices serving West Hawaii.
- o Three different schools, including:
  - One elementary school with an adjacent park, totaling 15 acres;
  - One high school which, given the likely topography, will need 40 acres; and
  - A University of Hawaii campus with at least 200 acres.

- o A medical center complex of 20 acres which would feature an acute general care hospital with at least 120 beds utilizing 10 acres and surrounded by support facilities such as convalescent/retirement homes, clinics/out-patient services, and medical offices.

- o Recreation and open space uses totaling 260 acres, including:

  - A 100-acre regional sports complex;
  - A 150-acre public golf course oriented to local residents; and
  - Two five-acre neighborhood parks, one of which would be sited together with an elementary school.

III. PRIVATE SECTOR ANALYSIS

A. ANALYSIS OF RESIDENTIAL MARKET POTENTIALS

The following section evaluates the market potential for residential development on the QLT Property. This demand is determined from a review of regional market forces on the Island of Hawaii as well as local trends within the immediate Kailua-Kona area surrounding the property, and includes an assessment of large-scale competing residential development programs as well as the small lot filling in process occurring in established, residential neighborhoods.

The demand for housing at a specific location characteristically is determined by the following major factors:

1. An area's population base and rate of growth, which in the case of West Hawaii requires consideration of both permanent and part-time residents;

2. Household formation rates as a result of local population trends;

3. The socioeconomic characteristics of both permanent and part-time residents;

4. The size, composition and quality of the area's existing housing stock;

5. The access and amenity attributes of the property and its immediate surroundings; and

6. The presence or absence of favorable neighborhood attributes such as schools, major employers, shopping opportunities, recreation opportunities, or other activity generators.

The analysis first examines the major components of housing demand as they have developed on the Island of Hawaii generally, then reviews the QLT Property and its unique potentials within both the larger regional and local market contexts.

Regional Market Area Definition

For this analysis the regional housing market area for the QLT Property has been defined as encompassing the entire Island of Hawaii (County of Hawaii).

Socioeconomic Conditions

General Characteristics

The Island of Hawaii is the largest of the Hawaiian Islands. According to the Hawaii Department of Business and Economic Development (DBED) in 1980 the Island contained 4,034 square miles of land area or nearly 63 percent of the State total.

The settlement of the Island has been strongly influenced by five large shield volcanos (Mauna Loa, Mauna Kea, Kohala, Kilauea, and Hualalai) which create a very diversified climate. The windward side of the Island is wet, with rain exceeding 300

inches per year in some areas. The leeward side of the Island is mostly dry, with some locations considered to be approaching desert conditions while experiencing rainfall averaging under eight inches annually.

Because of the favorable climate, agricultural lands on the windward side of the Island have been used for sugar production. The deep water harbor at Hilo has historically made this area the primary center of population. Hilo also became the primary port for the trans-shipment of sugar to the west coast, and flourished as the seat of county government and a center for tourism.

The dry climate of the leeward side of the Island is ideal for ranching activities, resulting in the growth of Parker Ranch and other holdings centered around Waimea. To the south, coffee production historically was a major influence in the development of the Kona region; more recently, this area has been strongly influenced by the tourist industry, fishing and oceanographic activities.

The U.S. Census Bureau reported that the Island's resident population was 92,053 persons in 1980. The Hawaii County Department of Research and Development (DRD) estimates that the population had increased to 117,461 persons by 1988, which represents nearly a 28 percent increase over the eight year period. The DBED projects that by 2005 the Island's population will reach 180,800 persons, thus nearly doubling its 1980 population in 25 years. The Island's population is projected to reach 263,800 persons by 2020.

The Hawaii State Department of Labor and Industrial Relations (DLIR) reported that the civilian labor force had seen increases in the number of people employed and decreases in the percentage of people unemployed during the 1980s. The U.S. Census Bureau reported that in 1980 civilian labor force numbered 41,006 persons with a 7.0 percent unemployment rate. The DLIR reported that in 1987 civilian employment had increased to 51,050 persons with only a 5.7 percent unemployment rate. Recent growth in the construction industry has undoubtedly resulted in a further lowering of the unemployment rate as of mid-1989.

Economic Sector Analysis

The following paragraphs briefly review the major economic sectors in the County of Hawaii which provide the context for development of the QLT Property.

Tourism

After years of slow growth tourism has established itself as a major economic factor along the western coast of the Island. The future for tourism on the Island appears to be positive with the recent opening of the Hyatt Regency Waikoloa and the numerous planned projects for the Kohala and Kona coastal areas. According to the Hawaii Visitors Bureau (HVB) Visitor Plant Inventory as of February 1989 the existing visitor plant totalled 8,171 units which are spread between 5,994 hotel units and 2,167 condominium units. According to the HVB the Island has the most planned hotel and condominium projects of all the Hawaiian Islands. Total announced projects call for development of an additional 21,124 hotel units and 24,135 condominium units. These figures may be somewhat optimistic, but they demonstrate the enormous current interest in the expansion of tourism on the Island of Hawaii.

Another indicator of the growing strength of tourism on the Island has been the increase in visitor expenditures. The HVB estimated that 1987 visitor expenditures totalled $381.8 million, more than double the 1980 figure of $187.6 million. After allowance for inflation, the net real growth in tourist spending has averaged 10.7 percent annually over the most recent seven-year period for which data are available.

The annual number of visitors has also increased somewhat during the 1980s. In 1981 672.7 thousand Westbound tourists reached the Island. In 1988 it is estimated that 787.9 thousand Westbound tourists visited the Island. This represents a growth in tourist visitation of 2.3 percent annually over the period of investigation.

Sugar

The closing of sugar mills such as the Puna Sugar Company in September of 1984 has resulted in a decrease in the Island's production of sugar and slight reductions in agricultural employment. The DBED reported that in 1984 the Island produced 3.4 million tons of unprocessed cane. By 1987 that figure had decreased to just under 2.6 million tons of unprocessed cane.

Diversified Agriculture

The reduction in the production of sugar has resulted in efforts to increase the production of diversified crops. An example of this redirection can be seen in the production of Macadamia nuts, which has increased from 37.5 million pounds in 1984 to 41.3 million pounds in 1987.

Ranching

The number of livestock operations on the Island has remained relatively constant since 1984, although the number of cattle operations did decrease somewhat from 395 operations in 1984 to 380 operations in 1987. This decrease was offset by the volume of cattle marketing which increased from 20.9 million pounds in 1984 to over 25.9 million pounds in 1987.

High Technology

The importance of high technology on the Island has increased, as evidenced by the expansion of observatories atop Mauna Kea and development of support facilities in Waimea and Hilo. In addition, the Natural Energy Laboratory of Hawaii (NELH) has pushed forward on the commercialization of aquaculture projects. Successful operations are also moving or expanding into the Hawaii Ocean Science Technology (HOST) Park located at Keahole Point.

Regional Population Trends

The historic and projected population and household characteristics of the County of Hawaii residents are primary influences in the determination of the potential for future development on the QLT Property. The County of Hawaii has experienced significant population growth in the 1970s and 1980s after a period of actual decline during the 1950s and a virtually dormant period during the decade of the 1960s. As

shown in Table 1 the County has reversed the trend where it represented a declining percentage of the State's total population. The County has increased its share of total State residents from a low of 8.3 percent in 1970 to 10.7 percent by 1988. Between 1970 and 1988 the population in the County rose from 63.5 thousand persons to 117.5 thousand persons, a net increase of 54.0 thousand persons or 3,000 persons annually in 18 years. The annual growth rate for the population in the County from 1970 to 1980 was 3.8 percent; from 1980 to 1988 3.1 percent. In comparison, the annual growth rate for the State of Hawaii from 1970 to 1980 was 2.3 percent; and from 1980 to 1988, 1.6 percent.

Table 2(a) presents population for the County of Hawaii at selected dates between 1960 and 1988. The data further illustrate the recent surge of population growth in the County, which in the last eight years has averaged nearly 3,175 persons per year.

Table 2(b) presents population projections for the period 1988 to 2020 for the County of Hawaii. The County's population is projected to reach 263.8 thousand persons in 2020, according to the DBED's preferred population projection Series M-K report. The projection represents an increase of 146.3 thousand persons from the 1988 level of 117.5 thousand persons, and a composite growth rate from 1988 to 2020 of 2.6 percent or 4,572 persons annually. By component period the average annual growth rate for the County for the seven year between 1988 to 1995 is projected to be 2.8 percent or 3,571 persons annually; from 1995 to 2005 the annual growth rate is projected at 2.4 percent or 3,830 persons annually; and from 2005 to 2020 the annual growth rate is projected at 2.6 percent or 5,533 persons annually.

Household Size

Household size is a measure of the average number of persons living in an occupied dwelling unit within a given market area. Household size, a key determinant of housing requirements for a given population, has been declining in the County of Hawaii since 1970. Table 3 shows the trends in average household size for the period 1970 to 1988. In 1980 the ratio of population residing in households to total occupied dwelling units was 3.09 to one, a reduction of 16.8 percent below the household size figure of 3.61 persons per occupied unit recorded in 1970. This trend has continued through the 1980s. As of 1988 the ratio of population residing in households to total occupied dwelling units was estimated to have fallen to 3.08 persons per dwelling unit. The decline in household size is consistent with national patterns, and reflects socioeconomic trends toward smaller families, an older population, fewer families as a percent of total households, and delays in family formation and childbearing.

One major result of this trend toward smaller households has been an increased demand for housing per unit of population. In effect, even if significant population growth does not occur, high household formation rates resulting from the continuing decline in household size may result in a steady demand for new housing. As an example, in a given market with a fixed population of 1,000 persons, if the household size changes from 3.5 persons per unit to 3.0 persons per unit the effective demand for housing increases from 286 units to 333 units, an increase of 47 units, even though population has not changed. This computation is shown below.

Table 1
HISTORIC POPULATION TRENDS
STATE OF HAWAII AND COUNTY OF HAWAII
1950-1988
(Rounded to the Nearest Hundred)

Area	1950	1960	Net Change, 1950-1960 Number	Annual Percent
State of Hawaii	499,800	632,800	133,000	2.39%
County of Hawaii	68,400	61,300	(7,100)	-1.09%
County as Percent of State	13.69%	9.69%		

Area	1960	1970	Net Change, 1960-1970 Number	Annual Percent
State of Hawaii	632,800	769,900	137,100	1.98%
County of Hawaii	61,300	63,500	2,200	0.35%
County as Percent of State	9.69%	8.25%		

Area	1970	1980	Net Change, 1970-1980 Number	Annual Percent
State of Hawaii	769,900	964,700	194,800	2.28%
County of Hawaii	63,500	92,100	28,600	3.79%
County as Percent of State	8.25%	9.55%		

Area	1980	1988	Net Change, 1980-1988 Number	Annual Percent
State of Hawaii	964,700	1,098,200	133,500	1.63%
County of Hawaii	92,100	117,500	25,400	3.89%
County as Percent of State	9.55%	10.78%		

Sources: DBED (Data Book 1988, Table 41; M.M.

Note: Figures are for April 1 of year noted except 1988, which was taken on July 1.

Table 2 (a)
HISTORIC POPULATION GROWTH, COUNTY OF HAWAII
1960-1988

	1960	1970	1980	1985	1988	Net Change, 1960-1988 Number	Annual
County of Hawaii	61,300	63,500	92,100	109,500	117,500	56,200	2.3%

Sources: DBED (Data Book 1988, Table 4; M-K Series, Table 61; M.M.

Note: Figure for 1980 is a measure taken as of April 1, while figures for 1985 and 1988 are as of July 1.

Table 2 (b)
PROJECTED POPULATION GROWTH, COUNTY OF HAWAII
1988-2020

	1988	1990	1995	2000	2005	2010	2015	2020	Net Change, 1988-2020 Number	Annual
County of Hawaii	117,500	121,600	142,500	160,400	180,800	206,100	233,200	263,800	146,300	2.5%

Table 3
TRENDS IN AVERAGE HOUSEHOLD SIZE AS MEASURED
BY AVERAGE PERSONS PER OCCUPIED UNIT
COUNTY OF HAWAII
1970, 1980, 1988

Year	Number of Households	Persons Per Household	Net Change, 1960-1970 Number	Annual Percent
1970	17,260	3.61		
1980	29,237	3.09	(0.52)	(1.53)
1988	37,386	3.08	(0.01)	(0.05)

Sources: U.S. Censes 1970, 1980; DBED (Data Book 1988, Table 34); M.M.

Note: Figures for 1970 and 1980 are as of April 1 while figure for 1988 is as of July 1.

Housing Demand for 1,000 Residents with Household Size @ 3.5 persons per unit:	1,000 ÷ 3.5 =	286 units
Housing Demand for 1,000 Residents with Household Size @ 3.0 persons per unit	1,000 ÷ 3.0 =	333 units
Net change in Housing Demand, with Constant Population of 1,000 Residents and Change in Household Size from 3.5 to 3.0 persons per unit		47 units

Regional Housing Trends

The housing market for the County of Hawaii is somewhat unique insofar as the demand for certain types of units is dominated by tourists, other short-term visitors, and part-time residents. Given the large number of units which can be occupied by residents or visitors, past and present data collected by the HVB regarding the number of condominium units devoted to short-term use is often understated. As such, field surveys were conducted in order to adjust HVB data for use in assessing the current distribution of condominium units between the visitor and local resident market.

Table 4 presents the change in dwelling unit inventory for the County of Hawaii from 1970 to 1988. In 1970 the total housing unit inventory stood at 18,972 units with a total of 17,260 occupied dwelling units. The total housing unit inventory consisted of 16,671 single-family homes, or 87.9 percent, and 2,300 multiple-family units, or 12.1 percent. In 1980 the total housing unit inventory stood at 34,215 units with 29,237 occupied dwelling units. The total housing unit inventory consisted of 25,396 single-family units, or 74.2 percent, and 8,819 multiple-family units, or 25.8 percent. Finally, it is estimated that in 1988 the housing unit inventory totalled 44,700 units with a total of 37,386 occupied dwelling units. Of the total housing inventory 33,494, or 74.9 percent, were single-family homes and 11,206, or 25.1 percent were multiple-family homes.

Housing Absorption Rates

Housing absorption rates measure the rate of change in occupied housing units per 1,000 change in resident population. Table 5(a) shows the housing absorption rate for the County of Hawaii from 1970 to 1980, with the same information for the periods 1980 to 1988 and 1970 to 1988 provided in Tables 5(b) and 5(c). The total population residing in households increased from 62.3 thousand persons in 1970 to 115.1 thousand persons in 1988. During the same period the number of resident-occupied dwelling units increased from 17.3 thousand units to 37.4 thousand units. The comparison of these two rates of change indicate that 381 dwelling units were absorbed per each 1,000 resident population change over the last 18 years for the County of Hawaii. In effect, one new dwelling unit was required for every 2.6 new full-time residents.

Projected Demand for New Resident-Oriented Housing, County of Hawaii

Based upon the 1970 to 1988 absorption rate the resident demand for new housing for the County of Hawaii is projected to reach 91,994 units by the year 2020 as shown in

Table 4
CHANGE IN DWELLING UNIT INVENTORY, COUNTY OF HAWAII
1980-1988

	1970	1980	1988
Total Housing Units	18,972	34,215	44,700
Occupied Dwelling Units	17,260	29,237	37,386
Vacant	9.0%	14.5%	16.4%
Unit Type			
Single Family	16,671	25,396	34,419
Multiple Family	2,301	8,819	10,281
Persons Per Occupied Dwelling Unit	3.61	3.89	3.08

Sources: U.S. Census 1980; County of Hawaii Planning Department; M.W.

Table 5 (a)
HOUSING ABSORPTION RATE
COUNTY OF HAWAII
1970-1988

	1970	1988	Change in Dwelling Units Per 1,000 Population Change
Persons in Occupied Dwelling Units	62,389	98,436	426
Occupied Dwelling Units	17,260	29,237	

Table 5 (b)
HOUSING ABSORPTION RATE
COUNTY OF HAWAII
1988-1968

	1988	1968	Change in Dwelling Units Per 1,000 Population Change
Persons in Occupied Dwelling Units	98,436	115,149	330
Occupied Dwelling Units	29,237	37,386	

Table 5 (c)
HOUSING ABSORPTION RATE
COUNTY OF HAWAII
1970-1968

	1970	1968	Change in Dwelling Units Per 1,000 Population Change
Persons in Occupied Dwelling Units	62,389	115,149	381
Occupied Dwelling Units	17,260	37,386	

Sources: U.S. Census 1970, 1980; DBED (Data Book 1988, Table 341; MLM.

Note: Figures are as of April 1 of year noted except 1988, which is as of July 1.

Table 6. This projection represents a net increase in demand of 54,608 units over the estimated 1988 resident-occupied inventory of 37,386 units. After allowance is made for (1) the replacement of obsolete units at a rate of 45 units per year and (2) a five percent vacancy rate, the new net housing requirement for the period 1988 to 2020 is projected to be a total of 58,779 units or 1,837 units per year.

The resident demand for housing units for the County of Hawaii may be distributed by period as follows:

COUNTY OF HAWAII RESIDENT HOUSING REQUIREMENTS
1988 - 2020

Period	Total Units	Annual Units
1988-1990	2,873	1,436
1990-1995	7,240	1,448
1995-2000	7,240	1,448
2000-2005	8,220	1,644
2005-2010	10,141	2,028
2010-2015	10,846	2,169
2015-2020	12,218	2,444
Grand Total	58,779	1,837

Socioeconomic profile analysis and field investigations, together with recent sale characteristics of new resident product suggest that there is a substantial pent-up demand for affordable housing for the County of Hawaii's residents. Discussions with public planning officials, developers, and real estate brokers further confirm that demand. In order to meet that demand the State plans to provide 4,000 affordable units at the Kealakehe site which is adjacent to the QLT Property. Notwithstanding the provision of these units, there will continue to be a shortage of affordable housing as a large number of planned visitor units get constructed.

West Hawaii Market Area Definition

The local housing market area for the QLT Property encompasses a geographic locale which may be referred to as West Hawaii. Geographically and statistically the West Hawaii housing market area is coterminous with census tracts 213 through 218, and includes County jurisdictions of North Kona, South Kona, North Kohala, and South Kohala as delineated in Figure 3.

Socioeconomic Conditions

General Characteristics

North Kohala until recently was dominated by economic activities related to sugar cane production. The area, comprised of the six towns of Hawi, Kapaau, Halaula, Makapala, Halawa, and Niulii, in the past had hosted numerous sugar mills, the last

Table 6
PROJECTED DEMAND FOR NEW RESIDENT-ORIENTED HOUSING, COUNTY OF HAWAII
1968-2020

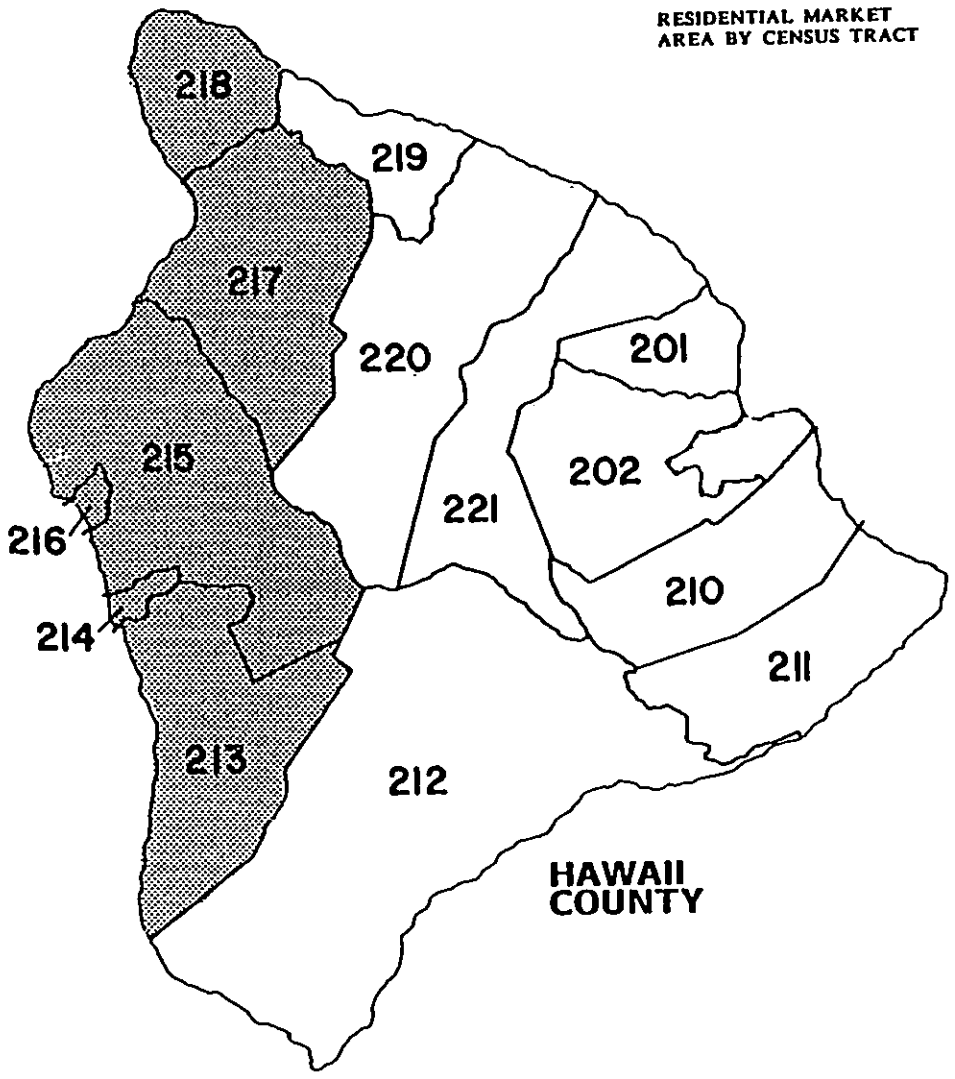
		1968	1970	1975	2000	2005	2010	2015	2020
Total Population in Households		115,149	122,187	139,649	157,198	177,182	201,976	228,534	258,521
Potential Occupied Dwelling Units (1)		37,386	40,836	46,718	53,399	61,014	70,457	80,572	91,994
			1968-1970	1970-1975	1975-2000	2000-2005	2005-2010	2010-2015	2015-2020
Incremental Demand For New Housing			2,650	6,681	6,681	7,615	9,444	10,115	11,422
Add: Allowance for Vacancy Rate @	5.00%		133	334	334	381	472	506	571
Add: Replacement of Obsolete Units @	45 Per Year		90	225	225	225	225	225	225
Total Increase in Resident-Oriented Housing Per Period			2,873	7,240	7,240	8,220	10,141	10,846	12,218
	Annual		1,436	1,448	1,448	1,644	2,028	2,169	2,444
Cumulative Increase			2,873	10,113	17,354	25,574	35,715	46,561	58,779

(1) - Based upon 1970-1968 absorption rate.

Sources: DBED (Data Book 1968, Table 618); U.S. Census; M.M.

FIGURE 3

RESIDENTIAL MARKET AREA BY CENSUS TRACT



of which closed in 1975. North Kohala is characterized by its ethnically varied population, a result of the waves of immigrants that were brought in to cultivate the sugar cane grown in the local area.

South Kohala consists of both the high plains of the Kohala mountain foothills and the dry coastal area which includes the residential communities of Puako, Kawaihae Village, and Waikoloa Village. The area is dominated by Parker Ranch which consists of 223,000 owned and leased acres of land. The area represents a relatively homogeneous community with the exception of descendants of Paniolos (Spanish Cowboys) which were originally brought to the ranch by its founder. Recently, there has been an influx of second home owners, young professionals and resort workers who prefer the cooler climate and unique setting offered by the town of Waimea.

The Kona area was strongly influenced by ranching activities and coffee production through most of this century. However, with the instability of the international coffee market and the introduction of jet service to the islands, the Kona coastline began to host numerous visitors. This trend has continued, and the area has become a resort destination which is the dominant tourist center on the Island.

The U.S. Census Bureau reported that the Primary Study Area (PSA) had a population of 27,518 persons in 1980. North Kona accounted for 50.0 percent of the total with 13,748 persons, while North Kohala totalled 3,249 persons, South Kohala totalled 4,607 persons, and South Kona totalled 5,914. The DRD estimates that the 1988 population of the PSA increased to 40,240 persons, a 46.2 percent increase over the 1980 figure. North Kona experienced significant growth as the population reached 21,484 persons, a 56.3 percent increase over the 1980 figure. Similarly, South Kohala also grew rapidly, as the population reached 7,562 persons, a 64.1 percent increase since 1980. South Kona was estimated to have a population of 7,504 persons, a 26.9 percent increase over the 1980 figure. In contrast, the North Kohala area, which has been somewhat removed from tourist development, achieved more modest growth, with its population reaching 3,690 persons during the same period for a 13.5 percent increase.

Economic Sector Analysis, PSA

The following paragraphs briefly review the major economic sectors in the PSA.

Tourism

Since the 1960s tourism has played an increasingly important role in the local economy of the PSA. Resort development began in North Kona, and has spread more recently to the South Kohala area. Several master planned resorts have been developed in the area. The resorts include the following:

South Kohala	North Kona
Mauna Kea	Kailua-Kona
Mauna Lani	Kona at Keauhou
Waikoloa Beach Resort	Kona Village

The North Kona/South Kohala coastal area has emerged as the new center of the tourist industry on the Island, replacing Hilo as the dominant focus for visitor activity. According to the HVB Visitor Plant Inventory, as of February 1989 the visitor plant inventory for the PSA accounted for 6,825 visitor units or 83.5 percent of the Island's current total.

Sugar

Overall, sugar production in the PSA has decreased recently. North Kohala originally developed as a sugar production and processing area until the last mill closed in 1975. Since that time the area has experienced significant population losses and relatively high unemployment rates. The area is now supported primarily by small scale agricultural and retail activities.

Diversified Agriculture

Diversified agriculture has played an important role in the economic development of the PSA. Coffee production served as North Kona's primary export economic base for many years; however, international market fluctuations have recently reduced its role. The production of Macadamia nuts has increased in such areas as North Kohala, while the production of vegetable crops such as celery, cabbages, and lettuce has increased in the area around Waimea.

Ranching

Although tourism has passed cattle operations as the leading economic activity in South Kohala, ranching continues to play an important role in the area, led by the Parker Ranch headquartered in Waimea. In addition to ranching and tourism, South Kohala is supported by vegetable crops, truck farming, retail establishments and second home industries.

High Technology

High technology industries in the PSA include the support facilities for the observatories on Mauna Kea, the Natural Energy Laboratory of Hawaii (NELH) and the Hawaii Ocean Science Technology (HOST) Park located at Keahole Point.

Shipping

Shipping plays an important role in the PSA. Kawaihae Harbor is a deep water harbor located in South Kohala. In 1985 the harbor handled 493 million tons of cargo according to the Hawaii State Department of Transportation. The harbor receives and ships general cargo, bulk sugar, molasses, lava cinders, petroleum products, and bulk fertilizers.

Construction

The release of lands by the Parker Ranch has resulted in the development of numerous residential subdivisions in Waimea. The availability of Hawaiian Homestead lands has

also resulted in increased residential development. More recently, the construction of visitor plants such as the Hyatt Regency Waikoloa has resulted in significant employment increases within that sector of the economy, and further fueled the demand for residential units in the PSA.

Population and Housing Growth Trends

Between 1970 and 1980 West Hawaii's population nearly doubled, growing from 14,472 persons to 27,518 persons. This growth represented an annual increase of 6.6%. The dwelling unit inventory grew at an even faster rate, expanding from 4,845 units to 12,091 units and realizing an annual percentage growth of 9.6%. As of 1980 West Hawaii contained 29.9% of the County's total population and 35.3% of its total housing inventory.

Table 7 presents the comparative population and housing growth for all of West Hawaii, the District of North Kona and the remainder of the West Hawaii area. The North Kona district consists of census tracts 215 and 216, while the remainder of West Hawaii consists of tracts 213, 214, 217 and 218. The data indicate that North Kona has been the major focal point for development in the region. Between 1970 and 1980 North Kona received nearly 70% of the region's population and housing increase. While North Kona was expanding at the rate of 892 persons and 494 units on an annual basis, the rest of West Hawaii achieved more modest growth of 413 persons and 229 units on an annual basis. Correspondingly, by 1980 North Kona's market share of the West Hawaii population was nearly 50.0%; its share of the regional housing market stood at 57.3%.

West Hawaii Population Growth Projections

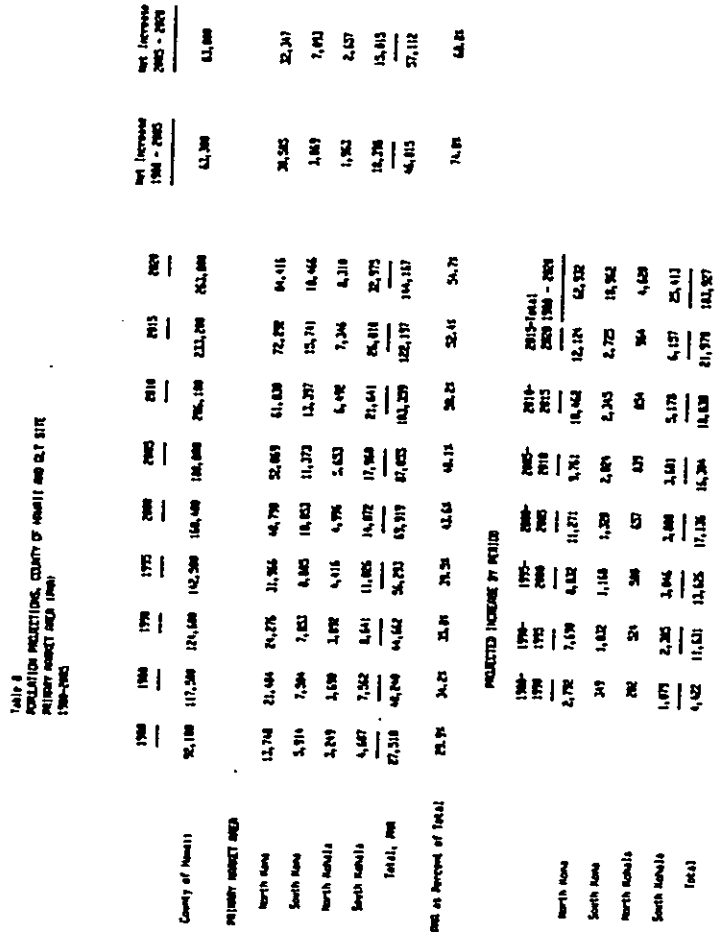
Given the continued expansion of tourist industries planned for the North Kona and South Kohala areas, West Hawaii's market share of the County's overall population should continue to increase through 2020. The County's most recent population estimate indicates that West Hawaii had grown to 40,240 persons in 1988. Forecasts prepared by NLW and the DBED suggest that West Hawaii's overall population should reach 56.3 thousand persons in 1995 and 87.1 thousand persons in 2005 as shown in Table 8. West Hawaii's share of total Island population should reach 48.1 percent in 2005 as compared to its 1988 share of 34.3 percent. Over the 17-year projection period the QLT site's primary market area of West Hawaii is thus expected to increase its population by 46.8 thousand persons, capturing roughly 74 percent of the total anticipated population growth on the Island. On an annual basis the number of new residents in West Hawaii is anticipated to be 2,293 persons between 1988 and 1995 and 3,076 persons between 1995 and 2005.

Table 8 also provides a projection of population growth in the PMA for the period 2005 to 2020. During that 15-year period the West Hawaii PMA is projected to expand from 87.1 thousand persons to 144.2 thousand persons, a net gain of 57.1 thousand persons, or 3,807 persons annually. The projections reflect the DBED's view that West Hawaii will show significant population growth with the development of the numerous planned projects.

Table 7
COMPARATIVE POPULATION AND HOUSING GROWTH, WEST HAWAII, NORTH KONA DISTRICT AND REMAINDER OF WEST HAWAII PMA 1970-1980

			Net Change, 1970-1980	
North Kona Area (Tracts 215 & 216)	1970	1980	Number	Annual Percent
Population	4,832	13,748	8,916	11.02%
Housing Units	1,982	6,923	4,941	13.32%
Remainder of West Hawaii (Tracts 213, 214, 217 & 218)				
Population	9,640	13,770	4,130	3.63%
Housing Units	2,878	5,168	2,290	6.03%
Total, West Hawaii				
Population	14,472	27,518	13,046	6.64%
Housing Units	4,860	12,091	7,231	9.54%
North Kona as a Share of West Hawaii				
Population	33.39%	49.96%		
Housing Units	40.78%	57.26%		

Sources: U.S. Census 1970 and 1980; NLW.



Within the West Hawaii Market Area, population growth should be fairly concentrated within the immediate vicinity of the QLT Property. As shown in Table 8, of the 46,815-person projected population increase for the period 1988-2005, 30,585 persons or 65 percent of the anticipated increase is forecasted for North Kona. Similarly, between 2005 and 2020 North Kona is projected to capture 32,347 persons or 56.7 percent of the total increase in West Hawaii.

Housing Market Trends, West Hawaii

There is limited information currently available which provides a comprehensive overview to the existing housing stock in the West Hawaii market area which is occupied by the resident market population. Given this lack of information it is necessary to portray the current market from inferences derived from 1980 census data and building permit data for the entire County of Hawaii housing market area.

Dwelling Units by Unit Type, 1980

In 1980 the total dwelling unit inventory for the Island of Hawaii stood at 34,215 units, distributed by unit type as follows:

Unit Type	Number	Percent Distribution
Single-Family	25,396	74.2%
Multiple-Family	8,819	25.8
Total	34,215	100.0

In contrast, the distribution of units by type in West Hawaii was as follows:

Unit Type	Number	Percent Distribution
Single-Family	7,811	64.6%
Multiple-Family	4,280	35.4
Total	12,091	100.0%

Changes in Dwelling Units 1980-1988

Table 9 provides building permit data for the period 1979 through 1987 for the County of Hawaii. It can be seen that single-family units have been the dominant type of unit which has been authorized during the 1980s. Allowing for unit completions to lag one year behind authorizations, of the 12,607 units authorized between 1979 and 1987 a total of 12,417 units (or 98.5%) were estimated to have been completed. Of this number, 77.2% of the units were single-family and only 22.8% were multiple-family, a distribution which virtually parallels the historic distribution between single-family and multiple-family units on an island-wide basis.

In the absence of more definitive data, it has been assumed that additions to the housing inventory in the West Hawaii PMA have paralleled those for the Island overall, yielding the following distribution of housing by type as of 1988:

Table 9
ANALYSIS OF COUNTY OF HAWAII
BUILDING PERMIT DATA, 1979 - 1988

	Total Authorized	Single Family	Multiple Family	SF as % of Total	MF as % of Total
1979	2,163	1,429	734	66.07%	33.93%
1980	1,931	1,192	739	61.73%	38.27%
1981	1,318	1,033	285	78.38%	21.62%
1982	1,054	809	245	76.76%	23.24%
1983	976	880	96	90.16%	9.84%
1984	1,091	910	181	83.41%	16.59%
1985	1,178	988	190	83.87%	16.13%
1986	1,168	1,129	39	96.66%	3.34%
1987	1,728	1,367	361	79.11%	20.89%
1988	2,189	1,715	474	78.35%	21.65%
Total	14,796	11,452	3,344	77.40%	22.60%
1979 - 1987	12,607	9,737	2,870	77.23%	22.77%

	Total Dwelling Units	Change By Year
1979	32,283	
1980	34,215	1,932
1981	36,180	1,965
1982	37,738	1,558
1983	38,702	964
1984	39,763	1,061
1985	40,820	1,057
1986	41,944	1,124
1987	43,756	1,812
1988	44,700	944
Change, 1980-1987	12,417	12,417

Source: Bank of Hawaii, Construction in Hawaii, 1989.

Unit Type	Number	Percent Distribution
Single-Family	11,823	66.3%
Multiple-Family	6,000	33.7
Total	17,823	100.0%

Demand For Permanent Resident Housing, West Hawaii

The number of new resident-oriented dwelling units required to support anticipated population growth in the West Hawaii market area between 1988 and 2020 is projected to be 41,452 units or 1,295 units per year. This requirement is based upon DBED population forecasts and application of the 1970 to 1988 unit absorption rate in the local area, with allowance for (1) replacement of obsolete structures at a rate of 23 units per year and (2) a five percent vacancy rate in new units. The replacement of obsolete structures is based on a weighted average of historic County trends. These projections are distributed by time period as follows:

WEST HAWAII PMA RESIDENT HOUSING REQUIREMENTS
1988 - 2005

Period	Total Units	Annual Units
1988-1990	1,778	889
1990-1995	4,671	934
1995-2000	5,453	1,091
2000-2005	6,829	1,366
2005-2010	6,503	1,301
2010-2015	7,495	1,499
2015-2020	8,723	1,745
Grand Total	41,452	1,295

A detailed summary by major component is provided in Table 10.

In addition to local permanent residents, visitors to West Hawaii should continue to represent a significant source of demand for units within the PMA. Projections of visitor housing requirements are developed in Section III.E. as part of a more detailed evaluation of tourism in West Hawaii. When combined, the cumulative demand for new housing as shown in Table 11 is projected at 49,510 units over the 32-year period 1988-2020, translating into an annual requirement of 1,547 units per year. These requirements units may be distributed by basic unit type as follows:

Table 10
PROJECTED LOCAL RESIDENT HOUSING DEMANDS, PMA
1988-2020

	1988	1990	1995	2000	2005	2010	2015	2020
Total Population in Households	39,435	43,768	55,167	68,520	85,313	101,291	119,752	141,282
Potential Occupied Dwelling Units (1)	16,630	18,288	22,622	27,786	34,184	40,190	47,221	55,422

		1988-1990	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Incremental Demand For New Housing		1,651	4,341	5,866	6,396	6,006	7,031	8,201
Add: Allowance for Vacancy Rate @	5.00%	83	217	254	320	304	352	410
Add: Replacement of Obsolete Units @	23 Per Year	45	113	113	113	113	113	113
Total Increase in Resident-Oriented Housing Per Period		1,778	4,671	5,453	6,829	6,583	7,495	8,723
Annual		889	934	1,091	1,366	1,301	1,499	1,745
Cumulative Increase		1,778	6,449	11,902	18,730	25,233	32,728	41,452

(1) - Based upon 1970-1988 absorption rate.

Sources: U.S. Census 1988; DBED; M.W.

Table 11
PROJECTED WEST HAWAII PMA HOUSING DEMAND
FOR BOTH LOCAL RESIDENTS AND VISITORS
1988-2020

			1988-1990	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Total Visitor Demand									
Visitor/Part-time SF		30%	186	387	359	346	355	482	463
Visitor/Part-time MF		70%	433	717	837	808	828	938	1,860
	Total		619	1,024	1,195	1,154	1,184	1,341	1,542
	Cumulative		619	1,643	2,838	3,992	5,176	6,517	8,059
Total Resident Demand									
Resident SF		80%	1,422	3,737	4,362	5,463	5,282	5,996	6,978
Resident MF		20%	356	934	1,091	1,366	1,301	1,499	1,745
	Total		1,778	4,671	5,453	6,829	6,583	7,495	8,723
	Cumulative		1,778	6,449	11,902	18,730	25,233	32,728	41,452
Distribution By Unit Type:									
Single-Family									
Visitor/Part-time			186	387	359	346	355	482	463
Resident			1,422	3,737	4,362	5,463	5,282	5,996	6,978
	Total		1,608	4,044	4,721	5,809	5,557	6,399	7,441
	Cumulative		1,608	5,652	10,373	16,182	21,739	28,138	35,579
Multiple Family (Condominium)									
Visitor/Part-time			433	717	837	808	828	938	1,860
Resident			356	934	1,091	1,366	1,301	1,499	1,745
	Total		789	1,651	1,927	2,174	2,129	2,438	2,824
	Cumulative		789	2,440	4,367	6,541	8,670	11,107	13,932
Total Demand By Period			2,397	5,695	6,648	7,983	7,686	8,836	10,266
Cumulative Demand			2,397	8,092	14,740	22,723	30,409	39,245	49,510

Source: M.W.

TOTAL WEST HAWAII HOUSING REQUIREMENTS
1988 - 2020

Unit Type	Total Units	Annual Units	Percent
Single-Family	35,579	1,112	71.9
Multiple-Family	13,932	435	28.1
Total	49,510	1,547	100.0

A more detailed presentation which indicates projected demand by major source -- resident and visitor -- is offered in Table 11.

Planned Competitive Development

The Hawaii County Planning Department provided a list of the major proposed developments as of August 1989 for the West Hawaii area. The unit counts for these projects represent the total capacity of the site. It is highly unlikely that most of these units will ever be constructed. Table 12 shows that the total number of units included in these programs is 52,401 units, with 21,532 single-family homes and 30,869 multiple-family units.

Projects most likely to occur within the next three to five years are those which currently have the required zoning. In this regard it is possible that 3,250 single-family units and 2,200 multiple-family could be constructed in that time frame. These figures do not include the 4,000+ residential unit project to be undertaken by the State. The State should be able to receive approvals more quickly than private developers, and this factor should be taken into consideration when examining the likelihood of new projects in the near future.

Potential Capture of Residential Demand, QLT Property

As previously discussed there is a shortage of affordable housing in the County of Hawaii. This shortage is highlighted in the West Hawaii area, particularly in North Kona and South Kohala. Taking into consideration the State's planned project, only 5,074 units are being planned exclusively as affordable projects. This figure represents less than 10 percent of the total units planned for West Hawaii. Affordable housing is an issue which will likely delay the development of other projects.

Given its location and amenities, the QLT Property has an opportunity to provide affordable housing. The site has close proximity to existing shopping facilities, employment centers, existing schools, and recreational opportunities such as County and State parks and beaches. In addition, the site has excellent view opportunities and access to major roadways such as Queen Kaahumanu Highway and Palani Road. Also, given its location adjacent to the State's property, the site should serve as a logical expansion area for the Kealakehe project. Furthermore, it is unlikely that an exclusive type of community could be developed next to a high density affordable project.

PLANNED RESIDENTIAL DEVELOPMENTS
WEST HAWAII RMR

Development	Developer	Single Family Acres	Single Family Units	Multiple Family Acres	Multiple Family Units	Status
Ainaloa Village	Oceanic Properties	67	150	215	3,200	Zoning Granted
Kohanaiki Resort	Kohanaiki Properties	182	350	230	2,000	General Plan Amendment (Pending County Council)
Kohala Ranch Rev. Com.	Kohala Joint Venture	370	1,050	N/A	1,320	General Plan Amendment (Comprehensive Review)
Kohau Ranch	Kohau Ranch & Shores Ltd.			N/A	416	General Plan Amendment (Comprehensive Review)
Kohala Mauka I	Kohala Mauka I					General Plan Amendment (Comprehensive Review)
State Project	State Dept. of Hi Home Lands	227	300	15	150	State Land Use Boundary Amendment Granted
Parker Ranch 20/20 Plan	Richard Smart Personal Revocable Trust	224	500	30	450	Zoning Granted
South Kohala Resort	Kohala Ko Properties	30	110	750	900	General Plan Amendment (Comprehensive Review)
Puako Mauka Residential	California-Kohala Assoc.	150	1,100	30	300	General Plan Amendment (Comprehensive Review)
Signal Puako	Signal Puako Corporation	457	2,400	N/A	2,166	Zoning Granted
Anaeho Lani	Anaeho Lani	N/A	240	N/A	2,200	Portion Zoning Granted Portion General Plan Amendment (Comprehensive Review)
Waikoloa Resort	Transcontinental					
Waikoloa Village	Transcontinental	N/A	4,815	N/A	1,441	Portion Zoning Granted Portion General Plan Amendment (Comprehensive Review)
Kaupulehu Residential	Kaupulehu Developments			150	600	State Land Use Boundary/General Plan Amendments Granted
Kona Beach Resort	Nansay Ranch	258	774	131	1,253	State Land Use Boundary/General Plan Amendments Granted
Anaeho Resort	Kohala Capital Corp.			72	300	General Plan Amendment (Pending County Council)
Oma Resort	Kohala Capital Corp.			25	200	General Plan Amendment Granted

Continued next page...

Table 12 (Continued)
PLANNED RESIDENTIAL DEVELOPMENTS
WEST HAWAII 1989

Development	Developer	Single Family Acres	Single Family Units	Multiple Family Acres	Multiple Family Units	Status
Kohana Ikl Resort	Kona Beach Dev. Venture	72	288	88	320	State Land Use Boundary/General Plan Amendments Granted
Mixed Use Res.	I-O Ltd. Partnership	375	2,186	24	240	Zoning Granted
Mixed Use Res.	Lanihau Partners			530	2,000	General Plan Amendment (Comprehensive Review)
Kealakehe Res. Comm.	HHC	1,500	4,000			Portion Zoning Granted Portion General Plan Amendment (Comprehensive Review)
Residential Community	Taiyo HI Co., Ltd.			20	240	Zone Change Pending (County Council)
Residential Community	Alii Kona Ventures	N/A	73	120	510	Subdivision Pending
Residential Community	Easton Corp.	182	215	63	475	Zoning Granted
Keahou View Estates	Taiyo HI Co., Ltd.	150	307			Zoning Granted
Keauhou Resort	Kamehameha Dev. Corp.	723	1,320	277	1,664	Portion Zoning Granted Portion State Land Use Boundary Amendment Granted
Honokohau Riviera Resort	Palace Dev. Corp.	*	632	*	1,125	State Land Use Boundary Amendment Pending
Pomaika'i Resort	C. Brewer Properties Inc.	43	80	120	1,560	Portion General Plan Amendment Granted Portion Zoning Granted
	6000 TOTAL	5,451	21,332	2,772	30,869	

(1) - A portion of 2,244 Acres.

Sources: Hawaii County Planning Department; M.A.

Another incentive to provide affordable housing lies in the County approval process. The County has indicated that projects that will provide affordable housing will likely receive approvals significantly faster than other residential projects. Given the large number of planned projects that have received some form of approval, it would appear that the approval process for a residential project other than affordable housing would encounter substantial delays.

(a) Single-Family

Table 13 presents the forecast of the potential capture of West Hawaii housing by the QLT Property from 1989 to 2020, for single-family homes. Of West Hawaii's total projected demand for housing units, the QLT Property should be able to achieve a 15% capture rate for resident-oriented single-family units. This capture rate assumes that for every six to seven units constructed in West Hawaii, the QLT Property should be able to construct one unit. Given its location and amenities discussed above, and taking into consideration the growth in population projected for North Kona, this capture rate appears reasonable. The analysis also assumes a 5% capture rate for visitor-oriented single-family units. Although the QLT Property is located near the high density tourist area of Kona, it is assumed that the QLT Property will not provide substantial tourist facilities. Rather, the site will attempt to cater to business-oriented travelers. As such, it is assumed that the site will be able to capture a modest amount of the visitor-oriented demand for West Hawaii. Over the 31-year period, 1989 to 2020, the total potential single-family units is projected at 4,984 units, or 161 units per year. The distribution of these units is projected as follows:

POTENTIAL CAPTURE OF WEST HAWAII SINGLE-FAMILY DEMAND
QLT PROPERTY
1989 TO 2020

Period	Total Units	Annual Units	Acres (5 du/ac)
1989-1990	111	111	22
1990-1995	576	115	115
1995-2000	672	134	134
2000-2005	837	167	167
2005-2010	798	160	160
2010-2015	920	184	184
2015-2020	1,070	214	214
Total	4,984	161	996

Unit Characteristics - Single Family

The QLT Property should provide affordable single-family homes ranging in price from $125,000 to $175,000 in 1989 dollars. The homes should be single-family detached units and should provide from 1,000 to 1,250 square feet of living area on lots averaging 5,000 square feet. The project should be able to achieve densities of 5 units per acre inclusive of roadways.

Table 13
PROJECTED CAPTURE OF WEST HAWAII PMA HOUSING DEMAND
BY THE QLT PROPERTY
1989-2020

		1989-1990	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
A. SINGLE FAMILY								
Visitor/Part-time	5.0%	5	15	18	17	18	20	23
Resident	15.0%	107	561	654	819	780	899	1,047
Total By Period		111	576	672	837	798	920	1,070
Annual By Period		111	115	134	167	160	184	214
Cumulative		111	687	1,359	2,196	2,994	3,914	4,984
B. MULTIPLE FAMILY								
Visitor/Part-time	(1)	4	6	7	6	7	8	9
Resident	15.0%	27	140	164	205	195	225	262
Total By Period		31	146	170	211	202	232	270
Annual By Period		31	29	34	42	40	46	54
Cumulative		31	177	347	558	760	992	1,263
Grand Total By Period		142	722	843	1,048	1,000	1,152	1,340
Cumulative		142	864	1,706	2,754	3,754	4,906	6,247

Source: MLH.

(1) Includes total visitor-oriented units less visitor-oriented single family units capturable by QLT Properties.

Table 13 also presents the forecast of the potential capture of West Hawaii housing by the QLT Property from 1989 to 2020 for multiple-family units. Of West Hawaii's total projected demand for housing units, the QLT Property should be able to achieve a 15% capture rate for resident-oriented multiple-family units. Population growth projections for the North Kona area, as well as location and amenity factors, support this capture rate. Also, the QLT Property should be able to capture from 4% to 5% of the multiple-family visitor-oriented units. This includes total visitor-oriented units less visitor-oriented single-family units capturable by the QLT Property. Again, these visitor-oriented units will cater to business travelers and those persons visiting residents. Over the 31-year period, 1989 to 2020, the total multiple family units is projected at 1,263 units, or 41 units per year. Of this total, 1,218 should be demanded by permanent residents with the balance being sought by visitors and part-time residents. The distribution of these units is projected as follows:

POTENTIAL CAPTURE OF WEST HAWAII MULTIPLE-FAMILY DEMAND
QLT PROPERTY
1989-2020

Period	Total Units	Annual Units	Acres (12 du/ac)
1989-1990	31	31	2.6
1990-1995	146	29	12.2
1995-2000	170	34	14.2
2000-2005	211	42	17.6
2005-2010	202	40	16.8
2010-2015	232	46	19.3
2015-2020	270	54	22.5
Total	1,263	41	105.2

Unit Characteristics-Multiple Family

Again, the analysis assumes provision of affordable multiple-family units. These units should range in price from $110,000 to $165,000 in 1989 dollars. The units should provide 850 to 1,150 square feet of living space and be similar to the James K. Schuler product line. The project should be able to achieve densities of 12 units to the acre including roadways. Each building should consist of four to eight units.

Demand for Elderly Housing

A growing component of housing demand is represented by the elderly population of West Hawaii, which for purposes of this analysis has been defined as persons 65 years in age or older. As shown in Table 13A, in 1980 for the State of Hawaii 76.3 thousand persons fell into the "elderly" category, representing 7.9% of the total resident population. According to DBED's population forecast for the Year 2010 the State of Hawaii should witness a growth in its elderly population of nearly 150 percent, reaching 188.0 thousand persons by that year. People 65 and over would then represent 13.1 percent of the total population in the State.

According to the most recent available data found in the 1980 census, the West Hawaii PMA held 2,345 persons in the age group 65 and over, representing 8.5% -- a slightly higher concentration than found in the State overall -- of its total 27,518 local residents. Assuming that the local population in West Hawaii achieves the same age

distribution as the State overall by the Year 2010, it would then have approximately 13.5 thousand elderly residents, a net increase over the 1980 number by 11.2 thousand persons and a projected increase of 8.6 thousand persons over the projected 1990 total.

Senior citizens characteristically exhibit smaller household sizes than the aggregate resident population. In the absence of more definitive data, an average household size of 1.5 persons per unit has been utilized for projecting the housing needs of this segment of the population. Application of this household size factor to the projected increase of 8.6 thousand elderly persons for West Hawaii between 1990 and 2010 results in a housing demand from persons 65 and over approaching 5,700 units over the 20-year projection period or approximately 285 units per year.

The final consideration in the analysis is the translation of total elderly housing demand into specific demand for senior citizen housing. Demand for this type of product is a function of: the relative affluence of the elderly population; their age distribution and ability to function more or less independently; availability of alternative housing choices; and the range of services to be provided in the senior citizen housing facilities. Of the total housing demand represented by elderly households, 15 to 20 percent would likely choose to live in senior citizens' complexes, though more definitive studies would need to be done to validate such estimates. At that level of interest, senior citizen housing demand would average between 40 to 60 units per year, representing 800 to 1,200 units over the 20 year projection period. Of this total, from 250 to 400 units should be capturable on the QLT Property provided it also offers nearby shopping, recreation opportunities and medical services to support such a complex.

Table 13 (a)
RESIDENT POPULATION PROJECTIONS BY AGE AND SEX,
STATE OF HAWAII AND WEST HAWAII
1980 TO 2010
(In Thousands)

Age in Years	1980	1990	2000	2010
State:				
65 to 69	28.8	45.8	43.8	56.4
70 to 74	20.6	33.4	42.4	40.8
75 to 79	13.7	22.7	36.1	34.3
80 to 84	7.6	13.8	22.8	29.5
85 and over	5.6	9.6	16.5	27.8
Total	76.3	125.3	160.8	188.8
All Residents	968.8	1,137.2	1,285.1	1,435.5
Percent 65 and Over	7.9%	11.0%	12.5%	13.1%
West Hawaii:				
Total 65 and Over	2.3			13.5
All Residents	27.5			103.4
Percent 65 and Over	8.4%			13.1%

Sources: DBED, Population and Economic Projections for the State of Hawaii to 2010 (Series H-R1; MLH, Inc.

B. ANALYSIS OF COMMERCIAL MARKET POTENTIALS

The following section examines the potential for development of commercial retail and services land uses on the QLT Property. Commercial retail land uses examined include:

1) Community-oriented convenience and shopper goods retail uses; and
2) Tourist-oriented specialty retail uses.

Methodological Approach

A variety of research techniques and data sources were utilized in the formulation of the body of information in this section. These included extensive field surveys of all existing and potential retail sites; review of published information concerning the socioeconomic base in the West Hawaii market area which support the existing retail base; and discussions with numerous retailers and shopping center owners who are currently operating within the area.

In order to facilitate the present and future analysis of the West Hawaii retail requirements, a computer program was developed which can forecast retail demand within the area. From a comparison of the computer-forecasted retail sales requirements with the retail sales performance of existing establishments it is possible to identify deficiencies or shortages in supportable retail space which can then be translated into commercial land use requirements.

Retail Demand

The market potential for retail goods and supportable retail space is primarily a function of market area population, personal income, and that proportion of income which is spent for various categories of retail goods. For the purposes of this analysis primary focus is placed upon the projected number of residents expected to reside within the Primary and Secondary Market areas between 1990 and 2020. Notwithstanding, consideration was also given to demand generated by tourists for certain types of convenience and shopper goods which would commonly be found in local market-oriented shopping facilities.

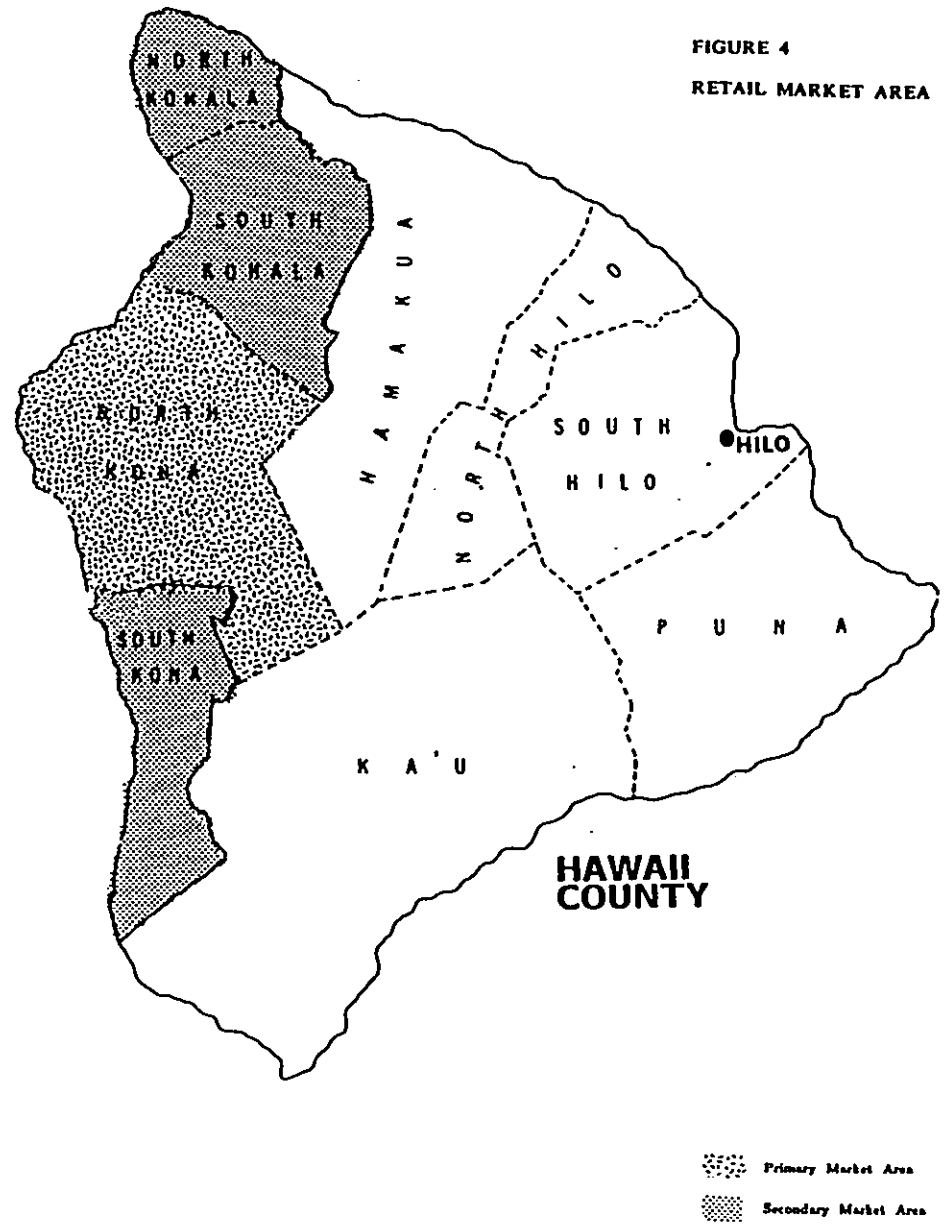
Market or Trade Area

The market or trade area is defined as the geographic area which contains people who are likely to purchase a given class of goods or services from a particular firm or group of firms such as a collection of stores within a shopping center. Two distinct market areas have been delineated for the purposes of this analysis. The market areas are defined below and depicted in Figure 4.

Primary Market Area (PMA). The PMA has been defined as contiguous with the boundaries as delineated by the North Kona Judicial District. This area consists of census tracts 215 and 216. It is assumed that residents of this area will likely purchase the majority of goods or services within this district and that leakage to other areas will be minimal.

FIGURE 4

RETAIL MARKET AREA



Secondary Market Area (SMA). The SMA has been defined as contiguous with the boundaries as delineated by the districts of South Kona, South Kohala, and North Kohala. This market area consists of census tracts 213, 214, 217 and 218. The SMA reflects the shortage of existing retail facilities within the West Hawaii area. Currently, the only major shopping alternatives exist in Kona and Waimea. The analysis assumes that there will be leakage from the areas discussed above.

Demand Sectors

The following paragraphs examine the demand generated by residents and visitors. Each sector is examined with respect to population projections, income characteristics, and retail expenditure potentials. Capture potentials for the QLT Property are the evaluated to determine the size and type of center(s) which can logically be developed on the site.

Resident Population

Population projections for the market areas are primary determinants of retail expenditure potentials. The West Hawaii area has grown substantially in terms of population over the last several years. These figures are presented in Table 14 and are summarized below.

Primary Market Area (PMA). The PMA's 1988 population was estimated at 21,484 persons, accounting for 53.4 percent of West Hawaii's population. It is projected that the PMA's population will increase to 52,069 persons by 2005 and 84,416 persons by 2020. By 2020 the PMA will account for 58.6 percent of West Hawaii's total population. The 2020 figure represents an increase of 62,932 persons, an annual growth rate of 4.4 percent.

Secondary Market Area (SMA). The SMA's 1988 population was estimated at 18,756, or 46.6 percent of the West Hawaii's population. It is projected that by 2005 the population will increase to 34,986 persons; by 2020 59,751 persons. The 2020 figure represents an increase of 40,995 persons, or a 3.7 percent annual growth. The SMA's share of West Hawaii population will fall to 41.4 percent.

Combined, the population of the PMA and SMA has increased substantially since 1980. In 1980, the West Hawaii area accounted for 29.9 percent of the total County population and in 1988 the figure increased to a 34.3 percent share. It is projected that by 2020 the area will account for 54.7 percent of the total County population.

The projected increase in population in West Hawaii is primarily based on the large number of planned visitor-oriented projects for the area. The visitor-oriented projects will generate employment opportunities which will likely attract new full-time residents. The new residents will generate demand for retail goods and services.

Table 14
RESIDENT AND VISITOR POPULATION PROJECTIONS
1988-2020

	1988	1990	1995	2000	2005	2010	2015	2020
A. RESIDENTS								
Primary Market Area	21,484	24,276	31,966	40,798	52,069	61,838	72,292	84,416
Secondary Market Area	18,756	20,386	24,327	29,121	34,986	41,529	49,985	59,751
Total	40,240	44,662	56,293	69,919	87,055	103,359	122,197	144,167
B. VISITORS								
---Average Daily Population---								
Primary Market Area	7,325	8,826	11,175	13,917	16,566	19,282	22,358	25,898
Secondary Market Area	3,944	4,752	6,017	7,494	8,920	10,383	12,039	13,945
Total	11,269	13,578	17,192	21,411	25,486	29,664	34,397	39,842
---Annual Visitor Days---								
Primary Market Area	2,673,654	3,221,490	4,078,750	5,079,750	6,046,625	7,037,875	8,160,750	9,452,625
Secondary Market Area	1,439,660	1,734,680	2,196,250	2,735,250	3,255,875	3,789,625	4,394,250	5,089,875
Total	4,113,314	4,956,000	6,275,000	7,815,000	9,302,500	10,827,500	12,555,000	14,542,500

Source: M.M.

Income

Another primary determinant of retail expenditure potential is personal income. Table 15 presents per capita income projections, total market area income projections, and resident retail expenditure potentials for both the Primary Market and Secondary Market Areas for the period 1988 to 2020. Local economic growth inspired principally by resort development is expected to raise market area income levels at a real rate (net of inflation) of 1.5 percent annually, from a 1988 base level. This rate is slightly above recent trends in the State overall.

Primary Market Area (PMA). The per capita income for the PMA in 1988 was estimated at $11,837. The PMA residents have incomes slightly below the County average of $13,152. However, since 1980 the PMA has closed the gap between the two figures. This is consistent with the increase in the tourist industry and provision of new jobs in the area. The per capita income figure is projected to increase to $19,061 by 2020 expressed in 1988 dollars.

Secondary Market Area (SMA). The per capita income for the SMA in 1988 was estimated at $10,552. This figure is substantially lower than the County average of $13,152. The reason for the modest income level in the SMA can in large part be attributed to the lower-income levels found in North Kohala and South Kona. The per capita income figure is projected to increase to $16,944 by 2020 as expressed in 1988 dollars.

Retail Expenditure Potentials

The potential buying power represented by West Hawaii residents is a function of total population, their level of income, and their relative propensities to spend income for various retail goods and services. Comparison of actual retail sales with total personal income for the State's population indicates that retail purchases by local residents represent roughly 36 percent of total resident personal income after allowance for purchases made by tourists, local businesses, governmental, and other institutions.

Primary Market Area (PMA). The potential buying power in the PMA in 1988 was estimated at $91.6 million. This figure is projected to increase to $285.8 million by 2005 and $579.3 million by 2020. These figures are expressed in 1988 dollars. The 2020 figure represents an increase of more than six times the 1988 figure, or an annual growth rate of 5.9 percent.

Secondary Market Area (SMA). The potential buying power in the SMA in 1988 was estimated at $71.0 million. It is projected to increase to $170.7 million in 2005 and $364.5 million in 2020, as expressed in 1988 dollars. The 2020 figure represents an increase of more than five times the 1988 figure, or an annual growth rate of 5.2 percent.

Table 15
RESIDENT RETAIL EXPENDITURE POTENTIALS
WEST HAWAII
1988-2020
(In 1988 Constant Dollars)

	1988	1990	1995	2000	2005	2010	2015	2020
A. PRIMARY MARKET AREA (North Kona)								
Population	21,484	24,276	31,966	40,798	52,869	61,838	72,292	84,416
Per Capita Income	$11,837	$12,195	$13,137	$14,153	$15,246	$16,424	$17,694	$19,061
Total Personal Income ($000's)	$254,386	$296,046	$419,937	$577,414	$793,844	$1,015,496	$1,279,135	$1,609,853
Total Retail Sales ($000's)	$91,558	$106,576	$151,177	$207,869	$285,784	$365,579	$460,488	$579,259
B. SECONDARY MARKET AREA (North Kohala, South Kohala, South Kona)								
Population	18,756	20,386	24,327	29,121	34,986	41,529	49,985	59,751
Per Capita Income	$10,522	$10,848	$11,678	$12,588	$13,553	$14,600	$15,728	$16,944
Total Personal Income ($000's)	$197,351	$220,984	$284,891	$366,342	$474,165	$606,326	$784,983	$1,012,416
Total Retail Sales ($000's)	$71,046	$79,554	$102,573	$131,883	$170,699	$218,277	$282,565	$364,478

Source: N.W.

Distribution of Resident Retail Demand by Retail Category

Projected retail demand can be disaggregated into various retail categories based upon historic retail expenditure patterns. After removal of tourist expenditures, historic patterns suggest the distribution of sales by retail category as noted in Table 16. As delineated in the table, an estimated 25 percent of retail demand is allocable for shopper goods purchases which include the retail categories of apparel, general merchandise, specialty and furniture/appliances. Shopper goods typically encompass 50 to 60 percent of the range of goods which would normally be considered for a major community center. In comparison, the demand for convenience goods, including food and drug/proprietary stores, is estimated at 38 percent of total resident retail sales demand; demand for eating and drinking facilities, 12 percent; and the balance of automotive and "heavy commercial" retail activities represents 25 percent of retail demand.

Projected Demand for Retail Goods

Given the anticipated population growth, real income growth, and distribution of retail sales by category, existing and projected demand for retail goods generated by residents is portrayed in Table 17. The combined West Hawaii resident demand for retail goods and services was estimated at $162.6 million in 1988. This figure is projected to increase to $943.7 by 2020 million as expressed in 1988 dollars. The 2020 figure represents an increase of nearly five times the 1988 figure.

Retail Demand Generated by Tourists

A second major demand source for retail goods in the West Hawaii market area is the visitor population, primarily those tourists who are spending their vacation in the Kailua/Kona and the South Kohala areas. The opening of high activity resorts such as the Hyatt Regency Waikoloa has increased the demand for tourist-oriented retail space. There is currently a shortage of visitor-oriented retail space in the South Kohala area. Tourists are forced to travel to the Kona area to shop.

The projected average daily visitor population and annual visitor days for both market areas was presented previously in Table 14.

Primary Market Area (PMA). It is estimated that in 1988 approximately 7,325 visitors per day were found in the PMA. This figure is projected to increase to 25,898 visitors per day by 2020. The 2020 figure represents an increase of 18,573 persons per day.

Secondary Market Area (SMA). The SMA received a smaller number of visitors per day compared to the PMA primarily due to the exclusive nature of the Mauna Kea and Mauna Lani resorts. In 1988 it was estimated that 3,944 visitors per day were found in the SMA. This figure is projected to increase to 13,945 visitors per day by 2020.

The combined total for West Hawaii of 11,269 visitors per day in 1988 is projected to reach 39,842 visitors per day by 2020.

Table 16
PROJECTED DISTRIBUTION OF RESIDENT RETAIL DEMAND
BY MAJOR CATEGORY

RETAIL CATEGORY		PERCENT OF RETAIL DEMAND
Shopper Goods		25.0%
Apparel	4.0%	
General Merchandise	10.0%	
Specialty - (1)	8.0%	
Furniture/Appliances	3.0%	
Convenience Goods		38.0%
Food/Liquor	31.0%	
Drug/Proprietary	7.0%	
Eating and Drinking		12.0%
Heavy Commercial Goods - (2)		25.0%
Total		100.0%

(1) - Includes gifts, jewelry, sporting goods, books, florists, and other shopping goods stores.

(2) - Includes automotive dealers and supplies, service stations, and building materials and hardware stores.

Sources: Hawaii Taxable Sales; M.W.

Table 17
PROJECTED RESIDENT DEMAND FOR RETAIL GOODS
1988-2020
(In 000's of 1988 Constant Dollars)

A. PRIMARY MARKET AREA	1988	1990	1995	2000	2005	2010	2015	2020
Shopper Goods								
Apparel	$3,662	$4,263	$6,047	$8,315	$11,431	$14,623	$18,428	$23,178
General Merchandise	$9,155	$10,658	$15,118	$20,787	$28,578	$36,558	$46,049	$57,926
Specialty	$7,324	$8,526	$12,094	$16,630	$22,863	$29,246	$36,839	$46,341
Furniture/Appliances	$2,747	$3,197	$4,535	$6,236	$8,574	$10,967	$13,815	$17,378
Convenience Goods								
Food/Liquor	$28,381	$33,039	$46,865	$64,439	$88,593	$113,329	$142,751	$179,578
Drug/Proprietary	$6,489	$7,468	$10,582	$14,551	$20,005	$25,598	$32,234	$40,548
Eating and Drinking	$18,986	$22,089	$18,141	$24,944	$34,294	$43,869	$55,259	$69,511
Heavy Commercial Goods	$22,868	$26,644	$37,794	$51,967	$71,446	$91,395	$115,122	$144,815
Total	$91,558	$106,576	$151,177	$207,869	$285,784	$365,579	$460,488	$579,259
B. SECONDARY MARKET AREA								
Shopper Goods								
Apparel	$2,842	$3,182	$4,091	$5,275	$6,828	$8,731	$11,383	$14,579
General Merchandise	$7,105	$7,955	$10,227	$13,188	$17,070	$21,828	$28,256	$36,447
Specialty	$5,684	$6,364	$8,182	$10,551	$13,656	$17,462	$22,605	$29,158
Furniture/Appliances	$2,131	$2,387	$3,068	$3,956	$5,121	$6,548	$8,477	$10,934
Convenience Goods								
Food/Liquor	$22,024	$24,662	$31,705	$40,864	$52,917	$67,666	$87,595	$112,986
Drug/Proprietary	$4,973	$5,569	$7,153	$9,232	$11,949	$15,279	$19,788	$25,513
Eating and Drinking	$2,526	$9,547	$12,273	$15,826	$20,484	$26,193	$33,908	$43,736
Heavy Commercial Goods	$17,762	$19,893	$25,568	$32,971	$42,675	$54,569	$70,641	$91,117
Total	$71,046	$79,554	$102,273	$131,863	$170,699	$218,277	$282,565	$364,470
GRAND TOTAL, BOTH MARKET AREAS	$162,536	$186,131	$253,450	$339,732	$456,483	$583,856	$743,053	$943,729

Source: MLM.

Table 18 presents the expenditure patterns of the Primary Market Area visitors as reflected in their percentage distribution of purchases by major retail category. Taking into account the different spending habits of westbound and eastbound visitors as well as differences between visitors staying in hotels vis a vis condominiums, the average daily visitor expenditure is estimated in 1988 constant dollars at $140 per day for the Primary Market Area and $175 per day for the Secondary Market Area. The expenditure total represents purchases of all goods and services, including hotel, restaurant, retail, transportation, and other services. Average daily expenditures in the Secondary Market Area are higher due to the presence of luxury resorts located in the South Kohala District. These figures are expected to remain constant over the projection period, thus are expressed in uninflated (or constant) dollars.

Based upon expenditure profiles developed by the HVB, visitor retail expenditures are estimated to represent the equivalent of 35 percent of expenditures within both market areas. Eating and Drinking facilities receive 48 percent of the total retail sales; other major retail sectors benefiting from tourism include Apparel Stores (10%), Specialty Stores (22.5%), General Merchandise (7.5%), Food/Liquor (9%), and Drug/Proprietary (3%).

Projected visitor demand for retail goods in West Hawaii is shown in Table 19.

Primary Market Area (PMA). Retail expenditures by tourists in the PMA in 1988 totalled an estimated $131.0 million. This figure is projected to increase to $463.2 million by 2020 as expressed in 1988 dollars. The 2020 figure represents approximately three and one-half times the 1988 figure.

Secondary Market Area (SMA). Retail expenditures by tourists in the SMA in 1988 totalled an estimated $81.2 million and are projected to increase to $311.8 million by 2020 as expressed in 1988 dollars. The 2020 figure represents nearly four times the 1988 figure.

The total retail expenditures for both areas was estimated at $219.2 million in 1988. The combined total is projected to reach $774.9 million by 2020 as expressed in 1988 dollars.

Projected Sales Demand Capture

Table 20 presents projected capture rates achievable by North Kona retail facilities within the Primary and Secondary Market Areas. Capture rates are based primarily on the existing and planned supply of retail space in the West Hawaii area. Consideration is also given to proximity of facilities, income characteristics of shoppers, and potential losses losses of sales to facilities located outside North Kona in West Hawaii as well as in the Honolulu and Hilo areas.

Based on these capture rates Table 21 shows that in 1988, assuming facilities were made available, the estimated capturable retail sales by residents and visitors in North Kona by market area stores could approach $244.7 million; this sales potential is projected to reach $627.4 million annually by 2005. By the year 2020 total capturable retail sales in North Kona should approach $1.14 billion. This sales potential in 2020 represents an overall capture rate by North Kona of 60 percent of the total projected retail sales in West Hawaii.

Table 18
VISITOR EXPENDITURE FOR RETAIL GOODS
(In 1968 Constant Dollars)

	1968	1990	1995	2000	2005	2010	2015	2020
Visitor Expenditures Per Day, Average								
Primary Market Area	$140.00	$140.00	$140.00	$140.00	$140.00	$140.00	$140.00	$140.00
Secondary Market Area	$175.00	$175.00	$175.00	$175.00	$175.00	$175.00	$175.00	$175.00
Visitor Retail Expenditures as Percent of Total Expenditures								
Primary Market Area	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Secondary Market Area	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%

Retail Category	Percent of Retail Demand
Shopper Goods	
Apparel	10.0%
General Merchandise	7.5%
Specialty	22.5%
Convenience Goods	
Food/Liquor	9.0%
Drug/Proprietary	3.0%
Eating and Drinking	48.0%
	100.0%

Sources: HVB; M.W.

Table 19
PROJECTED VISITOR DEMAND FOR RETAIL GOODS
1968-2020
(In 000's of 1968 Constant Dollars)

	1968	1990	1995	2000	2005	2010	2015	2020
A. PRIMARY MARKET AREA								
Shopper Goods								
Apparel	$13,181	$15,765	$19,986	$24,891	$29,628	$34,486	$39,968	$46,318
General Merchandise	$9,886	$11,839	$14,989	$18,668	$22,221	$25,864	$29,991	$34,738
Specialty	$29,477	$35,516	$44,968	$56,004	$66,664	$77,593	$89,972	$104,215
Convenience Goods								
Food/Liquor	$11,791	$14,206	$17,987	$22,402	$26,666	$31,037	$35,989	$41,686
Drug/Proprietary	$3,930	$4,735	$5,996	$7,467	$8,889	$10,346	$11,996	$13,895
Eating and Drinking	$62,884	$75,767	$95,932	$119,476	$142,217	$165,531	$191,941	$222,326
Total	$131,089	$157,849	$199,859	$248,908	$296,285	$344,856	$399,877	$463,179
B. SECONDARY MARKET AREA								
Shopper Goods								
Apparel	$8,818	$10,624	$13,452	$16,753	$19,942	$23,211	$26,915	$31,175
General Merchandise	$6,613	$7,968	$10,089	$12,565	$14,957	$17,409	$20,186	$23,382
Specialty	$19,840	$23,905	$30,267	$37,695	$44,878	$52,226	$60,558	$70,145
Convenience Goods								
Food/Liquor	$7,936	$9,562	$12,107	$15,078	$17,948	$20,890	$24,223	$28,058
Drug/Proprietary	$2,645	$3,187	$4,036	$5,026	$5,983	$6,963	$8,074	$9,353
Eating and Drinking	$42,326	$50,997	$64,578	$80,416	$95,723	$111,415	$129,191	$149,642
Total	$88,179	$106,244	$134,529	$167,534	$199,422	$232,115	$269,148	$311,755
GRAND TOTAL	$219,188	$264,093	$334,379	$416,442	$495,707	$576,970	$669,025	$774,933

Source: M.W.

Table 20
POTENTIAL CAPTURE RATES OF RESIDENT AND VISITOR
RETAIL DEMAND BY NORTH KONA RETAIL FACILITIES
1988-2020 (Projected to Remain Constant)

	1988	2020
Apparel		
Primary Resident Market Area	75%	75%
Secondary Resident Market Area	30%	30%
Primary Visitor Market Area	85%	85%
Secondary Visitor Market Area	20%	20%
General Merchandise		
Primary Resident Market Area	75%	75%
Secondary Resident Market Area	30%	30%
Primary Visitor Market Area	85%	85%
Secondary Visitor Market Area	20%	20%
Specialty (Gifts, etc.)		
Primary Resident Market Area	75%	75%
Secondary Resident Market Area	30%	30%
Primary Visitor Market Area	85%	85%
Secondary Visitor Market Area	20%	20%
Furniture/Appliances		
Primary Resident Market Area	90%	90%
Secondary Resident Market Area	70%	70%
Food/Liquor		
Primary Resident Market Area	95%	95%
Secondary Resident Market Area	35%	35%
Primary Visitor Market Area	90%	90%
Secondary Visitor Market Area	20%	20%
Drug/Proprietary		
Primary Resident Market Area	95%	95%
Secondary Resident Market Area	35%	35%
Primary Visitor Market Area	90%	90%
Secondary Visitor Market Area	20%	20%
Eating and Drinking		
Primary Resident Market Area	90%	90%
Secondary Resident Market Area	30%	30%
Primary Visitor Market Area	90%	90%
Secondary Visitor Market Area	20%	20%
Heavy Commercial Goods		
Primary Resident Market Area	90%	90%
Secondary Resident Market Area	70%	70%

Source: MLM.

Table 21
POTENTIAL CAPTURE OF RESIDENT AND VISITOR
RETAIL DEMAND BY NORTH KONA RETAIL FACILITIES
1988-2020
(In 000's of 1988 Constant Dollars)

Retail Category	1988	1990	1995	2000	2005	2010	2015	2020
Shopper Goods								
Apparel	$16,498	$19,694	$25,441	$32,327	$39,795	$47,542	$56,578	$67,357
General Merchandise	$18,672	$22,036	$29,165	$37,928	$48,434	$59,433	$72,543	$88,582
Specialty	$36,222	$43,273	$55,882	$70,788	$86,882	$103,572	$122,999	$146,115
Furniture/Appliances	$3,964	$4,548	$6,238	$8,382	$11,301	$14,454	$18,367	$23,294
Subtotal	$75,356	$89,552	$116,637	$149,416	$186,412	$225,001	$270,487	$325,348
Convenience Goods								
Food/Liquor	$46,869	$54,717	$74,228	$98,784	$130,273	$163,457	$203,507	$253,266
Drug/Proprietary	$11,895	$13,936	$18,762	$24,788	$32,383	$40,363	$49,957	$61,827
Subtotal	$58,764	$68,652	$92,991	$123,484	$162,656	$203,820	$253,464	$315,092
Eating and Drinking	$77,566	$92,764	$119,262	$150,809	$184,149	$218,681	$258,490	$305,783
Heavy Commercial Goods	$33,832	$37,902	$51,913	$69,858	$94,174	$120,454	$153,859	$194,116
GRAND TOTAL	$244,658	$288,870	$380,802	$493,559	$627,331	$767,876	$935,499	$1,140,258

Source: MLM.

Existing and Projected Supply of Retail Space

The relative dominance of Hilo as a retail center is declining as West Hawaii has become the new tourist center for the County. In the absence of published data field surveys were conducted to determine the current supply of retail space in the North Kona area which would be potentially competitive with new facilities developed on the QLT Property. The field surveys focused on identifying major stand alone shopping centers including convenience and tourist-oriented facilities. The survey identified 495,000± square feet of retail space found in major clusters within the market area. Existing facilities are summarized in Table 22. It should be further noted that there exists a substantial amount of retail space in the Kona Industrial Subdivision. This space is of modest quality and would not likely be competitive with the QLT Property and is included in the light industrial section of this report.

With the exception of the 58,000 square foot Parker Ranch Shopping Center located in Kamuela, there are presently no major tourist-oriented retail facilities in the South Kohala District. The Mauna Kea, Mauna Lani, Waikoloa, and Kona Village resorts have minimal retail facilities within the resorts and are somewhat removed from the Parker Ranch Shopping Center. While the Mauna Kea, Mauna Lani, and Waikoloa resorts are planning to construct retail facilities in the future, it is unlikely that any will begin construction for at least three years. Currently, the majority of tourist-oriented retail facilities are located in the Kona area in smaller, modest shopping facilities.

Convenience/Resident-Oriented Facilities

The survey identified approximately 325,000± square feet of convenience/resident-oriented retail space. The majority of these facilities are located along Palani Road in Kona. The two main facilities, the Lanihau Center and the Kona Coast Shopping Center, account for 177,600 square feet of the total resident-oriented retail space or 55 percent of the total. The Lanihau Center is a highly successful center with anchor stores averaging $400 per square foot in sales annually and other stores averaging $350 per square foot. The center opened in 1987 and is operating at 99 percent occupancy. Rents average $3.00 per square foot triple net or 10 percent of gross sales plus common area maintenance (CAM) and other charges of $0.52 per square foot. The Kona Coast Shopping Center, which opened in 1975, is operating at 96.1 percent occupancy and commands rents of $2.50 per square foot triple net or 8 percent of gross sales plus CAM charges of $0.35 per square foot. The center averages $375 to $400 per square foot in annual sales volume.

Tourist-Oriented Retail Facilities

The tourist-oriented retail facilities in the Kona area are characteristically older, smaller facilities. The majority of the facilities were constructed in the 1960s and 1970s and are of modest quality. The survey identified approximately 170,000+ square feet of tourist-oriented retail space located in five locations. Rents for these facilities range from $1.60 to $10.00 per square foot triple net, with CAM charges ranging from $0.30 to $0.95 per square foot. Percentage rents range from 8 to 12 percent of gross sales. The wide disparity in rents can be attributed to the loca-

Table 22
EXISTING INVENTORY OF RETAIL SPACE
PRIMARY MARKET AREA

Complex	Square Feet	Anchors	Asking Rents	Sales Per Sq. Ft.	Occupancy
Lanihau Center	87,500	Food 4 Less (33K SF) Longs Drugs (23K SF)	$3.00 PSF MMM/10% Gross Sales +$0.40 CAM + $0.05 Merchant Ass. +$0.07 Taxes	Anchors $400 PSF Other $350 PSF	99 3%
Kona Inn Center	33,000	None	$1.65 - $1.95 Gross	Mostly Office	90.7%
Kona Coast Shopping Center	89,900	Pay-N-Save (21K SF) ETA Super Store (20K SF)	$2.50 PSF MMM/8% Gross Sales +$0.35 CAM	$375 - $400 PSF	96 1%
North Kona Shopping Center	15,000	None	$1.25 MMM + $0.50 - $0.60 CAM	Mostly Service Oriented	93 3%
83 Furniture (Unnamed Complex)	27,000	None	Retail: $1.20 MMM + $0.10 CAM Warehouse: $0.60 + $0.10 CAM	N/A	100.0%
Kaahumanu Square	17,200	None	$1.60 MIN + $0.45 CAM +$0.00 Taxes	N/A	95 3%
Kona Square	9,000	None	$2.50 - $3.50 PSF MMM/8-12% of Gross Sales + $0.95 CAM	$370 PSF	100 0%
Keauhou Bay Inn Plaza	15,000 +	None	$7.00 - $10.00 PSF MMM/ 10-12% Gross Sales (Street Front) +$0.30 CAM	N/A	96 6%
Kona Market Place	46,000	None	N/A	N/A	N/A
King Kamehameha Mall	32,000	Liberty House	N/A	N/A	N/A
Waterfront Row	21,000	None	$3.50 PSF MIN + $0.62 CAM 10-12% Gross Sales + 11 Adv. Fee	N/A	93 0%
Unnamed Complex	32,000	Panaro	$3.00 PSF MIN + $0.30 CAM 12% Gross Sales	N/A	100 0%
Keauhou Shopping Village	72,000	ETA Super Store	N/A	N/A	N/A
Kona Center	18,500	None	N/A	N/A	83 7%
Total	495,200				

Source: RLW.

tion of the site as well as the size of the facility. Small shops with excellent frontage along the main roadway command the highest rents. Typical sales per square foot figures were not provided by landlords and store operators surveyed during the analysis.

Planned Facilities

There are currently three major developments proposed for construction in the Primary Market Area. These proposed facilities are reviewed below.

Under construction is the Old Kailua Town Shopping Center located along the main tourist thoroughfare in Kona. The center will provide 50,000 square feet of retail and restaurant space, and is projected to open in the early part of 1990. The primary market orientation for this facility is for tourists and other visitors.

The Lanihau Center is currently planning a Phase II component which could provide 250,000 to 260,000 square feet of additional retail space on 24 acres. The Lanihau Center Venture plans to begin construction in 1990, with a 1992 planned opening date. Phase II is likely to have the following anchor tenants: Woolworth, Sears, and Liberty House. Phase II will be characterized by retail facilities which would have significantly greater "regional drawing power" than the current tenant mix.

The Kona Coast Shopping Center has plans to add an additional 110,000 square feet of retail space. This addition is currently in the conceptual stage and is several years away from development.

Market Potentials at the QLT Property

The QLT Property has excellent potential for long-term development of major retail shopping facilities. The site is ideally located in close proximity to major sources of demand such as the Kona Central Business District and the State's proposed Kealakehe Project. In addition, the site is accessible from the major regional thoroughfare, Queen Kaahumanu Highway, and also has excellent visibility from that roadway. Given these factors and after deducting the existing and planned retail space in the West Hawaii area, it is reasonable to believe that the QLT Property would be able to capture 35 percent of supportable new retail space developed in North Kona over the period 1989 to 2020.

Projected retail sales volume for each of the major retail categories are translated into supportable retail space by utilizing the following sales standards per square foot of gross leasable area (GLA). These figures were derived by analyzing current performance of existing facilities.

Retail Category	Sales Per Square Foot
Shopper Goods	
Apparel	$300
General Merchandise	300
Specialty	325
Furniture/Appliances	250
Convenience Goods	
Food/Liquor	425
Drug/Proprietary	350
Eating and Drinking	325
Heavy Commercial Goods	300

As shown in Table 23, projected capturable retail space at the QLT Property totals 119,270 square feet in 1990, rising to a total of 959,979 square feet by 2020. The demand by 2020 would ultimately require approximately 96.0 acres, based on a development density of 10,000 square feet per acre of land. The demand can be distributed as follows:

Period	Supportable Retail Space	Required Acres
1990-1995	163,415	16.3
1995-2000	118,475	11.8
2000-2005	140,281	14.0
2005-2010	147,329	14.7
2010-2015	175,808	17.6
2015-2020	214,671	21.5
Total	959,979	96.0

The following paragraphs review the retail market potentials by type of retail facility on the QLT Property.

Regional Center Potential

The core retail development on the QLT Property should be a regional shopping center featuring two to three major department stores. The center should provide from 400,000 to 500,000 square feet of Gross Leasable Area (GLA). The site should be located along Queen Kaahumanu Highway with excellent visibility and access. A first phase for this facility with 200,000 to 250,000 square feet could be developed within the next 10 years.

Community/Neighborhood Center Potential

The QLT Property should provide two community/neighborhood centers ranging in size from 100,000 to 125,000 square feet of GLA. Each center should include a major drugstore and supermarket as anchor tenants, and should have a location at a major intersection offering easy access and visibility to local resident population.

Heavy Commercial/Automobile Related

These types of retail facilities typically have unique site and specialized facility requirements that would dictate a location along a major arterial road allowing separate identify and access. Typical users would include the following: auto dealers; auto supplies; service stations; building materials; and hardware stores. These facilities should ultimately require 25 to 30 acres.

Table 23
SUPPORTABLE RETAIL SPACE IN WEST HAWAII MARKET AREA
1980-2020
(In Square Feet of Gross Leasable Area or GLA)

Retail Category	Sales Per Sq. Ft. Factor	1980	1990	2000	2010	2015	2020
Shopper Goods							
Apparel	$300	54,995	63,647	107,735	132,644	156,472	224,322
General Merchandise	$300	62,241	72,033	125,425	154,443	186,110	255,273
Specialty	$325	111,451	122,149	217,785	267,330	316,684	448,584
Furniture/Appliances	$250	13,035	14,193	33,556	43,263	57,648	51,175
Convenience Goods							
Food/Liquor	$425	118,088	128,745	222,244	306,524	384,686	595,928
Drug/Proprietary	$320	33,986	36,617	78,000	92,523	115,222	176,647
Eating and Drinking	$325	236,481	255,459	464,858	566,613	672,619	946,823
Heavy Commercial Goods	$300	118,116	125,229	232,834	313,913	401,312	647,652
Subtotal		727,395	876,772	1,481,399	1,886,253	2,307,142	3,422,798
Less:							
Existing Retail Space		278,000	428,000	636,000	636,000	636,000	636,000
Retail Space Proposed or Under Construction		50,000	110,000	0	0	0	0
Subtotal		428,000	538,000	636,000	636,000	636,000	636,000
NET POTENTIAL SUPPORTABLE SPACE		317,395	348,772	845,399	1,250,253	1,671,142	2,742,798
GLA PROPERTIES CAPTURE		111,088	119,279	261,990	422,171	569,300	959,979
	35%	39,000	42,000	92,000	148,000	200,000	336,000

Source: RAL

C. ANALYSIS OF OFFICE MARKET POTENTIALS

The following section examines the market potentials for office space on the QLT property through an examination of current and future market forces as well as a review of the current supply of office space in North Kona. Potential demand for office should come from the following major sources:

- Governmental activities which locate in response to the needs of their constituents;
- Services related to population, as provided by medical practitioners, attorneys, and real estate agents;
- Services related to an employment base, such as accounting, legal, and consulting activities;
- Services related to both employment activities and households, such as major financial institutions and insurance companies; and
- Firms which are seeking a special environment and lower costs than traditional office centers.

Existing Supply of Office Space

Field surveys were conducted to determine the current supply of office space in the North Kona area which would be potentially competitive with new facilities developed on the QLT Property. Field research was conducted of free-standing office space in North Kona of buildings of 5,000 square feet or larger. A total of 10 buildings were identified which were primarily used as office space. In total they represented nearly 190,000 square feet of existing office space. These buildings are presented in Table 24. The average occupancy rate for existing buildings approaches 99 percent. Current rents average $1.50 to $1.75 triple net and can go as high as $2.00 triple net. Common Area Maintenance (CAM) charges range from $0.35 to $0.65 per square foot.

Employment-County of Hawaii

Table 25 presents the estimates of office-using employment by major employment sector for the years 1980, 1985 and 1987. The estimates are based on the actual number of employees in each sector multiplied by the percentage that actually use office space. In 1980 there were approximately 5,269 office-using employees in the County of Hawaii. In 1987 that figure had increased by 2,126 persons to 7,395 office-using employees. The change represents an additional 304 office-using employees per year.

Table 25 also presents the total job count for the County excluding agricultural employees. In 1980 that figure totalled 28,300 employees; by 1987 it had increased to 35,100 employees. The total job count as a percentage of total population

Table 24
EXISTING INVENTORY OF OFFICE SPACE
PRIMARY MARKET AREA

Complex	Square Feet	Asking Rents	Occupancy
Bank of Hawaii	12,746	$1.65 - $1.75 PSF NNN +$0.52 CAM	100.00%
Bougainvillea Plaza	5,400	$1.75 - $2.00 PSF NNN +$0.25 CAM	77.78%
First Federal Savings	9,000	$1.40 PSF NNN +$0.65 CAM	100.00%
Mualalai Center	27,600	$1.50 - $1.85 PSF NNN +$0.25 CAM	100.00%
Mualalai Medical Center	23,484	$1.73 PSF NNN +$0.35 CAM	100.00%
Kailua Trade Center	38,880	$1.45 - $1.60 PSF NNN +$0.53 CAM	99.47%
Pottery Terrace	46,000	$1.40 PSF NNN Includes CAM & Taxes	100.00%
Territorial Centre	16,000	$1.25 - $2.00 PSF NNN +$0.55 CAM	100.00%
Village Professional Plaza	10,290	$1.40 PSF NNN +$0.32 CAM	90.52%
Kushini Tower	25,962	N/A	100.00%
Total	187,562		98.76%

Source: MLW.

Table 25
ESTIMATES OF OFFICE EMPLOYMENT BY
MAJOR EMPLOYMENT SECTOR

	% Using Office	1980	1985	1987
Contract Construction	10.00%	100	130	150
Manufacturing	5.00%	140	140	120
Trans., Comm., Utilities	30.00%	585	600	615
Fin., Ins., R.E.	100.00%	1,200	1,500	1,800
Services/Other	35.00% / 40.00%	2,485	3,360	3,840
Government	5.00%	320	345	360
Agriculture	2.50%	81	86	93
Self-Employed	5.00%	270	333	363
Subtotal		5,259	6,494	7,395
Total Employees, Excluding Agriculture		20,300	32,000	35,100
Population		92,100	109,500	117,500
Labor Force as % of Population		30.73%	29.22%	29.87%
Office Employees/ 1,000 Population		57.2	59.3	62.9

Source: Hawaii Department of Labor and Industrial Relations; DBED; MLW.

remained relatively constant at 30.73 percent in 1980 and 29.87 percent in 1987. However, the office-using employees per 1,000 population increased from 52.7 in 1980 to 62.9 per 1,000 population in 1987.

Employment Projections - County of Hawaii

Table 26 presents the projections of office-using employment for the County from 1970 to 2020. The 1987 figure of 7,395 office-using employees is projected to reach 13,018 employees by 2005 and will ultimately reach 19,785 employees by 2020.

Office Space Potential - County of Hawaii

Based on the projected growth of population and the resultant growth in office-using employees, there exists a strong market for office space for the County of Hawaii, Table 27 presents the projected demand for office space for the County. Office space required per employee is anticipated to increase from 200 square feet per employee in 1987 to 230 square feet per employee by 2020. Based on these requirements the projected demand for office space should reach 2.8 million square feet by 2020.

Office Space Potential - West Hawaii

Given the recent and anticipated growth of the West Hawaii area, there exists a strong demand for office space in the area. This demand is confirmed by real estate brokers knowledgeable about the West Hawaii area. In addition, the occupancy rates of existing buildings in North Kona currently approach 99 percent suggesting a strong demand for more facilities.

The anticipated growth for the West Hawaii area will undoubtedly require that governmental facilities be offered in the area. Governmental facilities constitute a major source of demand for office space. In addition to the governmental facilities other private sector office users such as law offices and banking will likely be attracted to the area.

Assuming a 50 percent capture rate of the County demand, it is projected that West Hawaii will capture 1.4 million square feet of office space by 2020.

Office Space Potential-QLT Property

The site has excellent potential for office space. The site is located near employee generating areas such as the airport, the Kona Industrial Subdivision, and the Kona Central Business District. In addition, there is an opportunity to work with the County to provide a West Hawaii Civic Center/Government facility. Based on these factors, it is assumed that the QLT Property can capture 35 percent of the West Hawaii demand, or 487 thousand square feet of space by 2020. This demand can be distributed by time period and acreage as follows:

Table 26
PROJECTIONS OF OFFICE USING EMPLOYMENT
COUNTY OF HAWAII
1980 - 2020

	1980	1985	1987	1990	1995	2000	2005	2010	2015	2020
Population	92,100	109,500	117,500	124,500	142,500	160,400	180,800	206,100	233,200	263,800
Total Employment	28,300	32,000	35,100	38,625	44,531	50,525	57,484	65,952	75,790	86,375
Employees/ 1000 Population	30.73%	29.22%	29.87%	31.00%	31.25%	31.50%	31.75%	32.00%	32.50%	32.75%
Office Employees/ 1000 Population	57.21	59.30	62.94	66.00	68.00	70.00	72.00	73.00	74.00	75.00
Office Using Employment	5,269	6,494	7,395	8,224	9,698	11,228	13,018	15,045	17,257	19,785

Source: Hawaii Department of Labor and Industrial Relations; DBED; M.M.

Table 27
PROJECTED DEMAND FOR OFFICE SPACE
COUNTY OF HAWAII AND THE QLT PROPERTY
1987 - 2020

	1987-1990	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020
Change in Office Using Employment	829	1,466	1,538	1,790	2,028	2,212	2,528
Cumulative Increase in Office Using Employment	829	2,295	3,833	5,623	7,650	9,862	12,390
Office Space Required Per New Employee (In Square Feet)	200	210	220	230	230	230	230
Office Space Required Per Period	165,720	307,944	338,360	411,690	466,371	508,645	581,486
Cumulative Office Space Required	165,720	473,664	812,024	1,223,632	1,690,003	2,198,648	2,780,134
WEST HAWAII MARKET POTENTIAL							
Capture Rate	50%	50%	50%	50%	50%	50%	50%
Office Space Required Per Period	82,860	153,972	169,180	205,844	233,185	254,323	290,743
Cumulative Office Space Required	82,860	236,832	406,012	611,816	845,002	1,099,324	1,390,067
QLT PROPERTIES MARKET POTENTIAL							
Capture Rate of West Hawaii	35%	35%	35%	35%	35%	35%	35%
Office Space Required Per Period	29,001	53,890	59,213	72,031	81,615	89,013	101,760
Cumulative Office Space Required	29,001	82,891	142,104	214,136	295,751	384,763	486,523

Source: Hawaii Department of Labor and Industrial Relations; DBED; M.M.

OFFICE SPACE POTENTIAL
QLT PROPERTY

Period	Square Feet	Acreage
1990-1995	82,891	8.3
1995-2000	59,213	5.9
2000-2005	72,031	7.2
2005-2010	81,615	8.2
2010-2015	89,013	8.9
2015-2020	101,760	10.2
Total	486,523	48.7

D. ANALYSIS OF LIGHT INDUSTRIAL MARKET POTENTIALS

The following section examines the market potentials for light industrial space on the QLT Property through an examination of current and future market trends as well as a review of the existing and planned supply of light industrial space on the Island.

Existing and Planned Light Industrial Activity in West Hawaii

With the exception of some agricultural processing, there is little heavy industry or large scale manufacturing currently in operation in West Hawaii. A field survey was conducted in order to identify those areas in which industrial activities are located and to determine the types of industrial activity presently active in this region. The survey indicated that there are four major light industrial areas in the Kailua-Kona area comprising a total of 1,113 developable acres and a port-oriented, heavy industrial (primarily bulk loading) facility in Kawaihae. The light industrial parks which represent the major competitive supply of industrial space are reviewed below:

Kona Industrial Subdivision. The Kona Industrial Subdivision is owned by QLT and consists of 50 acres located in close proximity to the Kona Central Business District. The subdivision is completely built out with a mix of retail, service and industrial uses. At present there are 45 buildings or building complexes totalling over 800,000+ square feet of leasable space. Currently this space is 92 percent occupied, a figure somewhat misleading insofar as the only vacant space is found in older structures such as the Crown Building. After discounting for the lesser quality facilities, the space is virtually 100 percent occupied. The lease rates range from $0.42 to $1.25 per square foot rented on a triple net basis. The wide variation in lease rates can in large part be attributed to the fact that there exists a wide variety of activities in the subdivision, particularly the retail space which achieves the higher rents. Technically, retail uses should not be permitted within the subdivision, though County officials are not very strict in enforcing the zoning code for the area. The Planning Department has further indicated that the zoning of the subdivision may change to a mixed-use designation which would allow for retail space.

Kaloko Industrial Park. The Kaloko Industrial Park developed by TSA International, Ltd., is located near Kona's Keahole Airport and has a total potential development area of 194 acres. The first phase of development consists of 55 one-acre lots, all of which have been sold and approximately 30% of which have been improved and leased.

Natural Energy Laboratory of Hawaii (NELH). This industrial facility was established in 1974 at Keahole Point, and has a total potential development area of 322 acres. As the NELH conducts ocean and solar energy research, the primary emphasis of this development is focused on research and development-related activities. The project is funded by the State of Hawaii, the United States Department of Energy and private investors. Two of its major tenants include Ocean Farms of Hawaii and Cyanotech, both commercial aquaculture projects.

Hawaii Ocean Science and Technological Park (HOST). The HOST park was established in 1988 on a site adjacent to the NELH facility at Keahole Point. The project, reportedly funded by the State of Hawaii (estimated level of commitment $18 million) with the support of the U.S. Department of Energy and the County of Hawaii will provide 547 acres for development with high-tech uses which can advantage of the available pure water and other natural resource opportunities.

In addition to the industrial parks identified above there are five proposed industrial developments which have been identified as potentially competitive with industrial land provided at the QLT site. These five projects include the following:

- Ooma, a 50-acre site which is part of a proposed resort complex, is located adjacent to the HOST park which is being reserved for future high tech industrial usage;
- Hawaiian Home Lands, a 154-acre property located along the Kawaihae-Mahukona Highway at the boundary between the North and South Kohala districts to be developed with one- and two-acre sites;
- Signal Puako property, a 50-acre site lying mauka of the Queen Kaahumanu Highway near the Mauna Lani Resort;
- Lanihau, a 103-acre property proposed for development by Lanihau Partners LP and Palani Land Trust as part of a larger mixed use project consisting of 1,325 acres.
- Keahuolu Property, a 100-acre site owned by QLT which has received zoning to effectively expand its existing Kona Industrial subdivision with 76 lots ranging in size from one to two acres.

Together, these proposed projects represent a total of 457 acres of industrially-developable property, thus representing a potential future inventory of competitive industrial land.

Potential for Light Industrial Development in West Hawaii

The potential for major development of industrial activities on the Island of Hawaii in the immediate future would appear to be limited for a number of reasons:

- The State of Hawaii represents a relatively small local or regional market;
- There is substantial existing competition from both mainland and far eastern industrial centers;
- Hawaii offers relatively high local costs for labor, raw materials, and transportation services.

In addition, in some important respects there are significant shortages on the Big Island with respect to a skilled labor force having the ability to fulfill "high-tech" or other skilled manufacturing positions, and few educational programs or technical schools on the Big Island which can train the local population for such positions. Finally, high land values together with the State's tax structure have also been cited as potential constraints on industrial growth.

While it can be argued that West Hawaii is unlikely to emerge as a major industrial manufacturing center, the present and likely future mix of local economic activities should engender a substantial demand for industrial land. Those businesses which should require industrial land in the future include:

- Automobile-oriented activities serving both visitors and local residents, such as car rental agencies, auto storage areas, auto repair shops, and other transportation-related services;
- Wholesalers serving retail, restaurant and hotel operations who need warehousing facilities;
- Cottage industries producing such items as traditional handicrafts, sports equipment, and apparel manufacturing;
- Businesses providing services and supplies to the building industry;
- Contract construction storage yards and other storage facilities, including public storage; and
- Local consumer-oriented businesses which can be supported by the expanding local population base such as bakeries, printing companies and various repair services.

Over the projection period 1989 through 2020, these expanding activities are likely to require between and 10 and 15 acres annually, or between 300 and 450 acres in total.

Potential for Industrial Development at the QLT Site

The QLT property has a number of locational advantages which make it a desirable site for industrial activities. The property has excellent regional road access from the Queen Kaahumanu Highway, the prime arterial serving the West Hawaii area and is within a short distance of the mauka-makai roadways connecting to the upper roadways and the local resident population base. The property is also centrally-located with respect to existing businesses, Kona hotels, and the Keahole Airport. Over time portions of the QLT site could logically serve as expansion areas for the existing 50-acre Kona Industrial Park and its 100-acre second phase which is already zoned and undergoing development. A total of 100 acres should be reserved for this use, with the phasing of development scheduled to occur subsequent to major build-out of the previously-identified second phase of the Kona Industrial Park.

E. ANALYSIS OF HOTEL AND VISITOR-ORIENTED RESIDENTIAL POTENTIALS

The following section examines the market potential for visitor accommodations for the QLT Property. The analysis covers the demand for hotel facilities as well as for visitor-oriented residential units. The demand is based on anticipated future tourist/business activity and the existing and the projected supply of hotels and visitor-oriented residential units.

Visitor Forecast, State of Hawaii and County of Hawaii

Table 28 presents historical data for Westbound visitors to the County of Hawaii and total State visitors from 1975 through 1988. The estimated 787.9 thousand westbound visitors to the County of Hawaii in 1988 represent an increase of only 18.1 thousand visitors over the 1975 figure. From 1975 to 1988 the annual growth rate of westbound visitors was less than 1 percent reflecting a slow growth rate in terms of actual visitors. Westbound visitors to the County of Hawaii as a percent of total State visitors has decreased steadily from 27.2 percent in 1975 to a low of 12.8 percent in 1988. This trend in large part can be attributed to the growth of major tourist areas such as Kaanapali and Wailea in Maui, and Poipu Beach and Princeville in Kauai, combined with a comparative lack of new, unique facilities in the County of Hawaii.

Recent trends in the growth rate of Westbound visitation do not accurately portray future visitation patterns for the County. With the recent opening of the Hyatt Regency Waikoloa and the planned opening of the Ritz Carlton the tourist industry looks promising for West Hawaii. Nationally recognized hotel chains such as these will attract visitors who are seeking newer facilities.

As shown in Table 29 westbound visitors to the County of Hawaii are expected to increase not only in actual number of tourists but also as a percent of the total state visitors from their current levels. Westbound visitors to Hawaii County are projected to reach 2,720,000 persons in 2020. This would represent 18.5 percent of the projected state total of visitors. Westbound visitors are projected to increase following the maturation of the Hyatt Regency Waikoloa and the development of internationally recognized hotels as the Ritz-Carlton at Mauna Lani Resort and the proposed Prince Hotel at the Mauna Kea Resort.

Recent trends have shown a significant increase in the number of eastbound travelers to the neighbor islands. In 1988 approximately 126,000 eastbound travelers visited the County of Hawaii. The strength of the Yen and existing surplus in the Japanese economy in large part can explain the increase in the number of eastbound travelers. The number of eastbound visitors is projected to reach 315,000 thousand persons by 2020.

With the continued growth in the number of eastbound visitors, total visitors to Hawaii are projected to reach 3,035,000 persons by 2020. This represents 20.6 percent of the projected total of visitors to the State. Over the 35 year period 1985 to 2020 the annual growth rate of total visitors is projected to be 3.2 percent as

Table 29
PROJECTED STATE OF HAWAII AND BIG ISLAND VISITATION
1985-2020
(In 000's)

	1985	1986	1990	1995	2000	2005	2010	2015	2020	Annual % Growth 1985-2020
Total State Visitors (MLW)	4,884	6,125	6,500	7,750	9,000	10,150	11,500	13,000	14,700	3.20%
County of Hawaii Visitors										
Westbound	697	788	923	1,163	1,440	1,726	2,013	2,340	2,720	
Eastbound	105	126	155	185	205	225	255	285	315	
Total Co. of HI Visitors	802	914	1,078	1,348	1,645	1,951	2,268	2,625	3,035	3.87%
Westbound Co. of HI Visitors as Percent of Total State	14.28%	12.84%	14.20%	15.00%	16.00%	17.00%	17.50%	18.00%	18.50%	
Total Co. of HI Visitors as Percent of Total State	16.42%	14.90%	16.58%	17.39%	18.28%	19.22%	19.72%	20.19%	20.64%	

Sources: Hawaii Visitors Bureau (HVB); Highlights of Japanese Visitors To Hawaii, 1987, Page 1; DBED (Series H-4, Table 9); MLW.

Table 28
WESTBOUND COUNTY OF HAWAII VISITORS AS PERCENT OF TOTAL STATE VISITORS
(In 000's)

Year	Westbound Co. of HI Visitors	Total State Visitors	Westbound Co. of HI Visitor As % Of Total
1975	769.8	2,829.1	27.2%
1976	816.5	3,220.2	25.4%
1977	839.0	3,433.7	24.4%
1978	909.0	3,670.3	24.8%
1979	860.9	3,960.5	21.7%
1980	761.1	3,934.5	19.3%
1981	672.7	3,934.6	17.1%
1982	678.2	4,242.9	16.0%
1983	712.4	4,368.1	16.3%
1984	760.9	4,855.6	15.7%
1985	697.4	4,884.1	14.3%
1986	786.9	5,607.0	14.0%
1987	782.6	5,799.8	13.5%
1988	787.9	6,134.9	12.8%
Annual Percentage Growth, 1975-1988	0.18%	6.13%	

Note: Figures for 1988 are preliminary estimates provided by the Hawaii Visitors Bureau (HVB).

Sources: Department of Business and Economic Development (DBED); Data Book 1984, Table 214; Data Book 1988, Tables 198, 201; Natelson-Levander-Whitney, Inc. (NLW).

as compared to 3.9 percent annual growth rate for visitors to the Island of Hawaii. The forecast is premised on the following major considerations with regard to the Island's tourist market.

- o There should be increasing growth in the eastbound traveler segment of the County of Hawaii tourist market, approximately 72 percent of which is currently of Japanese origin. Moreover, as the eastbound traveler becomes more familiar with the neighbor islands, an increasing number of this market should be encouraged to stay overnight or longer instead of limiting their visit to a single day-trip from Honolulu.

- o An increase in the supply of high quality visitor-oriented accommodations, both hotel and condominiums, should support more tourists on the County of Hawaii.

Table 30 compares visitor growth projections prepared by the State Department of Business and Economic Development (DBED) with the NLW forecast. The NLW forecast, based upon long-term growth trends, suggests a visitor count in 2020 which is nearly identical to the projected DBED figure Series M-K report of 14.7 million State visitors. The Series M-K report represents a revision of the Series M-F report of 1984 which substantially underestimated State visitation.

Visitor Accommodation Forecast, Hawaii County and West Hawaii

Table 31 shows the projected accommodation demand for Hawaii County from 1985 to 2020. The forecast was derived by analyzing historical data collected by the DBED and the Hawaii visitor's average length of stay on the Island, average party size, and relative distribution of visitors staying in hotel accommodations vis a vis visitor-oriented residential units. Based on current visitation patterns and occupancy characteristics, the average party size has decreased to an estimated 1.83 persons. The average visitors length of stay must be distinguished between westbound and eastbound tourists. Westbound visitors average nearly 5 nights per visit while eastbound visitors average nearly 2 per visit. The average percent of visitors staying in hotel/condominium accommodation is 90 percent. As such, the County of Hawaii's accommodation demand is projected to reach 19,383 units in 2020 based upon current and future visitation patterns and occupancy characteristics.

The allocation of Hawaii County accommodation requirements by general location and facility type for the period 1985 to 2020 is presented in Table 32. It is projected that in 2005, and allowing for a conservative 70.0 percent occupancy rate, 11,513 hotel rooms will be supportable in the County of Hawaii. With respect to visitor-oriented residential units (condominiums, apartments, single-family homes, camping facilities, cottages, etc.) and allowing a 65 percent occupancy rate, 6,676 units will be supportable in 2005. It is projected that on an island-wide basis, hotel room demand in 2020 will support 17,998 rooms at a 70 percent annual occupancy rate. This represents a potential increase in supportable rooms of 12,852 or 402 rooms per year over the 32-year period 1988 to 2020. The visitor-oriented residential unit demand will support 10,437 units by 2020 at an annual occupancy level of 65 percent. The projected increase in supportable units over the 32-year projection period is

Table 30
COMPARISON BETWEEN NLW AND DBED FORECASTS OF STATE VISITATION
1985-2020
(In 000's)

	1985	1988	1990	1995	2000	2005	2010	2015	2020
NLW Forecast	4,864	6,135	6,500	7,750	9,000	10,150	11,500	13,000	14,700
DBED Forecast (Series M-K, 1988)	4,864	6,135	6,521	7,746	8,979	10,159	11,494	13,004	14,713
DBED Forecast (Series M-F, 1984)	5,000	6,135	6,863	7,852	7,786	8,183	—	—	—
NLW as % of DBED Series M-K Model	100.00%	100.00%	99.65%	100.05%	100.23%	99.91%	100.05%	99.97%	99.91%

rces: DBED (Series M-K, Table 9; Data Book 1984, Table 217); N.W.

Table 31
PROJECTED COUNTY OF HAWAII ACCOMODATION DEMAND
1985-2020

	1985	1988	1990	1995	2000	2005	2010	2015	2020
Total Co. of HI Visitors (In 000's)									
Westbound	657	788	923	1,163	1,448	1,726	2,013	2,340	2,720
Eastbound	185	126	155	185	205	225	255	285	315
Total Visitors	842	914	1,078	1,348	1,645	1,951	2,268	2,625	3,035
Average Length of Stay in Nights									
Westbound	4.2	4.9	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Eastbound	1.0	2.0	2.2	2.5	3.0	3.0	3.0	3.0	3.0
Total Visitor Nights in Co. of HI (In 000's)									
Westbound	2,936	3,861	4,615	5,813	7,298	8,628	10,063	11,700	13,598
Eastbound	189	253	341	463	615	675	765	855	945
Total Visitor Nights	3,125	4,113	4,956	6,275	7,915	9,303	10,828	12,555	14,543
Average Daily Census	8,562	11,269	13,578	17,192	21,411	25,486	29,664	34,397	39,842
Average Party Size	1.85	1.83	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Percentage of Visitors Staying in Hotel/Condominium Accomodations	90%	90%	90%	90%	90%	90%	90%	90%	90%
Projected Co. of HI Accomodation Demand	4,165	5,542	6,686	8,364	10,416	12,399	14,431	16,734	19,383

Sources: DBED (Data Book 1988, Tables 201, 208);
HVB (Japanese Visitors 1987, Page 71, MLH.

Table 32
ALLOCATION OF COUNTY OF HAWAII ACCOMODATION DEMAND
BY FACILITY TYPE AND LOCATION
1985-2020

	1985	1988	1990	1995	2000	2005	2010	2015	2020
Projected Average Daily for Accomodation Demand	4,165	5,542	6,686	8,364	10,416	12,399	14,431	16,734	19,383
Projected Allocation by Unit Type - (1):									
Hotel	53%	65%	65%	65%	65%	65%	65%	65%	65%
Condo/Other	47%	35%	35%	35%	35%	35%	35%	35%	35%
Net Co. of HI Hotel Room Requirement	2,207	3,602	4,294	5,436	6,770	8,059	9,380	10,877	12,599
Supportable Rooms @ Occupancy of 70.0%	3,154	5,146	6,134	7,766	9,672	11,513	13,401	15,539	17,998
Net Co. of HI Condo/Other Unit Requirement	1,958	1,940	2,312	2,927	3,646	4,340	5,051	5,857	6,784
Supportable Units @ Occupancy of 65.0%	3,012	2,984	3,557	4,503	5,609	6,676	7,771	9,011	10,437
TOTAL VISITOR ACCOMODATION REQUIREMENT	6,165	8,131	9,691	12,270	15,281	18,189	21,171	24,549	28,435
Allocation of Demand By General Location									
A. WEST HAWAII									
Hotel Market Share	68.1%	88.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Condo/Other Market Share	90.0%	91.5%	91.5%	91.5%	91.5%	91.5%	91.5%	91.5%	91.5%
Hotel Room Demand	1,327	2,911	3,650	4,621	5,755	6,850	7,973	9,245	10,709
Condo/Other Demand	1,762	1,775	2,115	2,678	3,336	3,971	4,622	5,359	6,207
Total West Hawaii Accomodation Demand	3,089	4,686	5,765	7,299	9,091	10,821	12,595	14,604	16,916
B. REST OF THE ISLAND									
Hotel Market Share	31.9%	12.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Condo/Other Market Share	10.0%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%
Hotel Room Demand	881	692	644	815	1,016	1,209	1,407	1,632	1,890
Condo/Other Demand	176	165	197	249	310	369	429	498	577
Total Rest of the Island Accomodation Demand	1,077	857	841	1,064	1,325	1,578	1,836	2,129	2,466

(1) - Change in allocation in 1988 due to opening of Hyatt Regency Waikoloa.

Sources: HVB (Visitor Plant Inventory (1987); MLH.

7,453 units or 233 units on an annual basis. The combined projections total 28,435 supportable units at the respective occupancy rates and represent a 250 percent increase in the total number of supportable hotel rooms and visitor-oriented residential units over the 32-year period 1988 to 2020.

Between 1988 and 2020 the percent allocation of demand between hotel rooms and visitor-oriented residential units is likely to remain relatively constant. In 1988 hotel units represented 65 percent of the visitor inventory while visitor-oriented residential units comprised 35 percent. The high percentage of hotel units can in part be attributed to the opening of the Hyatt Regency Waikoloa. It is likely that the future distribution will be approximately 65 percent hotel units and 35 percent visitor-oriented residential units.

Finally, the geographic distribution of tourist demand in the County is projected in Table 32, effectively dividing the market between West Hawaii and the rest of the Island. West Hawaii's hotel market share in 1988 was estimated to be nearly 81 percent of all units in the County. West Hawaii's projected capture is expected to initially increase slightly to 85 percent by 1990 and level off at that point until 2020. The projected increase is consistent with the planned development of the Ritz Carlton and other hotels. West Hawaii's visitor-oriented unit market share of the County's total number of such units devoted to tourist use was estimated in 1988 at nearly 92 percent. The projected capture rate is expected to remain relatively constant through 2020.

Table 33 presents a translation of West Hawaii visitor accommodation demand into a range of supportable units by facility type. Supportable hotel rooms are projected for the period 1988 to 2020 utilizing alternative 70 percent and 65 percent occupancy levels. These occupancy rates are conservative in light of recent trends. Assuming a 70 percent occupancy rate, the number of supportable hotel rooms on West Hawaii in 2020 is projected to reach 15,299 rooms. This is an increase of 268 percent from the measure of 4,158 rooms considered supportable in 1988. Supportable visitor-oriented residential units available for tourist use are forecast using alternative 60 percent and 55 percent occupancy levels. Allowing a 60 percent occupancy rate for visitor-oriented residential units, 10,346 units will be supportable on West Hawaii in 2020. This represents a 250 percent increase over the 2,958 units determined to be supportable in 1988.

Table 33
TRANSLATION OF WEST HAWAII ACCOMODATION DEMAND
INTO SUPPORTABLE ROOMS
1985-2020

		1985	1988	1990	1995	2000	2005	2010	2015	2020
A. HOTEL ROOMS										
Projected Demand		1,327	2,511	3,650	4,621	5,755	6,850	7,973	9,245	10,789
Supportable Rooms @ Occupancy of	70.0%	1,895	4,158	5,214	6,601	8,221	9,786	11,390	13,208	15,299
Supportable Rooms @ Occupancy of	65.0%	2,041	4,478	5,615	7,109	8,854	10,539	12,267	14,224	16,475
B. CONDO/OTHER										
Projected Demand - (1)		1,752	1,775	2,115	2,678	3,336	3,971	4,622	5,359	6,207
Supportable Rooms @ Occupancy of	60.0%	2,936	2,958	3,526	4,464	5,560	6,618	7,703	8,932	10,346
Supportable Rooms @ Occupancy of	55.0%	3,203	3,227	3,846	4,870	6,065	7,219	8,403	9,744	11,286

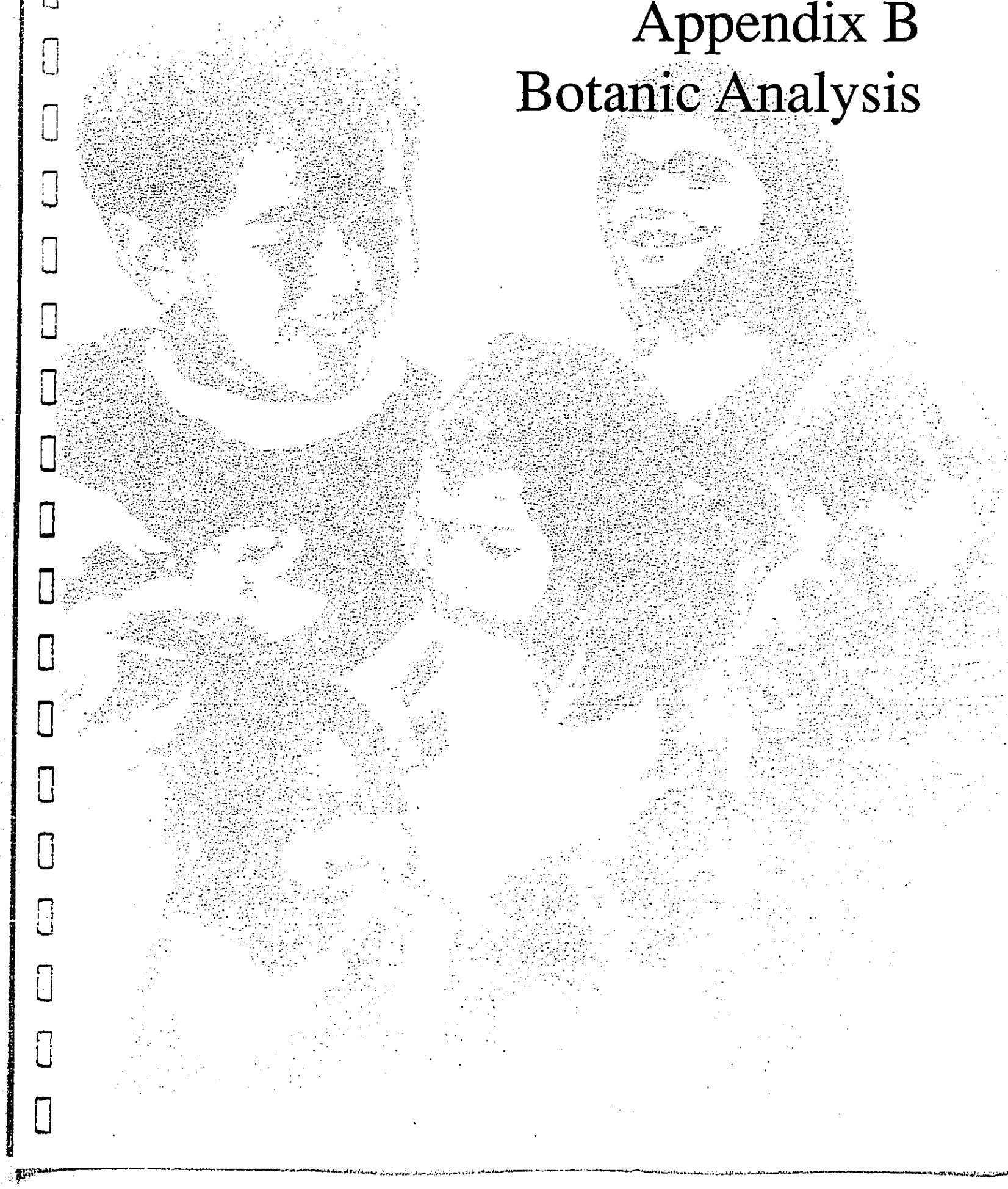
(1) - Short-term reduction in demand caused by introduction of Hyatt Regency Waikoloa into the market.

Source: M.M.

Existing Hotel Inventory

Table 34 shows the existing hotel inventory in the County of Hawaii in 1989. Of the existing inventory of 6,167 hotel rooms, 5,095 rooms or 82.6 percent were located in the West Hawaii area. Of the Island of total, nearly 43 percent, or 2,547 units were located in the Kona Coast Area. There is a wide range of hotel accommodations available ranging in price from $35 to $490 per night, double occupancy. Suites are also offered at various hotels with the most expensive suite being offered for $2,500 per night at the Hyatt Regency Waikoloa.

Appendix B
Botanic Analysis



BOTANICAL SURVEY
QUEEN LILI'UOKALANI TRUST PROPERTY
KEAHUOLU LANDS, KAILUA-KONA, HAWAI'I

by

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Prepared for: BELT COLLINS & ASSOCIATES
May 1989

BOTANICAL SURVEY
QUEEN LILI'UOKALANI TRUST PROPERTY
KEAHUOLU LANDS, KAILUA-KONA, HAWAI'I

INTRODUCTION

The Queen Lili'uokalani Trust (QLT) has selected Belt Collins and Associates to prepare an Environmental Impact Statement and State Land Use Boundary Petition for a portion of its ±4,000-acre Keahuolu lands. The parcels proposed for the boundary amendment comprise approximately 1,100 acres and are identified as THK 7-4-8: por. 2, por. 12. The irregularly-shaped project site is divided by the Queen Ka'ahumanu Highway into two parcels. The smaller of the two parcels, located below the highway, is here referred to as the "makai parcel"; the larger parcel above the highway is the "mauka parcel". These two parcels will be proposed for Urban designation.

Field studies to assess the botanical resources on the project site were conducted on April 26 to 28, 1989. A total of three botanists were used to gather the technical data contained in this report. The primary objectives of the field studies were to 1) provide a general description of the major vegetation types; 2) inventory the terrestrial, vascular plants; and 3) search for threatened or endangered plant species on the project site.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical or biological studies conducted in the

general area. Topographic maps and recent aerial photographs were examined to determine access points, terrain characteristics, boundaries and reference points, and vegetation patterns.

Access onto areas makai of the Queen Ka'ahumanu Highway was by means of a paved road which services the Queen Lili'uokalani Childrens Center Keahuolu Camp. Palani Road and the unpaved road to the abandoned quarry, as well as several bulldozed paths (dozer walks) which appear to randomly cross the project site, served as access onto the mauka area. From these access points, transects were made. A walk-through survey method was used. Areas most likely to harbor native species such as the Canthium/Christmas berry shrubland were more intensively examined. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Species were identified in the field; plants which could not be positively determined were collected for later determination in the herbarium and for comparison with the taxonomic literature.

The species recorded are indicative of the season (rainy vs. wet) and environmental conditions under which this survey was made. Surveys taken at different times of the year and under varying environmental conditions, would no doubt yield slight variations in the species list especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

For the most part, the vegetation on the project site is dominated by introduced or alien species. On the makai parcel, the introduced fountaingrass along with scattered trees and shrubs of various species forms and open scrub. On the mauka parcel, kiawe forest with dense fountaingrass ground cover covers one-half of the parcel with the remainder occupied equally by scrub vegetation and Canthium/Christmas berry shrubland. In the

Canthium/Christmas berry shrubland vegetation, Canthium odoratum, an indigenous native species, is codominant with the introduced Christmas berry. This shrubland also supports a number of other native elements not found elsewhere on the site. A detailed description of the three major vegetation types is presented below.

A list of all those vascular plant species inventoried during the field studies is presented at the end of the report. Maintained or landscaped areas as around the Queen Lili'uokalani Childrens Center Keahuolu Camp facility and the row of planted windbreak material near the Kailua-Kona Industrial Park boundary were not included in the species list.

Scrub Vegetation

This vegetation type covers all of the makai parcel and a portion of the mauka parcel, roughly 100 acres, adjacent to the highway and the Kealakehe County Sanitary Landfill. Slope in these areas is 0-5% and rainfall is between 20 to 30 inches per year. Fountaingrass (Pennisetum setaceum) with scattered shrubs and kiawe (Prosopis pallida) trees typifies this vegetation type. Since its introduction into the Kona District in the early 1900s as an ornamental (Wagner et al. in press), fountaingrass has aggressively spread and now dominates much of the lowland areas along West Hawai'i, doing especially well on lava flows and burn areas.

On the site, fountaingrass cover may vary from 40 to as much as 80%; it is particularly dense in the area mauka of the highway. Kiawe trees from 9 to 20 ft. tall occur as scattered individuals or as small stands of trees. Christmas berry (Schinus terebintifolius), koa-haole (Leucaena leucocephala), and klu (Acacia farnesiana) shrubs are often associated with these small stands of trees. In some low-lying areas (swales), koa-haole may

form dense thickets from 6 to 12 ft. tall. Smaller shrubs common to occasional in the scrub vegetation include 'ilima (Sida fallax), 'uhaloa (Waltheria indica), maiapilo (Capparis sandwichiana), lantana (Lantana camara), and noni (Morinda citrifolia). Other grass species are a minor component in this vegetation type, although, in places, Natal redtop (Rhynchelytrum repens) may be locally abundant.

Minor variations of the scrub vegetation may occur where there are differences in substrate types, past disturbances, drainage patterns, etc. For example, scattered throughout the scrub are large pahoehoe knolls; these are usually barren except for a few plants of hairy sword fern (Nephrolepis multiflora) and kumu-niu (Doryopteris decora). Areas containing young 'a'a flows as well as areas which have been recently bulldozed support sparser vegetation, usually weedy annuals.

Kiawe Forest

On the drier, leeward sides of all the main Hawaiian Islands, the lowland vegetation near the coasts is often characterized by kiawe (Prosopis pallida) forests. This vegetation type is usually very species-poor and consists almost exclusively of species introduced since the 19th century (Wagner et al. in press).

On the project site, the kiawe forest occupies a large portion of the mauka parcel, from the highway to about 400 ft. elevation, and occurs on old, broken pahoehoe and older 'a'a flows. It may vary from open (canopy cover lees than 60%) to closed (canopy cover greater than 60% and crowns of trees interlocking) with the open canopy situation being most common. Trees vary from 15 to 25 ft. in height, although some large trees, 30 to 40 ft. tall, can be found along the old quarry road area. In places, koa-haole (Leucaena leucocephala) shrubs may form a subcanopy layer. Other trees and larger shrubs found scattered through this vegetation

type include Christmas berry (Schinus terebinthifolius), pluchea (Pluchea symphytifolia), 'opiuma (Pithecellobium dulce), klu (Acacia farnesiana), and a few plants of the endemic wiliwili (Erythrina sandwicensis).

Fountaingrass (Pennisetum setaceum) is very dense in this vegetation type, even where the forest cover is closed, thus there are few other species. Most of the smaller shrubs, grasses, and herbaceous material occur along roadsides, bulldozed areas, and the old quarry where the fountaingrass cover has been disturbed. Some of the more frequently encountered plants in these areas are Florida beggarweed (Desmodium tortuosum), Natal redtop (Rhynchyletrum repens), 'uhaloa (Waltheria indica), 'ihi (Portulaca pilosa), red-flowered boerhavia (Boerhavia coccinea), partridge pea (Chamaecrista nictitans), virgate mimosa (Desmanthus virgatus), and love grass (Eragrostis tenella). Where Palani Road intersects Queen Ka'ahumanu Highway, near the "runaway truck ramp", Guinea grass (Panicum maximum) is locally abundant under the kiawe forest, displacing the ubiquitous fountaingrass.

Canthium/Christmas berry Shrubland

This vegetation type generally occurs above 400 ft. elevation on the mauka parcel, although smaller areas of shrubland may extend down into the kiawe forest. This portion of the mauka parcel receives between 30 to 45 inches of rainfall per year. Canthium/ Christmas berry shrubland occurs on very rocky substrates consisting primarily of geologically younger 'a'a flows or, in places, on rough, broken pahoehoe flows with numerous rocky outcrops.

Canthium odoratum or alahe'e and Christmas berry (Schinus terebinthifolius) are of equal dominance (codominant) in this vegetation type. These two species form a dense thicket, from 12 to 18 ft. tall; botanizing is difficult. Ground cover is about

40% with the rugged 'a'a largely bare. Unlike the other two vegetation types on the project site, fountaingrass is rare in the shrubland. Low-lying areas accumulate slightly more runoff and debris so support a dense growth of mixed species, usually weedy; these include lantana (Lantana camara), Natal redtop (Rhynchelytrum repens), molassesgrass (Melinis minutiflora), guava (Psidium guajava), and air plant (Kalanchoë pinnata).

Many native species are associated with this vegetation type. These include 'ohe (Reynoldsia sandwicensis), mamane (Sophora chrysophylla), lama (Diospyros sandwicensis), uhiuhi (Senna gaudichaudii), huehue (Cocculus trilobus), 'ala'ala-wai-nui (Peperomia leptostachya), 'ulei (Osteomeles anthyllidifolia), maiapilo (Capparis sandwichiana), 'ilima (Sida fallax), and a'ali'i (Dodonaea viscosa). Although the last three species mentioned above also occur throughout the project site, they reach their greatest abundance in this vegetation type.

THREATENED AND ENDANGERED SPECIES

During the field studies, a more intensive search was made of the Canthium/Christmas berry shrubland as these areas were most likely to harbor native plants. The officially listed, endangered Caesalpinia kavaiensis (formerly Mezoneuron kavaiense) has been recorded from similiar dry shrubland types on the slopes of Hualalai from Pu'u-wa'awa'a to Kalaoa ahupua'a (Lamoureux 1982; Linney and Char 1988). No plants of Caesalpinia were found. Nor were there any other officially listed, proposed or candidate threatened or endangered plants (U. S. Fish and Wildlife Service 1985; Herbst 1987) on the project site.

While none of the native species on the site such as mamane (Sophora chrysophylla), uhiuhi (Senna gaudichaudii), 'ohe (Reynoldsia sandwicensis) or maiapilo (Capparis sandwichiana) are considered rare or depleted (Wagner et al. in press) at

present, continued development within the lower elevation habitats will no doubt eventually cause these lowland populations to become uncommon or rare, in some cases.

DISCUSSION AND RECOMMENDATIONS

Introduced or alien species dominate much of the vegetation on the project site. Scrub vegetation composed of fountaingrass with scattered kiawe trees and shrubs covers all of the makai parcel and a portion of the mauka parcel. Kiawe forest with dense fountaingrass ground cover occupies the majority of the mauka parcel. Only in the Canthium/Christmas berry shrubland do natives become significant components.

A total of 148 plant species were inventoried on the project site. Of these, 116 (78%) are introduced species; six (4%) are originally of Polynesian introduction; and 26 (18%) are native to the Hawaiian Islands. Of the native species, 17 are indigenous, i.e., they are native to the islands and also elsewhere through the Pacific, and nine are endemic, i.e., they are native only to the islands.

None of the native plants found on the project site are officially listed, proposed or candidate threatened or endangered species. While none are considered rare or depleted at present, future development of lowland habitats will no doubt cause these lowland populations to become uncommon.

It is recommended that use of native plants for landscaping be considered. Native plants on the site are already adapted to the site's climatic conditions and would therefore require less maintenance. Among the more "ornamental" natives are:

- Wiliwili (Erythrina sandwicensis): A medium-sized tree, fast growing, with rounded crown. Flower colors vary from fiery

orange to yellow to white to chartreuse. The striking color polymorphism found in this Hawaiian endemic is considered unique among the Erythrina. This species does not produce large, messy pods like the introduced Erythrina variegata which is commonly used for landscaping.

- Mamane (Sophora chrysophylla): A small-sized tree to large shrub with numerous bright-yellow flowers in hanging clusters. Suitable for planting on the upper portions of the mauka parcel.

- Uhiuhi (Senna gaudichaudii): Same growth habit as the mamane with flowers in apple-green to pale yellow (occasionally tinged red) clusters.

- 'Ohe (Reynolsia sandwicensis): Medium to large tree, very stately with straight trunk and spreading crown. Bark reddish and lacquered.

- Naiapilo (Capparis sandwichiana): A large, sprawling shrub which does well on 'a'a. Flowers white, showy, fragrant. Related to the commercial caper (Capparis spinosa).

- Alahe'e (Canthium odoratum): A member of the Coffee Family, this medium-sized shrub to small tree has glossy, dark green leaves and very fragrant white flowers borne in dense clusters.

PLANT SPECIES LIST -- Queen Lili'uokalani Trust Property

Following is a checklist of all those vascular plants inventoried during the course of the field studies. Plant families are arranged alphabetically within each of three groups: Ferns and Fern Allies, Monocots, and Dicots. Taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux (1984); the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (in press). In most cases, common English and/or Hawaiian names given follow St. John (1973) or Porter (1972).

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 but also occurring in one or more other geographic area(s)
   P = Polynesian = plants of Polynesian introduction prior to Western contact (1778); not native
   X = introduced or alien = all those plants brought to the islands 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 discussion):
   S = Scrub Vegetation
   K = Kiawe Forest
   C = Canthium/Christmas berry Shrubland

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
FERNS & FERN ALLIES					
NEPHROLEPIADACEAE (Sword Fern Family)					
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X	+	-	+
POLYPODIACEAE (Common Fern Family)					
Phlebodium aureum (L.) J. Sm.	laua'e-haole	X	-	-	+
Phymatosorus scolopendria (Burm.) Pic.-Ser.	laua'e, lauwa'e	X	-	-	+
PSILOTACEAE (Psilotum Family)					
Psilotum nudum (L.) Beauv.	moa, pipi	I	-	-	+
PTERIDACEAE (Pteris Family)					
Pteris vittata L.	pteris	X	+	-	-
SINOPTERIDACEAE (Cliffbrake Fern Family)					
Doryopteris decora Brack.	kumu-niu, 'iwa'iwa	E	+	-	-
MONOCOTS					
AGAVACEAE (Agave Family)					
Agave sisalana Perrine	sisal	X	-	-	+
Cordyline fruticosa (L.) A. Chev.	ti, ki	P	+	-	-
COMMELINACEAE (Spiderwort Family)					
Commelina benghalensis L.	hairy honohono	X	-	+	+
CYPERACEAE (Sedge Family)					
Cyperus compressus L.	cyperus	X	+	-	-
Cyperus rotundus L.	nutgrass	X	-	-	+
Fimbristylis hawaiiensis Hillebr.	fimbristylis	E	+	-	-
Kyllinga brevifolia Rottb.	kyllinga, kili'o'opu	X	+	-	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
DIOSCOREACEAE (Yam Family)					
Dioscorea bulbifera L.	bitter yam, pi'oi	P	-	-	+
ARECACEAE (Palm Family)					
Cocos nucifera L.	coconut, niu	P	+	+	-
PANDANACEAE (Screw Pine Family)					
Pandanus tectorius S. Parkinson ex Z	hala, puhala	I?	+	-	-
POACEAE (Grass Family)					
Cenchrus ciliaris L.	buffel grass	X	+	+	+
Cenchrus echinatus L.	common sandbur, 'ume'alu	X	+	+	-
Chloris barbata (L.) Sw.	swollen finger grass, mau'ulei	X	+	+	+
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	+	+	+
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	X	+	-	-
Digitaria ciliaris (Retz.) Koeler	crabgrass	X	-	+	+
Digitaria insularis (L.) Mez ex Ekman	sourgrass	X	+	+	+
Digitaria setigera Roth	itchy crabgrass, kukaepua'a	I?	+	-	+
Digitaria sp.	crabgrass	X	+	-	-
Eleusine indica (L.) Gaertn.	wiregrass	X	+	+	+
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	X	+	+	+
Melinis minutiflora P. Beauv.	molassesgrass	X	-	+	+
Panicum maximum Jacq.	Guinea grass	X	-	+	+
Pennisetum setaceum (Forssk.) Chiov.	fountaingrass	X	+	+	+
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	+	+	+
Setaria verticillata (L.) P. Beauv.	bristly foxtail	X	-	-	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
DICOTS					
ACANTHACEAE (Acanthus Family)					
Barleria cristata L.	white shrimp plant	X	-	+	+
AMARANTHACEAE (Amaranthus Family)					
Achyranthes aspera L.	achyranthes	X	-	+	-
Amaranthus spinosus L.	spiny amaranth	X	+	+	-
Amaranthus viridus L.	pakai	X	+	-	-
ANACARDIACEAE (Mango Family)					
Schinus terebinthifolius Raddi	Christmas berry, wilelaiki	X	+	+	+
APOCYNACEAE (Dogbane Family)					
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X	+	+	+
ARALIACEAE (Ginseng Family)					
Reynoldsia sandwicensis A. Gray	'ohe	E	-	-	+
ASCLEPIADACEAE (Milkweed Family)					
Calotropis procera (Ait.) Ait. f.	small crown flower	X	+	-	-
Cryptostegia grandiflora (Roxb.) R. Br.	Indian rubber vine	X	-	+	-
Stapelia gigantea N. E. Brown	carrion flower	X	-	-	+
ASTERACEAE (Sunflower Family)					
Ageratum conyzoides L.	maile hohono	X	+	-	-
Bidens cynapiifolia Kunth	West Indian beggar's tick	X	-	+	+
Bidens pilosa L.	ki, ki nehe	X	+	+	+
Calyptocarpus vialis Less.	hierba del cabello	X	+	-	-
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	+	-	+
Emilia fosbergii Nicolson	pualele	X	+	+	+
Pluchea indica (L.) Less.	Indian pluchea	X	+	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	+	+	+
Sonchus oleraceus L.	sow thistle	X	+	+	+
Synedrella nodiflora (L.) Gaertn.	synedrella	X	-	-	+
Tridax procumbens L.	coat buttons	X	+	+	+
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X	-	+	-
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur	X	-	-	+
BIGNONIACEAE (Bignonia Family)					
Jacaranda mimosifolia D. Don	jacaranda	X	-	-	+
Spathodea campanulata P. Beauv.	African tulip	X	-	-	+
BORAGINACEAE (Heliotrope Family)					
Heliotropium curassavicum L.	kipukai, nena	I	+	-	-
BUDDLEJACEAE (Butterfly Bush Family)					
Buddleia asiatica Lour.	dogtail, huelo 'ilio	X	-	-	+
CACTACEAE (Cactus Family)					
Hylocereus undatus (Haw.) Britton & Rose	night-blooming cereus	X	-	+	-
Opuntia ficus-indica (L.) Mill.	panini, papipi	X	+	+	-
CAPPARACEAE (Caper Family)					
Capparis sandwichiana DC	maiapilo, pilo	E	+	+	+
Cleome gynandra L.	wild spider flower	X	+	+	-
CARICACEAE (Papaya Family)					
Carica papaya L.	papaya, mikana	X	-	+	+
CHENOPODIACEAE (Goosefoot Family)					
Chenopodium murale L.	'aheahea	X	+	-	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
CLUSIACEAE (Mangosteen Family)					
Clusia rosea Jacq.	autograph tree, copey	X	+	+	+
CONVOLVULACEAE (Morning-glory Family)					
Ipomoea indica (J. Burm.) Merr.	koali-'awania	I	+	+	+
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X	-	+	+
Ipomoea pes-caprae ssp. brasiliensis (L.) Ooststr.	beach morning-glory, pohuehue	I	+	-	-
Ipomoea triloba L.	little bell, pink bindweed	X	-	-	+
Merremia aegyptia (L.) Urb.	hairy merremia, koali kua hulu	X?	-	+	-
CRASSULACEAE (Orpine Family)					
Kalanchoe pinnata (Lam.) Pers.	air plant	X	-	-	+
Kalanchoe tubiflora (Harv.) Raym.-Hamet	air plant	X	-	+	-
CUCURBITACEAE (Gourd Family)					
Coccinia grandis (L.) Voigt	scarlet-fruited gourd	X	-	+	-
Cucumis dipsaceus Ehrenb. ex Spach	wild cucumber	X	+	+	-
Citrullus lanatus (Thunb.) Matsum. & Nakai	watermelon, ipu	X	-	+	-
Momordica charantia L.	wild bittermelon	X	+	+	+
CUSCUTACEAE (Dodder Family)					
Cuscuta sandwichiana Choisy	kauna'oa	E	-	-	+
EBENACEAE (Ebony Family)					
Diospyros sandwicensis (A. DC) Fosb.	lama	E	-	-	+
EUPHORBIACEAE (Spurge Family)					
Aleurites moluccana (L.) Willd.	kukui, tutui	P	-	-	+
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	+	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
Chamaesyce hypericifolia (L.) Millsp.	spurge	X	-	+	-
Chamaesyce hyssopifolia (L.) Sm.	spurge	X	-	+	-
Chamaesyce prostrata (Aiton) Sm.	prostrate spurge	X	-	+	-
Euphorbia heterophylla L.	fire plant	X	-	+	-
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X	-	+	+
Ricinus communis L.	castor bean	X	-	+	+
FABACEAE (Pea Family)					
Abrus precatorius L.	rosary pea	X	-	-	+
Acacia farnesiana (L.) Willd.	klu	X	+	+	+
Albizia lebbeck (L.) Benth.	siris tree	X	-	-	+
Chamaecrista nictitans (L.) Moench.	partridge pea, lauki	X	-	-	+
Crotalaria incana L.	fuzzy rattlepod	X	+	+	+
Crotalaria pallida Aiton	rattlepod	X	-	-	+
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	-	+	+
Desmodium tortuosum (Sw.) DC	Florida beggarweed	X	+	+	+
Desmodium sandwicense E. Mey.	Spanish clover	X	-	-	+
Erythrina sandwicensis Degener	wiliwili	E	-	+	-
Indigofera suffruticosa Mill.	indigo, 'iniko	X	+	+	+
Leucaena leucocephala (Lam.) de Wit	koa-haole	X	+	+	+
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X	+	+	+
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X	+	+	+
Samanea saman (Jacq.) Merr.	monkeypod	X	+	+	+
Senna gaudichaudii (Hook. & Arnott) H. Irwin & Barneby	uhiuhi, kolamona	I	-	-	+
Senna occidentalis (L.) Link	coffee senna, 'auko'i	X	-	+	-
Senna septemtrionalis (Viv.) H. Irwin & Barneby	senna	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.	spurflower	I	-	-	+
Salvia coccinea Juss. ex J. A. Murray	scarlet sage	X	-	-	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
MALVACEAE (Mallow Family)					
Abutilon grandifolium (Willd.) Sweet	abutilon, mao	X	-	-	+
Malva parviflora L.	cheese weed	X	-	+	-
Malvastrum coromandelianum (L.) Garcke	false mallow, hauuoi	X	+	+	+
Sida fallax Walp.	'ilima	I	+	+	+
Sida rhombifolia L.	Cuba jute	X	-	+	-
Sida spinosa L.	prickly sida	X	+	+	-
MENISPERMACEAE (Moonseed Family)					
Cocculus trilobus (Thunb.) DC	huehue	I	-	-	+
MORACEAE (Mulberry Family)					
Ficus microcarpa L. f.	Chinese banyan	X	+	+	+
Morus alba L.	mulberry	X	-	+	+
MYRTACEAE (Myrtle Family)					
Psidium cattleianum Sabine	strawberry guava	X	-	-	+
Psidium guajava L.	guava	X	-	-	+
Syzygium cumini (L.) Skeels	Java plum	X	+	-	-
NYCTAGINACEAE (Four-o'clock Family)					
Boerhavia coccinea Mill.	red-flowered boerhavia	X	+	+	+
PAPAVERACEAE (Poppy Family)					
Argemone glauca (Nutt. ex Prain) Pope	pua-kala, native poppy	E	+	-	-
PASSIFLORACEAE (Passionflower Family)					
Passiflora foetida L.	pohapoha	X	+	+	+
PHYTOLACCACEAE (Pokeweed Family)					
Rivinia humilis L.	rouge plant	X	+	+	+
PIPERACEAE (Pepper Family)					
Peperomia leptostachya Hook. & Arnott	'ala'ala-wai-nui	I	-	-	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
PLANTAGINACEAE (Plantain Family)					
Plantago lanceolata L.	narrow-leaved plantain	X	-	+	+
PLUMBAGINACEAE (Leadwort Family)					
Plumbago zeylanica L.	'ilie'e, hilie'e	I	-	-	+
PORTULACACEAE (Purslane Family)					
Portulaca oleracea L.	pigweed, 'akulikuli kula	X	+	+	+
Portulaca pilosa L.	'ihi	X	+	+	+
Talinum triangulare (Jacq.) Willd.	talinum	X	+	+	+
PROTEACEAE (Protea Family)					
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X	-	+	-
ROSACEAE (Rose Family)					
Osteomeles anthyllidifolia (Sm.) Lindl.	'ulei	I	-	-	+
RUBIACEAE (Coffee Family)					
Canthium odoratum (G. Forster) Seem.	alahe'e, walahe'e	I	+	+	+
Morinda citrifolia L.	noni	P	+	+	+
SAPINDACEAE (Soapberry Family)					
Cardiospermum halicacabum L.	balloon vine	X	-	-	+
Dodonaea viscosa Jacq.	a'ali'i	I	+	-	+
SOLANACEAE (Nightshade Family)					
Lycopersicon pimpinellifolium (Jusl.) Mill.	currant tomato	X	-	+	-
Nicotiana glauca R. C. Graham	tree tobacco	X	-	-	+
Solanum americanum Mill.	popolo	I?	-	+	+
STERCULIACEAE (Cacao Family)					
Waltheria indica L.	'uhaloa, hi'aloa	I?	+	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE S	K	C
TILIACEAE (Linden Family)					
Triumfetta trilobа Jacq.	burbush	X	+	-	+
VERBENACEAE (Verbena Family)					
Lantana camara L.	lantana, lakana	X	+	+	+
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	vervain	X	+	-	+
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain	X	+	+	+
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved v	X	+	+	+
ZYGOPHYLLACEAE (Caltrop Family)					
Tribulus terrestris L.	puncture vine	X	+	+	+

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Appendix C
Avifauna and Feral Mammal Analysis

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT QUEEN LILIUOKALANI TRUST PROPERTY, KAILUA, KONA, HAWAII

Prepared for

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7 July 1989

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT QUEEN LILIUOKALANI TRUST PROPERTY, KAILUA, KONA, HAWAII

INTRODUCTION

The purpose of this report is to summarize the findings of a four day (28 June-1 July 1989) bird and mammal field survey of Queen Liliuokalani Trust Property, Kailua, Kona, Hawaii (see Fig. 1). Also included are references to pertinent literature as well as unpublished reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the type of habitats available.

2- Provide some baseline data on the relative abundance of each species as well as general habitat preferences.

3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property identify what

features of the habitat may be essential for these species and suggest how those resources may best be protected.

4- Determine if the property contains any special habitats that if lost or altered by development might result in a significant impact on the fauna in this region of the island.

GENERAL SITE DESCRIPTION

The project site is located on approximately 1,100 acres at Kailua, Kona, Hawaii (see Fig. 1). Both dry coastal as well as slightly wetter higher elevation second growth forest occur on the site. The makai sections contain grasslands with a few scattered low trees (Kiawe (Prosopis pallida) and Fountain Grass (Pennisetum setaceum) are the most abundant plants. A row of Ironwood (Casuarina spp.) border one side of the makai section of the property and provide a refuge for wildlife. Small coastal patches of forest also provide important habitat. The mauka property is covered by a dense second growth forest with Christmas Berry (Schinus terebinthifolius) one of the dominant species.

Weather during the field survey was variable with

clear mornings and cloudy afternoons. Winds were also variable with both calm and gusty periods. The direction of the wind was primarily from the east.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

At various locations (see Fig.1) eight minute counts were made of all birds seen or heard. Between these counts stations walking tallys of birds seen or heard were also kept. These data provide the basis for the relative abundance estimates given in this report. Unpublished reports of birds known from similar habitat on lands elsewhere in West Hawaii were also consulted in order to acquire a more complete picture of possible avifaunal activity (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1985c, 1988a, 1988b, 1989). Observations of feral mammals were limited to visual sightings and evidence in the form of skeletal remains, scats and tracks. No attempts were made to trap mammals

in order to obtain data on their relative abundance and distribution. Three nights were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinerus semotus).

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1984), A 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) Land and Water Birds:

No endemic species were recorded during the course of the field survey. The Short-eared Owl or Pueo (Asio flammeus sandwichensis) might be expected to occur on occasion at this site. This species is relatively common on Hawaii particularly at higher elevations (Berger 1972, Hawaii Audubon Society 1984, Pratt et al. 1987). The Short-eared Owl is an endemic subspecies which is listed by the State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife as "endangered" on Oahu but not elsewhere in the State. Although not recorded on this field survey Pueo have been found in similar habitat elsewhere in West Hawaii. No other endemic birds

would be expected at this site given the location and nature of the habitats available. Several small anchialine ponds located on property makai of the actual site may provide occasional foraging opportunities for the endemic and endangered Black-necked Stilt or Ae'o (Himantopus mexicanus knudseni).

Migratory Indigenous (Native) Birds:

Migratory shorebirds winter in Hawaii between the months of August through May. Some juveniles will stay through the summer months as well (Johnson et al. 1983, 1989). Of all the shorebird species which winter in Hawaii the Pacific Golden Plover (Pluvialis fulva) is the most abundant. Plovers prefer open areas such as mud flats, lawns, pastures, plowed fields and roadsides. They arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April (Johnson et al. 1981). Bruner (1983) and Johnson et al. (1989) have also shown plover are extremely site-faithful on their wintering grounds and many establish foraging territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years. No plover were recorded during the survey.

This result was not unexpected due to the time of year of the survey. The present nature of the habitat, however, is largely unsuitable for plover as the vegetation is much too tall and dense. It is likely that during the time of year when plover are in Hawaii that very few actually utilize this property. Two migratory species were recorded along the shoreline makai of the property, Ruddy Turnstone (Arenaria interpres) and Wandering Tattler (Heteroscelus incanus).

Resident Indigenous (Native) Birds:

No indigenous species were recorded nor would any be expected at this site. Black-crowned Night Heron (Nycticorax nycticorax) probably forage infrequently at the anchialine ponds makai of the actual property.

Resident Indigenous (Native) Seabirds:

No seabirds were observed on the property. Some seabirds nest and roost in barren lava flows in Hawaii but at a much higher elevation than the project property (Pratt et al. 1987).

Exotic (Introduced) Birds:

A total of 17 species of exotic birds were recorded during the field survey. Table One shows the relative

abundance of each species as well as general habitat preferences. The most abundant species were Japanese White-eye (Zosterops japonicus), Nutmeg Mannikin (Lonchura punctulata), and Zebra Dove (Geopelia striata). Black Francolin (Francolinus francolinus) and Gray Francolin (Francolinus pondicerianus) were also common. Given the present habitat and based on previous surveys (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1985c, 1988a, 1988b) as well as information provided in Berger (1972), Hawaii Audubon Society (1984), and Pratt et al. (1987) the following exotic bird species might also occur on or near the property: Erckel's Francolin (Francolinus erckelii), California Quail (Callipepla californica), Japanese Quail (Coturnix japonica), and Northern Mockingbird (Mimus polyglottos). The most unexpected sightings were the Lavender Waxbill (Estrilda caerulescens) and a parrot (Psittacula spp?). The parrot,probably an escaped pet, was seen flying over the upper section of the property. The bird was all green with a long pointed tail but was too far away to determine the exact species.

Feral Mammals:

A total of 18 Small Indian Mongoose (Herpestes auropunctatus) were seen during the survey. Two cats

were also recorded along with the skeletal remains of pigs and cows. Evidence of rats and mice were also found. Although no trapping was done in order to assess the relative abundance of mammals on this property, there was no obvious indication that the feral mammals in this area were more or less numerous than elsewhere in similar habitat in West Hawaii.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) are sketchy but the species has been reported from Hawaii (Tomich 1986). None were observed on this field survey despite three nights of observations. This species roosts solitarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements here in Hawaii. Bruner (1984d) found bats on the Sheraton Waikoloa Beach Resort property located to the NW of this site.

CONCLUSION

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the

available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite obviously be a part of the faunal picture 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). Thus only long term studies can provide an in depth view of the bird and mammal populations in a particular area. However, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

The following are some general conclusions related to bird and mammal activity on the property.

1- The present habitat provides a limited range of living spaces which are utilized by the typical array of exotic species of birds one would expect at this elevation and in this type of environment in Hawaii. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief or that their numbers are so low that they went undetected or a combination of these and other factors. No endemic birds or seabirds were recorded

nor would they be expected to occur on this property. The creation of open short grass habitat such as lawns will increase the usuable space for birds like Pacific Golden Plover.

2- The proposed development will create a more urban environment. Species which might increase in abundance on the site following development include: Common Myna (Acridotheres tristis) and the ubiquitous House Sparrow (Passer domesticus). This latter species is typically limited to areas of human activity. Other species such as Japanese White-eye (Zosterops japonicus), Warbling Silverbill (Lonchura malabarica) and game birds like Black Francolin (Francolinus francolinus) may decline in number.

3- In order to obtain more definitive data on mammals, a trapping program would be required. No endangered species were observed. Populations of Mongoose, mice and rats may increase slightly following the development of the property.

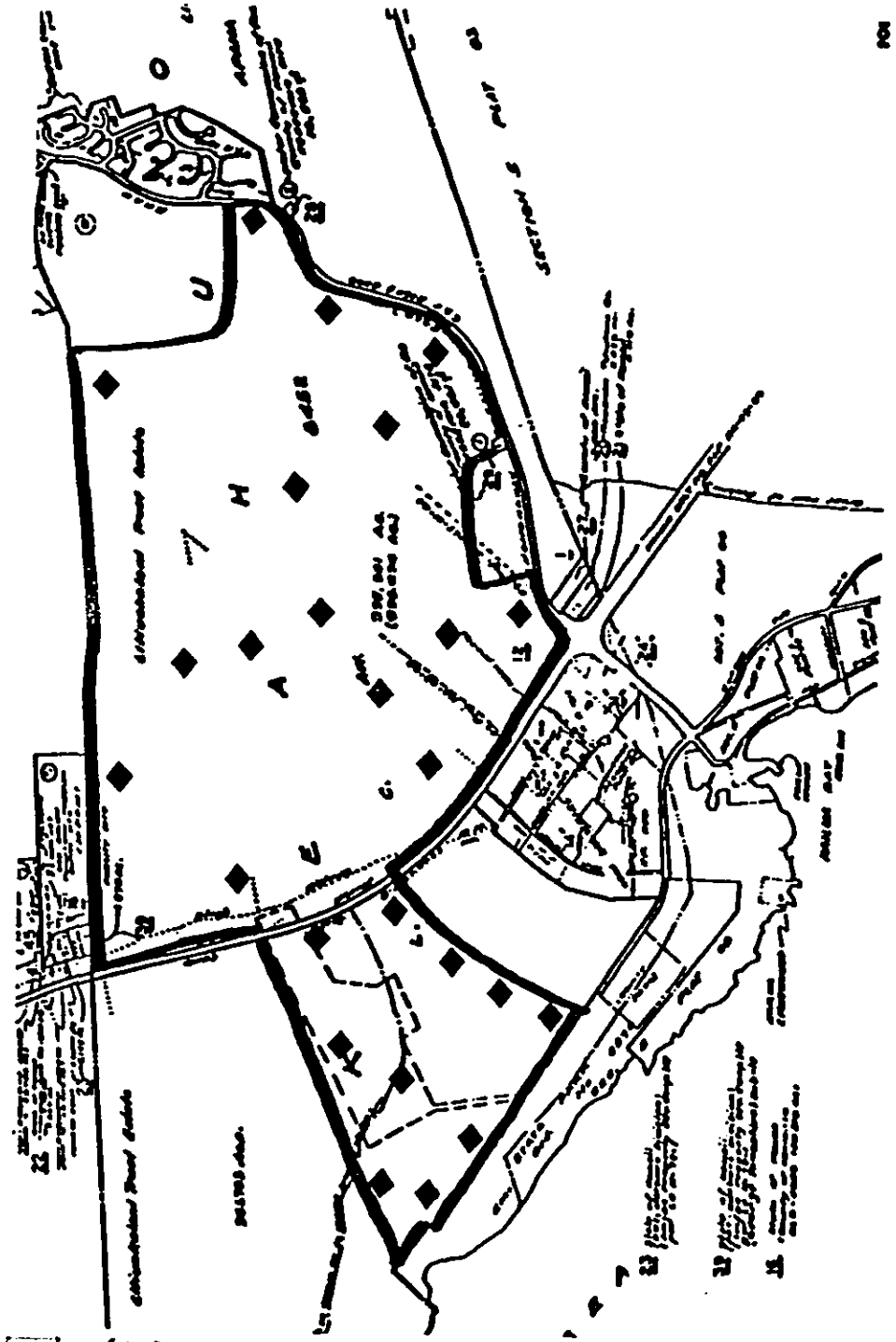

Fig. 1. Project property with eight minute count stations marked by a ◆.

TABLE 1

Exotic species of birds recorded on Queen Liliuokalani Trust Property, Kailua, Kona, Hawaii.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*	HABITAT PREFERENCES*
Feral Chicken	Gallus gallus	R= 3	T,E
Ring-necked Pheasant	Phasianus colchicus	R= 2	G,E
Black Francolin	Francolinus francolinus	C= 5	G,E
Gray Francolin	Francolinus pondicerianus	C= 5	E,T
Spotted Dove	Streptopelia chinensis	U= 4	E
Zebra Dove	Geopelia striata	A= 12	E
Common Barn Owl	Tyto alba	R= 1	G,E
Parrot	Psittacula spp.	R= 1	T
Common Myna	Acridotheres tristis	C= 8	E
Yellow-billed Cardinal	Paroaria capitata	C= 6	T
Northern Cardinal	Cardinalis cardinalis	C= 7	T
Japanese White-eye	Zosterops japonicus	A= 18	T,E
Nutmeg Mannikin	Lonchura punctulata	A= 11	G,E
Warbling Silverbill	Lonchura malabarica	C= 6	G,E
Lavender Waxbill	Estrilda caerulescens	R= 15	E,G
House Finch	Carpodacus mexicanus	C= 8	T,E
House Sparrow	Passer domesticus	C= 9	E

* (See page 13 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+) Number which follows is average of data from all survey days

C = common (ave. 5-10) Number which follows is average of data from all survey days

U = uncommon (ave. less than 5) Number which follows is average of data from all survey days

R = recorded (seen or heard at times other than on 8 min. counts. Number which follows is the actual number seen or heard).

HABITAT PREFERENCE = habitat type most frequently recorded in during survey. If more than one then listed in descending order of usage.

G = grassland

T = thickets of brush and trees

E = edge habitat: roadsides, forest edge

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Appendix D
Air Quality Analysis

AIR QUALITY STUDY
FOR THE PROPOSED
KEAHUOLU LANDS DEVELOPMENT PROJECT

KAILUA-KONA, HAWAII

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

Queen Liliuokalani Trust is proposing to develop a new urban center near Kailua, North Kona on the Island of Hawaii (see Figure 1). The proposed project will occupy an approximately 1135-acre portion of the Keahuolu ahupua'a located on the western slope of Hualalai and adjacent to Kailua Town. The area included in the Keahulou Lands Development Project is bordered by Palani Road and the existing Kona Industrial area to the south, Queen Liliuokalani Village to the east, the ahupua'a of Kealakehe to the north, and the Old Kona Airport State and County Park to the west. Specific elements of the proposed project include government office buildings, retail and commercial shops, a judiciary complex, an industrial and business park, a financial plaza, a region-serving hospital, a business oriented hotel with exhibition center, cultural facilities, an historic park, residential development and a new roadway network to provide access. Construction of the proposed project will begin as soon as all of the necessary government approvals can be obtained. Full build out is projected in 20 to 30 years.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short-term and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate these impacts are suggested where possible and appropriate.

2.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National

AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, AAQS have been established for six air pollutants. These regulated air pollutants include: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case or the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide standards to the national levels, but at present there are no indications that such a change is being considered.

3.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state and most of the year, significant differences in these

parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

Kailua-Kona, the site of the proposed project, is located near the midpoint of the western coast of the island of Hawaii. The topography of this island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes. The site of the proposed project occupies a portion of the lower western slope of Hualalai extending from near sea level up to an elevation of about 750 feet.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach the areas to the lee. Due to wind shadow effects caused by the terrain, winds in the Kailua-Kona area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds tend to dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds which move downslope and out to sea. Calms occur about 29 percent of the time at nearby Keahole Point.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade wind tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location and low-level elevation results in a relatively moderate temperature profile compared to windward locations near sea level. At the Old Kona Airport located adjacent to the project, average daily minimum and maximum temperatures are 67°F and 83°F, respectively. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the lower elevations of the project site are about the same as at the old airport. Temperatures at higher elevations of the project site are probably about 1 to 3 degrees F cooler on average compared to the airport and show a slightly larger diurnal variation due to the somewhat elevated and inland location.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is oftentimes measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails.

In the Kailua-Kona area, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm nighttime or early morning hours when temperature inversions form either due to radiational cooling or to downslope winds that push warmer air aloft. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas may also experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Although there is no mixing height data for the Kailua-Kona area, mixing heights elsewhere in the state typically are above 3000 feet (1000 meters). Mixing heights in the Kailua area probably tend to be somewhat lower due to the fact that light winds often prevail and also because sea breeze conditions often develop during the daytime.

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it may also "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The Kailua-Kona area

being a leeward location experiences a relatively dry climate. Some of the rainfall occurs in conjunction with winter storms, and some occurs during summer afternoons and evenings as a result of the onshore and upslope movement of moisture laden marine air. At the Old Kona Airport, average annual rainfall amounts to about 24 inches but may vary significantly from one year to the next. Average annual rainfall at the project site is estimated to amount to about 24 to 30 inches depending on elevation.

4.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from natural, industrial, agricultural and/or vehicular sources. Natural sources of air pollution emissions which may affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and volcanoes. Of these natural sources of air pollution, volcanoes are the most significant. Volcanic emissions periodically plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consistent primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates. Although emissions from Kilauea are vented more than 50 miles east of the project site, the prevailing wind patterns eventually carry the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area. The American Lung Association is currently studying the character and concentrations of volcanic air pollution in the Kona area, but to date no results of the study are available.

The major industrial sources in the project vicinity include the Keahole Power Plant, operated by Hawaii Electric Light Company, and the Kailua Landfill, operated by the County of Hawaii. Air pollution emissions from Keahole Power Plant consist mostly of sulfur dioxide and oxides of nitrogen. Emissions from the county landfill consist mainly of fugitive dust from heavy equipment operations and noxious fumes from underground fires, the latter of which has been the subject of numerous complaints from people residing and working nearby. Potential impacts on the proposed project from emissions emanating from the landfill are discussed in more detail later in this report.

Queen Kaahumanu Highway, which bisects the project site, is the region's major arterial roadway. Some contamination from the exhausts of motor vehicles traversing Queen Kaahumanu Highway and other roadways nearby occurs, although elevated concentrations are likely confined to limited areas near intersections where and when traffic congestion occurs during poor dispersion conditions.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very little data are available for the island of Hawaii, and even less are available for the Kona area specifically. As indicated in Table 2, the only existing monitoring data in the vicinity of the project site consist of sulfur dioxide and particulate measurements that were made about 12 miles to the south at Kealakekua during 1985 and 1986. During this two-year period, measurements of 24-hour average sulfur dioxide concentration at this location were consistently low with daily mean values ranging from less than 5 to 12 $\mu g/m^3$. No exceedances of the state/national

24-hour AAQS for sulfur dioxide were recorded. Twenty-four hour average particulate concentrations ranged from 4 to 28 $\mu g/m^3$; no violations of the state AAQS were measured.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems; concentrations of these contaminants generally have not been found to exceed AAQS elsewhere in the state. Carbon monoxide air pollution, on the other hand, typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on mathematical modeling of motor vehicle emissions.

5.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions which could directly result in short-term air quality impacts during the construction phase: (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.

Fugitive dust emissions may arise from the grading and dirt/rock-moving activities associated with site preparation once the area is cleared. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because of its elusive nature and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of earth-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions from project construction would probably be somewhere near this level. In any case, State of Hawaii Air Pollution Control Regulations [4] stipulate that emissions of fugitive dust from construction activities cannot be visible beyond the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-earth surfaces in work areas from becoming significant dust generators. In some cases, other control measures such as limiting the area that can be disturbed at any given time and/or using wind screens may be necessary. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and/or establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. Thus, most potential short-term air quality impacts from project construction can be mitigated.

6.0 LONG-TERM IMPACTS OF PROJECT

6.1 Roadway Traffic

After construction is completed, use of the proposed facilities 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. The use of leaded gasoline in new automobiles is now prohibited. As older vehicles continue to disappear from the numbers of those currently operating on the state's roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is proposing a total ban on leaded gasoline to take effect immediately. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations also call for increased efficiency in removing carbon monoxide and nitrogen oxides from the exhausts of new motor vehicles. By the year 1995 carbon monoxide emissions are expected to be about 30 percent less than the amounts now emitted due to the replacement of older vehicles with newer models. Further reductions in vehicular emissions have recently been proposed by the President for areas of the country which do not currently meet AAQS, mainly through the use of alternative fuels.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem, whereas nitrogen oxides air pollution most often is a regional issue. This is reflected in the fact that the AAQS for carbon monoxide are specified on a short-term basis

(1-hour and 8-hour averaging times) while the AAQS for nitrogen dioxide is set on an annual basis.

For this project, three scenarios were selected for the carbon monoxide modeling study: year 1990 with present conditions, year 2010 without the project, and year 2010 assuming the project is built and complete. To begin the modeling study, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic cycling: decelerating, stopping, queuing and accelerating. For this study, key intersections identified in the traffic study [5] were also selected for air quality analysis. These include: Queen Kaahumanu Highway at the proposed Liliuokalani Boulevard, Queen Kaahumanu Highway at Palani Road, the proposed Mid-Level Road at Palani Road, Mid-Level Road at Liliuokalani Boulevard and Kuakini Highway at Palani Road. Modeling of the present scenario was performed assuming the existing roadway configurations (including the assumption that there is presently through traffic only at the location of the future intersection of Mid-Level Road and Palani Road). Briefly, for the future air quality modeling scenarios, the following roadway configurations were assumed based on the project traffic study:

- With the project in the year 2010, Queen Kaahumanu Highway will be elevated and uninterrupted at Liliuokalani Boulevard and one of the three concepts recommended in the traffic study for this interchange will be implemented. Off/on ramps and/or frontage roads will be signalized.

- Without the project in the year 2010, Queen Kaahumanu Highway at Palani Road will be an at grade intersection. With the

project, Queen Kaahumanu Highway will be elevated and uninterrupted at this location and one of the three concepts suggested in the traffic study will exist. Off/on ramps and/or frontage roads will be signalized.

- With or without the project in the year 2010, Kuakini Highway at Palani Road will remain in its present configuration.

The project traffic impact assessment report referenced above describes the present and future conditions and configurations of these intersections in more detail.

The main objectives of the modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentrations which could then be directly compared to the national and state AAQS. The traffic impact assessment report indicates that traffic volumes generally are or will be higher during the afternoon peak hour than during the morning peak period. Worst-case emission and meteorological dispersion conditions typically occur during the morning hours at many locations. Thus, even though traffic volumes may be higher in the afternoon than in the morning, worst-case air pollution concentrations may occur during the morning. However, since data for morning peak hour traffic were not available, only the afternoon period could be assessed. Other recent air quality studies for the area [6][7] indicate that air pollution concentrations during the morning may be about 20 to 30 percent higher than during the afternoon at some locations.

The EPA computer model MOBILE4 [8] was used to calculate vehicular carbon monoxide emissions for each of the years studied. One of the key inputs to MOBILE4 is vehicle mix. Based on recent vehicle

registration figures, the present and projected vehicle mix in the project area is estimated to be 91.9% light-duty gasoline-powered vehicles, 5% light-duty gasoline-powered trucks and vans, 0.5% heavy-duty gasoline-powered vehicles, 0.6% light-duty diesel-powered vehicles, 1% heavy-duty diesel-powered trucks and buses, and 1% motorcycles.

Other key inputs to the MOBILE4 emission model are the cold/hot start fractions. Motor vehicles operating in a cold- or hot-start mode emit excess air pollution. Typically, motor vehicles reach stabilized operating temperatures after about 4 miles of driving. For traffic operating within the immediate project area, it was assumed that about 25 percent of all vehicles would be operating in the cold-start mode and that about 5 percent would be operating in the hot-start mode. These operational mode values were estimated based on a report from the California Department of Transportation [9] and taking into consideration the likely origin of afternoon traffic in the project area. MOBILE4 idle emissions were adjusted to account for excess cold/hot-start emissions per a recent U.S. EPA memorandum [10].

An ambient temperature of 68 degrees F was used for afternoon peak-hour emission computations. This is a conservative assumption since afternoon ambient temperatures will generally be warmer than this and emission estimates given by MOBILE4 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE4, these data were then input to the latest version of the computer model CALINE4 [11]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement

and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. The traffic volumes given in the traffic study for the future scenario include project traffic as well as traffic from other growth that is expected to occur in the area by the year 2010. Traffic queuing estimates were made based on the project traffic study, Transportation Research Board procedures [12], U.S. EPA guidelines [13], and traffic observations at the subject intersections.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Pedestrian walkways either exist or were assumed to exist within a few meters of the roadways within the project area. Thus, model receptor sites were located approximately 2 to 4 meters from the edge of the roadways near the intersections studied. All receptor heights were placed at 1.5 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 4 was assumed in all cases. This is the most conservative stability category that can be used for estimating pollutant dispersion during the afternoon hours. A surface roughness length of 150 centimeters was assumed with a mixing height of 300 meters. Worst-case wind conditions were defined as

a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at relatively low levels. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.1 ppm to all predicted concentrations for the 1990 scenarios. Due to the expected significant development that is predicted to occur in the Kona area within the next several years, a background value of 0.5 ppm was used for all 2010 scenarios.

Table 3 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 1990 with existing traffic, year 2010 without project traffic and year 2010 with project traffic. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the estimated present (1990) worst-case 1-hour carbon monoxide concentration in the project area during the afternoon peak traffic hour, 17.4 mg/m^3, occurred near the intersection of Kuakini Highway and Palani Road. This is due to the high volume of traffic and the congested conditions that prevail at this intersection. The worst-case 1-hour afternoon concentration at the other busy intersection in the project area, Queen Kaahumanu Highway and Palani Road, was estimated to be 16.4 mg/m^3. At through locations along Palani Road, such as near

the location where the proposed Mid-Level Road will intersect, worst-case afternoon concentrations were estimated to be 1.5 mg/m^3.

In the year 2010 without the proposed project, a worst-case 1-hour afternoon concentration of 16.2 mg/m^3 was predicted to occur near the intersection of Kuakini Highway and Palani Road, the same location and time as the highest concentration for the existing case. It should be mentioned here that this assumes no improvement at this intersection and that the traffic study indicates that this intersection will be severely over capacity. At Queen Kaahumanu Highway and Palani Road, the worst-case afternoon concentration was estimated to be 15.8 mg/m^3. This assumes an at-grade intersection will exist as presently but with substantial added capacity. At through traffic locations along Palani Road, afternoon peak-hour concentrations were estimated to reach about 2.3 mg/m^3. Compared to present conditions, worst-case concentrations in the year 2010 without the project should be about the same or lower within the project vicinity.

Predicted 1-hour worst-case concentrations during the afternoon for the 2010 with project/Concept 1 scenario range from 11.2 mg/m^3 at the proposed Mid-Level Road and Palani Road intersection to 18.6 mg/m^3 at the Kuakini Highway and Palani Road intersection (assuming no improvement). Under Concepts 2 and 3, worst-case concentrations along Queen Kaahumanu Highway were estimated to be about 20 to 30 percent lower compared to Concept 1. Compared to the without project case, predicted concentrations are considerably higher at the Mid-Level Road/Palani intersection due to the creation of this intersection and the stop-and-go traffic that would result; concentrations at Queen Kaahumanu Highway and Palani Road will be significantly reduced (assuming one of the interchange concepts is adopted) while air pollution in the vicinity of Kuakini

Highway and Palani Road will be slightly worse. Compared to the present case, worst-case concentrations in 2010 with the proposed project will be about the same or lower at most locations.

All estimated worst-case 1-hour carbon monoxide levels for all scenarios are well within the national AAQS of 40 mg/m^3. It appears likely, however, that existing concentrations of carbon monoxide as well as future concentrations either without or with the project may exceed the State of Hawaii 1-hour AAQS of 10 mg/m^3 on occasion at several locations in the project area. With either Concept 2 or 3, the state 1-hour AAQS may be achieved along Queen Kaahumanu Highway at Liliuokalani Boulevard and at Palani Road, whereas under Concept 1 it probably will not.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One recent study based on modeling [14] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [13] recommend using a value of 0.6 to 0.7 unless a locally derived persistence factor is available. Recent monitoring data for Honolulu reported by the Department of Health [15] suggests that this factor may range between about 0.35 and 0.55 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-

hour to 8-hour persistence factor of 0.5 is probably most appropriate for this application.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 4. (As mentioned previously, all estimates are based on the afternoon period only; 8-hour concentrations including the morning peak traffic hour could be 20 to 30 percent higher at some locations.) For the 1990 scenario, the estimated worst-case 8-hour carbon monoxide concentration was 8.7 mg/m^3 at the intersection of Kuakini Highway and Palani Road; other locations studied ranged from 8.2 mg/m^3 near Queen Kaahumanu Highway and Palani Road to 0.8 mg/m^3 along through sections of Palani Road. The predicted maximum values for the year 2010 without and with project scenarios were 8.1 and 9.3 mg/m^3, respectively; both occurred at the Kuakini Highway/Palani Road intersection. Other locations were generally in the 5 to 6 mg/m^3 range. Either with or without the project, 2010 concentrations should be about the same or lower than existing concentrations at most locations. Comparing the predicted values for the existing case to the AAQS, it appears that although the state 8-hour standard may be exceeded near traffic congested areas along Palani Road, worst-case concentrations during 1990 will likely comply with the national 8-hour standard. (However, other recent studies of this area based on morning peak-hour traffic indicate that the national 8-hour standard may also be exceeded at times.) With or without the project in 2010, concentrations in the vicinity of Kuakini Highway and Palani Road will exceed the state standard but comply with the national limit (assuming no roadway improvements). Other locations studied indicate that with or without the project, the state standard will likely be exceeded while the national AAQS will be achieved. Concepts 2 and 3 in the with project case will provide for lower concentrations in the project area.

The results of this study reflect several assumptions that must be made concerning traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and it may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

6.2 Electrical Demand

The proposed project will also cause indirect emissions from power generating facilities as a consequence of electrical power usage. Peak project power demand at full build-out is not expected to exceed about 50 megawatts. Present generating capacity on the Big Island is 161 megawatts with most of this power provided by oil-burning generating units. Thus, the project electrical demand will represent a substantial increase. Average annual electrical demand of the project when fully developed is not expected to exceed about 220 million kilowatt-hours (assuming average electrical demand is about one-half peak demand). This power demand will most probably be provided mainly by oil-fired turbine generating facilities located on the island. In order to meet the electrical power needs of the proposed project, power generating facilities will have to be expanded and/or burn more fuel, and hence more air pollution will be emitted at these facilities. Given in Table 5 are estimates of the indirect air pollution emissions that will result from the project electrical demand assuming all power is provided by burning more fuel oil at Hawaii's oil-fired power plants. Based on the ratio of peak project power demand to total present

generating capacity on Hawaii, the project power demand will result in about a 25 percent increase in emissions from the electric utility if all project power is derived from fuel oil.

6.3 Solid Waste Disposal

Solid waste generated by the project when fully completed is expected to amount to less than 96 tons of refuse (about 16 truckloads) per day. Most if not all of this refuse will likely be hauled away and either landfilled or burned at another location. If all refuse is landfilled, the only air pollution emissions associated with solid waste disposal (assuming problems similar to those which currently exist at the Kailua Landfill are avoided) will be due to exhaust fumes and fugitive dust from trucks and heavy equipment used to place the refuse in the landfill. If, on the other hand, all or part of the refuse is burned at a municipal incinerator, disposal of solid waste from the project will also result in emissions of particulate, carbon monoxide and other contaminants from the incineration facility. Table 6 gives emission factors for municipal refuse incinerators (without controls) in terms of pounds of air pollution per ton of refuse material charged. Thus, uncontrolled air pollutant emission rates in terms of pounds per year, for example, can be estimated by multiplying the emission factors given in the table by the number of tons per year of refuse that is burned. Use of emission filtration equipment will substantially reduce emissions of particulate.

7.0 SUMMARY OF IMPACTS AND MITIGATIVE CONSIDERATIONS

7.1 Impacts Summary

The major short-term air quality impact will be the potential emission of significant quantities of fugitive dust during project construction phases. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month. During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project.

The primary long-term air pollution impact from the project will arise from the increased motor vehicle traffic associated with the project. Potential increased levels of carbon monoxide concentrations along roadways leading to and from the proposed development will be the primary concern. Based on mathematical modeling of projected vehicular traffic and on atmospheric dispersion estimates of vehicular emissions, it is predicted that with the proposed project carbon monoxide concentrations in the year 2010 along roadways in the project vicinity will be higher at some locations and lower at others compared to the without project case. With the project, concentrations during the afternoon peak-traffic hour at the worst location (Kuakini Highway and Palani Road) will be slightly higher than existing levels. With the project roadway improvements at Queen Kaahumanu Highway and Palani Road, worst-case concentrations will be lower than both the existing levels and the future without project scenario. With or without the project, worst-case concentrations during the afternoon should comply with both the national 1-hour and 8-hour ambient air quality standards set by the U.S. Environmental Protection Agency, but higher

concentrations may occur during the morning, exceeding the national 8-hour standard on occasion near the Queen Kaahumanu Highway/Palani Road intersection [6][7]. During 1990, the U.S. EPA 8-hour standard for carbon monoxide will likely be maintained during afternoon peak traffic periods in the project vicinity, but morning concentrations may potentially exceed this limit at some locations (based on other studies cited previously). The more stringent State of Hawaii ambient air quality standards for carbon monoxide may be exceeded at times during the current year and either with or without the project in the year 2010 near high-volume traffic locations within the study area. The state standards are set so low, however, they are probably exceeded at many intersections in the state that have even moderate traffic volumes. It is worth noting here that, although the national AAQS allow higher levels of carbon monoxide, the national standards were developed after extensive research with the objective of defining levels of air quality that would protect the public health with an adequate margin of safety.

Some long-term impacts also could potentially occur due to indirect emissions from power generating facilities supplying the project with electricity and from the burning of waste materials generated by the project. Quantitative estimates of these impacts were not made, but it appears that some impacts are possible due to the magnitude of the project electrical and solid waste demands compared to the present county demands.

7.2 Mitigative Considerations

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. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

Options available to mitigate traffic-related air pollution are to improve roadways, reduce traffic or reduce individual vehicular emissions. Long-term projections of carbon monoxide emissions from vehicular traffic associated with the completed development are based on the traffic impact study findings. It has been assumed that the roadway improvements recommended in the traffic study will be implemented to move traffic efficiently through the project area and adjacent locations. Although not addressed in the traffic study, improvement of the Kuakini Highway/Palani Road intersection will be necessary with or without the project. Aside from improving roadways, air pollution impacts from vehicular emissions can be mitigated by reducing traffic through the use of mass transit and car pooling and/or by adjusting local school and business hours to begin and end during off-peak times. Due to the extended completion date for the project, it is conceivable that the efficiency of motor vehicle engines and/or emission control equipment will be improved or that vehicles will be developed which burn cleaner fuels before the project reaches full build-out. If this occurs, then impacts will be less than predicted. With regard to cleaner burning fuels, vehicles burning methanol or compressed natural gas or powered by electrical motors are some of the possibilities for technological development that are currently being

contemplated. Lastly, even without technological breakthroughs, it is also possible that at some point in the future the state may decide to adopt either a motor vehicle inspection and maintenance program which would ensure that emission control devices are properly maintained, and thereby reduce emissions, or more restrictive emission control standards.

Indirect emissions from project electrical demand could be reduced somewhat by utilizing solar energy design features to the maximum extent possible. This might include installing solar water heaters, designing homes and building space so that window positions maximize indoor light without unduly increasing indoor heat, and using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning. Use of wind power generating units, geothermal energy, ocean thermal energy conversion and/or other alternative energy sources by the utility instead of fuel-burning facilities also would lessen indirect emissions from project electrical demand.

Most probably solid waste from the project will be buried at a landfill, and any air pollution impacts will be minimal if the landfill is operated properly. If project refuse is burned instead at a municipal incinerator, air pollution impacts could be reduced substantially if the incinerator is fitted with pollution control equipment, i.e., electrostatic precipitators or fabric filters. Conservation and recycling programs also could reduce solid waste which would reduce any related air pollution emissions proportionately. Lastly, if the new H-Power garbage-to-energy facility located on Oahu proves successful, similar facilities on the other islands may be developed before project completion. Use of solid waste to generate power will offset emissions that would otherwise

occur from fossil-fueled power plants if the waste would be simply incinerated instead.

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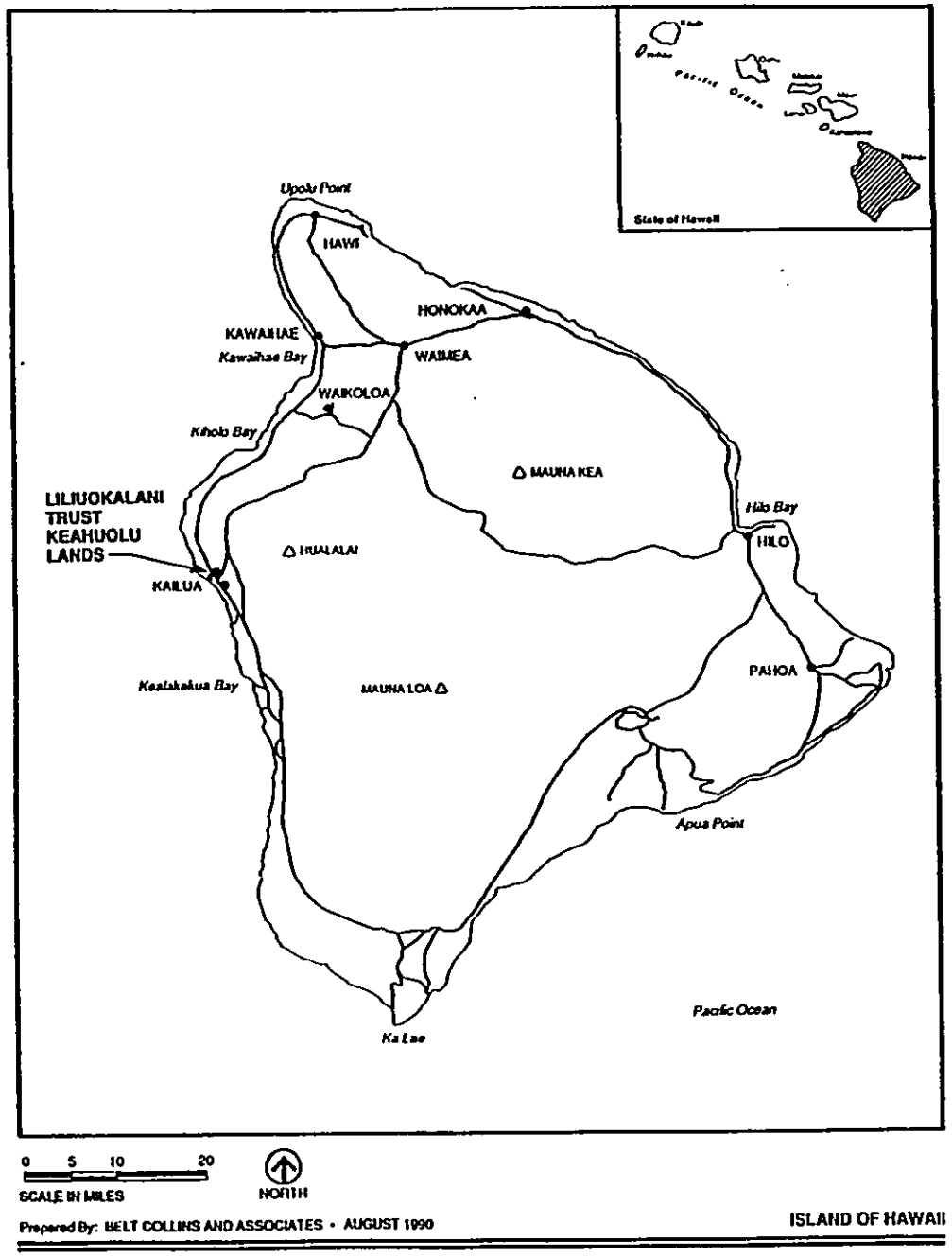


Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration: National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter	$\mu g/m^3$	Annual	-	-	60[a]
		24 Hours	-	-	150[b]
Particulate Matter[c]	$\mu g/m^3$	Annual	50	50	-
		24 Hours	150[b]	150[b]	-
Sulfur Dioxide	$\mu g/m^3$	Annual	80	-	80
		24 Hours	365[b]	-	365[b]
		3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide	$\mu g/m^3$	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours	10[b]	-	5[b]
		1 Hour	40[b]	-	10[b]
Ozone	$\mu g/m^3$	1 Hour	235[b]	235[b]	100[b]
Lead	$\mu g/m^3$	Calendar Quarter	1.5	1.5	1.5

[a] Geometric mean

[b] Not to be exceeded more than once per year

[c] Particles less than or equal to 10 microns aerodynamic diameter

Table 2

ANNUAL SUMMARY OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KEAHUOLU LANDS DEVELOPMENT PROJECT

Parameter / Location	1985	1986
Sulfur Dioxide / Kealakekua, Kona		
Period of Sampling (months)	7	8
No. of 24-Hr Samples	31	40
Range of 24-Hr Values (ug/m3)	<5-8	<5-12
Average Daily Value (ug/m3)	<5	<5
No. of State AAQS Exceedances	0	0
Particulate / Kealakekua, Kona		
Period of Sampling (months)	7	8
No. of 24-Hr Samples	34	40
Range of 24-Hr Values (ug/m3)	6-22	4-28
Average Daily Value (ug/m3)	12	16
No. of State AAQS Exceedances	0	0

Source: State of Hawaii Department of Health, "Hawaii Air Quality Data for the Period of January 1985 to December 1987"

Table 3

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KEAHUOLU LANDS DEVELOPMENT PROJECT DURING AFTERNOON PEAK TRAFFIC HOUR
(milligrams per cubic meter)

	Year/Scenario				
Roadway Intersection	1990/ Present	2010/ Without Project	2010/ With Project Concept 1	2010/ With Project Concept 2	2010/ With Project Concept 3
Queen Kaahumanu Hwy at Liliuokalani Blvd[a]	-	-	11.7	7.6	8.9
Queen Kaahumanu Hwy at Palani Road	16.4	15.8[b]	11.5	9.4	9.4
Mid-Level Road at Palani Road	1.5[c]	2.3[c]	11.2	-	-
Mid-Level Road at Liliuokalani Blvd[a]	-	-	12.2	-	-
Kuakini Highway at Palani Road	17.4	16.2	18.6	-	-

Hawaii State AAQS: 10
National AAQS: 40

[a] In 1990 and in 2010 w/o project scenarios, intersection does not or will not exist.

[b] Assumes intersection with three northbound and three southbound through lanes, two eastbound and two westbound through lanes and two left and one right turn lanes on all approaches.

[c] Assumes through traffic only.

Table 4

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR KEAHUOLU LANDS DEVELOPMENT PROJECT
BASED ON AFTERNOON PEAK TRAFFIC HOUR
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario 1990/ Present	2010/ Without Project	2010/ With Project Concept 1	2010/ With Project Concept 2	2010/ With Project Concept 3
Queen Kaahumanu Hwy at Liliuokalani Blvd[a]	-	-	5.8	3.8	4.4
Queen Kaahumanu Hwy at Palani Road	8.2	7.9[b]	5.2	4.7	4.7
Mid-Level Road at Liliuokalani Blvd[a]	0.8[c]	1.2[c]	5.6	-	-
Kuakini Highway at Palani Road	6.7	8.1	9.3	-	-

Hawaii State AAQS: 5
National AAQS: 10

[a] In 1990 and in 2010 w/o project scenarios, intersection does not or will not exist.

[b] Assumes intersection with three northbound and three southbound through lanes, two eastbound and two westbound through lanes and two left and one right turn lanes on all approaches.

[c] Assumes through traffic only.

Table 5

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM
KEAHUOLU LANDS DEVELOPMENT PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	40
Sulfur Dioxide	550
Carbon Monoxide	120
Volatile Organics	45
Nitrogen Oxides	530

[a] Based on U.S. EPA emission factors for utility gas turbines [3]. Assumes net electrical demand of 220 million kw-hrs per year and low sulfur oil used to generate power.

Table 6

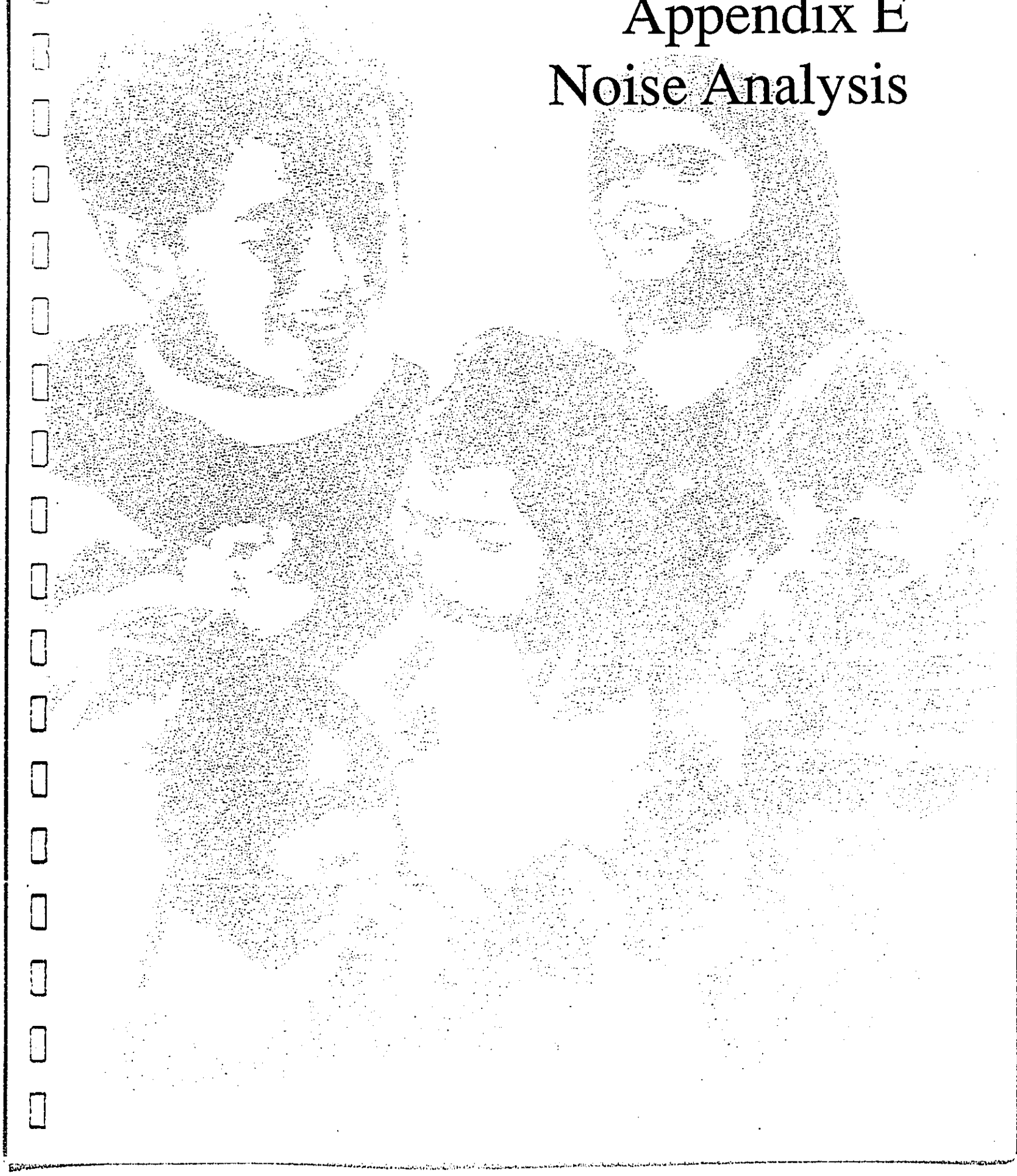
UNCONTROLLED AIR POLLUTION EMISSION FACTORS FOR MUNICIPAL REFUSE INCINERATORS (lb/ton)[a]

Air Pollutant	Emission Factor
Particulate	14[b]
Sulfur Oxides	2.5
Carbon Monoxide	35
Organics	1.5
Nitrogen Oxides	3

[a]Emission factors are given in terms of weight of material emitted per unit weight of refuse material charged.
[b]Assumes incinerator equipped with settling chamber and water spray.

Source: U.S. Environmental Protection Agency [3]

Appendix E
Noise Analysis



NOISE STUDY
FOR
QUEEN LILIUOKALANI TRUST'S KEAHUOLU LANDS
KONA, HAWAII

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CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Keahuolu Lands Development Project in North Kona, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. The future traffic noise levels along the primary access roadways to the project were calculated for the Year 2010 with and without the proposed development. The noise analysis assumed that the necessary roadway improvements would be implemented in order to accommodate the increases in future project and non-project traffic.

Along the Queen Ka'ahumanu Highway and Palani Road, traffic noise levels are expected to increase significantly by 3.5 to 7.4 Ldn between CY 1990 and CY 2010, with worsening traffic conditions requiring major improvements to the existing highway and other roadways in the project area. Project traffic are predicted to cause a 0.5 to 1.0 Ldn increase in traffic noise levels along the existing Queen Ka'ahumanu Highway from the present to CY 2010. Along Palani Road, project traffic are predicted to cause a 0.0 to 0.3 Ldn increase in traffic noise levels. These increases in traffic noise levels over an 20 year period are not considered to be significant.

The large traffic noise increases are expected to occur as a result of non-project traffic growth in the North Kona area by CY 2010. The projected increases are in the order of 3.6 to 7.0 Ldn, and are the result of a five-fold increase in traffic volumes due to other planned developments in the North Kona area. Residents along Palani Road may be impacted by future increases in traffic noise if adequate setback distances are not provided from the roadway, or if other noise mitigation measures are not incorporated into the roadway improvement projects which will be necessary to accommodate the increased traffic volumes. Similar conclusions also apply to areas south of the project along Queen Ka'ahumanu Highway.

The project's Development Plan locates non-noise sensitive land uses in the high noise zones along Queen Ka'ahumanu Highway. For this reason, and the relatively small increases in traffic noise associated with project traffic, the plan should not cause severe or adverse noise impacts on existing noise sensitive developments in the project environs. The planned hospital at the highway will probably be air conditioned, and this should be an adequate traffic noise mitigation measure.

Proposed residential developments in the mauka (or east) sections of the project may be impacted by the relatively high traffic noise levels along the north section of Palani Road and mauka of the proposed Mid-Level Road. Noise mitigation measures, such as adequate setback distances, berms, or sound attenuation walls, may be employed in order to minimize traffic noise impacts on these future residences.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed Keahuolu Lands Development Project in North Kona on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Recommendations for minimizing these noise impacts were also to be provided as required. Assessments of possible future impacts from short term construction noise at the project site were also included in the noise study objectives.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the Ldn descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in APPENDIX B to this report.

TABLE 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in FIGURE 1. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. In the North Kona area, noise levels at lots which front Queen Ka'ahumanu Highway and Palani Road are typically above 60 Ldn. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 Ldn lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (Reference 2), including Hawaii.

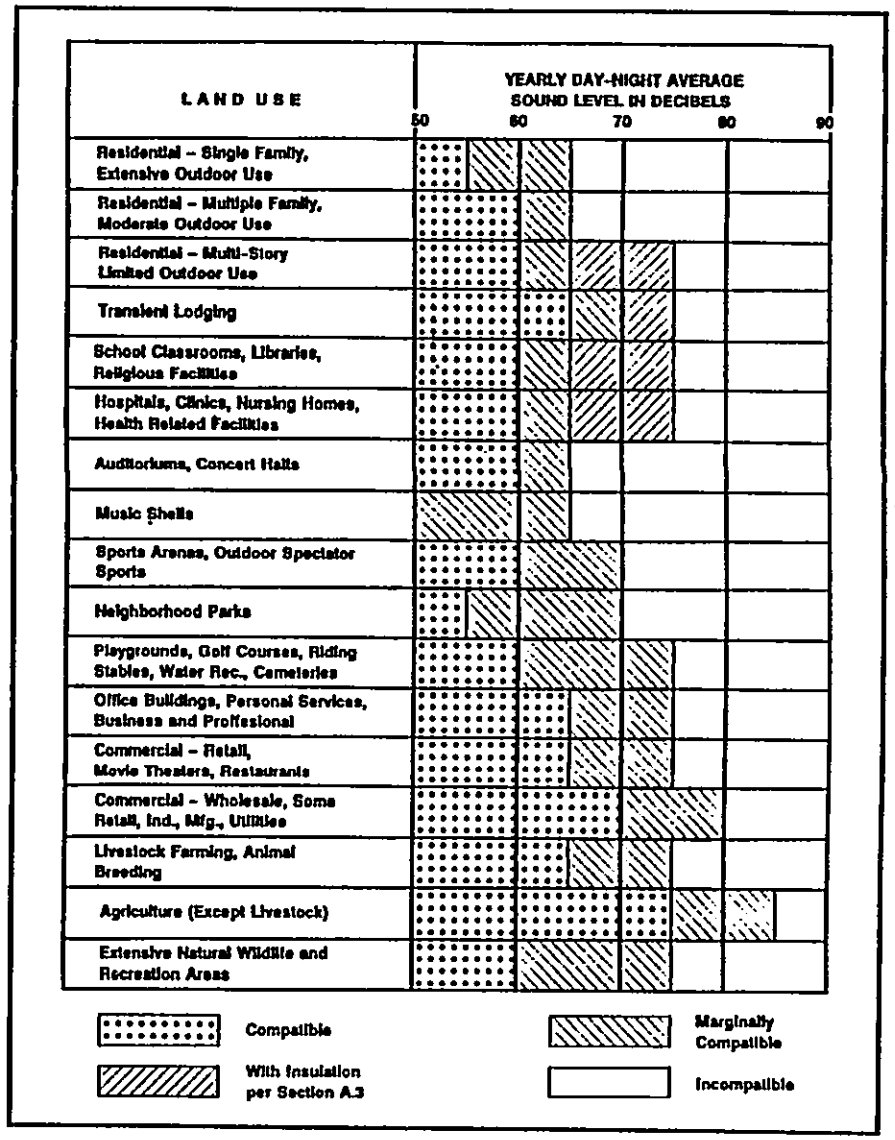
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL[1] STANDARD
Minimal Exposure	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
Moderate Exposure	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable[2]
Significant Exposure	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
Severe Exposure	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the L_{eq} instead of the L_{dn} descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 L_{eq}.



LAND USE COMPATIBILITY
WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL
AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED
(Source: American National Standards Institute S3.23-1980)

FIGURE 1

Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 3, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

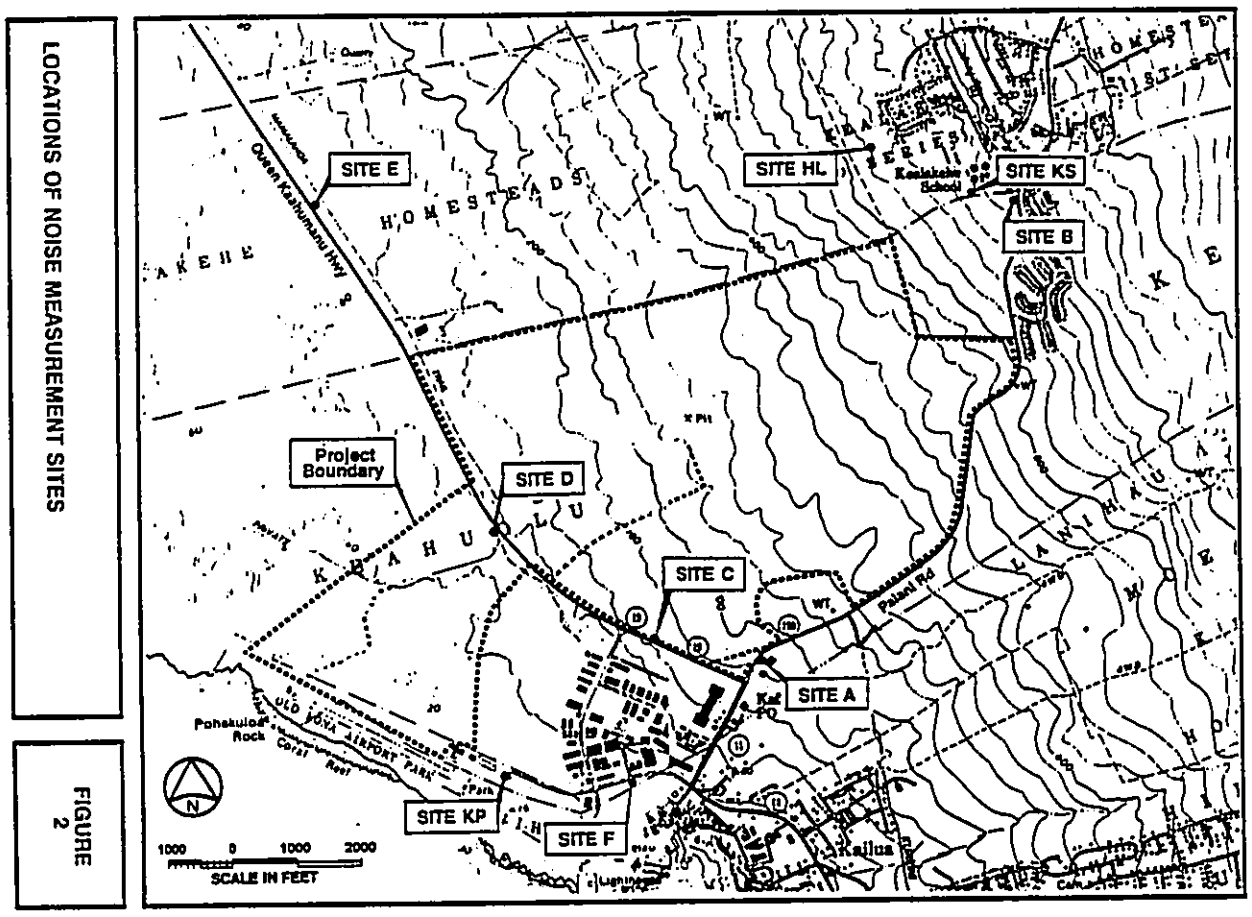
As indicated in FIGURE 1, relatively high exterior noise levels of 65 to 80 Ldn are considered to be "Compatible" or "Hargi-nally Compatible" for Commercial land uses such as those planned within the proposed development. Hospitals are considered compatible in areas with exterior noise levels as high as 75 Ldn, as long as sound attenuation measures (such as total closure and air conditioning) are provided to reduce interior noise to acceptable levels.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic noise levels were measured at nine locations in the project environs to provide a basis for developing the project's traffic noise contributions along the roadways which will service the proposed development: Queen Ka'ahumanu Highway, Palani Road, Kuakini Road, the proposed Mid-Level Road, and the proposed Liliuokalani Boulevard. The locations of the measurement sites are shown in FIGURE 2. Noise measurements were performed during the latter part of June 1989. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in TABLE 2. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the Year 2010 were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 4). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. The traffic study for the project (Reference 5) and Hawaii State Department of Transportation counts on Queen Ka'ahumanu Highway, Palani Road, and Kuakini Road (References 6 and 7), were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were equal to the 24-hour Ldn along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour Ldn of traffic noise on Queen Ka'ahumanu Highway and Palani Road (see FIGURES 3 thru 5).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. The forecasted increases in traffic noise levels over existing levels were



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2

TABLE 2

TRAFFIC NOISE MEASUREMENTS
(June 27, 1989)

Location	Time of Day (HRS)	Ave.Speed (MPH)	Hourly Traffic Volume: Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
A. 50 FT from the centerline of Palani Road at Fire Station.	0715 TO 0750	45	1,129	21	21	67.6	67.7
B. 50 FT from the centerline of Palani Road at Kealakaa St.	1525 TO 1539	45	986	21	4	64.3	64.2
C. 50 FT from the centerline of Queen Kaahumanu Hwy. at Industrial Park.	0925 TO 0954	46	1,232	29	29	68.7	68.9
D. 50 FT from the centerline of Queen Kaahumanu Hwy. at Road to Children's Center.	1012 TO 1042	48	1,009	49	34	68.1	68.4
E. 50 FT from the centerline of Queen Kaahumanu Hwy. North of Police Station.	1148 TO 1224	49	1,014	53	43	68.7	69.2
F. 50 FT from the centerline of Kuakini Road toward Old Kona Airport.	1245 TO 1254	37	899	41	8	64.2	64.3
HL. Makai Boundary of Existing Residential Area.	1841 TO 1843	N/A	N/A	N/A	N/A	43.8	N/A

TABLE 2 (CONTINUED)

TRAFFIC NOISE MEASUREMENTS
(June 27, 1989)

Location	Time of Day (HRS)	Ave.Speed (MPH)	——Hourly Traffic Volume—— Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
KS. Makai Boundary of Kealakehe School.	1820 TO 1829	N/A	N/A	N/A	N/A	46.3	N/A
KP. 105 FT from the centerline of Kuakini Road at Old Kona Airport.	1905 TO 1916	30	104	16	0	53.2	50.3

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY AT PALANI ROAD

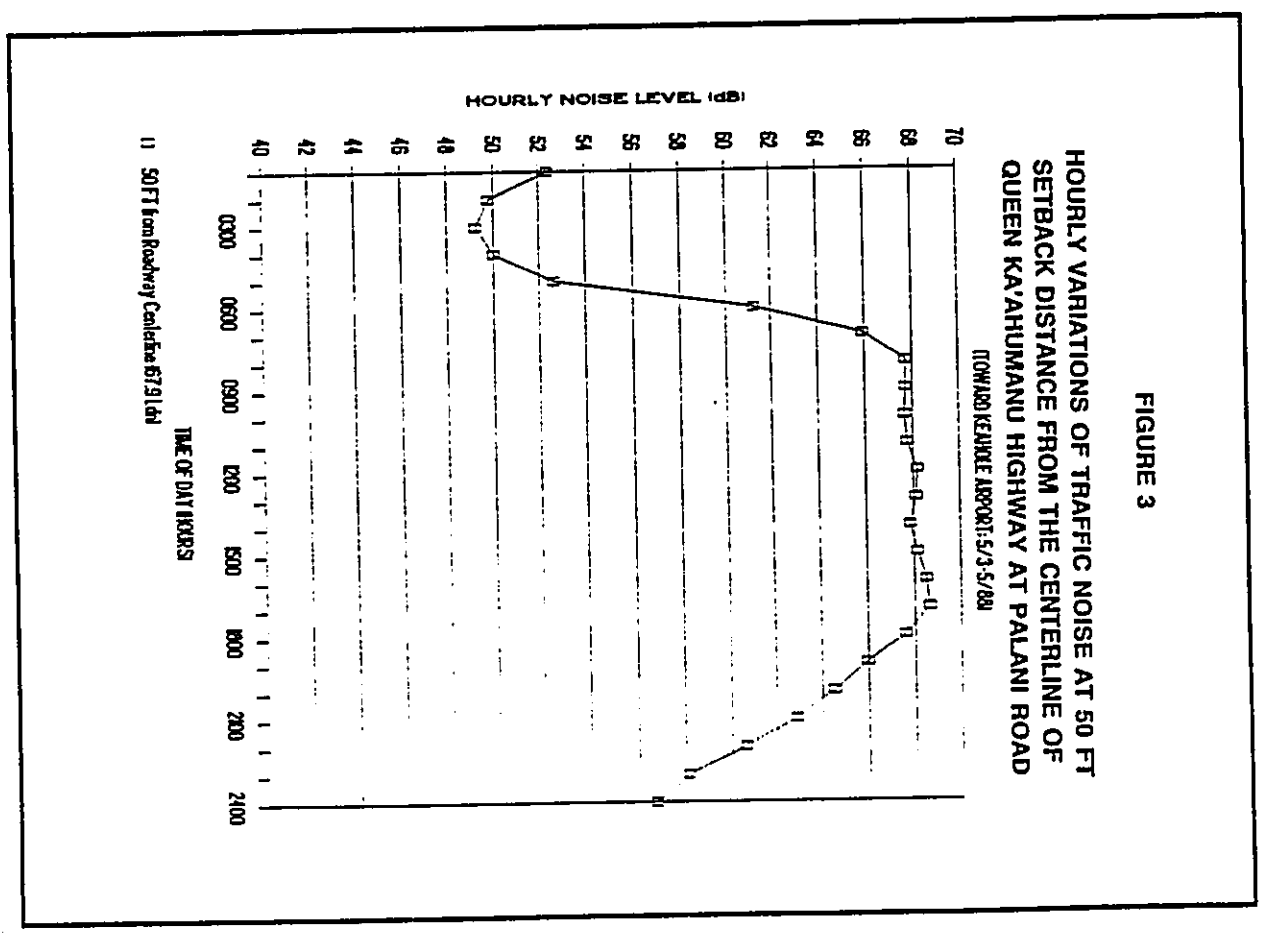


FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY AT PALANI ROAD

(TOWARD CAPTAIN COOK: 5/3-5/88)

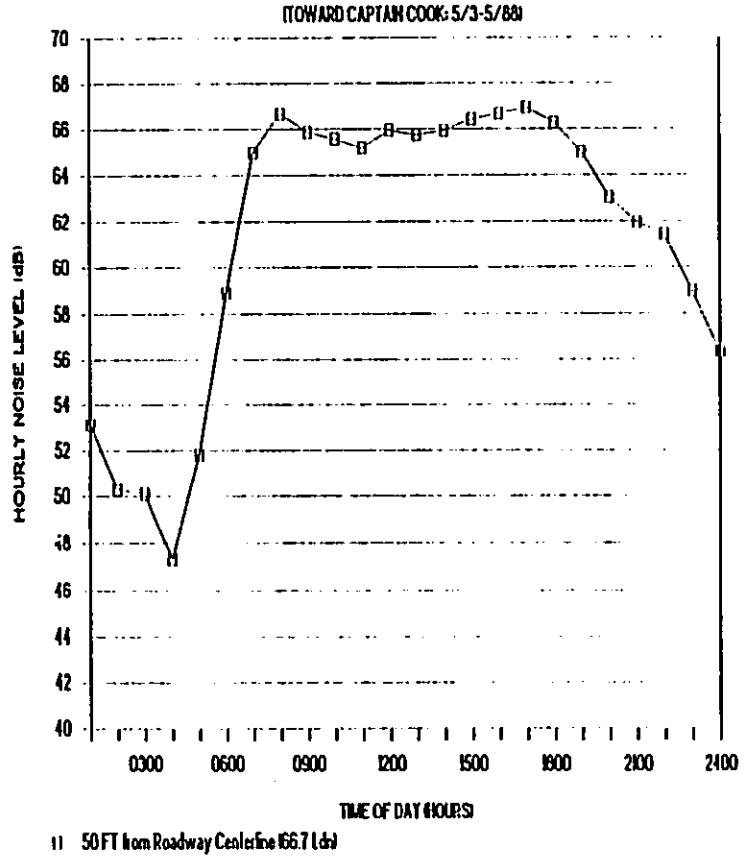
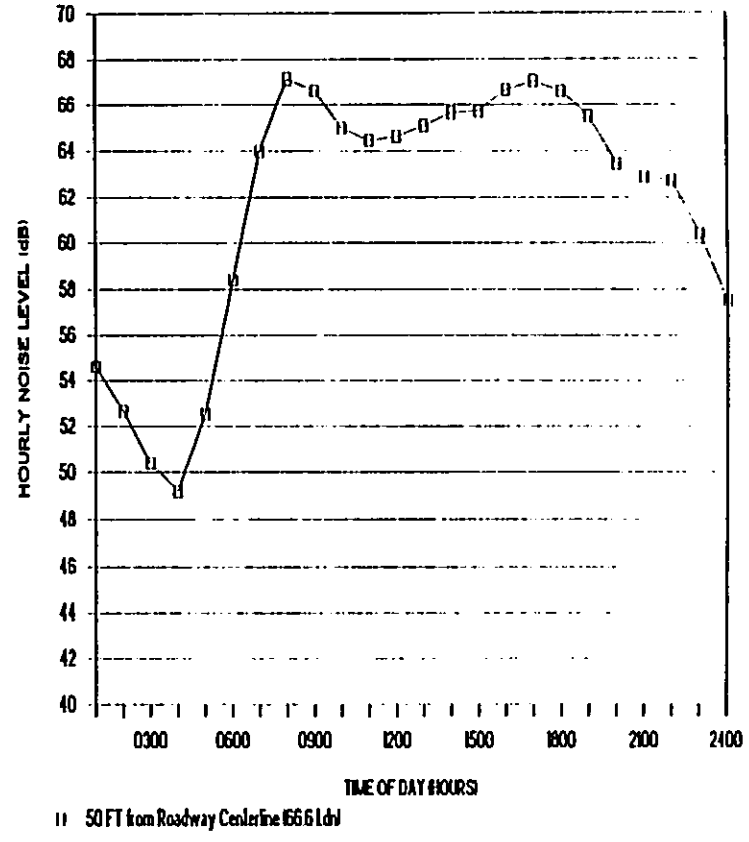


FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF PALANI ROAD AT QUEEN KA'AHUMANU HIGHWAY

(TOWARD WAIMEA: 5/3-5/88)



calculated for conditions with and without the project. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation of possible traffic noise impacts was made.

CHAPTER V. EXISTING NOISE ENVIRONMENT

The existing traffic noise levels in the project environs (see **FIGURE 2**) are in the "Significant Exposure, Normally Unacceptable" category at 50 FT distance from the centerlines of Queen Ka'ahumanu Highway and Palani Road. Traffic noise levels along the Right-of-Way of a roadway generally represent the worst case (or highest) levels due to the proximity of the Right-of-Way to the noise sources. At greater setback distances of approximately 75 to 110 FT, traffic noise along Queen Ka'ahumanu Highway decrease to the "Moderate Exposure, Acceptable" category. Setback distances of approximately 45 to 80 FT are required from the centerline of Palani Road to be in the "Moderate Exposure, Acceptable" noise exposure category.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in **TABLE 3**. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 60, 65, and 70 Ldn contours were also calculated as shown in **TABLE 4**. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. The existing setback distances to the 65 Ldn contour lines are relatively large along Queen Ka'ahumanu Highway and the makai (or west) section of Palani Road. Along the mauka (or east) section of Palani Road and along Kuakini Road, the setback distances to the 65 Ldn contour are relatively small.

Existing traffic noise levels at the mauka (inland) portions of the project site are very low (less than 60 Ldn) due to their large setback distances from Queen Ka'ahumanu Highway. The proposed residential areas of the project are located beyond a half mile from the highway. At 45 FT or greater setback distance from

TABLE 3

COMPARISONS OF EXISTING AND CY 2010 TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(PM PEAK HOUR AND 100 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	*** HOURLY LEQ IN dB @ 100 FT ** AUTO	MT	HT	ALL VEH.
EXISTING PM PEAK HR. TRAFFIC:						
Q. Kaahumanu Hwy. (North)	48	1,100	59.5	54.7	59.3	63.1
Q. Kaahumanu Hwy. (Front)	46	1,560	61.8	57.1	61.8	65.5
Q. Kaahumanu Hwy. (South)	46	1,270	60.9	56.2	60.9	64.6
Palani Rd. (North)	45	750	56.8	50.7	55.5	59.8
Palani Rd. (South)	45	1,300	60.7	54.6	59.4	63.7
Kuakini Road	37	1,400	58.3	52.5	58.1	61.8
CY 2010 PM PEAK HR. TRAFFIC WITH THE PROJECT:						
Q. Kaahumanu Hwy. (North)	48	5,700	66.6	61.9	66.4	70.2
Q. Kaahumanu Hwy. (Front)	46	6,500	68.0	63.3	68.0	71.7
Q. Kaahumanu Hwy. (South)	46	7,000	68.3	63.6	68.3	72.0
Palani Rd. (North)	45	2,750	62.4	56.3	61.1	65.4
Palani Rd. (South)	45	2,900	64.2	58.1	62.9	67.1
Kuakini Road	37	1,800	59.4	53.6	59.2	62.8
Mid-Level Road	46	3,450	65.2	60.6	65.3	68.9
Liliuokalani Blvd. (North)	45	1,700	61.8	55.7	60.5	64.8
Liliuokalani Blvd. (South)	45	2,950	64.2	58.1	62.9	67.2

Notes:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

(a) Queen Kaahumanu Highway: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks or buses.

(b) Palani Road: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

(c) Kuakini Road: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

(d) Liliuokalani Boulevard: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

(e) Mid-Level Road: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks or buses.

TABLE 4

EXISTING AND CY 2010 DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	60 Ldn SETBACK (FT) CY 2010	65 Ldn SETBACK (FT) EXISTING	65 Ldn SETBACK (FT) CY 2010	70 Ldn SETBACK(FT) EXISTING	70 Ldn SETBACK(FT) CY 2010
Q. Kaahumanu Hwy. (North)	160	479	74	222	34	103
Q. Kaahumanu Hwy. (Front)	232	601	108	279	50	130
Q. Kaahumanu Hwy. (South)	202	632	94	293	44	136
Palani Rd. (North)	96	229	45	106	21	49
Palani Rd. (South)	175	299	81	139	38	64
Kuakini Road	131	155	61	72	28	33
Mid-Level Road	N/A	394	N/A	183	N/A	85
Liliuokalani Blvd. (North)	N/A	210	N/A	97	N/A	45
Liliuokalani Blvd. (South)	N/A	303	N/A	140	N/A	65

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM Peak Hour Leq along all roadways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

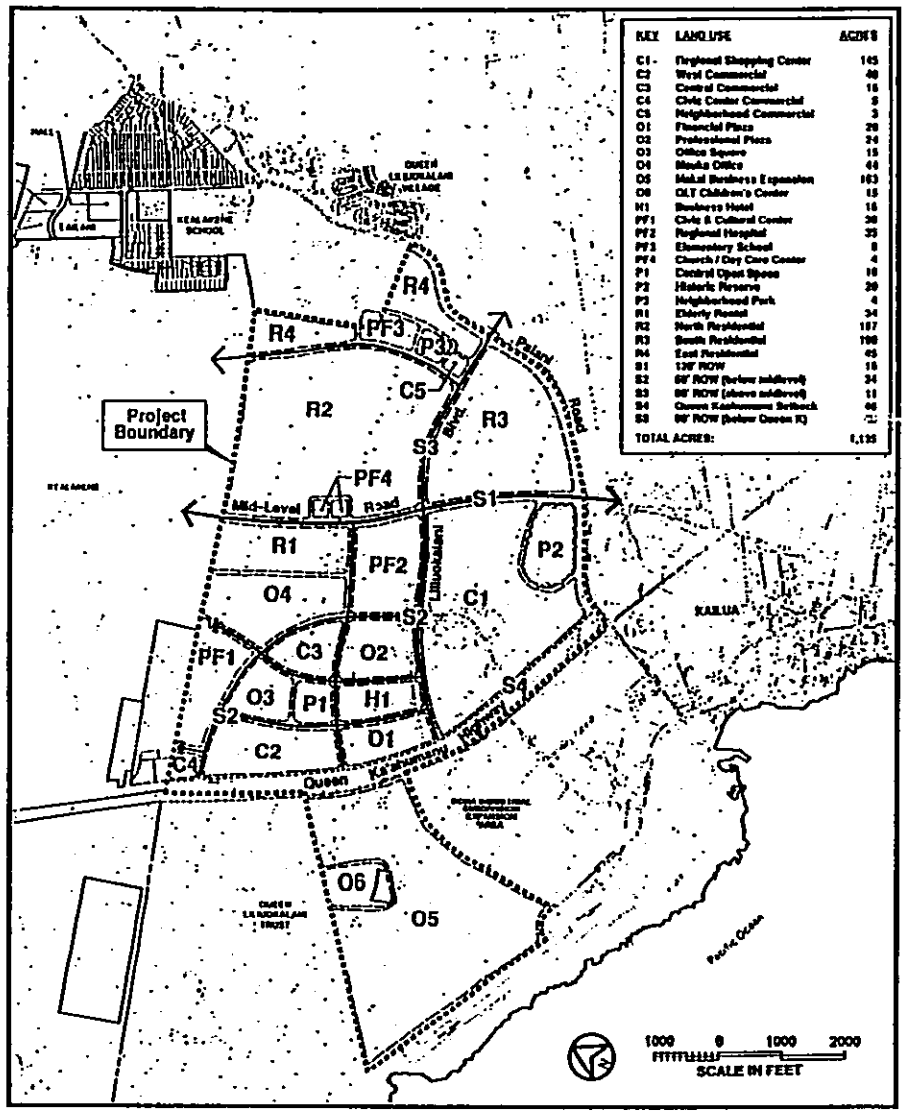
the centerline of the mauka sections of Palani Road, traffic noise levels from this lower volume roadway are less than 65 Ldn. For these reasons, the existing levels of roadway traffic noise at the proposed residential portions of the project are not expected to exceed current FHA/HUD noise standards or cause adverse noise impacts on future project residents.

CHAPTER VI. FUTURE TRAFFIC NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 5 for CY 2010 without the project, as well as with the project and its recommended roadway network. FIGURE 6 identifies the major roadways of the preferred project development alternative for which traffic noise levels were calculated. The future projections of project plus non-project traffic on the roadways which would service the project are shown in TABLE 3 for the PM peak hour of traffic. As indicated in TABLE 3, by CY 2010, traffic conditions on all existing roadways will worsen, and major improvements to the roadway network will be required with or without the project. If these roadway improvements are implemented to accommodate the projected future traffic volumes, traffic noise levels will increase significantly (by 3.5 to 7.4 Ldn) above existing levels. If the required roadway improvements are not implemented to maintain current levels of service, future traffic noise level increases will be less than those indicated in TABLE 3 due to increased congestion and reduced average vehicle speeds.

TABLE 4 summarizes the predicted setback distances to the 65, 70, and 75 Ldn traffic noise contour lines along the roadways servicing the project and attributable to both project plus non-project traffic by CY 2010. The setback distances in TABLE 4 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in TABLE 4, relatively large setback distances to the 65 Ldn contour of 106 to 293 FT from the centerlines of the improved Queen Ka'ahumanu Highway and Palani Road are predicted in CY 2010.

TABLE 5 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2010, and as measured by the Ldn descriptor system. As indicated in TABLE 5, the increases in traffic noise along Queen Ka'ahumanu



PROJECT DEVELOPMENT PLAN
AND IDENTIFICATION OF PRIMARY
ROADWAYS SERVICING THE PROJECT

FIGURE
6

TABLE 5

CALCULATIONS OF PROJECT AND NON-PROJECT
TRAFFIC NOISE CONTRIBUTIONS (CY 2010)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Q. Kaahumanu Hwy. (North)	6.3	0.9
Q. Kaahumanu Hwy. (Front)	5.4	0.8
Q. Kaahumanu Hwy. (South)	7.0	0.5
Palani Rd. (North)	5.3	0.3
Palani Rd. (South)	3.6	-0.1
Kuakini Road	-0.7	1.8
Mid-Level Road	73.3	0.2
Liliuokalani Blvd. (North)	0.0	69.3
Liliuokalani Blvd. (South)	0.0	71.7

Highway due to project traffic are relatively small when compared to those increases expected from non-project traffic. Similar conclusions apply along Palani Road. Project traffic noise increases are expected to be greatest relative to non-project traffic along Kuakini Road, where existing and future land uses are not considered noise sensitive.

As a result of the construction of the proposed Mid-Level Road and Liliuokalani Boulevard, traffic noise levels are expected to increase significantly at the inland areas mauka of Queen Ka'ahumanu Highway.. By CY 2010, following the construction of these new roadways, traffic noise levels at the future residential area mauka of the Mid-Level Road are expected to increase to levels as indicated in TABLE 4. Setback distances of approximately 183 FT from the centerlines of the Mid-Level Road will be required to meet the FHA/HUD noise standard of 65 Ldn under unobstructed line-of-site conditions. Setback distances of 97 to 106 FT from the centerlines of Palani Road and Liliuokalani Boulevard will be required to meet the same standard. It should be noted that the primary cause of these relatively large setback distances is the forecasted non-project traffic.

CHAPTER VII. DISCUSSION OF PROJECT RELATED TRAFFIC NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

The increases in traffic noise levels attributable to the project from the present to CY 2010 are predicted to range from 0.5 to 0.9 Ldn along Queen Ka'ahumanu Highway, where traffic noise levels are expected to remain above 65 Ldn along the highway Right-of-Way. This degree of increase in traffic noise levels attributable to the project will be difficult to perceive over a 20-year period from CY 1990 to CY 2010, and is not considered to be significant. Existing and planned land uses along the highway are primarily commercial and light industrial. For these reasons, traffic noise impacts along Queen Ka'ahumanu Highway and resulting from project traffic are not considered to be serious.

Relatively large increases in traffic noise levels along the improved Palani Road are expected to occur as a result of project plus non-project traffic. By CY 2010, non-project traffic is expected to increase traffic noise levels along Palani Road by 3.6 to 5.3 Ldn, with project traffic adding 0.0 to 0.3 Ldn to the non-project noise levels. Setback distances of 106 to 139 FT from Palani Road's centerline will be required to meet FHA/HUD noise standards under unobstructed line-of-sight conditions between the roadway and noise sensitive receptors. Under conditions of noise shielding by terrain features or man-made obstructions, setback distances required to meet the FHA/HUD standard would be significantly less, and be probably less than 100 FT from the roadway centerline.

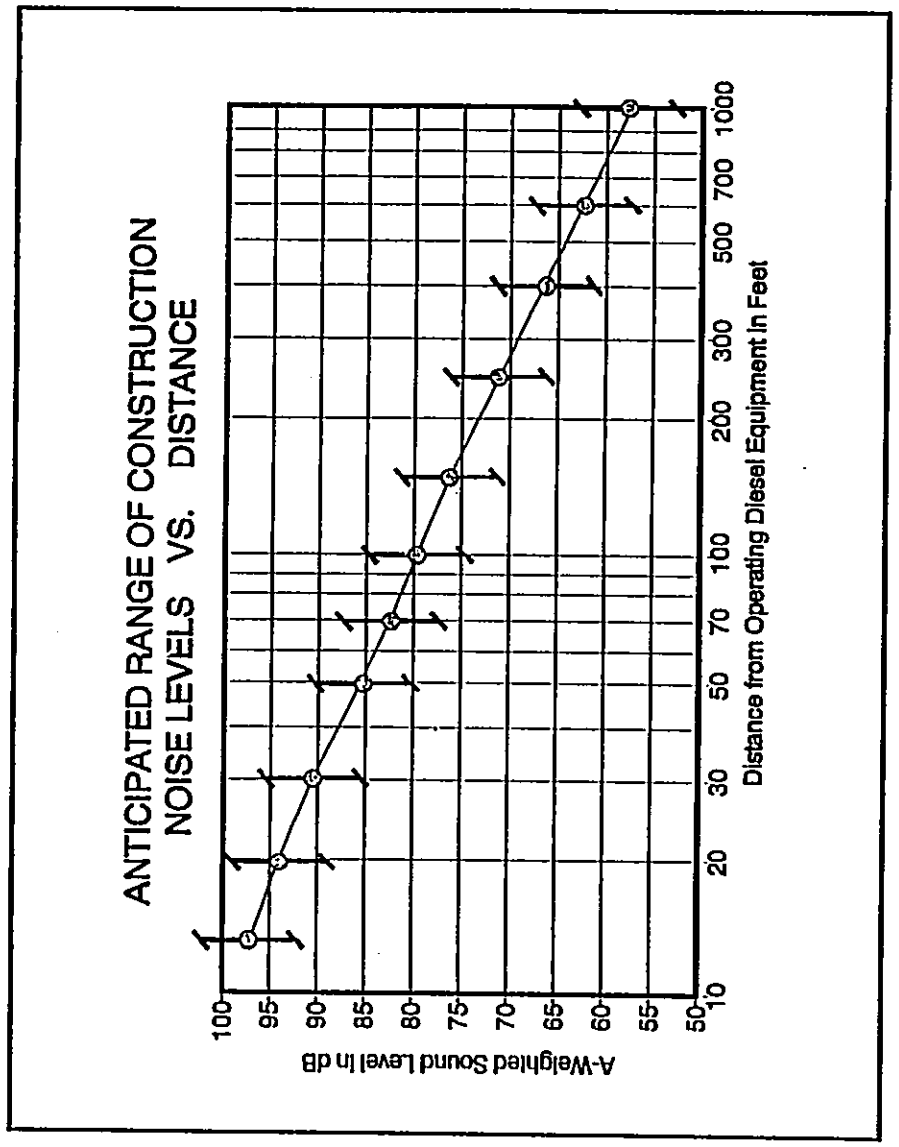
Potential noise impacts along the improved Palani Road are possible, both in respect to existing and planned noise sensitive receptors along the roadway. Existing residences located along the roadway may be impacted by the added traffic noise as well as by the future roadway improvements if noise mitigation measures are not included with the construction of the roadway improvements. Mitigation of off-site traffic noise impacts are generally

performed by individual property owners fronting the roadways' Right-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Severe noise impacts should not occur as a result of the proposed project as long as noise mitigation measures are incorporated into the Palani Road improvement projects.

CHAPTER VIII. OTHER NON-TRAFFIC NOISE CONSIDERATIONS

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in FIGURE 7. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in FIGURE 7, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (pile driving, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. In addition, if soil conditions allow, the use of vibratory pile driving equipment is also recommended for minimizing construction noise impacts. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (Reference 8), is another noise mitigation measure which can be applied to this project. TABLE 6 depicts the allowed hours of construction for normal construction



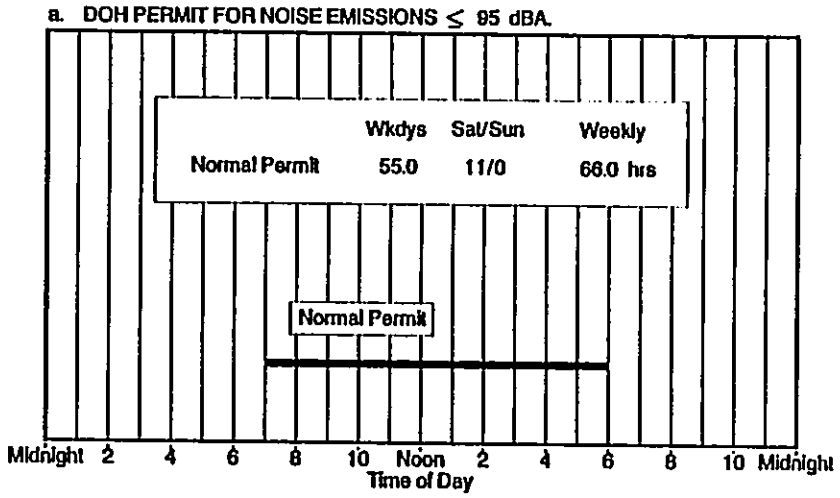
CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 7

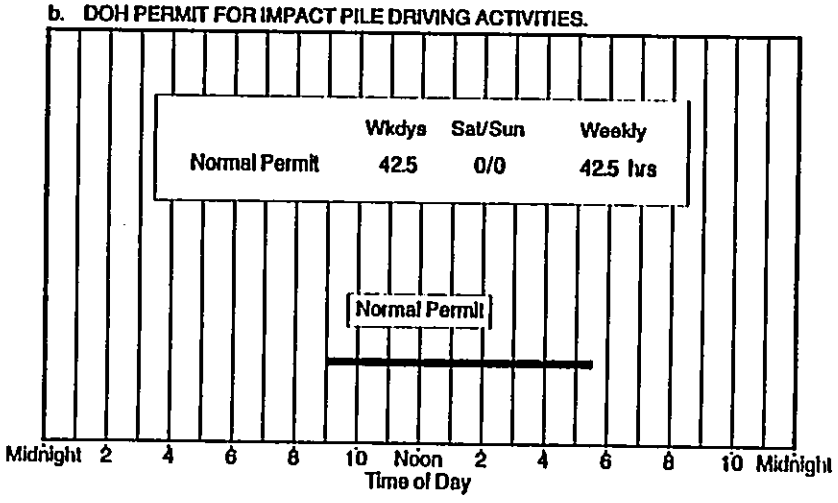
TABLE 6

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤ 95 dBA.



b. DOH PERMIT FOR IMPACT PILE DRIVING ACTIVITIES.



noise (levels which do not exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control"; Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B"; U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety"; Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model"; FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(5) "Transportation Analysis - Keahuolu Lands Development;" Wilbur Smith Associates; May 1990.

(6) May 3-5, 1988 24-Hour Traffic Counts; Queen Ka'ahumanu Highway at Palani Road; Hawaii State Department of Transportation.

(7) May 9-10, 1988 24-Hour Traffic Counts; Kuakini Highway at Alii Drive; Hawaii State Department of Transportation.

(8) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu"; Hawaii State Department of Health; November 6, 1981.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "Lepn" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (lpn was found to be 75 dB. lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., decl).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PWL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_d	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

Appendix F
Archaeological Analysis

Archaeological Inventory Survey
Queen Liliuokalani Trust Property

Land of Keahuolu, North Kona District, Island of Hawaii

(TMK:3-7-4-8:Por.2,12)

by

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Prepared for

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August 1990

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Report 596-021290

Archaeological Inventory Survey
Queen Liliuokalani Trust Property

Land of Keahuolu, North Kona District,
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SUMMARY

At the request of Mr. Lee Sichter of Belt, Collins and Associates, on behalf of their client, Queen Lilioukalani Trust (QLT), Paul H. Rosendahl, Ph.D. Inc. (PHRI) conducted a surface and limited subsurface archaeological inventory survey of the c. 1,100-acre proposed Queen Liliuokalani Trust Property project area, located in the Land of Keahuolu, North Kona District, Island of Hawaii (TMK:3-7-4-8:Por.2,12). The survey field work was conducted July 10-27, 1989 and January 22-29, 1990, and consisted of a 100%-coverage pedestrian survey augmented with an aerial reconnaissance survey. During the survey, 239 sites with 1,810+ component features were identified. State Inventory of Historic Places (SIHP) site numbers* were assigned to 237 sites. Two sites, Mamalahoa Trail (Site 00002) and Kuakini Wall (Site 07276) had been previously assigned SIHP numbers.

The predominant feature types identified within the project area are pahoehoe excavations, rock mounds, and modified blisters or outcrops, which together comprise 76% of all features (1,374 of 1,810). These and other features such as small terraces, low platforms, C-shapes, enclosures, and rubble walls are representative of agricultural activities, which account for 85-90% of all identified features.

Among the 239 identified sites, 84 are assessed as having information value that has been mitigated during this survey; no further work is determined necessary for these 84 sites. Further data collection only is recommended for 123 sites which appear to have value only for information content. Twenty-five sites are recommended for interpretive development, following further data collection. All of these sites except two are located within the area designated as an archaeological preserve by QLT. As a group, these sites possess a generally high cultural value as well. Eight of the sites recommended for interpretive development have features that are provisionally assessed as having cultural value, due to the possible presence of burials. Two sites, Mamalahoa Trail and Kuakini Wall, are assessed as having interpretive and cultural value, in addition to their information value.

Six cave sites are recommended for further data collection, stabilization, and preservation "as is," due to the presence of human skeletal remains. Finally, one shrine is recommended for preservation "as is."

In addition to site-specific recommendations concerning further treatment of the information obtainable within the project area, it is recommended that a systematic sampling program be designed and implemented during the data collection phase. Such a program should provide a more workable and accurate means of documenting the numerous features that are present within the project area.

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* State Inventory of Historic Places (SIHP) site designation system: all five-digit site numbers prefixed by 50-10-27 or -28 (50=State of Hawaii, 10=Island of Hawaii, 25 or 27=USGS 7.5'series quad map ["Kailua" or "Keahole, Hawaii"]).

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INTRODUCTION

BACKGROUND

This report presents the results of a surface and limited subsurface archaeological inventory survey conducted at the proposed Queen Liliuokalani Trust Property project area, located in the Land of Keahuolu, North Kona District, Island of Hawaii (TMK:3-7-4-8:Por.2,12). The survey was conducted by Paul H. Rosendahl, Ph.D., Inc (PHRI), at the request of Mr. Lee Sichter of Belt, Collins & Associates, on behalf of their client, the Queen Liliuokalani Trust. The overall purpose of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Impact Statement (EIS) that could be submitted in conjunction with a Land Use Boundary Ammendment petition to the Land Use Commission.

The survey field work was conducted July 10-September 27, 1989, and January 22-29, 1990. The field crew consisted of three to eight persons under the direction of Supervisory Archaeologist Theresa K. Donham, M.A., with field supervision by Supervisory Field Archaeologist Amy Dunn and Field Archaeologist Keala Kauhi. The project was conducted under the overall direction of Principal Archaeologist Dr. Paul H. Rosendahl. Approximately 3,177 man-hours of labor were expended on the field work portion of the project.

An ifterim report of findings and general significance asessments was prepared for this project in February 1990 (Donham 1990a). This report is the final report for the project.

SCOPE OF WORK

The basic purpose of an archaeological inventory survey is to identify—to discover and locate on available maps—all sites and features of potential archaeological significance present within a specified project area. An inventory survey constitutes an initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted primarily to determine the presence or absence of archaeological resources. This level of survey indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains. It permits a general significance assessment of the archaeological resources, and facilitates formulation of realistic recommendations and estimates for any subsequent mitigation work as might be necessary or appropriate. Such mitigative work could include further data collection involving detailed recording of sites and features, and limited test excavations; in addition, mitigation could also include more extensive and intensive data recovery excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

In consideration of the above, the basic objectives of the present inventory survey were fourfold: (a) to identify (find and locate) all sites and site complexes present within the area of potential effect; (b) to evaluate the potential general significance of all identified archaeological remains; (c) to determine the possible impacts of proposed future developments upon the identified remains; and (d) to define the general scope of any subsequent intensive data collection and/or other mitigation work that might be necessary or appropriate.

Prior to carrying out the field work, a general scope of work and specific field tasks for the project were discussed with Dr. Ross H. Cordy, chief archaeologist in the Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office (DLNR-HSS/SHPO). Based on a preliminary review of available background literature and records, and based on discussions with Mr. Sichter of BCA and appropriate DLNR-HSS/SHPO personnel, the following specific tasks were determined to constitute an adequate scope of work for the inventory survey of the proposed Kealakehe Planned Community project area:

1. Conduct archaeological background and historical documentary research involving review and evaluation of readily available archaeological and historical literature, historic documents and records, and cartographic sources relevant to the immediate project area;

2. Conduct a 100%-coverage, low-level (30-50 ft altitude) aerial survey (helicopter) of the entire project area, with special emphasis on (a) following out any foot trails present and plotting them on aerial photographs and/or maps, (b) identifying all sites obsreved, and (c) identifying areas devoid of sites (e.g., relatively recent lava flows and mechanically altered lands);

3. Conduct variable-coverage (partial to 100%), variable- intensity (30-90 ft intervals) ground survey of the project area, with the actual extent and intensity of coverage determined on the basis of the aerial survey;

4. Conduct limited subsurface reconnaissance testing of selected sites and features identified within 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; and

5. Analyze background research data and field data, and prepare appropriate reports.

The significance of all archaeological remains identified within the project area was to be assessed in terms of the National Register criteria contained in the Code of Federal Regulations (36CFR Part 60) and criteria for evaluation of traditional cultural values prepared by the national Advisory Council on Historic Preservation. These criteria are used by the DLNR-HHS/SHPO for the evaluation of cultural resources. Specific concerns to be addressed in site assessments were the potential for significant information content, the potential for providing a unique interpretive example of a past architectural or landscape form, and the potential for preserving or promoting cultural identity and values.

PROJECT AREA DESCRIPTION

The proposed Queen Liliuokalani Trust Property project area consists of six adjoining development parcels which together comprise approximately 1,100 acres (Parcels C, E, F1, F2, F3, and J1). Parcel C consists of approximately 200 acres and is located between Queen Kaahumanu Highway and the old Kona Airport State Park. The remaining parcels are on the east side of Queen Kaahumanu Highway, and include all lands between Palani Road to the south and the Keahuolu/Kealakehe boundary to the north. The eastern boundary of the project area is along the western boundary of the proposed Kealakehe Planned Community project area (Keahuolu parcel).

Keahuolu ahupua'a, in which the project area is situated, lies along the western slope of Hualalai volcano, where Pleistocene to recent Hualalai Series flows form the surface mantle. These flows are comprised primarily of alkalic olivine basalt, and are both aa and pahoehoe types (Macdonald, Abbott, and Peterson 1983:366). Specifically, the flows consist of pahoehoe flats, fissures, upthrusts, and collapsed blisters and tubes interspersed with fingers of aa that are generally oriented east-west. Although the topography of the flows is relatively rough in places, their overall aspect is a gradual slope from east to west. Elevation in the area is nine to 650 ft AMSL (above mean sea level). The lower portion of the area (Parcel C) exhibits a slope grade of less than 5%; the remaining areas exhibit slope grades of 5-10%. In Parcel C, the project area is within 105.0 m of Pawai Bay. The upper boundary of the project area is 3.6 km from the shoreline.

Annual median rainfall within the project area ranges from approximately 500 mm (20 inches) in the lower elevations to 1,000 mm (40 inches) in the upper elevations. In general, the density of vegetation within the project area increases with increasing elevation and rainfall. Vegetation is extremely sparse in Parcel C, and extremely dense in areas above 500 ft AMSL. There is little to no surface visibility in much of the upper portions of the project area, particularly in the southern half.

Predominant tree species within the project area are kiawe (*Prosopis pallida* [Humb. and Bonp. ex Willd.] HBK), koa-haole (*Leucaena leucocephala* [Lam.] de Wit), alahe'e (*Canthium odoratum*), and Christmas-berry (*Schinus terebinthifolius* Raddi). Understory plants consist predominantly of lantana (*Lantana camara* L.), kolu (*Acasia farnesiana* [L.] Willd.), 'ilima (*Sida cordifolia* L.), fountain grass (*Pennisetum setaceum* [Forsk.] Chiov.), California grass, (*Brachiaria mutica* [Forsk.] Stapf, Jamaica vervain (*Stachytarpheta jamaicensis* [L.] Vahl), and airplant (*Bryophyllum pinnatum* [Lam.] Kurz).

In addition to the species listed above, several species are represented by scattered individual plants or small clusters of plants. These include kukui (*Aleurites moluccana*), ti (*Cordyline terminalis*), guava (*Psidium guajava*), mango (*Mangifera indica*), day flower (*Commelina diffusa* Burm.f.), sword fern (*Nephrolepis* spp.), and sisal (*Agave sisalina*).

Bulldozer grubbing has taken place in two major zones within the project area. The first grubbed zone is a c. 335.0 m wide area along the west side of Queen Kaahumanu Highway, in Parcel C. The second disturbed zone is an abandoned quarry site, located near the center of the upper project area parcels, between 250 and 300 ft AMSL. This area is approximately 460.00 m N-S by 310.00 m E-W. If surface features once existed in the grubbed areas, they have been destroyed.

Ornamentals and herbaceous plants are being cultivated in isolated pockets in the upper portions of the project area and along the lower project area boundary, adjacent to State Park lands. Surface features in current use for cultivation include enclosures, modified outcrops, pahoehoe excavations, low curvilinear walls, and cleared areas with associated

rock mounds. During the survey, these features were designated as recent agricultural features when plants or sufficient amounts of modern gardening tools, and materials such as potting soil ags, etc. were present. It should be noted that some of the features in current use are formally indistinguishable from the numerous agricultural features assumed to be pre-contact or early historic. It is possible that the features are pre-contact or early historic features that have, with minimal modification, been reused. It is also likely that a some abandoned features of modern construction were not identified as such, due to a lack of diagnostic artifacts and construction style.

A number of cave sites which exhibit evidence of current habitation were located during the survey. These sites contained quantities of recent refuse, modern furnishings, and sleeping areas that were obviously currently used at the time of survey. These sites were recorded only if non-modern refuse, such as shell midden, or indigenous artifacts were observed. Some of the current habitation caves exhibit extensive modifications and alteration of prehistoric period deposits.

Surface features within the project area are in generally very good condition and do not appear to have been disturbed by livestock or grubbing to the extent observed in Kealakehe to the north.

HISTORIC BACKGROUND AND SUMMARY OF HISTORICAL DOCUMENTARY RESEARCH

The area of North Kona between Kailua Bay and Keauhou Bay to the south is generally recognized as the population core and fertile agricultural district of North Kona (Kirch 1985:166;Kelly 1983). To the north of Kailua Bay, beginning at Honokohau, is the relatively dry Kekaha district of North Kona, with its barren lava inlands and coastal fishponds (Springer 1986:121). Keahuolu is situated in the transition zone between these two constrasting environmental districts, and is immediately north of Kailua Bay, a center of both political and economic activities since before Western contact.

The southern boundary of Keahuolu, at the shoreline, is located at Mahaihale, approximately 1.8 km north of Kukailimoku Point, named after the deity of victory in battle. Between Kukailimoku Point and the Keahuolu boundary is a narrow strip of coastal land that is within Lanihau Ahupua'a (where much of the old Kona Airport is located). Consequently, the shoreline of Keahuolu is considerably narrower than expected, given the width of the ahupua'a less than 1.00 km inland of the coast, and about 2.0 km of Keahuolu lands (N-S) are fronted by Laniahu along the shoreline.

Kukailimoku Point and the coastal sand dunes to the north and south were apparently repeatedly used during the prehistoric and early historic periods as burial grounds. Jackson's 1883 survey map locates graves at Kukailiomku and a relatively large burial ground at Kaliliki Point to the south. Jackson referred to one massive masonry tomb as "Kamehameha's Tomb" (Neller 1980:5). Reinecke located additional graves in Lanihau and Keahuolu in 1930, and more recently Neller reported on exposed human remains at nine different locations along the coast, five in Lanihau and four at the Lanihau/Keahuolu boundary (Neller 1980:11-13). Historic period burials were also recently identified at Pawai Bay by Neighbor Island Consultants (1973).

At least two coastal heiau have been identified within Keahuolu. One of these is a small fishing heiau, referred to by Stokes as the Ko'a of Halepau. The Heiau of Kawaluna is described by Stokes (1919) as being at Pawai Bay. This latter site (SIHP 3843) was not relocated by Reinecke in 1930, nor was it field-verified by Emory in 1970 during his inventory of Big Island sites. The Neighbor Island Consultants survey (1973) of the Pawai Bay shoreline area did not identify this heiau, which Stokes describes as a loosely constructed enclosure with no opening (1919).

A third heiau, the Heiau of Palihiolo, was first described by Stokes as being at or near the Keahuolu/Lanihau boundary. This site was not identified by Reinecke in 1930; it was, however, tentatively identified by Newman in 1970, and recorded as SIHP Site 2002. Newman identified burials at this site and located it in Lanihau, several hundred meters south of the Keahuolu boundary.

Twentieth century archaeological surveys (discussed below) and recent historical documentary research by Wong-Smith (Appendix B) indicates that, formerly, the immediate coastal area of Keahuolu consisted of coconut groves with houselots, graves, and shrines, and salt production areas. Gardens were undoubtedly present along the coastline as well. Ellis, during his 1822 tour of Hawaii Island, described an area he referred to as the "suburbs of Kailua," which probably included lower Keahuolu. According to Ellis:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses are built, wherever soil could be found sufficient to nourish the sweet potatoe, the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots (Ellis 1963:31).

In a letter dated July 8, 1869, David K. Kalakaua describes Keahuolu to his sister, Liliuokalani. The coastal area is summarized as follows:

> The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grows on it and [it is] suitable for feed of sheep and goats.

At least one kuleana land grant was awarded in coastal Keahuolu (LCA 10303 to Maa). This grant consisted of 2.25 acres and included a coconut grove, seven fan palm trees, 11 taro kihapais, 10 potato kihapais, and salt land. According to the testimony of Mahu, the salt land was productive at the time of the legal conveyance of the grant. According to the Native Testimony records, coconuts obtained from the grove in Maa's kuleana were the property of Keohokalole.

The ahupua'a of Keahuolu was awarded to Ane Keohokalole during the Mahele of 1848. According to testimony documented during the Mahele, two walled houselots in Keahuolu had been held by Keohokalole's ancestors "from very ancient times" (Foreign Testimony 3:573). At least one of these lots was located along the shoreline. Keohokalole sold portions of her 15,000-20,000 acre grant to the government and other parties, with the balance being transfered to her heir, Liliuokalani.

There is little historic information concerning traditional Hawaiian land use for the inland portion of the project area in Keahuolu, and no kuleana grants were awarded there. Nineteenth century descriptions of inland Keahuolu by government surveyors reflect the same general environmental conditions present in the barren lava lands of Kekaha to the north. Emerson surveyed the area in the 1880s, and his map (Reg. Map 1280) denotes "rough pahoehoe, little vegetation" in the Keahuolu ahupua'a. David Kalakaua (1869) described the lower inland portions of Keahuolu as being suitable for livestock grazing (Appendix B), an assessment found in numerous nineteenth century descriptions of North Kona kula lands.

No historic references specifically describing traditional agricultural activities in inland Keahuolu or adjacent ahupua'a to the north or south have been located. It is apparent from the archaeological record observed at Keahuolu, Kealakehe, and Honokohau 2nd, that agricultural activities (apparently prehistoric) were relatively intensive in the area designated historically as grazing land.

Comparisons by Kelly (1983) between the kuleana lands claimed and lands actually awarded in North Kona indicates to her that dryland agriculture was being conducted historically until the time of the Mahele, when vast expanses of kula lands were granted to konohiki, who utilized it as livestock grazing land (Kelly 1983:67). Kelly found that garden land claims located in the kula zone were generally not awarded to the claimants.

The forested upland area of Keahuolu was historically the primary agricultural zone and the location of kuleana grants. According to Kalakaua, "[t]he upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, bananas &c. Breadfruit trees grow wild as well as the Kuki oil seed" (1869).

Wong-Smith reports (Appendix B) that five kuleana awards were granted in upland Keahuolu. These five grants comprise a total of 7.9 acres and range in size from 2.9 to 0.6 acres. The most common cultigen mentioned in descriptions of the claims is taro (three of three claims which name cultigens). Potatoes are mentioned in one claim, and a single coffee patch is mentioned in one claim.

During Emerson's 1880 Government Survey of North Kona, he identified the lower (makai [seaward]) edge of a forest zone, which he described as "lava covered with scattering forest and dense masses of ki root" (Kelly 1983:58). The land below this forest edge was described as "rocks covered with long grass" (Kelly 1983:58). According to Kelly's estimations, the forest edge occurred at an average elevation of 550 to 650 ft around Kailua and to the south (1983:58). However, it appears that the forest edge was somewhere between 750 and 800 ft elevation in Keahuolu (see reproduction of Emerson's map in Kelly 1983:59). This approximation places the nineteenth century forest edge very close to the eastern (mauka) boundary of the project area. According to Emerson's documentation of nineteenth century vegetation, the project area would be within the kula zone.

It was shortly after the systematic delineation of kula lands as grazing land that the Kuakini Wall was constructed. This wall extends from Kahaluu Bay to the southern portion of Keahuolu, at an average distance of 1.6 km from the coastline. At the northern end in Keahuolu, the wall is at an

elevation of 220 ft; further to the south, its average elevation is 160 ft. The purpose of the wall, as proposed by Kelly (1983:75), was to keep the free-ranging livestock contained within the kula zone, and out of the coastal settlements and gardens. The Kuakini Wall does not cross Keahuolu, but extends 183.00 m north of Palani Road, at which point it may turn west (or a later western extension was added) for a distance of approximately 380.00 m. To date, no historical information has been located that would aid in determining the reason why the wall ends where it does, rather than at an ahupua'a boundary, trail or some type of land division feature. There is a definite concentration of habitation and agricultural features at the end of the wall, to the south of the western extension.

Sometime during the late 1890s, a sisal mill was established in Keahuolu along the south side of the old Palani Road corridor. This mill location is shown on a 1924 USGS topographic map, at 428 ft AMSL (Appendix B: Figure B-1). Kelly reports that a 500-acre tract of land was cultivated in sisal, and was known as the McWayne sisal tract (Kelly 1983:89). Recent informant interviews conducted by Wong-Smith indicate that as much as 1,000 acres may have been in sisal cultivation in Keahuolu and Kealakehe. According to informant Mr. Minoru Inaba, the mill was surrounded by sisal fields (Appendix B) and was in operation until 1924.

The location of the sisal tract is yet to be determined; if, however, it surrounded the mill, as indicated by Mr. Inaba, it would have been within the current project area. There are scattered clumps of sisal within the project area, and a very concentrated growth along a section of the old Palani Roadbed, at 600 ft AMSL. In the area of the concentrated sisal are a series of walled enclosures and ramps which abut the old roadbed (SIHP Site 13435). This site is apparently at too high an elevation to correlate with the mill; it may, however, be associated with the sisal transport operations.

In comparing Keahuolu land use with Kealakehe to the north, it appears that Keahuolu was exposed to far less livestock grazing than Kealakehe. Lands in Kealakehe between 200 and 600 ft AMSL are currently used for livestock, and appear to have been used in this manner for about a century. The absence of ranching features and the relatively good preservation of most surface features in Keahuolu attests to a more limited use of the area for cattle.

PREVIOUS ARCHAEOLOGICAL WORK

Coastal Keahuolu

The earliest archaeological field investigations in Keahuolu focused on the major sites located along the coastline. In his study of Hawaiian heiau, Stokes (1919) described two coastal heiau sites in Keahuolu (Halepau and Kawaluna), and a third heiau (Palihiolo) at or very near the Keahuolu/Lanihau boundary. The Halepua site was described by Stokes as a ko'a, or shrine for fishermen, located 100 ft from the shore in a coconut grove. The walls were up to four feet high and in good preservation at the time of his survey (1919). During his coastal survey in 1930, Reinecke located structural remains at Halepau (Site 15, house site of coral and remains of a pen around it), but he did not identify the ko'a. A short distance to the north, Reinecke identified an enclosure, with 4 ft high walls, paved with coral. This enclosure (Site 17) was in a setting described by Reinecke as "[a] regular oasis of pools, kiawe and luxuriant grass" (1930:6), and may actually correlate with the Ko'a of Halepau. According to Neller (1980), the shrine is registered as SIHP Site 2139.

The Heiau of Kawaluna is described by Stokes as a rebuilt enclosure located on the beach at Pawai Bay (see Appendix B for Stokes' narrative descriptions of the heiau). In 1930, Reinecke identified four house platforms, enclosure remains, and an unidentifiable ruin at Pawai Bay, (Sites 23 and 24), but he did not identify a heiau site. The site was registered as SIHP 3843 in 1970, but was not field verified by Emory during his inventory survey. A later survey of the Pawai Bay area by Neighbor Island Consultants (1973) did not identify the Kawaluna Heiau, although an enclosure with historic period burials was located.

The Heiau of Palihiolo was first described by Stokes as being at or near the Keahuolu/Lanihau boundary. It consisted of an enclsure with coral paving. According to Stokes' informants, this heiau was used for human sacrifice, and Kalakaua had it rebuilt prior to his departure from Hawaii. The site was not identified by Reinecke, although he did identify an enclosure associated with house platforms in the vicinity (Site 9). Newman tentatively identified the heiau in 1970 (SIHP 2002), and located it in Lanihau, not far from the Ko'a of Makaeo.

During his survey of coastal North Kona, Reinecke identified and located 12 sites in Keahuolu and eight sites in Lanihau (Reinecke 1930:4-8). The Keahuolu sites consisted primarily of habitation platforms and enclosed yards. Reinecke enumerated 41 platforms, nearly all of which were interpreted as house sites, and seven enclosures at the 12 sites. The greatest concentration of house platforms was at Site 20, where 12 were counted. This complex is located on a flat north of Keahuolu Point. Another concentration (seven houses) was identified at the Keahuolu/Lanihau boundary (Site 12), which Reinecke associated with the Makeo complex. In addition to houses, Reinecke identified petroglyphs

(Site 20), modified pools (Sites 12 and 17), burials (Sites 12, 13, and 19), and a canoe landing (Site 14). None of Reinecke's sites are located within the current project area.

Among the identified Lanihau features, Reinecke enumerated 15 platforms, nine of which were interpreted as house sites. Eight of these house platforms were concentrated in the Makeo complex (Site 9), which also included a modified fishpond and several modified anchailine pools. Other features identified at Lanihau included petroglyphs (Sites 5, 6, 8, and 11), enclosures (Sites 7 and 9), and burials (Sites 4 and 6).

In 1970, Emory mentioned the two Keahuolu heiau sites in his inventory of known sites for selected areas of Hawaii (Emory 1970). That same year, Newman conducted an inspection of the old Kona Airport grounds, prior to its development as a State Park (Newman 1970). Newman described three Lanihau sites (SIHP 2000-2002), and one Keahuolu site (not designated) consisting of historic period burials and a cluster of ground "bait cups" (Newman 1970).

Coastal reconnaissance in Keahuolu was conducted by Bevacqua in 1972. Bevacqua's survey area was located in the immediate coastal zone, to the north of the present project area. During this survey, nine sites were identified (Bevacqua 1972). Some of these sites were later relocated by Ching, who assigned new numbers to them, due to "...vague locations...and the change in site conditions" (Ching 1978:1).

In 1975, Sinoto surveyed a road corridor through coastal Keahuolu, wherein seven sites were identified (Sinoto 1975:1). All sites were described as being "small, semi-permanent or temporary structures associated with coastal, probably marine activities" (Sinoto 1975:3). It is difficult to determine where Sinoto's survey area was located based on the report. It appears to have been to te north of the current survey area.

A series of reconnaissance survey reports were completed between 1973 and 1980 in conjunction with development of the old Kona Airport State Park along the shoreline in Keahuolu and Lanihau (Neighbor Island Consultants 1973, Fuke and Goldstein 1978, Estioko-Griffin and Lovelace 1980, and Neller 1980). Estioko-Griffin and Lovelace's survey relocated sites previously identified within the 89.7 acre parcel, and located additional sites, for a total of 35 sites. The majority of identified sites (28) were concentrated in an area just north of the old runway, along the shoreline at Pawai Bay. The most frequently identified site types included caves (11), petroglyphs (7), burials (5) and house sites (3) (Estioko-Griffin and Lovelace 1980:iii).

In 1978, Ching conducted a reconnaissance survey of all Keahuolu lands between the shoreline and Queen Kaahumanu Highway (987 acres). Ching's survey identified 59 sites with 140 component features, including sites previously identified by Bevacqua and Sinoto. The most frequently occurring features were reported to be salt pans (29), cave shelters (25), pavings (21), and cairns (21) (Ching 1978:32).

Nine of the 59 sites identified by Ching are within the boundaries of the current project area. Ching's descriptions of these sites are summarized below:

6537 - U-shaped boulder alignment
6538 - Well inside a modified cave, small platform present
6539 - Walled pahoehoe depression; planting or storage area
6540 - Habitation complex 150.00 by 300.00 m; several platforms, pavements, alignments, large habitation cave with midden and modern car parts
6541 - Circular alignment
6542 - Enclosure, constructed with aa, 4.50 by 4.00 m
6543 - Habitation complex; enclosure, platform, three paved areas
6544 - Walled cave shelter
6548 - Two cairns

During the current survey, difficulties were encountered in establishing reliable correlations between most of Ching's sites and features identified in the field. The only available map of Ching's sites was too generalized to accurately determine locations. In addition, many of Ching's descriptions do not provide dimensions or are too generalized to be reidentified. For most of his single features, there were several similar types in the general vicinity of his mapped locations. The tentative correlations with PHRI temporary site numbers, and problems with the correlations are summarized below (see Table 1 for correlation of temporary numbers with permanent SIHP numbers):

6537 - Similar alignments were identified at Sites T-42 and T-31, both in the vicinity of the mapped location of this site.

6538 - A water cave was identified at Site T-128 (Feature B). The location is close, but this pool does not have a small platform, and the entrance is not lined with boulders, although a few are present.

6539 - There are literally dozens of features that fit this description in the general vicinity of this site. They occur at Sites T-30, -32, -50, -51, and -52.

6540 - The only feature resembling Ching's description that waslocated is the cave with car parts (T-36). No platforms, pavements or trail was located. The area around the cave has been affected by road grubbing, and some of these features may have been disturbed since Ching's survey.

6541 - There are dozens of these features in the vicinity of Ching's mapped location for this sites. They occur at Sites T-19, T-21, and T-26.

6542 - An enclosure of similar dimensions (Site T-8) was identified in the vicinity of the mapped location of this site; however, it is constructed with pahoehoe slabs, not with aa.

6543 - A complex was located (Site T-15) which nearly fits this site description and its location. However, the enclosure is larger (by 7.5 sq m) than the dimensions given by Ching, and a terrace, rather than a platform, is associated.

6544 - It is uncertain whether this site is actually within the project area. There are two caves (T-10 and T-13) in the vicinity that may correlate; the dimensions, however, of neither site fit those given by Ching.

6548 - These two cairns were not relocated; they appear to have been located in the area that is currently bulldozed.

Because of the uncertainty in correlating Ching's complexes and single features, it was decided that his SIHP numbers would not be reused for this survey. It is very likely that, with the exception of disturbed features, all of the features he identified within the project area have been relocated. The problem is determining which features in the current inventory are the ones Ching identified.

A reconnaissance and testing survey was conducted in selected coastal Keahuolu parcels by Folk in 1980 (Folk 1980). Folk conducted a reconnaissance survey of a c. 20-acre proposed building site (current location of the Queen Liliuokalani Children's Education Center), wherein no sites were identified. He also conducted intensive-level mapping and recording of 21 sites in three kipuka, located near the shoreline, north of the old Kona Airport, and north of the current project area. Test excavations were also conducted in the center of the kipuka in order to determine if buried cultural deposits were present.

During his study, Folk documented seven pavements, three caves, two platforms, four historic/recent campsites, a burial or shrine, a historic period animal enclosure, and three habitation areas (Folk 1980:21-22).

Inland Keahuolu

In 1983, Soehren conducted a reconnaissance survey of a 10-acre parcel in upper Keahuolu, adjacent to the eastern edge of the existing Queen Liliuokalani Village subdivision. The parcel is located between 800 and 1000 ft AMSL (Soehren 1983). Soehren located no sites or culturd features within the parcel, and he describes the area as follows:

> ...such land appears suited only for aboreal crops, such as paper mulberry, if any. No evidence was found of traditional agricultural structures such as kuaiwi, clearing mounds or terraces, nor were there any other featurwes atributed to prehistoric Hawaiian culture seen on the parcel (Soehren 1983).

Reconnaissance surveys conducted in inland portions of Keahuolu include two studies conducted by PHRI between 1983 and the present. In 1983, Rosendahl surveyed three separate parcels, including 100 acres west of Queen Kaahumanu Highway, along the southern boundary of Keahuolu (Area 1), 100 acres east of the highway and along the south side of Palani Road (Area 2), and 12 acres along the southern edge of Keahuolu and the northern side of Palani Road (Area 3) (Rosendahl 1983). Area 2 is within the boundaries of the current project area. Rosendahl located five sites in Area 1, two large complexes and five additonal sites in Area 2, and a large complex in Area 3. The Area 3 complex was interpreted as a probable continuation of the Area 2 complex. No SIHP numbers were assigned during this survey.

The seven sites/site complexes identified by Rosendahl Within Area 2 are summarized below:

D A complex consisting of a large low platform, mounds, alignments, modified outcrops, and cleared areas.

E A complex consisting of numerous walls, platforms, enclosures, caves, pavements and alignments; 260.00 by 350.00 m area.

Table 1.

CORRELATION OF SITE NUMBERS

SIHP Site No.	PHRI Temp. Site No.	SIHP Site No.	PHRI Temp. Site No.
13255	T- 1	13297	T- 47
13256	T- 3	13298	T- 48
13257	T- 4	13299	T- 49
13258	T- 5	13300	T- 50
13259	T- 6	13301	T- 51
13260	T- 7	13302	T- 52
13261	T- 8	13303	T- 53
13262	T- 9	13304	T- 54
13263	T-10	13305	T- 55
13264	T-11	13306	T- 57
13265	T-12	13307	T- 58
13266	T-13	13308	T- 60
13267	T-14	13309	T- 61
13268	T-15	13310	T- 62
13269	T-16	13311	T- 63
13270	T-17	13312	T- 64
13271	T-18	13481	T- 65
13272	T-19	13313	T- 66
13273	T-20	13314	T- 67
13274	T-21	13315	T- 68
13275	T-22	13316	T- 69
13276	T-23	13317	T- 70
13277	T-24	13318	T- 71
13278	T-25	13319	T- 72
13279	T-26	13320	T- 73
13280	T-27	13321	T- 74
13281	T-28	13322	T- 75
13282	T-29	13323	T- 76
13386	T-30	13324	T- 80
13283	T-31	13325	T- 83
13284	T-32	13326	T- 85
13285	T-33	13482	T- 87
13286	T-34	13327	T- 88
13480	T-35	13328	T- 89
13287	T-36	13483	T- 92
13288	T-37	13329	T- 93
13289	T-38	13330	T- 94
13290	T-39	13331	T- 95
13291	T-40	13332	T- 96
13292	T-41	13333	T- 97
13293	T-42	13334	T-100
13294	T-43	13335	T-101
13295	T-44	13336	T-102
13296	T-45	13337	T-104
13484	T-108	13378	T-161

Table 1. (cont.)

SIHP Site No.	PHRI Temp. Site No.	SIHP Site No.	PHRI Temp. Site No.
13338	T-109	13379	T-162
13485	T-110	13380	T-163
13486	T-111	13381	T-164
13339	T-112	13382	T-165
13340	T-113	13383	T-166
13341	T-114	13384	T-167
13342	T-116	13385	T-168
13343	T-117	13387	T-170
13344	T-118	13388	T-171
13345	T-119	13389	T-172
13346	T-120	13390	T-173
13347	T-121	13391	T-174
13348	T-122	13392	T-175
13349	T-123	13393	T-176
13350	T-124	13394	T-177
13487	T-125	13395	T-178
13351	T-126	13396	T-179
13352	T-127	13397	T-180
13353	T-128	13398	T-181
13354	T-129	13399	T-182
13355	T-130	13400	T-183
13488	T-131	13401	T-184
13356	T-132	13402	T-185
13357	T-133	13403	T-186
13358	T-134	13404	T-187
13359	T-137	13405	T-188
13360	T-138	13406	T-189
13361	T-139	13407	T-190
13362	T-140	13408	T-191
13363	T-143	13409	T-192
13364	T-144	13410	T-193
13489	T-145	13411	T-194
13490	T-146	13412	T-195
13491	T-147	13413	T-196
13365	T-148	13414	T-197
13366	T-149	13415	T-198
13367	T-150	13416	T-199
13368	T-151	13417	T-200
13369	T-152	13418	T-201
13370	T-153	13419	T-202
13371	T-154	13420	T-203
13372	T-155	13421	T-204
13373	T-156	13422	T-205
13374	T-157	13423	T-206
13375	T-158	13424	T-207
13376	T-159	13425	T-208
13377	T-160	13426	T-209

Table 1. (cont.)

SIHP Site No.	PHRI Temp. Site No.	SIHP Site No.	PHRI Temp. Site No.
13427	T-210	13454	T-237
13428	T-211	13455	T-238
13429	T-212	13456	T-239
13430	T-213	13457	T-240
13431	T-214	13458	T-241
13432	T-215	13459	T-242
13433	T-216	13460	T-243
13434	T-217	13461	T-244
13435	T-218	13462	T-245
13436	T-219	13463	T-246
13437	T-220	13464	T-247
13438	T-221	13465	T-248
13439	T-222	13466	T-249
13440	T-223	13467	T-250
13441	T-224	13468	T-251
13442	T-225	13469	T-252
13443	T-226	13470	T-253
13444	T-227	13471	T-254
13445	T-228	13472	T-255
13446	T-229	13473	T-256
13447	T-230	13474	T-257
13448	T-231	13475	T-258
13449	T-232	13476	T-259
13450	T-233	13477	T-260
13451	T-234	13478	T-261
13452	T-235	13479	T-262
13453	T-236		

F Modified sinkhole with several chambers and internal structures such as enclosures and platforms; artifacts and midden present.

G Papamu and other petroglyphs.

H Modified sinkhole with several lava tube caves and internal structures.

L Kuakini Wall.

M Wall attached to north end of Kuakini Wall.

Rosendahl's Complexes D and E correlate with a several sites that were identified during the current project within the preserve area. These include Sites 13370-13376, 13381, and 13382. Kuakini Wall (L) had previously been assigned an SIHP number (07276). The remaining sites identified by Rosendahl were relocated and assigned SIHP numbers during this survey. The correlations are as follows: F (13350), G (13348, Fea. C), H (13387), and M (13349).

Rosendahl recommended intensive survey of all three of the areas he examined, as well as preservation of Kuakini Wall and portions of Complex E (Rosendahl 1983:13). The latter area was subsequently set aside as an archaeological preserve by QLT. An inventory of features within the area was conducted during this survey; however, specific feature descriptions and measurements were not completed.

In 1989, PHRI conducted an inventory survey of the proposed Kealakehe Planned development, which included a 150-acre parcel in Keahuolu immediately east of the current project area and northwest of Palani Road (Donham 1990b). During the survey, 53 sites were identified, most of which were interpreted as agricultural features or complexes. Eighteen agricultural complexes with three to 120 features were identified (Donham 1990b:19). Predominant feature types identified included rock mounds (278) and pahoehoe excavations (173). Only a single platform and six terraces were identified in the Keahuolu parcel. Ideally, the feature patterns of this parcel should be considered in conjunction with the current survey area for a more complete representation of the overall settlement pattern of Keahuolu.

Keahuolu was included in a regional historic overview compiled by Kelly (1983), in conjunction with the Kuakini Highway realignment corridor mitigation study. This overview included approximately 30 ahupua'a between Keahuolu and Keokea to the south. Kelly summarizes early historic and traditional Hawaiian agriculture as it was practiced in the dry mid-slope inland areas (kula) of Kona (Kelly 1983:55-75). She also provides background for the historic processes that led to abandonment of kula farming by Hawaiians during the nineteenth century.

Archaeological field work along Kuakini Highway Realignment Corridor was conducted from 1980-83 by B.P. Bishop Museum (Schilt 1984). The corridor crossed 24 ahupua'a located between Palani Road and Kilohana Subdivision to the south. The northern end of the 4.96 km long corridor was in Keahuolu. A total of 134 sites (455 features) were identified along the corridor; two sites were located in Keahuolu. These included a cairn and a modified outcrop. Twenty-two radiocarbon dates were determined from samples collected during the project (Schilt 1984:262). On the basis of the dated samples, their contexts, and other information, Schilt postulates that agricultural use of the kula was probably not intensive until after AD 1400-1500. Schilt suggests that erosional deposition of soil from agricultural areas located upslope was probably a major factor in permitting such use of the kula (Schilt 1984:274). She also suggests that due to differences in rainfall patterns, initial exploitation of the kula zone at the north end of the highway construction project area (Keahuolu) occurred later (c. AD 1550-1650) than use of this zone at the southern end (c. AD 1400-1650; 1983:274).

RESEARCH PROBLEMS AND APPROACH

Selected research issues of importance to further archaeological investigations in Keahuolu are presented here in order to provide an explicit context for the assessment of research significance of sites identified within the project area. These issues fall under three general approaches to archaeological interpretation—culture history, settlement pattern analysis, and human ecology.

Culture history has as its primary concern the formulation and testing of temporal models. Of major importance is the documentation of earliest human presence in a given area, and the chronological placement of significant cultural changes, events, or individuals. The development of a local cultural history, or chronology, is often viewed as a necessary first step in the pursuit of other archaeological problems, because in the absence of temporal control, synchronic patterns cannot be distinguished from diachronic patterns.

On the basis of prior analyses of archaeological data and age determinations of charcoal samples recovered from areas near the project area, it is reasonable to expect that most of the identified habitation and agricultural features in the upper portions of the project area should post-date AD 1300-1400. This hypothesis is based on dates assayed from features in Kealakehe and Honokohau, as well as the dates assayed from sites within the Kuakini Highway corridor (Schilt 1984). During a testing program in upper Kealakehe at c. 800-1000 ft AMSL, Hammatt, Shideler, and Borthwick recovered a dating sample from a hearth feature at Site 11. The sample was determined to have a calendric range of AD 1645-1950 (Hammatt et al. 1987:60).

A second date was determined from a charcoal sample collected at SIHP Site 13188 (a cave), located at 375 ft AMSL in Kealakehe (Donham 1990b:22). In Honokohau 2nd, five age determinations were derived from three sites (SIHP 12981, 12994, and 13019) (Donham 1990c:19). Four of the five determinations yielded calendric ranges between AD 1610-1955. One sample exhibited a calendric range of AD 980-1650, and is considered to have limited interpretive value due to the large standard error of the sample.

On the basis of findings along the Kuakini highway corridor, Schilt postulated that exploitation of the kula zone north of Kailua would have occurred about 100 years later (AD 1550-1650) than the spread of agriculture into the kula zone further south. This temporal difference is attributed by Schilt to the differences in rainfall patterns between the two areas (Schilt 1984:7). If there is a south-to-north gradient in the beginning of agricultural use of the kula, it should also be apparent to some degree between the southern portion of Keahuolu, which exhibits distinctively more lush vegetation, and the ahupua'a of Honokohau 2nd, which is located within the environmental district of Kekaha. We should

therefore expect to find inland cultural deposits in southern Keahuolu which predate the earliest Honokohau 2nd deposits.

To date, no age determinations have been obtained from coastal Keahuolu sites. Deposits identified as being derived from permanent habitation sites by Cordy were apparently present at Koloko by around AD 1050-1100 (Cordy 1981:180). Given the proximity of Keahuolu to Kailua Bay, and its situation between Kailua and Koloko, it is reasonable to expect that permanent coastal habitation was occurring here prior to or around AD 1100. The area of permanent coastal habitation (and household garden plots) in Keahuolu is makai of the current project area. Much of the activity reflected in lower Keahuolu appears to be agricultural, yet this area is the driest of all the kula lands in Keahuolu.

If the rainfall gradient model is to be used for predicting agricultural use on a north-south axis, then it should also be applicable on an elevational axis. Since rainfall is significantly lower in the lower elevations, then agricultural exploitation of these areas should not precede exploitation of areas with greater rainfall. However, if coastal residents were commuting to upland or inland agricultural plots, or were trading with upland agriculturalists, then deposits in temporary habitation sites should date to the period of trade or commutation. On the basis of the above hypotheses concerning the use of the kula zone by agriculturalists, we should expect that inland sites at elevations between c. 10 and 400 ft AMSL will not predate sites located above 400 ft AMSL.

One of the goals of field reconnaissance during this survey was to locate deposits in caves or other features that had potential for containing carbonized material for dating, and to collect dating samples. A wide range of formal feature types was tested, not only to aid in determining function, but to determine if carbonized remains could be expected to occur in certain types of agricultural features.

Settlement pattern analysis is an integral component of archaeological studies due to its utility in summarizing locational strategies and changes in land utilization through time. Settlement pattern analysis requires the development and application of an accurate functional typology for sites and component features, and reliable temporal control. When land use models developed through settlement pattern analysis attempt to account for or explain interrelationships between human populations and their environment, elements of the human ecology approach are being manifest. This approach adds another dimension to a local cultural history and settlement pattern by attempting to provide insight into the dynamics of group survival, as reflected in ecofactual remains left at sites or in the relationship between specific functional feature types and aspects of the reconstructed environment.

On the basis of previous findings in inland Honokohau 2nd, Kealakehe, and Keahuolu, it was expected that the predominant material remains within the project area would be agricultural features that normally contain little to no foodstuff remains and a relatively limited range of ecofactual information. The formal variation exhibited within this general functional category has not been specifically examined for the area of North Kona located at the transition between the Kailua agricultural zone and the barren rocklands of Kekaha. Of particular interest in the study of these features is to determine, to the extent possible, what cultigens might be associated with specific feature types. If more specific functional categies can be assigned to formal types, then a considerably more accurate model of agricultural land use for North Kona will be possible. One of the more refined models proposed to date is based on environmental variants and traditional Hawaiian vegetation zones which followed the elevational gradient.

Kelly (1983) and Schilt (1984) outline four subzones along the ecological gradient which correlate with traditional Hawaiian cultivation zones, as identified in historic sources and in kuleana land claim descriptions (Kelly 1983:47-64, Schilt 1984:3-11). The four subzones and their estimated elevational ranges are: (a) the kula, from 0 to c. 500 ft AMSL; (b) the kalualu, or breadfruit zone, from c. 500 to 1,000 ft AMSL; (c) the apaa, from c. 1,000 to 2,500 ft AMSL; and (d) the amau, or upland jungle, from c. 2,500 to 4,000 ft AMSL (Schilt:1984:6). According to this model, the project area encompasses portions of the kula subzone.

As indicated by Schilt, the elevational ranges of specific subzones appear to vary on a north to south gradient, along with variation in rainfall patterns. The upper extent of the kula zone should therefore be at a higher elevation in the northern reaches of the agricultural district, where rainfall isohyets swing inland, away from the coast. A higher elevation for the kula/kalualu transition in Keahuolu is also supported by cartographic data from two primary sources. Emerson's survey map (discussed above), places the forest edge at approximately 750-800 ft in Keahuolu.

Given the expansiveness of the kula subzone in Keahuolu, it is desirable to obtain a more refined interpretation of elevational variation within this subzone. It might be noted that rainfall, on an elevational axis, varies by as much as 20 inches per annum within this subzone. If the patterning and relative densities of various formal or preferably, functional

types of agricultural features can be shown to be dependent on elevation, then hypothetically, it can be argued that the kula subzone as identified by Schilt and others was in fact subdivided into smaller cultivation zones by the Hawaiian agriculturalists. Such a pattern may be unique to the ahupua'a situated at the Kailua/Kekaha transition, or it may be replicated in the drier lands to the north.

In order to address this problem, much of the synthetic analysis of the survey findings is aimed at examining feature patterning and occurrence by elevation. Variables such as overall surface area of the features, associations, and degree of aggregation are examined for the various formal types, in addition to spatial patterning.

FIELD PROCEDURES

Aerial reconnaissance of the project area was conducted July 13, 1989, via helicopter, by Supervisory Archaeologist Theresa K. Donham, Supervisory Field Archaeologist Amy Dunn, and Field Archaeologist Keala Kauhi. The survey was conducted at the lowest elevation permissible, in overlapping sweeps oriented north-south across the project area. Visibility of the surface from the air was somewhat limited by vegetation. The survey indicated that cultural features occurred on all undisturbed lava types present within the project area. Sites located from the air included the larger platforms, several caves, numerous rock piles, and major walls. The visibility conditions and general patterning of sites identified by air indicated that the pedestrian survey could not be effectivley conducted using variable-intensity pedestrian sweeps. All pedestrian sweep corridors would therefore be maintained at the 10.0 m interval or less.

The pedestrian survey was conducted July 10-August 14, 1989, by a crew of five to six persons. The survey was begun in Parcel C, where sweeps were oriented E-W, beginning at the southern boundary of the parcel. Crew members involved in the pedestrian survey included Amy Dunn and Field Archaeologists Dave Dillon, Ranae Ganske, Jack Harris, Nick Kailipaka, Keala Kauhi, and Eric Pearthree. After completion of the Parcel C sweeps, a recording crew began recording located sites while the sweep crew continued to the upper project area parcels. Sweeps in the upper area were oriented N-S, beginning along the east side of Queen Kaahumanu Highway. After completion of the pedestrian survey, recording and testing continued through September 27. Additional crew members involved in the recording included Charlane Gross, Steve Ervin, Ellen Glassmeyer, Jenny O'Claray, John Risedorf, Richard Sullivan, and Debra Soper. Subsequently, additional subsurface testing was conducted January 22-29, 1990 by a crew of three persons—Supervisory Archaeologists Theresa Donham and Bea Burgett, and Field Archaeologist Ranae Ganske.

During the pedestrian survey, survey transects were flagged in order to insure complete coverage, and all identified features were flagged, were assigned PHRI temporary site numbers, and were plotted onto a 1":200 ft scale aerial photograph. A total of 262 temporary site numbers were assigned during the pedestrian sweeps.

During the recording phase, sites were cleared of vegetation. If the sites were determined to be cultural, they were tagged with metal site tags, were photographed, were measured and described, and in certain cases, were mapped. An attempt was made to define as accurately as possible the boundaries of the site. The overall site area was measured along two perpendicular axes. In some areas, very poor surface visibility affected the accuracy of site boundary definition. Further field work, particularly vegetation clearing in some areas, may indicate that some sites are parts of the same continuous complex. It was not possible to measure and describe every observed feature within the large agricultural complexes. At these complexes, an attempt was made to obtain an accurate count of the various agricultural feature types within a specific measured area of the sites so that feature density could be estimated. Features counted, but not individually recorded in all cases, include rock mounds, pahoehoe excavations, and modified outcrops.

In general, surface visiblity was such that all or nearly all surface features could be located with persons spaced c. 10.0 m apart. However, it is likely that there are additional rock mounds, pahoehoe excavations, and other minor agricultural features that were not observed during the sweeping or recording phases of field work.

Of the 262 temporary site numbers assigned, 25 were either combined with other temporary sites during the recording phase, or were deleted upon vegetation clearing and determination that the feature was noncultural (Table 1). Two sites (Mamalahoa Trail and Kuakini Wall) were not given temporary site numbers during sweeps, since these sites had been previously registered on the SIHP and their locations were well documented and unmistakable.

Subsurface testing was conducted at 33 features (24 sites). Four of the features are caves with habitation midden deposits (Sites 13287, Feature A; 13302, Feature C; 13350; and 13441, Feature P. The remaining tested features include faced mounds, terraces, platforms, pahoehoe excavations, and filled crevices. A total of 29 test units (28.48 sq m) was

excavated to depths ranging from 0.03 to 1.48 m below surface. Among the excavation units, 19 were 1.00 sq m or larger. Midden was collected from the screened soil of five test units. Soil in quantities sufficient for sampling was observed and collected from 25 test units. Charcoal was collected from six test units. The charcoal samples of sufficient size for age determination analysis were transported to the Hilo laboratory where they were prepared and shipped to Beta Analytic, Coral Gables, Florida for radiometric age determination.

All soil screening was conducted in the field, with nested 1/8 and 1/4 inch mesh hardware cloth. In some cases, the soil was too damp for dry screening, so water was used with the screens. Several features contained insufficient amounts of soil for both screening and soil sample collection. In these cases, the soil was collected for further examination. All lithic, botanical, and faunal materials collected from the 1/4" mesh samples were sorted and weighed at the Hilo laboratory. Materials recoverd from the 1/8" mesh were examined for artifacts, fish and mammal remains, and shellfish species not represented in the 1/4" collections. Recovered artifacts were catalogued, drawn, measured, and described prior to curation.

Soil samples were examined closely for various inclusions (gravels, rootlets, landsnails, ecofacts, etc.) and were described using standard USDA/SCS categories and Munsell color charts.

FINDINGS

SURFACE FINDINGS

During the present survey, 239 sites consisting of 1,810+ component features were identified within the project area. The sites are summarized in Appendix C, and their approximate locations are shown in Figure 1.

Within the project area are four relatively distinct clusters of sites. These occur at the northwestern end of the project area, between nine and 20 ft AMSL; along the east side of Queen Kaahumanu Highway, between 50 and 150 ft AMSL; along the north side of Palani Road, between 200 and 400 ft AMSL; and at the eastern end of the project area, between 450 and 600 ft AMSL. The patterning of these clusters is such that they are in non-overlapping elevation ranges which encompass the overall elevation range of the project area.

The distribution of sites in general shows no marked tendency toward higher densities at specific elevations. If the project area is stratified in 100 ft intervals, the greatest number (70) of sites is in the 0-100 ft interval; however, this interval also covers the greatest surface area. The four intervals between 100 ft and 500 ft have similar surface areas, and three of the intervals have nearly identical site counts that range between 31 and 35 sites. The exception is the 200-300 ft interval, which contains 50 sites, most of which are clustered at the south end of the project area. When patterning of features is examined, however, there is less regularity in the distribution.

In order to examine the patterning of features by elevation, three general intervals were selected—less than 200 ft (101 sites, c. 580 acres, 53% of total surface area); 200-399 ft (117 sites, c. 380 acres, 34% of total surface area); and 400 ft or greater (51 sites, c. 140 acres, 13% of total surface area). These elevation intervals approximate three rainfall zones of 20-30 inches, 30–40 inches, and 40-50 inches per annum. It should be noted that the 30 and 40 inch isohyets swing upland approximately in the center of Keahuolu. The 30 inch isohyet, for example, is slightly below 200 ft AMSL in the southern portion of the project area, yet is at c. 350 ft in the northern portion.

A breakdown of formal feature types by elevation interval (Table 2) indicates that, overall, feature density is greater in the upper interval (400 ft or greater). In this interval, 26.4% of all features occur in 13% of the total surface area. The occurrence rate for features here is approximately 3.4 features per acre. In the lower elevation interval (less than 200 ft), the feature occurrence rate is approximately 1.3 features per acre, and in the 200-399 interval, there are approximately 1.5 features per acre. It is likely that additional features (not located during this survey) are present in the upper elevation interval, where visibility was extremely limited.

As indicated in the following discussion, the distribution pattern for specific formal feature types does not conform to the overall feature occurrence pattern. The various formal categories are summarized below.

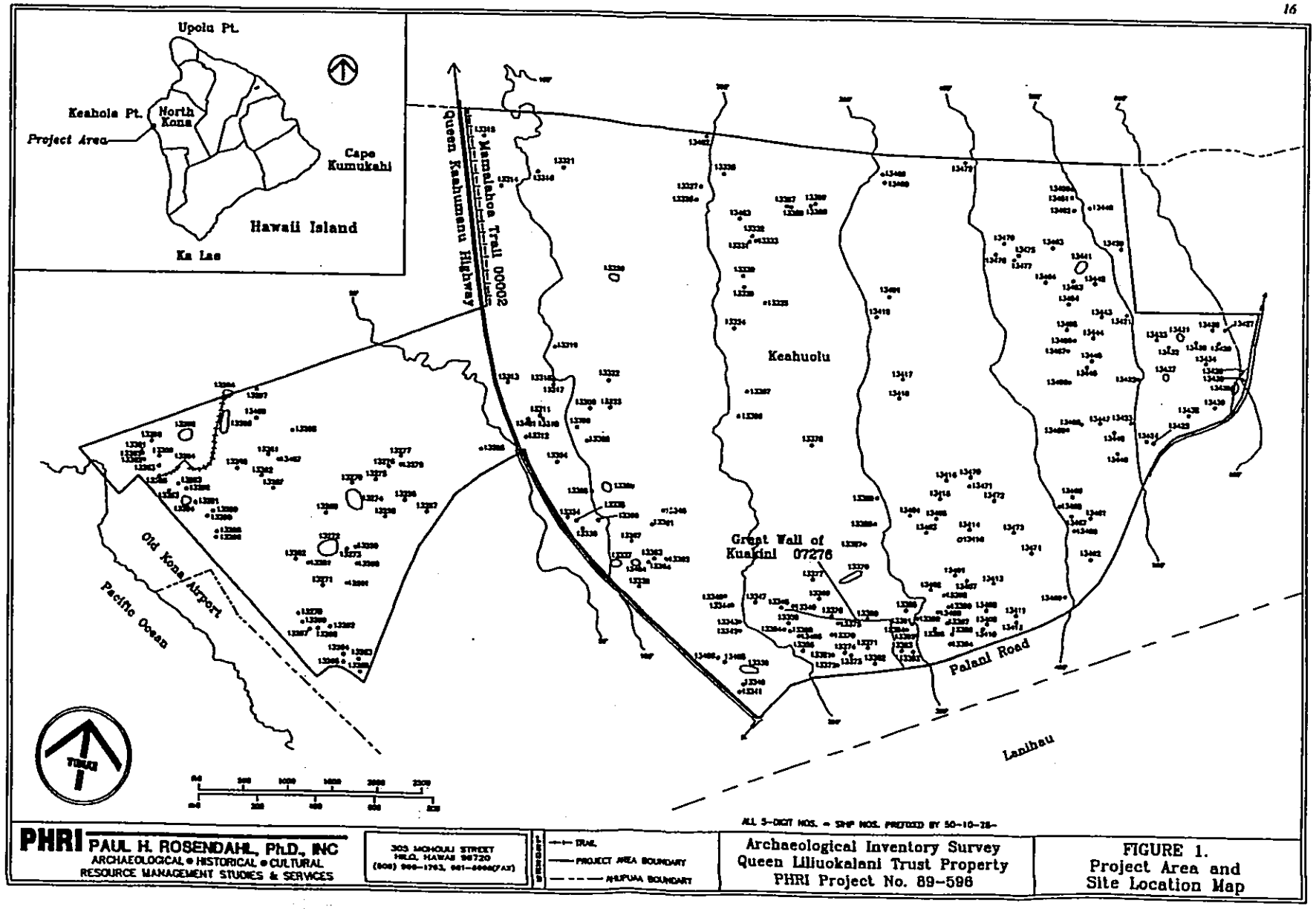
Twenty-six formal types are represented among the identified features. These include the types listed in Table 2 as well as five types with less than three occurrences each that were combined in the "other" category. These include two roadbed sections, a cupboard, a loading ramp, two modified pools, and two uprights. Predominant among the formal types are pahoehoe excavations (892, 49.3% of all features), three varieties of rock mounds (236, 13.1%), and modified blisters and outcrops (246, 13.6%). The clear majority of these features, which together comprise 76% of all features (1,374), reflect agricultural activities. Agricultural activities are also represented by enclosures, terraces, rubble walls, and low platforms. Overall, approximately 90.0% of all features are associated with agricultural functions.

Formal feature types representing temporary habitation include caves (44 of 50, 2.4%), overhangs (10, 0.6%) and possibly one or two of the five identified C-shapes. Permanent habitation is suggested, but not yet demonstrated, for 22 medium to large platforms. These features occur in complexes that contain additional agricultural features. Other functions represented by a few features each include transportation, rock art/recreation, possible aquaculture (limited to small pools), markers, burial, and ceremonial.

Ten of the formal feature types are represented by more than 2.0% of the total feature inventory. These types are individually discussed below.

Caves

Fifty caves with evidence of prehistoric occupation or utilization were identified. These features are most common in the 200-399 elevation interval, where nearly half (48%) occur. This is also the area where most of the currently occupied caves are located. The frequency of caves in



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Archaeological Inventory Survey
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FIGURE 1.
Project Area and
Site Location Map

Table 2.

FEATURE COUNTS BY FORMAL TYPE AND ELEVATION INTERVAL

Formal Type	<200ft N	<200ft %	200-399ft N	200-399ft %	400 ft + N	400 ft + %	Total	Percent
Alignment	16	51.6	8	25.8	7	22.6	31	1.7
Cairn	10	25.0	13	32.5	17	42.5	40	2.2
Cave	9	18.0	24	48.0	17	34.0	50	2.8
C-Shape	2	40.0	1	20.0	2	40.0	5	0.3
Enclosure	8	18.6	17	39.5	18	41.9	43	2.3
Faced mound	-	-	2	15.4	11	84.6	13	0.7
Filled crevice	4	80.0	-	-	1	20.0	5	0.3
Linear mound	4	22.2	13	72.2	1	5.6	18	1.0
Midden scatter	3	100.0	-	-	-	-	3	0.2
Modified blister	12	19.0	17	27.0	34	54.0	63	3.5
Modified outcrop	136	74.3	20	10.9	27	14.8	183	10.1
Mound	46	22.4	20	9.7	139	67.8	205	11.3
Overhang	9	90.0	-	-	1	10.0	10	0.6
Phh. excavation	392	43.9	368	41.3	132	14.8	892	49.3
Pavement	5	31.3	2	12.5	9	56.2	16	0.8
Petroglyph	13	72.2	2	11.1	3	16.7	18	1.0
Platform	8	18.2	22	50.0	14	31.8	44	2.4
Rock concentration	17	100.0	-	-	-	-	17	0.9
Terrace	27	32.5	27	32.5	29	34.9	83	4.6
Trail	7	53.8	-	-	6	46.2	13	0.7
Wall (faced)	1	12.5	6	75.0	1	12.5	8	0.4
Wall	11	26.8	23	56.1	7	17.1	41	2.3
Other	5	55.6	2	22.2	2	22.2	9	0.5
Total:	745	41.2	587	32.4	478	26.4	1,810	99.9

Keahuolu contrasts markedly with Kealakehe to the north, where only a single habitation cave was located (Donham 1990b:13). The Keahuolu cave features generally reflect very little or limited evidence of habitation. Three caves with the thickest identified cultural deposits were tested during this survey (Sites 13287, 13350, and 13441). These features are located in the lower, middle, and upper elevation intervals, respectively. The deepest cultural deposit located within the project area (0.14 m) is at Site 13287, where a number of portable artifacts, such as coral abraders and hammerstones, were also found. A dating sample collected at this cave yielded a calendric range of AD 1430-1650 (BETA-35482).

The Site 13350 cave complex is the most extensive cave shelter within the project area. This site consists of four major lava tubes, joined at a central collapsed blister. The interior area is extensively modified and includes enclosures, terraces, pavements, and walls. A human burial is also present. Although the midden/soil deposit is quite thin (generally less than 0.02 m), numerous portable remains and artifacts are present. Artifacts include abraders, adzes, hammerstones, bone picks, and shell scrapers. This feature may have functioned as a short-term refuge cave. Four dating samples were collected from various chambers and internal features at this cave. Two of the samples returned calendric ranges that extended into the modern era and two samples returned dates with calendric ranges between AD 1305-1650 (the dates are discussed in further detail below).

The cave tested at Site 13441 is spatially associated with a number of platforms, terraces, and modified outcrops.

It is likely that at least two of the platforms in this complex were permanent habitation features. The cultural deposit in this cave has a maximum thickness of 0.05 m. Fewer artifacts and portable remains are present here, in comparison with the preceding caves, and they are not in close association with other habitation features. A dating sample recovered from this feature has two alternative calendric ranges, AD 1523-1568 or AD 1633-1955. A prehistoric component is indicated for the site, based on portable remains. Therefore, given these alternative ranges, the occupation is likely to have occurred sometime after AD 1523.

Among the cave sites not tested, the majority exhibited modifications, such as walled entrances or cleared floors, but contained no portable remains (57%). Scattered marine shell fragments (mostly Cypraeidae and *Cellana*) were observed in 23% of the 47 caves not tested. Additional portable remains were observed in six of these caves, and consist primarily of kukui nut shell (which may not be culturally introduced), charcoal flecks (three caves), and fishbone (one cave). Coconut husks, bamboo, and hearth features were observed at one cave (Site 13458). Early twentieth century artifacts (bottle glass) were observed in two caves (13377 and 13445), and modern artifacts were observed in three caves. As noted above, modern habitation caves with no evidence of prehistoric habitation were not recorded.

In addition to the Site 13350 feature, five caves contained human interments. These caves exhibited no evidence of habitation, and minimal modifications are present in most cases.

The caves with midden remains are relatively evenly distributed across the three elevation intervals. Among the ten caves with midden deposits (not necessarily with soil), three are in the lower interval (less than 200 ft), three are in the middle interval (200-399 ft), and four are in the upper interval (400 ft and above). The burial caves are present in middle (4) or upper (2) elevations only.

Enclosures

Most of the enclosures identified within the project area are generally small, loosely constructed features with low walls, and they appear to be associated primarily with agriculture. There are a few enclosures that are relatively unique in size and/or construction. The largest and most unique enclosure within the project area has an interior area of approximately 10,340 sq m; it surrounds the Site 13441 complex. The second-largest enclosure is square, with an interior area of 1,024 sq m. It is one of very few enclosures recorded to date with core-filled, bifaced walls. This feature (Site 13462) is located in the preserve area. The only features observed inside the enclosure were pahoehoe excavations.

A group of seven enclosures at Site 13435 may have been constructed during the historic period. These features abut an abandoned section of Palani Road, and appear to have been built after the roadbed was in place. They range in size from 18.20 to 118.80 sq m; some sections of the feature walls are bifaced, others are stacked. The nearness of these features to the roadbed, and the presence of ramp-like filled areas from the road to the enclosures, suggest that they were utilized in the sisal mill operations that took place in the area (see Appendix B); probably the enclosures functioned in the transporting process.

Four enclosures are located inside a cave shelter (Site 13350). These features range in area from 1.7 to 13.5 sq m.

Among the larger enclosures is a circular feature at Site 13404 that has an interior area of 207.0 sq m. A portion of this enclosure wall forms a terrace, and the entire feature is very likely agricultural. Among the remaining enclosures for which measurements are available (20), three have interior areas greater than 50.00 sq m. Areas range from 3.4 to 120.0 sq m. None of the enclosures identified appear to be associated with ranching. Data is presently missing for most of the enclosures located within the preserve area; these features are associated with interior structures such as platforms and terraces.

One enclosure (Site 13329) was in current use at the time of survey. The 40.00 sq m interior area was found subdivided into small planting areas for ornamentals and other plants. No mango tree enclosures, such as those found at Kealakehe (11 located), were observed during the survey, although one was located in the Keahuolu parcel east of this survey area (Donham 1990b:13).

Two enclosures (Sites 13261 and 13381), both located in the lower elevation interval, were tested in an attempt to better define the functions of the features. Both enclosures are small and low-walled, and contain single interior features that incorporate branch coral. The Site 13261 enclosure has an interior surface area of 21.5 sq m and very low walls (0.39 m maximum height). The interior area is scattered with branch and waterworn coral, and a depression near the center is filled with cobbles and boulders. Because it was thought that this feature may enclose a human interment, it was submitted to subsurface testing. No human remains were located; however, an organically rich soil deposit was

located beneath the rock fill inside the structure. No portable remains suggesting temporary habitation were present. It is therefore most likely that this is a small planting area that may have also contained a shrine.

The Site 13381 enclosure has an interior area of 12.0 sq m, and encloses a rock and coral-filled terrace. This feature was also thought to possibly contain a human interment, and was tested. The terrace was found to contain coral throughout, and no human remains. No soil was present beneath the fill, or elsewhere inside the structure. No portable remains indicative of temporary habitation were present. This feature is most likely a shrine.

Modified Blisters and Outcrops

These two categories are combined here, because they do not appear to have been consistently distinguished in the field by the recording crew. The definition of a modified outcrop includes the group modified blisters, which theoretically is more specific. Modified outcrops consist of natural pahoehoe depressions, slopes, or flats that have been cleared of large loose rocks and filled in places with gravel and small cobbles. The larger stones are generally arranged around or near the outer perimeter of the cleared area in loose piles or alignments. In some cases, the resulting feature is somewhat terrace-like in appearance. Modified outcrops are distinguished from pahoehoe excavations in that the lava mantle is not penetrated. They may otherwise have similar morphological characteristics.

The occurrence pattern of modified outcrops and blisters indicates a very distinct concentration between 50 and 150 ft AMSL, to the east of Queen Kaahumanu Highway (Figure 2). Excepting a few features near the coast, nearly all other modified outcrops and blisters are present in the southern portion of the project area, with slightly greater density above 400 ft AMSL. As indicated below, this patterning is quite divergent from the patterning of pahoehoe excavations. It is suspected that the availability of surface soil may be a determining factor in the location of modified outcrops and blisters.

Modified outcrops tend to occur in aggregates; the 246 features enumerated occur at only 34 sites. Groups of 10-33 modified outcrops or blisters occur at nine sites.

A single modified outcrop (Site 13424) was tested, and found to contain a 0.05 m thick deposit of organic soil beneath size-sorted layers of cobble (upper) and pebble (lower) fill.

Pahoehoe Excavations

Characteristic pahoehoe excavations consist of small lava blisters that have the surface broken away, creating a hole where the gas pocket existed between layers of lava. Depth of the hole usually ranges from 0.4 to 0.9 m. When the excavations were utilized, presumably for agriculture, the blocks and pieces of pahoehoe debris broken away were usually arranged around the perimeter of the hole in a circular alignment, or were rearranged inside the excavation, with larger stones around the perimeter. The hole is often partially filled with pieces of pahoehoe that are size-sorted (smaller pieces on the bottom, larger pieces on top). The gravel present in lower layers of these holes are often very angular and unweathered, and they appear to be artificially produced by crushing larger rocks. Soil is often mixed with the gravel, or is present as a distinct layer beneath the rock fill, not visible unless the fill is removed.

If the pahoehoe excavation is essentially a by-product of stone quarrying, there is generally no associated loose blocks in or around the hole, although smaller debris is present, and there is no evidence of modifications in or around the hole. Excavations that exhibit no internal backfilling or modifications, yet have associated piles of removed stones are problematic, since they could represent a production stage of either a stone quarry or an agricultural plot.

The required descriptive data for reliable functional interpretation of all of the identified pahoehoe excavations is currently not available, or has not been compiled and tabulated from the feature descriptions available. Such a task will require far greater time than allowed for this project. Pahoehoe excavations thought to represent quarries are indicated in Appendix C. It should be noted, however, that there has been insufficient work focused on these features to provide clear guidelines for functional interpretation. The majority of the quarry excavations appear to have been for the purpose of constructing mounds, terraces, or similar agricultural surface features. In this capacity, the quarry is associated with agriculture.

Pahoehoe excavations are widely dispersed across the project area, with one prominent cluster near the coast (Figure 3). This cluster may represent garden plots associated with coastal residencies. There is essentially no surface soil in this area, and unless artificially broken, very few natural breaks in the lava mantle. Immediately to the north, however, is naturally broken, upthrusted tubes and blisters,

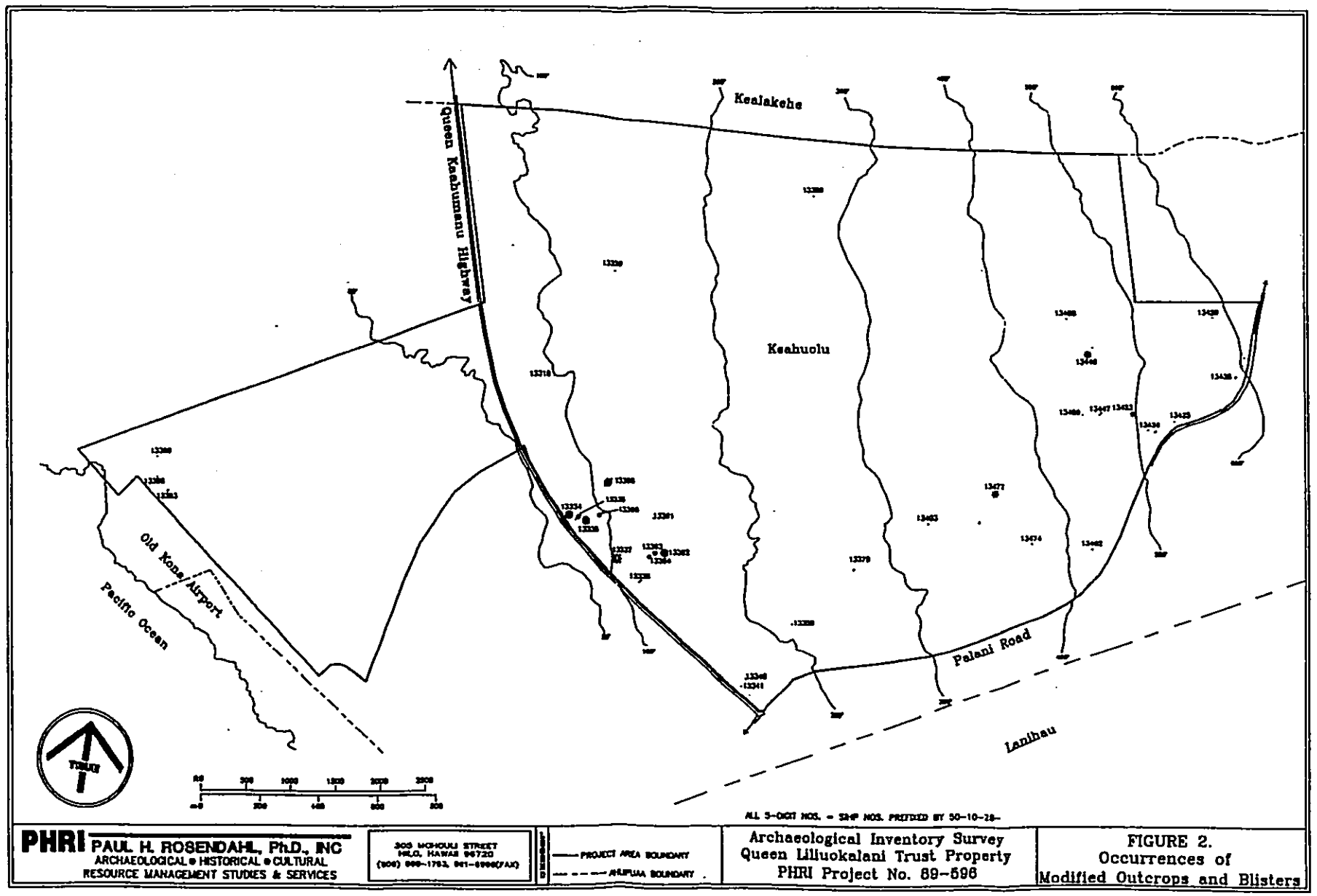
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FIGURE 2.
Occurrences of
Modified Outcrops and Blisters

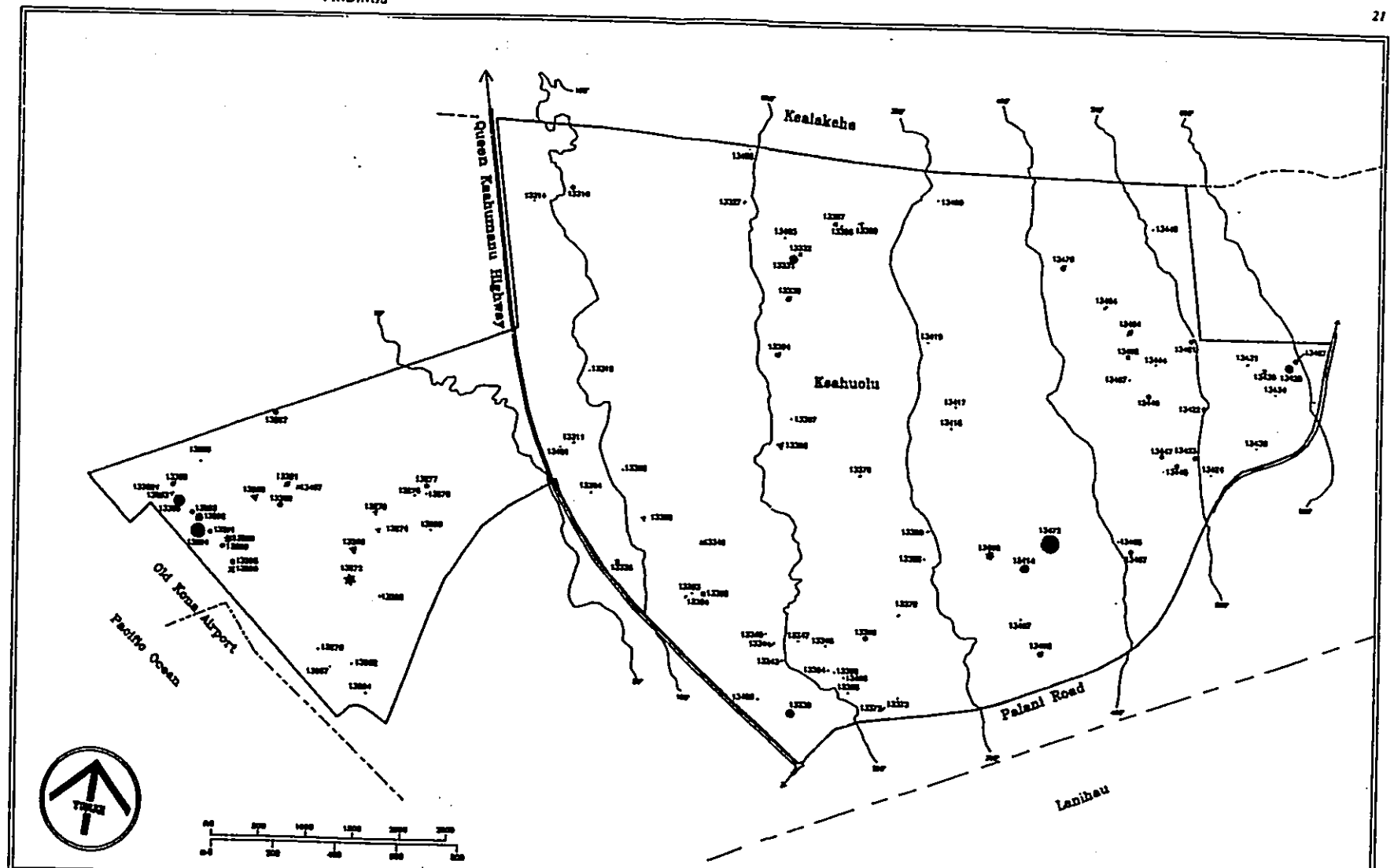

FIGURE 3.
Occurrences of
Pahoehoe Excavations

and several caves. It is interesting to note that the pahoehoe excavation frequency is very low in the coastal area behind the Lanihau shoreline strip (Figure 3).

Based on available data, it appears that the pahoehoe excavations along the coast are generally smaller than inland excavations. Average surface area for lower elevation excavations is 8.9 sq m, compared with 15.8 sq m in the upper elevation interval. This difference is affected to an unknown degree by the fact that a greater percentage of all excavations in the lowlands were measured, whereas the more prominent, i.e., larger features in the upper areas were measured.

The frequency of pahoehoe excavations in Keahuolu is considerably greater than that for Kealakehe, where only 85 excavations were located within an 800 acre area between 90 and 700 ft AMSL. In Keahuolu immediately upslope from the project area, 173 excavations were enumerated within a 150 acre area (Donham 1990b:14). This frequency is very similar to that for the 140 acre area above 400 ft AMSL within the project area.

Mounds

A total of 236 rock mounds were recorded or enumerated within the project area. Thirteen of these are faced, and 18 are linear in form, as opposed to the circular to oval form of most (205) mounds. Among the circular to oval mounds, a clear majority (67%) occur in the upper elevation interval, at a rate of nearly one mound per acre of total surface area. These features are currently more frequent than pahoehoe excavations in the upper elevation interval. Only 20 circular to oval mounds were located between 200 and 399 ft AMSL, for a rate of one for every 19 acres. Mound frequency is slightly higher in the lower elevation, where one mound is present for every 13 acres. The rock concentrations observed in the lower elevations (17) are generally too small to be considered as collapsed mounds, although they could represent early construction stages of mounds.

The distribution of faced mounds shows a marked concentration in the upper elevation interval. Eleven of 13 identified faced mounds are above 400 ft AMSL; none are in the lower elevation interval. In addition, the only occurrences of noticeable aggregation of mounds at complexes is in the upper elevations (Figure 4). Mound frequency appears to increase slightly upslope from the project area, where 209 were identified in the 150 acre Keahuolu parcel previously surveyed (Donham 1990b:16).

Four faced mounds, a linear mound, and two circular to oval mounds were tested during this survey. The principal purpose of the testing was to ascertain whether they contained internal features. The faced mounds were located at Sites 13428 (2), 13434, and 13460. These structures consisted of ring-like, faced perimeters of pahoehoe slabs that were filled with smaller cobbles and pebbles. Soil was encountered beneath two of the mounds, and an unburned kukui nut (complete, but fragmented) was located near the base of one mound (Site 13428, Feature E).

The linear mound tested (Site 13298) is one of four linear mounds in the lower elevation interval. This feature exhibited no internal differentiation of fill, and was covering a thin soil deposit. The other two mounds tested were also in the lower elevation interval (Sites 13255 and 13265). Neither of these mounds contained soil deposits. The Site 13255 mound was constructed with aa, and was mostly destroyed by grubbing. The intact portion indicated that a single layer of pahoehoe slabs had been placed on the aa prior to mound construction. Perimeter stones were slightly larger than the core filling.

Platforms

Half of the 44 identified platforms are present in the 200-399 ft elevation interval and are mostly concentrated at the southern end of the project area, in the vicinity of Kuakini Wall. In addition, all eight of the platforms in the lower elevation interval are at 80 ft AMSL or greater; five are over 150 ft AMSL and are at the southern end of the project area. No platforms were identified makai of Queen Kaahumanu Highway.

Prior to subsurface testing, it was assumed that the faced, paved platforms with surface areas of around 17.0 sq m or greater were originally constructed as habitation features, and that some might contain human interments (cf. Cordy 1981). Eight platforms were tested during this survey; subsurface findings at these features do not readily support the hypothesis that these features were habitation structures, or that they are burial monuments. It is therefore with some uncertainty that many of the medium to large platforms are assigned habitation functions.

There appears to be some elevation difference in the patterning of platforms by size. Between 200 and 399 ft AMSL, platforms exhibit an average surface area of 42.2 sq m (maximum area is 224.0 sq m). Above 400 ft, the average platform area is 29.5 sq m (maximum area is

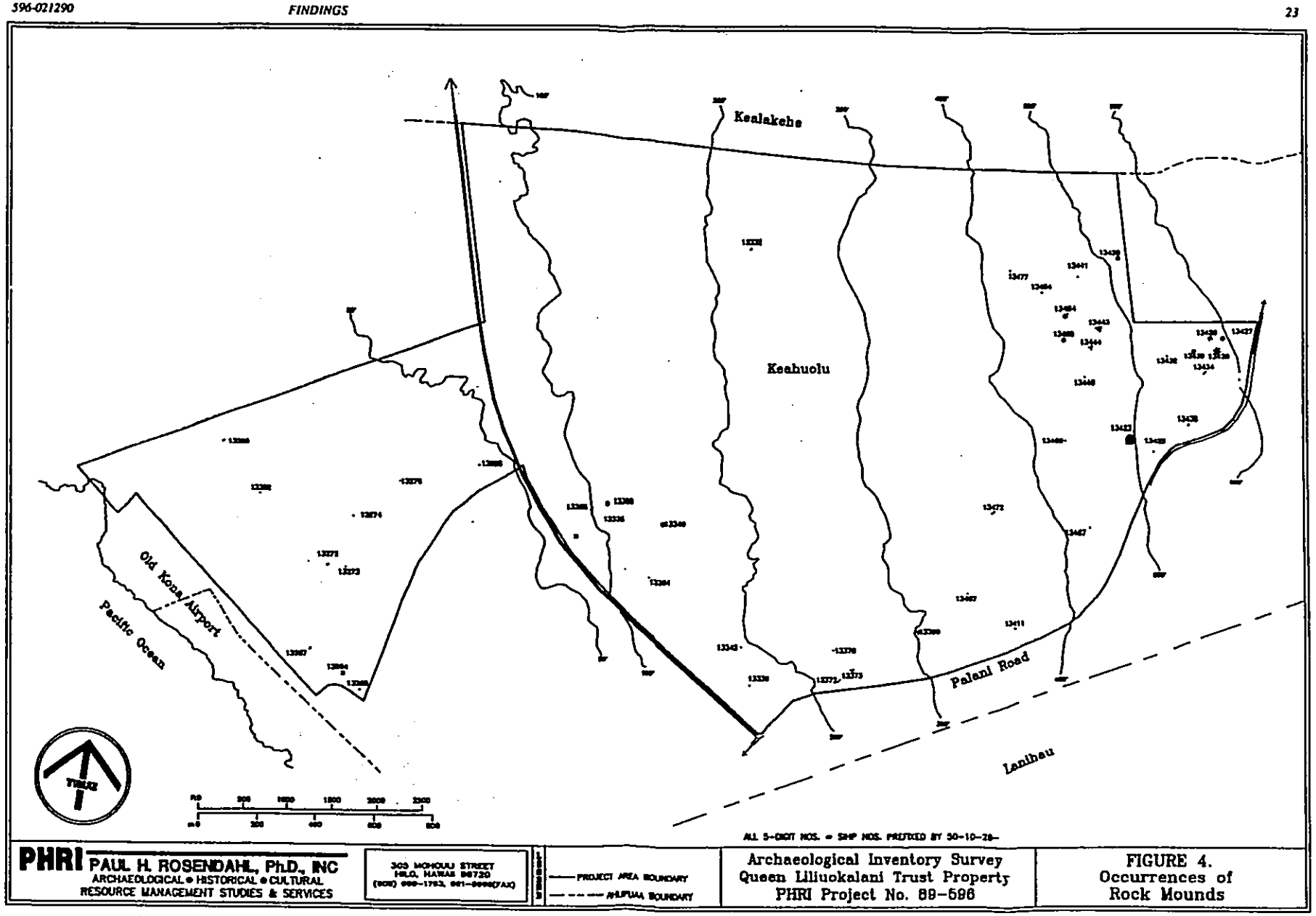

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FIGURE 4.
Occurrences of
Rock Mounds

92.4 sq m). Average platform heights for the two elevation intervals is, however, nearly identical (0.81 and 0.82 m).

Four of the tested platforms exhibit surface areas between 22.0 and 26.0 sq m. One of the larger platforms (and the highest) tested is present at Site 13365 (Feature A); it has a surface area of 22.0 sq m, with an average height of 1.2 m. The structure is vertically faced on all sides and paved on the surface. Overlying approximately half of the surface pavement is a layer (up to three stones thick) of large cobbles and small boulders that appears to have been thrown onto the platform. It appears that this layer represents backfill from a possible excavation into the platform, possibly for an interment which followed abandonment of the feature, or occurred at the time of abandonment.

Excavation indicated that the platform had not been previously disturbed; that it contained no internal features or portable remains; and that it was constructed over a prominent pahoehoe blister. The platform perimeter is essentially a faced facade around the sides of a blister. The area between the pahoehoe slope and the walls was filled with undifferentiated rock fill, and the top was leveled and covered with smaller stones. The center of this and all other platforms tested is actually the shallowest point of the fill, since it is the highest point of the underlying blister. No portable remains whatsoever were encountered in the platform fill—a situation that is highly unlikely if the feature was used for habitation.

This and other platforms tested appear to be formalized agricultural features. All of the tested platforms contained buried soil deposits up to 0.4 m thick. Soil was not observed immediately around the exterior of these features, and it is unlikely that the buried soil occurred naturally on the tops of the pahoehoe blisters. The low platforms might very well represent planting beds. The higher platforms might represent abandoned planting beds that were gradually built up as adjacent areas were cleared of loose rubble. Three of the tested platforms exhibited layers of large cobbles and boulders overlying a leveled surface of smaller stones. Such layering of fill attests to accretional buildup, rather than construction of the entire feature at one time. It is extremely difficult to properly document this process though excavation of single test units, and the presence of fill layering may have been missed in some features.

None of the platforms located in the preserve area were tested, and there is currently insufficent information concerning their construction to determine if they are habitation or agricultural features.

Terraces

The 83 terraces identified within the project area are, in terms of numbers, evenly distributed across the three elevation intervals; the interval above 400 ft AMSL exhibits a greater count per acre. There are 29 terraces present between 400 and 600 ft AMSL. In contrast, only six terraces were enumerated in the Keahuolu parcel upslope from the project area (Donham 1990b:16).

There is little difference in the size of terraces when elevation is considered. For elevations above 400 ft AMSL, the average surface area is 34.5 sq m (19 terraces); for less than 200 ft AMSL, the average area is 36.4 sq m (20 terraces); and for the middle interval, average area is 20.35 (13 terraces).

One terrace (Site 13299) near the coast was tested in order to determine if the suspected function as a burial feature was correct. This feature contained a relatively high amount of branch coral, incorporated into the fill and placed on the surface. No internal features were observed; however, a soil deposit was encountered at the base of the rock fill.

A second terrace, located in the upper elevation interval, was also tested. This feature contained no portable remains and no soil was present beneath the fill. With the exception of terraces located inside caves, and possibly some terraces inside enclosures (preserve area), most of the terraces in the project area are probably agricultural features.

Walls

The distribution of the 49 walls (8 bifaced) within the project area is very similar to that for platforms. The greatest proportion (in terms of numbers) occurs between 200 and 399 ft AMSL. Among the bifaced walls, 75% (6) are in the middle elevation interval, with only one each in the upper and lower intervals.

Nearly all of the unfaced walls incorporate natural rock features, which results in definition of a small space or relatively sheltered low area. Only one of the unfaced walls occurs in isolation, with no additional associated features. All other unfaced walls are in complexes with agricultural features.

SUBSURFACE FINDINGS

Subsurface testing was conducted at 24 sites (33 features) within the project area (Table 3). Twenty-nine test units were excavated to depths ranging from 0.03 to 1.48 m below surface. Four additional subsurface samples were collected from areas each c. 0.2 m square. Five of the features tested are caves or overhangs containing habitation midden deposits. All soil excavated from units at these features was screened through 1/4- and 1/8-in mesh, and all portable remains were collected. Eight of the remaining 29 features tested contained no soil for screening, and the deposits in the rest of the features were sterile (with one exception). Bulk samples, usually consisting of all available soil, were collected from these latter features for further examination in the laboratory.

A total of 1,451.83 g of marine invertebrate remains were collected from the 1/4-in size grade mesh at four

Table 3.

SUMMARY OF SUBSURFACE TESTING

SIHP No.	Feature	Formal Type	Unit Size	Max. Depth	Material Recovered
13255	-	Mound	1.00 sq m	0.87 m BS	-
13257	-	Filled crev.	0.25 sq m	0.55 m BS	-
13261	-	Enclosure	1.00 sq m	0.49 m BS	Soil sample
13265	-	Mound	1.00 sq m	0.32 m BS	-
13268	F	Filled crev.	0.64 sq m	0.48 m BS	Soil sample
13272	G	Pthh excav.	0.25 sq m	0.60 m BS	Soil sample
13272	L	Pthh excav.	0.20 sq m	0.05 m BS	Soil sample
13281	-	Enclosure	1.60 sq m	0.70 m BS	-
13386	A	Walled overhg.	1.00 sq m	0.10 m BS	Soil samples (3)
13287	A	Cave	2.00 sq m	0.14 m BS	Soil,mid,date smpl
13298	C	Lin. mound	2.00 sq m	1.07 m BS	Soil sample
13299	-	Terrace	1.00 sq m	0.38 m BS	Soil sample
13300	D	Overhang	0.20 sq m	0.02 m BS	Soil sample
13300	A	Mod. sinkhole	0.40 sq m	0.05 m BS	Soil samples (3)
13302	C	Overhang	0.50 sq m	0.05 m BS	Shellfish remains
13325	-	Terrace	0.25 sq m	0.18 m BS	-
13326	-	Platform	1.00 sq m	0.61 m BS	Soil, midden
13335	B	Platform	2.10 sq m	0.90 m BS	Soil sample
13350	H	Cave	0.25 sq m	0.02 m BS	Dating, midden
13350	H	Cave	0.25 sq m	0.05 m BS	Soil,mid,date smpl
13350	A	Cave	0.20 sq m	0.03 m BS	Soil sample
13424	B	Mod. outcrop	0.25 sq m	0.59 m BS	Soil sample
13428	C	Faced mound	1.00 sq m	0.67 m BS	Soil sample
13428	E	Faced mound	1.00 sq m	1.05 m BS	-
13428	G	Platform	1.00 sq m	0.90 m BS	Soil sample
13434	A	Faced mound	1.00 sq m	1.48 m BS	-
13441	C	Platform	1.00 sq m	0.75 m BS	Soil sample
13441	K	Platform	0.60 sq m	0.70 m BS	Soil samples (2)
13441	O	Platform	0.25 sq m	0.63 m BS	Soil, dating
13441	P	Cave	1.25 sq m	0.05 m BS	Soil,mid,date smpl
13460	A	Faced mound	1.00 sq m	0.50 m BS	-
13471	B	Platform	1.00 sq m	0.38 m BS	Soil sample
13465	A	Platform	4.00 sq m	1.16 m BS	Soil sample

features (13287, Feature A; 13302, Feature C; 13350, Feature A; and 13441, Feature P). The majority of these remains (1426.7 g, 98%) were collected from two test units excavated at Site 13287 (Table 4).

Test Unit 1 at Site 13287 was placed over a rock-filled terrace inside the cave. The upper layer (Level 1) of the test unit consisted of rock fill that contained only scattered Isognomonidae fragments. The upper level of the soil deposit (Level 2) (0.05 m thick) contained 12 varieties of gastropods, with Cypraeidae and *Nerita picea* the predominant species. The only bivalve species present in this level was Isognomonidae. Other food remains represented in Level 2 were Echinoidea, Crustacea, bird, fish and mammal bones (Table 4).

The second level of the soil deposit (Level 3; 0.05 m thick) of TU-1 exhibited an increase in the total weight of some species, a decrease in the varieties of gastropods represented, and an increase in the varieties of bivalves. The total weight of *N. picea* and Conidae nearly doubled in Level 3, whereas the weight of Cypraeidae decreased slightly. The number of gastropod species represented decreased from 12 to 8. Five bivalve species were represented in Level 3, including a significant increase in Isognomonidae by weight. Weights for Echinoidea doubled, and weight of mammal bone increased five-fold. The differences in the proportions of shellfish species represented between Levels 2 and 3, and the fact that there was no consistent trend of increasing or decreasing frequencies in the shellfish, suggest that different occupation components are represented.

TU-2 at Site 13287 was located near the center of the cave chamber, 3.0 m east of TU-1. Two levels, each 0.05 m thick, were excavated. Due to the irregularity of the deposit, portions of the unit were excavated to bedrock within the first level, and the soil volume was considerably less for Level 2 as compared with Level 1. This difference in volume probably accounts for the consistent decrease in all remains between Levels 1 and 2. In Level 1, eight gastropod species and four bivalve species are represented. In Level 2, six gastropod species and three bivalve species are represented, all of which are present in Level 1. The predominant shellfish in Level 1 are Cypraeidae, *N. picea*, and Conidae. In Level 2, Cypraeidae and *N. picea* predominate, with Thaididae ranking third, and Conidae fourth by weight. All shellfish species present in TU-2 are present in TU-1 in greater quantities (overall, more than twice the quantity by weight). TU-2 does not exhibit sufficient variability between levels to indicate two possible components in this area of the cave.

The second highest quantity of shellfish remains recovered by weight is from Site 13350. A single 0.05 m thick level was excavated near the center of this cave, yielding 18.79 g of shellfish. A single gastropod species (Cypraeidae) and a single bivalve species (Isognomonidae) is represented, in addition to Echinoidea, and bird, fish, and mammal bone.

Midden collections from the cave feature (Feature P) at Site 13441 and the overhang feature (Feature C) at Site 13302 are very sparse (less than 5.0 g). Shellfish species recovered from Site 13441 include, primarily, trace amounts of Cellana, *Nerita picea*, *Drupa ricina*, and Isognomonidae. Echinoidea, bird bone, and mammal bone are also present in very small quantities.

Shellfish recovered from Site 13302 include *Nerita picea*, *Theodoxus* spp., and Cypraeidae. No Echinoidea or other faunal remains were recovered.

The overall volume of recovered midden remains, as well as the thickness of the deposits in the four tested habitation features indicates that Site 13287 was the most intensively utilized shelter identified to date within the project area. Although distinct occupational components are not discernible in stratigraphic profile, the differences in occurrences and amounts of various shellfish species between the 0.05 m thick levels indicates at least two distinct occupations.

The frequency of recovered artifacts for TU-1 and TU-2 at Site 13287 exhibits a reverse pattern when compared to midden remains. Eight of the ten indigenous artifacts collected during excavation are from TU-2. These include a bone hook fragment, an Echinoid spine abrader, three volcanic glass flakes, a perforated pig tooth, and two perforated mammal bone fragments. Two Echinoid spine abraders were recovered from TU-1, one from each level. Eight metal fragments and a glass bead were also recovered from TU-2. All artifacts from TU-2 were from Level I (Table 5).

The bone hook fragment recovered from TU-2 consists of a 19.6 mm long shaft section of what appears to have been a one-piece hook. The section is relatively straight, suggesting that the hook was originally somewhat large. Weight is 0.11 g.

The perforated pig tooth is broken laterally across the drilled hole, which was positioned in the center of the short axis of the tooth. Overall length of the fragment is 20.8 mm; weight is 0.49 g.

Table 4.

SUMMARY OF MIDDEN REMAINS

CATEGORY	13287 Feature A TU-1 1-1	TU-1 1-2	TU-1 1-3	TU-1 Total	TU-2 1-1	TU-2 1-2	TU-2 Total	13302 Feature C TU-1 II	13350 Feature P TU-2 1-1	13441 TU-1 1-1	GRAND TOTAL
MARINE INVERTEBRATES											
GASTROPODS											
Cellana spp.	-	13.33	2.24	15.57	0.65	0.15	0.80	-	-	1.35	17.72
Trochus intextus spp.	-	2.32	-	2.32	-	-	0.00	-	-	-	2.32
Nerita spp.	-	1.55	-	1.55	7.43	-	7.43	-	-	-	8.96
N. picea spp.	-	80.54	141.23	221.77	70.40	20.01	90.41	0.04	-	0.41	312.83
N. polita spp.	-	15.74	22.90	38.64	2.96	-	2.96	-	-	-	41.60
Theodoxus spp.	-	0.31	-	0.31	-	-	0.00	0.54	-	-	0.85
Littorina pintado spp.	-	6.62	9.17	15.79	6.30	3.26	9.56	-	-	-	25.35
Mitraria spp.	-	0.07	-	0.07	-	-	0.00	-	-	-	0.07
Cypraeidae	-	156.69	149.87	306.56	94.96	37.48	132.44	1.36	18.24	-	458.60
Cymatiidae	-	0.72	-	0.72	-	-	0.00	-	-	-	0.72
Thaididae	-	65.81	66.85	132.66	38.99	24.09	63.08	-	-	-	195.74
Drupa ricina spp.	-	-	-	0.00	-	-	0.00	-	-	1.64	1.64
Conidae	-	61.15	109.26	170.41	74.48	13.61	88.09	0.54	-	-	259.04
Terebridae	-	-	0.34	0.34	-	-	0.00	-	-	-	0.34
Unidentified gastropods	-	-	25.41	25.41	-	8.20	8.20	-	-	-	33.61
SUBTOTAL GASTROPODS	0.00	404.83	527.47	932.30	296.37	106.80	403.17	2.48	18.24	3.40	1339.39
BIVALVES											
Brachidontes crebristriatus	-	-	0.20	0.20	-	-	0.00	-	-	-	0.20
Isognomonidae	7.63	1.01	6.42	15.06	7.37	4.30	11.67	-	0.14	0.20	27.09
Tellinidae	-	-	3.76	3.76	3.22	-	3.22	-	-	-	6.98
Veneridae	-	-	3.15	3.15	1.92	0.79	2.71	-	-	-	5.86
Chamacea	-	-	0.48	0.48	-	-	0.00	-	-	-	0.48
Unidentified bivalve	-	-	-	0.00	2.07	-	2.07	-	-	-	2.07
SUBTOTAL BIVALVES	7.65	1.01	14.01	22.67	14.58	5.09	19.67	0.00	0.14	0.20	42.68
OTHER											
Echinoidea	-	12.96	21.95	34.91	10.90	2.33	13.23	-	0.41	0.29	48.84
Crustacea	-	0.72	-	0.72	-	-	0.00	-	-	-	0.72
TOTAL MARINE INVERTEBRATES	7.65	419.52	563.43	990.60	321.85	114.22	436.07	2.48	18.79	3.89	1451.83
VERTEBRATES											
Bird	-	1.32	2.97	4.29	2.88	-	2.88	-	0.20	0.17	7.54
Fish	-	0.50	-	0.50	-	0.74	0.74	-	0.51	-	1.75
Mammal	-	1.38	5.26	6.64	6.75	-	6.75	-	2.96	14.47	30.82
TOTAL VERTEBRATES	0.00	3.20	8.23	11.43	9.63	0.74	10.37	0.00	3.67	14.64	40.11
VEGETAL REMAINS											
Charcoal	-	11.31	0.01	11.32	43.62	0.03	43.65	-	5.40	-	60.37
Aleurites moluccana	-	3.33	2.19	5.52	3.31	-	3.31	-	22.79	51.33	82.95
TOTAL VEGETAL REMAINS	0.00	14.64	2.20	16.84	46.93	0.03	46.96	0.00	28.19	51.33	143.32
GRAND TOTAL	7.65	425.92	579.89	1013.46	341.11	115.70	456.81	2.48	26.13	33.17	1532.05

Table 5.

SUMMARY OF PORTABLE ARTIFACTS, SUBSURFACE COLLECTION - SITE 13287

Artifact Category	TU-1 L-2	TU-1 L-3	TU-2 L-1	Total
INDIGENOUS				
FISHING GEAR				
Hook fragment (bone)	-	-	1	1
TOOLS				
Abrader (Echinoid)	1	1	1	3
FLAKED STONE				
Volcanic glass	-	-	3	3
ORNAMENTS				
Perforated pig tooth	-	-	1	1
OTHER				
Perf. mammal bone	-	-	2	2
TOTAL INDIGENOUS:	1	1	8	10
NON-INDIGENOUS				
ORNAMENTS				
Glass bead	-	-	1	1
OTHER				
Metal fragments	-	-	8	8
TOTAL NON-INDIGENOUS:	0	0	9	9
TOTAL ARTIFACTS:	1	1	17	19

Two very small pieces of mammal bone with small drilled holes were recovered. The original sizes or shapes of these items cannot be determined from the fragments, which weigh 0.23 and 0.65 g.

Indigenous artifacts were recovered from screened soil only at Site 13287. Historic period artifacts, consisting of glazed stoneware sherds, were collected from the surface inside Feature A at Site 13386. No artifacts or midden were recovered from the screened soil excavated at this feature.

Sixteen soil samples collected from 16 features at 12 sites were subjected to standard soil description analysis and were closely examined for inclusions (see Table 6 for summary of soil samples). All samples were collected from beneath the rock fill of platforms, terraces, mounds, modified outcrops, or filled crevices and depressions. None of the soil deposits sampled were exposed, although some may have been on an existing surface for an indeterminate period prior to construction of the overlying feature.

Eight of the soil samples were collected from beneath platforms, three from beneath mounds (two faced), and one each from beneath a terrace, an enclosure, a filled crevice, and a modified outcrop. Five samples are from features below 200 ft AMSL; eight are from features above 400 ft AMSL, and two are from features between 200 and 399 ft AMSL. With one exception, all sampled deposits had at least 0.3 m of rock fill over them; average beginning depth of the samples is 0.59 m below the surface of the feature.

The most common texture of collected soil is silt loam (sil), present in nine samples. Gravelly silt loam (gsl) occurs in two samples collected from the base of a filled crevice

Table 6.

SUMMARY OF SOIL SAMPLES

SIHP No.	Feature	Depth	Color	Texture	Structure	Consistence
13261	-	47-49	5YR2.5/0	sil	1fgr	dsh, mfi, wso
	Angular basalt gravel common; lichens present; high organic content, very sparse tiny rootlets					
13268	F	43-48	2.5YR3/2	gsil	1fsbk	dso, mfr, wss
	Very little organic content; mostly decomposing basaltic lava; very common angular gravels					
13298	C	102-107	2.5YR2.5/0	sil	1msbk	dsh, mfi, wss
	Rich, organic matrix; no gravel; few land snails; very tiny rootlets common; may have carbonized material					
13299	-	35-38	5YR2.5/2	sil	0msbk	dso, mfr, wss
	Decomposing roots and land snail; gravel rare; may have carbonized material					
13326	-	55-59	5YR2.5/1	sil	1fcr	dlo, mlo, wss
	Rich in organic material; numerous small pieces Echinoidea, land snails; gravel very sparse, few tiny rootlets					
13335	B	44-47	2.5YR3/4	sicl	2msbk	dso, mfr, wss
	Very little organic content; no land snails, sparse rootlets; no gravel					
13424	A	54-59	5YR2.5/1	gsil	2fbk	dh, mfi, wso
	Numerous tiny gravels; scattered weathered pebbles; rootlets common					
13428	A	95-97	5YR3/2	sl	0vfsg	dlo, mvf, wso
	Humic, duff-like matrix; roots and rootlets common; broken land snails					
13428	C	57-67	2.5YR2.5/2	sl	0vfcr	dlo, mvfr, wso
	Numerous small roots; weathered gravels; few land snails; very humic					
13428	G	76-82	2.5YR2.5/2	sil	3msbk	dh, mvf, wss
	Angular gravels common; numerous rootlets, land snails; koa seeds					
13441	C	56-66	2.5YR2.5/0	sil	3fsbk	dh, mvf, wss
	Few angular gravels; numerous rootlets, land snails, and seeds					
13441	K	10-14	2.5YR2.5/0	sil	1fcr	dso, mf, wso
	Scattered weathered basalt pebbles; possible carbonized material; rootlets common; no snails					

(Soil Survey Staff 1962)

Table 6. (cont.)

SIHP No.	Feature	Depth	Color	Texture	Structure	Consistence
13441	O	60-63	2.5YR2.5/0	sil	3fsbk	dh, mvf, wso
	Few angular gravels; rootlets uncommon; no snails; possible carbonized material; very similar to Feature C soil					
13465	A	114-116	2.5YR3/2	sil	1vfcr	dlo, mf, wss
	Duff-like matrix; numerous angular gravels; seeds; broken land snails					
13471	B	31-35	2.5YR2.5/2	sicl	2fsbk	dh, mvf, ms
	Angular gravels common; scattered weathered pebbles; numerous rootlets					

(Site 13268) and from the base of a modified outcrop (Site 13424). Sandy loam occurs in two samples, both of which were collected from beneath faced mounds at Site 13428. Silty clay loam is present in two samples, collected from beneath platforms (Sites 13335 and 13471).

Samples which appeared to be essentially undisturbed duff were collected at Sites 13428 and 13465. These samples include the sandy loam located beneath two faced mounds, and a silty loam located beneath a platform. This latter sample was collected from the deepest provenience, as measured from the top of the feature.

Soil which is very black, highly organic, and somewhat greasy to the touch occurs in five samples, four of which may have decomposing carbonized material. These soils occurred under various feature types, in all three elevation intervals. Feature types include three platforms, two of which are at Site 13441, a terrace, an enclosure, and a linear mound.

Marine faunal remains were observed in one sample recovered from beneath a platform at Site 13326. Numerous tiny pieces (less than 1/8-in in diameter) of Echinoidea occur in this matrix, which consists of highly organic silty loam. No kukui nut remains occur in collected soil; however, kukui shell was observed in three features, a faced mound (Feature E) and a platform (Feature G) at Site 13428, and a platform (Feature C) at Site 13441. In all three cases, the nut remains were located near the rock fill/soil interface and appeared to represent a complete, unburned nut. The soil matrix in all of these features is humic topsoil and additional seeds, such as koa-haole, are present in the matrix. It is therefore uncertain whether the nuts were purposely placed or planted in these features, or were present in the duff prior to feature construction. In no case were they buried in the soil deposit.

Distinct patterns of soil type occurrence associated with specific feature types, elevation intervals, or depth below feature surface are not readily apparent among the collected samples. It is possible that more in-depth examination of the soil through chemical and palynological analysis will provide more relevant data for the interpretation of specific feature functions. A systematic study of existing natural soil deposits would provide a baseline for comparative analyses of the soils.

AGE DETERMINATIONS

Seven dating samples, collected from three sites, were of sufficient size for age determination analysis. The samples were processed by Beta Analytic, Inc. They were calibrated according to Stuiver and Pearson (1986), and adjusted ages were normalized to 0.25 per mil carbon 13, with the calendric range calculated at two sigmas (Table 7). All of the samples consisted of charcoal. Two samples (RC-654 and 656) were less than 1.0 g and were given extended counting time in order to reduce the statistical error.

Six of the seven assayed samples were recovered from cave features at Sites 13287, 13350, and 13441. The seventh sample was collected from the surface of a soil deposit in Feature O, a platform, at Site 13441. Both

samples from Site 13441, and a Level 1 sample from Site 13350, were determined to be influenced by bomb C-14. Two of these samples returned the nineteenth century adjusted C-14 ages. All other samples returned adjusted C-14 ages ranging from AD 1580 to 1790.

Samples collected from Level 3 at Site 13287 and from a hearth at Site 13350 returned the earliest adjusted C-14 ages—AD 1580+/-50 and 1580+/-90, respectively. These ages have identical calibrated calendric ranges of AD 1430-1650. The Site 13287 and 13350 caves are the most intensively utilized habitation caves identified to date within the project area. Site 13287 is located at 12 ft AMSL and Site 13350 is located at 217 ft AMSL.

A second sample, collected from from the cave floor at Site 13350, returned an adjusted C-14 age of AD 1510+/-90. The adjusted calendric range for this sample has two alternatives, AD 1305-1360 or AD 1380-1650. The latter alternative appears to be most compatible with the C-14 age. This date is essentially contemporaneous with the Sample 653 date from this site.

Later occupation of Site 13350 is suggested by a third dated sample collected within the cave. This sample (652) returned an adjusted C-14 age of AD 1730+/-50. Five alternative adjusted calendric ranges are given for this sample; two extend into the nineteenth century and one is modern. The median range among the five alternatives is AD 1726-1818. On the basis of this date, it appears that an early historic component is present at Site 13350.

The dated sample from Site 13287 was recovered from the base of a cultural deposit which appears to represent the earliest of at least two occupational components. Later occupation(s) of Site 13287 is indicated by changes in the midden deposit and by the presence of possibly early historic period artifacts (a glass bead and small metal fragments).

On the basis of these dates, and recovered artifacts, it appears that Sites 13287 and 13350 were being utilized during the same time period(s).

Table 7.

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 13287						
650	35482	Feature A, TU-1, Level 3, 84-89 cmbd	290±50	-20.2	370±50	1430-1650
SITE 13350						
651	35483	TU-1, Layer I, Level 1, 0-2 cmbs	120±70	-26.1	100±70	1650-1955#
652	35484	TU-2, Layer I, Level 1, 0-5 cmbs	150±50	-21.0	220±50	1523-1566 1629-1696 1726-1818 1859-1861 1921-1954
653	35485	TU-3, Layer I, Level 1, 0-5 cmbs	410±60	-27.5	370±60	1430-1650
654	35486	Feature C, TU-4, Level 1, Surface	460±90	-26.2	440±90	1305-1360 1380-1650
SITE 13441						
655	35487	Feature P, TU-1, Layer I, Level 1, 0-5 cmbs	100.3±1.0% modern	-13.7	160±80	1523-1568 1630-1955#
656	35488	Feature O, HF-1, 43-45 cmbs	60±90	-21.6	120±90	1640-1955#

* Calibrated according to Stuiver and Pearson (1986). Range at two sigmas.
# Denotes influence of bomb C-14.

CONCLUSION

DISCUSSION

The principal research goals of this preliminary analysis of inventory survey data were to examine existing hypotheses concerning the chronology of settlement and agricultural expansion in Keahuolu, and to search for patterns in the spatial distribution of various features that might be used to infer specific land use patterns as practiced by traditional Hawaiian agriculturalists.

One hypothesis examined here is Schilt's suggestion that agricultural expansion into the kula zone occurred in the Kona agricultural district between AD 1400 and 1650, with a similar expansion beginning in the area north of Kailua approximately 100 years later, between AD 1550-1650 (Schilt 1984:274). Radiocarbon dates from deposits in Kealakehe have suggested that agricultural activities in the inland portion of Keahuolu should postdate AD 1400 (Dorham 1990b). The only reliable dates from the current project area are from two habitation caves; one is located 0.5 km from the coast and one is located 1.6 km from the coast. The artifactual deposits and extent of structural modifications in these caves suggest that they were used more intensively than as temporary shelters for travelers. The earliest dates returned for both caves indicate possible initial use during the same time period, between AD 1430 and 1650. This period may well represent the time of initial agricultural expansion into the kula zone, which is not considerably later than Schilt's hypothesized expansion period further south, in the core area of the Kona Field System.

There is ample evidence of relatively widespread activities in Keahuolu through the early historic period. During the current project, artifacts of early historic period manufacture were recovered from surface proveniences at three sites in the lower elevation interval (below 200 ft AMSL), and early historic period rock carvings such as names and initials occur in all elevation intervals. A radiometric date was also returned from the Site 13350 cave, a date which brackets the Contact Period. The chronology for inland Keahuolu is still tentative; however, indications are that the Keahuolu kula zone was used by traditional agriculturalists for at least a 400 year period, between c. AD 1450 and 1850. The absence of evidence for intensive cattle grazing, particularly in southern Keahuolu, means a possible extension of agricultural utilization through the nineteenth and early twentieth centuries.

The technique employed in this study to examine variation in land use has been to stratify the project area into three elevation intervals, which approximate the rainfall isohyets as projected for Keahuolu (following the data provided in the EIS for this project). The lower elevation interval (less than 200 ft AMSL) encompasses approximately 52.7% of the total surface area examined during the project, and contains 41.2% of the identified features. Features reflecting agriculture, temporary habitation, transportation, aquaculture, and possibly ceremonial activities are present. This area contains a relatively high proportion of the identified petroglyphs (72.2%) and trails (53.8%). The identification of both of these formal types is greatly enhanced in the lower elevations, due to sparse vegetation cover.

The 200-399 ft elevation interval encompasses 34.5% of the total surface area and contains 32.4% of the identified sites. This area differs from the lower elevations in that no trails were located, and surface features such as midden scatters, filled crevices, overhangs, and rock concentrations were absent. The middle elevation interval contains a significantly higher proportion of bifaced walls and platforms, as compared to the other two intervals. This difference is attributable to the concentration of possible habitation and agricultural features in the vicinity of the north end of Kuakini Wall. It is uncertain at this time whether the site cluster predates or postdates the wall. The eastern extent of the site concentration extends well beyond the wall to the east, and apparently continues to the south side of Palani Highway, outside the current project area (Rosendahl 1983).

The middle elevation interval also exhibits a substantial increase in cave shelters, cave burials, enclosures, and linear mounds, as compared with the lower elevation interval. Pahoehoe excavations and terraces show no major change in general frequencies between these two intervals, although they are more dense in the middle interval when relative surface areas are considered.

The upper elevation zone exhibits a substantial increase in rock mounds, particularly faced mounds, and modified blisters. Other agricultural features such as pahoehoe excavations, enclosures, terraces and platforms exhibit a higher density here than in lower elevations, but there is no significant difference in the occurrence of these features between the upper and middle elevation intervals. Findings from a prior survey of a 150-acre parcel in Keahuolu

immediately east of this project area indicate that between 600 and 750 ft AMSL, feature density increases, and the predominance of rock mounds becomes more apparent (Donham 1990b).

Examination of variation in the size, construction, and deposits of agricultural features by elevation intervals failed to determine substantive differences that might be dependent upon the elevation gradient. There does, however, appear to be differences in the occurrence patterns of certain formal feature types. These differences undoubtedly signal functional variation in some cases, but may also signal temporal variation. For example, faced rock mounds and possibly the agricultural platforms may be later variants of these general feature types. Likewise, the higher incidence of bifaced walls in the middle elevation interval may reflect more intensive use of this area during the historic period.

In order to obtain reliable data for continued analysis of the agricultural complexes, it is recommended that a systematic sampling approach be adopted, whereby sample blocks or transects are cleared of vegetation and all features within the designated area are plotted and recorded. These sample transects or blocks should be located independently of the existing sites in order to control for those features not located between survey sweeps in areas of dense vegetation.

The use of sampling blocks will provide a reliable basis for the analyses of feature density and relative frequency of types, and will provide a more realistic framework for comparing elevation variation. A sampling scheme will also help determine the best means for identifying site boundaries (or the absence of such) in areas where this is problematic. For example, it is suspected that several of the complexes in the upper elevations are currently delineated on the basis of no visibility, rather than the absence of features. Total clearing of the entire area is not feasible; however, this would be nearly accomplished if every complex was cleared in order to determine site boundaries. A systematic sampling approach should provide sufficient data for the mitigation of adverse effects on a large proportion of the agricultural complexes recommended for further data collection.

In conjunction with a sampling approach to further data collection within the project area, a more exact and replicable feature typology should be developed. With a proper typology, the spatial patterning of various feature types can be rapidly recorded, without the timely process of drawing each feature to scale. Given the expansiveness of the project area and the extensive clearing that will have to be completed for detailed scaled mapping, this procedure will of necessity be limited to a relatively small proportion of the area recommended for further work. Plotting features by type will provide a much larger data base for examining spatial patterns.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

General significance assessments and recommended general treatments for all identified sites are summarized in Table 8. Specific field work tasks for individual sites are summarized in Appendix C. 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). DLNR-HSS/SHPO 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." 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 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."

To further facilitate management decisions regarding the subsequent treatment of resources, the general significance of the archaeological resources identified during the inventory survey were also evaluated in terms of potential scientific research, interpretive, and/or cultural values (PHRI Cultural Resource Management [CRM] Value Modes; see Appendix C for individual assessments of sites). 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,

Table 8.

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

SIHP Site No.	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
13255	-	+	-	-	-	+	-	-
13256	-	+	-	-	-	+	-	-
13257	-	+	-	-	-	+	-	-
13259	-	+	-	-	-	+	-	-
13261	-	+	-	-	-	+	-	-
13263	-	+	-	-	-	+	-	-
13264	-	+	-	-	-	+	-	-
13265	-	+	-	-	-	+	-	-
13266	-	+	-	-	-	+	-	-
13267	-	+	-	-	-	+	-	-
13269	-	+	-	-	-	+	-	-
13270	-	+	-	-	-	+	-	-
13271	-	+	-	-	-	+	-	-
13273	-	+	-	-	-	+	-	-
13276	-	+	-	-	-	+	-	-
13278	-	+	-	-	-	+	-	-
13282	-	+	-	-	-	+	-	-
13283	-	+	-	-	-	+	-	-
13284	-	+	-	-	-	+	-	-
13285	-	+	-	-	-	+	-	-
13286	-	+	-	-	-	+	-	-
13288	-	+	-	-	-	+	-	-

General Significance Categories:

A = Important for information content, further data collection necessary (PHRI=research value);
X = Important for information content, no further data collection necessary (PHRI=research value, SHPO=not significant)
B = Excellent example of site type at local, region, island, state, or national level (PHRI=interpretive value); and
C = Culturally significant (PHRI=cultural value).

Recommended General Treatments:

FDC = Further data collection necessary (detailed recording, surface collections, and limited excavations, and possibly subsequent data recovery/mitigation excavations);
NFW = No further work of any kind necessary, sufficient data collected archaeological clearance recommended, no preservation potential;
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 possibly minimal further data collection necessary

Table 8. (cont.)

SIHP Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
13292	-	+	-	-	-	+	-	-
13293	-	+	-	-	-	+	-	-
13296	-	+	-	-	-	+	-	-
13297	-	+	-	-	-	+	-	-
13298	-	+	-	-	-	+	-	-
13299	-	+	-	-	-	+	-	-
13301	-	+	-	-	-	+	-	-
13303	-	+	-	-	-	+	-	-
13304	-	+	-	-	-	+	-	-
13305	-	+	-	-	-	+	-	-
13307	-	+	-	-	-	+	-	-
13310	-	+	-	-	-	+	-	-
13311	-	+	-	-	-	+	-	-
13312	-	+	-	-	-	+	-	-
13313	-	+	-	-	-	+	-	-
13314	-	+	-	-	-	+	-	-
13316	-	+	-	-	-	+	-	-
13317	-	+	-	-	-	+	-	-
13318	-	+	-	-	-	+	-	-
13319	-	+	-	-	-	+	-	-
13320	-	+	-	-	-	+	-	-
13321	-	+	-	-	-	+	-	-
13325	-	+	-	-	-	+	-	-
13326	-	+	-	-	-	+	-	-
13327	-	+	-	-	-	+	-	-
13329	-	+	-	-	-	+	-	-
13338	-	+	-	-	-	+	-	-
13341	-	+	-	-	-	+	-	-
13345	-	+	-	-	-	+	-	-
13347	-	+	-	-	-	+	-	-
13354	-	+	-	-	-	+	-	-
13361	-	+	-	-	-	+	-	-
13363	-	+	-	-	-	+	-	-
13366	-	+	-	-	-	+	-	-
13367	-	+	-	-	-	+	-	-
13369	-	+	-	-	-	+	-	-
13378	-	+	-	-	-	+	-	-
13388	-	+	-	-	-	+	-	-
13389	-	+	-	-	-	+	-	-
13406	-	+	-	-	-	+	-	-
13424	-	+	-	-	-	+	-	-
13426	-	+	-	-	-	+	-	-
13432	-	+	-	-	-	+	-	-
13433	-	+	-	-	-	+	-	-
13434	-	+	-	-	-	+	-	-
13439	-	+	-	-	-	+	-	-
13442	-	+	-	-	-	+	-	-

Table 8. (cont.)

SIHP Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
13444	-	+	-	-	-	+	-	-
13453	-	+	-	-	-	+	-	-
13461	-	+	-	-	-	+	-	-
13469	-	+	-	-	-	+	-	-
13470	-	+	-	-	-	+	-	-
13475	-	+	-	-	-	+	-	-
13480	-	+	-	-	-	+	-	-
13481	-	+	-	-	-	+	-	-
13482	-	+	-	-	-	+	-	-
13483	-	+	-	-	-	+	-	-
13485	-	+	-	-	-	+	-	-
13486	-	+	-	-	-	+	-	-
13487	-	+	-	-	-	+	-	-
13489	-	+	-	-	-	+	-	-
13490	-	+	-	-	-	+	-	-
Subtotal:	**0**	**84**	**0**	**0**	**0**	**84**	**0**	**0**
13258	+	-	-	-	+	-	-	-
13260	+	-	-	-	+	-	-	-
13262	+	-	-	-	+	-	-	-
13268	+	-	-	-	+	-	-	-
13272	+	-	-	-	+	-	-	-
13274	+	-	-	-	+	-	-	-
13277	+	-	-	-	+	-	-	-
13279	+	-	-	-	+	-	-	-
13280	+	-	-	-	+	-	-	-
13287	+	-	-	-	+	-	-	-
13289	+	-	-	-	+	-	-	-
13290	+	-	-	-	+	-	-	-
13291	+	-	-	-	+	-	-	-
13294	+	-	-	-	+	-	-	-
13295	+	-	-	-	+	-	-	-
13300	+	-	-	-	+	-	-	-
13302	+	-	-	-	+	-	-	-
13306	+	-	-	-	+	-	-	-
13308	+	-	-	-	+	-	-	-
13309	+	-	-	-	+	-	-	-
13315	+	-	-	-	+	-	-	-
13322	+	-	-	-	+	-	-	-
13323	+	-	-	-	+	-	-	-
13324	+	-	-	-	+	-	-	-
13328	+	-	-	-	+	-	-	-
13330	+	-	-	-	+	-	-	-
13331	+	-	-	-	+	-	-	-
13332	+	-	-	-	+	-	-	-
13333	+	-	-	-	+	-	-	-

Table 8. (cont.)

SIHP Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
13334	+	-	-	-	+	-	-	-
13335	+	-	-	-	+	-	-	-
13336	+	-	-	-	+	-	-	-
13337	+	-	-	-	+	-	-	-
13339	+	-	-	-	+	-	-	-
13340	+	-	-	-	+	-	-	-
13342	+	-	-	-	+	-	-	-
13343	+	-	-	-	+	-	-	-
13344	+	-	-	-	+	-	-	-
13346	+	-	-	-	+	-	-	-
13348	+	-	-	-	+	-	-	-
13349	+	-	-	-	+	-	-	-
13351	+	-	-	-	+	-	-	-
13352	+	-	-	-	+	-	-	-
13353	+	-	-	-	+	-	-	-
13355	+	-	-	-	+	-	-	-
13356	+	-	-	-	+	-	-	-
13357	+	-	-	-	+	-	-	-
13358	+	-	-	-	+	-	-	-
13362	+	-	-	-	+	-	-	-
13364	+	-	-	-	+	-	-	-
13365	+	-	-	-	+	-	-	-
13368	+	-	-	-	+	-	-	-
13370	+	-	-	-	+	-	-	-
13374	+	-	-	-	+	-	-	-
13379	+	-	-	-	+	-	-	-
13385	+	-	-	-	+	-	-	-
13386	+	-	-	-	+	-	-	-
13387	+	-	-	-	+	-	-	-
13391	+	-	-	-	+	-	-	-
13397	+	-	-	-	+	-	-	-
13399	+	-	-	-	+	-	-	-
13401	+	-	-	-	+	-	-	-
13402	+	-	-	-	+	-	-	-
13403	+	-	-	-	+	-	-	-
13404	+	-	-	-	+	-	-	-
13405	+	-	-	-	+	-	-	-
13407	+	-	-	-	+	-	-	-
13410	+	-	-	-	+	-	-	-
13411	+	-	-	-	+	-	-	-
13412	+	-	-	-	+	-	-	-
13414	+	-	-	-	+	-	-	-
13415	+	-	-	-	+	-	-	-
13416	+	-	-	-	+	-	-	-
13417	+	-	-	-	+	-	-	-
13418	+	-	-	-	+	-	-	-
13419	+	-	-	-	+	-	-	-

Table 8. (cont.)

SIHP Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
13420	+	-	-	-	+	-	-	-
13421	+	-	-	-	+	-	-	-
13422	+	-	-	-	+	-	-	-
13423	+	-	-	-	+	-	-	-
13425	+	-	-	-	+	-	-	-
13427	+	-	-	-	+	-	-	-
13428	+	-	-	-	+	-	-	-
13429	+	-	-	-	+	-	-	-
13430	+	-	-	-	+	-	-	-
13431	+	-	-	-	+	-	-	-
13435	+	-	-	-	+	-	-	-
13436	+	-	-	-	+	-	-	-
13437	+	-	-	-	+	-	-	-
13438	+	-	-	-	+	-	-	-
13440	+	-	-	-	+	-	-	-
13443	+	-	-	-	+	-	-	-
13446	+	-	-	-	+	-	-	-
13447	+	-	-	-	+	-	-	-
13448	+	-	-	-	+	-	-	-
13449	+	-	-	-	+	-	-	-
13450	+	-	-	-	+	-	-	-
13451	+	-	-	-	+	-	-	-
13452	+	-	-	-	+	-	-	-
13454	+	-	-	-	+	-	-	-
13455	+	-	-	-	+	-	-	-
13456	+	-	-	-	+	-	-	-
13457	+	-	-	-	+	-	-	-
13458	+	-	-	-	+	-	-	-
13459	+	-	-	-	+	-	-	-
13460	+	-	-	-	+	-	-	-
13462	+	-	-	-	+	-	-	-
13464	+	-	-	-	+	-	-	-
13465	+	-	-	-	+	-	-	-
13466	+	-	-	-	+	-	-	-
13467	+	-	-	-	+	-	-	-
13468	+	-	-	-	+	-	-	-
13471	+	-	-	-	+	-	-	-
13472	+	-	-	-	+	-	-	-
13473	+	-	-	-	+	-	-	-
13474	+	-	-	-	+	-	-	-
13476	+	-	-	-	+	-	-	-
13477	+	-	-	-	+	-	-	-
13478	+	-	-	-	+	-	-	-
13479	+	-	-	-	+	-	-	-
13484	+	-	-	-	+	-	-	-
13488	+	-	-	-	+	-	-	-
13491	+	-	-	-	+	-	-	-
Subtotal:	123	0	0	0	123	0	0	0

Table 8. (cont.)

SIHP Site No.	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
13371	+	-	+	-	+	-	+	-
13372	+	-	+	-	+	-	+	-
13375	+	-	+	-	+	-	+	-
13380	+	-	+	-	+	-	+	-
13381	+	-	+	-	+	-	+	-
13382	+	-	+	-	+	-	+	-
13383	+	-	+	-	+	-	+	-
13384	+	-	+	-	+	-	+	-
13390	+	-	+	-	+	-	+	-
13393	+	-	+	-	+	-	+	-
13394	+	-	+	-	+	-	+	-
13396	+	-	+	-	+	-	+	-
13400	+	-	+	-	+	-	+	-
13413	+	-	+	-	+	-	+	-
13445	+	-	+	-	+	-	+	-
Subtotal:	15	0	15	0	15	0	15	0
13373	+	-	+	*	+	-	+	-
13408	+	-	+	*	+	-	+	-
13441	+	-	+	*	+	-	+	-
13376	+	-	+	*	+	-	+	-
13392	+	-	+	*	+	-	+	-
13395	+	-	+	*	+	-	+	-
13398	+	-	+	*	+	-	+	-
13409	+	-	+	*	+	-	+	-
Subtotal:	8	0	8	8	8	0	8	0
13275	+	-	-	+	+	-	-	+
13281	+	-	-	+	+	-	-	+
13350	+	-	-	+	+	-	-	+
13359	+	-	-	+	+	-	-	+
13360	+	-	-	+	+	-	-	+
13377	+	-	-	+	+	-	-	+
13463	+	-	-	+	+	-	-	+
Subtotal:	7	0	0	7	7	0	0	7
00002	+	-	+	+	+	-	+	-
07276	+	-	+	+	+	-	+	-
Subtotal:	2	0	2	2	2	0	2	0
Total: 239	155	84	25	17	155	84	25	7

*Provisional assessment; definite assessment pending completion of further data collection.

and interregional levels of organization. Interpretive value refers to the potential of 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. These three value modes are derived from the above state and federal evaluation criteria.

Based on the above federal criteria, 207 of the 239 sites identified during the current project (86.9%) are assessed as significant solely for information content. No further work is recommended for 84 (40.6%) of the 207 sites. These 84 sites (pahoehoe excavations, cairns, rock mounds, walls, and modified outcrops) are generally isolated agricultural features which lack cultural deposits and portable remains; they have been measured, mapped, described, photographed, plotted, and selected examples have been excavated. Data collected from them during the present survey is considered sufficient; their preservation is not essential, although they could perhaps be considered for inclusion into development landscaping. Further data collection is recommended for the remaining 123 of the 207 sites (59.4%). After further data collection is completed, if warranted, a data recovery plan should be prepared and implemented for sites not recommended for preservation or interpretation.

Twenty-three of the 239 recorded sites are assessed as significant under National Register Criterions C (GSA Category B, excellent embodiment of a distinctive type) and D (GSA Category A, information content). The majority of these sites are habitation/agriculture complexes located within a distinct concentration at the northern end of Kuakini Wall, along Palani Road. The fact that these sites are spatially concentrated within a "district-like" area greatly enhances their integrity and Criterion C significance. As a group, these sites also exhibit a high cultural value, which cannot be attributed to most of them on an individual basis. One site (13441 - complex) is not located within the preserve district ["district-like area"]. This complex includes a number of unique and exemplary agricultural and habitation features, and is contained within a relatively well-preserved enclosure. The formal attributes of the features at this site are not repetitive of the features within the preserve district, and it is likely that a different time period, social group, or agricultural pattern is represented.

Eight of the sites within the preserve district with Criterion C and D significance (GSA categories A and B) are individually assessed as having provisional cultural value, in addition to high interpretive and information values (13373, 13408, 13441, 13376, 13392, 13395, 13398, 13409). These sites include features which potentially contain human interments. Presence or absence of the burials can only be determined through subsurface testing. If, however, the features are preserved for their interpretive value within the context of the surrounding area, there would be no need to disturb the features or potential interments.

One site (13281) is assessed under National Register Criterion D (GSA Category A) and as having high cultural value (GSA CAtegory C). This site is a shrine, and preservation "as is" is recommended.

Six of the 239 total identified sites are assessed as significant under National Register Criterion D (GSA Category A, information content) and as having high cultural value (GSA Category C), due to the presence of human remains (13275, 13350, 13359, 13360, 13377, 13463). These sites consist of cave shelters with exposed human interments that are generally in poor preservation and disturbed. It is recommended that the remains be preserved "as is" in the location of original interment, with stabilization of the disturbed burial features and documentation of the nature (i.e., disposition prior to stabilization) and the location of the remains.

If the burials are not preserved "as is," it is required that the procedures of Section 43 of Chapter 6E (Historic Preservation, Haw. Rev. Stat., as amended) be followed. DLNR-HSS/SHPO should be notified and will contact the Office of Hawaiian Affairs (OHA). A mitigation plan for burials, with osteological analyses, should be worked out with DLNR-HSS/SHPO. In addition, a search for direct lineal descendants should be undertaken, consisting minimally of publishing a public notice in a newspaper of general circulation. If direct lineal descendants are found, the osteological analyses shall be subject to their wishes. Lastly, a plan for final disposition of the remains should be developed in accordance with Section 43 of Chapter 6E. It is recommended that any remains found be reinterred within the project area. If this is not possible, they should be reinterred in a nearby cemetery. A disinterment permit may be required from the State Department of Health.

Two sites, Mamalahoa Trail (0002) and Kuakini Wall, (07276) are assessed as significant under National Register Criterions C and D (GSA Categories A and B), as well as having high cultural value (GSA Category C). Preservation with interpretive development of the portions of the sites within the project area is recommended.

As an important initial step prior to data collection, it is recommended that all identified sites recommended for

further archaeological work be accurately located and plotted by professional surveyors, with the aid of an archaeologist, on an appropriate scale topographic map of the project area. This would greatly aid development planning by allowing further archaeological work determinations (further data collection, data recovery and/or preservation) to be more accurately considered on a site-by-site basis.

The evaluations and recommendations presented within this final report have been based on a 100% aerial, variable-coverage surface, and limited subsurface inventory survey of the project area. There is always the possibility, however remote, that potentially significant, unidentified surface and/or subsurface cultural remains will be encountered in the course of future archaeological investigations or subsequent development activities. In such situations, archaeological consultation should be sought immediately.

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APPENDIX A

SITE DESCRIPTIONS

SITE NO.: State: 50-10-27-00002
SITE TYPE: Mamalahoa Trail
TOPOGRAPHY: Relatively flat to undulating pahoehoe and aa flows.
VEGETATION: Kiawe, koa-haole and grass
ELEVATION: c. 50-93 feet
CONDITION: Fair
INTEGRITY: Affected by vehicular traffic
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 674.00 m by 4.20 m
DESCRIPTION: Mamalahoa Trail is generally a graded curbstone horse trail/road that was constructed under government direction during the nineteenth century. Portions of the trail follow a prehistoric transportation route. The trail is discernible in the northern portion of the project area, 45.00 to 60.00 m east or and generally parallel with Queen Kaahumanu Highway. The trail surface has been affected by vehicular use, resulting in degradation of the kerbstone alignments along the sides.

SITE NO.: State: 13255 PHRI: T-1 *(Figure A-1)*
SITE TYPE: Mound
TOPOGRAPHY: Relatively flat ropy pahoehoe and aa that has been flattened by bulldozing.
VEGETATION: Christmas-berry, grass, and some 'ilima
ELEVATION: c. 37 feet
CONDITION: Poor
INTEGRITY: Original size, shape indeterminate
PROBABLE AGE: Possible prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 3.35 m by 3.00 m by 1.07 m
DESCRIPTION: A single feature site that has been isolated in a bulldozed area. The mound is oval to oblong in plan, with a rounded top and outsloping sides. It is constructed with a perimeter of loosely piled aa boulders and cobbles, and filled with smaller pahoehoe and aa pebbles. The feature has been affected by bulldozer grubbing, and presently has a quantity of dozer-deposited aa pebbles against the western side. The only intact portion of the original feature is at the NE corner, where faced perimeter slabs are stacked c. 0.60 m high for 0.83 m along the north side.

A 0.70 m wide test trench was excavated across the center the feature, in order to determine the extent of dozer disturbance and to determine the function of the feature. All material encountered in this trench was dozer disturbed. A second unit (1.0 by 1.0 m sq) was therefore excavated into the intact portion of the mound, in order to determine if an internal feature was present. At the base of the mound (0.77 m below existing top at this corner), a single layer of pahoehoe slabs was encountered. Below the layer of slabs was a very thin duff deposit overlying a consolidated aa surface. No midden remains, artifacts or other cultural materials were encountered.

SITE NO.: State: 13256 PHRI: T-3 *(Figure A-2)*
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Flat, ropy pahoehoe in immediate area of site. Undulating aa and pahoehoe field in vicinity.
VEGETATION: Sparse grasses, ferns and low lantana bushes
ELEVATION: c. 23 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 6.00 m by 5.50 m by 0.60 m maximum depth
DESCRIPTION: A single pahoehoe excavation area divided into two linear sections. Depth of the excavation averages 0.15 m around the edges, with maximum depth at the center. Excavated pahoehoe blocks have been arranged in four distinct concentrations in and around the perimeters of the feature. Two rock concentrations occur at the inside edges of one section of the excavation, and one concentration is along the center of the other section. The fourth concentration is a loose pile to the east of the excavation. The pahoehoe blocks range in size from 11x10x7 cm to 56x45x15 cm. No soil was observed in the feature, however, soil deposits may be present beneath rock fill.

SITE NO.: State: 13257 PHRI: T-4 *(Figure A-3)*
SITE TYPE: Filled crevice
TOPOGRAPHY: The site consists of a major upthrust of pahoehoe with a wide crevice area at the center.
VEGETATION: Thick to moderate grasses, kiawe, lantana, Christmas-berry; sword fern in the crevice area.
ELEVATION: c. 28 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 3.05 m by 1.05 m by 3.00 m maximum height
DESCRIPTION: An irregular-shaped area 0.70 by 0.75 m has been cleared of natural boulders cobble fall and has been leveled with cobble-size fill. The cleared stones are

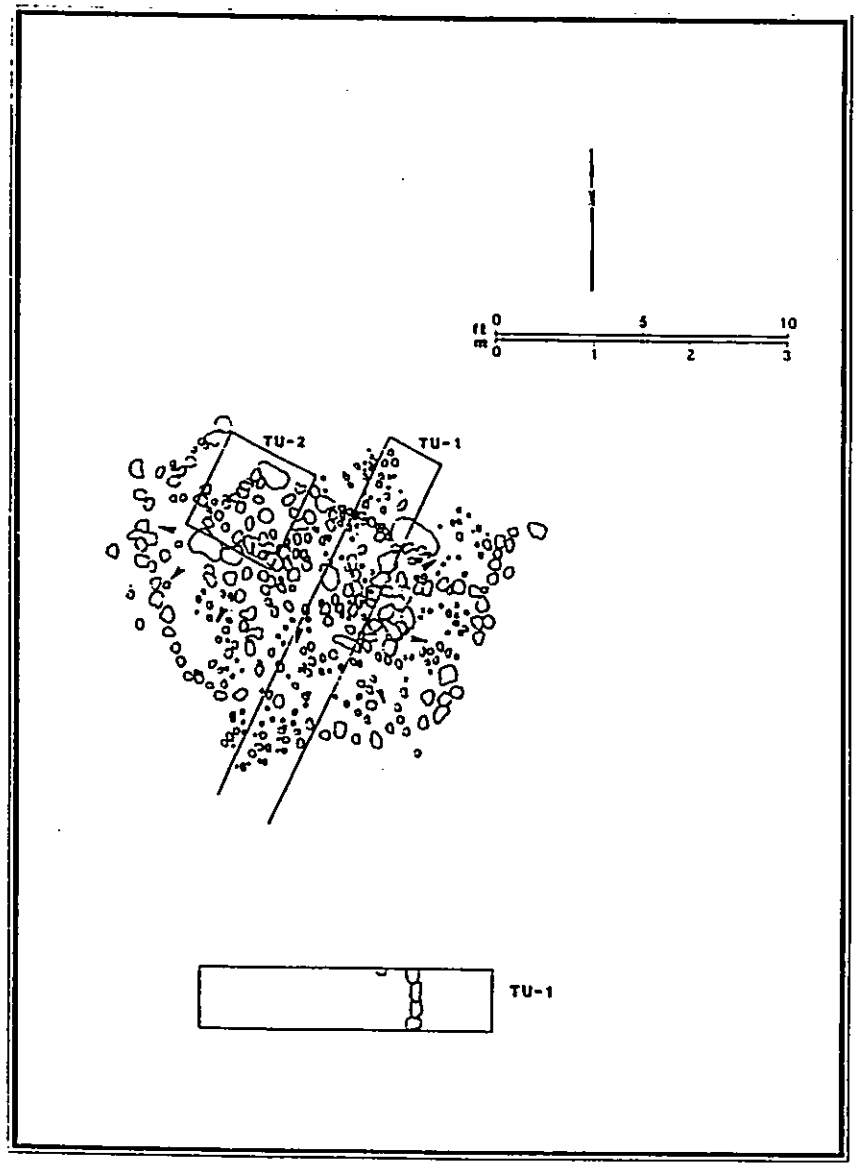


Figure A-1. SITE 13255

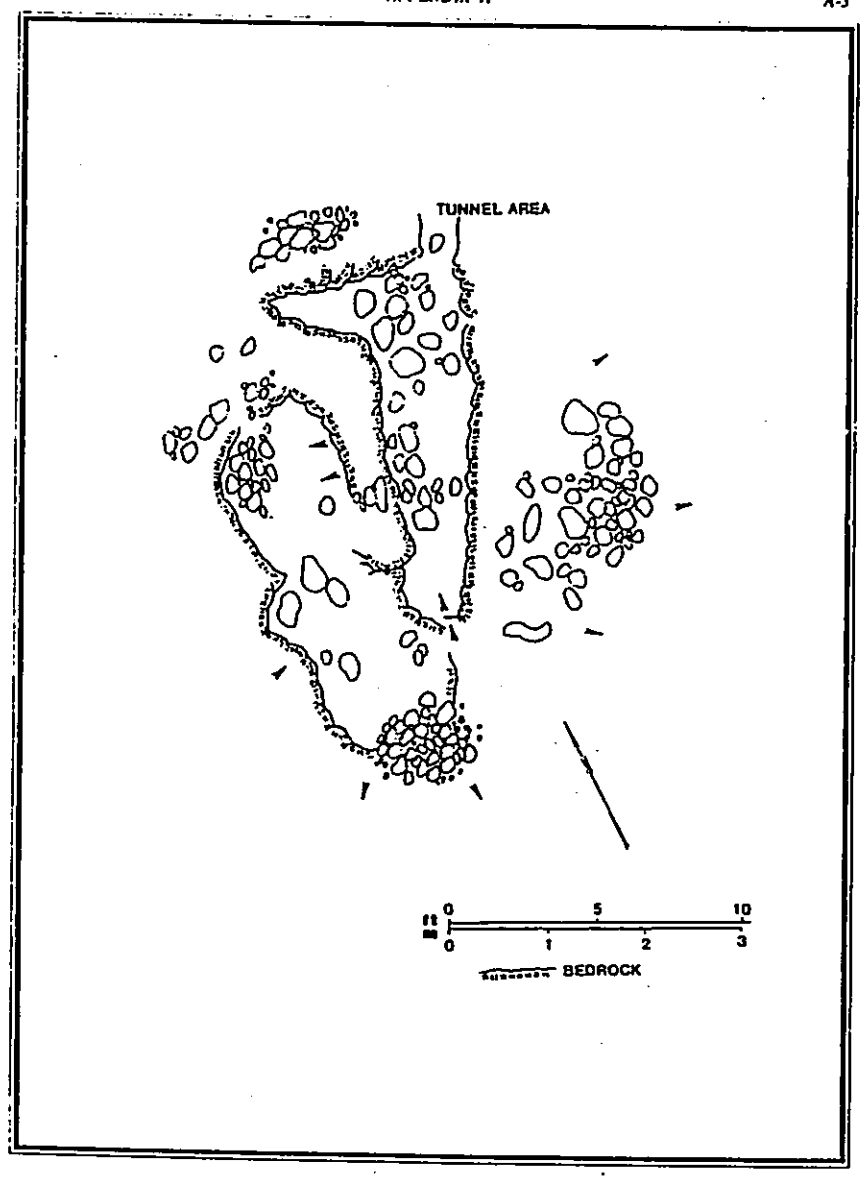


Figure A-2. SITE 13256

concentrated in the crevice to the sides of the leveled area. A small test unit was excavated into the fill, in order to determine possible function. The fill was found to be only one to two layers thick, overlying two sharp, vertical pahoehoe projections. It appears that the feature was constructed in order to permit easier access into the crevice area, which contains two natural cupboards. No soil or portable remains were located in or under the fill, or in the natural cupboards.

SITE NO.: State: 13258 PHRI: T-5
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Undulating terrain consisting of uneven flows of smooth and ropy pahoehoe and aa.
VEGETATION: Sparse grass, noni, kiawe, and Christmas-berry
ELEVATION: c. 26 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Temporary habitation
DESCRIPTION: Overall complex area measures c. 24.0 m (E-W) by 5.0 m (N-S). The site consists of an overhang (Feature A) and a cupboard (Feature B). One isolated waterworn hammerstone was observed on the surface between the features.

FEATURE A: Overhang
FUNCTION: Habitation
DIMENSIONS: 3.75 m by 2.51 m by 0.92 m maximum ceiling height
DESCRIPTION: The overhang faces the northwest and utilizes natural upthrusts of pahoehoe in front and along the sides. Blocks and upright slabs of pahoehoe have been placed to form a windbreak in front of the opening. The opening of the shelter ranges c. 0.33 to 0.92 m.

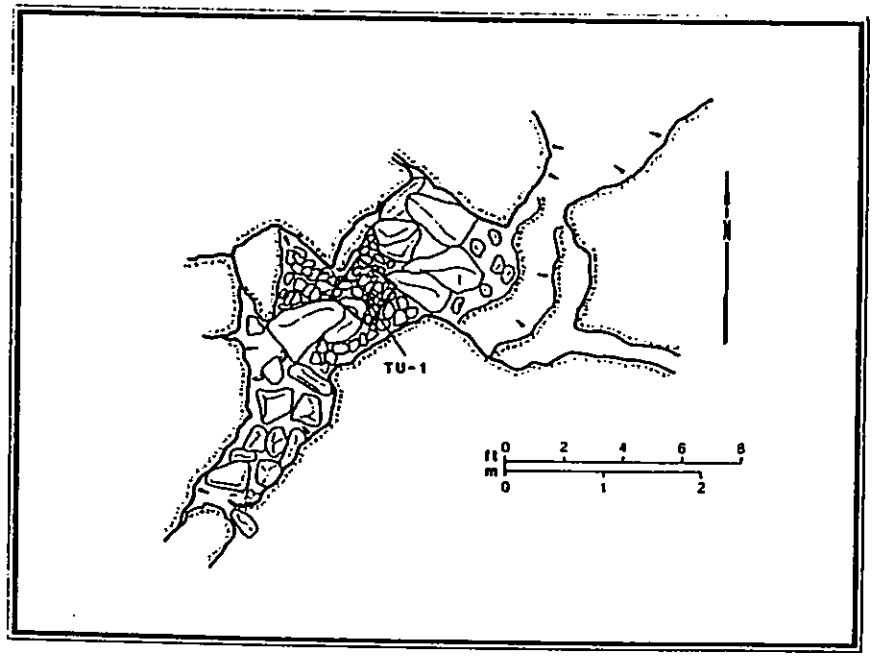


Figure A-3. SITE 13257

No cultural deposits or remains found in the shelter area. However, the rectangular area in front of the opening has been modified as an apparent windbreak. Rough dimensions of interior area in front of the rock shelter, from the opening to the alignment of slabs and blocks measures c. 2.64 (E-W) by 2.58 m (N-S).

FEATURE B: Cupboard
FUNCTION: Storage
DIMENSIONS: 0.93 m by 0.88 m by 0.67 m
DESCRIPTION: Roughly square shape in plan, the feature consists of an excavated hole within a low depression of aa. The cupboard is located 23.32 m from Feature A at 289 degrees Az. No portable remains or deposits were observed inside the feature.

SITE NO.: State: 13259 PHRI: T-6
SITE TYPE: Rock concentration
TOPOGRAPHY: Smooth pahoehoe blister slightly raised from the surrounding terrain.
VEGETATION: Thick grass, noni, and kiawe in the surrounding area
ELEVATION: c. 22 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 4.00 m by 4.00 m by 0.32 m maximum height
DESCRIPTION: Approximately 11 large angular basalt blocks are situated in a random arrangement along a large crack near the summit of a low pahoehoe dome. A section of the crack is also filled with smaller angular blocks. The basalt blocks range in size from 14x10x7 cm to 38x32x27 cm.

A small excavated area is situated c. 2.3 m north of the rock scatter. The excavation is shallow, with a maximum depth of c. 5 cm, and contains one waterworn basalt hammerstone. Another small excavated area is situated c. 1.5 m northeast. Both of these excavated areas has the uppermost layer of pahoehoe bedrock removed, and exhibit no evidence of internal modification or deposits.

SITE NO.: State: 13260 PHRI: T-7
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Undulating terrain consisting of pahoehoe and sinkholes.
VEGETATION: Grasses, Christmas-berry, lantana, 'ilima and noni
ELEVATION: c. 19 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-quarry-water catchment
DESCRIPTION: Overall complex area measures c. 25.0 m (N-S) by 28.0 m (E-W). The site consists of two walls, one of which is constructed across an overhang (Feature A). The second wall is associated with a sinkhole (Feature B). Also present are two pahoehoe excavations (Features C and D), a filled crevice (Feature E) and an overhang (Feature F).

FEATURE A: Wall
FUNCTION: Water catchment
DIMENSIONS: 1.82 m by 0.36 m by 1.10 m (height from overhang floor)
DESCRIPTION: Feature A consists of a wall built across a V-shape overhang. This wall is constructed with large angular basalt boulders, stacked single width and faced on one side. Medium to large angular cobbles are used as fill behind the unfaced side of the wall. The filled area is up to 0.80 m wide, and is on the exterior side, with the overhang to the faced side of the wall. The floor of the overhang is fairly smooth, and possibly paved with small slabs of pahoehoe. Ceiling height of the catchment ranges form 0.41 to 0.83 m. Approximately three gourd fragments are present inside the overhang.

FEATURE B: Wall
FUNCTION: Water catchment
DIMENSIONS: 1.75 m by 1.70 m by 0.83 m
DESCRIPTION: This wall is built across a sinkhole and pahoehoe crevice. It is constructed with small angular boulders, single stacked and faced on one side, with smaller cobbles as fill against the unfaced side. A small overhang is situated east of the wall. It measures c. 4.5 m (NE-SW) by 2.5 m (NW-SE), with a ceiling height of 0.40 to 0.65 m. A coconut shell fragment, gourd fragments, and 12 thin, smooth sticks (c. 15 cm in length and c. 0.8 cm in diameter) occur inside the overhang. The sticks are situated beneath the gourd and coconut fragments. A waterworn basalt hammerstone (16x13 cm) is also present.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.50 m by 0.35 m by 1.30 m maximum depth
DESCRIPTION: Large blocks of pahoehoe have been excavated along a sinkhole edge with the area immediately around and below the excavated area cleared of material. The excavated pahoehoe face is c. 25 to 30 cm thick. One waterworn basalt hammerstone (23x20x13 cm) and one Conidae shell fragment were observed.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.45 m by 0.69 m by 0.20 m maximum depth
DESCRIPTION: A small excavated area within flat to gently undulating pahoehoe flow. The excavated area is smooth and clean with no excavated material present in the immediate area except for gravel sized angular pieces against the downhill corner. It appears that all sides are excavated. Two cracks, filled with rubble, oriented c. NW-SE are situated east of the excavated area.

FEATURE E: Filled crevice
FUNCTION: Indeterminate
DIMENSIONS: 6.80 m by 0.36 m by 0.70 m maximum depth from fill
DESCRIPTION: A cobble filled crevice oriented c. E-W is situated within undulating, glassy and somewhat vesicular pahoehoe. Two small areas along the east side of the crevice show evidence of excavation. It is partially filled with angular basalt cobbles. The surface of the cobble fill is c. 0.54 to 0.70 m below the surface of the crack. The thickness of the cobble fill can not be determined, but it is at least 0.20 m. The average size of the angular cobbles used as fill measures c. 0.13 m by 0.12 m by 0.8 m. Three to ten boulders and cobbles are visible on the pahoehoe surface. Two waterworn basalt hammerstones (27x17x10 cm; 26x20x14 cm) are present on fill inside the crevice. A third hammerstone (21x13x14 cm) occurs 2.50 m to the south.

FEATURE F: Overhang
FUNCTION: Habitation/water catchment
DIMENSIONS: 2.70 m by 1.60 m by 0.74 m
DESCRIPTION: A natural overhang with a partially cleared floor. Flat slabs of pahoehoe are set back in the north corner, and could possibly function as a water catchment area. One Cypraea sp. fragment was present on top of the pahoehoe slabs. One waterworn basalt hammerstone was also present to the exterior of the overhang, c. 2.45 m to the WNW, on top of the pahoehoe surface.

SITE NO.: State: 13261 PHRI: T-8 *(Figure A-4)*
SITE TYPE: Enclosure
TOPOGRAPHY: Gentle slope of pahoehoe flow.
VEGETATION: Sparse grass, lantana, and one Christmas-berry outside of the enclosure.
ELEVATION: c. 18 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible ceremonial/indeterminate
DIMENSIONS: 5.00 m by 4.32 m by 0.39 m maximum wall height
DESCRIPTION: This roughly square enclosure is situated around the perimeter of a shallow pahoehoe depression. It is constructed with loosely stacked pahoehoe slabs, and exhibits no evidence of faced sides. The walls are c. 0.4-0.6 m wide and have tumbled in places, with the slabs falling to the interior of the enclosure. The lowest portion of the wall is at the southwest corner, where a possible entrance occurs. In this area, slabs were piled over a crevice and natural depression of indeterminate depth.

A 1.0 by 1.0 m test unit was excavated into the rock fill in order to determine if subsurface features occurred. The surface of the filled area varied from 0.17 to 0.32 m below the top of the wall prior to excavation. The rock fill consisted of a single layer of slabs (possibly wall fall) and two to three layers of smaller pahoehoe cobbles and pebbles. Thickness of the fill ranged from 0.16 to 0.20 m. Two small pockets of very dry soil were located in low spots of the crevice, beneath the rock fill. A sample of the soil was collected. No portable remains or other cultural material occurred in the test unit.

Three waterworn basalt cobbles and five coral fragments were observed within the enclosure.

SITE NO.: State: 13262 PHRI: T-9
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Smooth and fairly flat pahoehoe flow
VEGETATION: Moderate amounts of lantana and grasses.
ELEVATION: c. 14.5 feet
CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture/possible habitation
DESCRIPTION: Overall complex area measures c. 13.0 m (N-S) by 14.0 m (E-W). The site consists of an L-shape wall (Feature A), and a pahoehoe excavation (Feature B).

FEATURE A: L-shape wall
FUNCTION: Possible temporary habitation
DIMENSIONS: 4.00 m by 2.50 m by 0.48 m maximum wall height
DESCRIPTION: Feature A is an L-shape, bifaced and core filled wall. The wall is built low and abuts the pahoehoe flow edge along its SE corner. The pahoehoe flow forms a natural eastern perimeter of the feature, giving it an overall U-shaped enclosure appearance. Portions of the wall are collapsed.

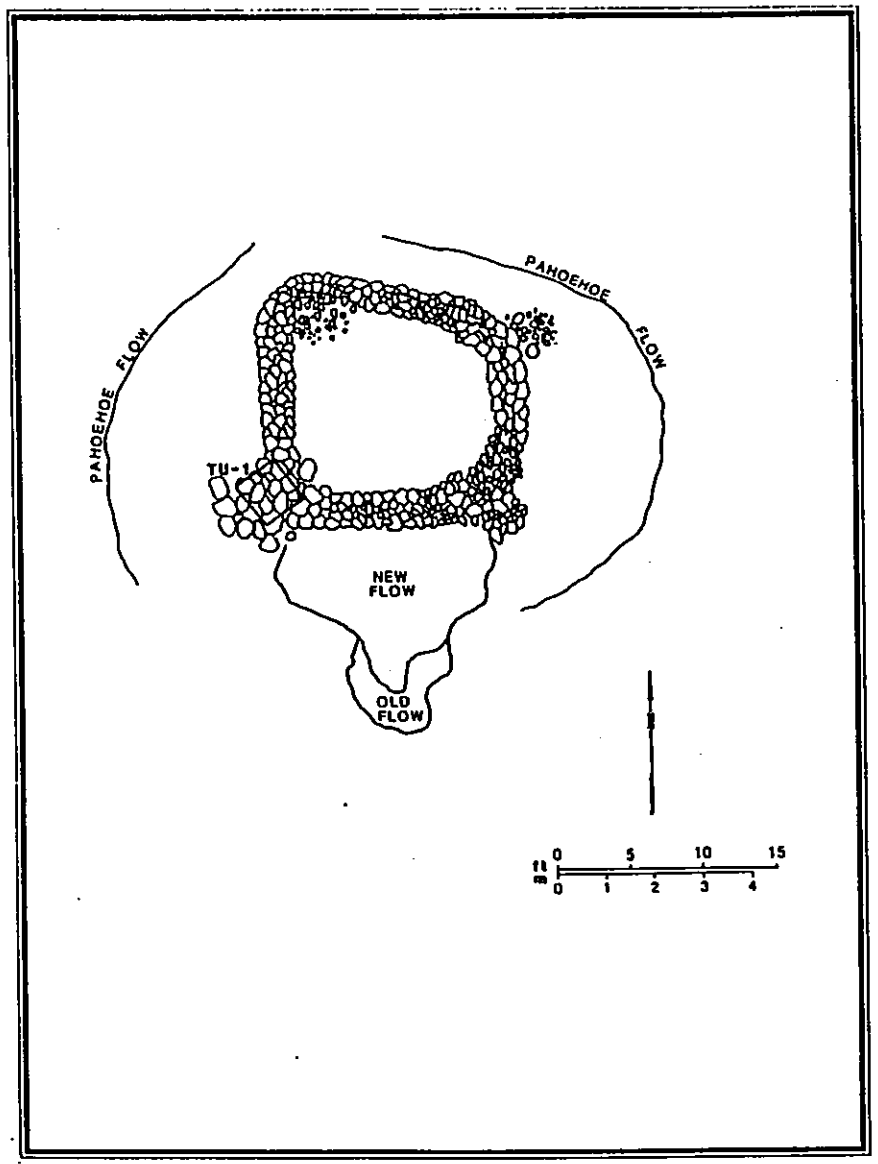


Figure A-4. SITE 13261

A deposit of dark brownish-black soil (at least 7 cm thick) is present within the enclosure interior. A possible semicircular ring of stones is located against the interior side of the south wall.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.14 m by 1.20 m by 0.28 m
DESCRIPTION: Feature B consists of an excavated face along a flow edge. The excavation is situated immediately south of Feature A, and may have functioned as a quarry site for the basalt blocks used in the construction of the wall.

SITE NO.: State: 13263 PHRI: T-10
SITE TYPE: Overhang
TOPOGRAPHY: Sinkhole within smooth pahoehoe.
VEGETATION: Grasses, few lantana, and one kiawe tree
ELEVATION: c. 17.5 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Possible habitation
DIMENSIONS: 2.76 m by 2.16 m by 0.68 m maximum ceiling height
DESCRIPTION: Along the west side of a natural overhang opening, cobbles and slabs of pahoehoe appear to have been placed as a wind break. It is constructed perpendicular to the overhang opening, roughly bisecting the overhang area. This windbreak is possibly natural collapse, and since no other modifications are evident this site is questionable.

SITE NO.: State: 13264 PHRI: T-11
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Undulating terrain consisting of smooth and ropy pahoehoe.
VEGETATION: Moderate density of grasses, a few lantana, one Christmas-berry, and one noni.
ELEVATION: c. 16.5 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site is located in the southwest corner of the project area near the fence. Overall complex area measures c. 44.0 m (E-W) by 20.0 m (N-S). The site consists of five mounds (Features A, C thru F), and a pahoehoe excavation (Feature B).

FEATURE A: Mound *(Figure A-5)*
FUNCTION: Agriculture
DIMENSIONS: 2.93 m by 2.25 m by 0.47 m maximum height
DESCRIPTION: Feature A is constructed with angular pahoehoe cobbles and clinkers, placed in a circular concentration on top of a smooth pahoehoe surface. It is generally circular shape in plan and is centrally raised in profile. A very roughly rectangular alignment exists on top of the mound, outlined by large angular pahoehoe blocks with small cobble and clinkers as paving.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.70 m by 1.30 m by 0.47 m
DESCRIPTION: Feature B is located 6.5 m northeast from Feature A. It consists of a clearly excavated face within the pahoehoe flow. Excavated basalt blocks are piled above and c. 0.5 m to 1.0 m to the northwest.

FEATURE C: Mound
FUNCTION: Quarry/agriculture
DIMENSIONS: 1.03 m by 0.92 m by 0.35 m
DESCRIPTION: A random arrangement of excavated blocks of basalt on top of smooth pahoehoe. Feature B is located 5.0 m to the northwest.

FEATURE D: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.55 m by 1.22 m by 0.30 m
DESCRIPTION: A low circular rock mound constructed on top of smooth pahoehoe. It is constructed with angular slabs and blocks of pahoehoe. Small cobbles are used as fill. Roughly circular shape in plan, it contains some facing along the north and northeast sides. Two uprights are visible, one north of the facing and the other south of the facing. The surface interior is of roughly level fill of pahoehoe slabs and cobbles. Feature E is located 3.00 m to the southwest.

FEATURE E: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.95 m by 1.38 m
DESCRIPTION: Feature E is a small low flat rock mound. Two rough alignments parallel to each other and oriented c. E-W are situated on the north and south sides of the mound. These alignments consists of medium to large angular pahoehoe blocks. Small cobbles are used in between. The mound is roughly circular shape in plan and centrally raised. It is located 3.20 m south from Feature D.

FEATURE F: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.13 m by 1.36 m
DESCRIPTION: Feature F is located 3.40 m east from Feature E. It is roughly rectangular shape in plan, and

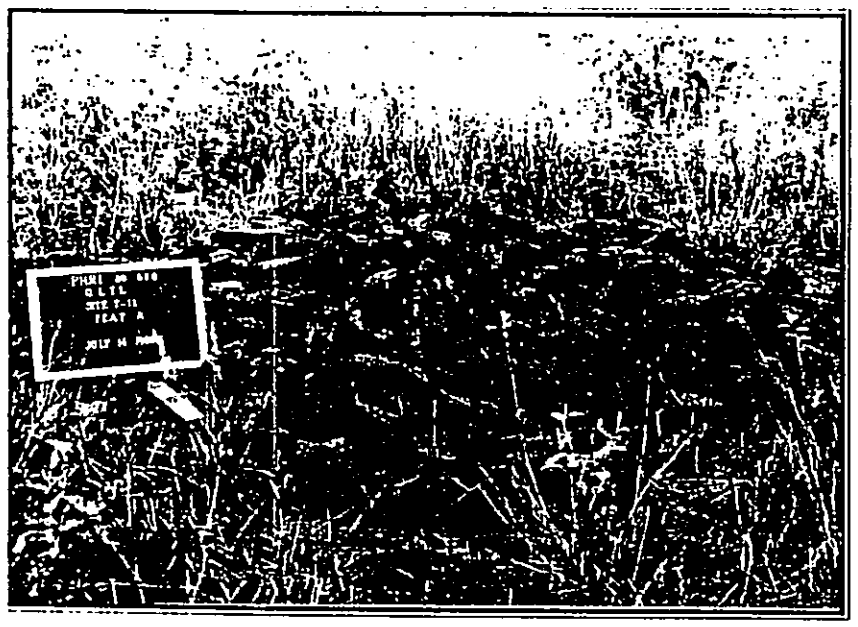


Figure A-5. SITE 13264, FEATURE A. View to Northeast. (PHRI Neg.1231-4)

constructed with small angular pahoehoe boulders and small to large angular cobbles. At the top of the centrally raised mound, there appears to be a partially faced circle of larger angular cobbles with smaller cobble interior fill.

SITE NO.: State: 13265 PHRI: T-12
SITE TYPE: Mound
TOPOGRAPHY: Undulating terrain consisting of smooth pahoehoe.
VEGETATION: Sparse grasses and lantana.
ELEVATION: c. 18 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 1.77 m by 1.47 m by 0.42 m maximum height
DESCRIPTION: This relatively isolated rock mound is constructed with small to large pahoehoe blocks and slabs piled on top of smooth pahoehoe. It is roughly circular in plan and centrally raised. Perimeter stones on the north, east, and northwest sides are turned on edge, up to 0.20 m in height. One piece of coral was observed on the surface near the mound.

A 1.0 by 1.0 m square test unit was excavated into the center of the mound, in order to determine if a subsurface feature or deposit was present. Beneath the surface layer of pahoehoe slabs, a fill of small to medium size irregular cobbles and pebbles was encountered. This fill overlaid a thin layer of surface duff which varied from less than 0.01 m to 0.02 m in thickness. Pahoehoe bedrock was encountered beneath the duff layer. A single unidentifiable fragment of marine shell was encountered in the duff layer; no other portable remains or cultural features were observed.

SITE NO.: State: 13266 PHRI: T-13
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Smooth pahoehoe
VEGETATION: Sparse grasses and kiawe around cave opening
ELEVATION: c. 16.5 feet
CONDITION: Fair-good
INTEGRITY: Unaltered-partially altered
PROBABLE AGE: Historic-possibly prehistoric
FUNCTIONAL INTERPRETATION: Temporary habitation
DESCRIPTION: The site consists of a cave (Feature C) that contains a wall (Feature A) and an alignment (Feature B).

FEATURE A: Wall
FUNCTION: Indeterminate
DIMENSIONS: 0.80 m by 0.50 m by 0.60 m maximum height
DESCRIPTION: A wall consisting of seven stacked slabs and blocks of pahoehoe, located immediately to the left of Feature C cave opening. It is constructed along the NNW side of the cave wall and built from the floor to the ceiling. Two slabs were removed from the wall in order to determine if any features were present behind it. Nothing was observed. One waterworn basalt is present c. 1.6 m east of Feature A.

FEATURE B: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 0.90 m by 0.40 m by 0.35 m maximum height
DESCRIPTION: Roughly piled slabs of roof fall constructed into a short alignment with a single upright slab on the SE end. Scattered skeletal remains of a dog are partially under the NW portion of the alignment.

FEATURE C: Cave
FUNCTION: Temporary habitation
DIMENSIONS: 13.00 m by 4.50 m by 0.70 m maximum ceiling height
DESCRIPTION: A natural cave containing Feature A, Wall and Feature B, Alignment. A lot of recent garbage is concentrated at the cave opening. No soil deposits or portable remains other than recent refuse and dog remains were observed inside the cave.

SITE NO.: State: 13267 PHRI: T-14
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Gently undulating smooth pahoehoe flow.
VEGETATION: Moderate density of grasses, two Christmas-berry trees, small 'ilima, and kiawe bushes.
ELEVATION: c. 12.5 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/agriculture
DESCRIPTION: Overall complex area measures c. 15.2 m (E-W) at 120 degrees by 6.7 m (N-S). The site consists of a pahoehoe excavation (Feature A), and two mounds (Features B and C).

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.37 m by 0.52 m by 0.50 m
DESCRIPTION: Feature A consists of an excavated crack along a pahoehoe fault edge located between two blisters. Excavated material is in a linear pile north of the excavated area. The excavated hole is fairly cleared of quarried material.

FEATURE B: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.81 m by 1.23 m by 0.32 m
DESCRIPTION: Roughly oval to circular shape in plan, it is bordered with large angular cobbles with clinkers and small angular cobbles on top. The east side is slightly faced, and crudely stacked 1-2 blocks high. The west border is collapsing with a couple of the larger pahoehoe blocks still intact. The boulders range in size from 0.19-0.32 m in length by 0.14-0.27 m in width and 0.12-0.13 m in height. The mound is constructed on top of a pahoehoe blister.

FEATURE C: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.38 m by 1.30 m by 0.41 m
DESCRIPTION: Roughly circular in shape, it is constructed mostly of single stacked (with some portions stacked 2-3 courses high) angular pahoehoe blocks. The north and east sides of the mound are partially intact and standing. One cowrie shell is visible in the NW portion of the mound.

SITE NO.: State: 13268 PHRI: T-15
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: The terrain consists of undulating smooth pahoehoe.
VEGETATION: Moderate amounts of grasses, large Christmas-berry tree, 'ilima, and lantana.
ELEVATION: c. 13 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/possible habitation
DESCRIPTION: Overall complex area measures c. 16.2 m (E-W) by 30.5 m (N-S). The site consists of an enclosure (Feature A), a terrace (Feature B), two paved areas (Features C and D), a walled sinkhole (Feature E), and a filled crevice (Feature F).

FEATURE A: Enclosure
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 4.60 m by 3.60 m by 0.47 m
DESCRIPTION: The enclosure is roughly square shape in plan with walls ranging in height from 0.32-0.47 m and in width from 0.60-1.0 m. The walls are partially faced on both the interior and exterior sides with small to medium pahoehoe boulders. The north, south and east interior corners are still clearly defined. The southwest wall appears to be very collapsed but a few of the boulders seem to be intact so that the boundary of the southwest wall is fairly evident. A possible stepped terrace is in the east corner. One small waterworn basalt cobble is present. A soil deposit up to 0.15 m thick occurs in this feature.

FEATURE B: Terrace *(Figure A-6)*
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 4.50 m by 3.66 m by 0.65 m maximum height
DESCRIPTION: This rectangular terrace is raised on the north (0.35 m), south (0.45 m) and east (0.65 m) sides. The raised perimeters are constructed with large pahoehoe angular cobbles and small boulders, stacked to three courses high. The surface interior is fairly flat with small angular pahoehoe cobbles and pebbles. A small pahoehoe excavation is situated NE of Feature B and measures c. 0.85 m wide and c. 0.60-0.65 m deep. Feature A is located 2.00 m to the north.

FEATURE C: Paved area
FUNCTION: Indeterminate
DIMENSIONS: 1.95 m by 1.55 m by 0.16 m
DESCRIPTION: Feature C is located 11.0 m southeast of Feature A. This small paved area is roughly triangular shape in plan and is constructed with a single layer of small angular pahoehoe cobbles and slabs. Portions of the perimeter are defined with slighlty larger pahoehoe cobbles. Feature C is constructed on top of smooth pahoehoe.

FEATURE D: Paved area
FUNCTION: Indeterminate
DIMENSIONS: 2.68 m by 2.31 m by 0.18 m
DESCRIPTION: A paved area, roughly circular in shape. It is constructed with pahoehoe boulders along its perimeter and with angular cobbles and pebbles within the center. The northern end appears to be c. 0.12 m higher than the southern half. This raised area appears to be delineated by a rough boulder alignment oriented c. E-W. It is located 0.65 m southwest from Feature C.

FEATURE E: Walled sinkhole
FUNCTION: Possible cupboard
DIMENSIONS: 2.00 m by 1.00 m by 0.92 m
DESCRIPTION: The sinkhole is oriented c. N-S and consists of a cobble paved floor and a wall. The wall measures c. 1.0 m (E-W) and 0.35-45 m (N-S). It is constructed with small angular pahoehoe boulders, stacked three courses high, and bisecting the sinkhole into western and eastern halves. The height of the west side of the wall is 0.5 m and the height of the east side of the wall is 0.92 m. Feature E is located c. 7.00 m northwest from Feature F.

FEATURE F: Filled crevice
FUNCTION: Agriculture
DIMENSIONS: 0.90 m by 0.60 m by 0.20 m maximum depth
DESCRIPTION: This feature is located 10.20 m southeast from Feature A. It consists of a filled, leveled area situated

Figure A-6. SITE 13268, FEATURE B. View to North (PHRI Neg.1231-13)

between three large, naturally uplifted pahoehoe slabs. A 0.80 by 0.80 m square test unit was excavated into the filled area, in order to determine if buried materials or deposits were present. Beneath a relatively homogenous fill of angular pahoehoe pebbles was a thin (0.01 m) soil deposit, which overlaid bedrock. No cultural material or portable remains were observed. A soil sample was collected from this feature, for comparison with soil from other tested agricultural features (see subsurface findings).

An associated pahoehoe excavation is c. 1.1 m to the NE of the feature. The pahoehoe excavation measures c. 0.65 m by 0.8 m with a depth of c. 0.9 m. One piece of waterworn coral is present c. 4.2 m northeast of the pahoehoe excavation.

SITE NO.: State: 13269 PHRI: T-16
SITE TYPE: Wall
TOPOGRAPHY: Relatively level pahoehoe flow.
VEGETATION: Predominantly fountain grass, lantana, 'uhaloa, kiawe, kolu, noni, capparis, Christmas-berry, and indigo
ELEVATION: c. 12.5 feet
CONDITION: Poor
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 2.60 m by 2.40 m by 0.30 m
DESCRIPTION: This low wall is consists of subangular blocky basalt boulders crudely stacked 1-2 courses high and 1-2 wide. The rock wall is circular shape in plan, and incorporates several upright boulders. The sides are not faced. The structure is built on pahoehoe bedrock; no deposits or portable remains were observed.

SITE NO.: State: 13270 PHRI: T-17
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Relatively level pahoehoe flow.
VEGETATION: Predominantly fountain grass, lantana, 'uhaloa, Chrismas-berry, with scattered 'ilima, kolu, and kiawe.
ELEVATION: c. 13 feet
CONDITION: Poor
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DIMENSIONS: 2.20 m by 1.70 m by 0.70 m
DESCRIPTION: The overall area measures c. 10.0 m (E-W) by 12.0 m (N-S). Site consists of artificially broken and excavated pahoehoe bedrock. The excavated pahoehoe bedrock creates a pit-like feature. Most of the broken pahoehoe boulders have been removed and piled on the south side of the excavated area. The remaining boulders and cobbles have been used to fill in low areas north of the pahoehoe excavation.

SITE NO.: State: 13271 PHRI: T-18
SITE TYPE: Alignment
TOPOGRAPHY: Relatively level pahoehoe flow.
VEGETATION: Low cover of fountain grass, lantana, kolu, 'uhaloa, capparis, noni, kiawe, Christmas-berry, and koa-haole
ELEVATION: c. 17 feet
CONDITION: Poor
INTEGRITY: Unaltered
PROBABLE AGE: Possibly prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 1.90 m by 1.80 m by 0.35 m
DESCRIPTION: The rock alignment is generally circular shape in plan. It is constructed of subangular blocky basalt boulders placed one course high and wide. It ranges in height from 0.15-0.35 m and in width from 0.2-0.35 m wide.

Basalt boulders and cobbles are also scattered on the surface, inside and outside the alignment. The structure is built on unbroken pahoehoe bedrock; no soil is present.

SITE NO.: State: 13272 PHRI: T-19
SITE TYPE: Complex (36+ Features)
TOPOGRAPHY: Collapsed tube formation around rim of kipuka generally consisting of faulted pahoehoe. Some flat area inside of the kipuka. The rim tube looks like later flow compared to the floor of the kipuka.
VEGETATION: Scattered 'ilima, some pili grass, vines and lantana outside of kipuka. Grasses, kiawe, lantana along the rim. Christmas-berry, noni in low places and some ferns in small crevices inside of kipuka.
ELEVATION: c. 18-20 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-possibly historic
FUNCTIONAL INTERPRETATION: Agriculture-quarry
DESCRIPTION: The site consist of various excavations and rock discard features, most of which are located on the kipuka rim or on high upthrusts of pahoehoe inside of the kipuka. Overall complex size is 75.00 m (N-S) by 46.0 m (E-W).

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.55 m by 0.65 m by 0.68 m
DESCRIPTION: This excavated pahoehoe crevice is located along the center of the upthrusted, collapsed tube which forms the rim of the kipuka. A buried flow is also

cracked within the excavated crevice, and two layers of pahoehoe were penetrated during excavation.

The uppermost pahoehoe layer is c. 0.25 to 0.40 m thick, fairly vesicular and dense, with weathered surface cortex. The lower layer has air pockets above and below it and is denser with fewer holes than the upper layer. Average thickness is 0.28 m. The excavated blocks removed from this layer are more regular in size and shape than pieces removed from the upper layer of pahoehoe.

The excavated blocks are in linear alignments on either side of the crevice, and some are scattered in the center of the excavation. The overall area of the associated excavated scatter is c. 2.8 m (N-S) by 3.0 m (E-W).

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.50 m by 0.70 m by 0.45 m
DESCRIPTION: A flow edge that has been excavated through one upper layer of pahoehoe. The quarried material consists of a honeycombed type with red mineral deposits in air pockets within a black matrix. The quarried material is placed on the west side of the edge. The scatter area measures c. 2.2 m (E-W) by 2.3 m (N-S). The west side of the excavated area is not quarried and also contains upturned slabs of older pahoehoe.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.80 m by 0.55 m by 0.60 m
DESCRIPTION: The excavated opening is cleared of quarried material. Small cobble and pebble sized pieces are at the bottom, where the crevice in the older flow continues. Only the upper pahoehoe material is mined, and only along the south and east faces. The total linear area on the south side is 0.64 m and on the east side it is 1.8 m.

The removed blocks are in a linear pile at the base of the tube c. 1.0 m to the east. A few smaller blocks are placed on the west side along the ridged and upturned lava plates. The excavated material is layered with red mineral bands, honeycomb type with thin weathered zone on top.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry/agriculture
DIMENSIONS: 4.00 m by 3.40 m by 0.35 m
DESCRIPTION: Feature D is located at the base of the northwest rim along the side of the rim formation, at c. 3.0 m at 350 degrees from Feature K. It consists of two depression areas c. 0.50 m apart. The NW depression is excavated along its southern end for a length of c. 0.75 m. The SE depression is excavated along the north and south edges. The excavated crevices contain flat floors with a drop off shelf that is filled with basalt blocks. The blocks are piled inside the depression adjacent to the NW (upper) hole and in a crude line to the north. In the SE (lower) excavation it is also piled inside the depression adjacent to the hole and in a less distinct alignment outside of the depression. There are thin mantles of relatively damp soil under the blocks in both depressions mixed with smaller pieces of debris.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.90 m by 1.20 m by 0.31 m
DESCRIPTION: An excavated pahoehoe blister with a crude wall. The interior of the excavation is cleared; the floor is a very level surface of older flow with no cobbles and very few pebbles on top of it.

The wall is situated exterior of the excavated face to the south side on top of the mined flow. The wall is constructed with loosely stacked blocks, c. one to three courses wide and two courses high and measures c. 2.5 m long and 1.9 m wide. One large slab measuring c. 0.80 m by 0.50 m is set on end and propped up by smaller blocks. A couple of large blocks are set together in an alignment

A very heavy waterworn basalt boulder with pecking scars on one end is present on the wall. The edges are not extensively battered and it measures c. 30x27x20 cm.

Basalt blocks are piled in an area adjacent to the excavated face to the west. The overall area measures c. 4.3 m (E-W) by 6.5 m (N-S). The basalt blocks are haphazardly piled three high with a few additional blocks located c. 2-3 m to the north in addition to a few blocks to the west side of the excavated rim.

A small shallow cave is situated along the SE excavated face. It is c. 1.0 m wide to the NW under the upper flow, and it is c. 0.65 m deep. The opening measures c. 0.80 m by 0.27 m.

This feature may be possibly historic because portions of the excavated face exhibits vertical gouge marks that were possibly made with metal chisels.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.50 m by 2.10 m by 0.60 m
DESCRIPTION: A partially cleared pahoehoe excavation within a vaulted pahoehoe blister forms an opening to a very low crawlspace. The excavation is mostly cleared except for a scattering of small cobbles and pebbles immediately below the opening. The floor inside of the crawlspace

slopes to the west, is very rough and contains no deposit. The opening is 0.6 m high on the south side and 0.3 m high on the north side. The crawlspace measures c. 8.0 m (N-S) by 5.0 m (E-W).

The quarried blocks are placed immediately at the rim on the north side and one on the south side. Others are scattered 2.0 m to the north, 1.7 m to the south and 1.0 m to the west. There are c. 21 pahoehoe blocks of various sizes in a dispersed arrangement. The excavated pahoehoe is c. 0.29 m to 0.32 m thick; honeycombed but dense, with white precipitates at bottom of layer.

FEATURE G: Pahoehoe excavation *(Figure A-7)*
FUNCTION: Quarry/agriculture
DIMENSIONS: 6.00 m by 4.50 m by 0.60 m
DESCRIPTION: A natural crevice and upturned pahoehoe slab are excavated. Quarried basalt are strewn along all sides, mostly to the east. The floor of the excavation is cleared with the natural crevice at the bottom. The crevice contains small cobbles and pebbles. A large waterworn basalt cobble with battered ends is visible immediately exterior of the excavation, to the north.

In addition, two separate crawlspaces are opened from different excavations. One to the east and one to the south.

The feature is situated on a blistered area in the center of the kipuka, c. 2.0 m below the top of the rim, in the area of the later flow. The soil deposit present in this feature was sampled, for comparison with soils from other agricultural features (see subsurface findings).

FEATURE H: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.80 m by 0.80 m by 0.40 m
DESCRIPTION: Feature H is situated at the northern base of a pahoehoe blister near the center of the kipuka. The quarried blocks are placed in a linear arrangement 0.25 m west of the excavation and aligned 0.6 m in length. Some smaller pieces are scattered within the sloping floor.

FEATURE I: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 4.50 m by 1.15 m by 0.65 m
DESCRIPTION: Feature I is situated inside the west rim of kipuka, c. 5.5 m east of Feature G. The excavated area has the basalt blocks on the floor interior. In the southern end it appears to be in a C-shape, open to the northwest and c. 0.27-0.37 m wide.

FEATURE J: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.60 m by 0.57 m by 0.47 m
DESCRIPTION: Three large quarried blocks are piled on top of smooth pahoehoe on the eastern edge of faulted and broken area. The blocks average c. 18x18x33 cm is size.

FEATURE K: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.21 m by 4.12 m by 0.62 m
DESCRIPTION: An excavated and cleared blister with a floor interior that slopes southeast toward the kipuka. Nearly circular in shape, all sides of the feature are mined except for the northwest side. The quarried rock is piled immediately to the southeast and northwest of the feature. Soil is present on the floor of the feature, along the southeast side.

FEATURE L: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.00 m by 3.20 m by 0.70 m
DESCRIPTION: The excavated hole measures c. 1.3 m (N-S) by 1.2 m (E-W). It is excavated along all sides. The floor interior is gently sloping and filled with pebbles, few small cobbles and dark soil. The soil deposit was sampled for purposes of comparison with other agricultural features within the project area (see subsurface findings).

Blocks excavated from this feature are concentrated in a linear pile adjacent to the east side at the base of the slope. The pile measures c. 3.0 m in length and 1.2-1.5 m in width and is mostly 1-2 courses high.

A small crawlspace along the north side opens to Feature K. This crawlspace measures c. 0.9 m wide with a ceiling height of 0.42 m.

FEATURE M: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 2.20 m by 2.00 m by 0.55 m
DESCRIPTION: Feature M is 1.4 m north from Feature L, along the southwest side of the kipuka rim, just above the floor of the kipuka. It is an excavated and cleared blister, with a floor interior sloping to the west. It contains an overhang/lip that opens again to the west forming a bridge. The excavated hole measures 1.7 m by 0.8 m. This feature appears to be mostly cleared with minimal excavation, with the removed blocks piled in a natural depression immediately to the north. Another possible basalt source is immediately to the east.

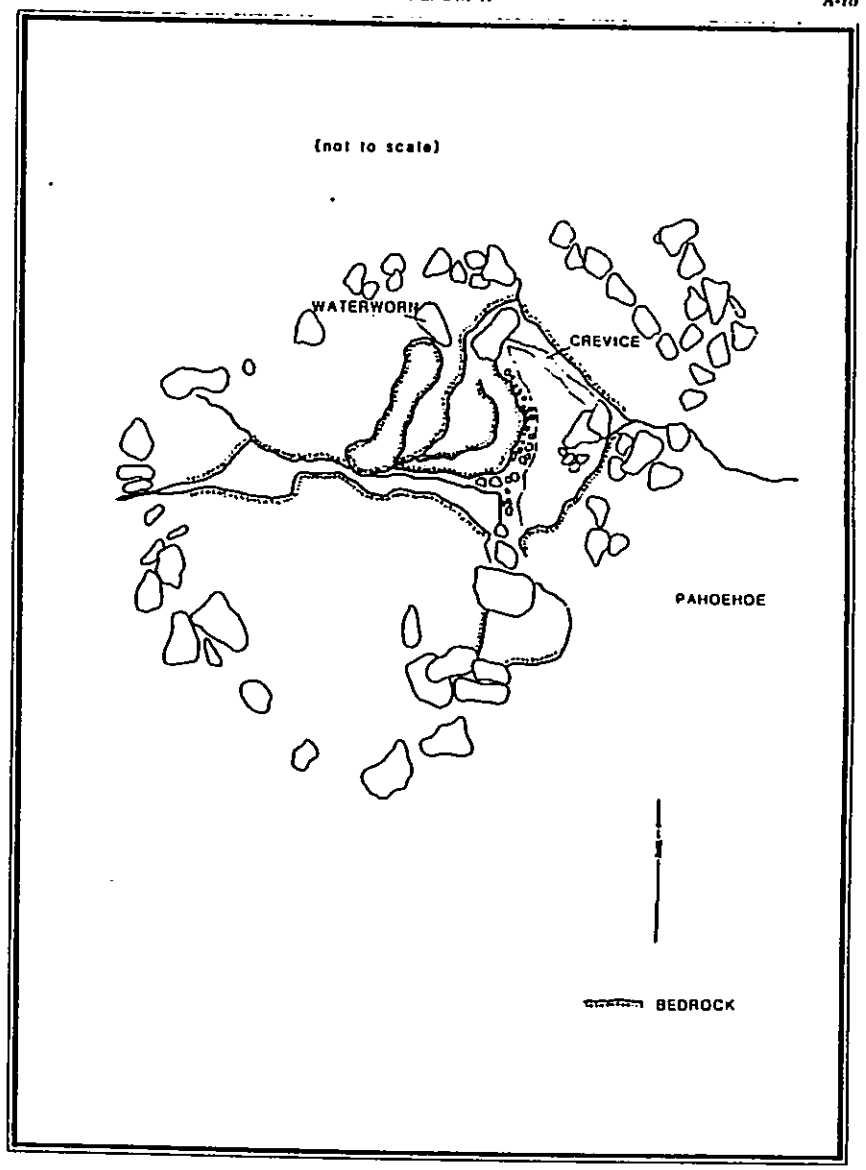


Figure A-7. SITE 13272, FEATURE G

FEATURE N: Pahoehoe excavation *(Figure A-8)*
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 4.30 m by 0.80 m
DESCRIPTION: Excavated crevice in area of natural collapse, some of which was cleared and then excavated along two faces. The opening measures c. 1.7 m (N-S) by 1.6 m (E-W). The blocks were removed and placed in a rough wall-like stack around the perimeter of the opening. Only a few blocks are to the north, under a shelf, that leads into a crawlspace. The crawlspace measures c. 2.0 m deep with a ceiling height of 0.4 m. There is moist dark soil present under a layer of basalt pebbles. This deposit was sampled for purposes of comparison with soil from other similar features.

FEATURE O: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.90 m by 0.70 m by 0.60 m
DESCRIPTION: A small nearly circular hole in a recent flow. The floor is flat with one crevice that has small cobbles and pebbles inside. The removed blocks are in a haphazard scatter mostly to the south side. A single piece of branch coral was noted. Feature O is located on the west rim of the kipuka that is associated with Site 13272 (T-19), which is also the east rim of the kipuka associated with Site 13281 (T-28).

FEATURE P: Pahoehoe excavation
FUNCTION: Possible agriculture/quarry
DIMENSIONS: 3.00 m by 2.20 m by 0.50 m
DESCRIPTION: An excavated pahoehoe crevice with a flat bottom and small air pockets on all sides. The rocks are removed but scattered to the north, northwest, and west sides of the hole. A relatively thick brown soil mixed with pebbles is present on the floor interior. The opening measures 0.9 m (E-W) by 0.74 m (N-S).

FEATURE Q: Mound
FUNCTION: Agriculture
DIMENSIONS: 0.85 m by 0.35 m by 0.40 m
DESCRIPTION: A mound constructed with piled subangular basalt blocks in a linear formation. Large rocks are used at the bottom, with smaller ones in between. There are c. 12 rocks used stacked c. four courses. Other cobble sized blocks are haphazardly scattered to the north and east of the pile. The overall feature including the scatter measures c. 2.7 m by 3.2 m.

FEATURE R: Pahoehoe excavation
FUNCTION: Indeterminate/quarry
DIMENSIONS: 4.00 m by 3.80 m by 0.50 m
DESCRIPTION: One excavated crevice and a cleared area along a fault looks like broken rocks were removed from the fault rim and the excavated crevice to a localized pile along the slope in a crevice. Over 50 pieces are used. A chain and leather collar and dog tag (dated 1960, Reg.5437) are caught in the rocks; no evidence of dog.

FEATURE S: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.60 m by 3.00 m by 0.35 m
DESCRIPTION: An excavated flow edge is cleared of rocks and the rocks are piled to the southeast side along the opening of the excavated area. A small overhang with a shaded area at the west end of the opening measures c. 0.6 m wide by 0.19 m deep and with a ceiling height of 0.2 m.

FEATURE T: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.90 m by 0.60 m by 0.92 m
DESCRIPTION: An excavated pahoehoe blister is situated on a southern slope of pahoehoe. It is along the south wall c. 12.0 m east of Feature S. The basalt blocks are piled northeast of the excavation.

FEATURE U: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 1.00 m by 0.85 m by 0.45 m
DESCRIPTION: An excavation with the quarried rocks tossed exterior of the excavation, mostly to the west. Fine brown loam visible on the floor interior.

FEATURE V: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.60 m by 3.40 m by 0.80 m
DESCRIPTION: An excavated crevice, only partially cleared; some of it is natural collapse that is still in place. The cleared area is a shelf and a portion of a relatively deep crevice. The quarried blocks are removed and arranged in a definite circular pattern to the northeast side of the excavation along the sloping rim into the kipuka.

FEATURE W: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 5.80 m by 0.80 m by 0.32 m
DESCRIPTION: Feature W is situated on a very cracked, faulted and steep, smooth pahoehoe slope leading downward to the kipuka floor. The floor of the excavation is smooth with a few cracks and some small pebbles scattered about. The NE face is excavated, and possibly the SW face. No vegetation is in the immediate area.

FEATURE X: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture

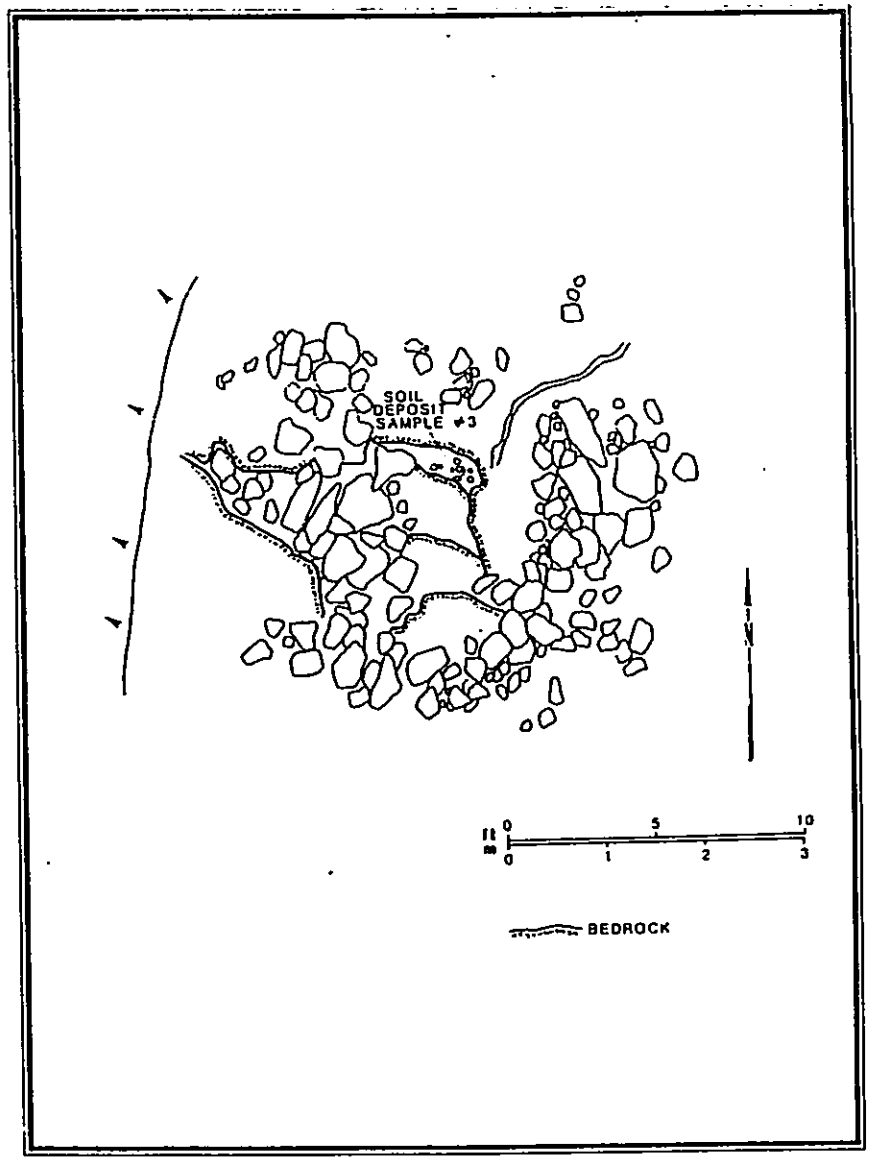


Figure A-8. SITE 13272, FEATURE N

DIMENSIONS: 3.20 m by 2.10 m by 0.24 m
DESCRIPTION: Feature X is situated in an area of natural collapse, on the west slope of the kipuka ridge, on the base of the NW slope. Some pahoehoe blocks have been removed and scattered in and around the crevice holes in close proximity to each other forming two depressions in the newer pahoehoe flow, exhibiting the older pahoehoe flow inside the openings. There are c. 20+ blocks in various sizes ranging from 0.9 m to 0.44 m.

FEATURE Y: Terrace
FUNCTION: Possibly agriculture
DIMENSIONS: 3.95 m by 2.85 m by 0.91 m
DESCRIPTION: An area of natural collapse, some of which large blocks have collapsed and were moved to form a terrace in front of the NW wall of the kipuka ridge. The retaining east edge consists of large basalt blocks with small to large angular cobbles used as fill between the terrace and ridge wall.

FEATURE Z: Boulder concentration
FUNCTION: Quarry
DIMENSIONS: 3.24 m by 1.84 m by 0.29 m
DESCRIPTION: A concentration of c. 30 angular pahoehoe blocks. It is built on top of smooth but cracked pahoehoe.

FEATURE Aa: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.92 m by 1.45 m by 0.26 m
DESCRIPTION: A naturally cracked and smooth pahoehoe area with a small fault or upthrust where possible excavation occurred. Associated blocks are located immediately downslope from the excavation area. The blocks range in size from 0.11-0.35 m in length, 0.6-0.33 m in width and 0.14 m high.

FEATURE Ba: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.46 m by 1.28 m by 1.00 m
DESCRIPTION:
A partially excavated blister with many basalt blocks surrounding the area. A large boulder is protruding from the center of the excavation with smaller boulder blocks around it. It is located c. 10.0 m at 233 degrees northeast of Feature Ca on top the rough and sloping southwest edge of kipuka.

FEATURE Ca: Pahoehoe excavation
FUNCTION: Agriculture/habitation
DIMENSIONS: 4.36 m by 2.30 m by 1.33 m
DESCRIPTION: An excavated blister in area of natural collapse, some of which was cleared and excavated to form a cave. The opening is cleared with some blocks possibly piled on the bottom of the entrance floor. Blocks are also piled along the west side of the cave.

The cave entrance is c. 1.0 m wide and 0.8 m high. The opening faces to the NE and is situated on the SW rim of the kipuka. Northwest of the cave is a linear pile of stacked blocks roughly oriented c. N-S. The average height of the SE side of the cave is c. 0.97 m while towards the NW portion it starts to narrow to a average height of c. 0.42 m in addition to widening. The length of the cave is c. 6.55 m (NW-SE) and 2.92 m (E-W). The cave continues to turn to the north, but the cave opening is small c. 0.25 m wide with heights of 0.30-0.40 m. Here, the cave is smaller, c. 2.6 m (NE-SW), and it appears to continue northeast.

FEATURE Da: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.68 m by 1.00 m by 0.33 m
DESCRIPTION: A pahoehoe excavation along a fault area. Parts of one face along the fault show excavation activity. A large crevice between the faulted slabs may have been filled.

FEATURE Ea: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.30 m by 0.30 m by 0.03 m
DESCRIPTION: A human figure, stick form petroglyph on a flat and fairly smooth pahoehoe. It is oriented c. 318 degrees NW. It is located near the center of the kipuka at c. 16.0 m at 350 degrees north of Feature Fa.

FEATURE Fa: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.67 m by 1.29 m by 0.52 m
DESCRIPTION: Excavation along a crack of a pahoehoe blister which is oriented c. E-W. It is excavated through the top layer of pahoehoe with the associated quarried basalt scattered to the SSW and to the north of the excavation. An area running along the northeast edge consists of naturally broken blocks, some still in place. This area was not excavated, but blocks simply pulled out of place.

FEATURE Ga: Mound
FUNCTION: Possible agriculture
DIMENSIONS: 1.97 m by 1.84 m by 0.26 m
DESCRIPTION: Midway along the slope at the SE end of the kipuka is a circular mound of piled large and small angular cobbles. There are a few additional blocks scattered around the mound. It is constructed with c. 15 small and large angular rocks ranging in size from 0.8-0.17 m by 0.14-0.28 m by 0.5-0.13 m in height.

FEATURE Ha: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 4.40 m by 3.90 m by 0.48 m
DESCRIPTION: This feature is in more recent pahoehoe, along the east side of the kipuka ridge. It consists of a partially excavated crevice, on an area of natural collapse. Some of the lava blocks were removed and scattered around the excavation. There are c. 30 basalt blocks concentrated at the bottom of the slope.

FEATURE Ia: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.67 m by 0.65 m by 0.64 m
DESCRIPTION: A pahoehoe excavation that has been cleared of its quarried material. The quarried blocks are crudely piled west of the excavated area. Roughly square shape in plan, the piled rocks appears not to be formally arranged.

FEATURE Ja: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.61 m by 0.47 m by 0.54 m
DESCRIPTION: Small triangular shaped area with three faces excavated. The floor of the excavation is covered with pahoehoe cobbles and pebbles. Excavated material is located southeast of the excavated area.

SITE NO.: State: 13273 PHRI: T-20
SITE TYPE: Mound
TOPOGRAPHY: Fairly flat pahoehoe.
VEGETATION: Sparse grass and one lantana bush.
ELEVATION: c. 20 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 1.16 m by 0.81 m by 0.28 m
DESCRIPTION: Situated on smooth and ropy pahoehoe. It is constructed with 25 angular blocks ranging in size from 15x8x7 to 25x21x13 cm. The blocks are placed in a low pile, no more than two courses high.

SITE NO.: State: 13274 PHRI: T-21
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: The site is situated on top of a pahoehoe ridge with a depression area to the southwest.
VEGETATION: Sparse grass, a few Christmas-berry trees, and noni bushes.
ELEVATION: c. 20-23 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-quarry
DESCRIPTION: The overall complex area measures c. 16.0 m (E-W) by 27.0 m (N-S). The site consists of four pahoehoe excavations (Feature A, Features C and D, and F), an alignment (Feature B), and a mound (Feature E). An additional 21 pahoehoe excavations are situated along the perimeter of the depression area.

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 6.00 m by 6.00 m by 0.87 m maximum height
DESCRIPTION: This feature consists of a large pit quarried into the northeast edge of a large circular pahoehoe flow edge. The pit is linear and measures c. 3.24 m (NW-SE). Most of the excavated boulders and large cobbles are stacked in a N-S alignment on the east edge of the excavated pit. Boulders are piled along the south edge with some smaller boulders and cobbles on the west edge. Some rubble has collapsed into the excavation. Two waterworn basalt stones, possible hammerstones, are situated at the bottom of the excavated pit.

FEATURE B: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 1.50 m by 1.20 m by 0.15 m
DESCRIPTION: A small semicircular alignment of excavated pahoehoe blocks, on smooth, unbroken pahoehoe. It is constructed with eight blocks ranging in size from 17x18x13 cm to 36x23x27 cm. The boulder blocks are spaced an average of 5 cm apart. The alignment is 4.63 m northeast from Feature A.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.16 m by 1.57 m by 0.34 m
DESCRIPTION: Feature C is located 4.80 m northwest from Feature A. It consists of a pahoehoe excavation within a collapsed blister, with the excavated blocks placed along the south and southwest perimeter of the excavated area. There are c. 50 blocks ranging in size from 10x7x8 cm to 47x26x25 cm. No soil was observed in the excavation.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 6.36 m by 1.00 m by 0.50 m
DESCRIPTION: This feature is 2.85 m southeast from Feature C. The pahoehoe excavation is generally rectangular shape in plan. The excavated blocks are piled along the northeast side of the excavated area. No soil was observed in the feature.

FEATURE E: Mound
FUNCTION: Quarry/Agriculture
DIMENSIONS: 2.26 m by 1.97 m by 0.57 m
DESCRIPTION: Generally oval shape in plan, it is constructed with small to large pahoehoe blocks. The mound is built on top of smooth and ropy pahoehoe. The excavated pahoehoe blocks range in size from 10x10x6 cm to 50x33x21 cm, and were probably removed from Feature F, an adjacent pahoehoe excavation.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry/agriculture
DIMENSIONS: 15.23 m by 2.20 m by 1.05 m maximum depth
DESCRIPTION: Feature F occurs in a natural pahoehoe fault that is oriented c. N-S, 8.25 m south from Feature E. The sides of the fault are excavated, and the bottom of the excavation is covered with small excavated blocks. The excavated face is c. 0.4 m thick and the deepest portion of the crevice is c. 1.05 m.

SITE NO.: State: 13275 PHRI: T-22
SITE TYPE: Cave
TOPOGRAPHY: Pahoehoe lava tube with a later intrusive flow.
VEGETATION: A few unidentified vines in the entrance area.
ELEVATION: c. 21 feet
CONDITION: Poor
INTEGRITY: Possibly altered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Burial
DIMENSIONS: 8.00 m by 3.20 m by 1.07 m
DESCRIPTION: One lava tube which is oriented NNW-SSE with an entrance that is perpendicular to the tube at about a 45 degree angle. The lava tube entrance is full of angular blocks of pahoehoe, ranging in size from 3x4x2 cm to 30x24x10 cm.

The lava tube contains two chambers. The entrance to the first chamber measures c. 3.2 m by 5.95 m and 1.7 m in height. The floor is cleared of any roof fall.

The second chamber measures c. 1.63 m by 1.75 m and 0.55 m in height. This chamber contains a human burial. The skeletal remains are badly deteriorated and they occur in an area of c. 90 by 60 cm. The area of the burial is very moist with standing water in the cracks beneath the burial.

SITE NO.: State: 13276 PHRI: T-23
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Both smooth and ropy pahoehoe flow are around the features. A small field of aa is c. 5.0 m SE, and a crest of pahoehoe is c. 10.0 m NW.
VEGETATION: Sparse grasses, ferns, and 'ilima
ELEVATION: c. 28 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/agriculture
DESCRIPTION: Overall complex area measures c. 12.0 m (E-W) by 15.0 m (N-S). The site consists of two pahoehoe excavations (Features A and B).

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry/agriculture
DIMENSIONS: 1.76 m by 1.53 m by 0.29 m average depth
DESCRIPTION: A circular excavated area of pahoehoe with blocks placed on the immediate edge to the east and southeast. A single waterworn basalt cobble (17x15 cm) occurs inside the excavation. No soil is present.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry/agriculture
DIMENSIONS: 1.21 m by 1.17 m by 0.36 m
DESCRIPTION: Feature B is located 0.39 m north from Feature A. It is an oblong excavation area in pahoehoe, with blocks placed on the immediate west and northwest edge of the excavated area. Small cobbles and pebbles are scattered inside the excavation; no soil is present.

SITE NO.: State: 13277 PHRI: T-24
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe near a large depressed area. A bulldozed flat area with a road beyond to the north. Aa fields on all other sides of the site area.
VEGETATION: Sparse grasses and noni
ELEVATION: c. 28 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: The overall complex area measures c. 12.45 m (E-W) by 12.6 m (N-S). The site consists of eight pahoehoe excavations (Features A-H). No soil or deposits were observed in these features.

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.45 m by 3.42 m by 0.25 m
DESCRIPTION: Feature A is roughly circular shape in plan. The excavated blocks are concentrated in the west half of the excavated area and on top of the surface of the

pahoehoe to the west of the excavated area. The large depression of aa and pahoehoe is located immediately to the south.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.00 m by 0.00 m by 0.36 m
DESCRIPTION: Located 3.95 m west from Feature A, this excavation is small and roughly oval in plan, with blocks ranging from 14 to 30 cm in length. The blocks are in and around the northwest edge of the excavated hole.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.16 m by 0.00 m by 0.36 m
DESCRIPTION: The Feature C pahoehoe excavation is 2.29 m southwest from Feature B. It has a slightly raised south face which has been excavated. Large and small angular blocks, ranging in length from 12 cm to 53 cm, are tossed south of the excavated face.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.82 m by 0.00 m by 0.31 m
DESCRIPTION: A single-faced excavated area with c. 20 angular blocks, ranging in length, from 9 cm to 54 cm. The blocks are placed c. 1.0 m to the north and northwest of the excavated face. This feature is 3.20 m south from Feature C.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.91 m by 0.52 m by 0.26 m
DESCRIPTION: Roughly rectangular shape in plan, it has an excavated thickness of 13 to 26 cm. There are c. ten angular blocks ranging in size from 12x20x13 to 48x39x23 cm located inside and outside of the excavation. It is located 3.44 m west from Feature D.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.38 m by 0.38 m by 0.32 m
DESCRIPTION: A small triangular excavated hole. Four angular pahoehoe blocks (14 to 20 cm long) are c. 1.0 m SE of the excavated opening. It is located 4.75 m south from Feature D.

FEATURE G: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.09 m by 0.00 m by 0.22 m
DESCRIPTION: A small face of ropy pahoehoe is excavated with many small thin pieces of pahoehoe in the immediate area of the excavation. Two medium angular blocks are directly NW of the excavated face. The excavation is 2.94 m southeast from Feature F.

One waterworn basalt is located c. 13 cm from Feature G. It contains pecked areas at the base and may be a possible hammerstone.

FEATURE H: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.72 m by 0.00 m by 0.42 m
DESCRIPTION: An excavated face of pahoehoe with the quarried blocks located c. 1.0-1.4 m to the east. There are c. 28 blocks ranging in size from 10x7 to 39x17 cm. Located 2.52 m southeast from Feature G.

SITE NO.: State: 13278 PHRI: T-25
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: On gently rolling pahoehoe at the edge of the flow, with aa along the flow edge.
VEGETATION: Sparse grass with 'ilima and lantana
ELEVATION: c. 26 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/early historic
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: Overall complex area measures c. 7.0 m (E-W) by 13.0 m (N-S). The site consists of a mound (Feature A) and a pahoehoe excavation (Feature B).

FEATURE A: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.25 m by 0.78 m by 0.40 m
DESCRIPTION: Feature A consists of c. 14 blocky boulder size pahoehoe in a linear pile c. two courses high. No formal construction evident. It is situated on a small depression in the ropy pahoehoe along the northern perimeter. The blocks average c. 0.23 m thick. One of the quarried blocks fits into the rim of Feature B.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.50 m by 1.20 m by 0.23 m
DESCRIPTION: Feature B is a pahoehoe excavation, located 2.6 m at 140 degrees from Feature A. A spot along the rim of Feature B is the source for a particular block present at Feature A, and it is likely that other stones in the mound are from this excavation. Loose pahoehoe pieces are scattered in the excavation, along with decomposing lava.

SITE NO.: State: 13279 PHRI: T-26
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Undulating smooth and ropy pahoehoe flow on edge of aa flow.
VEGETATION: Sparse grass, small 'ilima bushes, and lantana
ELEVATION: c. 22 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: Overall complex area measures c. 17.6 m at 185 degrees by 9.3 m. In all cases, the excavated blocks are piled in close proximity to their respective excavation holes. In addition, the features appear to have all faces excavated. Soil is present in Feature B.

FEATURE A: Pahoehoe excavation *(Figure A-9)*
FUNCTION: Quarry
DIMENSIONS: 5.23 m by 2.91 m by 0.39 m
DESCRIPTION: Generally rectangular shape in plan. Feature A consists of at least three excavated faces. The excavated thickness is c. 24 cm with the maximum depth of the hole at 39 cm below surface. The excavated blocks range in size from 10x9x1 cm to 50x30x24 cm.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry/agriculture
DIMENSIONS: 3.30 m by 3.03 m by 0.44 m
DESCRIPTION: A rectangular-shaped excavated area with three quarried faces. The excavated thickness is c. 21 cm. The excavated blocks range in size from 6x5x3 cm to 59x28x23 cm. A deposit of medium brown, loose gravelly loam, up to 0.07 m thick, is present inside the excavation.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.26 m by 1.96 m by 0.62 m
DESCRIPTION: A small, square shaped excavated area with all four faces quarried. The excavated hole measures 0.81 m by 0.82 m. The thickness of the excavated face is 29 cm. The average block measures c. 34x23x20.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 5.48 m by 2.54 m by 0.50 m
DESCRIPTION: The excavated hole measures c. 1.09 m by 2.69 m. The thickness of the excavated face is 0.22 m. The average block measures c. 34x31x23 cm.

SITE NO.: State: 13280 PHRI: T-27
SITE TYPE: Complex (26+ Features)
TOPOGRAPHY: Undulating and smooth pahoehoe flow with small faults and upthrusts.
VEGETATION: Grasses, kiawe, bushes, lantana, noni, impatiens, 'ilima bushes, and koa-haole
ELEVATION: c. 22 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Habitation-quarry-rock art
DESCRIPTION: Overall complex area measures c. 34.8 m (N-S) by 40.2 m (E-W). Soil deposits and ecofactual materials are present at a number of features, in addition to historic period portable remains and historic period petroglyphs.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 12.00 m by 6.60 m by 1.12 m
DESCRIPTION: An excavated and cleared blister within an area of natural collapse. Some of the blocks were excavated and removed along two faces to form an opening. The opening of the cave faces to the NW with large and small angular rocks and collapsed rubble. It measures c.1.17 m wide and 1.12 m high.

Basalt blocks are placed around and on the floor of the entrance of the cave on the SE end. The interior dimensions of the cave are c. 4.16 m (N-S) by 7.10 m (E-W) with a ceiling height between 0.55-0.90 m.

The floor interior consists of pahoehoe with dark brown moist soil and scattered cobbles on the surface. The northern end of the cave has kukui, faunal remains and marine shell.

The cave narrows but continues to the east and joins with a lava tube that is oriented c. NW-SE. The lava tube measures c. 9.0 m by 1.5 m and with a ceiling height of 0.40 m.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 5.10 m by 4.05 m by 0.36 m
DESCRIPTION: Feature B is an excavated and partially cleared crevice in an area of natural collapse. There are c. 50+ large and small angular rocks placed to the west and southeast side of the hole. Some soil with pebbles is present on the north side of the excavation. There are some gouge marks on the northwest and southeast interior face of the hole.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture

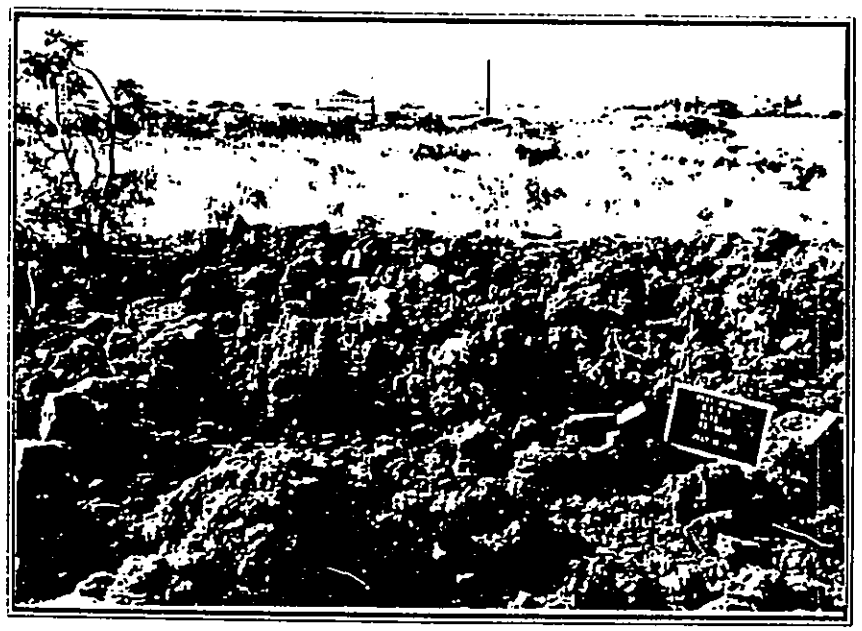


Figure A-9. SITE 13279, FEATURE A, View to East (PHRI Neg. 1236-13)

DIMENSIONS: 4.00 m by 3.18 m by 0.29 m
DESCRIPTION: A pahoehoe excavation with evidence of quarrying is present on the SE side. The excavation area measures c. 1.7 m (NW-SE) by 2.1 m (NE-SW). Some of the quarried blocks were removed and shifted around the feature opening. Displacement of rocks is on the NE side and scatter of smaller angular basalt is on the SW and NW side of the feature. A thin layer of soil deposit is present on the top and bottom slope of the crevice where the excavation is located.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 13.50 m by 4.70 m by 0.50 m
DESCRIPTION: Located 8.0 m southeast from Feature C, this excavated area measures c. 0.23 m by 0.45 m. There are c. 100 + small and large blocks in various sizes displaced and scattered in and around the feature. The thickness of the excavated pahoehoe on the SW side is c. 0.30-0.32 cm and on the NE side it is 0.18-0.20 m.

FEATURE E: Petroglyph *(Figure A-10)*
FUNCTION: Rock art
DIMENSIONS: 0.47 m by 0.45 m by 0.02 m
DESCRIPTION: A geometric petroglyph of a male figure, situated on the NW side of the kipuka. It is located c. 13.6 m southwest from Feature A.

FEATURE F: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 1.42 m by 0.36 m by 0.23 m
DESCRIPTION: A slightly curved alignment of five pahoehoe blocks, with two other blocks within 10-50 cm of the alignment. The pahoehoe blocks range in size from 20x18x12 cm to 31x19x26 cm and are placed end to end on top of smooth pahoehoe.

FEATURE G: Pahoehoe excavation
FUNCTION: Water catchment
DIMENSIONS: 1.85 m by 1.40 m by 0.22 m

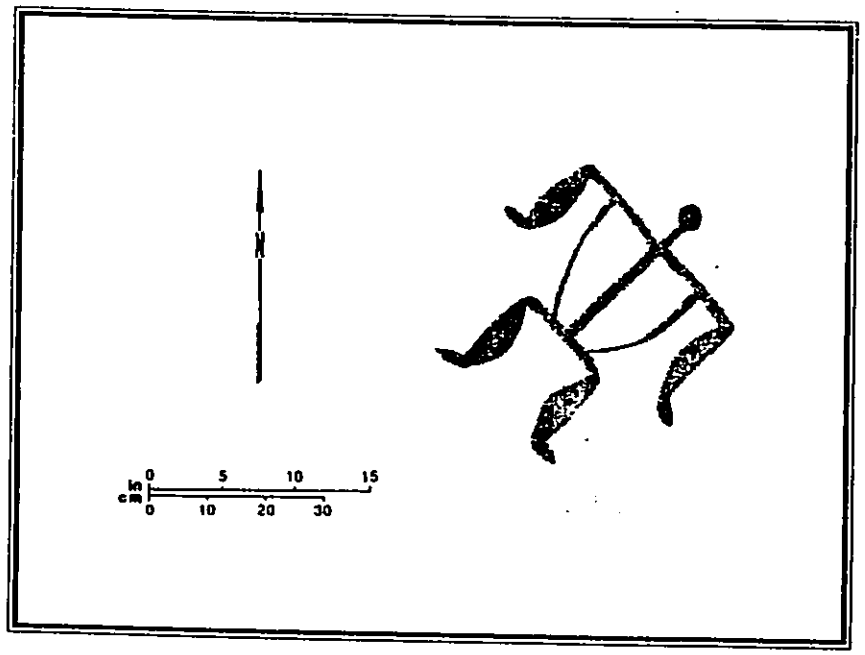


Figure A-10. SITE 13280, FEATURE E

DESCRIPTION: Feature G is located 12.0 m southeast from Feature F. The pahoehoe excavation is roughly rectangular shape in plan and is excavated through the first layer of pahoehoe. The thickness of the excavated face is c. 14-22 cm with the maximum depth of the hole at 70cm.

The quarried blocks are located immediately NE of the excavated area in a concentrated pile. The blocks range in size from 5x3x6 cm to 70x40x18 cm. The floor of the excavation is fairly cleared of material.

At least three coconut shell fragments were present and located at c. 1.80 m at 90 degrees from the south corner of the excavated area.

FEATURE H: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 5.45 m by 4.53 m by 0.20 m
DESCRIPTION: A pahoehoe excavation situated on a small pahoehoe blister and upthrust area. The associated blocks are piled above the hole to the NW. There is evidence of other obvious displacement and movement of naturally broken up cobbles in the immediate area. The randomly placed pahoehoe blocks range in size from 8x3x4 cm to 85x43x14 cm. The feature is 10.40 m southwest from Feature A.

FEATURE I: Pahoehoe excavation
FUNCTION: Quarry/possible water catchment
DIMENSIONS: 2.53 m by 2.36 m by 0.42 m
DESCRIPTION: Located 8.80 m southwest from Feature A, this excavation is roughly oval shape in plan. The excavated hole measures 1.35 m by 1.56 m with the excavated face ranging 0.14-0.42 cm thick. The floor of the excavation is covered with small angular cobbles. A small pile of excavated blocks are set on the northern half of the hole. One coconut fragment, a waterworn pebble, rusty metal and c. 5 cm of loose brown silty loam are visible on the floor of the excavation.

FEATURE J: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.47 m by 1.24 m by 0.24 m
DESCRIPTION: The top layer of pahoehoe has been excavated in a small area along a large fault face. The maximum depth of the fault is c. 0.7 m. Ten quarried blocks are piled below the excavated face. A few small angular cobbles fill the crack of the fault. It is located 17.44 m southwest from Feature A.

FEATURE K: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 4.85 m by 3.86 m by 0.34 m
DESCRIPTION: One face along a slighdy faulted crack has been excavated. The average thickness of the excavated face is c. 0.20 m. A total of c. 16 quarried blocks are in the immediate area. Two large blocks are located 2-3 m to the south, and c. ten smaller blocks are scattered below to the north and to the east of the feature. At least 4 cm of loose brown silty loam has accumulated in the excavation, which is located 34.8 m south from Feature A.

FEATURE L: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.44 m by 1.29 m by 0.31 m
DESCRIPTION: A rectangular opening measuring c. 0.47 m by 1.24 m. The maximum depth of the hole is c. 0.92 m. All four sides have been excavated and the quarried material piled in the immediate area directly SE of the excavation. The floor is composed of smooth pahoehoe sloping into a cave-like area. It is located 25.6 m southwest from Feature A.

A large soil deposit of black silty loam is present in the cave-like area. The soil is moist throughout the entire area, with a depth of c. 5 cm. The soil area measures c. 1.6 m by 3.0 m.

Southeast and c. 0.9 m from the excavated face are large boulders in another possible excavated area.

FEATURE M: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.34 m by 0.33 m by 0.00 m
DESCRIPTION: Feature M consists of lines that appears to represent a human figure. It is c. 1.0 mm maximum thickness, faint and difficult to distinguish. It is located 28.43 m from Feature A at 254 degrees Az.

FEATURE N: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.84 m by 0.64 m by 0.00 m
DESCRIPTION: Feature N consists of a series of superimposed lines and geometric shapes engraved into the smooth pahoehoe at a maximum depth of 5.0 mm. Some of these shapes appear to be letters. Two volcanic glass flakes are present. The petroglyph is 6.23 m from Feature M at 317 degrees Az.

FEATURE O: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.80 m by 0.60 m by 0.00 m
DESCRIPTION: Feature O contains pecking marks in a small area on top of pahoehoe surface. The maximum depth is 4.0 mm. It is situated immediately SE of Feature P.

FEATURE P: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.62 m by 0.20 m by 0.00 m
DESCRIPTION: Situated on top of smooth pahoehoe it has been pecked to a maximum depth of 4.0 mm. The petroglyph consists of a series of the letters U, H, A and N. It is 1.40 m east from Feature N.

FEATURE R: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.37 m by 0.26 m by 0.00 m
DESCRIPTION: Appears to be the letters NA or VN engraved into smooth pahoehoe surface. Maximum depth of engraving is c. 4.0 mm. It is located 1.00 m east from Feature P.

FEATURE S: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 1.10 m by 0.28 m by 0.00 m
DESCRIPTION: The letters N, E and A engraved on smooth pahoehoe flow. The letters are spaced 0.20 m apart and oriented in different directions. Located 1.60 m east from Feature R.

FEATURE T: Enclosure
FUNCTION: Habitation/agriculture
DIMENSIONS: 8.20 m by 5.30 m by 0.57 m
DESCRIPTION: Generally rectangular shape in plan. It is constructed with angular pahoehoe boulders and cobbles some of which appear to have been quarried. They range in size from 15x12x8 cm to 54x45x24 cm and are stacked c. two courses high. The floor interior contains scattered small cobbles and pebbles, with rough alignments visible along the NW and SE walls. Brown silty loam is present in crevices both inside and outside the enclosure. A single *N. picea* shell fragment was observed inside the enclosure.

FEATURE U: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.52 m by 0.49 m by 0.01 m
DESCRIPTION: A petroglyph with geometric lines that is possibly animal like in form. It is situated on the WNW slope of the kipuka. In addition, there are c. seven angular rocks scattered south and northeast of the feature. The rocks average in size of 20x21x11 cm.

FEATURE V: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 0.31 m by 0.29 m by 0.002 m
DESCRIPTION: A human figure is carved into smooth pahoehoe, 20.57 m from Feature A at 273 degrees Az. The petroglyph is 2.00 mm deep.

FEATURE W: Mound
FUNCTION: Possible agriculture/possible quarry
DIMENSIONS: 6.38 m by 2.48 m by 0.40 m
DESCRIPTION: A rock concentration of excavated pahoehoe blocks and boulders scattered among the slope of a smooth pahoehoe surface. The excavated blocks may have been removed from Features X and Y, which are pahoehoe excavations. It is located 21.82 m from Feature A at 267 degrees Az.

FEATURE X: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.75 m by 0.52 m by 0.22 m
DESCRIPTION: The excavated face ranges in thickness from 18-22 cm. Only the northeast face appears to have been excavated and the blocks removed. The floor is composed of cleared, smooth pahoehoe; some rubble occurs along the southeast side of the excavation, however, it appears that much of the excavated stone is not in the immediate vicinity of the excavation. Some of the stones may have been carried to mounds at Features T and W.

FEATURE Y: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 5.64 m by 3.38 m by 0.38 m
DESCRIPTION: A pahoehoe flow with numerous excavated faces and natural cracks from which basalt blocks have been removed. Most of the quarried materials have been removed from the immediate vicinity of the excavation, except for two large boulders situated directly in front of the northeast face. Cobbles are scattered throughout the immediate area. Located 20.38 m from Feature A at 287 degrees Az.

SITE NO.: State: 13281 PHRI: T-28 *(Figure A-11)*
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Situated at the base and along the NE facing slope of the kipuka rim. The rim is upthrust and major slabs are oriented nearly vertical.
VEGETATION: Christmas-berry, lantana, and noni in the immediate area.
ELEVATION: c. 15 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible ceremonial
DESCRIPTION: Overall complex area measure c. 14.5 m (N-S) at 190 degrees by 10.5 m (E-W). The site consists of an enclosure (Feature A) and a small C-shape (Feature B).

FEATURE A: Enclosure
FUNCTION: Possible ceremonial

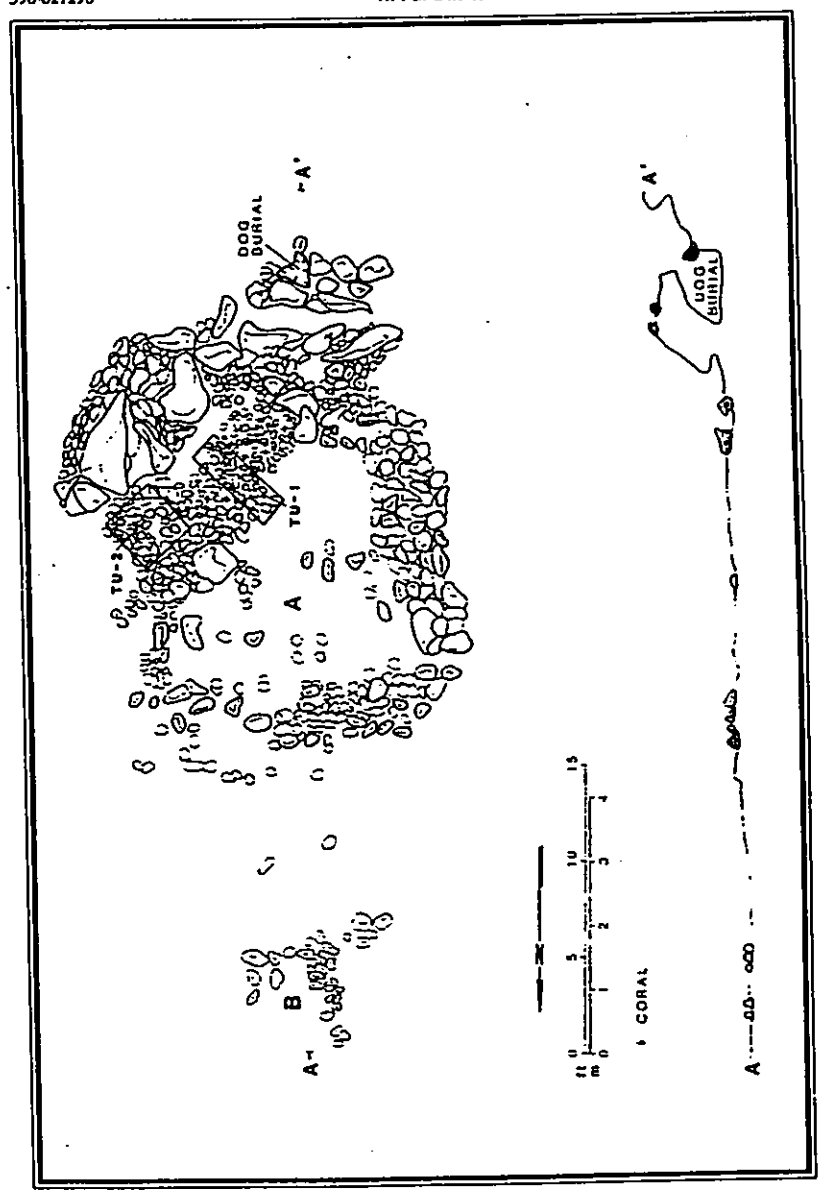


Figure A-11. SITE 13281

DIMENSIONS: 10.50 m by 9.30 m by 0.90 m
DESCRIPTION: The enclosure is roughly rectangular shaped in plan. The interior measures c. 4.8 m (N-S) by 3.05 m (E-W). The walls are loosely stacked, three courses high, with mined and natural pahoehoe slabs and boulders. The average wall height is 0.45 m. Segments of the wall appears somewhat faced especially in the northwest interior corner.

The exterior ground surface along the western wall is slightly higher than the interior floor surface. It is c. 0.60 m from the interior floor surface to the top of the wall and c. 0.30 m from the exterior ground surface to the top of the wall. The south end of the wall goes up onto the natural upright slabs and circles around on the south side between two large natural slabs.

A terrace-like filled area occurs inside the enclosure, against the base of natural upthrusted slabs that rise 1.10 m above the fill level. The filled area is 2.8 m long and has a maximum width of 1.80 m. It is built with mostly slab-like pieces laid flat over a slightly sloping surface, with c. 20 pieces of branch coral on top and intermixed with the fill. The east wall of the enclosure defines the east end of the fill area. Along the west side is a perimeter alignment of larger blocks.

To the north side of the filled area is a rock pile which measures 1.10 m (N-S) by 0.60 m (E-W) by 0.47 m average height. This pile is aligned with the enclosure wall and consists of large pahoehoe cobbles and blocks.

There is a small cave on the upper level, just south of the enclosure wall and at the lower bedrock upthrust. The opening is triangular shape in plan and measures c. 0.57 m by 0.50 m and 0.52 m high at the opening. The interior of the cave contains the skeletal remains of a small dog.

A 1.20 by 0.50 m test trench was excavated across the filled terrace-like area, in order to determine if subsurface features or deposits were present. The fill was found to be an average of 0.06 m thick over pahoehoe bedrock. Three waterworn pebbles were observed in the fill, in addition to several pieces of branch coral. One echinoid spine was also encountered at the base of the fill. No soil was encountered.

A 1.00 by 1.00 m square test unit was excavated into the rock pile located adjacent to the filled area. The pile was found to consist of 32 large cobbles and boulders (up to 40x20x12 cm), and 10 pebbles. It was constructed on a sloping pahoehoe surface which has no soil or other deposits present.

FEATURE B: C-Shape
FUNCTION: Indeterminate
DIMENSIONS: 2.10 m by 1.40 m by 0.30 m maximum height
DESCRIPTION: Feature B is constructed with aligned and stacked pahoehoe blocks. It is located 3.50 m north from the Feature A enclosure wall, on smooth, bare pahoehoe. The C-shape opens to the north with scattered stone present around the opening; it may have been circular in plan at one time. The interior area is quite small and contains no deposits or portable remains. This feature does not appear to have functioned as a temporary habitation shelter.

SITE NO.: State: 13282 PHRI: T-29
SITE TYPE: Alignment
TOPOGRAPHY: Smooth flat pahoehoe terrain.
VEGETATION: Thick grass, small 'ilima, and yellow flowering weeds.
ELEVATION: c. 15 feet
CONDITION: Poor
INTEGRITY: Altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 8.20 m by 3.57 m by 0.42 m
DESCRIPTION: The site consists of two alignments and rock scatter on top of a smooth pahoehoe field. The northwest alignment consists of single blocks placed end to end. The north end of the alignment is a fairly incoherent pile of blocks two courses high. The southeast alignment consists of seven blocks, only two of which are touching.

At the southwest end of the site are two concentrations of angular pahoehoe blocks, one small pile of 11 blocks, and a larger scattering of angular blocks with no formal pattern. These blocks range in size from 17x8x21 cm to 52x26x24 cm. Small blocks, averaging 11x9x4 cm in size, are used to fill in the natural cracks at the northeast end. One waterworn stone measuring 10x7x5 cm is present.

SITE NO.: State: 13283 PHRI: T-31
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Top of smooth pahoehoe ridge.
VEGETATION: Sparse grasses, a few small 'ilima bushes, and some small Christmas-berry trees.
ELEVATION: c. 15 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 4.62 m by 2.40 m by 0.33 m
DESCRIPTION: The site consists of a rock alignment in addition to five pahoehoe excavated areas. The total area

including the pahoehoe excavations measures c. 32.0 m by 37.5 m.

The rock alignment is constructed with blocks and slabs of pahoehoe in a C-shape plan. It is constructed one to three blocks high with a small pile of slabs located c. 0.5 m west of the alignment. The blocks range in size from 11x10x3 cm to 45x38x33 cm.

Five excavated pahoehoe blister areas with associated piles of blocks are in the area. The measurements average c. 1.0 m by 0.64 m. The excavated face thickness is c. 12.0 m and the maximum depth is c. 26.0 m. The excavated blocks average 54x42x9 cm.

Two waterworn basalt hammerstones were noted 3.0 m north of the alignment; they exhibit pecking and battering on both ends.

SITE NO.: State: 13284 PHRI: T-32
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Small ridge of smooth and ropy pahoehoe.
VEGETATION: Thick to moderate density of grass, small 'ilima, and koa-haole and kiawe bushes.
ELEVATION: c. 9-20 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DESCRIPTION: Overall site complex area measures c. 55.0 m (N-S). It consists of pahoehoe slabs and blocks placed in four concentrated areas.

FEATURE A: Rock concentration
FUNCTION: Possible agriculture
DIMENSIONS: 1.27 m by 1.20 m by 0.40 m
DESCRIPTION: Feature A consists of seven pahoehoe slabs with surface cortex and eight pahoehoe blocks. The blocks range in size from 15x11x3 to 42x28x17 cm. Some of the stones are placed on edge in a small concentrated area and stacked to two courses high.

FEATURE B: Rock concentration
FUNCTION: Possible agriculture
DIMENSIONS: 2.90 m by 2.80 m by 0.30 m
DESCRIPTION: A rock concentration consisting of 20+ pahoehoe slabs stacked one to two courses high on top of smooth pahoehoe surface. The slabs range in size from 16x13x4 cm to 60x27x6 cm. No obvious form or pattern is evident. This feature is located 46.80 m from feature A at 12 degrees Az.

FEATURE C: Rock concentration
FUNCTION: Agriculture
DIMENSIONS: 2.60 m by 2.10 m by 0.52 m
DESCRIPTION: Feature C is a pile of 20 pahoehoe slabs situated on the northeast slope of a ridge. It lies on smooth, ropy pahoehoe and is surrounded by fountain grass, 'ilima, kiawe trees and an unidentified weed. The dimensions of the slabs range from 17x10x4 cm to 88x42x11 cm. This feature is located 53.5 m from Feature A at 348 degrees Az.

FEATURE D: Rock concentration
FUNCTION: Possible marker
DIMENSIONS: 1.70 m by 1.50 m by 0.30 m
DESCRIPTION: Amorphous in plan view, it is constructed with pahoehoe blocks and slabs.

SITE NO.: State: 13285 PHRI: T-33
SITE TYPE: Complex (12 Features)
TOPOGRAPHY: Along a ridge of pahoehoe oriented E-W, and one large upthrust of faulted area north of the ridge.
VEGETATION: Moderate density of fountain grass, lantana, 'ilima, kiawe bushes, and a few small Christmas-berry trees.
ELEVATION: c. 9 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry/agriculture
DESCRIPTION: This site contains a total of twelve pahoehoe excavated areas consisting of seven excavated faults, three excavated blisters and two excavated cracks. Six of these features have cleared floors, and two of these have no associated excavated material present. The other features have quarried blocks in the interior of the excavated area. The average excavated area is c. 1.6 m and the thickness ranges from 16-28 cm with the maximum depth at 70 cm. Overall site area is 57.00 m by 56.40 m. Additional areas are visible where pahoehoe is naturally cracked and possibly displaced. One Cypraeidae shell fragment and two shotgun shells were noted on the surface.

SITE NO.: State: 13286 PHRI: T-34
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Smooth pahoehoe ridge oriented c. NE-SW.
VEGETATION: Moderate density of fountain grass, small 'ilima, and koa-haole bushes.
ELEVATION: c. 13-17 feet
CONDITION: Good
INTEGRITY: Unaltered

PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Indeterminate/markers/possible agriculture
DESCRIPTION: Overall complex area measures c. 31.0 m (NE-SW) by 74.0 m (NW-SE). The site consists of an alignment of four cairns (Feature A), a mound (Feature B), an alignment (Feature C), a rock concentration (Feature D), a mound (Feature E), a wall (Feature F), and four concentrated areas of boulders, slabs and stacked pahoehoe slabs (Features G to J).

FEATURE A: Alignment of cairns
FUNCTION: Possible marker
DIMENSIONS: 2.14 m by 0.64 m by 0.40 m
DESCRIPTION: Feature A consists of four short stacks or piles of pahoehoe slabs in an alignment that is oriented c. SE-NW. The cairns are single stacked to five courses high. The slabs of pahoehoe are fairly uniform in size and are placed on top of smooth pahoehoe. The stacks range in dimensions from 30x28x16 cm to 77x50x40 cm.

FEATURE B: Mound
FUNCTION: Possible agriculture/marker
DIMENSIONS: 8.25 m by 2.10 m by 0.21 m
DESCRIPTION: This feature lies on top of a small ridge. It consists of a circular pile of pahoehoe slabs on an area of smooth pahoehoe. Tweny-five pahoehoe slabs have been moved from an unknown area and placed in a nearly circular form on top of a small ridge. The northwest side of the feature is double stacked and the southeast side of the feature is single stacked. The smallest pahoehoe slab measures c. 9x5x2 cm and the largest pahoehoe slab measures c. 30x39x6 cm. This feature could possibly be a collapsed cairn. It is located 12.20 m from Feature A at 323 degrees Az.

FEATURE C: Alignment/low wall
FUNCTION: Indeterminate
DIMENSIONS: 1.36 m by 0.62 m by 0.26 m
DESCRIPTION: A small semicircular alignment of pahoehoe slabs, single to three slabs high. It consists of two single slabs of pahoehoe placed next to each other with a stack of three slabs on one end. The slabs range in size from 36x25x10 cm to 55x50x6 cm. Located 5.70 m from Feature A at 28 degrees Az.

FEATURE D: Rock concentration
FUNCTION: Possible marker
DIMENSIONS: 0.50 m by 0.38 m by 0.17 m
DESCRIPTION: A concentration of six small pahoehoe slabs, four of which are in a single stack. Located 5.70 m northeast from Feature C.

FEATURE E: Mound
FUNCTION: Marker/indeterminate
DIMENSIONS: 3.40 m by 2.15 m by 0.31 m
DESCRIPTION: Two small stacks of pahoehoe slabs c. 1.65 m apart with other scatter of slabs in the surrounding area. The south stack is c. 20+ small pahoehoe slabs arranged in a low circular pile measuring c. 1.0 m (N-S) by 0.75 m (E-W) with other slabs scattered to the south. The north stack consists of four pahoehoe slabs one on top another and measuring c. 0.47 m (E-W) by 0.40 m (N-S). Three additional slabs are to the southeast. Feature E is constructed on top of smooth, fairly flat pahoehoe, and located 13.60 m from Feature A at 60 degrees Az.

FEATURE F: Wall
FUNCTION: Indeterminate
DIMENSIONS: 2.85 m by 0.70 m by 0.60 m
DESCRIPTION: Stacked pahoehoe blocks on the lip of a sinkhole. The wall is constructed with single stacked pahoehoe blocks stacked c. 3-4 courses high. The wall is oriented E-W. The height on the west side is c. 0.60 m and on the east side it is c. 0.30-0.50 m high. The average block measures c. 28x22x12 cm. It is located 45.30 m from Feature B at 296 degrees Az.

FEATURE G: Boulder concentration
FUNCTION: Possible agriculture
DIMENSIONS: 6.30 m by 5.10 m by 1.20 m
DESCRIPTION: A concentration of angular boulders partially filling a sinkhole which contains an overhang along the north rim. A small cleared area is situated at the opening of the overhang. The boulders are randomly placed in the sinkhole, with the average size of the angular boulders measuring c. 50 x 30 x 30 cm. Located 23.10 m from Feature F at 354 degrees Az.

FEATURE H: Stacked pahoehoe
FUNCTION: Possible marker
DIMENSIONS: 0.88 m by 0.52 m by 0.31 m
DESCRIPTION: Four slabs of pahoehoe stacked one on top of another atop flat, smooth pahoehoe blister. No vegetation within 2.0 m of the feature. Fountain grass and small 'ilima comprise the vegetation.

FEATURE I: Stacked pahoehoe
FUNCTION: Possible marker
DIMENSIONS: 2.60 m by 1.72 m by 0.21 m
DESCRIPTION: Feature I consists of three columns of stacked pahoehoe slabs. The west column consists of two single slabs. The middle column consists of four slabs, one to three courses high. The east column consists of four

slabs, one to two courses high. The slabs range in size from 30x26x5 cm to 74x65x6 cm. The feature is located 12.80 m northeast from Feature F.

FEATURE J: Stacked pahoehoe
FUNCTION: Indeterminate
DIMENSIONS: 1.20 m by 0.95 m by 0.28 m
DESCRIPTION: Feature J consists of two columns of pahoehoe slabs stacked on top of a smooth pahoehoe surface. The NE column consists of two stacks, stacked two slabs high. The SW column consists of three stacks, stacked one-two slabs high. All slabs measure c. 37x28x4 cm.

SITE NO.: State: 13287 PHRI: T-36 *(Figure A-12)*
SITE TYPE: Cave Complex (6 Features)
TOPOGRAPHY: Undulating pahoehoe terrain.
VEGETATION: Lichens and large Christmas-berry tree growing out of the cave entrance.
ELEVATION: c. 12 feet
CONDITION: Fair
INTEGRITY: Altered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: Overall complex measures c. 30.0 m (N-S) by 25.0 m (E-W). It consists of a lava tube containing two hearths (Features A and D), three midden deposits (Features B, C and E) and a terrace (Feature F). The lava tube is fairly clear of debris with many boulders and cobbles at the entrance. The entrance measures c. 3.44 m (N-S) by 2.33 m (E-W) with a height of c. 2.11 m.

Some scatter of angular boulders and cobbles are at the cave entrance and on the cave floor. A wet, very dark brown silty clay cultural deposit (c. 0.10 m thick) and surface concentrations of marine shell, mammal bone, and artifacts occur in the immediate vicinity of the interior features. All identified surface features except Feature F are in the front portion of the tube, within an area 10.0 m from the entrance. The tube continues an additional 29.0 m from the entrance, and contains a pile of discarded jeep parts.

The cave becomes partially inundated during high tide, with a shallow pool forming behind the area of concentrated cultural features and deposits.

FEATURE A: Circular alignment (hearth)
FUNCTION: Habitation
DIMENSIONS: 1.26 m by 1.00 m by 0.45 m
DESCRIPTION: A circular alignment of lava blocks with a waterworn coral at the north side of the feature. Feature A consists of twelve pahoehoe boulders and large rocks surrounding c. 13 cm of a blackish charcoal deposit. Two rocks have collapsed into the hearth. The northwest side is double stacked and the SE side is single stacked. The dimensions of the rocks measures c. 8x16x6 cm to 40x28x18 cm.

In addition to the charcoal deposit, there is shell midden, animal bones and a scattering of rocks around the feature.

A 1.0 by 1.0 m square test unit (TU-1) was excavated into the area of concentrated rock, immediately southwest of the hearth alignment. The purpose of the excavation was to determine if buried features or deposits were present beneath the rock feature, and to hopefully obtain datable charcoal samples.

The uppermost layer consisted of pahoehoe cobbles with scattered waterworn coral cobbles and marine shell fragments. This layer had an average thickness of 0.30 m, and overlies a layer of small to medium pebbles and small cobbles in a soil matrix of black silty clay loam. Two ash deposits were observed at the surface of the pebble/soil layer, and collected for radiometric age determination. The pebble/soil deposit was excavated in two 0.05 m thick levels, and screened through 1/8 inch mesh with water. Shellfish and mammal remains and charcoal fragments were recovered from both levels. These materials are described in the subsurface findings section.

FEATURE B: Midden concentration
FUNCTION: Habitation
DIMENSIONS: 5.50 m by 2.70 m by 0.00 m
DESCRIPTION: A midden concentration on top the fairly flat surface of the cave floor. Situated c. 6.0 m inside of the cave entrance there also appears to be another deposit associated with it. A 1.0 by 1.0 m square test unit (TU-2) was excavated near the center of this deposit, in order to determine depth, presence or absence of stratigraphy, and midden constituents. An undifferentiated deposit of very moist, black silty clay 0.11 to 0.16 m thick was excavated in two levels and screened through 1/8" mesh with water. Shellfish remains, mammal bone and charcoal for age determination was recovered from both levels. These materials are described in the subsurface findings section.

FEATURE C: Midden scatter
FUNCTION: Habitation
DIMENSIONS: 7.50 m by 3.50 m by 1.60 m
DESCRIPTION: The midden scatter is situated on top of a lava shelf. It consists of shell midden, fish bones and scales, kukui nut and historic material such as galvanized aluminum and a fragmented wooden box scattered over the lava shelf surface. The northern side of the shelf contains a partially circular alignment of small angular rocks measuring c. 0.50 m (E-W) by 0.65 m (N-S).

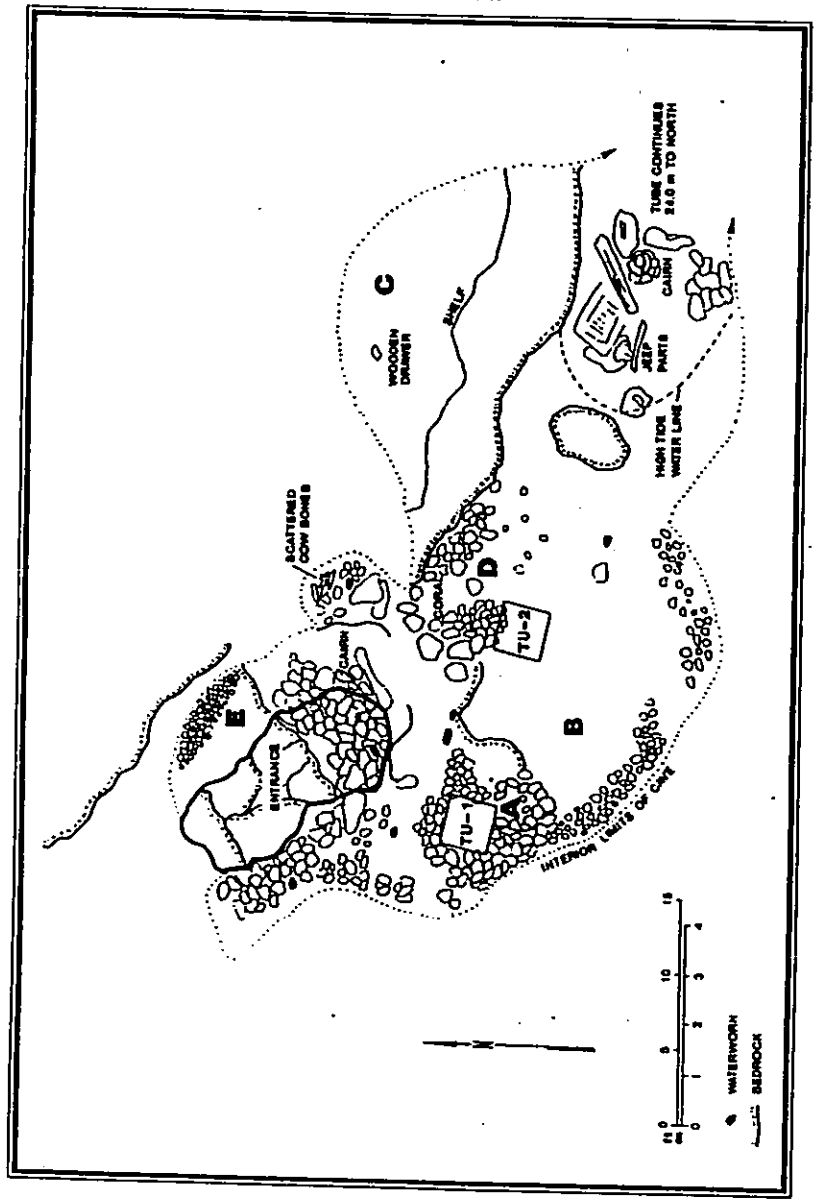


Figure A-12. SITE 13287

FEATURE D: Circular alignment (possible hearth)
FUNCTION: Habitation
DIMENSIONS: 1.43 m by 1.22 m by 0.36 m
DESCRIPTION: Feature D consists of a circular alignment of angular slab and waterworn rocks. The northeast side of the feature contains double stacked blocks. The northwest side is bounded by an upright pahoehoe slab and the south side is disturbed. The cobbles and rocks range in size from c. 10x8x2 cm to 25x15x10 cm. The largest boulder is c. 44x31x10 cm. There is c. 17 cm of a wet, silty, blackish-brown deposit. In addition, marine shell midden, charcoal and skeletal remains of a boar are present.

A high concentration of large and small cobbles are northwest of feature. There are waterworn corals present in the concentrated area.

FEATURE E: Midden scatter
FUNCTION: Habitation
DIMENSIONS: 3.00 m by 1.50 m
DESCRIPTION: Midden scatter on a natural shelf-like area that is situated immediately northwest of the entrance. It is in a small overhang with a fairly flat floor, which is covered with kukui nut, marine shell midden and a few mammal bone fragments. Also present are scattered large angular basalt boulders and small cobbled roof collapse.

FEATURE F: Terrace
FUNCTION: Indeterminate
DIMENSIONS: 1.40 m by 1.30 m by 0.55
DESCRIPTION: The terrace is located c. 14.0 m from the entrance. It is a roughly faced and partially collapsed terrace that is built against the cave wall. The eastern edge of the feature is indistinct where it abuts a roughly piled wall which partially closes off another chamber of the lava tube. The north and west faces are formed with a rough boulder alignment. The surface interior is filled with pahoehoe cobbles and the upper surface is covered with small cobbles and pebbles.

Numerous coral fragments, a cowrie shell and mammal bones were present in the vicinity.

SITE NO.: State: 13288 PHRI: T-37
SITE TYPE: Retaining wall/terrace
TOPOGRAPHY: Undulating pahoehoe and aa lava flows. 1-2% slope to the south. Bedrock outcrop immediately adjacent to the northwest.
VEGETATION: Christmas-berry, kiawe, fountain grass, 'ilima, and noni.
ELEVATION: c. 22 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Loading ramp
DIMENSIONS: 11.50 m by 1.00 m by 1.30 m
DESCRIPTION: A stacked wall constructed with basalt boulders and cobbles. It is oriented NE-SW and built on the southeast side of a bedrock outcrop. The wall is stacked three to six courses high and c. 0.80-1.0 m wide. A terrace abuts the bedrock and is c. 6.0-6.25 m wide. The surface of the terrace is flat and roughly level with areas of asphalt paving. There is a bulldozed slope oriented to the northeast from the terrace for c. 15.0 m to a jeep road. One short section of this slope also has a faced retainment oriented N-S, 2.9 m wide, one to three courses high for a height range of 0.25-0.5 m. The terrace and the bulldozed slope may have been used for dumping or for asphalt tar preparation. Immediately adjacent to the southwest end of the terrace is a large pile of metal tar barrels. Other historic rubbish is in the immediate area.

SITE NO.: State: 13289 PHRI: T-38
SITE TYPE: Complex (15 Features)
TOPOGRAPHY: Undulating field of smooth and ropy pahoehoe with numerous natural crevices.
VEGETATION: Moderate density of grass, small 'ilima, and lantana bushes, some kiawe, and small Christmas-berry trees.
ELEVATION: c. 9-10 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: Overall complex area measures c. 49.75 m (N-S) at 358 degrees by 27.14 m (E-W). The site consists of 15 quarried holes with associated excavated blocks. The blocks range in size from 9x6x4 cm to 78x31x28 cm. Thin soil deposits are in Features I and J. Four waterworn basalt cobbles and one piece of coral are present.

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.01 m by 0.92 m by 0.45 m
DESCRIPTION: This square-shaped excavation is in a large cracked blister. The floor interior is cleared and all faces are excavated. The thickness of the excavated faces range from 0.27-0.33 m. The excavated blocks are north, east, and south of the excavation. One piece of waterworn coral is located c. 2.24 m from the southwest corner of Feature A.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 5.65 m by 3.14 m by 0.55 m
DESCRIPTION: A large L-shaped excavated area quarried in a large cracked blister. Excavated in smooth and ropy pahoehoe with the quarried blocks inside of the excavated hole and around all edges. The thickness of the excavated face is 0.17-0.31 cm with the depth ranging from 0.32 m to 0.55 m below surface.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.68 m by 1.05 m by 0.41 m
DESCRIPTION: A small excavation with a partially cleared floor quarried into a large pahoehoe blister. The excavated blocks are piled to the east and south of the excavation. The thickness of the excavated face is 0.16 m and the depth ranges from 0.13 m to 0.41 m below surface.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.04 m by 0.95 m by 0.42 m
DESCRIPTION: Oblong shape in plan, the interior is cleared except for a few angular cobbles. The quarried blocks are placed exterior of and along the western half of the feature. A waterworn cobble/boulder with one battered end lies on the southeast floor of the feature. It measures c. 19x12x8 cm. The thickness of the excavated face ranges 18-20 cm. Old pahoehoe is visible as the interior floor surface.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.54 m by 0.39 m by 0.48 m
DESCRIPTION: Triangular shape in plan it is mostly cleared of quarried material. The quarried material is placed north of the feature. The thickness of the excavated face is 19-23 cm.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.30 m by 1.17 m by 0.45 m
DESCRIPTION: A fully excavated and cleared pahoehoe blister. Quarried blocks form a semicircular shape on the southwest side of the pahoehoe excavation. There are blocks within the feature that are possibly natural. The thickness of the excavated face ranges from 17 cm to 29 cm.

FEATURE G: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.80 m by 0.30 m by 0.49 m
DESCRIPTION: Feature G consists mostly of a natural crack along a blister from which rocks were removed. The quarried blocks were removed and placed on the southwest and west side of the feature. The thickness of the excavated face is c. 23 cm.

FEATURE H: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.65 m by 0.60 m by 0.23 m
DESCRIPTION: A small excavated crack with a cleared floor. The quarried blocks are placed south, east, and west of the excavation. The maximum depth of the hole is c. 0.7 m. A small waterworn pebble is present c. 1.87 m at 193 degrees from the south corner of Feature H.

FEATURE I: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 0.90 m by 0.76 m by 0.20 m
DESCRIPTION: Roughly rectangular shape in plan, with quarried blocks placed c. 0.50 m to the northwest. The thickness of the excavated face is c. 15-20 cm. A deposit of brown, gravelly soil loam, c. 0.05 m thick, occurs in the interior floor of Feature I.

FEATURE J: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.88 m by 1.00 m by 0.38 m
DESCRIPTION: A rectangular shaped collapsed blister with three faces excavated and with some displacement of broken cobbles. The floor interior is fairly cleared of quarried material. The thickness of the excavated face is 0.14-0.22 m. The depth ranges from 0.22-0.38 m below surface. One waterworn basalt hammerstone measuring c. 22x23x17 cm with two battered corners is in the southeast corner of Feature J.

FEATURE K: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.69 m by 1.14 m by 0.22 m
DESCRIPTION: Rectangular shape in plan, all faces are excavated. The floor interior is fairly cleared with blocks placed east and west of the excavation. The depth of the feature ranges between 0.45-0.63 m below surface. Two layers of pahoehoe area are excavated and the thickness of the excavated face averages 0.22 m.

FEATURE L: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.22 m by 1.15 m by 0.43 m max. depth
DESCRIPTION: A collapsed blister with three excavated faces. The floor interior is cleared with the quarried blocks placed along the north and southwest edges. The thickness of the excavated faces are 0.9-0.28 m. The range of depth

is 0.15-0.43 m below surface. One waterworn basalt hammerstone measuring c. 35x28x18 cm is present c. 1.45 m southeast of Feature L. It shows evidence of battering on one end.

FEATURE M: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.34 m by 2.20 m by 0.62 m maximum depth
DESCRIPTION: Generally rectangular shape in plan with all faces excavated. The floor is partially cleared with quarried blocks in the hole and around the edges. The thickness of the excavated face is 0.21 to 0.37 m. The depth range is 0.40 to 0.62 m below surface. It is situated within a small outcrop of pahoehoe blister that consists of slight faulting and cracks at the north end of the site. One mammal bone fragment is present in the southeast corner of the excavated hole.

FEATURE N: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.36 m by 0.00 m by 0.31 m
DESCRIPTION: A small collapsed area with one face excavated. The excavated blocks are removed and the floor interior is clear of material. The thickness of the excavated face averages 0.22 m. It is situated on a small outcrop of pahoehoe at the north end of the site.

FEATURE O: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.46 m by 0.00 m by 0.32 m
DESCRIPTION: A small cracked and partially collapsed blister with an excavated face along the NW side of the collapse. Quarried blocks occur inside the excavation. Thickness of the excavated face averages 0.16 m.

SITE NO.: State: 13290 PHRI: T-39
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: The site is situated on uneven pahoehoe flow, with collapsed blisters, cracks and faulted areas.
VEGETATION: Moderate density of grass, small lantana, and 'ilima bushes.
ELEVATION: c. 9-10 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry/agriculture
DESCRIPTION: The overall complex area measures c. 35.9 m at 160 degrees by 7.45 m. The quarried blocks range in size from 12x9x5 cm to 42x36x29 cm and are either in the excavations or around the perimeters. A large waterworn basalt hammerstone is present on the site; no soil was observed in the excavations.

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.83 m by 1.72 m by 0.48 m
DESCRIPTION: Feature A is a blister with all faces excavated and with the quarried blocks placed along the northeast edge. There are also a few blocks on the feature floor. The thickness of the excavated face is 0.29 m.

FEATURE B: Pahoehoe excavation *Figure A-13*
FUNCTION: Quarry
DIMENSIONS: 2.53 m by 0.47 m maximum depth
DESCRIPTION: Feature B consists of an excavation along a faulted face, 2.79 m southeast from Feature A. Thickness of the excavated pahoehoe face is 0.24 m. The quarried blocks are in a concentrated area east of the excavation.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.78 m by 0.85 m by 0.74 m
DESCRIPTION: Feature C is situated at the south end of a small pahoehoe ridge, 14.1 m south from Feature A. All faces are mined with the associated blocks concentrated to the east. The floor is partially cleared of excavated blocks. The thickness of the excavated face is 0.39 m.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.82 m by 0.51 m by 0.33 m
DESCRIPTION: Feature D is a blister excavation, 30.93 m south from Feature A. It shows evidence of all faces being quarried with the associated blocks located around the excavated hole. The thickness of the excavated face is 0.22 m. One waterworn basalt measuring c. 29x19x17 cm with some evidence of battering is present 0.93 m north of Feature D. It is located on the north to west side of a large collapsed blister.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.35 m by 1.00 m by 0.63 m
DESCRIPTION: Feature E consists of a blister excavation, 30.35 m southeast from Feature A. It shows evidence of all faces being quarried and has been cleared of loose rubble. The associated blocks are located around the excavated hole. The thickness of the excavated face is 30 cm. The depth ranges from 0.51 to 0.63 m below surface. It is located on the north to west side of a large collapsed blister.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.96 m by 1.40 m by 0.47 m
DESCRIPTION: A blister excavation with evidence of all

Figure A-13. SITE 13290, FEATURE B. View to Northwest (PHRI Neg.1238-17)

faces being quarried. The associated blocks are located around the perimeter of the excavated hole. The thickness of the excavated face is 0.20 to 0.24 m. The depth of the hole ranges from 0.34 to 0.47 m below ground surface. It is located on the north and west side of a large collapsed blister, 31.93 m southeast from Feature A.

SITE NO.: State: 13291 PHRI: T-40
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Gently undulating smooth and ropy pahoehoe with natural cracks. The surface area is littered with pahoehoe pebbles.
VEGETATION: Moderate thick density of grasses, small 'ilima, kiawe bushes, and two small Christmas-berry trees.
ELEVATION: c. 9 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry
DESCRIPTION: Overall complex area measures c. 14.0 m at 272 degrees by 17.5 m. The site consists of six pahoehoe excavations (Features A-F). No soil or cultural deposits were observed in or around the excavations. A single piece of waterworn coral is present near Feature A. There appears to be some bulldozer activity to the southeast of the site area, c. 10-20 m. It is probably associated with a nearby roadway.

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 4.43 m by 2.44 m by 0.47 m
DESCRIPTION: Feature A is an excavated pahoehoe blister. It is roughly rectangular shape in plan with associated blocks piled along the edge to the south. Some blocks are present on the floor surface.

The overall feature, including the quarried block pile, measures c. 7.37 m at 115 degrees by 4.84 m. The thickness of the excavated face is 0.33 m. The excavated blocks average size measures c. 36x20x16 cm. One piece of waterworn coral is present.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.36 m by 1.22 m by 0.54 m
DESCRIPTION: Generally rectangular shape in plan, Feature B consists of an excavated pahoehoe blister. The excavated blocks are piled along the southern edge and scattered on the floor interior. The thickness of the excavated face is 0.21 m on the southeast side and 0.25 m on the northwest side. The maximum depth ranges from 0.46 to 0.54 m below surface. This excavation is 0.52 m east from Feature A.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.12 m by 2.00 m by 0.45 m
DESCRIPTION: Feature C consists of an excavated pahoehoe blister, 5.62 m east from Feature B. It is roughly rectangular shape in plan, and all faces show evidence of quarrying. The associated quarried blocks are piled along the northern and the western edge. The total area including the excavated hole and the quarried block piles measures 4.73 m at 74 degrees by 5.49 m. The thickness of the excavated face measures 0.32 m. The average quarried block size is 35x19x15 cm.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.18 m by 1.35 m by 0.46 m
DESCRIPTION: Feature D is an excavated pahoehoe blister, 5.6 m southeast from Feature A. It is generally rectangular shape in plan, and excavated blocks are stacked on all sides of the excavated area. The average block size measures c. 20x16 x27 cm. The thickness of the excavated face is 0.26 m.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.90 m by 1.12 m by 0.47 m
DESCRIPTION: Feature E is an excavated pahoehoe blister located adjacent to Feature D. It is generally rectangular shape in plan, with an excavated face thickness of 0.30 m. The average block size measures 20x16x27 cm.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.75 m by 1.06 m by 0.48 m
DESCRIPTION: An excavated crevice, it is in an area of natural collapse in which large and small angular rocks were removed and placed northwest of the feature. Feature F contains three faces that are excavated with three to four large rocks within the excavation. It is located 2.10 m northwest from Feature A.

There are small angular blocks to the east that may have naturally collapsed into the feature interior. There are c. 100+ excavated blocks in and around the feature. The average size of the blocks is 27x22x18 cm. The overall feature dimensions including the scattered blocks measures c. 5.68 m (E-W) by 3.85 m (N-S).

SITE NO.: State: 13292 PHRI: T-41
SITE TYPE: Complex (18 Features)
TOPOGRAPHY: Terrain consists of a ridge of faulted and cracked smooth and ropy pahoehoe that is oriented c. N-S.
VEGETATION: Sparse fountain grass, a few small lantana and 'ilima bushes, and two Christmas-berry trees on the a ridge.
ELEVATION: c. 9 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: The overall site complex consists of 18 pahoehoe excavations. The total area measures c. 52.90 m (N-S) by 17.5 m (E-W). The excavated areas range in size from c. 0.66-4.60 m x 0.4-1.82 m with face thicknesses of c. 0.10-0.32 m and total depths of c. 0.54-0.61 m below surface. The pahoehoe excavations consists of eight fault excavations, six blister excavations, three crevices and one collapsed blister excavation.

The pahoehoe excavation complex contains c. four excavated faces per feature. Six of the features have totally cleared floors and within four of these there are no associated blocks present. The remaining features have quarried blocks within the excavations or in close proximity to the excavated edges. The blocks range in size from 8x7x9 cm to 55x42x26 cm. One waterworn basalt with evidence of battering marks was present along the southeast boundary of the site. Three Cypraeidae shell fragments were also observed scattered on the site surface. No soil was observed in the excavations.

SITE NO.: State: 13293 PHRI: T-42
SITE TYPE: Complex (9 Features)
TOPOGRAPHY: Situated between two low ridges of pahoehoe, the terrain is of undulating pahoehoe flow consisting of small cracks andnatural faulting.
VEGETATION: Moderate to thick grass, small 'ilima and koa-haole bushes, Christmas-berry, and kiawe trees.
ELEVATION: c. 9 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: The overall complex area measures c. 23.8 m at 26 degrees by 13.8 m. This site consist of a rock alignment (Feature A) and eight pahoehoe excavations. No soil or portable remains were observed.

FEATURE A: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 2.25 m by 1.70 m by 0.35 m
DESCRIPTION: An area of smooth pahoehoe and natural collapse which features a C-shape alignment of pahoehoe blocks. There are c. 15+ angular pahoehoe rocks and slabs placed in a single stacked C-shape alignment. The blocks range in size from 15x13x8 cm to 31x26x28 cm. Some of the rocks were scattered around the alignment. The interior measures 1.12 m (N-S) by 1.05 m (E-W).

FEATURE -: Pahoehoe excavation (8)
FUNCTION: Quarry/possible agriculture
DESCRIPTION: This area consists of eight pahoehoe excavations; six blister type excavations and two crevice type excavations. Three of these have cleared floors. All excavations exhibit at least one to four excavated faces with only one layer of pahoehoe quarried. The floors are the exposed second layer of pahoehoe.

The quarried basalt blocks are either on the floor of the excavations or along the perimeters in circular alignments. The average block size is c. 28x18x12 cm; the average excavated area is c. 1.97 m by 0.66 m; the excavated face thickness ranges from 0.11 to 0.34 m and the depth of the excavations range from 0.26 to 0.81 m below surface.

SITE NO.: State: 13294 PHRI: T-43 *(Figure A-14)*
SITE TYPE: Complex (73 Features)
TOPOGRAPHY: Relatively level pahoehoe with an adjacent aa finger flow. There are collapsed tubes in the area and modified shallow blisters.
VEGETATION: Fountain grass, noni trees, kiawe, koa-haole, 'ilima, some Christmas-berry, and lantana. Approximately 30% of the surface area is covered with vegetation. The remaining portions are bare.
ELEVATION: c. 9 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate/prehistoric-historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures c. 110.0 m (E-W) by 84.0 m (N-S). The site complex is divided into four quads for counting the pahoehoe excavations. A 20.0 by 20.0 m sample area in the SE corner of the SW quad was mapped, and individual features (A through F) were recorded. Features recorded and/or counted include a cairn (Feature A), an alignment (Feature B), a pile of pahoehoe blocks (Feature F), and 70 pahoehoe excavations (Features C-E, G-I, and 64 additional excavations. The site is affected along the SW and S side by airport construction and a service road and was possibly larger.

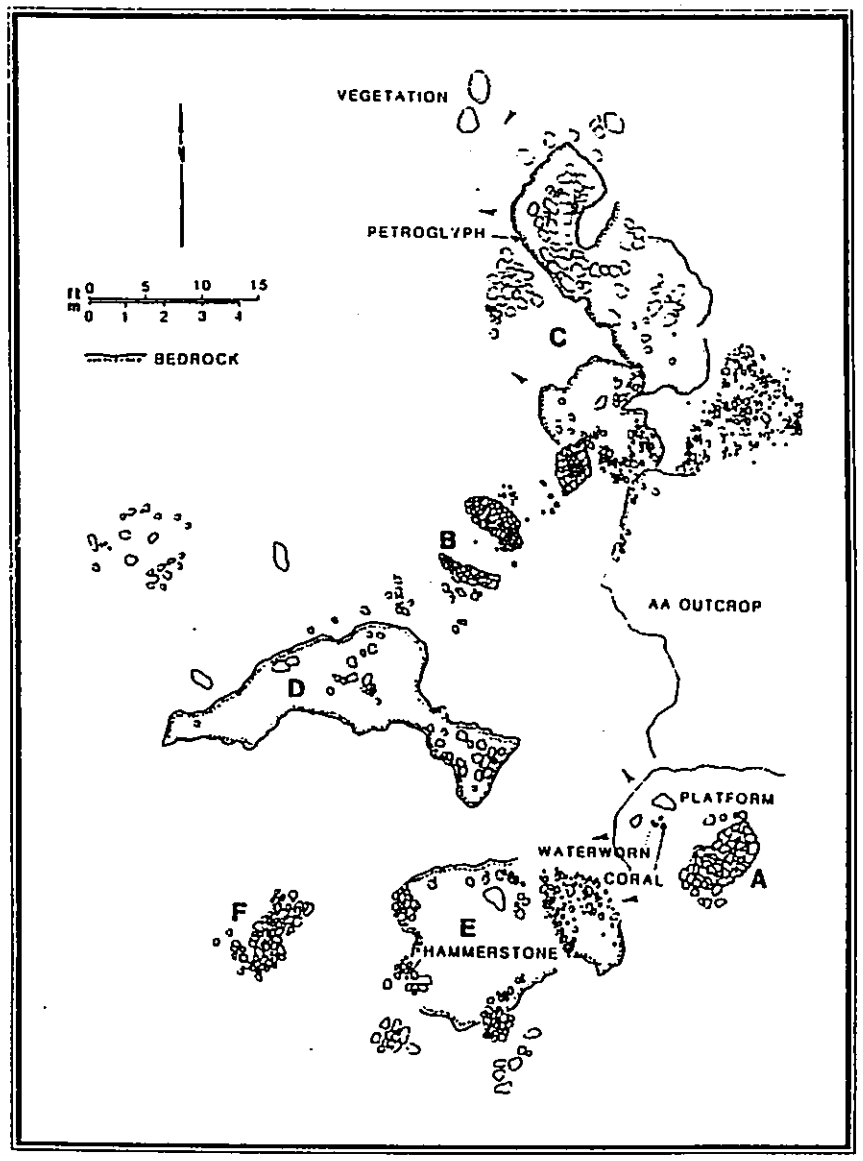


Figure A-14. SITE 13294, FEATURES A-F

Soil deposits were observed in Features G, H and I, and portable remains observed include waterworn pebbles, cobbles, and boulders, stoneware pottery sherds, and modern bottle glass.

FEATURE A: Cairn
FUNCTION: Marker
DIMENSIONS: 2.52 m by 2.34 m by 0.64 m
DESCRIPTION: The cairn is situated on a natural outcrop of aa at the southwest end of the site. Feature A is constructed with piled pahoehoe blocks at the bottom and with aa rocks at the top. There are c. 100+ rough aa boulders and cobbles and c. 20+ pahoehoe blocks. Presently, it is in a collapsed condition.

A waterworn cobble hammerstone with two battered ends lies on top of the eastern side of the cairn. In addition, there are three small coral fragments and a small waterworn cobble 1.2 m west of Feature A.

FEATURE B: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 3.37 m by 2.48 m by 0.45 m
DESCRIPTION: A roughly U-shaped alignment, 2-3 courses wide and 1-3 courses high. It is constructed with blocks of pahoehoe and aa. Clinker size pieces of pahoehoe and aa are on top of the feature and in portions around the alignment. Two waterworn basalt fragments and broken glass are present. Feature B is situated at the far SW corner of the site, near the fence line along the old airport runway.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 12.35 m by 3.40 m by 0.39 m
DESCRIPTION: Feature C is situated at the southwest corner of the site, adjacent to Feature B. It consists of a quarried blister with a partially cleared floor. A second layer of pahoehoe is exposed. There are c. 16 blocks located to the SW of the excavated area, and one small pile of aa and pahoehoe cobbles located on the NW edge of the excavated area. This small pile of cobbles measures c. 1.22 m (N-S) by 0.98 m (E-W). It is piled 2-3 courses high and is c. 0.34 m above the ground surface. The thickness of the excavated face ranges from 0.14-0.37 m and the depth ranges from 0.14-0.39 cm below surface. No soil is present.

The portable remains consists of *Cellana*, rock oyster, and *Cypraeidae* shell fragments, two pieces of coral, one waterworn basalt, glass sherds, and tin cans.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 9.50 m by 4.00 m by 0.30 m
DESCRIPTION: Feature D is located immediately south of Feature B. The main portion of the pahoehoe excavation is roughly circular in plan and measures c. 2.90 m in diameter. It is a broad, shallow hole with a slightly sloping rough floor. Most of the blocks were removed from the excavation, which is possibly the source for the Feature B alignment.

There are extensions along crevices from the east side and the northwest side of the excavation. Both extensions are 3.2 m in length and are 0.6 to 1.7 m wide. They contain the same flat, rough and cleared floor. The mined basalt is uniform vesicular with no air pockets. Only one layer was mined. A thin pocket of reddish-brown soil is present in the lowest point of the excavation near the center. One waterworn coral pebble, two pieces shatter from a basalt hammerstone, and brown bottle glass are present. The hammerstone shatter pieces were broken from the hammerstone currently located at Feature E.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 4.50 m by 3.80 m by 0.23 m
DESCRIPTION: Feature E is located 2.00 m east from Feature D. It is a broad, roughly circular, shallow hole with a flat rough floor. All faces were excavated except the SE side. Most of the excavated blocks were removed, however there are c. 12 large blocks remaining in the excavation. Some of the blocks are scattered on the aa flow to the east and a few to the north. The overall feature dimensions including the scatter is c. 6.8 m (N-S) by 5.7 m (E-W).

A large basalt boulder hammerstone is present inside the excavation, against the west wall. It has several flakes removed from it and appears to be the source for flakes observed scattered in the area of Features A-F.

FEATURE F: Block pile
FUNCTION: Quarry
DIMENSIONS: 2.60 m by 1.40 m by 0.40 m
DESCRIPTION: Feature F is located 2.20 m northwest of Feature D. It is a roughly curved pile of large excavated blocks, some of which are loosely stacked to two courses high. It is constructed with c. 50 pahoehoe blocks with three large aa cobbles. One broken waterworn boulder and one large flake from the Feature E hammerstone were also present. Feature D may be the possible quarry source for this rock pile.

FEATURE G: Pahoehoe excavation
FUNCTION: Possible agriculture
DIMENSIONS: 2.40 m by 1.90 m by 1.00 m

Feature G consists of an excavated blister and edge of finger. The overall feature area is c. 4.1 m (E-W) by 3.5 m (N-S). Two pahoehoe layers were excavated, however, the upper layer is broken off in a wider area than the lower, forming a shelf along the SW side of the hole. The upper layer of lava is 0.32 m thick and the lower layer is 0.27 m thick.

Broken and excavated blocks are loosely stacked on the north side of the excavation, forming a C-shaped perimeter around the depression. The base of the hole is filled with broken pieces of pebble size basalt. Brown soil mixed with pebble and gravel size pieces is also visible at the bottom of the hole.

FEATURE H: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.50 m by 1.60 m by 0.70 m
DESCRIPTION: The overall feature measures c. 6.5 m (N-S) by 5.5 m (E-W). Excavated blocks are used to make two compartments inside of the excavated blister and as perimeter around the lower north side.

Large naturally collapsed slabs were moved out of the hole. They measure c. 1.0x0.8x0.25 m. Other blocks were knocked off and arranged in a semicircle around the western compartment and encircle the eastern compartment. All are haphazardly stacked two courses high.

The east side of the western compartment has a cleared floor and the west side has pebbles and soil. A small overhang is situated at the west end of the western compartment. The western compartment measures c. 1.70 m (E-W) by 0.70 m (N-S). The eastern compartment is all pebbles and soil fill with some slabs set on edge around the perimeter. The eastern compartment measures c. 1.0 m (N-S) by 0.57 m (E-W). A small overhang is also present at the east end.

Two layers of pahoehoe were excavated. The upper layer is 0.25 m thick and the lower layer is 0.23 m thick. Feature H is located 3.70 m east of Feature G, and is on the same pahoehoe finger.

FEATURE I: Pahoehoe excavation
FUNCTION: Possible agriculture
DIMENSIONS: 7.40 m by 4.70 m by 0.40 m
DESCRIPTION: Feature I is c. 6.7 m east of Feature H. Very large blocks are removed from an excavated blister to form a crude enclosure around the excavation. The aligned debris goes around the west, north and east sides. There is a slight break in the center on the north side. The interior measures c. 3.5 m (E-W) by 2.5 m (N-S) and averages c. 0.9 m wide. Most of the excavation is loosely filled with blocks except for a small hole that contains pebbles and soil.

At the SE end is a filled crevice that has a relatively level surface. It measures c. 1.8 m (N-S) by 1.2 m (E-W) and goes under an overhang with a ceiling height of 0.4 m above the top of the rock fill. The overhang is c. 1.4 m wide and 0.6 m deep. The depth of the fill appears to be at least three layers of blocks.

At the east end, mixed with small pieces of debris, on top the pahoehoe surface at the base of the slope, are several pieces of broken branch coral and basalt hammerstone shatter and flakes.

FEATURE - : Pahoehoe excavation (35)
FUNCTION: Quarry/agriculture
DESCRIPTION: The northeast quadrant of the site contains at least 35 pahoehoe excavations, including 15 excavated blisters, 13 crevices and seven faults.

Of these 35 features, 19 have totally or partially cleared floors. Five of these features have an absence of excavated blocks. In the other cases, most blocks are either in the excavated holes and or in close proximity to the edges. For most cases, only the top layer of pahoehoe has been excavated and the floor is fairly level exposing the second layer of pahoehoe.

The excavated areas range in size from c. 0.90 m (NE-SW) by 0.38 m (NW-SE) with excavated face thickness of c. 0.33 m and a total depth of c. 0.52 m below surface, to c. 3.55 m (NE-SW) by 1.83 m (NW-SE) with an excavated face thickness of c. 0.13-0.28 m and a total depth of c. 0.28-0.61 m below surface.

There is a moderate density of recent garbage in the area, various marine shell, coral and two waterworn basalt boulders, the larger of which contains battering on one end. Sparse soil deposits have also collected in the cracks.

FEATURE - : Pahoehoe excavation (3)
FUNCTION: Quarry/possible agriculture
DESCRIPTION: The southeast quadrant of the site contains three pahoehoe excavations. Two of these features are single-faced excavations between boundaries of pahoehoe and aa flows. Their floors are partially cleared, but contain many cobble-sized aa pieces. The third feature is a blister excavation, which is also near the aa and pahoehoe boundary. The average excavated face length is 2.25 m and the average thickness of the excavated face is c. 0.18 m. The three

excavations range in depth from 0.26 to 0.64 m below surface.

Most of the excavated blocks are absent from the area. Some larger blocks are strewn c. 6.0 m to the south of the two single faced excavations. A few of the blocks are also located in the third excavated blister floor and along the SE face.

Historic garbage consisting of wood, nails, broken beer bottles are scattered throughout the quad. Near the roadway, much midden scatter and the evidence of bulldozer activity was visible. Coral fragments and shell fragments occur near the aa flow edge.

FEATURE -: Pahoehoe excavation (23)
FUNCTION: Possible agriculture
DESCRIPTION: The northwest quadrant consists of 23 excavated areas and one alignment. Formal variants include eight totally cleared shallow crevices, six deep, narrow crevices with pebble fill and three to four backfilled crevices.

The northern boundary is very indistinct and abuts SIHP Site No. 13386. Across the south half, and extending E-W is a raised finger with several excavations. To the north is a low area of broken pahoehoe and some aa. Features G, H, and I are situated along north face of the finger. They appear to be possible planting areas based on morphology, presence of soil, pebble fill, depth and exposure.

A circular alignment of odd-shaped blocks is situated on the flat at the northern end. The interior dimensions are c. 1.3 by 1.2 m and contains a flat and cleared surface. Portable remains consists of a basalt hammerstone flake, waterworn coral and basalt, shell midden, basalt shatter, and stoneware sherds.

FEATURE -: Pahoehoe excavation (12)
FUNCTION: Quarry
DIMENSIONS: 50.00 m by 42.00 m
DESCRIPTION: The southwest quadrant contains at least 12 features. There are three excavated crevices along an upthrust of ropy pahoehoe at the west boundary. Two broad shallow excavations are at the northeast corner of the quadrant, the smaller of which is backfilled with blocks and the larger one which is empty. Also, an excavated blister is visible just southwest of the area.

An excavated crevice at the western boundary of the site contains broken pebble-size pieces of pahoehoe and two waterworn cobbles, one of which is ground. It is a moist crevice with a small overhang on the south side. It measures c. 0.6 m deep with an opening of c. 0.8 m by 0.15 m and a ceiling height of c. 0.35 m. Blocks are scattered along the sides of the excavation.

The western boundary of the site is c. 10.0 m from SIHP Site No. 13353, a complex consisting of modified anchialine pools and petroglyphs.

SITE NO.: State: 13295 PHRI: T-44
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: A small ridge of smooth and ropy pahoehoe oriented roughly E-W.
VEGETATION: Moderate grasses, small 'ilima and lantana bushes, and small Christmas-berry trees.
ELEVATION: c. 9-10 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry
DESCRIPTION: Site complex consists of quarried faces of pahoehoe with blocks either closely associated around the excavation or in the hole. Two pieces of coral are present at Features H and I.

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.51 m by 1.39 m by 0.48 m
DESCRIPTION: Generally rectangular shape in plan with associated blocks placed on the east and southeast edges of the hole. The floor is partially cleared of excavated blocks. The overall feature including the scattered blocks measures 2.98 m (NW-SE) by 2.25 m (NE-SW). The thickness of the excavated face is 0.21 m.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 0.98 m by 0.88 m by 0.52 m
DESCRIPTION: Feature B is a pahoehoe excavation blister, located 2.25 m west from Feature A. A few excavated blocks are to the southeast of the excavation and many blocks are inside. The total feature area including the excavated material measures c. 1.83 m at 232 degrees by 2.37 m. The thickness of the excavated face is c. 0.25 m.

FEATURE C: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 4.14 m by 0.96 m by 0.68 m
DESCRIPTION: An excavated fault in which both faces were excavated. The floor is cleared of quarried material, some of which appear to be downhill to the east and south. The total area measures 4.19 m at 150 degrees by 6.05 m. The thickness of the excavated face is c. 0.39 m. Feature C is 2.90 m at 150 degrees Az. from Feature A.

FEATURE D: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 3.82 m by 0.45 m by 0.54 m
DESCRIPTION: Feature D is an excavated crevice situated 4.6 m from Feature A at 208 degrees Az. The excavation is generally cleared of rubble, which is concentrated to the southeast of the crevice. The overall feature area including the quarried material measures 3.82 m at 80 degrees by 5.74 m. The thickness of the excavated face is 0.27 m.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 2.96 m by 0.69 m by 0.37 m
DESCRIPTION: Feature E is an excavated blister and fault, situated on top of smooth and ropy pahoehoe on the north edge of a small depression. It is 7.11 m at 248 degrees Az. from Feature A. It consists of a square hole excavated through a blister, and an excavated face along a small fault adjacent the blister. Quarried blocks are located to the southwest and northeast of the excavated area. The overall feature area measures 4.31 m at 284 degrees by 4.51 m. The thickness of the excavated face ranges from 0.08-0.27 m. The depth ranges from 0.08-0.37 m below surface. Thick grass is growing in the excavation.

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.15 m by 0.64 m by 0.43 m
DESCRIPTION: Feature F is an excavated blister located 15.05 m at 263 degrees Az. from Feature A. All faces of the feature are excavated and the floor is partially cleared of loose rubble. Quarried blocks are placed on the seaward (west) side of the excavation. The thickness of the excavated face is 0.24 m.

FEATURE G: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.32 m by 0.91 m by 0.53 m
DESCRIPTION: Feature G is an excavated blister located 17.71 m from Feature A at 265 degrees Az. All faces of the feature are excavated and the floor is partially cleared of rubble. Quarried blocks are placed on the seaward (west) side of the excavation. The excavated pahoehoe face here is 0.30 m thick.

FEATURE H: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.59 m by 1.19 m by 0.47 m
DESCRIPTION: Feature H is an excavated blister located 19.22 m at 269 degrees Az. from Feature A. All faces of the feature are excavated and the floor is partially cleared of loose rubble. Quarried blocks are placed on the seaward (west) side of the excavation. Thickness of the excavated pahoehoe layer is 0.28 m. One piece of coral was located 1.84 m to the northwest of Feature H.

FEATURE I: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.17 m by 1.12 m by 0.46 m
DESCRIPTION: Feature I is another excavated blister located 17.54 m from Feature A at 270 degrees Az. All faces of this feature are excavated and the floor is partially cleared of loose rubble. Quarried blocks are placed on the seaward (west) side of the excavation. Thickness of the excavated pahoehoe layer here is 0.29 m. One piece of waterworn coral is located 1.74 m to the north of Feature I.

FEATURE J: Displaced quarried rocks
FUNCTION: Possible quarried material
DIMENSIONS: 9.65 m by 5.82 m by 0.22 m
DESCRIPTION: Feature J is situated c. 25.48 m at 183 degrees from Feature A. It is a displacement of cracked and broken ropy pahoehoe, located west of the major portion of this site. Slabs of pahoehoe are flipped over and moved from their original position. The slabs and blocks range in size from 6x3x6 cm to 80x73x21 cm.

SITE NO.: State: 13296 PHRI: T-45 *(Figure A-15)*
SITE TYPE: Complex (13 Features)
TOPOGRAPHY: Undulating ropy and smooth pahoehoe.
VEGETATION: Moderate density of grass, 'ilima, kiawe, and Christmas-berry.
ELEVATION: c. 9-10 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DESCRIPTION: The overall complex area measures c. 35.00 m at 180 degrees by 44.50 m. This site consists of 13 pahoehoe excavations. Formal variants include nine excavated faults, two excavated blisters, one crevice and one flow edge. Four of the excavations have cleared floors, all excavated areas have the majority of the excavated blocks in close proximity to the holes. One to four faces are excavated, usually the upper layer. The average excavated area is c. 1.25 m by 0.80 m. The average thickness of the excavated face is c. 0.47 m. The average depth is c. 0.65 m below surface. The excavated blocks range in size from 0.8x0.7x0.4 m to 0.75x0.30x0.27 m.

SITE NO.: State: 13297 PHRI: T-47
SITE TYPE: Complex (9 Features)
TOPOGRAPHY: Undulating smooth and ropy pahoehoe flow with natural cracks and faulting.

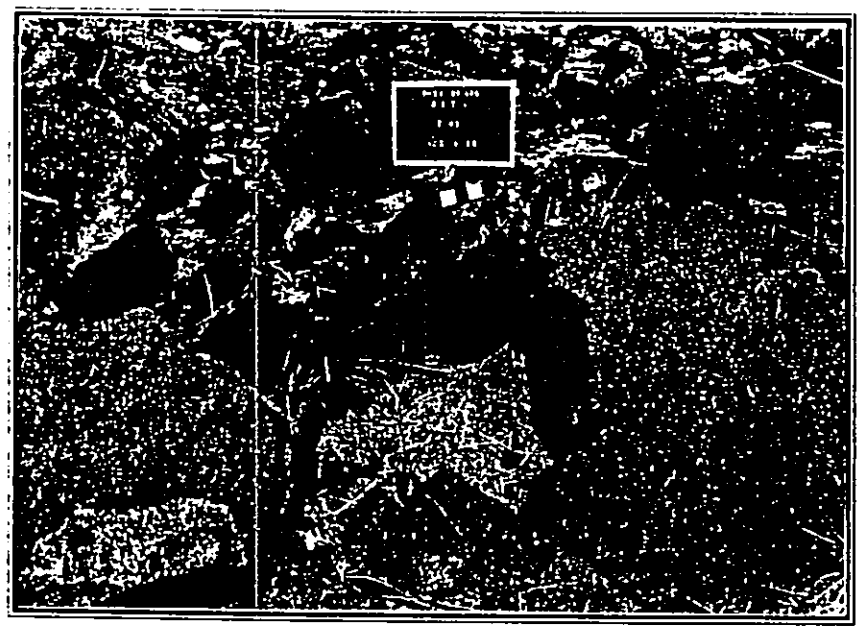


Figure A-15. SITE 13296. View to Northwest (PHRI Neg.1242-16)

VEGETATION: Moderate to thick density of grass, small 'ilima and koa-haole bushes, Christmas-berry, and kiawe treesand bushes.
ELEVATION: c. 17.5 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DESCRIPTION: This site consists of nine pahoehoe excavations within an area 42.73 m by 38.40 m. Formal variants observed include excavated blisters, crevices and faults. One to four faces are excavated per feature, with the average excavation measuring 1.68 m by 1.15 m. Thickness of the excavated pahoehoe layer averages 0.26 m and the average depth is 0.36 m below surface. Two of the excavations have cleared floors. The remaining have excavated blocks closely associated with the features in addition to a couple of isolated block scatters. The average block size is 31x12x28 cm. Ten stoneware pottery sherds are located c. 25.68 m at 12 degrees from the site datum.

SITE NO.: State: 13298 PHRI: T-48
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Depression between pahoehoe ridges oriented NW-SE.
VEGETATION: Thick grass, kiawe, koa-haole, lantana, purple flowering vines, and 'ilima in depression.
ELEVATION: c. 20 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/agriculture/ temporary habitation
DESCRIPTION: The site complex consists of a cairn (Feature A), a rubble concentration (Feature B), two linear mounds (Features C and F), a modified crevice (Feature D), a pahoehoe excavation (Feature E) and a modified fault (Feature G). The features are relatively dispersed over an area of at least 1000.00 sq m.

FEATURE A: Cairn
FUNCTION: Indeterminate marker
DIMENSIONS: 0.34 m by 0.30 m by 0.77 m
DESCRIPTION: The cairn is constructed with four pahoehoe blocks of similar shape and size stacked one on top of another. It is built on top of naturally cracked pahoehoe, situated on the southwest side of and below large ridge of pahoehoe.

FEATURE B: Rubble concentration
FUNCTION: Quarry
DIMENSIONS: 7.20 m by 4.50 m by 0.27 m
DESCRIPTION: Feature B is located 2.44 m south from Feature A. It consists of pahoehoe cobbles and boulders concentrated near an overhang at the base of a ridge. The cobbles and boulders range in size from 13x10x5 cm to 62x34x27 cm. They are concentrated in front of the overhang and were probably removed from the overhang area. No deposits or portable remains are present inside the overhang. A vesicular basalt abrader occurs on the rock concentration; it measures 12x12x10 cm.

FEATURE C: Linear mound *(Figure A-16)*
FUNCTION: Possible temporary habitation/agriculture
DIMENSIONS: 3.55 m by 1.68 m by 0.86 m
DESCRIPTION: A linear mound roughly oriented N-S, parallel to small the major axis of an adjacent overhang. The mound is partially faced on the west side and is constructed with crudely stacked angular pahoehoe cobbles and boulders. The rock size ranges from 10x9x7 cm to 54x47x12 cm. A waterworn basalt hammerstone with battering marks on two ends, is present between the linear mound and the overhang.

A 1.80 by 1.00 m test trench was excavated across the narrow axis of the mound, at the center, in order to determine if subsurface features were buried beneath the rocks. The rock fill was found to be overlying a depression in the pahoehoe surface, and continued to 0.94 m below the top of the mound. At the base of the rock fill, which was a uniform deposit of large cobbles and small boulders, a bedrock surface with narrow, soil-filled crevices was encountered. The soil deposits were up to 0.13 cm thick in the crevices and consists of very rich, black loam. No portable remains were observed. A sample of the soil deposit was obtained for additional analysis (see subsurface findings).

FEATURE D: Modified crevice
FUNCTION: Possible water catchment/agriculture
DIMENSIONS: 5.00 m by 2.20 m by 0.85 m
DESCRIPTION: Feature D is located 25.4 m from Feature B at 201 degrees Az. It consists of piled and stacked boulders and cobbles in a natural crevice between an aa flow and an overhang. The feature is situated along the southwest edge of the site at the southeast base of a pahoehoe ridge. The ends of the crevice, and a small area in front of the overhang are filled with slabs and blocks of pahoehoe, leaving a central area clear of cobbles. This central area has the appearance of a walled hole. The hole area measures c. 2.05 m at 228 degrees by 0.85 m. A large waterworn basalt hammerstone measuring c. 23x23x17 cm with battering on two ends is located in the NE wall.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 2.50 m by 1.30 m by 0.28 m
DESCRIPTION: Modified pahoehoe excavation, located 11.00 m south from Feature D. The excavation is rectangular in plan, and quarried blocks are stacked 1-2 courses high, directly on the edges of the excavation. Two layers of pahoehoe are excavated through. The hole is cleared, with the exception of a few blocks. The excavated hole measures c. 1.8 m at 210 degrees by 0.62 m. The hole depth is c. 0.78 to 1.2 m below surface.

FEATURE F: Linear mound
FUNCTION: Indeterminate
DIMENSIONS: 4.66 m by 1.58 m by 0.52 m
DESCRIPTION: This linear mound is situated on the top of a linear pahoehoe ridge, and is oriented northeast/southwest. It is constructed with thin slabs of pahoehoe and has a long rectangular shape. The slabs range from 16x10x3 cm to 96x46x6 cm. The area surrounding Feature F consists of broken pahoehoe slabs that cover the top of the ridge.

FEATURE G: Modified crevice *(Figure A-17)*
FUNCTION: Possible water catchment
DIMENSIONS: 4.20 m by 1.15 m by 1.55 m maximum depth
DESCRIPTION: This feature is located 24.10 m west from Feature B. It consists of a large crevice/fault area with two faced walls oriented across and perpendicular with the long axis of the crack. The wall are 0.66 m high, and are filled behind with small cobbles, creating a cleared, vertical-sided depression between the walls. This open depression measures 1.40 m at 88 degrees by 0.96 m. Maximum depth of the hole from the natural faulted surface is 1.55 m.

SITE NO.: State: 13299 PHRI: T-4 *(Figure A-18)*
SITE TYPE: Terrace
TOPOGRAPHY: The terrain consists of a depression area with an undulating floor, and high ridges in all directions.
VEGETATION: Thick grass, 'ilima, purple flowering vines, and kiawe trees.
ELEVATION: c. 17 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Ceremonial/ possible agriculture
DIMENSIONS: 3.50 m by 2.55 m by 0.55 m overall maximum height
DESCRIPTION: The site is located at the base of the northeast rim of a pahoehoe ridge, in a shallow depression. It is constructed with pahoehoe slabs and smaller pieces of broken pahoehoe. The slabs are concentrated in the northern portion of the terrace, where rock fill is deepest. The main terrace is D-shaped and raised along the western, curved side.

A semicircular extension occurs off the southwest edge of the terrace. The extension surface is level; fill consists of small pahoehoe pieces with a perimeter of larger pieces. It is raised 0.19 m on the west side, and is 0.36 m below the surface of the main terrace.

Portable remains present on the terrace include branch coral fragments, waterworn cobbles and pebbles, and concreted sand.

A 1.0 by 1.0 m test unit was excavated into the terrace in order to determine if buried features (i.e., human skeletal remains) were present. Surface fill in the test unit consisted of flat pahoehoe slabs, branch coral, four waterworn pebbles, and various-size pieces of broken pahoehoe. This deposit continued for 0.35 m. A thin deposit of small coral fragments and irregular, pebble-size pahoehoe pieces occurred immediately on the bedrock surface, 0.35 m below the terrace surface. A soil deposit 0.03 m thick occurred in a shallow crevice at the northwest corner of the unit. This deposit was sampled for further analysis (see subsurface findings). No portable remains or cultural deposit was encountered.

SITE NO.: State: 13300 PHRI: T-50
SITE TYPE: Complex (13 Features)
TOPOGRAPHY: Very uneven, upthrusted pahoehoe ridge that is oriented N-S with collapsed blisters and sinkholes in the surrounding area.
VEGETATION: Thick grasses, 'ilima and Christmas-berry in the sink holes, and sparse grass and 'ilima on the ridge.
ELEVATION: c. 17 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/possibly recent
FUNCTIONAL INTERPRETATION: Habitation-agriculture
DESCRIPTION: The overall complex area measures c. 39.42 m (N-S) by 26.65 m (E-W). Portable remains consists of waterworn basalt, coral, marine shell midden, and a possible cultural deposit. Recent refuse is also present in the area.

FEATURE A: Enclosure (4) *(Figure A-19)*
FUNCTION: Agriculture

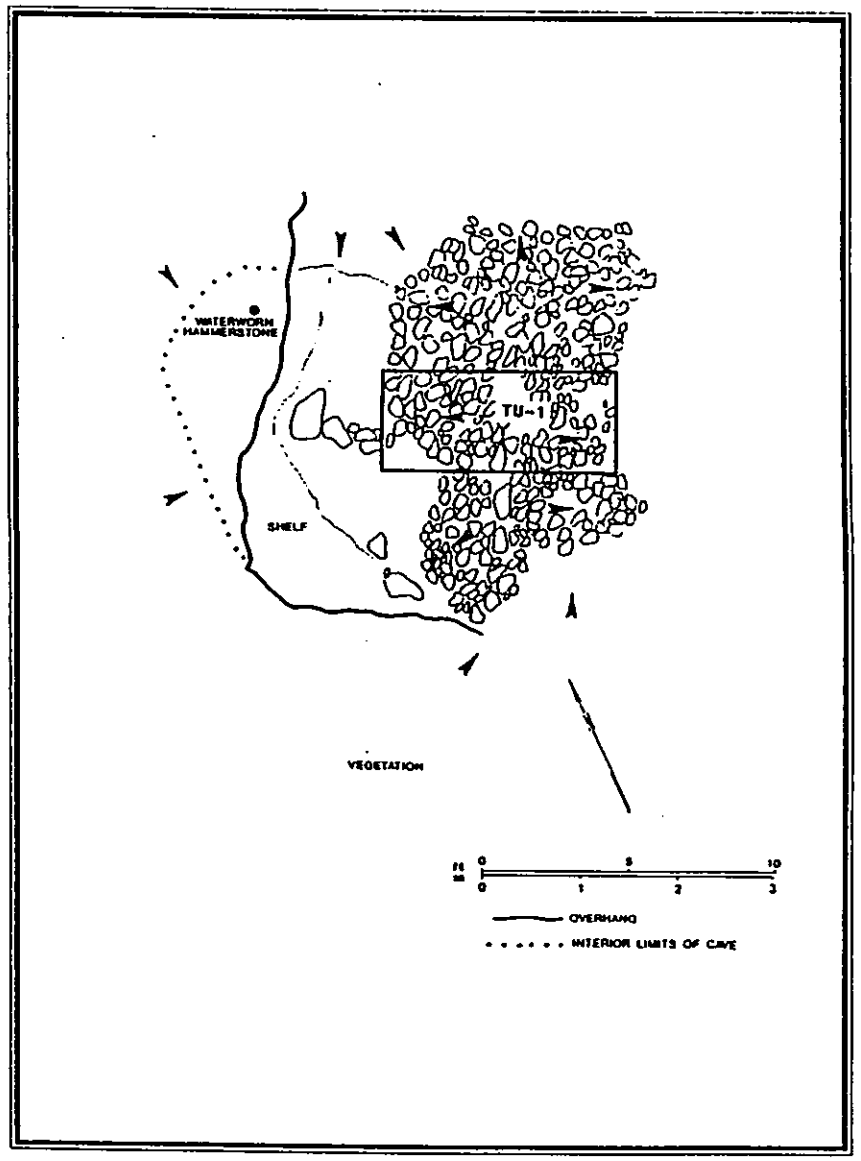


Figure A-16. SITE 13298, FEATURE C

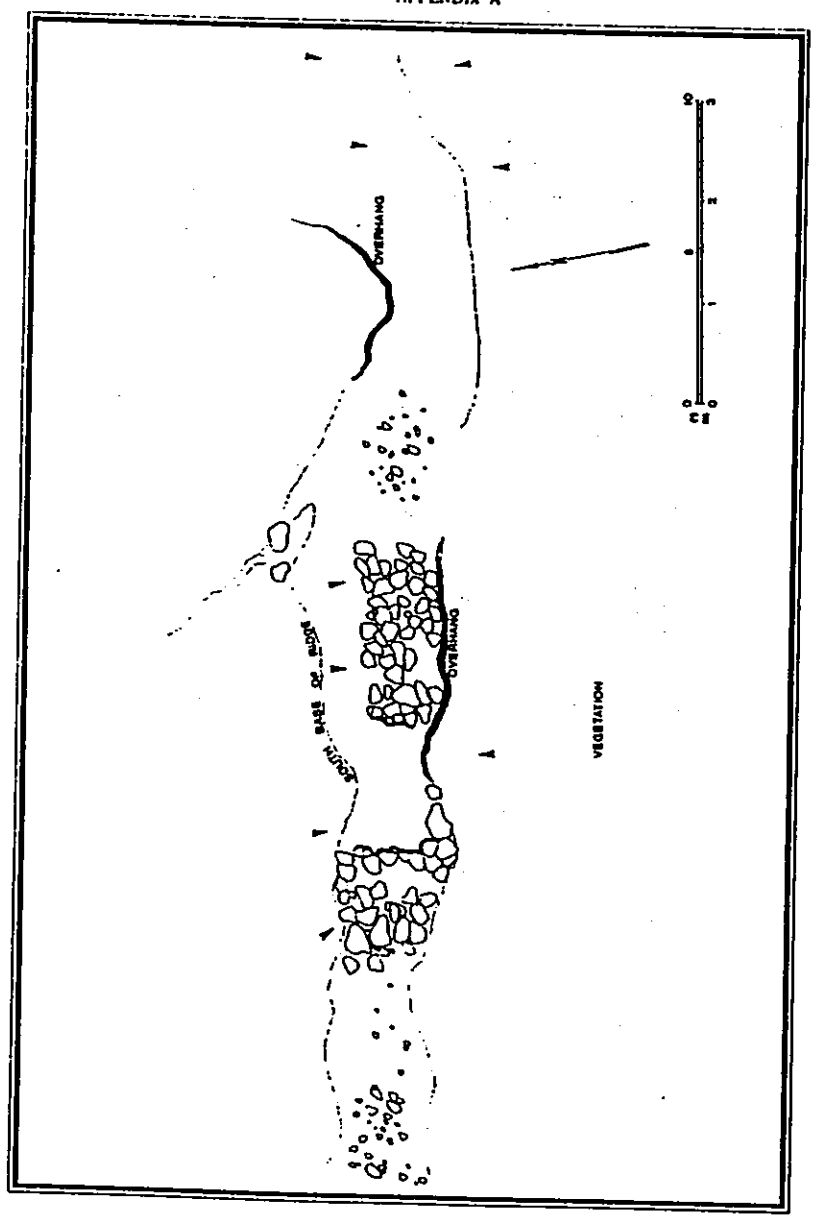


Figure A-17. SITE 13298, FEATURE G

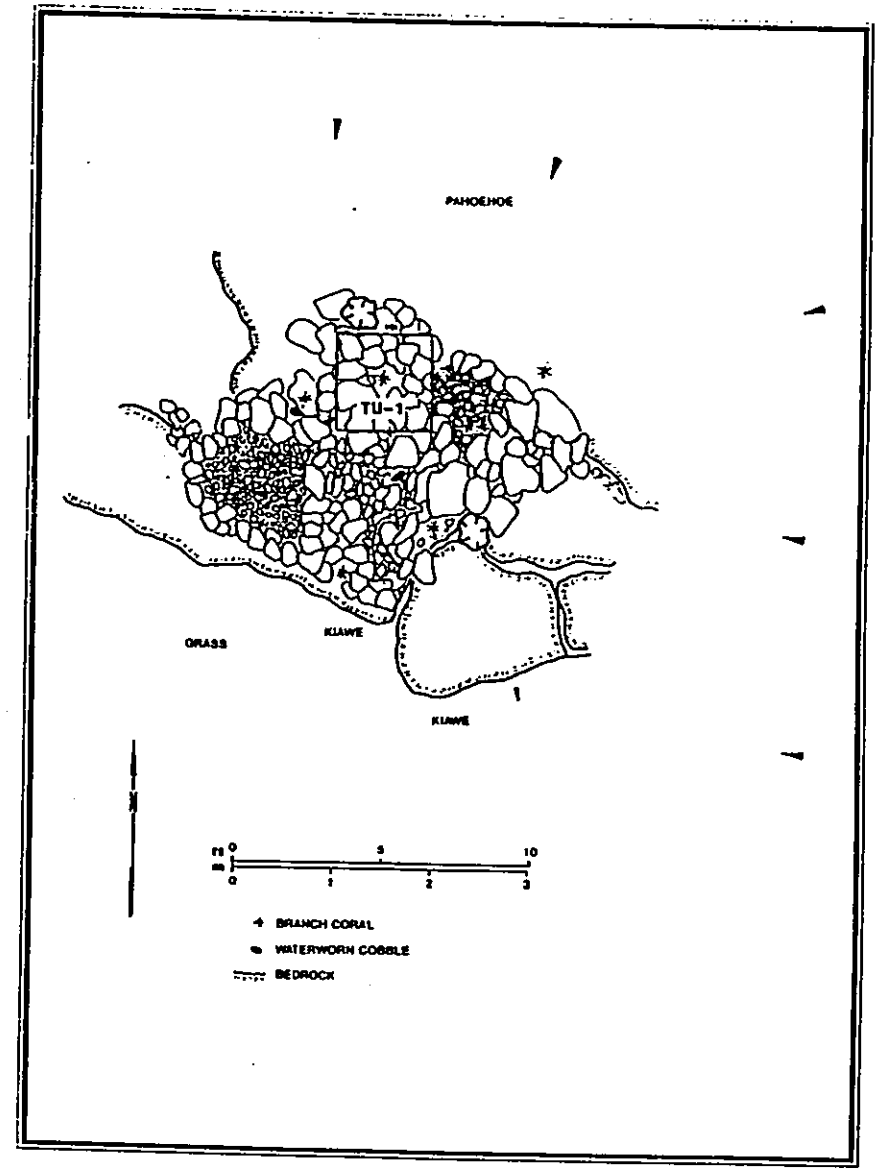


Figure A-18. SITE 13299

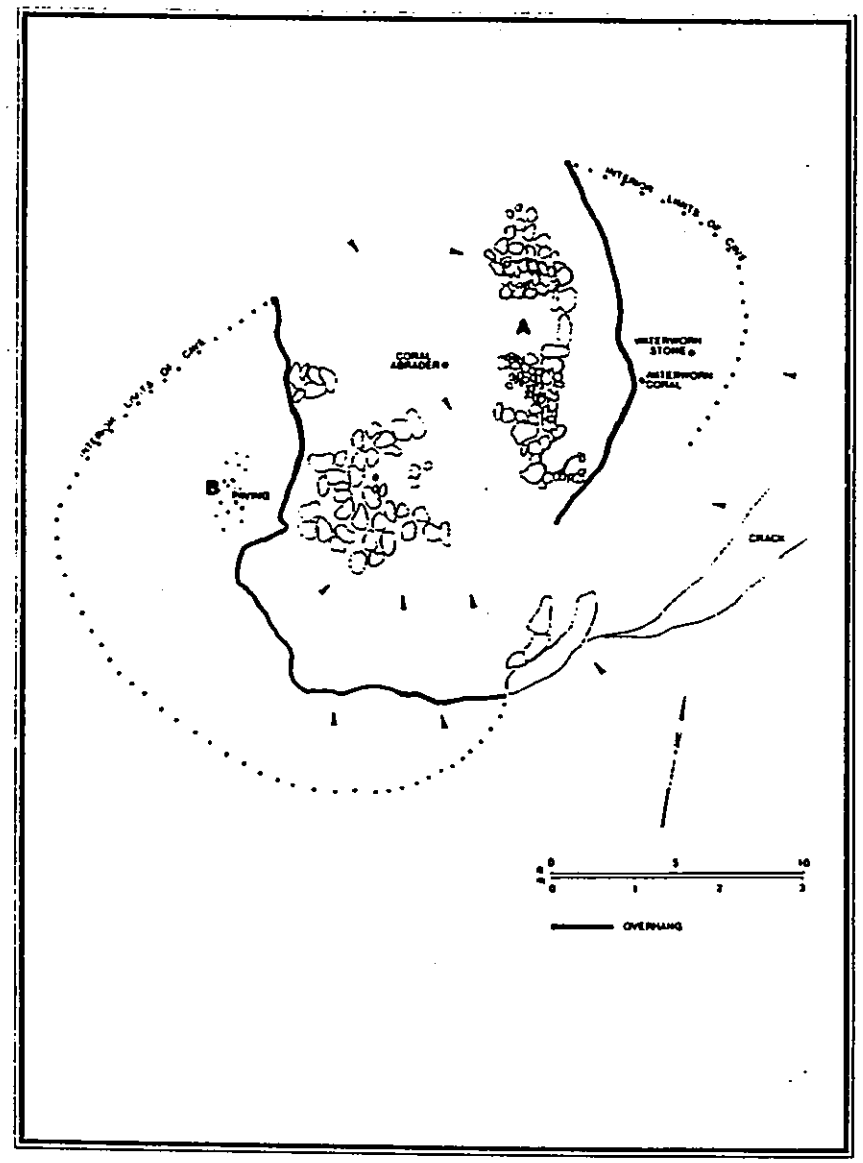


Figure A-19. SITE 13300, FEATURES A AND B

DIMENSIONS: 3.60 m by 0.90 m by 0.30 m
DESCRIPTION: The feature consists of four small enclosures located in the bottom of a 1.00 m deep sinkhole. The enclosures are adjacent to one another and share common walls. They vary in shape from roughly rectangular to circular, and follow natural formations in the sinkhole. Small blocks and slabs of pahoehoe are stacked in alignments to create the enclosures. The walls are stacked one and two cobbles high, with heights ranging from 0.13 to 0.30 m.

The enclosures or planting areas are numbered 1 to 4 from north to south in order to describe the dimensions. No. 1 measures 0.7 (N-S) by 0.68 m (E-W) and wall width of 0.18-0.4 m. No. 2 measures 0.45 m (N-S) by 0.4 m (E-W) and wall width of 0.2 m. No. 3 measures 0.4 m (N-S) by 0.35 m (E-W) and wall width of 0.2-0.4 m. No. 4 measures 1.2 m (N-S) by 0.36 m (E-W) and wall width of 0.2 m. No. 4's east wall incorporates natural pahoehoe collapse.

Soil deposits are present in all enclosures; two are cleared of stones and two have some small cobbles mixed with the soil. Plastic water jugs and plastic plant bags are scattered in an adjacent overhang, inside the sinkhole. Feature A has apparently been used recently for cultivation purposes, and may have been constructed recently as well. A soil sample was obtained from one of the enclosures for comparative purposes.

FEATURE B: Modified overhang
FUNCTION: Temporary habitation
DIMENSIONS: 11.00 m by 9.00 m by 0.95 m maximum ceiling height
DESCRIPTION: The overhang is located under the southwestern rim of the Feature A sinkhole. The overhang floor is 0.78 m above the floor of the sinkhole, and is slightly sloping and irregular. A depressed area of the floor at the access is paved with pahoehoe slabs and blocks. The paving measures 1.38 by 0.64 m. Ceiling height at the access from the sinkhole is 0.56 m. No portable remains or soil deposits are present inside the overhang.

FEATURE C: Modified sinkhole
FUNCTION: Agriculture
DIMENSIONS: 11.00 m by 4.20 m by 1.00 m maximum depth
DESCRIPTION: This modified sinkhole is located 7.30 m from the north rim of the Feature A/B sinkhole at 330 degrees Az. The Feature C sinkhole is oriented northeast-southwest and is collapsed and open at the southwest end. The floor of the sinkhole is covered with angular pahoehoe cobbles and boulders.

Four identifiable areas within the sink hole have been cleared. These areas are numbered 1 to 4. Clearing no. 1 is located at the far west end of the sinkhole. It measures 1.77 m at 272 degrees by 0.9 m. It extends 0.50-0.75 m below the surrounding boulders. Clearing no. 2 is located at the far south corner of the sinkhole. It measures 1.8 m at 168 degrees by 1.6 m, and is 0.5-0.7 m below the surrounding boulders. A large waterworn basalt hammerstone is inside the clearing. Clearing no. 3 is along the mid-south wall. It measures 2.8 m at 222 degrees by 1.4 m, and is 0.6-1.0 m deep. Clearing no. 4 is at the far southeast corner of the sinkhole. It measures 3.20 m at 93 degrees by 1.7 m, and is 0.8 m deep. No soil was observed inside the clearings, however, the rock fill continues below the base of the clearings, so buried soil may be present.

FEATURE D: Overhang *(Figure A-20)*
FUNCTION: Temporary habitation
DIMENSIONS: 11.00 m by 2.50 m by 1.76 m maximum ceiling height
DESCRIPTION: Feature D is an overhang situated along the eastern rim of a sinkhole, located 25.53 m northeast of the Feature A/B sinkhole. The floor of the sinkhole is 2.26 m below surface along the east side, and the overhang floor is on a shelf 0.50 m above the floor of the sinkhole.

The access to the overhang from the sinkhole is paved with pahoehoe slabs. The paved area measures 2.3 m (N-S) by 2.15 m (E-W). It is built with mostly single laid slabs with a maximum thickness of three slabs.

Kukui nut shells, marine shell, a waterworn basalt pebble, and pig skeletal remains are scattered inside the overhang. A waterworn basalt hammerstone was located c. 3.4 m WSW of the south end of the paving. Soil is present, however, no charcoal was observed. Two soil samples were collected from areas with the thickest soil deposition (0.03 m).

FEATURE E: Overhang
FUNCTION: Temporary habitation
DIMENSIONS: 4.50 m by 2.20 m by 1.47 m maximum ceiling height
DESCRIPTION: Feature E is located along the north rim of the Feature D sinkhole, 7.00 m northwest from Feature D. It is a small overhang shelter, situated on a shelf 0.50 m above the floor of the sinkhole. A small paved area consisting of flat pahoehoe slabs occurs at the access from the sinkhole. The pavement is 2.40 by 1.70 m and is raised a maximum of 0.05 m above the overhang floor. No soil or portable remains occur inside the overhang.

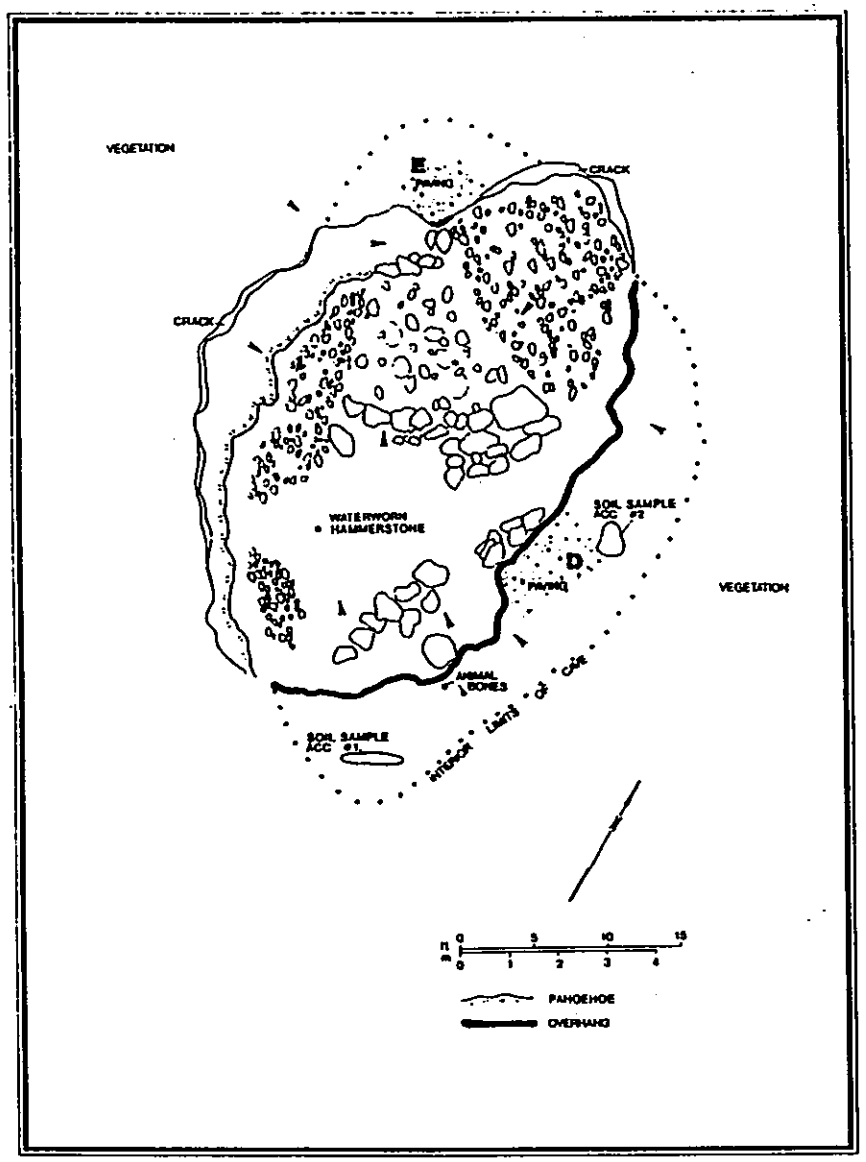


Figure A-20. SITE 13300, FEATURES D AND E

FEATURE -: Pahoehoe excavation (5)
FUNCTION: Quarry/agriculture
DESCRIPTION: Throughout Site 13300 are five pahoehoe excavations, including two excavated blisters, two crevices and one fault. Two of these excavations have totally cleared floors. One to four of the faces are excavated and the average pahoehoe layer thickness is 0.25 m; average depth of the excavations is 0.47 m below surface.

The quarried slabs and blocks are closely associated with the excavated areas. The blocks average size is c. 18x10x21 cm. Two small hammerstones were noted near the various pahoehoe excavation areas with battering and pecking marks visible on two to four sides.

SITE NO.: State: 13301 PHRI: T-51
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Site is situated at the bottom of a large collapsed blister. The floor of the blister is fairly flat, ropy pahoehoe.
VEGETATION: Thick grass, kiawe, and Christmas-berry trees.
ELEVATION: c. 20 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate/prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DESCRIPTION: The overall complex area measures c. 5.2 m at 234 degrees by 3.08 m. The site consists of a terrace (Feature A) and a cobble concentration (Feature B).

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 2.56 m by 2.28 m by 0.40 m maximum height
DESCRIPTION: The terrace is roughly triangular shape in plan. It is level with the ground surface on the north and east sides and raised two to three courses high (0.40 m) on the south and west sides. The terrace surface is relatively level and paved with small angular pahoehoe cobbles. The southwest corner is raised slightly above the terrace surface. Larger boulders and cobbles define the perimeter. A single cobble alignment extends from Feature A to Feature B along the southern boundary of the features.

FEATURE B: Angular cobble concentration
FUNCTION: Agriculture
DIMENSIONS: 1.74 m by 1.66 m by 0.36 m
DESCRIPTION: Feature B is a low pile of angular cobbles and slabs of pahoehoe. It consists of angular blocks and slabs ranging in size from 12x8x6 cm to 33x31x21 cm crudely stacked one to two courses high.

SITE NO.: State: 13302 PHRI: T-52
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Large pahoehoe ridge or upthrust with a low depression to the east.
VEGETATION: Thick grass, 'ilima, lantana bushes, and Christmas-berry trees.
ELEVATION: c. 18 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Temporary habitation-quarry/agriculture
DESCRIPTION: The overall complex area measures c. 27.5 m at 329 degrees by 15.2 m. The complex consists of two caves (Features A and B) a bi-level overhang shelter (Feature C) and four pahoehoe excavations.

Portable remains present at the site include coconut husks, coral, marine shell fragments, small pockets of soil in Features B and C and an ash deposit in Feature C. The midden is sparse and the ash deposits look very low in charcoal.

FEATURE A: Cave
FUNCTION: Temporary habitation
DIMENSIONS: 3.60 m by 3.20 m by 1.00 m
DESCRIPTION: The cave entrance is at the base of a large pahoehoe upthrust, and faces 100 degrees Az: it is horizontal and measures 0.85 m in width by 0.9 m in height. An area 1.10 m wide is blocked off on the south side of the entrance and 0.4 m wide is also blocked off on the north side of the opening. The stacked blocks may have been quarried from the cave dripline, which appears to have been mined. The cave interior floor is cleared of loose rubble and slightly lower that the surface exterior. A single Conus shell fragment and a piece of branch coral is present inside the cave. A concentration of coconut husks also occurs at the northern end where the ceiling is c. 0.6 m high.

FEATURE B: Cave
FUNCTION: Temporary habitation
DIMENSIONS: 6.75 m by 2.50 m by 1.17 m maximum ceiling height
DESCRIPTION: Feature B is located in a steep-sided ravine between two large upthrusts, 27.2 m from Feature A at 329 degrees Az. The sheltered area opens to to the southeast through a nearly vertical entrance. The entrance measures c. 2.8 m by 1.4 m with a ceiling height of 1.17 m. A depression immediately inside of the opening has been filled with large pahoehoe blocks possibly knocked from the rim of the overhang. The interior area is divided into three compartments that are separated by roughly aligned blocks.

The easternmost compartment is a crawlspace with scattered coconut husks on the floor. The western compartment also has coconuts and is a cleared, fairly level area measuring 1.4 m (E-W) by 1.37 m. A narrow tube (0.50 m wide) extends off the southeastern end of this compartment. The floor of the tube is very irregular and blocked at the western compartment by a large boulder; however, it is still accessible. Coconut husks are scattered in crevices in the tube floor 6.0 m from the west compartment. The tube branches and continues in both directions, but is not accessible.

Portable remains scattered on the cave floor include 20+ Cypraeidae shell fragments, six *Nerita picea* shells, four Thaididae shells and a Conus shell fragment, in addition to several coconut husks.

FEATURE C: Overhang *(Figure A-21)*
FUNCTION: Temporary habitation
DIMENSIONS: 5.00 m by 2.40 m by 2.15 m overall ceiling height
DESCRIPTION: Feature C is a bi-level overhang located along the south side of the narrow ravine, 15.0 m east from Feature B. The two overhang levels share the same opening, with the floor of the upper level forming the ceiling of the lower level. The upper level floor is 1.35 m above the lower level floor. Thin deposits of soil and ash occur in both levels.

The upper level is 5.00 m wide by 2.40 m deep and has an average ceiling height of 0.80 m. The floor is even, but irregular, and cleared of loose stones which were used to fill a depression at the east end. The filled depression is 1.55 m (E-W) by 0.9 m, and serves to extend the floor space of the shelter. Other rocks are loosely stacked behind the filled area. Two Thaididae shells and six Cypraeidae fragments are scattered on the upper level floor. Two very thin patches of ashy soil, suggestive of hearths, are present.

The lower level shelter is 4.30 m wide by 2.40 m deep and has an average ceiling height of 0.65 m, with a height of 0.84 m at the opening. The floor is relatively uneven and has been cleared of loose rubble, which is concentrated along the side walls. A depression at the north end of the shelter has been filled to level with the surrounding floor. The fill consists of a single layer of pahoehoe cobbles overlying a thin deposit of soil. Portable remains in this level include bird bone, Echinoidea spine pieces, Thaididae shell and Cypraeidae shell fragments.

A 1.00 by 0.50 m test unit was excavated into the cobble-filled depression, where the greatest deposit thickness was observed. The soil here was found to vary in thickness from 0.03 to 0.05 m. All soil was screened through 1/8 inch mesh. Three Cypraeidae shell fragments were recovered. No charcoal or other portable remains were recovered from the test unit.

At the west end of the overhang is a small shelf, situated midway between the upper and lower levels of the feature. An ashy soil deposit with Echinoidea spines occurs on the shelf. The shelf is a faulted portion of the upper level floor/lower level ceiling, which dropped 0.50 m. The ceiling is the western, low, end of same ceiling over upper level. The shelf and the deposit is best accessed from the lower level, the floor of which is 0.40 m below the shelf level.

FEATURE -: Pahoehoe excavation (4)
FUNCTION: Quarry/agriculture
DESCRIPTION: A total of four pahoehoe excavation areas were noticed southeast of Features A and B in a low area between pahoehoe upthrusts and ridges. All excavations have cleared interior floors with quarried blocks in close proximity. The average excavated area is 0.75 m by 0.63 m, and average thickness of the excavated pahoehoe layer is 0.16 m.

SITE NO.: State: 13303 PHRI: T-53
SITE TYPE: Cave
TOPOGRAPHY: Undulating pahoehoe with an aa field c. 10.0 m to the northwest.
VEGETATION: No vegetation in the immediate area.
ELEVATION: c. 20 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Storage
DIMENSIONS: 3.50 m by 2.35 m by 0.80 m maximum ceiling height
DESCRIPTION: The entrance opens to the north and measures 0.82 m wide and 0.37 m high. It is a natural lava bubble with a cleared floor area. It is small and not large enough for habitation. A single Echinoidea fragment was observed on the floor, in addition to coconut husks. A depression immediately outside the cave entrance is filled with pahoehoe cobbles to within 0.25 m below the surrounding surface.

SITE NO.: State: 13304 PHRI: T-54
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Smooth and flat pahoehoe surface.
VEGETATION: Small succulent vines and koa-haole, with a large noni growing out of the excavated opening.
ELEVATION: c. 84 feet
CONDITION: Good
INTEGRITY: Unaltered

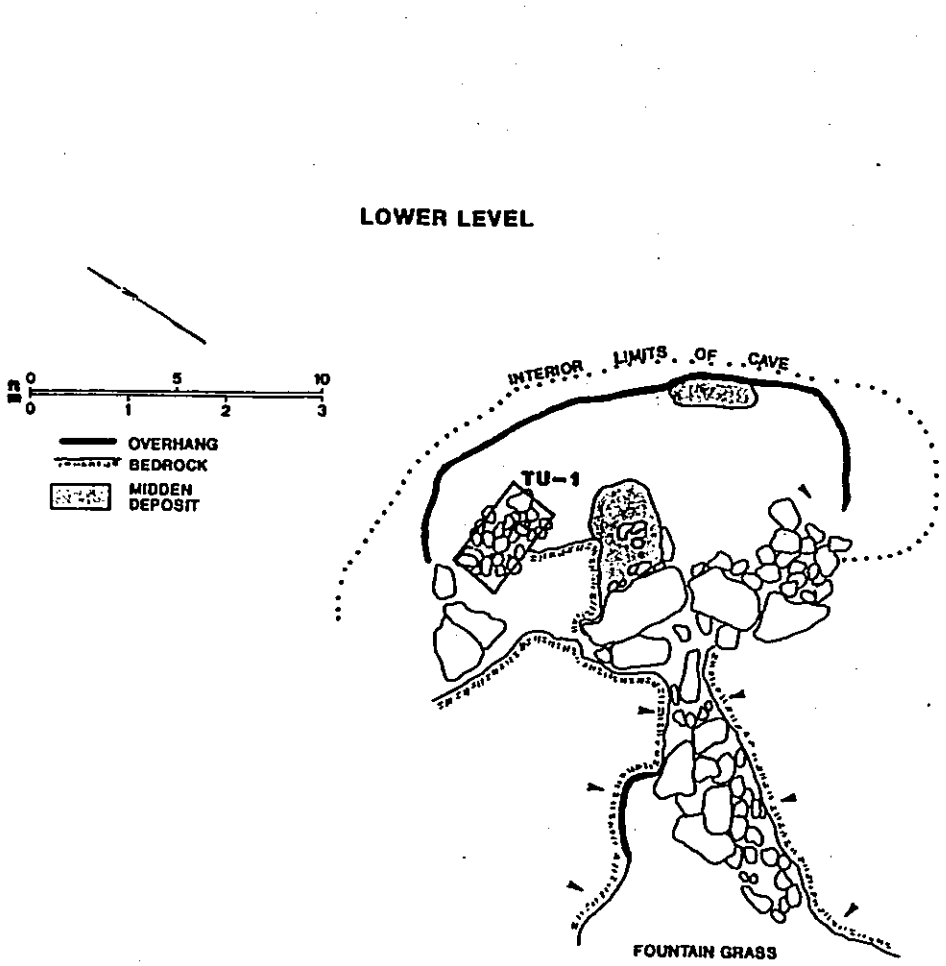


Figure A-21. SITE 13302, FEATURE C

PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DIMENSIONS: 0.57 m by 0.47 m by 0.38 m
DESCRIPTION: A blister type of excavation in which a small hole has been excavated. There are a few quarried blocks on the floor interior. No modifications except for c. 30 small boulders stacked in a circular arrangement around the opening.

SITE NO.: State: 13305 PHRI: T-55
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Smooth pahoehoe flow.
VEGETATION: Sparse grass, one kiawe tree, small 'ilima bushes, and succulent plants.
ELEVATION: c. 107 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DIMENSIONS: 0.63 m by 0.52 m by 0.53 m
DESCRIPTION: One small excavation into a pahoehoe blister. The associated quarried blocks are located 1.0 m to the northeast and are arranged in a rough alignment. Two faces are excavated; the mined pahoehoe layer is 0.15 m to 0.36 m thick. Depth of the excavation varies from 0.46 m to 0.53 m below surface. The interior is cleared of loose rubble and no soil is evident.

SITE NO.: State: 13306 PHRI: T-57
SITE TYPE: Complex (12 Features)
TOPOGRAPHY: Pahoehoe finger flows.
VEGETATION: Lantana, Christmas-berry, kiawe, and fountain grass.
ELEVATION: c. 209 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of 12 pahoehoe excavations, all of which are into blisters. Quarried stone is scattered haphazardly around and in the excavations. Overall site area is 55.0 m at 340 degrees Az. by 12.50 m.

SITE NO.: State: 13307 PHRI: T-58
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Pahoehoe fingers with aa flow surrounding the southeast area.
VEGETATION: Christmas-berry and fountain grass.
ELEVATION: c. 226 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DIMENSIONS: 1.10 m by 0.50 m by 0.35 m
DESCRIPTION: This is a semicircular excavation into a pahoehoe blister. A small overhang occurs under the north rim of the excavation. Quarried blocks are haphazardly arranged to the north and south of the excavation, and the interior area is cleared of larger pieces of rubble. The overall measurement including the quarried rocks is 4.10 m at 250 degrees by 2.20 m.

A soil deposit with gravel occurs within an area 0.70 by 0.35 m inside the excavation. The mined lava layer her is 0.22 m thick.

SITE NO.: State: 13308 PHRI: T-60
SITE TYPE: Trail
TOPOGRAPHY: The terrain consists of aa flow sloping NE to the SW.
VEGETATION: Sparse Christmas-berry and kiawe trees.
ELEVATION: c. 119 feet
CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 49.80 m by 0.82 m
DESCRIPTION: This trail section was identifiable only where it crossed an aa flow. It is segmented with places along the measured length that could not be distinguished. Portions of the trail that are distinguishable are slightly indented from the surrounding aa and paved with packed aa clinkers. A few portions of the trail are bordered with aa cobbles. The trail is oriented north/south, roughly parallel to the shoreline.

SITE NO.: State: 13309 PHRI: T-61
SITE TYPE: Terrace
TOPOGRAPHY: Uneven pahoehoe flow with a gentle flow from the northeast.
VEGETATION: Thick grass, lantana, koa-haole, kiawe, and sparse 'ilima.
ELEVATION: c. 106 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 2.80 m by 1.83 m by 0.25 m
DESCRIPTION: A roughly L-shape terrace, it is partially constructed on bedrock. It is faced on the SW side with large pahoehoe cobbles and is raised 0.25 m above the natural ground surface. The terrace surface is fairly smooth with small cobbles and pebbles used as fill.

SITE NO.: State: 13310 PHRI: T-62
SITE TYPE: Alignment
TOPOGRAPHY: Fairly flat smooth pahoehoe which slopes southeast of site.
VEGETATION: Fountain grass, kiawe, lantana, and koa-haole heavily surrounds the site.
ELEVATION: c. 74 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 4.20 m by 3.90 m by 0.21 m
DESCRIPTION: Pahoehoe blocks and slabs were removed and placed on top of smooth pahoehoe in a roughly semi-oval alignment. The blocks are single stacked, 0.10-0.20 m high, with additional blocks in and around the alignment. In all, there are c. 35 pahoehoe blocks. The interior measures 2.3 m (E-W) by 0.8 m (N-S). No indication of any type of pahoehoe excavation blister or crevice is in the area.

SITE NO.: State: 13311 PHRI: T-63
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Smooth pahoehoe flow that slopes to the SSW.
VEGETATION: Heavily surrounded with fountain grass, kiawe, koa-haole, lantana, and wild 'ilima.
ELEVATION: c. 71 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DIMENSIONS: 10.00 m by 9.20 m by 0.47 m
DESCRIPTION: This site consists of two excavated pahoehoe blisters. It is located within an area of smooth pahoehoe and heavy vegetation. All faces of both features are excavated. The excavated blisters are 5.8 m (NE-SW) apart from each other. Both blisters contain less than 0.05 m of brown soil deposit on the floor interiors.

One of the excavations is associated with an overhang that measures 6.0 m (N-S) by 3.5 m (E-W). The excavated blocks were removed and placed inside of the overhang at c. 1.0-2.0 m from the opening. There are c. 50 pahoehoe blocks in a random arrangement. This pahoehoe excavation measures 0.89 m (E-W) by 0.75 m (N-S). The maximum depth is 0.92 m and the excavated pahoehoe layer is 0.28-0.30 m thick. The excavated opening is semicircular shape in plan.

The second excavated blister is triangular in shape and measures 1.33 m (E-W) by 1.0 m (N-S). It is 0.36 m deep on the south side and 0.47 m on the north side. The 25 quarried blocks are placed on the south side of the excavation.

SITE NO.: State: 13312 PHRI: T-64
SITE TYPE: Terrace
TOPOGRAPHY: The immediate area consists of two flat areas separated by a 0.60 m vertical wall.
VEGETATION: Thick grass, koa-haole, and kiawe.
ELEVATION: c. 64 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 6.55 m by 1.13 m by 0.41 m
DESCRIPTION: This linear terrace is oriented NW-SE. It is raised on the southwest side 0.25 to 0.41 m, and faced with two to three courses of stacked cobbles. The terrace surface is fairly level, and fill consists of pahoehoe cobbles and pebbles. Two levels are present, with the upper level an average of 0.16 m above the lower level. The upper level surface is paved with small pebbles, whereas the lower level contains a deposit of soil at least 0.15 m thick.

SITE NO.: State: 13313 PHRI: T-66
SITE TYPE: Pecking marks
TOPOGRAPHY: The site is situated on top of smooth pahoehoe finger that slopes to the southwest. The finger is surrounded by aa flow.
VEGETATION: A low density of fountain grass, kiawe, kolu, and 'ilima surround the site.
ELEVATION: c. 65-70 feet
CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 0.30 m by 0.06 m
DESCRIPTION: The site consists of a series of pecked marks forming four round shallow depressions aligned on smooth pahoehoe. The average diameter of the depressions measures 0.05 m. There are many pahoehoe blocks and cobbles to the northwest and south side of the site.

SITE NO.: State: 13314 PHRI: T-67
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Undulating pahoehoe flow.
VEGETATION: Grass, koa-haole, and kiawe.
ELEVATION: c. 94 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/possible agriculture
DIMENSIONS: 1.61 m by 1.18 m by 0.63 m
DESCRIPTION: An excavated pahoehoe blister with one layer of pahoehoe penetrated. The interior of the excavation

is level and covered with small angular cobbles and three small boulders. The thickness of the excavated pahoehoe layer ranges from 0.23-0.63 m. The depth of the excavation ranges from 0.57-0.73 m below surface. There are c. 20 quarried blocks concentrated on the northwest side of the blister. They range in size from 19x11x20 to 45x23x18 cm.

SITE NO.: State: 13315 PHRI: T-68
SITE TYPE: Rubble wall
TOPOGRAPHY: The site is on a fairly flat pahoehoe blister that slopes slightly toward the WNW.
VEGETATION: The site is surrounded by koa-haole, fountain grass, kiawe, and Christmas-berry.
ELEVATION: c. 88 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 2.95 m by 0.95 m by 0.32 m
DESCRIPTION: A rubble wall of pahoehoe blocks and slabs occurs in an area of natural collapse and high density of vegetation. The wall width ranges from 0.24-0.95 m and the height from 0.12-0.32 cm. The types of rocks consists of surface blocks and slabs of both smooth and ropy pahoehoe, and aa cobbles. The wall is along the edge of a naturally collapsed blister. There are c. 30 blocks and/or slabs present.

SITE NO.: State: 13316 PHRI: T-69 *(Figure A-22)*
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Pahoehoe flow.
VEGETATION: Fountain grass, koa-haole, 'ilima, kiawe, impatiens, and lantana.
ELEVATION: c. 108 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DESCRIPTION: This site consists of eight pahoehoe excavations, six of which are in blisters and two of which are along crevices. Overall site area is 33.55 m at 356 degrees Az. by 12.60 m. The excavations range from 0.42 m x 0.45 m x 0.29 m to 2.54 m x 1.8 m x 0.52 m. The thickness of the excavated pahoehoe layer averages 0.25 m.

SITE NO.: State: 13317 PHRI: T-70
SITE TYPE: Pavement
TOPOGRAPHY: Fairly flat smooth pahoehoe setting.
VEGETATION: Dense grass, koa-haole, kiawe, and morning glory.
ELEVATION: c. 93 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 6.00 m by 2.00 m by 0.05 m
DESCRIPTION: An arrangement of pahoehoe cobbles set in a single layer on smooth pahoehoe. No portable remains or soil is present.

SITE NO.: State: 13318 PHRI: T-71
SITE TYPE: Modified blister
TOPOGRAPHY: Fairly flat and smooth pahoehoe flow.
VEGETATION: Moderate grass, small koa-haole trees, and lantana bushes.
ELEVATION: c. 98 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DESCRIPTION: A large collapsed pahoehoe blister that is partially cleared of natural collapse rubble. The cleared portion is 1.50 by 1.40 m, and located at the northwest eilge of the blister. The remained of the interior area is filled with loosely piled rubble. No portable remains were observed at the site.

SITE NO.: State: 13319 PHRI: T-72
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Fairly even pahoehoe flow to the west with an aa flow to the northeast.
VEGETATION: Koa-haole and morning glory.
ELEVATION: c. 105 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DIMENSIONS: 3.85 m by 0.00 m by 0.39 m
DESCRIPTION: This site consists of an excavated edge of the pahoehoe flow. The flow edge is oriented c. N-S with the actual excavation at various points along the face edge.

One layer of pahoehoe is excavated with the average thickness at 0.39 m. The quarried blocks are located to the west and east of the aa flow.

SITE NO.: State: 13320 PHRI: T-73
SITE TYPE: Modified blister
TOPOGRAPHY: A collapsed blister of smooth pahoehoe.
VEGETATION: Thick fountain grass, koa-haole trees, and small 'ilima bushes.
ELEVATION: c. 140-147 feet
CONDITION: Fair
INTEGRITY: Unaltered

Figure A-22. SITE 13316. View to West (PHRI Neg.1243-35).

PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate
DIMENSIONS: 9.00 m by 4.88 m by 0.82 m
DESCRIPTION: A wide alignment of angular boulders divides this collapsed blister into three small cleared areas that located along and under the rim of the blister perimeter. The rubble alignment is 9.00 m long and has a maximum width of 3.50 m and average height of 0.62 m. It is oriented E-W across the center of the blister, with the cleared compartments to the north and south sides.

Portions of the blister dripline have been excavated, and smaller blocks are randomly located around the rim edges of the blister. The blocks range in size from 12x9x10 cm to 84x61x16 m. The thickness of the excavated face ranges from 0.26 to 0.82 m. The depth ranges from 0.31 to 1.36 m below surface. Weathered pig bones and plastic are present in the blister.

SITE NO.: State: 13321 PHRI: T-74 *(Figure A-23)*
SITE TYPE: Boulder concentration
TOPOGRAPHY: A collapsed pahoehoe blister.
VEGETATION: Moderately thick fountain grass, lantana, 'ilima, koa-haole, kiawe, and Christmas-berry.
ELEVATION: c. 110 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 16.95 m by 5.08 m by 0.59 m
DESCRIPTION: The site consists of a boulder mound and concentration, located in a collapsed blister. The concentration consists of large angular cobbles and boulders, some of which appear to be excavated from sections around the rim of the blister. The blocks range in size from 9x4x6 cm to 94x52x37 cm. The mounded area of the concentration is oriented N-S, across the short axis of the blister, at the west end. It is 5.00 m long and 1.50 m wide, with a narrow 5.00 m long extension to the east. Average height is 0.50 m. A curved low rubble wall adjoins the west side of the mound, forming a 2.00 by 0.70 m enclosed area.

To the east of the mound is a 10.00 by 3.00 m area of rubble paving, which is slightly mounded in the center. The paving follows the northern perimeter of the blister and extends into the center, within 1.50 m from the south perimeter. A second smaller area of rubble occurs at the eastern end of the blister. No soil was observed in the blister, however, deposits could be present beneath the rubble fill.

SITE NO.: State: 13322 PHRI: T-75
SITE TYPE: Trail section
TOPOGRAPHY: A southwest sloping aa flow.
VEGETATION: Thick grass and koa-haole; succulents growing on portions of the trail.
ELEVATION: c. 129 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/early historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 7.30 m by 0.96 m
DESCRIPTION: A small foot trail oriented N-S across the aa flow. It consists of a cleared, packed linear area bordered by natural aa formations. AA cobbles border the sides of the trail in some places. The trail floor consists of small aa clinkers and occasional small aa cobbles.

The trail is distinguishable only where it crosses aa, and cannot be identified in the smooth pahoehoe to the east of the aa. The west end of the trail is at a ridge of mixed aa and pahoehoe. It is possible that this trail segment is part of the same trail as SIHP Site No. 13323.

SITE NO.: State: 13323 PHRI: T-76
SITE TYPE: Trail
TOPOGRAPHY: Very gently sloping aa field, fairly free of vegetation. The terrain slopes from the NE to the SW.
VEGETATION: Thick grass and large kiawe tree; Chrismas-berry and lantana on segment of trail.
ELEVATION: c. 134 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 36.20 m by 1.01 m
DESCRIPTION: This trail section is oriented NW-SE across an aa flow. It consists of a cleared linear area bordered by natural aa formations and aa cobbles at various places along the trail borders. The trail floor is mostly covered with small clinker size aa that is packed and slightly worn smooth by foot traffic.

At c. 10.0-15.0 meters northeast of the trail there are four surface pahoehoe slabs in an alignment, oriented parallel to the trail. The trail could not be followed beyond the aa flow. Site 13322, located c. 95.00 m to the north, is probably a continuation of this trail.

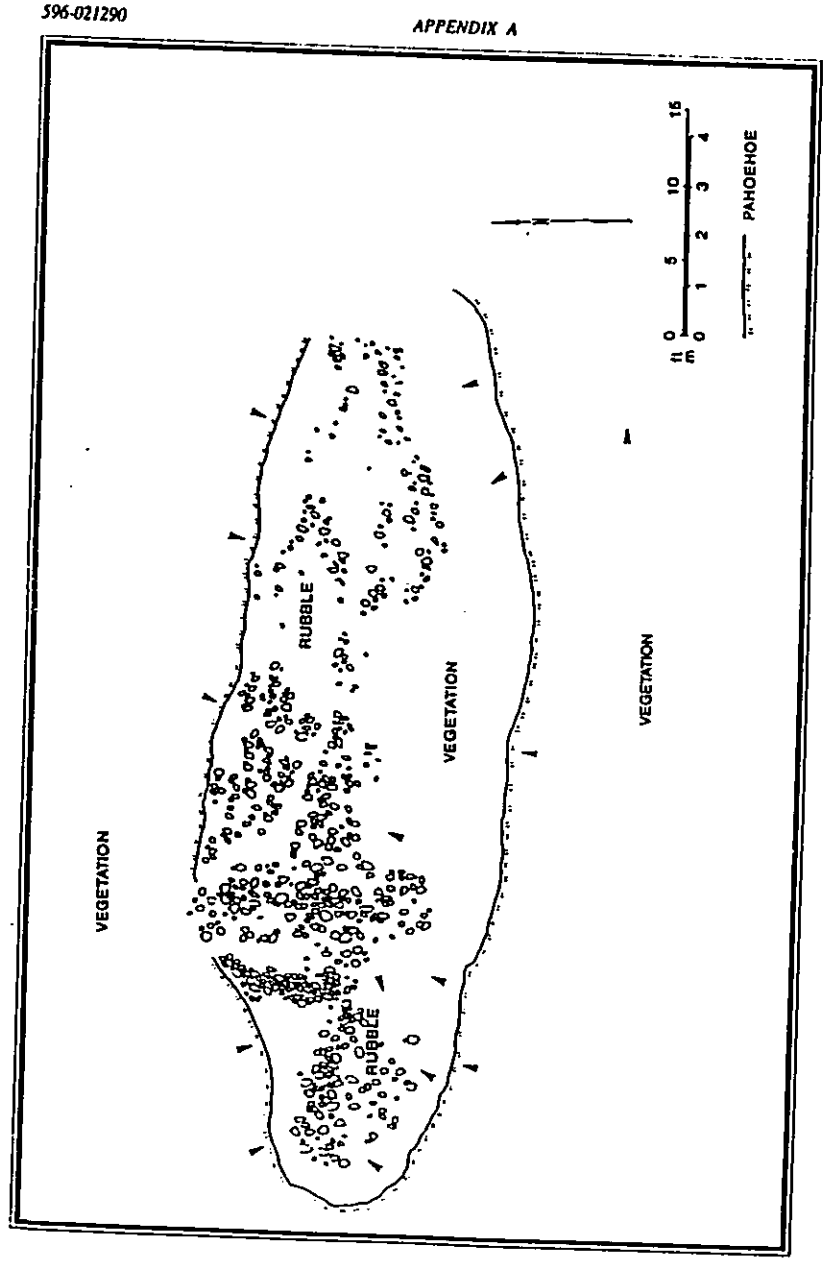


Figure A-23. SITE 13321

SITE NO.: State: 13324 PHRI: T-80
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Very broken, cracked, and slightly faulted smooth and ropy pahoehoe. It consists of a gentle slope from the east.
VEGETATION: Moderate grass, thick lantana, koa-haole, kiawe, small Christmas-berry trees, and 'ilima bushes.
ELEVATION: c. 213 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry/agriculture
DESCRIPTION: This site consists of ten excavated areas on top of a pahoehoe flow. Overall site area is 34.20 m at 185 degrees Az. by 30.92 m. There are five excavated crevices and five excavated blisters at the site. Six features have been cleared or partially cleared of loose rubble.

The excavated areas are small with two to four faces excavated. Average size of the excavations is 1.52 m by 1.38 m. Thickness of the excavated pahoehoe layer is 0.17 m and the maximum depth of the features is 0.31 m below surface. The quarried blocks are concentrated in close proximity around the excavated edges.

SITE NO.: State: 13325 PHRI: T-83 *(Figure A-24)*
SITE TYPE: Terrace
TOPOGRAPHY: Pahoehoe finger flow
VEGETATION: Fountain grass and Christmas-berry.
ELEVATION: c. 240 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 3.15 m by 2.90 m by 0.40 m maximum height
DESCRIPTION: The site consists of a circular terrace and adjacent area of cobble paving. The terrace is 3.80 m in diameter and raised on the north side. The paved area is immediately to the east and southeast sides of the terrace. It is 6.80 m N-S by 4.20 m E-W. The pavement and terrace surfaces are essentially level, and the edges of the pavement are scattered, with no defined perimeters.

A 1.00 by 1.00 m square test unit was excavated into the terrace, in order to determine if buried cultural features were present. The terrace fill was found to consist of two layers of cobble-size pahoehoe pieces, underlain by smaller pebble-size pieces and soil. The fill is 0.34 m thick and the soil/pebble layer is 0.06 m thick. A sample of the soil was collected for additional analysis (see subsurface findings). No portable remains or cultural material was encountered in the test unit.

SITE NO.: State: 13326 PHRI: T-85 *(Figure A-25)*
SITE TYPE: Platform
TOPOGRAPHY: Smooth and ropy pahoehoe flow sloping gently from the northeast.
VEGETATION: Thick grass, koa-haole, kiawe, and Christmas-berry.
ELEVATION: c. 189 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 2.99 m by 1.97 m by 0.81 m maximum height
DESCRIPTION: This small, amorphous platform is constructed from small to medium-size angular pahoehoe cobbles, with a perimeter of large blocks and slabs set on edge. It is built on smooth pahoehoe, near a partially collapsed blister.

The platform is raised on all four sides, with heights ranging from 0.23 to 0.81 m. The pahoehoe blocks used for the perimeter average 48x45x13 cm. No pavement is present, and the surface is somewhat irregular.

A 1.00 by 1.00 m square test unit was excavated into the feature, in order to ascertain whether it contained a subsurface feature, such a human skeletal remains. The test unit revealed a fill layer of 0.43 m thick, which exhibited no evidence of size or material sorting. A few Echinoidea fragments were located, scattered in the fill. At the base of the fill was a small opening in the pahoehoe surface which contained soil and additional midden remains (one Cypraeidae shell fragment, one *Brachidontes* c. valve, one Isognomonidae valve, and several Echinoidea fragments. The soil deposit was 0.04 m thick and occurred only in the pahoehoe opening. A sample of the soil was collected for further analysis (see subsurface findings).

Two pahoehoe excavations with associated blocks are located c. 10.0 m east of the platform.

SITE NO.: State: 13327 PHRI: T-88
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: A ridge top that is oriented c. inland/seaward. Smooth and ropy pahoehoe with natural cracks and breakage.
VEGETATION: Moderate amounts of grass, kiawe, koa-haole, and small 'ilima bushes.
ELEVATION: c. 191 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry

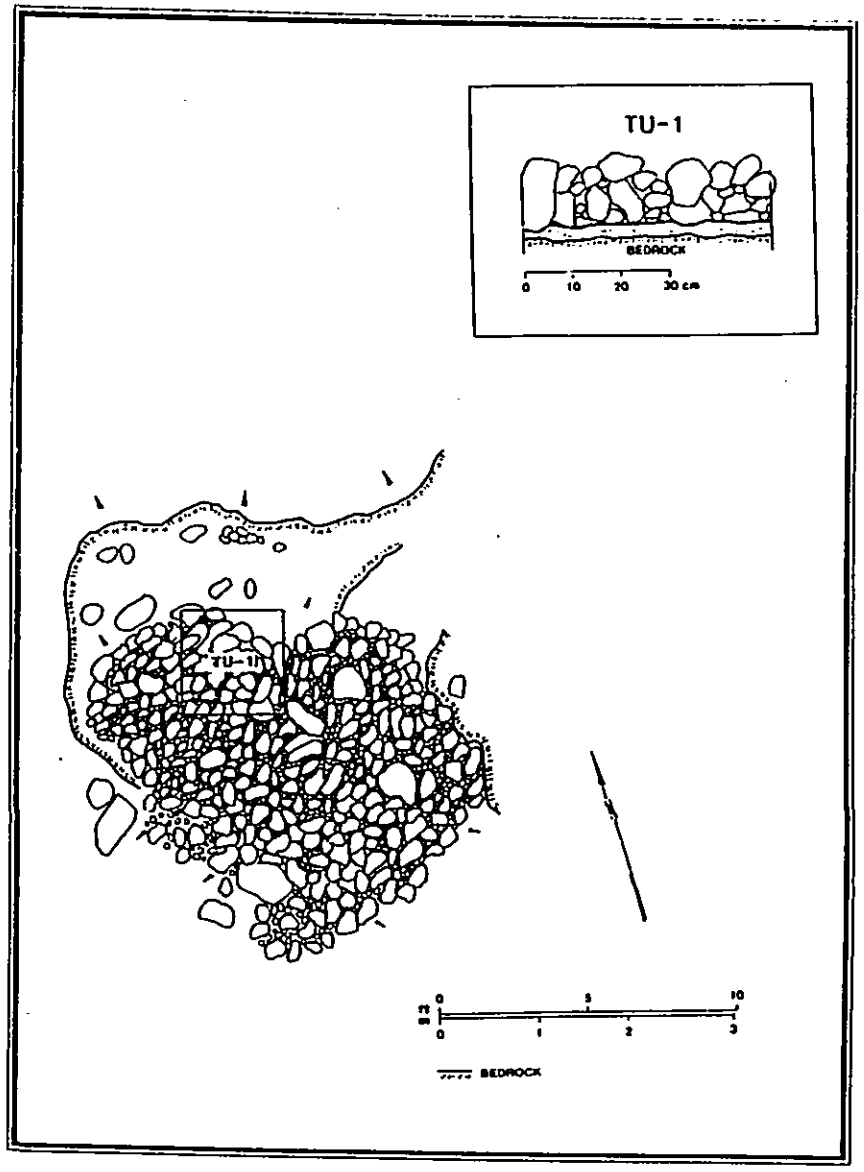


Figure A-24. SITE 13325

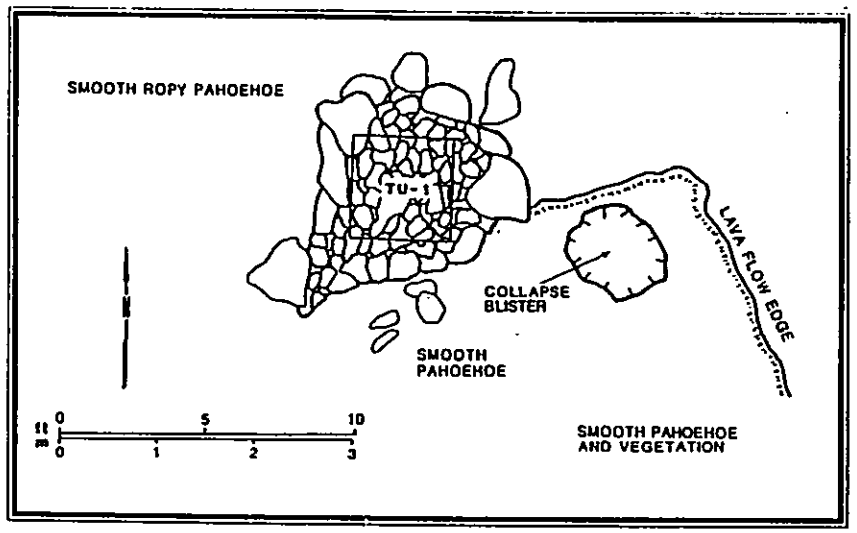


Figure A-25. SITE 13326

DIMENSIONS: 6.30 m by 5.35 m by 0.56 m
DESCRIPTION: This site consists of two small areas on a blister with excavated faces. One excavation measures 1.60 by 1.30 m and one measures 1.40 by 0.92 m. Average thickness of the excavated pahoehoe layer is 0.19 m, and average depth is 0.56 m.

The quarried blocks are concentrated to the southeast and range in size from 14x11x9 cm to 35x24x12 cm. The floor areas of the excavations are covered with a few of the quarried blocks.

SITE NO.: State: 13328 PHRI: T-89
SITE TYPE: Cave
TOPOGRAPHY: Located on the northeast side of a large collapsed blister.
VEGETATION: Koa-haole, kiawe, and fountain grass.
ELEVATION: c. 214 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 8.38 m by 6.52 m by 2.65 m
DESCRIPTION: The entrance to the cave faces southwest at 240 degrees Az. It is 2.25 m wide and has a ceiling height of 1.7 m. Directly south of the cave entrance is a collapsed tube which extends for an indeterminate distance (inaccessible due to ceiling collapse). The north corner of the cave contains a crawlspace which extends 3.0 m from the main chamber.

Most of the cave floor is covered with a layer of pahoehoe which collapsed from a shelf 0.24 to 0.66 m above the cave floor. The shelf is present around the perimeter of the cave, and protrudes 0.50 to 2.50 m from the side walls. The center of the cave floor consists of large scattered boulders and cobbles from ceiling collapse.

A 3.05 by 2.80 m area of concentrated midden, soil and ash occurs near the center of the cave. Portable remains observed on the surface include eight Cypraeidae fragments, 50+ *Nerita picea*, four Echinoidea fragments, fishbone, and scattered goat bones. A 0.06 m thick ash deposit with small pieces of charcoal is also present.

SITE NO.: State: 13329 PHRI: T-93
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: The site is located in a steeply cut ravine with rock faces measuring c. 4.0 m in height on both sides. Two caves are at the east and west ends of the ravine. The bottom of the ravine is filled with loose broken pahoehoe.
VEGETATION: Fountain grass, kolu, Christmas-berry and lantana.
ELEVATION: c. 226 feet
CONDITION: Good
INTEGRITY: Unaltered-altered
PROBABLE AGE: Modern historic
FUNCTIONAL INTERPRETATION: Habitation-agriculture
DESCRIPTION: The overall site complex measures c. 31.5 m from the opening of the cave to the west end of the agriculture feature by 11.0 m. The complex consists of a cave (Feature A), and a low agricultural enclosure (Feature B) that is in current usage. A second cave 15.0 m west of Feature B contains a large deposit of recent refuse; it was not designated a feature.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 9.75 m by 5.10 m by 1.65 m
DESCRIPTION: The cave consists of a broad overhang type opening which narrows as the floor slopes downward. The opening is 5.40 m wide with a ceiling height of 2.25 m. The main axis of the tube is oriented at c. 280 degrees azimuth and the drop in the tube floor is 2.50 m from the opening to the back of the cave. Portions of the steeply sloping floor appear to be filled, but not formally. Approximately 75% of the floor is covered with loose wall and ceiling collapse. A small leveled area is present on a small natural terrace midway along the main axis of the tube.

At the back of the cave is a low crawlspace with goat bones. It is too narrow for access and measures 2.5 m deep and 5.1 m wide with a ceiling height of 0.2 m to 0.6 m. Some soil and goat bones are present in the crawlspace.

Portable remains observed inside the cave include goat bones, one each Isognomonidae, *Brachidontes* c., Echinoidea, a golf ball, and some sticks.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 8.00 m by 5.00 m by 0.88 m
DESCRIPTTION: Generally oval shape in plan, the enclosure has cleared compartments separated by loosely stacked pahoehoe blocks. The planting areas are currently in cultivation with ornamentals and herbaceous plants growing. The enclosure walls are 0.51 m wide and 0.88 m high. Adjacent to the enclosure are three sleeping areas constructed with stacked slabs. These are in current usage, as indicated by sleeping bags and personal effects. There is a good deal of recent refuse in the immediate vicinity.

SITE NO.: State: 13330 PHRI: T-94
SITE TYPE: Complex (11 Features)
TOPOGRAPHY: Relatively undisturbed pahoehoe with large collapsed tube situated near a ravine. The tube measures c. 25.0 m long, by 8.0 m wide with a lava tube cave at the east end and overhangs along the rim.
VEGETATION: Relatively sparse on the site. Christmas-berry and fountain grass in low areas.
ELEVATION: c. 228 feet
CONDITION: Poor-good
INTEGRITY: Unaltered-altered
PROBABLE AGE: Prehistoric-historic (recent)
FUNCTIONAL INTERPRETATION: Agriculture-modern habitation
DESCRIPTION: The overall complex area measures 25.0 m at 240 degrees Az. by 15.0 m. It consists of five excavations along the south edge of the collapsed tube, one along the north side, one excavation and three cleared areas within the collapse, and a modern habitation cave.

The modern habitation cave is a long tube with openings at both ends. The main area of occupation is at the east end of the tube. There is a hearth with tin cans and a hanging (lantern) can at the west opening. On the south side are styrofoam cups and rocks arranged for sitting. Also noted were water bottles, glass, chairs, fast food containers and goat bones.

The pahoehoe excavations are shallow (less than 0.20 m deep) with flat, unbroken pahoehoe floors. The excavated blocks and slabs are haphazardly placed around the perimeter of the excavations, with some loose stacking. Little to no soil is present in the excavations or clearings.

SITE NO.: State: 13331 PHRI: T-95
SITE TYPE: Complex (33 Features)
TOPOGRAPHY: Gently undulating pahoehoe terrain.
VEGETATION: Christmas-berry, grass, and koa-haole.
ELEVATION: c. 238 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DESCRIPTION: The overall site complex measures at the least 75.0 m at 300 degrees Az. by 60.0 m. It consists of 24 excavated pahoehoe blisters, three rock mounds inside the excavated blisters, one low wall, and seven linear mounds.

The pahoehoe excavations are generally circular and shallow, with solid, flat floors and no soil. The excavations are concentrated in an area just west of the wall feature.

A typical pahoehoe excavation is 2.10 by 1.55 m by 0.44 m maximum depth. The overall area of scattered pahoehoe blocks is 6.00 by 5.00 m. Small pockets of pebbles occur around the perimeter, where a small dripline occurs. The central portion contains mostly larger blocks.

The wall is loosely stacked, four to five courses high, and unfaced. It is 13.00 m long, oriented 300 degrees Az. There are detached segments of the wall that continue in the same line for an additional 20.5 m. The average wall height is 0.35 m and the average width is 0.30 m. Parallel to the east at 4.0 m is a long alignment of detached wall segments.

Approximately 50.0 m to the southwest of the site is a large blister filled with modern trash and a recent sleeping area under the overhang with the sleeping bag still present. There was too much trash to determine if the large blister was modified or used prehistorically.

SITE NO.: State: 13332 PHRI: T-96
SITE TYPE: Complex (12 Features)
TOPOGRAPHY: Pahoehoe finger flows with caves and lava tubes.
VEGETATION: Christmas-berry, kiawe, fountain grass, and panini.
ELEVATION: c. 242 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall site complex measures 60.0 m at 25 degrees Az. by 15.0 m. Features identified include five pahoehoe excavations, two mounds, and five alignments. The features are in a roughly curved pattern around an unmodified cave that contains no evidence of cultural use. An opening to a lava tube that measures c. 80.0 m long exists opposite the cave and ends at SIHP Site No. 13357.

Two of the pahoehoe excavations have been backfilled and three have blocks haphazardly thrown to the outside, around the perimeter.

The features at this site have not been individually measured to date.

SITE NO.: State: 13333 PHRI: T-97
SITE TYPE: Wall
TOPOGRAPHY: Pahoehoe
VEGETATION: Fountain grass, kiawe, and Christmas-berry
ELEVATION: c. 244 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible agriculture
DIMENSIONS: 4.10 m by 3.20 m by 0.80 m
DESCRIPTION: The wall is constructed with piled boulders and cobbles, and is faced on the south side. The major axis is oriented 300 degrees Az. Portions of the wall are collapsing, however, it is in relatively good preservation.

SITE NO.: State: 13334 PHRI: T-100 *(Figure A-26)*
SITE TYPE: Complex (24+ Features)
TOPOGRAPHY: Undulating terrain with many exposed bedrock outcrops.
VEGETATION: Thick elephant grass, moderate to thick koa-haole and kiawe trees; yellow flowering weeds; moss and lichens.
ELEVATION: c. 81 feet
CONDITION: Fair-good
INTEGRITY: Unaltered-altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site complex consists of 16+ modified outcrops with angular cobbles and boulders stacked and piled around outcrops to create terraces, paved areas and clearing piles, and 4+ collapsed blisters filled with small angular cobbles. There are additional agricultural features on the site consisting of an indeterminate amount of pahoehoe excavations and modified outcrops.

FEATURE A: Modified outcrop (3 Terraces)
FUNCTION: Agriculture
DIMENSIONS: 12.00 m by 10.00 m by 2.45 m
DESCRIPTION: Feature A consists of three levels of modified outcrops. The uppermost level is partially excavated to form terracing along the south side. This terraced area measures 4.00 m (E-W) by 2.00 m (N-S). The terrace is raised on the south side with heights ranging from 0.34 to 1.08 m. The surface is level and paved with cobbles and small boulders. A cairn is situated at the SW corner with a second possible cairn located at the SE corner.

The two lower outcrops are modified to form terraces to the south and east of the upper level. The southern terrace is raised on the south side and is fairly flat with cobbles and soil fill. The terrace to the east has is raised along the southeast side, and has a flat surface of soil and cobbles. An outcrop adjoining this terrace on the east side outlines a

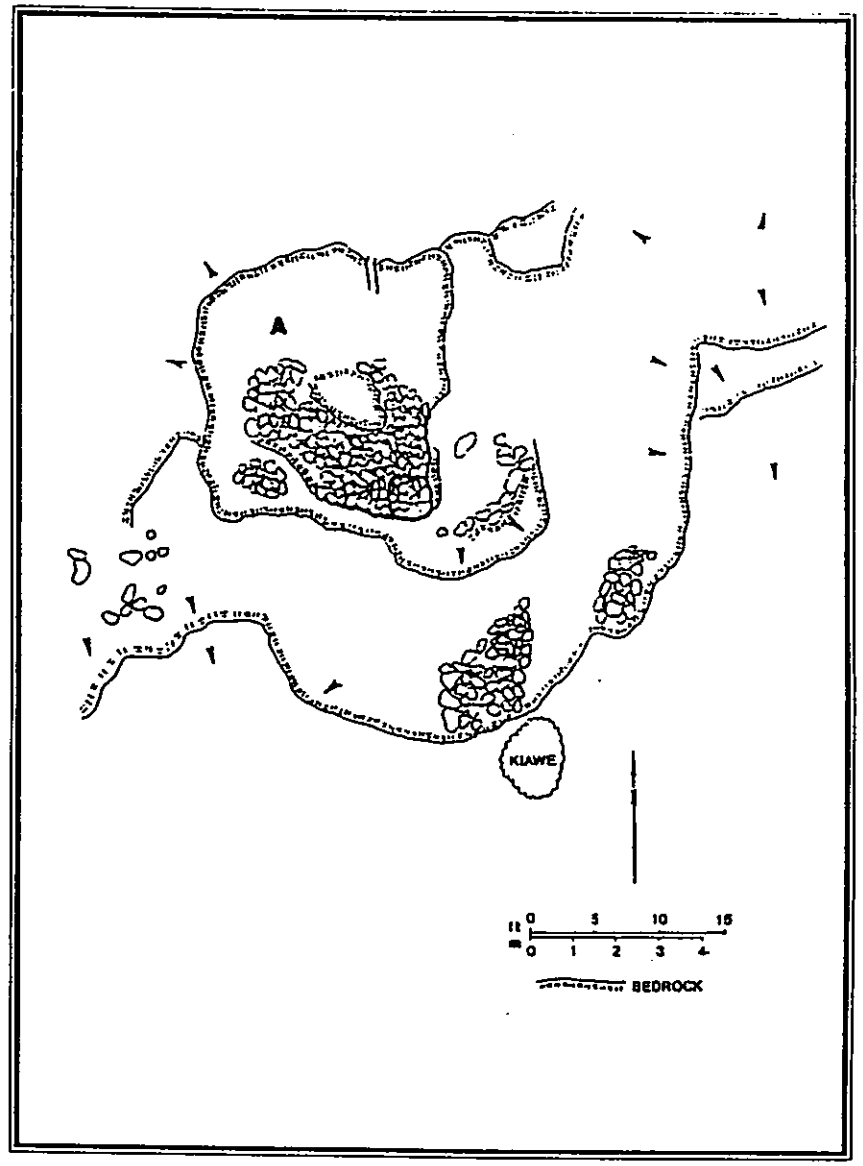


Figure A-26. SITE 13334, FEATURE A

rectangular-shaped area that has a soil deposit and a small cleared spot with pebbles and a Cypraeidae shell fragment. Another flat soil terraced area is to the west.

There are 16 additional modified outcrops on the site. Cobbles and boulders are stacked, piled and filled around the natural outcrops to create terraces, paved areas and clearing mounds. These modified outcrops are primarily to the west of Feature A.

At least four collapsed blisters are filled with small angular cobbles and pebbles. The resulting modifications are paved areas.

SITE NO.: State: 13335 PHRI: T-101
SITE TYPE: Complex (18 Features)
TOPOGRAPHY: Terrain consists of a gentle north to south slope with numerous naturally exposed bedrock outcroppings.
VEGETATION: Thick grass, moderate amounts of koa-haole and kiawe trees, a few lantana bushes and vines with yellow flowers.
ELEVATION: c. 82 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: This site consists of 11 modified outcrops, five rock mounds, one terrace (Feature A) and one platform (Feature B). The overall complex area measures 24.8 m at 53 degrees Az. by 30.6 m.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 12.60 m by 1.40 m by 0.32 m
DESCRIPTION: The terrace begins at the southwest corner of the site and is oriented diagonally NE-SW across the site. The retaining wall is constructed with stacked and piled small pahoehoe cobbles, one to three stones high, placed in a linear pattern. Several low bedrock outcrops with soil deposits on the surface between the outcroppings abut the retaining wall creating leveled areas.

FEATURE B: Platform *(Figure A-27)*
FUNCTION: Agriculture
DIMENSIONS: 4.50 m by 1.86 m by 0.66 m
DESCRIPTION: The platform is 5.00 m northeast from Feature A. It is roughly rectangular shape in plan it is constructed with piled pahoehoe cobbles, and paved with slabs at the south end. The perimeter is constructed with some boulders, but is not distinctive from the platform fill material. The feature has a ramp-like surface profile and slopes downhill from northeast to southwest, along the major axis.

A soil terrace defined by cobbles is situated on the east side of the platform. It measures c. 3.36 m by 1.0 m. One bovine leg bone shaft in very poor condition was found on the surface.

A 1.00 by 2.10 m test trench was excavated across the minor axis of the feature, at the center. The purpose of the trench was to determine if subsurface features, such as human skeletal remains, were present. The uppermost fill layer consisted of a single course of thin pahoehoe slabs, fitted tightly together to form a smooth surface. Beneath the surface layer was undifferentiated fill consisting of very large cobbles and boulders, up to five courses thick (0.68 m). A layer of dark brown loamy soil with numerous pebbles was encountered below the rock fill. This layer varied in thickness from 0.04 to 0.22 m, depending upon the configuration of underlying bedrock. No cultural material of portable remains occurred in the soil deposit. A soil sample was collected for further analysis (see subsurface findings).

The modified outcrops (n=11) range in size from 3.6 m x 1.7 m to 7.2 m x 1.2 m and consists of angular cobbles and small boulders filled in, around and on top of the exposed pahoehoe. The rock mounds (n=5) consist of angular cobbles stacked and placed in circular or linear low mounds. These mounds range in size from 0.85 x 0.60 m to 3.3 m x 3.0 m.

SITE NO.: State: 13336 PHRI: T-102
SITE TYPE: Complex (30+ Features)
TOPOGRAPHY: Fairly flat area with naturally occurring areas of exposed bedrock.
VEGETATION: Thick grass, moderate density of large kiawe trees, a few small koa-haole trees, yellow-flowered vines, and lantana.
ELEVATION: c. 84 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 39.0 m by 25.0 m. This site consists of 25 modified outcrops and at least five pahoehoe excavations and an enclosure.

The modified outcrops are constructed with angular cobbles and boulders that are stacked and piled along bases of small rises, used as fill within crevices, and stacked in alignments to create small soil-filled terraces. Areas have

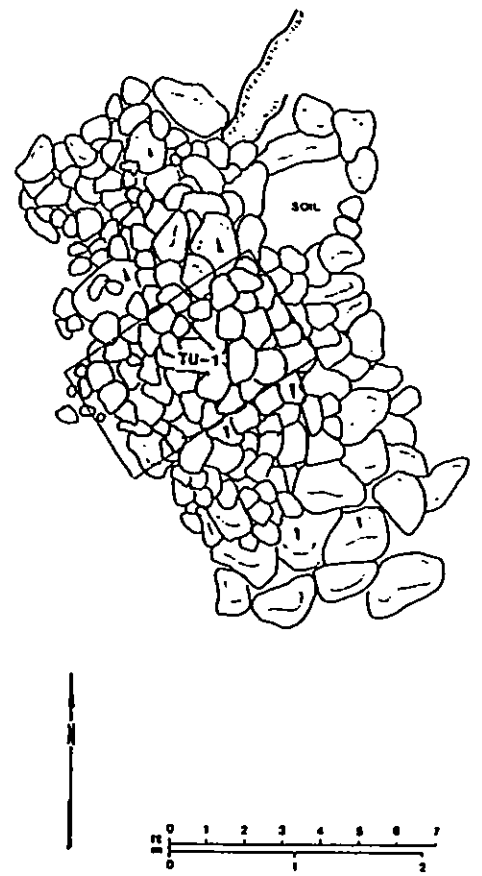


Figure A-27. SITE 13335, FEATURE B

been cleared and possibly excavated to create small planting plots. These range in size from 0.90 m x 0.70 m to 2.4 m x 1.3 m with at least 0.15 m thick soil deposits.

At the northwest base of a large modified outcrop is a small circular enclosure constructed with angular pahoehoe blocks, single stacked, 3-4 blocks high. The walls are 0.25-0.32 m wide and 0.25-0.71 m above the exterior ground surface. The interior floor is noticeably lower than the exterior ground surface. The interior depth of the floor is 0.34-0.53 m below the top of the wall. The interior area measures 0.97 m (NW-SE) by 0.63 m NE-SW. There is 0.20+ m soil deposit inside the enclosure. The SE end incorporates a natural bedrock outcrop.

SITE NO.: State: 13337 PHRI: T-104
SITE TYPE: Complex (34+ Features)
TOPOGRAPHY: Gently sloping from north to south, with much exposed bedrock outcrops with crevices and slight faulting.
VEGETATION: Thick elephant and fountain grasses, moderate density of koa-haole and kiawe trees, thick lantana, and a few monkey pod trees.
ELEVATION: c. 100-115 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 55.0 m (E-W) by 46.0 m (N-S). Features identified include a platform (Feature B) and 33 modified outcrops, eight of which have been designated Features A, C and D for individual description.

FEATURE A: Modified outcrop (5) ***(Figure A-28)***
FUNCTION: Agriculture
DIMENSIONS: 12.60 m by 11.00 m by 1.39 m
DESCRIPTION: This feature consists of five modified outcrops, one oriented N-S along the west boundary, one to the NE, one to the east, one to the SE and one located in the center of the feature area. Small to large angular cobbles have been stacked and piled around the exposed outcrops. In some cases the outcrops have areas that appear to have been paved. There are a few cobbles scattered over the soil area, between the outcrops. In addition, there are a couple of short rough alignments. There is at least 0.25 m of medium brown silty clay with organic material within the low areas bordered by the outcrops.

FEATURE B: Platform
FUNCTION: Agriculture
DIMENSIONS: 14.50 m by 5.75 m by 1.30 m

Feature B is 5.00 m northwest of Feature C. and 15.00 m east of Feature A. The main portion of this feature appears to be a SW sloping platform with faced sections on all four sides. There is exposed bedrock on the central NW side, east corner and central SE side.

The platform measures 8.0 m by 5.75 m. The surface is roughly flat and is built of small basalt boulders with some large cobbles, stacked on the outcrop. The highest face (NW) is six courses high with the remaining faces two to five courses high.

The upper center of the platform contains an excavated circular depression that measures 1.5 by 1.4 m and 0.3 m deep. The upper half of the platform is roughly level with the steeper slope starting about 1.0 m to the SW of the depression. There is a slight taper of the platform to the SW with the end being 2.3 m wide.

The top end of the platform contains another excavated circular depression measuring 2.5 m by 2.4 m and 0.5 m deep. The top facing of the platform forms part of the excavated wall.

There is a third circular depression at the north corner edge of the platform. It is faced on the south and east sides with a single alignment forming the rest of the circle. The facing averages 0.70 m in height. This facing is the northern corner of the platform. The depression appears natural and not excavated.

There is also a stone mound at the southwest end of the platform which may be a continuation of the platform as the sides follow the tapering lines. However, there is a 0.5 m separation between the mound and the platform with no stacked stone and the facing not evident. The mound is 2.3 m (NE-SW) and 2.35 m at the widest side (NE) and 0.9 m high. It is composed mainly of small basalt boulders with some large cobbles, stacked on bedrock.

There is a smaller modified outcrop 2.5 m to the NW. It measures 4.80 m (E-W) by 2.25 m (N-S) by 0.75 m in height. It is constructed of small basalt boulders and large to small cobbles stacked against the east side of a linear outcrop.

FEATURE C: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 13.50 m by 8.00 m by 0.60 m
DESCRIPTION: This feature consists of two adjacent modified bedrock outcrops. The first is linear with the long axis oriented NW-SE. Small basalt boulders and large medium cobbles are stacked on the outcrop leaving bedrock

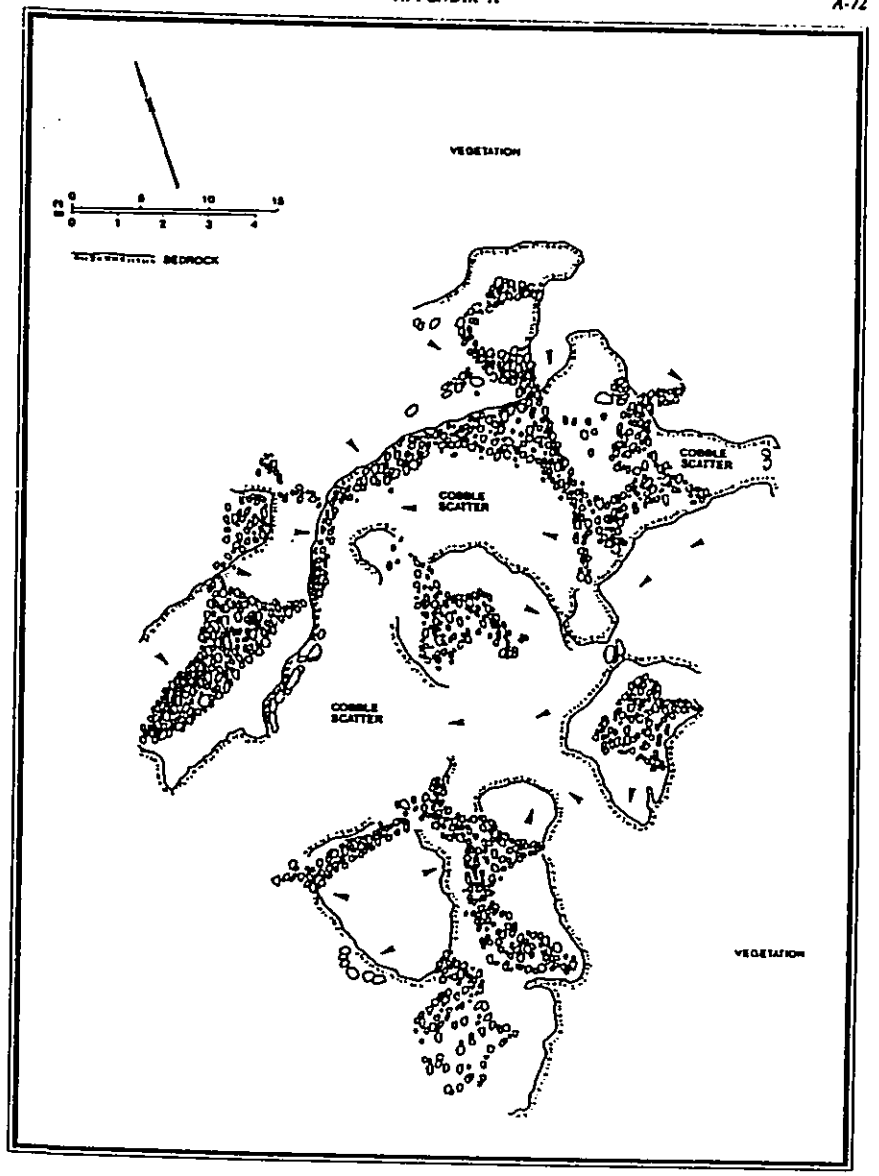


Figure A-28. SITE 13337, FEATURE A

exposed at the north and east corners and also the SW corner. There is a small faced section at the central SW edge, stacked 3 courses high. The linear outcrop measures 5.75 m (NW-SE) by 3.5 m (NE-SW) and 0.90 m in height. The surface is fairly rough.

The second outcrop begins 1.60 m to the NE. It measures 9.5 m (N-S) by 8.0 m (E-W). This outcrop is fairly flat with a slight slope to the SW. The surface is rough with scattered rubble. Three pahoehoe excavations were quarried into the outcrop. Some of the excavated material from this outcrop may have been moved to another feature.

The first pahoehoe excavation is circular and at the southern corner. The quarried material appears to have formed an alignment around the edges but much has collapsed inward. It is 1.20 by 1.20 by 0.45 m deep.

The second excavation is roughly located west of the central area of the outcrop. It is roughly circular with some of the material stacked on the edges. Slightly collapsing at present. It measures 1.30 m by 1.20 m by 0.30 m deep.

The third excavation is located at the NE side of the outcrop. It is roughly oval with the long axis running NW-SE. It measures 2.70 m by 1.70 m by 0.55 m deep. The bottom is fairly clear with minor collapse. Much of the excavated material appears to have been set in an alignment to the SW running NW-SE.

The second and third excavation have soil deposits of 0.10 to 0.25 m. Soil between the outcrops averages 0.10 m thick. There is a fourth depression on the SE edge which may have been utilized that appears unexcavated.

FEATURE D: Modified outcrop
FUNCTION: Indeterminate
DIMENSIONS: 12.00 m by 9.70 m by 1.75 m
DESCRIPTION: Roughly rectangular shape in plan. The south (upslope) portion of the outcrop consists of pahoehoe excavations which have been filled with excavated blocks to create a level surface.

The north end of the outcrop area appears to be piled with excavated blocks to form a wall. A rectangular wall-like extension occurs to the north. This section measures 1.43 by 1.35 m.

A linear rock alignment along the west slope of the outcrop appears to be a terrace retainer. It is oriented N-S, is doubled stacked with large boulders and measures 6.1 m by 5.7 m. The south end of the surface area is built of a linear segment of collapsed cobbles and boulders, possibly another terrace. The south side of the outcrop has been faced with large boulders. The east side appears to be unmodified pahoehoe.

The additional 26 modified outcrops are constructed with small to large angular cobbles placed around the bases, on the top and sides and used as fill in crevice. Areas around the outcrops appear to have been excavated with the quarried blocks placed on top of the outcrop. Some of the outcrop surfaces have been paved and the sides built up and squared off to form rough terraces. There are additional pahoehoe excavations and low rocks mounds in the area.

SITE NO.: State: 13338 PHRI: T-109
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: A gentle north to south sloping terrain with exposed bedrock.
VEGETATION: Thick elephant grass, high density of koa-haole, young kiawe trees, and a large noni tree on the east boundary of the site.
ELEVATION: c. 115 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Features identified at the site include two modified outcrops, a terrace and a filled blister. Overall site area is 28.00 m at 65 degrees Az. by 14.00 m.

The terrace is the most formally constructed feature on the site. It measures 3.36 m (E-W) by 3.16 m (N-S) and is rectangular in shape. The west half of the terrace consists mainly of exposed bedrock that rises 0.30 m above surrounding ground surface. The north and south perimeters are aligned angular cobbles and boulders, with natural bedrock incorporated. The eastern perimeter is angular cobbles and boulders stacked 1-2 courses high (0.23-0.65 m above the ground surface). The southeast portion of the terrace surface is paved with small angular cobbles and pebbles. The remainder of the terrace surface is uneven natural bedrock with scattered cobbles.

SITE NO.: State: 13339 PHRI: T-112
SITE TYPE: Complex (36+ Features)
TOPOGRAPHY: Gently sloping pahoehoe flow.
VEGETATION: Kiawe, Christmas-berry, lantana, fountain grass, and koa-haole.
ELEVATION: c. 177-185 feet
CONDITION: Fair-good
INTEGRITY: Partially altered
PROBABLE AGE: Prehistoric

FUNCTIONAL INTERPRETATION: Agriculture-habitation-possible ceremonial
DESCRIPTION: Overall complex area measures 40.0 m at 300 degrees by 80.0 m at 210 degrees. Features identified include five terraces (Features B, D, E, G, and K), two platforms (Features A and I), two caves (Features C and J), a mound (Feature H), a wall (Feature F), and 25 pahoehoe excavations.

FEATURE A: Platform with terrace *(Figure A-29)*
FUNCTION: Possible habitation
DIMENSIONS: 13.50 m by 12.50 m by 0.70 m
DESCRIPTION: Feature A is composed of a large terrace with a small platform adjacent to the southeast end of the feature, and a smaller terrace wall extending from the south corner. It is constructed of pahoehoe boulders and cobbles, formally faced on most exterior edges. The larger terrace is filled with small stones and is relatively flat. The platform is 2-3 courses high, faced on all four sides. The platform is edged with larger stones and filled with pahoehoe cobbles, also flattened on the top. Connected to the platform on the SE side, is a lower level of the platform, 1-2 courses high, faced on three sides. A small wall connects the platform wall to the SW part of the terrace.

FEATURE B: Stepped terrace
FUNCTION: Indeterminate
DIMENSIONS: 5.70 m by 4.40 m by 1.30 m
DESCRIPTION: Feature B is adjacent to the southwest side of Feature A. It is formally faced with five courses of pahoehoe boulders along the northeast side. It was probably faced on the south edge but is presently collapsed. Larger pahoehoe boulders are used along the exterior edges with cobble fill interiors. The east and west ends of the feature are flush with the natural ground slope. The terrace step is 0.50 m from the northeast side of the terrace wall; it rises 0.25 m.

FEATURE C: Cave
FUNCTION: Agriculture/habitation
DIMENSIONS: 54.00 m by 4.60 m by 1.60 m
DESCRIPTION: The lava tube is located 12.00 m at 245 degrees azimuth from Feature A. The entrance faces to the east and is 6.5 m wide by 2.1 m high. Portable remains are concentrated near the cave entrance and include waterworn stones, coral and Cellana shells. Also present is a large amount of recent refuse, associated with a modern habitation component. The tube constricts to a very small opening at 54.0 m from the entrance.

Adjacent to the cave opening is a large excavated blister. It measures 21.7 m by 8.7 m and the depth ranges from 1.25 m to 1.75 m. Large rocks excavated from the blister is used in adjacent features. The east end of the blister is filled with boulders from the construction of the Palani Road runaway truck ramp.

FEATURE D: Double terrace
FUNCTION: Agriculture
DIMENSIONS: 8.80 m by 6.30 m by 2.33 m
DESCRIPTION: Feature D is located 3.00 m northwest of Feature A. It consists of two terraces, one of which is constructed on top of the other. The lower, larger terrace measures 8.8 m by 6.3 m with heights of 1.0 m to 1.7 m. The upper terrace two measures 4.8 m by 3.2 m with a maximum height of 0.63 m.

The lower terrace perimeter wall is constructed of very large pahoehoe boulders and cobbles. The perimeter wall is faced, but irregular in shape. The upper terrace perimeter wall is linear and constructed from pahoehoe cobbles, stacked to two courses high. Two large boulders are incorporated into the perimeter as well. The terrace surface is paved with pahoehoe cobbles and gravel; it is irregular and has a sunken central portion.

FEATURE E: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.70 m by 4.10 m by 1.50 m
DESCRIPTION: Feature E is 11.00 m west from Feature B. The terrace is raised on three sides and incorporates natural bedrock to make a fairly level surface. The north side of the feature is flush with the ground surface. The east, west and south perimeters are two to five courses of pahoehoe boulders and cobbles, with some facing present.

FEATURE F: Wall
FUNCTION: Agriculture/land division
DIMENSIONS: 91.50 m by 0.80 m by 0.90 m
DESCRIPTION: The wall forms a roughly rectangular loop through the site and passes over or adjacent to Feature E (terrace), Feature C (cave), and Feature J (cave). The eastern stretch of the wall that extends from Feature C to Feature J is constructed of piled pahoehoe boulders and cobbles 0.50-0.65 m high. The wall is mostly rubble construction with loosely piled pahoehoe cobbles. In places, large boulders have been aligned, in other places pahoehoe slabs have been placed upright. Uprights especially occur along the stretch of the wall nearest to the Feature C cave shelter.

FEATURE G: Terrace
FUNCTION: Agriculture
DIMENSIONS: 11.90 m by 9.30 m by 0.75 m

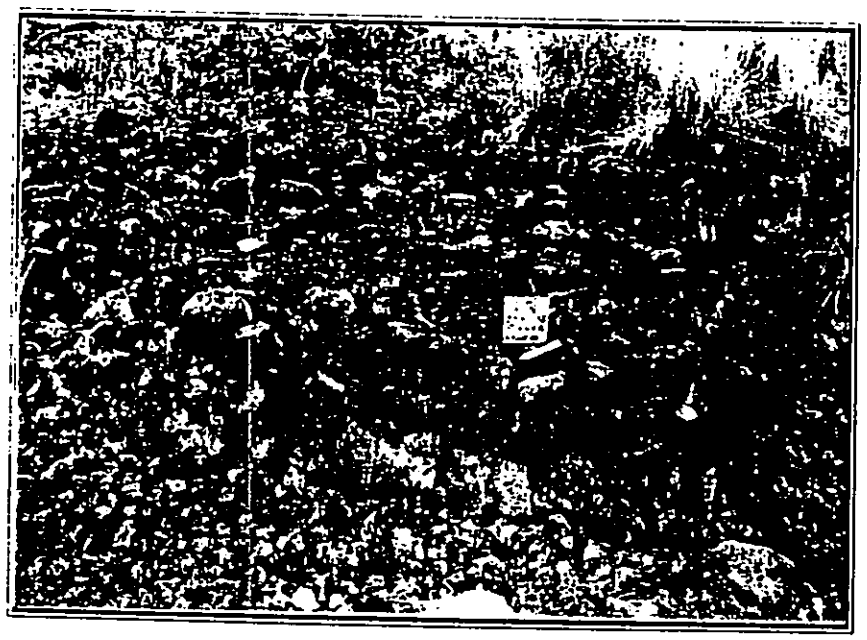


Figure A-29. SITE 13339, FEATURE A. View to Southeast (PHRI Neg.1248-27)

Feature G is adjacent to the west side of Feature E. It is rectangular shape in plan, and raised on the SW side with a faced perimeter of pahoehoe boulders. The terrace is filled with pahoehoe cobbles and pebbles.

FEATURE H: Rubble mound
FUNCTION: Agriculture
DIMENSIONS: 11.00 m by 6.50 m by 1.00 m
DESCRIPTION: This mound is located 3.0 m from Feature I at 350 degrees Az. It is irregularly shaped and is loosely constructed with large boulders, cobbles and gravel.

FEATURE I: Platform/enclosure
FUNCTION: Indeterminate/possible ceremonial
DIMENSIONS: 8.50 m by 4.60 m
DESCRIPTION: This feature is 3.00 m northeast from Feature G. The platform is raised on four sides with an alignment on the southeast edge that turns inward to form a square plan enclosure within the platform. This enclosure contains four boulders and an upright. The interior edges are faced 2-3 courses high and the exterior edges blend into the platform. The platform is constructed with pahoehoe boulders stacked 2-3 courses high around the exterior. The interior of the platform is filled with cobbles and clinkers. One Cypraeidae shell was observed.

FEATURE J: Cave
FUNCTION: Agriculture-habitation
DIMENSIONS: 8.85 m by 8.25 m by 2.10 m
DESCRIPTION: This cave is 34.00 m northeast from Feature C. It is a N-S oriented lava tube that originates in a collapsed blister. It contains a paved floor area with pahoehoe cobbles used as fill and excavated boulders haphazardly placed. A natural pahoehoe ledge surrounds 3/4ths of the paved area, except for the west side. A faced wall, stacked 2 courses high and 3.5 m in length occurs along this western side. South and west of the wall is a blister with a semicircular wall that is stacked 4 courses high. At the southern end of the blister is a chamber with modifications.

Oriented E-W across the north end of the chamber is another wall of boulders and cobbles stacked 3-5 courses high. At the west end, near the opening, it is stacked 8 courses high. The east corner, the wall becomes a single course alignment extending east and northeast.

The southeast corner of the chamber contains two rock mounds, spaced 0.50 m apart, and stacked 2-3 courses high. Exterior of the chamber and southwest of the paved floor is a raised paved area of boulders and pahoehoe slabs.

Portable remains observed in the cave include four Cypraeidae fragments, four *Nerita picea*, one Cellana, three Isognomonidae fragments and two waterworn basalt pebbles. In addition, there is a quantity of modern refuse, suggestive of a recent occupation component. Some or all of the modifications at this feature could therefore be recent.

FEATURE K: Terrace
FUNCTION: Possible agriculture
DIMENSIONS: 8.20 m by 6.00 m by 0.85 m
DESCRIPTION: Feature K is adjacent to and west of Feature J. Raised along the east side, it is constructed with large pahoehoe boulders stacked 2-3 courses high. The terrace fill consists of pahoehoe cobbles and clinkers. A waterworn basalt boulder is present on the feature.

SITE NO.: State: 13340 PHRI: T-113
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Undulating seaward slope with naturally exposed bedrock.
VEGETATION: Thick fountain grass, small lantana bushes, and several kiawe trees.
ELEVATION: c. 163-169 feet
CONDITION: Fair-good
INTEGRITY: Unaltered-except for some bulldozer disturbance
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-habitation-possible ceremonial
DESCRIPTION: The overall complex area measures 27.38 m at 143 degrees by 12.92 m. The site complex consists of three terraces (Features A, D and F), three upright blocks (Feature B), an enclosure (Feature C), a modified blister (Feature E), and a platform (Feature G).

FEATURE A: Terrace *(Figure A-30)*
FUNCTION: Habitation/possible ceremonial
DIMENSIONS: 11.35 m by 8.40 m by 0.60 m
DESCRIPTION: Rectangular shape in plan, the terrace is oriented c. NW-SE. The northeast and southwest sides are slightly raised and faced. The perimeter is constructed from generally large angular pahoehoe cobbles and boulders, some of which have been set upright or on edge. A few large slabs and boulders are placed at various locations on the terrace surface. The surface consists mostly of small cobbles and pebbles.

On the southwest side of Feature A is a smaller terrace which extends 3.0-4.0 m in length and is 2.0 m wide. Larger blocks comprise the perimeter of the terrace and it is filled with small angular cobbles.

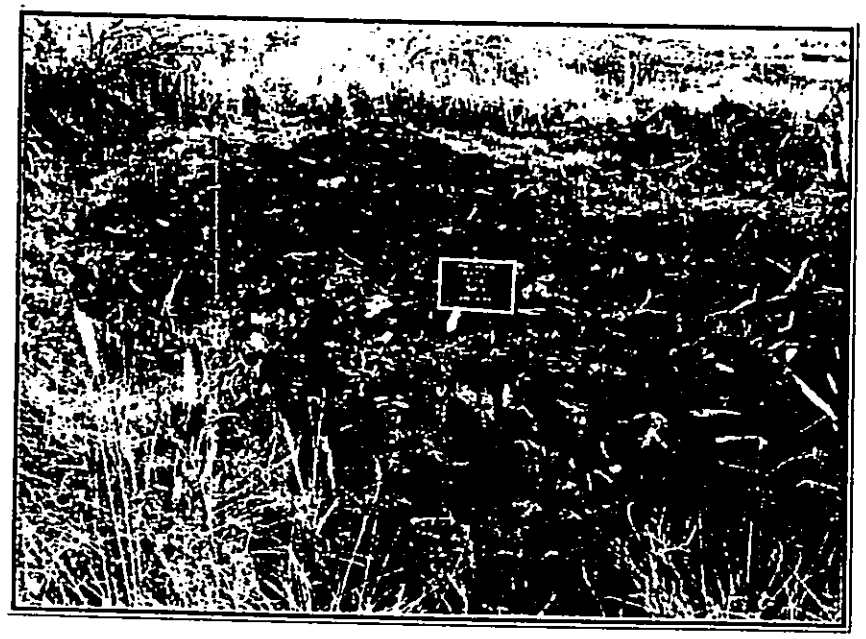


Figure A-30. SITE 13340, FEATURE A. View to South PIIRI Neg.1244-9)

A wall extends 5.0 m southeast from the smaller terrace. It is constructed with large perimeter blocks and filled with smaller angular cobbles. It is 0.80-1.0 m wide and 0.20-0.60 m high. Built on the edge of the pahoehoe flow, portions of wall show evidence of facing but, mostly is collasped.

FEATURE B: Upright/cairn
FUNCTION: Marker
DIMENSIONS: 0.85 m by 0.59 m by 0.65 m
DESCRIPTION: Three large angular pahoehoe blocks have been positioned on smooth pahoehoe. One block is in an upright position; one is leaning on the other two blocks, and the third block is laying on its side. The blocks are 0.40-0.62 m in length and 0.30-0.40 m in width. The cairn is 7.39 m east from Feature C.

FEATURE C: Enclosure and terrace
FUNCTION: Possible agriculture
DIMENSIONS: 6.20 m by 5.40 m by 0.45 m
DESCRIPTION: A small square shape enclosure with a small diamond-shaped terrace located at the southeast side of the enclosure. The enclosure is built on top of smooth pahoehoe. It measures 3.70 m (NE-SW) by 3.17 m (NW-SE) with interior measurements of 1.8 by 1.8 m. The enclosure wall has boulder perimeters that are faced on both sides, and is filled with angular cobbles. The northeast section of the wall is 1.4 m wide and the remaining portions are 0.60-0.70 m wide.

The terrace is built on the southeast side of the enclosure and at the edge of a pahoehoe lava flow. It measures 1.6 m (NE-SW) by 2.2 m (NW-SE). The perimeter is constructed with large pahoehoe blocks and the fill consists of small cobbles.

Also on the southeast corner of the enclosure is a small square-shaped crevice that has been excavated along three faces. It measures 0.75 m (NE-SW) by 0.50 m (SE-NW) and is not cleared of quarried material.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 4.50 m by 0.68 m
DESCRIPTION: Feature D is located 8.21 m southeast from Feature A. It consists of a terrace with a small paved area adjacent to the southeast side of the terrace. The overall dimensions for both the terrace and the paved area is 5.0 m by 4.5 m. The terrace is 3.50 m E-W by 2.75 m N-S. It is raised on the west side with aligned pahoehoe boulders and on the south side with loosely stacked pahoehoe boulders. The height along the west side is 0.48 m and the south side is 0.68 m.

The paved area measures 4.5 m (E-W) by 2.25 m (N-S). A humus deposit at least 0.08 m thick was observed between the cobbles.

FEATURE E: Modified blister
FUNCTION: Agriculture
DIMENSIONS: 4.70 m by 3.55 m by 0.76 m
DESCRIPTION: This feature is 8.05 m south from Feature C. It consists of a blister that is filled with pahoehoe slabs, boulders and cobbles, creating a roughly level surface. The fill is one to three layers deep. A rubble wall is constructed on the pahoehoe fill. The wall extends out of the blister to the north and connects with the Feature C enclosure wall.

FEATURE F: Terrace
FUNCTION: Possible ceremonial
DIMENSIONS: 6.80 m by 5.80 m
DESCRIPTION: This feature is 4.80 m from a larger shrine, Feature G. It is a small triangular terrace that abuts pahoehoe bedrock on two sides. The south side is raised with pahoehoe cobbles stacked two to three courses high. The terrace contains a small paved area with an upright stone at one end and aligned stones on either side. This paved area is situated near the east end of the raised terrace wall. The feature appears to be a shrine.

FEATURE G: Platform
FUNCTION: Possible ceremonial
DIMENSIONS: 5.35 m by 3.60 m by 1.05 m
DESCRIPTION: The platform is faced with pahoehoe blocks, boulders, and slabs along the northwest, north and east wall. The south wall is faced with pahoehoe blocks and boulders. The walls are stacked 3-4 courses high and the surface is paved with small cobbles. The wall heights range from 0.84 to 1.05 m on the south side and 0.72-0.87 m on the north side.

On the southwest corner of the platform is a raised terrace. It measures 3.12 m (E-W) by 2.9 m (N-S) and is built with stacked boulders 1-3 courses high. The surface of the terrace is slightly sloping cobble paving. The northern half of this raised terrace appears to have boulders enclosing a slightly raised portion. Based on construction and lack of portable remains of this structure, it may have functioned as a possible ceremonial feature.

SITE NO.: State: 13341 PHRI: T-114 *(Figure A-31)*
SITE TYPE: Modified outcrop
TOPOGRAPHY: Pahoehoe flow edge and area of bedrock outcrops.
VEGETATION: Koa-haole and fountain grass.

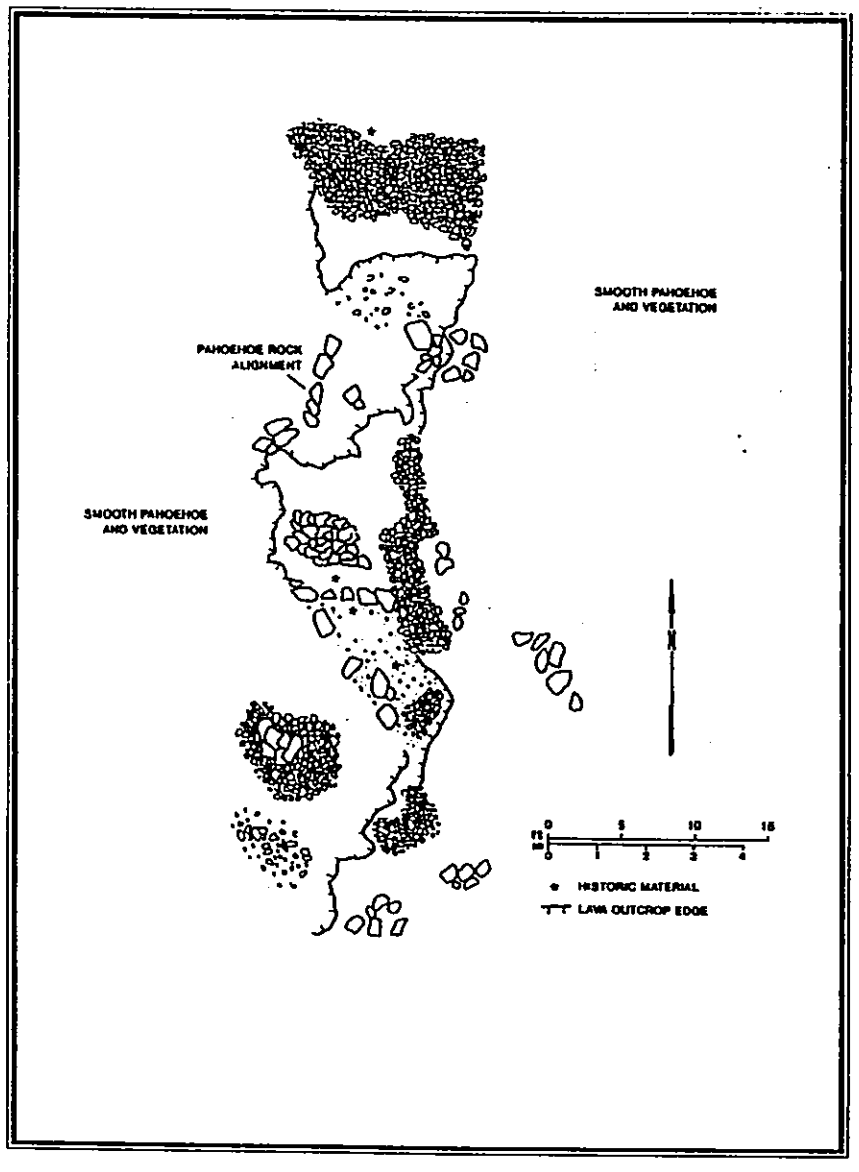


Figure A-31. SITE 13341

ELEVATION: c. 162.5 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 26.00 m by 17.50 m
DESCRIPTION: The overall dimensions of the modified outcrop complex measures c. 26.0 m (N-S) by 17.5 m (E-W). The mapped portion of the site measures c. 16.0 m (N-S) by 4.5-5.0 m (E-W). Generally, this site consists of a large pahoehoe bedrock outcrop area that is modified with piled pahoehoe rubble, rough alignments of pahoehoe blocks, and with cobbles used as paving or to fill in crevices. The modifications follow along the edge and on top of the outcrop. The portable remains consists mostly of historic trash, beer bottles, roofing material and one kukui nut.

SITE NO.: State: 13342 PHRI: T-116
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Pahoehoe flows scattered throughout the site area.
VEGETATION: Koa-haole, fountain grass, vines, air plants, lantana, and unidentified grasses and forbs.
ELEVATION: c. 193 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 53.0 m (N-S) by 28.0 m (E-W). The site consists of a mound (Feature A), three paved areas (Feature B), and a terrace (Feature C).

FEATURE A: Mound
FUNCTION: Agriculture
DIMENSIONS: 6.20 m by 4.10 m by 0.85 m
DESCRIPTION: This mound is built on the south and southeast sides of a low pahoehoe outcrop. It is oriented NE-SW and is constructed of small basalt boulders, blocky basalt cobbles, and pebbles. No formal facing is evident. A five boulder alignment roughly bisects the feature along the short axis, near the center.

FEATURE B: Paved area (3)
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 8.29 m
DESCRIPTION: Feature B is located on the edge of a pahoehoe flow in a depression that is filled with cobble to pebble size pahoehoe rocks, 48.00 m north from Feature A. It does not appear that the flow edge has been excavated.

There are two other paved areas 19.00 m north of the above pavement. The two paved areas are separated by a pahoehoe outcrop. One of the pavements covers an area 12.5 m (N-S) by 6.0 m (E-W). The other paved area measures 4.0 m (N-S) by 2.0 m (E-W).

FEATURE C: Terrace and pavement
FUNCTION: Agriculture/habitation
DIMENSIONS: 20.00 m by 9.00 m by 0.80 m
DESCRIPTION: The terrace is located 6.00 m northwest from Feature A. It is raised on the southwest side and incorporates a naturally terraced pahoehoe flow. It measures 14.0 m by 5.0 m, and is partially defined by pahoehoe excavations. A paved area is located 0.80 m below the terrace. The pavement is enclosed on three sides by natural outcrops. It has a surface area 20.0 m by 4.0 m and consists of pebble to large cobble size pahoehoe blocks.

SITE NO.: State: 13343 PHRI: T-117
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: The area is surrounded by pahoehoe flows and collapsed blisters. Generally, the terrain is irregular and on a slight slope.
VEGETATION: Rubber tree, Christmas-berry, and lantana.
ELEVATION: c. 197 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-agriculture
DESCRIPTION: The overall complex area measures 46.0 m (E-W) by 48.0 m (N-S). The site consists of two pahoehoe excavations (Features A and B) and a platform (Feature C). SIHP Site No. 13342 (T-116) and SIHP Site No. 13343 (T-117) may possibly be one site. Additional features consisting of pahoehoe excavations and paving are in the immediate area surrounding the features.

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 23.00 m by 5.60 m
DESCRIPTION: Feature A is situated within a large collapsed blister with excavated areas visible along the edges. Shallow overhang areas are created with rock alignments constructed in front of and enclosing them. The overhang areas are partially filled with pebble to cobble size pahoehoe rocks. The collapsed blister is also filled with pebble to small boulder size pahoehoe. In addition, some of the areas within the collapsed blister appears to be paved.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 11.20 m by 5.88 m
DESCRIPTION: Feature B is 11.00 m south from Feature A. It consists of a pahoehoe blister excavation filled with pahoehoe pebbles and cobbles, and terraced into three levels. The upper level terrace is small, one course high, and surrounded on three sides by the pahoehoe blister edge. The second terrace drops down into a depression rising on a slight slope to a flat paved area. This drops down a step, 2-3 courses of cobbles, onto the bottom floor. The terrace is oriented 230 degrees azimuth (NE-SW). The upper terrace measures 3.50 m by 1.53 m. The middle terrace measures 5.0 m by 3.0 m and the lower terrace measures 5.80 m by 5.25 m.

There are also three small overhang areas filled with pahoehoe cobbles and pebbles.

FEATURE C: Platform
FUNCTION: Habitation/agriculture
DIMENSIONS: 12.60 m by 8.80 m
DESCRIPTION: The platform is situated on a small knoll which is located 16.60 m north from Feature A. The platform is constructed from cobble-size pahoehoe rubble that is filled between the vertical perimeters and the sloping surface of the knoll. The relatively flat crest of the knoll forms the major portion of the platform surface, which is paved with smooth flat pahoehoe slabs. The southwest side of the platform appears to have been faced at one time, but it is presently collapsed with remnants and an upright remaining. A possible entrance is visible at the southeast corner consisting of a paved path leading to a step up onto the platform.

SITE NO.: State: 13344 PHRI: T-118
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Pahoehoe and aa flows in the immediate area with a slight southwest slope.
VEGETATION: Koa-haole, fiddle tree, lantana, and various grasses and vines.
ELEVATION: c. 190 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/quarry
DESCRIPTION: Overall complex area measures 11.0 m at 146 degrees Az. by 11.0 m. Three pahoehoe excavations were identified at the site.

FEATURE A: Pahoehoe excavation with alignment (2)
FUNCTION: Agriculture/possible quarry
DIMENSIONS: 5.50 m by 4.40 m by 0.50 m
DESCRIPTION: The feature consists of two adjacent pahoehoe excavations with alignments of large cobbles and small boulders, which form roughly sub-rectangular structures. The NW excavation measures 2.4 m (NE-SW) by 1.90 m (NW-SE). The SW excavation measures 3.10 m (NE-SW) by 2.50 m (NW-SE). The alignments are a maximum of two courses high and consist of small boulders and large cobbles. The area between the two excavations is paved with small cobbles and pebbles.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 1.20 m
DESCRIPTION: Rectangular shape in plan, the excavation is located in a blister. The excavation is filled with cobbles to small boulder size pahoehoe rocks.

SITE NO.: State: 13345 PHRI: T-119
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Pahoehoe and aa flows.
VEGETATION: Koiu, kiawe, and fountain grass
ELEVATION: c. 191 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of a rectangular shaped excavated blister and an alignment.

FEATURE - : Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.16 m by 1.14 m by 0.55 m
DESCRIPTION: The pahoehoe excavation is rectangular shape in plan. The quarried aa cobble material is piled along the west side of the excavated blister. The piled mound measures 2.10 m by 2.00 m and 0.59 m in height.

FEATURE - : Alignment
FUNCTION: Agriculture
DIMENSIONS: 4.10 m by 1.20 m
DESCRIPTION: The alignment is located 4.00 m from the pahoehoe excavation at 200 degrees Az. It is constructed from aa cobbles, stacked two courses high.

SITE NO.: State: 13346 PHRI: T-120 *(Figure A-32)*
SITE TYPE: Complex (13 Features)
TOPOGRAPHY: The terrain is a fairly flat sloping pahoehoe flow adjacent to and north of a relatively wide (c. 100.0 m) aa flow.
VEGETATION: Kiawe, koa-haole, lantana, grasses, and scrub brush.

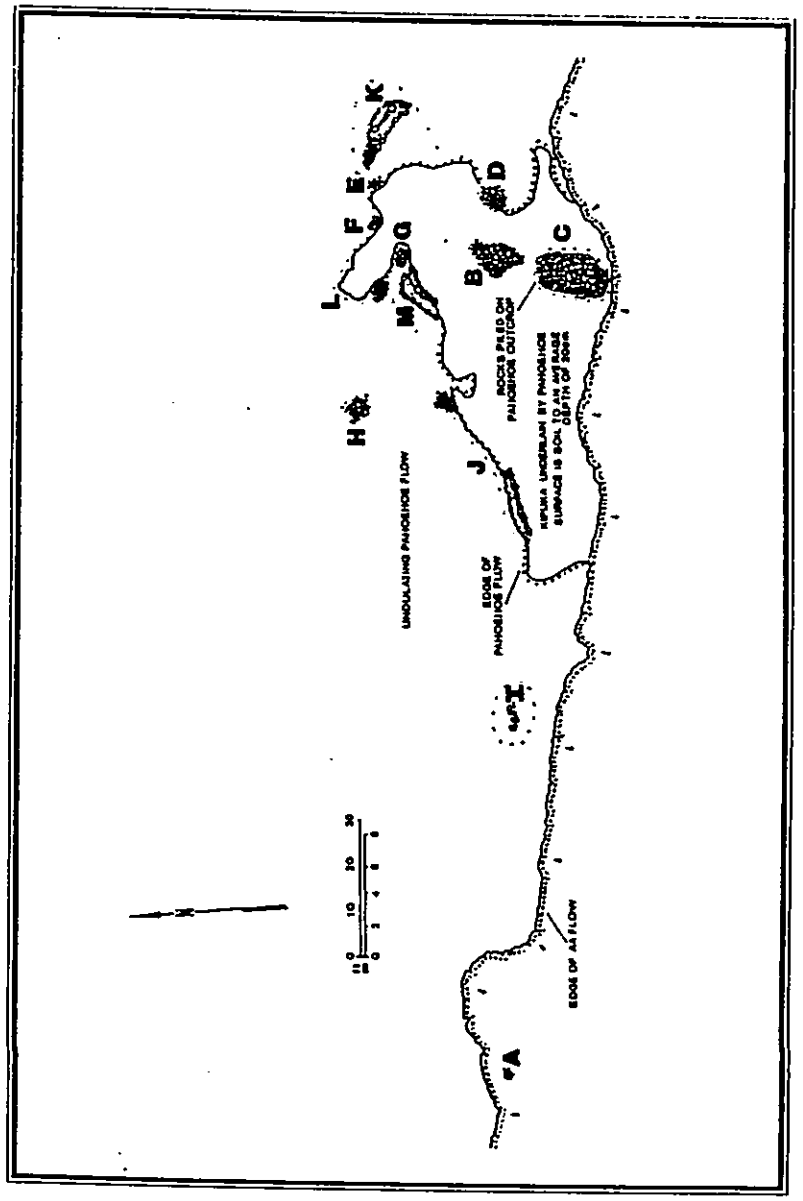


Figure A-32. SITE 13346

ELEVATION: c. 152 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: This complex consists of eight clearing mounds (Features A-H) and five pahoehoe excavations (Features I-M). The overall complex area measures 68.0 m (E-W) by 20.0 m (N-S).

FEATURE A: Mound
FUNCTION: Agriculture
DIMENSIONS: 0.85 m by 0.65 m by 0.60 m
DESCRIPTION: Feature A is at the western edge of the site, 24.00 m from the nearest feature (I). It is the only feature located on the aa flow. It consists of loosely piled cobbles ranging in size from 0.12-0.22 m.

FEATURE B: Mound
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.50 m by 0.65 m
DESCRIPTION: Feature B is near the center of a grass-covered pahoehoe kipuka along the aa flow edge. It is constructed with loosely stacked rocks which range in length from 0.15 m to 0.45 m.

FEATURE C: Mound
FUNCTION: Agriculture
DIMENSIONS: 6.00 m by 3.00 m by 0.80 m
DESCRIPTION: This mound is 1.00 m south from Feature B, on an outcrop at the edge of the aa flow. The sides of the mound are faced and the center is cleared, exposing the pahoehoe surface. The long axis is at 5 degrees Az.

FEATURE D: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.40 m by 0.80 m by 0.42 m
DESCRIPTION: Located 2.00 m east from Feature B, along the eastern perimeter of the kipuka. This oval mound is loosely piled, with rocks ranging in length from 0.10 m to 0.45 m. The long axis is at 280 degrees Az.

FEATURE E: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.00 m by 1.70 m by 0.20 m
DESCRIPTION: Feature E is just beyond the northern edge of the kipuka, on a pahoehoe flow, 7.00 m north from Feature D. It is loosely stacked, with faced sides. The rocks range in length from 0.15-0.50 m.

FEATURE F: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.70 m by 1.80 m by 0.30 m
DESCRIPTION: This oval mound is along the northern edge of the kipuka, 2.00 m west from Feature E. It is constructed with stacked cobbles and small boulders, and has faced sides.

FEATURE G: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.85 m by 0.90 m by 0.25 m
DESCRIPTION: Feature G is at the edge of the kipuka, 2.20 m southwest from Feature F. It consists of loosely stacked cobbles and boulders which range in length from 0.50 to 0.40 m. The long axis of the mound is oriented 125 degrees Az.

FEATURE H: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.10 m by 2.00 m by 0.35 m
DESCRIPTION: This mound is located 9.00 m west from Feature G. It has an irregular shape and is constructed with piled cobbles. The cobbles range in length from 0.12 to 0.31 m.

FEATURE I: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 1.70 m by 0.70 m
DESCRIPTION: Feature I is 9.00 m west of the kipuka and 2.50 m from the edge of the aa flow, on smooth pahoehoe. It consists of an excavated blister. The excavated pahoehoe layer here is 0.27 m. Quarried blocks are present, with lengths ranging from 0.10 to 0.42 m.

FEATURE J: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 10.00 m by 0.00 m by 0.65 m
DESCRIPTION: Feature J is located along the northern edge of the kipuka, 12.00 m east from Feature I. The edge of the pahoehoe flow surrounding the kipuka has been excavated and quarried blocks scattered in a linear arrangement to the south of the excavation. The excavated pahoehoe layer is an average of 0.33 m thick. The quarried blocks and pieces range in length from 0.5 to 0.25 m.

FEATURE K: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 7.00 m by 0.94 m
DESCRIPTION: Feature K is an excavated pahoehoe blister, located on smooth pahoehoe at the eastern edge of the site, 1.00 m east from Feature E. Quarry debris is scattered in a linear pattern around the perimeter of the excavation. The mined pahoehoe layer is an average of 0.75 m thick. The quarried material varies in length from 0.10 m to 0.65 m.

FEATURE L: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.10 m by 2.50 m by 0.48 m
DESCRIPTION: Feature L is located along the edge of the smooth pahoehoe which surrounds the kipuka. It is in a small pocket between rock mounds G and F. Adjacent to the excavated flow edge to the west is an associated pile of quarried debris. The excavated pahoehoe layer here is 0.48 m thick. Quarried rubble averages 0.17 m to 0.46 m long.

FEATURE M: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.50 m by 0.00 m by 0.30 m
DESCRIPTION: Feature M is a third excavated section of the pahoehoe flow edge. The Feature G mound, is located at the eastern end of the excavated face. The mined pahoehoe layer is 0.27 m thick and the quarried material averages 0.10 m to 0.36 m in length.

SITE NO.: State: 13347 PHRI: T-121
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Pahoehoe surface and finger flows.
VEGETATION: Fountain grass, Christmas-berry, koa-haole, kolu, kiawe, noni, and lantana.
ELEVATION: c. 208 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 6.50 m by 3.20 m by 0.49 m
DESCRIPTION: A pahoehoe blister excavation that is filled with excavated cobbles and boulders. In addition, pahoehoe and aa blocks have been strewn haphazardly within 2.00 m south of the excavation.

SITE NO.: State: 13348 PHRI: T-122
SITE TYPE: Complex (5+ Features)
TOPOGRAPHY: Generally irregular topography, the site is located on a genly sloping SSW pahoehoe flow that is on the side of a hill.
VEGETATION: Surrounding the area is noni, koa-haole, Christmas-berry, sword ferns, and fountain grass.
ELEVATION: c. 220 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Quarry-rock art-recreation
DESCRIPTION: The overall complex area measures c. 93.0 m (N-S) by 22.60 (E-W). The site consists of a pahoehoe excavation (Feature A), two cairns (Feature B), a papamu board (Feature C), a paved pathway (Feature D) and a cave (Feature E).

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 6.00 m by 5.90 m by 3.00 m
DESCRIPTION: Large blocks of pahoehoe were excavated and the quarried material used to construct the other features at the site. A C-shaped pathway has been constructed in the center of the hole. The upper dimensions of the excavation are 10.65 m (NE-SW) by 9.45 m (NW-SE).

FEATURE B: Cairn (2)
FUNCTION: Marker
DIMENSIONS: 2.80 m by 1.60 m by 0.55 m
DESCRIPTION: Two cairns are situated on the SW edge of Feature A. The area around the cairns is built up and slopes down onto the quarry edge. The cairn to the east is built with large slabs of flat pahoehoe three courses high. It is situated on a pahoehoe outcrop and measures 0.65 m by 0.55 m. The cairn to the west is four courses high, and the base consists of cobbles, rather than slabs. It measures 0.70 m by 0.65 m. Both cairns are 0.55 m high. The area between the two cairns is built up to the first course of the cairns. This section in between slopes downward and them flattens out. Although this is somewhat level it does not appear to be paved.

FEATURE C: Papamu *(Figure A-33)*
FUNCTION: Recreation
DIMENSIONS: 0.94 m by 0.89 m
DESCRIPTION: A papamu board carved into a smooth pahoehoe boulder, 5.00 m southeast from Feature B. The papamu consists of 74 pecked holes, arranged in eight rows and nine columns. Directly under the northern corner of the boulder are three pahoehoe slabs stacked three high and appears to function as a support for the papamu. Immediately adjacent to the papamu are the engraved letters VPE. They cover an area of c. 0.28 m by 0.14 m.

FEATURE D: Paved pathway
FUNCTION: Transportation
DIMENSIONS: 0.95 m by 2.50 m by 0.73 m
DESCRIPTION: A filled cobble area measuring 2.46 m by 0.86 m is immediately downslope from Feature C at 90 degrees Az. Adjacent to this cobble area is a cobble and pebble path that is aligned on either side and extends toward the pahoehoe excavation (Feature A). The pathway is oriented E-W up a slope to a paved area. It is 2.57 m long with an exterior height of 0.84 m and an interior height of 0.58 m. The paved area above the trail measures 2.90 m by 1.85 m. It is paved with aa and pahoehoe cobbles and boulders.

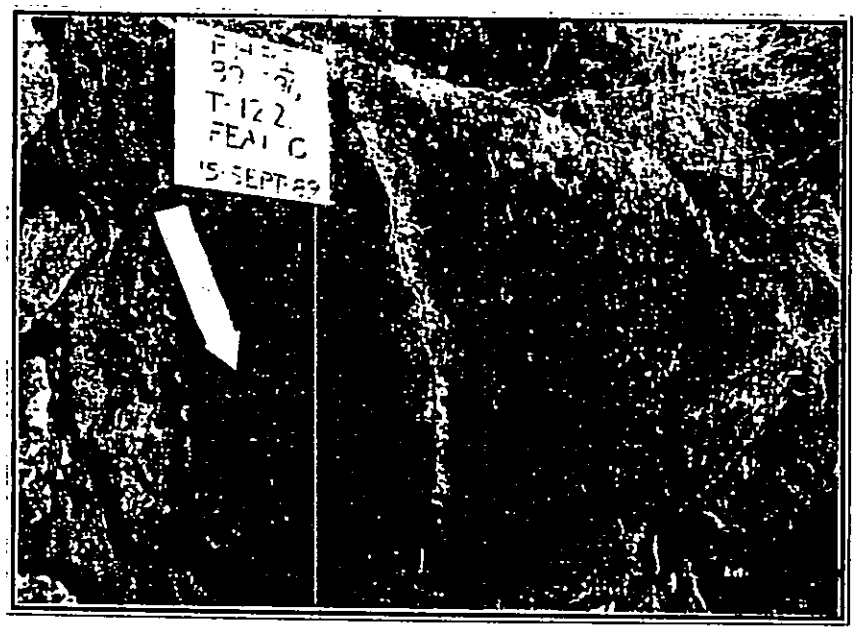


Figure A-33. SITE 13347, FEATURE C. View to South (PHRI Neg.1249-16)

FEATURE E: Cave
FUNCTION: Possible storage
DIMENSIONS: 2.80 m by 2.50 m by 1.74 m
DESCRIPTION: A small cave situated in the interior of Feature A that is filled nearly to the top surface with large basalt cobbles and small basalt boulders. The cave has two entrances; a roof entrance formed by the collapse of an overhang and a lateral entrance facing 60 degrees Az. upon which part of the collapsed overhang rests. There is a small hole in the scattered fill inside the cave, which may have been used for storage.

SITE NO.: State: 13349 PHRI: T-123
SITE TYPE: Wall
TOPOGRAPHY: The terrain is variable with numerous pahoehoe flows in the area.
VEGETATION: Thick koa-haole, lantana, and grasses.
ELEVATION: c. 222 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Land division
DIMENSIONS: 381.00 m by 1.60 m by 1.45 m
DESCRIPTION: This wall is oriented east-west and connected at the eastern end to the northern end of the Kuakini Wall. It is built with basalt boulders and cobbles stacked and faced three to nine courses high. It is core filled with smaller cobbles and pebbles. Portions of the wall are collapsing. It is uncertain at this time if the wall represents a continuation of the Kuakini Wall, or a later addition.

SITE NO.: State: 13350 PHRI: T-124 *(Figure A-34)*
SITE TYPE: Complex (11 Features)
TOPOGRAPHY: Pahoehoe flows.
VEGETATION: Fountain grass, kiawe, Christmas-berry, ferns, moss, noni, lantana, koa-haole, and succulents.
ELEVATION: c. 217 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-burial
DESCRIPTION: The overall complex area measures 144.0 m (N-S) by 50.0 m (E-W). The site consists of a large blister cave complex, with eleven features inside the cave. The main chamber (Feature A) contains a terrace (Feature B) and two enclosures (Features F and G). There are two chambers with modifications to the east of the main chamber (Features C and D), a third tube chamber to the northwest (Feature E) which contains two enclosures. A fourth tube chamber (Feature H) extends south from the main chamber. This long tube contains a terrace (Feature J) and two enclosures (Features I and K).

FEATURE A: Large blister cave
FUNCTION: Habitation
DIMENSIONS: 17.00 m by 19.50 m by 2.80 m maximum ceiling height
DESCRIPTION: This feature is the main and central chamber for an extensive lava tube cave system. It is accessed vertically through a circular collapse area 4.80 m in diameter, situated in the center of the feature. Three additional smaller entries are present to the west of the main entrance.

FEATURE B: Terrace
FUNCTION: Habitation
DIMENSIONS: 4.80 m by 4.30 m by 1.60 m
DESCRIPTION: The terrace is situated immediately north of the main complex entrance, against the north wall of the main chamber. The terrace is raised on the north and east sides, with pahoehoe boulders stacked 1-2 courses high. The west and south sides are flush with ceiling collapse rubble that is scattered on the cave floor. The terrace is filled with pahoehoe boulders and cobbles and is partially paved.

FEATURE C: Modified cave chamber
FUNCTION: Habitation
DIMENSIONS: 6.50 m by 5.00 m by 1.60 m maximum ceiling height
DESCRIPTION: The Feature C tube chamber extends northeast from the northeastern corner of the main chamber. The floor is cleared of large cobbles with scattered gravel size basalt remaining. A smaller tube chamber 4.40 m long and 3.50 m wide extends northeast from this main chamber. The entrance to the tube extension is partially blocked by a low rubble wall, 2.60 m long and 0.58 m high. A second wall is constructed across the chamber, oriented NW-SE. This wall is 3.00 m long, 1.10 m wide and 0.60 m high. At the east end of this wall is a rubble mound, faced on the west side. A third wall extends from the rubble mound to the east wall of the cave, forming an enclosed area between the two walls and the mound. The third wall is 2.45 m long, 0.40 m wide and 0.80 m high.

Portable remains observed in Feature C include a Cypraeidae shell lure, waterworn basalt pebbles, an Echinoid spine abrader, a coral abrader, marine shell midden, kukui nut shell, charcoal, feral goat remains, and coconut husks.

A large chunk of carbonized wood observed on the surface adjacent to the second rubble wall was collected for age determination analysis.

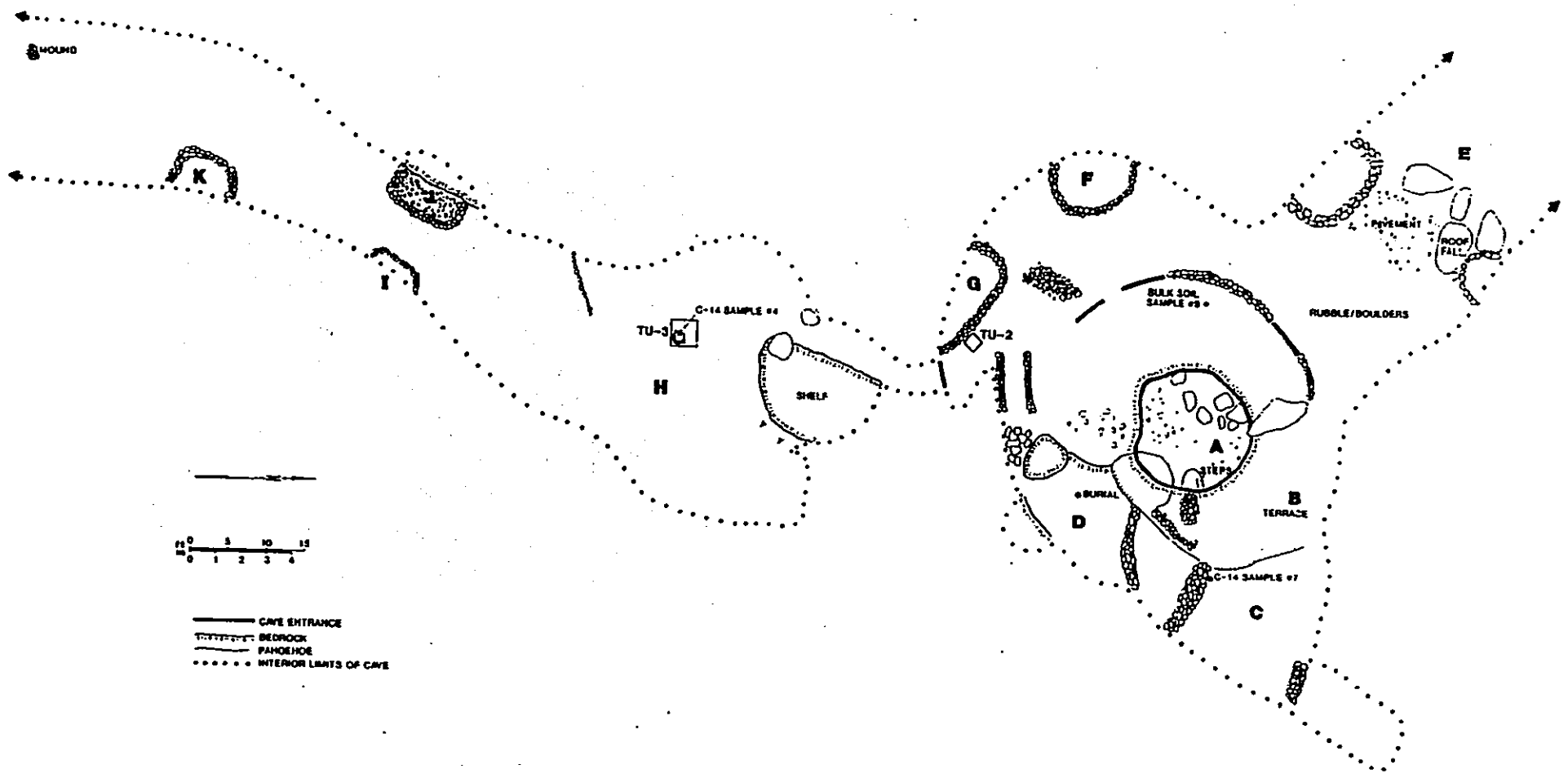


Figure A-34. SITE 13350

FEATURE D: Lava tube chamber
FUNCTION: Burial-possible habitation
DIMENSIONS: 4.70 m by 3.50 m by 1.70 m
DESCRIPTION: Feature D is to the south of the Feature C enclosed area, and east from the main chamber (Feature A). A small shelf chamber extends southeast from the sidewall of Feature D. It is 2.10 m wide and 1.20 m deep. The partial remains of a subadult skeleton were observed on a natural shelf at the center of the chamber. Portable remains scattered on the chamber floor include feral goat, Echinoidea, coral, kukui nut shell, and marine shell midden.

FEATURE E: Cave
FUNCTION: Habitation
DIMENSIONS: 51.60 m by 8.00 m by 2.20 m
DESCRIPTION: Feature E is a long, narrow lava tube which extends to the northwest from the main complex chamber (Feature A). Two enclosures are present at the front of the chamber, within 9.00 m of the main entrance. The largest of the enclosures is built against the south wall of the tube and has an interior area of 3.1 m by 1.6 m, with walls 0.30 m high. The other enclosure is directly across the chamber, against the north wall. It has an interior area of 2.1 m by 1.2 m and is 0.2-0.3 m high. The enclosures are 4.50 m apart; the area between them is leveled and paved.

FEATURE F: Enclosure
FUNCTION: Habitation
DIMENSIONS: 2.56 m by 2.00 m by 1.17 m
DESCRIPTION: Feature F is located against the west sidewall of the Feature A chamber, 3.2 m west from the opening. The enclosure wall is 2-4 courses high and faced with pahoehoe boulders, cobbles and slabs. It is C-shape in plan with the open end abutting the slanting cave wall. The floor is filled with pahoehoe cobbles and gravels. Portable remains observed include two coral abraders, an adze preform, Echinoidea and faunal material. Soil deposits are also present.

FEATURE G: Enclosure
FUNCTION: Indeterminate
DIMENSIONS: 2.55 m by 1.10 m by 0.80 m
DESCRIPTION: This enclosure is located along the rim of a natural depression, against the west sidewall of Feature A, 3.50 m south from Feature F. It is constructed with stacked cobbles and boulders, and is curved, with the open end abutting the cave wall. A pig mandible was observed inside the enclosure.

A 0.50 by 0.50 m square test unit was excavated immediately outside the wall of Feature G, to the east. A 0.02 m thick deposit of ashy soil containing charcoal was encountered, beginning from the surface of the unit. Beneath the ashy soil was a 0.03 m thick deposit of dark silty soil with midden remains. This deposit was screened through 1/8 inch mesh. Various shellfish fragments, charcoal, kukui nut shell, and mammal bone was recovered (see subsurface findings). Two bulk samples and a sample of charred wood were recovered for age determination analysis.

FEATURE H: Lava tube chamber
FUNCTION: Habitation-possible burial
DIMENSIONS: 80.00 m by 10.7 m maximum width by 2.00 m ceiling ht.
DESCRIPTION: This feature is a long, narrow lava tube extending south from the central area of the complex. It is accessed through a narrow (1.10 m wide) opening immediately west from Feature G. The chamber contains two enclosures (Features I and K), a terrace (Feature J), an alignment and a mound. The designated features are described below. The alignment is located 14.00 m south from the chamber entrance. The west end of the 2.30 m long alignment abuts the west wall of the chamber. The mound is located 36.00 m south from the chamber entrance, near the center of the tube, which is 6.00 m wide at this location.

Portable remains observed on the chamber floor include waterworn basalt pebbles and cobbles, coral, bamboo, coral abraders, an adze, a Cypraeidae shell lure, a bone pin, a Cellana shell scraper, modified mammal bone, and marine shell fragments. Long bones tentatively identified as an infant were also observed.

A hearth feature defined by an alignment of cobbles is located near the center of the chamber, 10.00 m from the entrance. A bulk sample was collected from the ash and charcoal deposit in the hearth, for age determination analysis.

FEATURE I: Enclosure
FUNCTION: Indeterminate
DIMENSIONS: 1.90 m by 0.90 m by 0.35 m
DESCRIPTION: This enclosure is located along and abutting the east wall of the Feature H tube, 20.5 m south from the entrance to the chamber. The wall is roughly rectangular with the open end abutting the tube wall. It is constructed with pahoehoe boulders and cobbles, stacked one to two courses high. Two coral abraders were observed inside the enclosure.

FEATURE J: Terrace
FUNCTION: Indeterminate
DIMENSIONS: 2.90 m by 1.50 m by 0.33 m
DESCRIPTION: Feature J abuts the west wall of the Feature H tube chamber, directly across from Feature I. The tube is 3.60 m wide at this location. It is built with pahoehoe cobbles and boulders along the exterior. The terrace interior is paved with pahoehoe slabs. A waterworn basalt cobble and an adze preform were observed on the feature.

FEATURE K: Enclosure
FUNCTION: Indeterminate
DIMENSIONS: 1.80 m by 1.10 m by 0.75 m
DESCRIPTION: Feature K is built abutting the east wall of the Feature H tube, 5.70 m south from Feature I. It is constructed with pahoehoe boulders and cobbles, loosely stacked two to three courses high. The wall is faced on the interior and exterior sides. No portable remains were observed within the enclosure, however, a concentration of charred wood and kukui nut shell occurs 15.55 m to the south. A sample of this concentration was collected for age determination analysis.

SITE NO.: State: 13351 PHRI: T-126
SITE TYPE: Complex (11 Features)
TOPOGRAPHY: Generally flat pahoehoe flow with features on and around the surrounding blisters.
VEGETATION: Fountain grass, sparse 'ilima, koa-haole, and kiawe.
ELEVATION: c. 10 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DESCRIPTION: The overall complex area measures 46.00 m at 46 degrees Az. by 28.00 m. Identified features include a water cave (Feature A) and ten pahoehoe excavations (Features B-F)

FEATURE A: Cave *(Figure A-35)*
FUNCTION: Water catchment
DIMENSIONS: 11.00 m by 9.00 m by 1.90 m
DESCRIPTION: Feature A contains an anchialine water pool that is influenced by the tides. The cave is primarily a partially collapsed blister with a small lava tube extending north. The lava tube measures 0.70 m in diameter and leads slightly downward of the collapsed area. This tube is cleared at the mouth probably for easy access to the 0.15 m deep pool of slightly brackish water that is present at high tide.

There are two other shallow depressed areas in a side chamber to the SW of the entrance. They also appear to have slight modifications such as cleared areas in addition to small charcoal pieces. These areas also contain water at high tide.

A cultural deposit consisting of c. 0.15 m of piled pahoehoe gravel mixed with charcoal chunks and branch coral is present. It is in a discrete area 4.5 m west of the cave entrance.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 4.10 m by 3.20 m by 0.60 m
DESCRIPTION: A fault type pahoehoe excavation along the west edge of the fault, 19.00 m southwest from Feature A. Pahoehoe blocks are piled to the southeast of the feature. It appears that few if any blocks were removed from the excavation.

There is a small excavation 3.00 m at 50 degrees north along the fault line. In addition, there is a very rough rectangular shaped area of scattered pahoehoe cobbles 3.00 m north of Feature B.

FEATURE C: Pahoehoe excavation (5)
FUNCTION: Quarry
DIMENSIONS: 9.00 m by 6.50 m by 0.95 m
DESCRIPTION: Feature C consists of three small areas that were quarried into the west side of a crack, 17.00 m south from Feature A. Also, two smaller pit excavations, one of which is excavated into a blister surface and measures 0.70 m by 0.40 m by 0.95 m deep. The other pit excavation is 2.5 m south. It is excavated into a crack and measures 1.50 m by 0.7 m and 0.85 m deep. There are several scattered pahoehoe cobbles and boulders on the surface around these excavations. They cover an area 2.0 m square and are piled up to 0.42 m high.

FEATURE D: Pahoehoe excavation (3)
FUNCTION: Quarry
DIMENSIONS: 2.00 m by 1.00 m by 0.48 m
DESCRIPTION: Feature D consists of three shallow excavated crevices, located 35.00 m southwest from Feature A. Four large quarried blocks are present. A thin moist dark brown silty loam occurs inside the crevices.

FEATURE E: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 7.60 m by 6.00 m by 0.76 m
DESCRIPTION: This excavated fault is located 45.00 m southwest from Feature A. The fault is 1.50 m high, with the excavation located at the base. The quarried blocks are mostly piled in the excavated area. There is a very small cairn constructed of pahoehoe cobbles and pebbles stacked two courses high. It is 0.20 m high and is situated on the north side of Feature E.

Figure A-35. SITE 13351, FEATURE A. View to Southwest (PHRI Neg. 1233-34)

FEATURE F: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.80 m by 0.90 m by 1.90 m
DESCRIPTION: Feature F is an excavated crevice situated off center of a pahoehoe ridge, 40.00 m northeast from Feature A. East of the excavation is a roughly linear mound of basalt blocks. It measures 5.0 m (N-S) by 1.0 m (E-W) and is 0.43 m high. Silty loam soil is present at the bottom of the excavation.

SITE NO.: State: 13352 PHRI: T-127
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Site is on and around a c. 30.0 m long lava tumulus that is c. 4.0 m high.
VEGETATION: Sparse fountain grass, 'ilima, Christmas-berry, and a passiflora plant.
ELEVATION: c. 9 feet
CONDITION: Good
INTEGRITY: Unaltered-possibly altered with a recent petroglyph
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Quarry
DESCRIPTION: The overall complex area measures 35.5 m (E-W) by 17.0 m (N-S). Very sparse midden and coral is scattered widely in the site area. A basalt hammerstone was present on Feature A. The complex is adjacent to Site 13287, a cave shelter. Features identified include nine pahoehoe excavations and a mound

FEATURE A: Pahoehoe excavation
FUNCTION: Quarry
DIMENSIONS: 1.33 m by 0.49 m by 0.30 m
DESCRIPTION: This small excavation is located along two sides of a crevice, at the base of a major upthrust. The excavation has a flat, cleared floor. Quarried stones are localized immediately downslope, along a crevice. The debris pile is 1.54 by 0.62 by 0.41 m high. Measurements for the additional excavations have not been obtained to date.

SITE NO.: State: 13353 PHRI: T-128
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Upthrusted and faulted pahoehoe.
VEGETATION: Sparse grass, 'ilima, red flowering plants, and Christmas-berry trees.
ELEVATION: c. 9 feet
CONDITION: Good
INTEGRITY: Unaltered-except for bulldozer activity around Feature C.
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Rock art-aquaculture-bathing
DESCRIPTION: The overall complex area measures 22.5 m at 256 degrees Az. by 19.0 m. The site consists of petroglyphs (Feature A) and two modified anchialine pools (Features B and C).

FEATURE A: Petroglyph
FUNCTION: Rock art
DIMENSIONS: 13.00 m by 5.00 m
DESCRIPTION: Feature A consists of three panels of petroglyphs that are concentrated in an area of natural collapsing pahoehoe. The petroglyphs are situated on an upthrust of smooth pahoehoe with an average thickness of 0.25 m. The panel of petroglyphs face northeast, northwest and southeast, respectively.

On the northeast-facing panel, there are at least nine human stick figures and six other geometric shapes or symbols. This panel is at a 45 degree angle and measures 5.15 m in length by 2.8 m in height.

The northwest-facing panel contains two human stick figures and two geometric shapes or symbols. This panel is at a 45 degree angle and measures 4.5 m in length and 0.80 m in height.

The southeast-facing panel contains at least one human stick figure and six other geometric shapes or symbols. This panel measures 3.15 m in length and 1.8 m in height.

There are two waterworn basalt cobbles and a waterworn coral cobble in front of the panels.

FEATURE B: Modified tide pool
FUNCTION: Aquaculture/bathing/water source
DIMENSIONS: 6.50 m by 2.60 m by 0.75 m
DESCRIPTION: Feature B is 9.80 m west from Feature A. It consists of an oblong opening in the surface pahoehoe layer which provides access to a small tidal pool. The feature is bordered by natural fault lines on the northwest and southeast sides, and by two walls of stacked angular cobbles and boulders on the northeast and southwest sides. The access opening between the fault lines and the two cobble walls measures 1.4 m (NE-SW) by 1.14 m (NW-SE). A few angular cobbles are piled behind the lip of the southeastern fault.

The water level of the pool appears to rise and fall with the tide. At the time of survey, it was 0.20 m deep, however a water line mark is visible at 0.70 m above the bottom of the pool. The bottom of the pool is covered with small angular cobbles and contains red shrimp.

FEATURE C: Modified tide pool
FUNCTION: Aquaculture/bathing/water source
DIMENSIONS: 2.70 m by 2.70 m by 1.65 m
DESCRIPTION: This feature is along the fenceline between the project area and the old Kona airport, 22.1 m west from Feature A. It consists of a tidal pool at the base of a collapsed blister that has been cleared. Surrounding all edges of the pond are angular cobbles and large boulders. The bottom of the pond is covered with small angular waterworn cobbles and sand. The pond extends under an overhang along the southwest rim of the blister. The water was 0.86 m deep at the time of survey, and red shrimp were observed. Coral and marine shells are also at the bottom of the pool.

There is at least 2-3 meters of bulldozer push on the south and west sides of the pool. There has been much bulldozing activity in the area. Also, recent garbage is present around the pool.

SITE NO.: State: 13354 PHRI: T-129
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: A pahoehoe finger abutting an aa flow.
VEGETATION: Dense grass, two kiawe trees, and one lantana.
ELEVATION: c. 212 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/quarry
DIMENSIONS: 3.00 m by 2.00 m
DESCRIPTION: The end of a pahoehoe blister has been excavated forming a blister "ledge". Some blocks are haphazardly thrown around the perimeter of the excavation. Many large blocks remain inside the excavation. It is located 28.0 m at 190 degrees Az. from SIHP Site No. 13350.

SITE NO.: State: 13355 PHRI: T-130
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Pahoehoe flows, variable slope and uneven terrain.
VEGETATION: Open area consisting predominantly of grass.
ELEVATION: c. 212 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible quarry-indeterminate
DESCRIPTION: Overall complex area measures 19.5 m at 330 degrees Az. by 4.0 m. The site consists of two cairns (Features A and C), and a pahoehoe excavation (Feature B).

Pahoehoe boulders and cobbles are strewn between Features B and C, and to the north of Feature C. A possible small mound of boulders is located 4.0 m north of Feature C, underneath a large kiawe tree. Dense grass makes it almost impossible to follow possible alignments of boulders without first extensively clearing the area.

FEATURE A: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.50 m by 0.50 m by 0.50 m
DESCRIPTION: Feature A consists of a large pahoehoe slab atop two smaller pahoehoe slabs. It is situated in the middle of an oblong rock mound of pahoehoe cobbles that is not formally constructed.

FEATURE B: Pahoehoe excavation
FUNCTION: Possible quarry
DIMENSIONS: 9.50 m by 4.00 m by 0.00 m
DESCRIPTION: Oval shape in plan, it is a blister type excavation. It is situated 8.3 m at 150 degrees Az. from Feature A. A few blocks are thrown along the edges of the excavation. The floor is covered with pahoehoe cobbles of varying sizes with no paving evident.

A second, smalle r pahoehoe excavation is located 0.70 m east of the southern end of Feature B. It measures 0.8 m by 0.5 m. The bottom of the small pahoehoe excavation is scattered with small pahoehoe cobbles and gravel.

FEATURE C: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.47 m by 0.42 m by 0.29 m
DESCRIPTION: Feature C consists of a large pahoehoe slab supported by three smaller pahoehoe slabs. It is located 2.7 m northwest from Feature A. The large slab is 0.12 m thick and lays horizontally across the top of the other slabs.

SITE NO.: State: 13356 PHRI: T-132
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Pahoehoe flow, c. 10.0 m away from the aa flow.
VEGETATION: Dense grass, lantana, and four kiawe trees.
ELEVATION: c. 205 feet
CONDITION: Good

INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 5.50 m by 2.30 m by 0.55 m
DESCRIPTION: Thick large blocks of pahoehoe have been excavated and loosely stacked around two-thirds (2/3) of the excavated area, forming an enclosure-like wall. Small to medium size cobbles remain on the floor of the excavation. Most of the boulders have been stacked on the northwest side of the excavation. It is located 20.0 m at 190 degrees Az. from SIHP Site No. 13354.

SITE NO.: State: 13357 PHRI: T-133
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Ropy pahoehoe flow surrounding the site.
VEGETATION: Christmas-berry, fountain grass, koa-haole, and lantana.
ELEVATION: c. 265 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 20.80 m at 35 degrees Az. by 12.60 m. The site consists of a cairn, a cave, and six pahoehoe excavations.

FEATURE -: Cairn
FUNCTION: Agriculture
DIMENSIONS: 1.00 m by 1.00 m by 0.46 m
DESCRIPTION: Oval shape in plan at the base. It is constructed with stacked excavated blocks four courses high. The stacked blocks range in size from 20.0 m by 12.0 m to 30.0 m by 18.0 m. Scatter of excavated blocks along the base is 1.80 m by 1.60 m. No evidence of cultural deposit visible. Measurements have not been obtained for the pahoehoe excavations to date. The cave does not appear to be modified, and there is no interior deposits or portable remains.

SITE NO.: State: 13358 PHRI: T-134
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Rolling mounds of both ropy and smooth pahoehoe flow.
VEGETATION: Kiawe, Christmas-berry, and koa-haole.
ELEVATION: c. 267 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/quarry
DESCRIPTION: Overall complex area measures 84.0 m at 90 degrees Az. by 61.05 m at 165 degrees Az, and consists of three pahoehoe excavations. The size of the excavated blocks vary throughout the three pahoehoe excavations. The boulders and cobbles range from 0.71 m by 0.51 m to 0.26 m by 0.20 m. There is no vegetation growing inside of the excavations.

FEATURE -: Pahoehoe excavation
FUNCTION: Agriculture/quarry
DIMENSIONS: 5.40 m by 2.43 m by 0.69 m
DESCRIPTION: S-shaped in plan it is excavated with a slight overhang to the east. Large boulders are strewn around the excavated area, generally in the areas to the southeast, northeast and northwest. Boulders also fill the excavated area along the north end. A linear alignment of large boulders extends west towards the second pahoehoe excavation. Southwest of the alignment at 0.75 m is a pile of excavated boulders and cobbles stacked two courses high. Inside the excavation is a thin layer of soil with pebbles, covering an area of 1.0 m by 0.53 m.

FEATURE -: Pahoehoe excavation
FUNCTION: Agriculture/quarry
DIMENSIONS: 2.23 m by 1.58 m by 0.70 m
DESCRIPTION: The second pahoehoe excavation is located 45.05 m west of the first pahoehoe excavation. Circular in shape, with one large boulder and many cobbles filling the excavated area. Pahoehoe cobbles have been strewn throughout the area along the south west side. Immediately to the north, excavated blocks have been piled. The pile of excavated blocks and cobbles connects to the third pahoehoe excavation.

FEATURE -: Pahoehoe excavation
FUNCTION: Agriculture/quarry
DIMENSIONS: 1.33 m by 0.80 m by 0.51 m
DESCRIPTION: This pahoehoe excavation is filled with quarried cobbles.

SITE NO.: State: 13359 PHRI: T-137
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Pahoehoe flow surrounds the complex.
VEGETATION: Sword and laua'e ferns inside the east chamber and also around the entrance area. Kiawe, Christmas-berry, and koa-haole surrounds the complex.
ELEVATION: c. 276 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-burial
DESCRIPTION: The overall complex area measures 19.45 m at 60 degrees azimuth by 9.75 m. The site consists of two caves and a modified outcrop (Feature C). One of the

caves contains two tube chambers (Feature A). The other cave contains skeletal remains (Feature B).

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 28.5 m by 4.75 m by 3.00 m maximum ceiling height
DESCRIPTION: Feature A is situated at the bottom of a collapsed blister that is 4.50 by 4.75 m. The entrance is 2.5 m below the ground surface. Two tube chambers are present, one the the east and one to the west. The western chamber is at least 28.50 m long, 2.60 m wide and has a ceiling height from 2.20 to 3.00 m. A rectangular enclosure is located inside the west chamber, 1.15 m from the entrance. The enclosure has an interior area of 2.75 by 0.90 m and an average wall width of 0.45 m. The interior floor consists of aa cobbles with small pockets of soil.

The eastern chamber is unmodified, however, historic period portable remains, such as tin cans and leather straps, are scattered on the floor, in addition to feral goat bones.

FEATURE B: Cave
FUNCTION: Burial
DIMENSIONS: 5.50 m by 4.50 m by 1.70 m
DESCRIPTION: The cave has a vertical opening 1.50 by 0.90 m that drops 2.60 m from the ground surface. The opening has been modified by excavation around the edges. The main chamber is unmodified, and the floor is scattered with roof fall. There are crawlspaces extending from the west and east ends of the south wall of the main chamber, and a tube extension eastward from the north wall. A human interment is located against the north wall of the tube extension, 1.60 m from its connection with the main chamber. The bones are currenly exposed.

FEATURE C: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 2.90 m by 1.60 m by 0.00 m
DESCRIPTION: Feature C is 5.50 m northeast of Feature A and 1.60 m northwest from Feature B. It consists of a natural pahoehoe depression that filled with pebble size pieces of pahoehoe. The perimeter of the filled area is outlined larger pahoehoe blocks. Two alignments are at the north side of the depression where a 0.57 m wide opening is present between the alignments.

SITE NO.: State: 13360 PHRI: T-138
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Pahoehoe flow with cave.
VEGETATION: Christmas-berry, kiawe, ooni, and fountain grass
ELEVATION: c. 278 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Burial-quarry
DESCRIPTION: The overall complex area measures 24.0 m at 20 degrees Az. by 15.00 m. A burial cave (Feature A) and four pahoehoe excavations (Feature B) are present.

FEATURE A: Cave
FUNCTION: Burial
DIMENSIONS: 14.20 m by 8.24 m by 2.08 m
DESCRIPTION: The cave opening measures 1.50 m at by 1.10 m with the ceiling height at the base of the entrance at 1.22 m. The entry has a sloping surface of collapsed stone. The tube is oriented N-S with a circular tube/chamber in the middle and to the west which houses the burial. The chamber measures 11.6 m by 8.24 m with a ceiling height of 2.08 m. The burial is beneath a rock mound in this chamber.

FEATURE B: Pahoehoe excavation (4)
FUNCTION: Quarry
DIMENSIONS: 3.80 m by 3.45 m
DESCRIPTION: Angular shaped pahoehoe excavations filled with two large excavated boulders and many cobbles. The northeast corner of the excavation has cobbles placed in a linear fashion and oriented NW-SE. Southwest of the excavation, cobbles are scattered upon the pahoehoe surface.

SITE NO.: State: 13361 PHRI: T-139 *(Figure A-36)*
SITE TYPE: Modified outcrop
TOPOGRAPHY: Undulating pahoehoe flow.
VEGETATION: Kiawe, koa-haole, lantana, grasses, and scrub brush.
ELEVATION: c. 142 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 15.00 m by 12.00 m by 2.00 m
DESCRIPTION: The outcrop is modified in two ways. The top northeast half is paved with small to large basalt cobbles a few small boulders. This paved surface is fairly flat and level. It extends from the north and west top edges of the outcrop to a straight alignment that is oriented NE-SW. The paving is thin, mostly one course high and measures 5.5 m (E-W) by 4.0 m (N-S).

The other modification is an oval shaped stone alignment that encloses a cleared and fairly flat soil filled area. The alignment is not continuous but utilizes natural bedrock

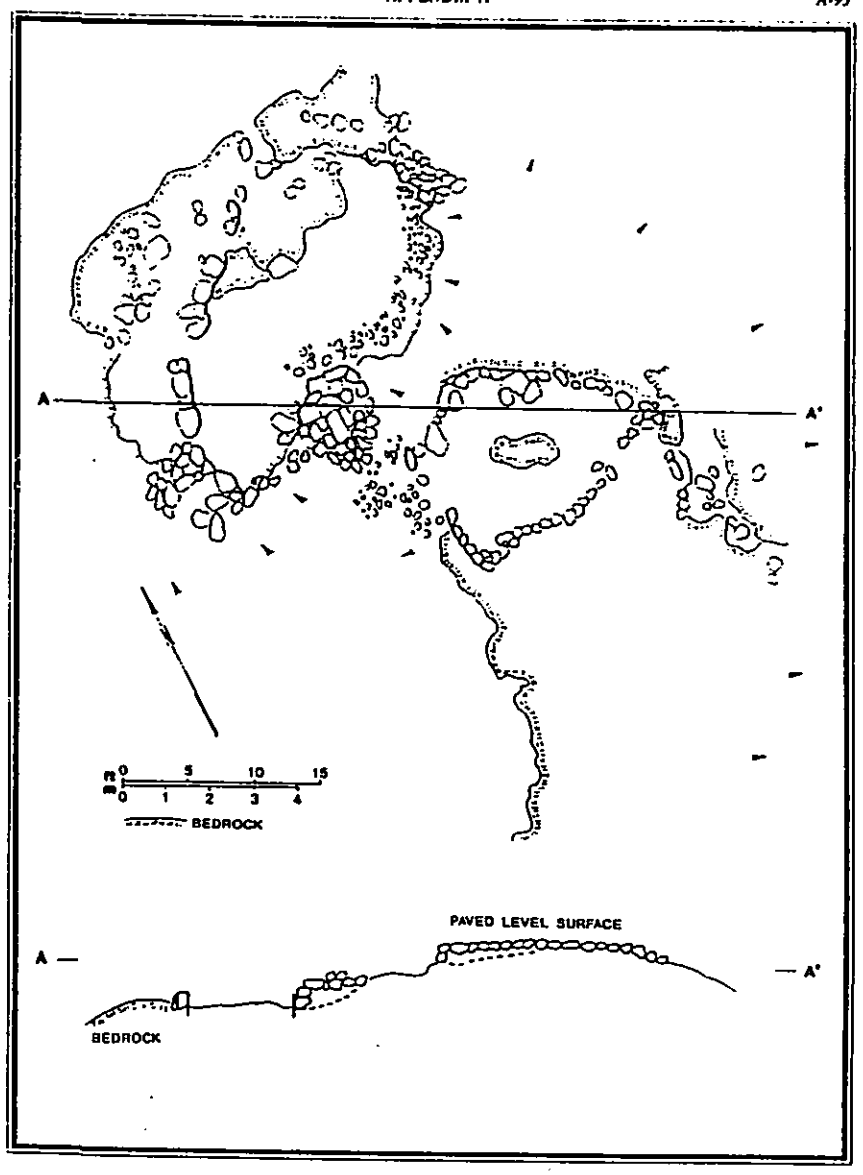


Figure A-36. SITE 13361

outcropping along sections. Situated on the NW side of the feature it appears to be a cleared planting are. Most of the loose rocks from the interior of the soil area have been removed and loosely placed within the alignment. It measures 8.0 m (NE-SW) by 4.5 m (NW-SE). The soil depth within this is 0.15 to 0.25 m deep. The enclosed area is like a small shelf with a drop off of c. 0.30 to 0.50 m to the west. The height of the outcrop along the southeast side is 2.00 m.

SITE NO.: State: 13362 PHRI: T-140
SITE TYPE: Complex (35+ Features)
TOPOGRAPHY: Slightly undulating pahoehoe flow that slopes slightly to the southwest.
VEGETATION: Kiawe, koa-haole, lantana, fountain grass, grass, vines, and scrub brush.
ELEVATION: c. 147 feet
CONDITION: Fair-good
INTEGRITY: Unaltered-except possibly by bulldozing
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 51.0 m (N-S) by 43.0 m (E-W). The site area has numerous modified basalt bedrock outcrops and pahoehoe excavations and wall alignments. A bulldozer push area is visible on the northeast edge of the site.

FEATURE - : Modified outcrop/pahoehoe excavation complex (24+)
FUNCTION: Agriculture
DESCRIPTION: The outcrops are modified by the mining of the bedrock and piling it on top of the outcrops. There are four large outcrops with measurements that average 5.0 m by 3.0 m and 0.97 m in height. Ten medium outcrops that average 3.0 m by 2.0 m and 0.50 m in height. Ten small modified outcrops with average measurements of 2.0 m by 1.0 m and 0.45 m in height.

FEATURE - : Pahoehoe excavation (9+)
FUNCTION: Agriculture
DESCRIPTION: Eight pahoehoe excavations were identified on the site, and it is likely that additional features are present. The excavations average 2.0 m by 2.0 m and 0.37 m deep. In addition, there is a larger pahoehoe excavation that measures 6.0 m by 5.50 m that is filled with rubble and a short wall section.

FEATURE - : Wall section (2)
FUNCTION: Agriculture
DESCRIPTION: There are two short wall sections. One is situated in a large pahoehoe excavation. It extends southeast and is 3.5 m long and 0.30 to 0.50 m in height. There is another short wall/alignment section in the NW quad of the site. It measures 2.5 m in length and is 0.30 to 0.50 m in height.

SITE NO.: State: 13363 PHRI: T-143
SITE TYPE: Complex (11 Features)
TOPOGRAPHY: Gentle NE to SW slope with an uneven surface and much exposed bedrock.
VEGETATION: Thick grasses, kiawe, koa-haole, and fairly thick lantana.
ELEVATION: c. 136 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: This site consists of eight modified outcrops, two low rubble concentrations, scattered rubble and one pahoehoe excavation. The overall complex area measures 25.27 m by 9.69 m at 219 degrees azimuth. Angular cobbles and boulders are concentrated around the bases and on top of the low exposed bedrock outcrops. The individual features have not been measured at this site to date.

SITE NO.: State: 13364 PHRI: T-144
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Gentle NE to SW slope with much exposed bedrock.
VEGETATION: Thick grasses, thick small koa-haole, several large dead kiawe trees, and moderate density of lantana.
ELEVATION: c. 133 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 30.0 m (NW-SE) by 30.0 m (NE-SW). Six modified outcrops, two pahoehoe excavated areas, and one rock mound are in a 10.0 m radius of Feature A, a platform.

FEATURE A: Platform *(Figure A-37)*
FUNCTION: Possible habitation/agricultural
DIMENSIONS: 9.55 m by 7.53 m by 1.62 m
DESCRIPTION: The platform is constructed over a rounded pahoehoe blister, portions of which protrude through the surface paving. It is rectangular shape in plan, and vertically faced on all four sides. The western side consists of a single width of facing stones, placed against the nearly vertical face of the blister. The northern side is sloping, following the natural bedrock, in a ramp-like form. Natural bedrock is incorporated into much of the southeast 1/3 of the structure.

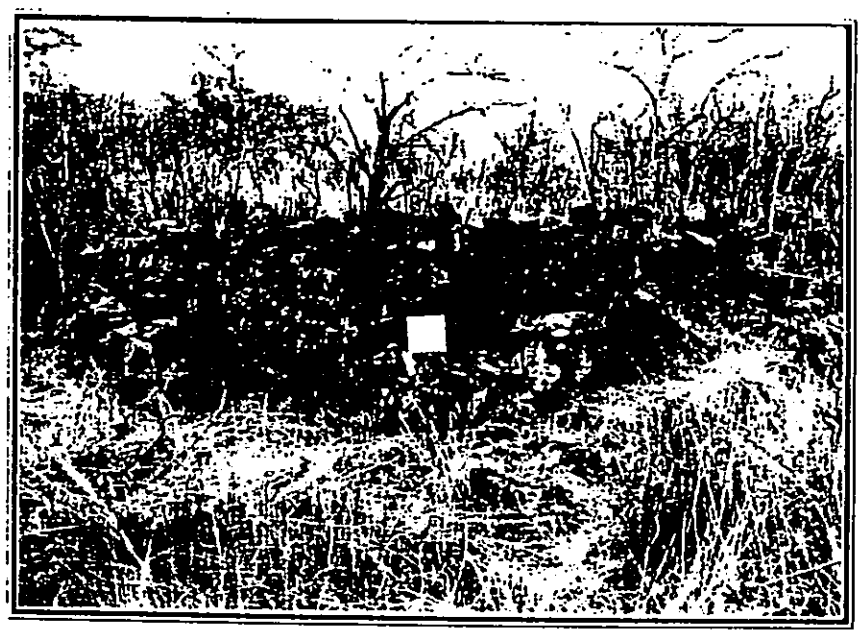


Figure A-37. SITE 13364, FEATURE A. View to Northeast (PHRI Neg. 1246-30)

The remainder of the platform filled with large angular boulders stacked four to six courses high.

At the SE end of the platform is a small vertical opening into the blister. It measures 0.87 m (NE-SW) by 0.33 m (NW-SE) and accesses an air pocket that extends 0.88 m below the platform surface. A small tube extends northwest and south from the air pocket, under the platform, and opens at the base of the south side of the platform. This opening is too small for human access. A small concentration of blocks and small angular cobbles is located on the platform, to the east of the crawlspace opening. These stones appear to have been moved from the opening, which may have been covered originally. No portable remains were observed in the crawlspace. A thin layer of wind-blown loess is present.

SITE NO.: State: 13365 PHRI: T-148
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Fairly flat pahoehoe flow with a light slope to the southwest.
VEGETATION: Koa-haole, kiawe, and fountain grass.
ELEVATION: c. 100 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: Overall complex area measures 27.0 m (E-W) by 25.0 m (N-S). It consists of a terrace (Feature A), and three mounds (Features B-D).

FEATURE A: Terrace
FUNCTION: Habitation
DIMENSIONS: 8.00 m by 7.00 m by 0.95 m
DESCRIPTION: A flat and mostly level paved terrace constructed on top of a fairly high outcrop. The southeast half of the outcrop was partly mined and filled with small basalt boulders and large to medium cobbles. These were partially fitted on the surface to form a level paving. The west edge has a straight facing/alignment of small boulders. The southern end of this alignment is raised and the northern section rests on sloping bedrock. The raised side is 3 to 4 courses high.

There is also boulder facing on the southwest corner which slowly curves away from the terrace to the west. It forms a small linear terrace against the south side of a bubble extension of the outcrop. This small area is the same level as the main terrace. The bubble outcrop has been mined to expose an almost square and flat floor surface. This floor has a soil deposit of 0.05-0.10 m. The terrace is built up to the bubble and crosses the opening with a straight alignment.

FEATURE B: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.90 m by 1.80 m by 0.95 m
DESCRIPTION: Feature B is 12.30 m at 128 degrees Az. from the center of Feature A. It is a small blister which has been mined and the material piled to form a mound.

FEATURE C: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.20 m by 2.10 m by 1.00 m
DESCRIPTION: Feature C is 17.30 m at 189 degrees Az. from Feature A. It is similar in construction to Feature B. Feature C is nearby a small blister that has been mined and the material piled to form the mound.

FEATURE D: Mound
FUNCTION: Agriculture
DIMENSIONS: 4.60 m by 1.80 m by 0.90 m
DESCRIPTION: Feature D is a modified outcrop with a small pahoehoe excavation. Portions of the south side of the outcrop was broken away and the rubble piled against the outcrop. It is 26.50 m at 222 degrees Az. from Feature A.

SITE NO.: State: 13366 PHRI: T-149
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Gently sloping from north to south smooth pahoehoe. A rubble filled blister is in the area.
VEGETATION: Moderate density of fountain grass, low bushes with yellow flowers, *portulaca* sp., thick lantana, koa-haole, and kiawe trees.
ELEVATION: c. 97 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 18.1 m at 60 degrees Az. by 13.5 m. It consists of a large collapsed and faulted blister with blocks arranged in two low, wide linear mounds and five cleared paved pahoehoe excavated areas. At various points around the blister edge there are small areas of basalt blocks.

Large angular cobbles and boulders are arranged in a linear formation bisecting the collapsed blister. The mound is oriented N-S and measures 7.2 m (N-S) by 1.7 m (E-W) and 0.70 m above the floor.

The second linear mound is situated east of and paralleling the first mound. This mound measures 6.0 m (N-S) by 1.8 m (E-W) and is stacked higher at the north end at 0.58 m above the blister floor.

There are five cleared areas within the blister which have small gravel and small cobble paving to level the floor area. These areas average 2.64 m by 1.73 m and 0.32 m below the blister surface. They contain no soil, only small cobbles and gravel. Besides these cleared areas the rest of the blister floor is covered with angular cobbles and boulders.

SITE NO.: State: 13367 PHRI: T-150
SITE TYPE: Terrace
TOPOGRAPHY: Undulating pahoehoe flow that is sloping to the southwest.
VEGETATION: Large kiawe, koa-haole, lantana, grasses, and small shrubs.
ELEVATION: c. 130 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 7.20 m by 5.20 m by 1.10 m
DESCRIPTION: This site appears is a large pahoehoe excavation which has been filled and leveled with pahoehoe boulders, cobbles and pebbles creating a roughly rectangular shaped terrace. The terrace abuts a pahoehoe outcrop along the west and north sides.

The south half of the terrace is faced along the west portion, to the southwest corner. The facing is of large cobbles and a few small boulders, two to four courses high at 0.65 m. There is a depression in the south central half which appears to be a filled excavation.

The north half of the terrace has a slightly domed surface and it is rough with large cobbles and small boulders. The remaining terrace surface is roughly flat with a slight slope to the south. The edges of the outcrop appear quarried, with the highest section at 0.55 m.

North and northwest of the terrace at 3.0 m is another quarried section of outcropping. It extends 3.5 m in a NW-SE direction.

SITE NO.: State: 13368 PHRI: T-151
SITE TYPE: Complex (45 Features)
TOPOGRAPHY: Gentle northeast to southwest slope with much exposed bedrock. An aa flow is to the NNW.
VEGETATION: Thick grass, large kiawe, koa-haole trees, lantana, and succulents.
ELEVATION: c. 111-116 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Agriculture-transportation
DESCRIPTION: The overall complex area measures 49.0 m at 133 degrees Az. by 26.8 m. Seven features were designated and individually recorded, and an additional 32 features were tabulated. Recorded features include 2 terraces (Features A and B), two walls (Features C and E), a modified outcrop/terrace (Feature D), and two trail sections (Features F and G). In addition to the designated features, there are 26 modified outcrops, four pahoehoe excavations and eight mounds.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.85 m by 1.82 m by 0.66 m
DESCRIPTION: Feature A is built up and abutting bedrock outcropping on the east side. Oriented N-S, it is slightly arch-shaped and roughly faced on the east side, 2-4 cobbles high. The remaining sides are level with the present ground surface. The terrace follows the natural slope of the outcrop from north to south, giving it the appearance of a ramp. The surface in and around the outcrop consists of flat and even paving. On the west side surface, small angular cobbles have been placed around the outcrop.

FEATURE B: Terraced outcrop
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 1.75 m by 1.50 m
DESCRIPTION: This is a linear terrace built on the southeast edge of an extended outcrop. Materials used were small basalt boulders with large to small cobbles. The southeast side is faced, 3 to 6 courses, to a height of 0.90 m above bedrock. The southwest end tapers to 1.0 m in width and connects with the southeast corner of the Feature C wall. The northwest side has a very rough facing of 1 to 2 courses high averaging 0.30 m. The northeast end appears to have been faced but is disturbed by a large kiawe tree. The surface of Feature B is roughly flat with a slight slope to the southwest.

There is a higher outcrop immediately to the north upon which the Feature E wall is constructed. Feature B may have abutted this outcrop, as there is a small amount of rubble collapsed below the outcrop and the northeast end of Feature B. It also appears that some of the stone used may have come from an aa flow 3.0 m to the north.

FEATURE C: Wall
FUNCTION: Agriculture
DIMENSIONS: 36.00 m by 16.00 m by 1.20 m
DESCRIPTION: This is a loosely stacked wall/alignment constructed mainly of small basalt boulders stacked on higher outcropped areas. The wall is curved in many areas, but generally it is oriented NW-SE, and follows the topography.

At the north end of the wall and to the east is a pahoehoe excavation. It measures 5.0 m by 4.0 m. The wall curves almost 90 degrees azimuth to the east along the north side of the excavation and continues for 5.0 m.

West from the northern end of the wall, a small terrace was constructed with two faced retaining walls along the northwest and southwest sides. These faces meet at a 90 degree angle abutting a small rubble pile. The faces are 0.70 m and three courses high. The terrace area measures 3.25 m (E-W) by 2.90 m (N-S) with roughly flat and level surfaces. The upslope and interior areas of the wall appears cleared.

FEATURE D: Modified outcrop/terrace
FUNCTION: Agriculture
DIMENSIONS: 9.50 m by 9.00 m by 3.25 m
DESCRIPTION: The outcrop is a large lava bubble with an apparent open interior which has been filled with small to large cobbles and small boulders of pahoehoe. The opening to the interior of the outcrop is faced with a straight wall of small boulders, 0.85 m in height, three courses high and 1.20 m wide. The southeast side is faced with small to medium boulders, 1.45 m and 6 to 7 courses high and 2.5 m wide. There is facing on the west side, 1.10 m and five courses high and 1.2 m wide. The surface of the fill is flat and level. It measures 2.90 m (NW-SE) by 2.35 m (NE-SW).

The northern portion of the outcrop is a cracked area that appears to have been excavated. It is 0.85 m deep and may have been the source for the terrace fill.

At the western base of the bubble/outcrop, appears to be a rough terrace of small boulders and large cobbles. There is a rough alignment oriented N-S along the western edge with a possible short alignment extending E-W on the north end.

FEATURE E: Wall
FUNCTION: Agriculture
DIMENSIONS: 12.00 m by 8.50 m by 1.25 m
DESCRIPTION: Northeast of the site is an outcrop that has several sections of loosely stacked boulders forming wall/alignments. They are situated along the south, southwest and western perimeters. These sections are mostly single stone high and wide with occasional double stones. They average in height 0.45 m. The left central half of the outcrop has a roughly circular stone alignment on the top surface constructed of single stones. This alignment is 3.10 m by 2.90 m and 0.25 m in height. The surface of the outcrop is flat with a slight slope to the NE and appears cleared of larger stone. The east half is aa type stone and appears slightly crushed. The southeast corner is a rubble pile of small boulders which abuts a collapsed area which might have been the northeast end of Feature B.

FEATURE F: Trail section
FUNCTION: Transportation
DIMENSIONS: 23.50 m by 0.75 m by 0.00 m
DESCRIPTION: This foot path crosses a small aa flow and cannot be seen in the vegetated pahoehoe areas at the flow edge. The large cobbles and small boulders have been removed leaving a small and medium cobble trail bed. This trail section has a slight curve upslope at both ends. There is a possible trail section leading from the south end of this section and upslope to the main site area. However, it is very obscured.

Two small cairns are nearby (upslope) and are both believed to be recent due to the stability and poor construction. The first cairn is on top bedrock boulder and measures 0.45 m in diameter and 0.85 m in height. It is 9.0 m northeast of the feature datum. The second cairn is 0.40 m in diameter and 0.40 m in height. It is 19.0 m east of the feature datum. The feature datum is 27.50 m at 148 degrees Az. from the site tag.

FEATURE G: Trail section
FUNCTION: Transportation
DIMENSIONS: 18.25 m by 0.75 m by 0.00 m
DESCRIPTION: This footpath crosses a small aa flow. Most of the small boulders and larger cobbles have been removed and thrown to the sides. There is a crude cairn on the northwest end and located on the north side of the trail. It measures 0.50 m in diameter and 0.65 m in height.

The trail is very rough and appears to be recent. It is 30.0 m west of Feature F and 30.0 m east of the old quarry road. Lots of historic rubbish is in the area.

SITE NO.: State: 13369 PHRI: T-152
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe flow with an aa flow that is oriented southeast.
VEGETATION: Fountain grass, lantana, kiawe, Christmas-berry, and noni.
ELEVATION: c. 237 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 45.0 m at 256 degrees Az. by 27.0 m . This site consists of

seven pahoehoe excavations (four cleared, two partially cleared and the largest with associated mounds).

The largest pahoehoe blister measures 27.0 m by 6.8 m. It has been quarried for basalt blocks and the mined material placed into distinct piles. The excavated blister is also filled with cobbles and boulders. The area of excavated blocks measures 12.50 m across.

At the northeast corner of the excavation, is a pile of excavated cobbles arranged in a circular pattern with an upright pahoehoe slab positioned in the center. The upright measures 1.43 by 1.08 m. Excavated cobbles have also been haphazardly placed on the very northeast corner of the excavation. Extending immediately to the southwest it is also excavated with boulders and cobbles piled in groups and singularly placed.

Six additional pahoehoe excavations are within an area 45.0 m at 265 degrees Az. from the above feature. Four of the excavations are cleared pahoehoe blisters with the following measurements: 1) 1.10 m by 0.80 m, 2) 1.90 m by 1.60 m, 3) 1.10 m by 0.75 m and 4) 1.49 m by 1.16 m. The depths range from 0.30-0.50 m. The remaining two are partially cleared blisters with measurements of 1.60 m by 1.50 m and 2.60 m by 1.45 m. The depths also range from 0.30-0.50 m. Excavated cobbles are strewn haphazardly throughout the surrounding area.

SITE NO.: State: 13370 [P]* PHRI: T-153
SITE TYPE: Mounded wall
ELEVATION: c. 232 feet
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 20.00 m by 0.00 m by 0.50 m

SITE NO.: State: 13371 [P] PHRI: T-154
SITE TYPE: Platform
ELEVATION: c. 225 feet
FUNCTIONAL INTERPRETATION: Possible habitation
DESCRIPTION: Rectangular shape with a level top. The platform is built partially against bedrock outcrop.

SITE NO.: State: 13372 [P] PHRI: T-155
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Pahoehoe flows on a mild slope.
VEGETATION: Very thick grasses, koa-haole, and lantana.
ELEVATION: c. 230 feet
CONDITION: Fair
INTEGRITY: Partially altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation-quarry
DESCRIPTION: The overall complex area measures 30.0 m (N-S) by 20.0 m (E-W). The site consists of a platform (Feature A), an enclosure (Feature B), a cairn, three mounds, three pahoehoe excavations, and a terrace Measurements were recorded for Features A and B, and for two pahoehoe excavations (Features G and H).

FEATURE A: Platform
FUNCTION: Indeterminate
DIMENSIONS: 6.10 m by 4.70 m by 1.02 m
DESCRIPTION: Pahoehoe boulders and cobbles loosely piled, with a relatively flat surface. It is situated 2.0 m at 133 degrees Az. from Feature B.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 4.00 m by 3.10 m
DESCRIPTION: Large pahoehoe boulders are loosely stacked 2 to 3 courses high in a circular fashion and filled with pahoehoe cobbles and loam. It is adjacent to Feature A, 2.0 m to the southeast.

FEATURE G: Pahoehoe excavation
FUNCTION: Possible quarry
DIMENSIONS: 4.03 m by 1.71 m by 1.04 m
DESCRIPTION: Feature G consists of a possible pahoehoe quarry area with an adjacent rock pile. It appears to be the edge of a large pahoehoe blister, partially broken off, with pahoehoe boulders and cobbles heaped on top and around it.

The adjacent rock pile is 1.12 m northeast from the quarry area. It measures 3.94 m E-W and is 0.59 to 0.68 m in height.

FEATURE H: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.10 m by 1.80 m by 0.50 m
DESCRIPTION: A pahoehoe flow with quarried pahoehoe cobbles and boulders from the interior stacked along the western part of the ledge. The interior has a deposit of loam and small cobbles and clinkers. On the SW exterior of the feature there appears to be rubble pile from the excavated pahoehoe. Directly south of Feature H is a rubble pile that measures 6.0 m E-W by 2.5 m N-S and 1.1 m high.

SITE NO.: State: 13373 [P] PHRI: T-156
SITE TYPE: Complex (10+ Features)
ELEVATION: c. 250 feet

*[P] Site is located in preserve area; recording was conducted only at sites near the western boundary of preserve.

FUNCTIONAL INTERPRETATION: Agriculture-habitation-possible ceremonial -possible burial
DESCRIPTION: The site complex consists of an enclosure, a C-shape wall, a midden scatter, terrace, two rock mounds and a low wall. Two more mounds that may be possible burials and many additional rock mounds and pahoehoe excavations are in the area. The enclosure is 12.00 by 10.00 m, with biface, core-filled walls 1.00 to 2.00 m wide. Coral is present on the wall.

SITE NO.: State: 13374 (P) PHRI: T-157
SITE TYPE: Complex (2 Features)
ELEVATION: c. 238 feet
FUNCTIONAL INTERPRETATION: Agriculture/land division
DESCRIPTION: Two walls are present at this site. One is C-shaped and oriented E-W. The other wall is 5.00 m long, 1.50 m wide and 0.50 m high. It is also oriented E-W. Additional agricultural features are undoubtedly in the vicinity.

SITE NO.: State: 13375 (P) PHRI: T-158
SITE TYPE: Complex (3 Features)
ELEVATION: c. 240 feet
FUNCTIONAL INTERPRETATION: Agriculture/habitation
DESCRIPTION: Two platforms and a terrace were identified at this site. One platform is 3.00 m square and 1.20 m high. The second platform is 6.00 by 5.00 m and 1.00 m high. Mounds and small walls are also in the vicinity.

SITE NO.: State: 13376 (P) PHRI: T-159
SITE TYPE: Platform
ELEVATION: c. 240 feet
FUNCTIONAL INTERPRETATION: Habitation/possible burial
DIMENSIONS: 7.00 m by 5.00 m by 1.20 m
DESCRIPTION: The platform is roughly paved and faced on all sides.

SITE NO.: State: 13377 PHRI: T-160
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Smooth pahoehoe ledge and surface flow.
VEGETATION: Lantana, laua'e, koa-haole, Christmas-berry, kiawe, and fountain grass.
ELEVATION: c. 232 feet
CONDITION: Fair-good
INTEGRITY: Unaltered-possibly altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-burial
DESCRIPTION: The overall complex area measures 13.70 m at 34 degrees Az. by 7.50 m. The site consists of three lava tube caves (Features A-C).

FEATURE A: Lava tube cave
FUNCTION: Habitation
DIMENSIONS: 68.35 m by 10.35 m by 2.80 m
DESCRIPTION: A blister type shelter cave with surface collapse. It is oriented NE-SW with a modified entrance and a cairn in the chamber. The entrance is 1.20 m by 1.10 m with a paved surface under the opening into the southwest chamber.

The southwest chamber appears to be modified with boulder and cobbles and pebbles as fill. There are two levels of paving. The first level is 0.38 m in height and measures 5.0 m by 2.9 m. Immediately northwest and below is the second level which is 0.51 m in height and measures 2.80 m by 0.73 m, and is built up on natural bedrock. There is a single course alignment of cobbles that surrounds this second level area.

Northeast of the first level area at 9.0 m is a cairn with a piece of coral on the southwest side. The cairn is 1.25 m in height and is stacked four courses high with boulders at the base and cobbles stacked on the top. There is another piece of coral 4.35 m northeast of the cairn.

FEATURE B: Lava tube cave *(Figure A-38)*
FUNCTION: Burial
DIMENSIONS: 40.00 m by 9.00 m by 1.90 m
DESCRIPTION: Feature B is 13.0 m at 20 degrees Az. from Feature A. The lava tube is oriented southwest 200 degrees Az. The opening measures 4.55 m wide by 1.47 m in height. The entry is very wide and narrowing midway with natural collapse at the mouth of the cave.

A possible hearth is situated 8.95 m from the cave opening. It consists of an ash deposit and bits of charcoal. One piece of coral is present 30.45 m from the opening into the southwest chamber.

The remains of a human burial is located 39.95 m in from the cave opening. The identified remains include a rib, incisor, molar and scattered fragments. Charcoal surrounds the burial.

FEATURE C: Lava tube cave
FUNCTION: Habitation
DIMENSIONS: 10.60 m by 4.50 m by 1.90 m
DESCRIPTION: The cave extends southwest with a paved area consisting of cobbles and pebbles. This paved area

Figure A-38. SITE 13377, FEATURE B. View to Southwest (PHRI Neg. 1249-28)

measures 8.60 m by 5.22 m. Prior to entering the chamber, there is a wall. It measures 4.90 m in length and 2.0 m in height. The wall is constructed with boulders and cobbles stacked five courses high. Portable remains observed in the cave include a piece of coral on the paved area, 2-3 beverage bottles (Kona Bottling Works) and plywood.

SITE NO.: State: 13378 PHRI: T-161
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Pahoehoe flow adjacent to an aa flow.
VEGETATION: Christmas-berry and grass.
ELEVATION: c. 267 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 14.0 m at 251 degrees Az. by 1.5 m. The site consists of two pahoehoe excavations. One is an excavated blister with the mined blocks haphazardly thrown. Small cobbles line the bottom of the excavation. The other is an excavated pahoehoe ledge that is backfilled with basalt blocks.

SITE NO.: State: 13379 PHRI: T-162
SITE TYPE: Complex (8+ Features)
TOPOGRAPHY: Pahoehoe outcrops are scattered throughout the area.
VEGETATION: Very dense koa-haole, various grasses, Christmas-berry, lantana, noni, and vines.
ELEVATION: c. 260-268 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 71.0 m at 34 degrees Az. by 65.0 m. It consists of two modified outcrops (Features A and C), two pahoehoe excavations (Features B and E), three terraces (Features D and G), an alignment (Feature F), and a wall (Feature H). Temporary Site T-169 was combined with this site complex.

FEATURE A: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 38.00 m by 12.20 m
DESCRIPTION: A horseshoe-shaped pahoehoe outcrop (possible the edge of a collapsed blister) and another large pahoehoe outcrop situated to the northeast side of the horseshoe shape. There is paving in between the two outcrops consisting of small pahoehoe boulders and pebbles.

An oval shaped alignment is near the center of the outcrop. It measures 4.0 by 1.50 m. The alignment is constructed with boulders and cobble size pahoehoe.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 9.60 m by 6.20 m by 1.20 m
DESCRIPTION: Feature B is a pahoehoe excavation quarried from a blister on the south and southwest face of an outcrop. The excavated material is piled in a rubble mound adjacent to the excavation. It is located 5.50 m southwest from Feature A.

FEATURE C: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 5.30 m by 5.15 m by 0.60 m
DESCRIPTION: A modified outcrop with a pahoehoe excavation and an alignment abutting the outcrop along the south side, is located 5.00 m east form Feature A. The alignment forms a small roughly circular enclosure. It is constructed with small pebble to large cobble sized basalt blocks. The interior of the circular shaped enclosure is paved with large pebbles and small cobbles.

FEATURE D: Terrace (2)
FUNCTION: Agriculture
DIMENSIONS: 6.00 m by 4.00 m by 1.50 m
DESCRIPTION: Feature D is 12.00 m southeast from Feature C. It consists of an upper and lower terrace that utilizes the pahoehoe outcrop for the base of the upper terrace. The lower terrace is located at the base of the outcrop. The terraces are raised on the southeast side. Portions of the outcrop have been excavated, then paved with pebble to cobble size basalt. The southern end has a small wall built up between the bedrock outcrops. It is possible that this wall may have encircled the paved area at one time but is presently collapsed.

FEATURE E: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 1.80 m by 0.00 m
DESCRIPTION: A pahoehoe excavation that is filled in with boulder to pebble size pahoehoe basalt. It is situated along the same pahoehoe outcrop as the upper terrace in Feature D, 10.00 m to the northeast. The outcrop is narrow with the center portion excavated and filled. The northern portion of the filled excavation appears to be more placed and slightly paved. The southern end is Feature D terrace. North of Feature E 2.0 m is another outcrop with a large crevice. A Cypraeidae shell was found in the crevice along with cobble and pebble size rocks.

FEATURE F: Alignment
FUNCTION: Agriculture/indeterminate
DIMENSIONS: 2.40 m by 1.70 m by 0.60 m
DESCRIPTION: Oval shape in plan, it is constructed with large pebble and cobble sized basalt blocks. Generally it is

single course in construction although one section is three courses high. The central portion of the feature is hollow. It is situated on top of the highest outcrop of pahoehoe within the area, 8.40 m south from Feature E.

FEATURE G: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.20 m by 3.30 m by 0.00 m
DESCRIPTION: The terrace is raised on the northwest side and is constructed off the side of a pahoehoe bedrock facing. It is built with small boulder to cobble size rocks. It is located 8.50 m northwest from Feature B.

Additional features are in the immediate area consisting of a paving, a filled depression and a mound. The paving surrounds Feature G but dense vegetation makes it impossible to determine a boundary. To the south is a depression filled and paved with pebble to cobble size pahoehoe rocks. West of Feature G 3.5 m is an agricultural mound.

FEATURE H: Wall
FUNCTION: Indeterminate/possible boundary
DIMENSIONS: 22.50 m by 1.50 m by 1.50 m
DESCRIPTION: The wall is oriented 319 degrees Az.; it is bifaced and core filled with cobble-size rubble. The wall is constructed with basalt boulders and cobbles. A probable pavement is situated downslope to the northeast; it is presently covered with heavy vegetation.

SITE NO.: State: 13380 [P] PHRI: T-163
SITE TYPE: Complex (5 Features)
ELEVATION: c. 264 feet
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The site consists of a platform, three walls and a cave. The platform is 6.00 m square and is connected to a wall that is 1.00-2.00 m high. One of the walls is 26.0 m long. The cave has a cleared floor and a thick cultural deposit.

SITE NO.: State: 13381 [P] PHRI: T-164
SITE TYPE: Enclosure
ELEVATION: c. 263 feet
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 4.00 m by 3.00 m by 1.00 m
DESCRIPTION: The enclosure is rectangular in plan.

SITE NO.: State: 13382 [P] PHRI: T-165
SITE TYPE: Enclosure
ELEVATION: c. 263 feet
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 7.00 m by 3.00 m by 0.75 m

SITE NO.: State: 13383 [P] PHRI: T-166
SITE TYPE: Complex (3 Features)
ELEVATION: c. 285 feet
FUNCTIONAL INTERPRETATION: Habitation/agriculture
DESCRIPTION: The site consists of a platform, an enclosure and a wall. The wall is oriented E-W and is c. 15.00 m long.

SITE NO.: State: 13384 [P] PHRI: T-167
SITE TYPE: Complex (3 Features)
ELEVATION: c. 295 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of a platform and two walls. The platform is 2.00 by 3.00 and 1.00 m high.

SITE NO.: State: 13385 [P] PHRI: T-168
SITE TYPE: Wall
ELEVATION: c. 295 feet
FUNCTIONAL INTERPRETATION: Land division
DESCRIPTION: Oriented NW-SE; it is bifaced and core-filled.

SITE NO.: State: 13386 PHRI: T- 30
SITE TYPE: Complex (49 Features)
TOPOGRAPHY: Uneven pahoehoe flow with small patches of aa.
VEGETATION: Sparse to moderate fountain grass, small 'ilima, lantana, and Christmas-berry trees.
ELEVATION: c. 15 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture/possible habitation
DESCRIPTION: The overall complex area measures 90.5 m at 48 degrees Az. by 85.0 m. The site consists of a walled overhang (Feature A), a cave (Feature B), two cairns (Features C and D), a modified blister (Feature E) and 44 pahoehoe excavations (31 in the SE half of the site and 13 in the NW half of the site).

Historic material consisting of pottery and glass sherds and a metal barrel hoop were found within and exterior of Feature A.

FEATURE A: Walled overhang *(Figure A-39)*
FUNCTION: Habitation
DIMENSIONS: 7.50 m by 3.50 m by 1.20 m
DESCRIPTION: The feature consists of a small enclosure, formed by natural bedrock and a constructed double faced, core filled wall. The wall is oriented NW-SE, parallel to the vertical face of the outcrop, and abuts the outcrop at the

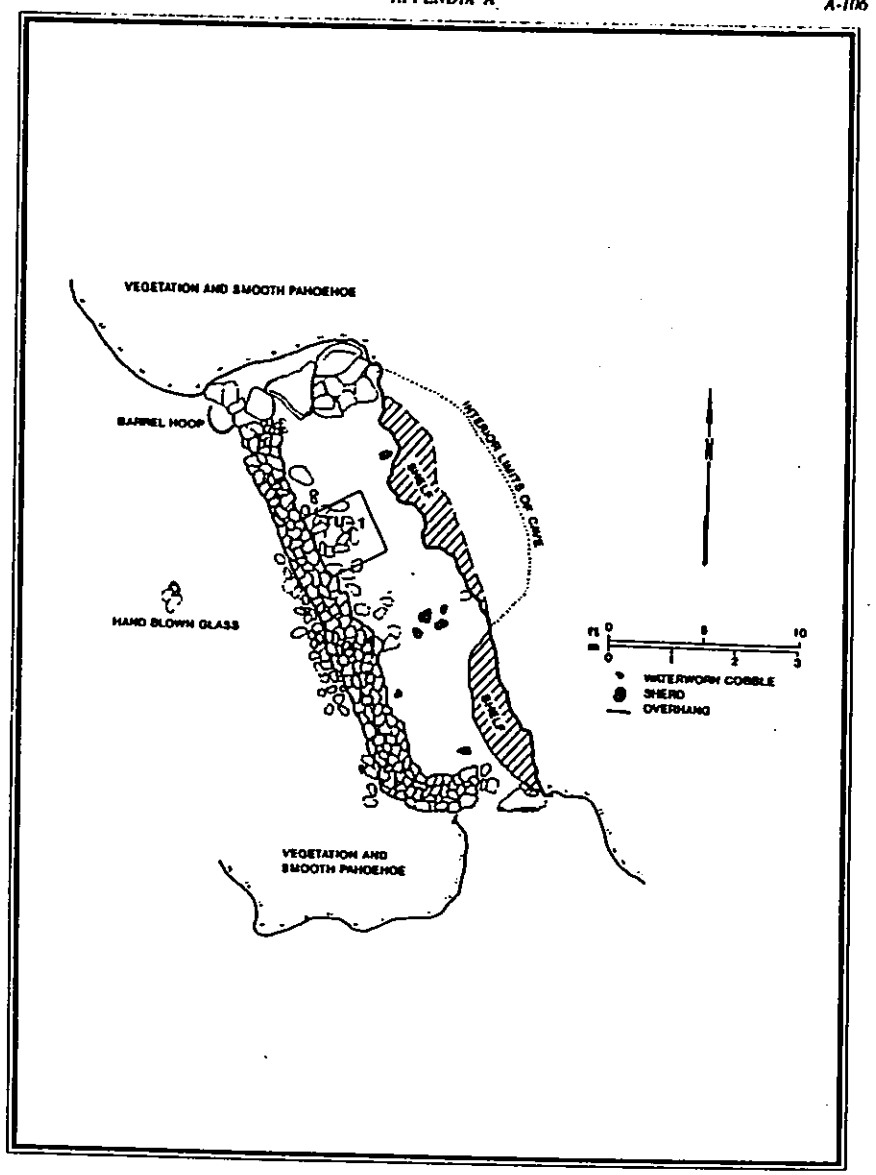


Figure A-39. SITE 13386, FEATURE A

northwest end. It is constructed with boulders and cobbles stacked 3-4 courses (0.44-0.79 m) high and 0.50-0.60 m wide.

There is a narrow opening at the southeast end of the wall, permiting access to the interior. The opening is 1.00 m wide.

There is a small shelf under the overhang that also extends beyond the overhang. At the northern end of the interior of the overhang is a crawlspace between the shelf and the ceiling. It measures 1.6 m wide, 10.0 m deep and with a ceiling height of 0.6 m. The maximum depth of the overhang from the base of the shelf is 0.65 cm in places. There is a circular alignment of cobbles between the wall and the overhang, and two semicircular pockets of pebble fill against the overhang shelf.

Along the interior side of the wall is a circular stone alignment that was thought to be a possible hearth. A 1.00 by 1.00 m square test unit was excavated over the alignment, in order to determine if datable charcoal remains were present. The unit was found to contain a thin (0.01 m) soil deposit over pahoehoe slabs, with pockets of soil to 0.05 m thick in crevices. No charcoal or ecofactual material was recovered from the screened soil. Soil samples were collected for further analysis.

Several sherd representing a single hand-thrown stoneware vessel (probably a jar) were observed scattered on the interior of the enclosure. These items were collected for reconstruction purposes. Sherds from the same or a matching vessel were recovered from the surface c. 50.00 m to the west of the enclosure. (Further discussed below).

FEATURE B: Cave
FUNCTION: Water catchment
DIMENSIONS: 4.50 m by 4.00 m by 1.65 m
DESCRIPTION: The cave is located in a small depression of pahoehoe between two large upthrusts of pahoehoe. It appears to fill with water as the tide changes. The water ranges in depth from 0.30 to 1.0 m in depth.

The cave entrance is vertical, measuring 1.65 by 0.56. m and opens to 210 degrees Az. Portions of the cave entrance and floor interior are paved. The interior of the cave measures 4.25 m by 2.6 m.

A small cairn is located directly above the entrance. It is constructed with c. ten pahoehoe rocks, stacked in a circular pattern. The cairn measures 0.60 by 0.50 m and 0.26 m in height. The area of the cave entrance and the cairn measures 3.6 m (NE-SW) by 2.05 m (NW-SE).

DESCRIPTION: A pocket of beach sand is present just below the interior of the entrance. Many marine shell fragments in and around the entrance of the cave, mammal bone fragments, basalt hammerstone and some recent refuse.

FEATURE C: Cairn
FUNCTION: Marker
DIMENSIONS: 0.46 m by 0.40 m by 0.56 m
DESCRIPTION: Feature C consists of two large pahoehoe blocks placed together, one set on end, with two smaller pahoehoe cobbles on top. Irregular shape in plan it probably marks the location for Feature B, Cave. It is 8.55 m at 92 degrees Az. from Feature B. Feature C is c. 9.0 m northeast of Feature D.

FEATURE D: Cairn
FUNCTION: Marker
DIMENSIONS: 0.66 m by 0.50 m by 0.52 m
DESCRIPTION: Roughly rectangular shape in plan it consists of six larger pahoehoe blocks at the base with cobbles and smaller boulders as fill. It is located 9.0 m at 150 degrees azimuth from Feature B and probably marks that feature's location. Feature D is 9.0 m southwest of Feature C.

FEATURE E: Modified blister
FUNCTION: Possible water catchment
DIMENSIONS: 4.20 m by 4.00 m by 1.10 m
DESCRIPTION: Feature E is 17.50 m northeast from Feature A. The interior of a collapsed blister has been modified with stacked pahoehoe boulders, 3-4 courses high, forming an enclosure. The portable remains consists of stoneware ceramic sherds and one rusted metal barrel hoop.

Pahoehoe Excavations--The NW half of the site complex consists of 13 pahoehoe excavations. Six are blister excavations and seven are fault excavations. The quarried material are either inside of the excavated area and/or near the edges. The average excavated area measures c. 1.27 m by 0.85 m, with an average pahoehoe thickness of 0.32 m. One to four faces are excavated through the first layer of pahoehoe.

The SE half of the site contains at least 31 pahoehoe excavations. Thirteen are blister excavations, nine crevices and nine faults. The majority are excavated through the first layer of pahoehoe. Some of the excavations have two layers excavated. The average excavated area measures 2.24 m by 1.7 m with an average face thickness of 0.25 m.

Both the NW and SE areas contain a light midden scatter, coral, waterworn basalt pebbles, hammerstones, small basalt flakes and some recent refuse.

SITE NO.: State: 13387 PHRI: T-170
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe finger and surface flows.
VEGETATION: Christmas-berry, lantana, fountain grass, and kiawe.
ELEVATION: c. 290 feet
CONDITION: good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The overall complex area measures 12.3 m at 240 degrees Az. by 10.0 m. It consists of three caves, all of which are entered from the same collapsed blister formation.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 6.10 m by 5.20 m by 1.50 m
DESCRIPTION: Feature A is a blister type cave that is oriented NE-SW. The opening faces southwest and measures 4.60 m wide and 1.30 m high. There is rubble collapse at the entrance and continuing along the interior perimeter.

There is a natural shelf area at the northern end of the cave that measures 6.0 m in length and 1.7 m in width. Directly below the shelf and to the west end of the cave is a hearth. The hearth measures 1.7 m by 1.4 m and contains three Cypraeidae fragments, a waterworn basalt pebble and an ash/charcoal deposit 0.10 m thick. The cave interior contains fragments of mammal bones (possibly dog), Cellana, Echinoidea, Thaididae and kukui nut shell, along with natural rubble and pebble collapse.

FEATURE B: Cave
FUNCTION: Habitation
DIMENSIONS: 5.50 m by 2.75 m by 1.94 m
DESCRIPTION: A blister type cave shelter that is separated from Feature A by ceiling collapse. Feature B is oriented NE-SW with the blister opening to the southwest. The mouth of the chamber is 1.55 m wide and 1.2 m high. There is a natural ledge across the blister opening that measures 1.71 m in height.

In the southeast corner of the chamber is a wall, stacked three courses high on natural collapse. The floor is slightly paved with cobbles and pebbles.

FEATURE C: Cave
FUNCTION: Habitation
DIMENSIONS: 8.40 m by 1.80 m by 1.20 m
DESCRIPTION: Feature C is directly across the collapsed blister from Feature A, and is oriented NE-SW. It contains a very small opening that measures c. 0.62 m in width and 0.41 m in height with collapse at the opening. Exterior of the blister opening is a paved area that is oriented NE-SW. The paved area is filled with cobbles and pebbles.

A possible stacked wall, five courses high is situated by the southeast corner of the paved area. The wall measures 2.7 m long and 1.35 m in height.

Portable remains observed in the cave include Cellana, Echinoidea and Cypraeidae, kukui nut shell, a waterworn basalt cobble, and charcoal. A midden/soil deposit is present in the southeast corner of the paved area.

SITE NO.: State: 13388 PHRI: T-171
SITE TYPE: Pahoehoe excavation
TOPOGRAPHY: Gently sloping pahoehoe with a western exposure.
VEGETATION: Christmas-berry, lantana, koa-haole, and thick grasses.
ELEVATION: c. 291 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 2.30 m by 1.50 m by 0.00 m
DESCRIPTION: This site contains no formal construction. It consists of scattered basalt around the excavated opening. The overall measurement including the scatter is 5.0 m in diameter. There may be other features in the area, however the visibility is very poor.

SITE NO.: State: 13389 PHRI: T-172
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: The terrain consists of smooth and ropy pahoehoe flow.
VEGETATION: Christmas-berry, lantana, koa-haole, and fountain grass.
ELEVATION: c. 297 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 9.50 m by 6.20 m.

FEATURE - : Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 5.80 m by 5.00 m
DESCRIPTION: The pahoehoe excavation is located in a blister. The quarried material has been removed and cobbles are strewn haphazardly around the blister opening.

FEATURE - : Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 5.95 m by 4.68 m
DESCRIPTION: The pahoehoe excavation is filled with cobbles. No other modifications or portable remains are present.

SITE NO.: State: 13390 [P] PHRI: T-173
SITE TYPE: Complex (15 Features)
ELEVATION: c. 302 feet
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The site consists of two platforms (Features A and I), an enclosure (Feature B), a wall (Feature C), four terraces (Features D-F and Feature H), four mounds (Feature G) and three linear mounds (Feature J). Measurements are currently available for Features A, D, F, H, and I.

FEATURE A: Platform
FUNCTION: Habitation
DIMENSIONS: 4.00 m by 3.00 m by 1.00 m
DESCRIPTION: Feature A is faced on four sides.

FEATURE D: Terrace
FUNCTION: Habitation/agriculture
DIMENSIONS: 10.00 m by 5.00 m

FEATURE F: Terrace
FUNCTION: Habitation/agriculture
DIMENSIONS: 5.00 m by 3.00 m by 1.00 m

FEATURE H: Terrace
FUNCTION: Habitation/agriculture
DIMENSIONS: 8.00 m by 4.00 m by 1.00 m
DESCRIPTION: Oriented NE-SW.

FEATURE I: Platform
FUNCTION: Habitation/agriculture
DIMENSIONS: 2.00 m by 1.00 m by 1.00 m

SITE NO.: State: 13391 [P] PHRI: T-174
SITE TYPE: Lava tube cave
ELEVATION: c. 297 feet
FUNCTIONAL INTERPRETATION: Habitation

SITE NO.: State: 13392 [P] PHRI: T-175
SITE TYPE: Platform
ELEVATION: c. 300 feet
FUNCTIONAL INTERPRETATION: Possible burial
DIMENSIONS: 4.50 m by 2.50 m by 1.00 m
DESCRIPTION: The surface interior is roughly level.

SITE NO.: State: 13393 [P] PHRI: T-176
SITE TYPE: Platform
ELEVATION: c. 292 feet
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 9.00 m by 9.00 m by 1.20 m
DESCRIPTION: The platform is roughly paved with cobbles and boulders. There is a hole present in the center of the platform.

SITE NO.: State: 13394 [P] PHRI: T-177
SITE TYPE: Alignment
ELEVATION: c. 330 feet
FUNCTIONAL INTERPRETATION: Indeterminate

SITE NO.: State: 13395 [P] PHRI: T-178
SITE TYPE: Platform
ELEVATION: c. 333 feet
FUNCTIONAL INTERPRETATION: Possible burial
DIMENSIONS: 3.00 m by 2.50 m by 0.95 m

SITE NO.: State: 13396 [P] PHRI: T-179
SITE TYPE: Platform
ELEVATION: c. 317 feet
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 8.00 m by 4.00 m by 1.00 m

SITE NO.: State: 13397 [P] PHRI: T-180
SITE TYPE: Complex (5 Features)
ELEVATION: c. 329 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of a five terraces, the largest of which is 8.00 by 4.00 by 0.60 m.

SITE NO.: State: 13398 [P] PHRI: T-181
SITE TYPE: Complex (4 Features)
ELEVATION: c. 320 feet
FUNCTIONAL INTERPRETATION: Habitation/agriculture/possible burial
DESCRIPTION: The site consists of a platform (Feature A), a wall (Feature B), and two cairns (Features C and D). Measurements are available for Features A and C.

FEATURE A: Platform
FUNCTION: Habitation/agriculture/possible burial
DIMENSIONS: 8.00 m by 7.00 m by 1.50 m

FEATURE C: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 1.00 m by 1.00 m by 0.70 m

SITE NO.: State: 13395 [P] PHRI: T-178
SITE TYPE: Platform
ELEVATION: c. 333 feet
FUNCTIONAL INTERPRETATION: Possible burial
DIMENSIONS: 3.00 m by 2.50 m by 0.95 m

SITE NO.: State: 13396 [P] PHRI: T-179
SITE TYPE: Platform
ELEVATION: c. 317 feet
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 8.00 m by 4.00 m by 1.00 m

SITE NO.: State: 13397 [P] PHRI: T-180
SITE TYPE: Complex (5 Features)
ELEVATION: c. 329 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of a five terraces, the largest of which is 8.00 by 4.00 by 0.60 m.

SITE NO.: State: 13398 [P] PHRI: T-181
SITE TYPE: Complex (4 Features)
ELEVATION: c. 320 feet
FUNCTIONAL INTERPRETATION: Habitation/agriculture/possible burial
DESCRIPTION: The site consists of a platform (Feature A), a wall (Feature B), and two cairns (Features C and D). Measurements are available for Features A and C.

FEATURE A: Platform
FUNCTION: Habitation/agriculture/possible burial
DIMENSIONS: 8.00 m by 7.00 m by 1.50 m

FEATURE C: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 1.00 m by 1.00 m by 0.70 m

SITE NO.: State: 13399 [P] PHRI: T-182
SITE TYPE: Terrace
ELEVATION: c. 329 feet
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 5.00 m by 2.00 m by 0.50 m

SITE NO.: State: 13400 [P] PHRI: T-183
SITE TYPE: Complex (2 Features)
ELEVATION: c. 319 feet
FUNCTIONAL INTERPRETATION: Agriculture/land division
DESCRIPTION: The site complex consists of a wall and an enclosure. the wall is oriented E-W and has a 90 degree corner, turning to the north. The enclosure is large and located at the end of the wall.

SITE NO.: State: 13401 [P] PHRI: T-184
SITE TYPE: Complex (2 Features)
ELEVATION: c. 319 feet
FUNCTIONAL INTERPRETATION: Agriculture/land division
DESCRIPTION: The complex consists of a wall (Feature A) and a terrace (Feature B).

FEATURE A: Wall
FUNCTION: Agriculture/land division
DIMENSIONS: 50.00 m long
DESCRIPTION: Feature A is a wall with a circular bend at the end.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 8.00 m by 2.00 m by 1.00 m
DESCRIPTION: Feature B is a faced terrace

SITE NO.: State: 13402 [P] PHRI: T-185
SITE TYPE: Wall
ELEVATION: c. 317 feet
FUNCTIONAL INTERPRETATION: Land division
DESCRIPTION: The wall is presently collapsed.

SITE NO.: State: 13403 PHRI: T-186
SITE TYPE: Modified cave
TOPOGRAPHY: The terrain consists predominantly of pahoehoe flows.
VEGETATION: Christmas-berry, noni, kiawe, lantana, and fountain grass.
ELEVATION: c. 320 feet
CONDITION: Good
INTEGRITY: May be partially altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 3.70 m by 3.00 m by 1.10 m
DESCRIPTION: A large pahoehoe blister that is collapsed at one end and with a terrace wall opposite the blister opening. The blister opening faces northeast and is 3.70 m wide by 1.1 m high. The terrace measures 3.00 m by 0.60-1.00 m wide and 0.60 m in height. It is constructed of pahoehoe boulders and cobbles, 3 to 4 courses high, and is oriented N-S. The south end of the terrace connects with the edge of the tube/blister opening.

Cowrie shell, kukui and faunal remains are present. Site No. 13406 is c. 20.0 m to the east.

SITE NO.: State: 13404 PHRI: T-187
SITE TYPE: Enclosure
TOPOGRAPHY: The terrain consists primarily of pahoehoe flows.
VEGETATION: Kiawe, Christmas-berry, fountain grass, lantana, and koa-haole.
ELEVATION: c. 311 feet
CONDITION: Poor-fair
INTEGRITY: May be partially altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/possible habitation
DIMENSIONS: 15.00 m by 13.80 m by 0.70 m
DESCRIPTION: This site is a circular enclosure wall which becomes a terrace at the southwest end. The wall is somewhat collapsed, rubble filled, and 1-4 courses high. It is faced along the interior and exterior edges and is 1.00-1.50 m wide. The terrace portion at the southwest end measures 4.00 by 4.00 m.

SITE NO.: State: 13405 PHRI: T-188
SITE TYPE: Complex (15+ Features)
TOPOGRAPHY: Predominantly pahoehoe flows.
VEGETATION: Christmas-berry, koa-haole, lantana, kiawe, and fountain grass.
ELEVATION: c. 325 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 25.00 m N-S by 20.00 m E-W. It consists of at least 15 pahoehoe excavations with associated pahoehoe rubble. The complex consists of excavated pahoehoe blisters containing some fill of pahoehoe cobbles, pebbles, clinkers and soil.

SITE NO.: State: 13406 [P] PHRI: T-189
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 332-335 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13407 [P] PHRI: T-190
SITE TYPE: Complex (2 Features)
ELEVATION: c. 319 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures c. 8.0 m by 5.0 m. The site consists of a mound and a pahoehoe excavation.

SITE NO.: State: 13408 [P] PHRI: T-191
SITE TYPE: Complex (19+ Features)
ELEVATION: c. 350 feet
FUNCTIONAL INTERPRETATION: Agriculture/possible habitation/possible ceremonial
DESCRIPTION: The complex includes a platform (15.00 by 10.00 m), a terrace, five walls, two enclosures, and at least 10 pahoehoe excavations. Two of the walls are connected to the platform.

SITE NO.: State: 13409 [P] PHRI: T-192
SITE TYPE: Complex (9 Features)
TOPOGRAPHY: --
VEGETATION: --
ELEVATION: c. 354 feet
CONDITION: --
INTEGRITY: --
PROBABLE AGE: --
FUNCTIONAL INTERPRETATION: Agriculture/habitation/possible burial
DESCRIPTION: The site consists of three platforms (Features A, G and H), two walls (Features B and I), an enclosure (Feature C) and three terraces (Features D-F). Measurements are available for the three platforms.

FEATURE A: Platform
FUNCTION: Agriculture/habitation
DIMENSIONS: 12.00 m by 6.00 m by 1.00 m

FEATURE G: Platform
FUNCTION: Agriculture/possible burial
DIMENSIONS: 4.00 m by 3.00 m by 0.50 m

FEATURE H: Platform
FUNCTION: Agriculture/possible burial
DIMENSIONS: 3.00 m by 2.00 m

SITE NO.: State: 13410 [P] PHRI: T-193
SITE TYPE: Platform
ELEVATION: c. 349 feet
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 16.00 m by 14.00 m by 0.00 m
DESCRIPTION: The platform surface is paved with a C-shape constructed on top. The C-shape contains hand-blown glass.

SITE NO.: State: 13411 [P] PHRI: T-194
SITE TYPE: Complex (4 Features)
ELEVATION: c. 366 feet
FUNCTIONAL INTERPRETATION: Agriculture/land division
DESCRIPTION: The site consists of three walls and a mound. The longest wall is at least 100.00 m long, and is oriented NW-SE.

SITE NO.: State: 13412 [P] PHRI: T-195
SITE TYPE: Complex (2 Features)
ELEVATION: c. 364 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION:The site consists of an enclosure and a terrace. The enclosure is c. 40.00 by 40.00 m square and the walls average 1.00 m high. The terrace is located inside the enclosure, at the southeast corner.

SITE NO.: State: 13413 [P] PHRI: T-196
SITE TYPE: Platform
ELEVATION: c. 336 feet
FUNCTIONAL INTERPRETATION: Habitation/ agriculture
DIMENSIONS: 4.00 m by 4.00 m by 0.80 m
DESCRIPTION:The platform is faced on all sides and the surface interior is paved.

SITE NO.: State: 13414 PHRI: T-197
SITE TYPE: Complex (20+ Features)
TOPOGRAPHY: The terrain consists mostly of pahoehoe flows.
VEGETATION: Kiawe, Christmas-berry, and lantana.
ELEVATION: c. 341 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION:The complex consists of excavated pahoehoe blisters and flow edges. It covers an area 25.00 by 20.00 m. No formal construction or portable remains were evident.

SITE NO.: State: 13415 PHRI: T-198
SITE TYPE: Terrace
TOPOGRAPHY: There is a pahoehoe flow adjacent and to the northwest of the site.
VEGETATION: Koa-haole, Christmas-berry, and lantana.
ELEVATION: c. 328 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 10.30 m by 3.80 m by 0.80 m
DESCRIPTION:The terrace is raised on the southeast side with pahoehoe slabs that are stacked three to four courses high. The northwest side is filled with pahoehoe slabs, cobbles and clinkers and abuts a pahoehoe flow edge.

SITE NO.: State: 13416 PHRI: T-199
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Pahoehoe flows on a mild slope.
VEGETATION: Chrismas-berry, kiawe, koa-haole, lantana, and fountain grass
ELEVATION: c. 337 feet
CONDITION: Fair
INTEGRITY: May be partially altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 10.0 m (N-S) by 4.0 m (E-W). It consists of a rubble wall with associated terrace and a wall.

FEATURE -: Rubble wall with terrace
FUNCTION: Agriculture
DIMENSIONS: 10.00 m by 1.20 m by 0.70 m
DESCRIPTION: A rubble filled wall which becomes terrace-like at the northern end. The wall is two to three courses of stacked pahoehoe slabs on edge. It is filled with cobbles and pebble size basalt. The wall measures 8.00 m long by 1.00 m wide and 0.40-0.60 m high.

The terrace is constructed with large pahoehoe boulders, piled two to three courses, with cobble and clinker backfill towards a pahoehoe ledge. It measures 2.00 m long by 1.20 m wide and 0.70 m high. Immediately to the east is another rubble filled wall. Cobble and clinker size pahoehoe are between the two walls.

FEATURE -: Wall
FUNCTION: Agriculture
DIMENSIONS: 3.40 m by 0.80 m by 0.50 m
DESCRIPTION: The wall is oriented N-S. It is constructed with 2-3 courses of stacked pahoehoe slabs on edge with cobble and clinker fill. It is east and parallel to the previous rubble wall/terrace with scattered cobbles and pebbles in between.

SITE NO.: State: 13417 PHRI: T-200
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 325 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13418 PHRI: T-201
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 328 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13419 PHRI: T-202
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 306 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13420 PHRI: T-203
SITE TYPE: Complex (8 Features)
ELEVATION: c. 515 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: This complex consists of eight rock mounds

SITE NO.: State: 13421 PHRI: T-204
SITE TYPE: Complex (18+ Features)
TOPOGRAPHY: Pahoehoe and aa flows on gentle sloping terrain.
VEGETATION: Christmas-berry, lantana, and fountain grass.
ELEVATION: c. 496 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 30.0 m (E-W) by 15.0 m (N-S). It is located 50.0 m at 350 degrees from Site 13422.

The site consists of three rock cairns (Features A through C) one cave shelter (Feature D), ten pahoehoe excavations three of which are filled with pahoehoe cobbles, and four small paved areas. Also, several naturally collapsed blisters are in the area.

FEATURE A: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.80 m by 0.73 m by 0.45 m
DESCRIPTION: Two pahoehoe boulders and eight pahoehoe cobbles are stacked, two courses high, on a pahoehoe flow. The largest boulder is on top.

FEATURE B: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 1.05 m by 0.75 m by 0.45 m
DESCRIPTION: This cairn is located c. 12.00 m southeast from Feature A. It consists of three courses high of pahoehoe boulders with one pahoehoe slab on top. It is built atop a pahoehoe excavation.

FEATURE C: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.60 m by 0.45 m by 0.43 m
DESCRIPTION: Feature C is built on the edge of a pahoehoe ledge excavation, 11.00 m northwest from Feature B. It is constructed with three pahoehoe blocks measuring c. 30x40x14 cm stacked two courses high.

FEATURE D: Cave
FUNCTION: Agriculture/habitation
DIMENSIONS: 60.00 m by 1.90 m by 1.10 m
DESCRIPTION: Feature D is a lava tube adjacent to Feature A, oriented at 260 degrees Az. The entrance measures 3.2 m wide and 1.1 m high. Portable remains observed include Cellana shell, feral goat bones, and wood.

SITE NO.: State: 13422 PHRI: T-205
SITE TYPE: Complex (8+ Features)
ELEVATION: c. 500 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of at least seven pahoehoe excavations and a cairn. The cairn is collapsed.

SITE NO.: State: 13423 PHRI: T-206
SITE TYPE: Complex (80 Features)
TOPOGRAPHY: Gently sloping pahoehoe with areas of natural disturbance.
VEGETATION: Thick Christmas-berry, small koa-haole, and scattered lantana.
ELEVATION: c. 498 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION:This site is located c. 67.00 to 70.00 m from Site 13422 at 315 degrees Az. The overall complex area measures 133.25 m at 180 degrees Az. by 78.0 m at 255 degrees Az. It consists of 36 small rock mounds/piles, 23 large rock mounds, eight pahoehoe excavations, eight modified outcrops/depressions, two alignments, one overhang shelter, one modified cave and one modified blister with a few pieces of Cypraeidae shell and small pockets of soil.

The modifications are made with pahoehoe blocks with no formally faced walls. The construction is mostly of loose stacks and loosely piled mounds of rocks.

The features may continue beyond the present identified boundaries. The vegetation makes it very difficult to determine accurately.

SITE NO.: State: 13424 PHRI: T-207
SITE TYPE: Complex (3 Features)
TOPOGRAPHY:
VEGETATION: Christmas-berry, air plants, guava, koa-haole and fountain grass.
ELEVATION: c. 511 feet

CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ possible ceremonial
DESCRIPTION: The overall complex area measures c. 23.0 m at 350 degrees by 17.3 m at 80 degrees.

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 10.75 m by 3.52 m by 0.54 m
DESCRIPTION: A blister type of pahoehoe excavation in which the excavated area has been filled in with angular pahoehoe pebbles, cobbles and boulders and with an alignment of possible steppingstone slabs of pahoehoe. Roughly rectangular shape in plan, cobbles and pebbles have been placed on the northern corner, 1-2 courses high, and measures 2.1 m by 0.72 m and 0.2 m high.

The SE corner of the entire excavated area has cobbles strewn haphazardly about. The excavated area at the SE corner, also blister type has been filled in with large boulders, cobbles and pebbles. This excavated blister measures 3.0 m by 2.48 m. A Christmas-berry tree is growing out of this excavation.

A pahoehoe finger divides the blister into two excavations and measures 1.75 m by 0.57 m. Approximately 1.58 m apart, pahoehoe slabs and cobbles have been placed oriented south in a linear direction, but slabs are laying flat on top of the pahoehoe finger. The largest slab is 0.57 m and the smallest is 0.34 m in length.

FEATURE B: Modified outcrop *(Figure A-40)*
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 3.90 m by 0.35 m
DESCRIPTION: This feature is a shallow excavated blister that has been filled with pahoehoe blocks and cobbles. The surface of the filled area is relatively level and contains three areas of pebble pavement, outlined with larger cobbles. Two of the pebble areas are adjacent to one another in the western half of the blister. They are roughly circular in plan, with interior areas 0.75 m in diameter. The third pebble area is at the eastern end of the blister, in a deeper section (0.27 m below surface). The surface area of this pebble plot is 1.50 by 1.40 m.

A 0.50 by 0.50 m sq test unit was excavated into the westernmost pebble-paved plot, in order to determine the nature of the fill, and if subsurface features were present. The pebble fill was found to be 0.26 m thick and overlying a 0.05 m thick deposit of silty loam. No cultural deposits or portable remains were located in the test unit. The soil deposit was sampled for further analysis (see subsurface findings).

FEATURE C: Cairn
FUNCTION: Indeterminate marker
DIMENSIONS: 0.85 m by 0.80 m by 0.47 m
DESCRIPTION: The cairn is located 15.00 m northwest from Feature B. It is generally circular shape in plan, and constructed with pahoehoe cobbles and slabs stacked two courses high. It is built on ropy pahoehoe with large cobbles at the base of the structure and smaller cobbles on top. The cairn is presently collapsed.

SITE NO.: State: 13425 PHRI: T-208
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Terrain consists of a gentle westward slope, irregular and disturbed pahoehoe flow with a northwestern exposure.
VEGETATION: Christmas-berry, lantana, noni, and sparse grass.
ELEVATION: c. 521 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 38.50 m at 225 degrees Az. by 23.90 m Identified features include two modified outcrops (Features A and B), a cave (Feature C), and a rock mound (Feature D).

FEATURE A: Modified blister
FUNCTION: Agriculture
DIMENSIONS: 9.25 m by 6.90 m by 0.87 m
DESCRIPTION: This feature is a collapsed blister that was modified to form boulder alignments and pavement fill. In the eastern portion of the blister is a pavement of pebble size pahoehoe pieces. Abutting the eastern wall of the outcrop, boulder alignments surround the western edge and divide the pavement into two areas. The pavement measures 3.50 m (E- W) by 2.00 m on the north side of the boulder alignment. On the south side of the alignment the pavement measures 3.20 m E-W by 3.0 m N-S at its widest point. It is a C- shape with a wall of boulders and cobbles on the northwest edge of the terrace and a circular alignment. The rock wall measures 0.62 m from the outcrop to the north. It is 1.00 m at its widest point and 0.61 m at its highest. The circular alignment is 1.20 m wide on the interior.

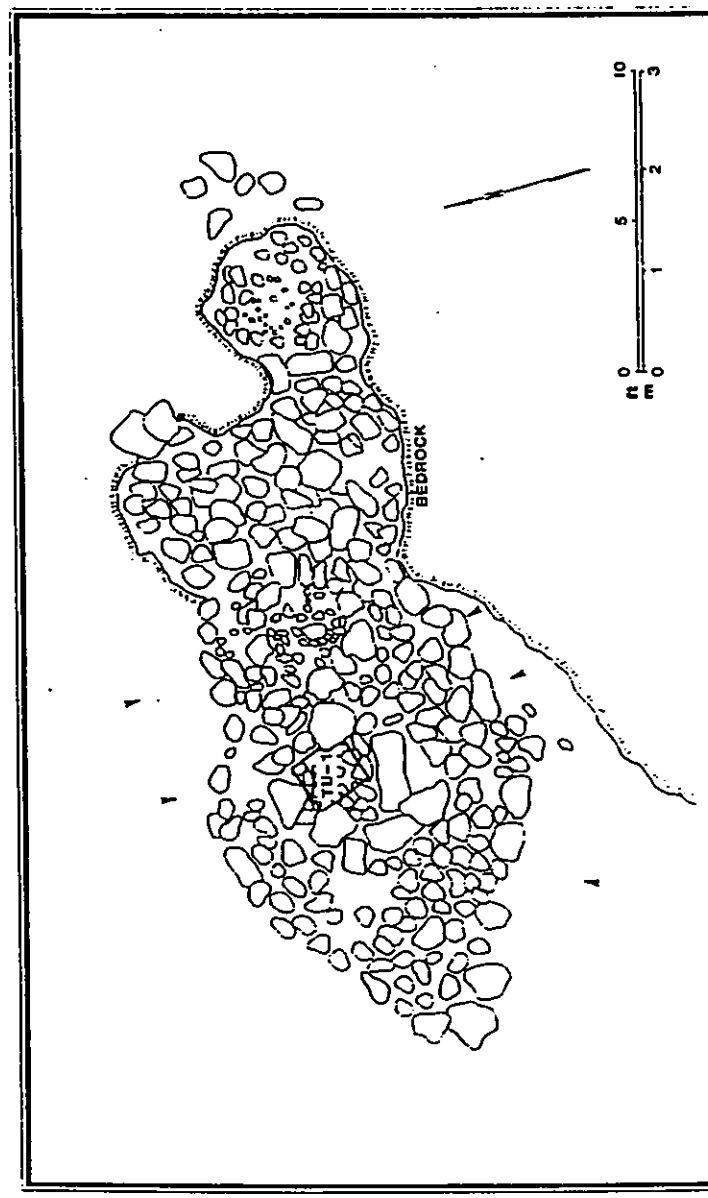


Figure A-40. SITE 13424, FEATURE B

FEATURE B: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 8.50 m by 5.50 m by 1.15 m
DESCRIPTION: Feature B is 6.00 m from Feature A at 310 degrees Az. It is an oval-shaped depression in pahoehoe that has been cleared of loose cobble and boulder size rubble. The cleared area measures 4.80 m by 2.20 m. Cleared stones are placed in various haphazard alignments along the base perimeter of the broken pahoehoe, some are along the rim slope and more are in piles.

The most formal arrangement is a small wall at the southwest corner between a small cave opening and at the base of the depression. It measures 1.50 m long, 0.50 m wide and 0.40 m high. The sides of the depression are sloping uphill.

There are three cave openings along the west side. The cave openings were examined and no portable remains were visible except for Feature C which has its opening along the southwest side of the Feature B blister rim. Most of the cleared blocks are along the eastern side of the slopes.

A soil area at the base of the depression measures 4.60 by 2.10 m. Average thickness is 0.06-0.08 m; it is black to dark brown granular loam.

FEATURE C: Cave
FUNCTION: Habitation
DIMENSIONS: 8.30 m by 3.00 m by 1.20 m
DESCRIPTION: It is situated along the southern rim of Feature B (modified outcrop) 2.00 m from the cleared area. The cave entrance is vertical with the chamber tube extending to the northwest at 220 degrees. The opening measures 1.25 m by 0.70 m with a height of 0.94 m.

The cave is generally unmodified with some evidence of moving large pieces of roof fall towards the edges of the chamber, along a shelf that defines the crawlspace. Four to six large blocks are in loose alignment at the east side of the chamber.

Portable remains consists of kukui nut, a waterworn basalt slab with one side possibly used for grinding, a possible coral abrader, a piece of coral and a large piece of charcoal. Dark brown, granular soil is present in pockets.

FEATURE D: Mound
FUNCTION: Indeterminate/possible agriculture
DIMENSIONS: 3.60 m by 3.20 m by 0.65 m
DESCRIPTION: Feature D is 12.00 m northeast from Feature A. It is constructed with aa and pahoehoe cobbles that range in size from 0.03 by 0.04 m to 0.20 by 0.30 m.

SITE NO.: State: 13426 PHRI: T-209
SITE TYPE: Roadbed
TOPOGRAPHY: Genuly to steeply sloping irregular pahoehoe and aa.
VEGETATION: Thick lantana, agave, guava, grasses, koa-haole, and kiawe.
ELEVATION: c. 600 feet
CONDITION: Good
INTEGRITY: Unaltered except by present roadway.
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 220.00 m by 6.20 m by 2.00 m
DESCRIPTION: The roadbed is stacked and faced along both sides, up to three courses high in places. The road surface is on a relatively level grade with retaining walls filling in the low places. The west side is also built up to maintain the grade. Most of the roadbed looks like rock fill covered with gravel size pieces of aa and some soil. The height of the roadbed ranges from 0.7 m to 2.0 m. This section of the road goes through the center of Site 13435, Possible Agriculture Complex. The feature appears to be an abandoned section of Palani Road.

SITE NO.: State: 13427 PHRI: T-210
SITE TYPE: Complex (17 Features)
TOPOGRAPHY: The terrain consists of pahoehoe lava flow with large boulders scatters on the surface, many of which appear to be quarried material.
VEGETATION: Christmas-berry, koa-haole, lantana, and fountain grass.
ELEVATION: c. 590 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area is 50.0 m by 50.0 m. Three rock mounds were individually recorded (Features A- C) and four additional mounds and ten pahoehoe excavations were identified. There are additional agriculture features in the area consisting of rock mounds, pahoehoe excavations and rock alignments. The area is covered with thick vegetation and extensive clearing is required before an accurate count of features can be obtained.

FEATURE A: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.36 m by 1.40 m by 0.88 m
DESCRIPTION: The mound is constructed with large boulders stacked three courses high on top of smooth pahoehoe.

FEATURE B: Mound
FUNCTION: Agriculture

DIMENSIONS: 2.00 m by 1.90 m by 0.95 m
DESCRIPTION: This mound is c. 30.00 m northwest from Feature A. It is constructed with large boulders (some uprights) around the base and is filled with small cobbles, piled four courses high.

FEATURE C: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.30 m by 1.40 m by 1.30 m
DESCRIPTION: Semicircular shape in plan, it is constructed with stacked boulders and cobbles. Large boulders are used along the perimeter and faced with cobbles on the interior. This mound is adjacent to Feature B.

SITE NO.: State: 13428 PHRI: T-211
SITE TYPE: Complex (43 Features)
TOPOGRAPHY: The terrain consists of irregular pahoehoe.
VEGETATION: Christmas-berry, lantana, and grass.
ELEVATION: c. 575 feet
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 48.0 m at 250 degrees Az. by 20.0 m. Eight features were individually recorded at the site, including five faced mounds (Features A-E), an alignment (Feature F), a platform (Feature G), and a terrace (Feature H). In addition, 25 pahoehoe excavations and 10 rock mounds were enumerated.

FEATURE A: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.55 m by 1.50 m by 1.20 m
DESCRIPTION: Generally circular shaped in plan, it is constructed with stacked and faced boulders with smaller cobbles as fill. A cleared pahoehoe excavation is present 0.70 m at 60 degrees from Feature A. The excavation may have been a quarry source for building material.

FEATURE B: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.80 m by 1.60 m by 0.95 m
DESCRIPTION: Feature B is c. 4.4 m at 190 degrees to Feature E and 6.9 m at 280 degrees to Feature B. Generally circular shape in plan, it is constructed with stacked boulders along the perimeter and filled with pahoehoe cobbles. Feature B is bounded on all sides by pahoehoe excavations.

FEATURE C: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.85 m by 1.80 m by 1.27 m
DESCRIPTION: Circular shape in plan, it is constructed with stacked pahoehoe boulders along the perimeter and cobble filled. Several boulders have fallen, but for the most part this mound appears to be in good condition. A pahoehoe excavation is adjacent to the east side of the mound.

The center fill of the mound was removed in order to determine if subsurface features were present. The fill was found to consist of undifferentiated cobbles and pebbles, with a slighlty higher proportion of pebbles toward the base of the mound. A 0.10 m thick deposit of silty clay loam was encountered beneath the core fill. The soil was directly on unbroken bedrock and contained no portable remains or indications of a cultural deposit. A sample of the soil was collected for further analysis (see subsurface findings).

FEATURE D: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.25 m by 1.20 m by 0.45 m
DESCRIPTION: Circular shape in plan, it is constructed with large boulders along the perimeter and filled with cobbles and pebbles. The mound is 7.40 m northwest from Feature B.

FEATURE E: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.80 m by 1.80 m by 0.95 m
DESCRIPTION: Generally circular shape in plan, the perimeter is built up with boulders and the interior is filled with cobbles. Feature E has collapsed along the eastern side with other fallen boulders surrounding the mound. It is located 4.2 m east from Feature A.

It is constructed on the very edge of a pahoehoe excavation located on the northern side of the mound. This excavation may have been a quarry source for building material.

The center core filling of the mound was removed in order to determine if subsurface features or deposits were present. The fill was found to be an undifferentiated mixture of pebbles and small cobbles, with slighlty more small pebbles toward the base of fill. The bedrock surface under the mound was broken and a soil deposit up to 0.30 m thick was present in the surface hole. No cultural materials or portable remains were located in the soil, however, a single kukui nut was located at the base of the pebble fill, 0.57 m below the present top of the mound. A sample of the soil was collected for further analysis (see subsurface findings).

FEATURE F: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 16.00 m by 1.00 m by 0.50 m
DESCRIPTION: Feature F is a boulder alignment that

connects and incorporates adjacent mounds. The alignment begins at the eastern end with a rock mound that measures 3.00 m by 3.00 m. It continues 5.10 m to a second mound that measures 1.90 m in diameter. The alignment continues 6.00 m to the Feature G platform. It continues along the western edge of the platform for 10.00 m to the Feature H terrace. Feature F varies from a single boulder alignment to stacked boulders, two high and three wide, with smaller cobbles used as fill.

FEATURE G: Platform *(Figure A-41)*
FUNCTION: Agricultural
DIMENSIONS: 3.50 m by 3.25 m by 0.85 m
DESCRIPTION: The platform is roughly rectangular in plan, with convex sides. It is constructed with a stacked pahoehoe boulder perimeter and with pahoehoe boulder and cobble fill. The platform surface was apparently leveled at one time and covered with a pavement of small cobbles and pebbles. Presently, the northern portion is covered with a deposit of large pahoehoe cobbles and slabs, piled to 0.40 m above the exposed portion of the original pavement.

Adjacent to the east side of the platform is a D-shaped terrace, constructed from large cobbles and boulders. The terrace is 2.50 m N-S by 1.50 m E-W and is connected to the Feature F alignment. Large cobbles and boulders are scattered to the east and north of this feature. The terrace surface is very irregular and it resembles a truncated mound.

A 1.00 by 1.00 m square test unit was excavated into the center of the platform in order to determine if subsurface features, such as a human interment, were present. The test unit confirmed that the original paved surface had covered the platform, and that the larger cobbles and slabs had been added later, possibly reflecting a different use phase of the feature. The small pavement fill consisted of only one to two layers of pebbles overlying larger cobble and boulder fill. The cobble/boulder fill varied in thickness from 0.30 to 0.70 m, depending on the underlying bedrock, which was a sloping blister formation. At the base of the large fill layer was a layer of small pebbles and fragments of rock, some of which apparently filtered down through the larger matrix. A layer of silty loam occurred directly on the bedrock surface; it varied in thickness from less than 0.01 m to 0.06 m. A single kukui nut (complete but fragmented) was located in the soil zone. No other portable remains were observed. A soil sample was collected for further analysis (see subsurface findings).

FEATURE H: Terrace
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 5.10 m by 0.80 m
DESCRIPTION: The terrace is located 13.60 m southwest from Feature G. It is constructed with a stacked boulder perimeter and loose boulder and cobble fill. A cleared pahoehoe excavation is located 2.20 m west of the northeast corner of the terrace.

SITE NO.: State: 13429 PHRI: T-212
SITE TYPE: Complex (9 Features)
TOPOGRAPHY: Natural smooth pahoehoe flow with many rock mounds and pahoehoe blister excavations.
VEGETATION: Lantana, Chrismas-berry, impatiens, koa-haole, and wild 'ilima.
ELEVATION: c. 575 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 35.00 m at 45 degrees Az. by 16.00 m. The site consists of two terraces (Features A and B), a modified blister (Feature C) and six mounds (Features D-I). All individual features are oriented in a NE-SW pattern.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.37 m by 2.61 m by 0.70 m
DESCRIPTION: Feature A is a low paved terrace that is rectangular in plan view. It is built on a bedrock outcrop and faced on the east side. The paved area is 1.88 m by 1.2 m with a semicircular retainer built around the paved area. The retaining wall is stacked three courses high. Large boulder and cobble fill make up the terrace interior.

Excavated blocks have been strewn haphazardly on the southeast side. Another terrace (Feature B) is located to the southeast.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 2.55 m by 1.40 m by 0.48 m
DESCRIPTION: The terrace is semicircular in plan view. Cobbles outline the semicircle with larger cobbles and boulders on top. It is faced and stacked three courses high with boulders and cobbles. The interior is paved with pahoehoe slabs and cobble fill; it measures 1.81 by 1.0 m.

FEATURE C: Modified blister
FUNCTION: Agriculture
DIMENSIONS: 5.57 m by 2.90 m by 0.57 m
DESCRIPTION: The northeast corner of a pahoehoe blister area is paved and filled with small cobbles. This paved area measures 1.79 m by 0.95 m.

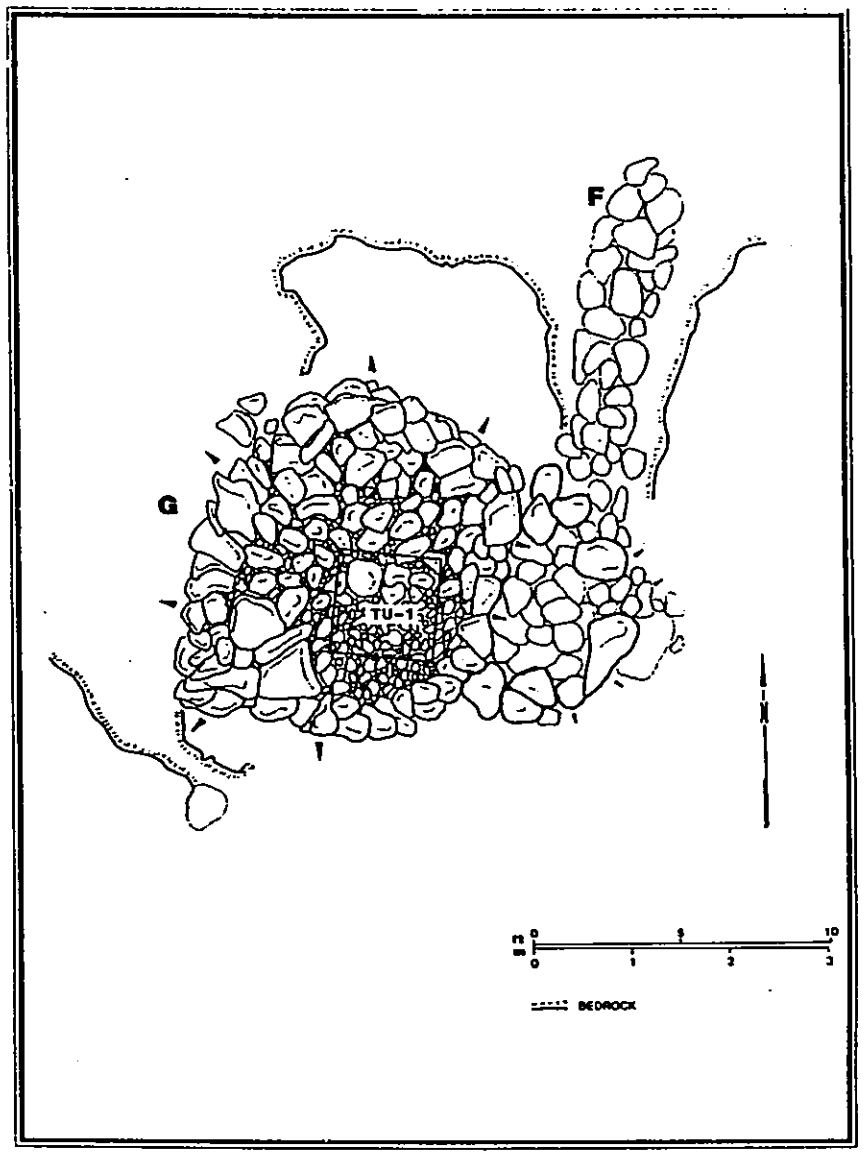


Figure A-41. SITE 13428, FEATURE G

An alignment built with large boulder size slabs is 1.50 m to the southwest. It is oriented NE-SW and measures 2.84 m by 0.61. In the center of the alignment along the exterior is an upright that measures 0.55 m by 0.43 m. The other slabs vary slighly in dimensions. Ten pahoehoe slabs make up this linear alignment.

In the center of the blister and the alignment is an excavated area with cobbles haphazardly placed. It contains soil with lantana bushes and measures 1.93 by 1.72 m.

FEATURE D: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.20 m by 2.00 m by 0.70 m
DESCRIPTION: Feature D is 5.0 m at 215 degrees Az. from Feature A. It consists of a rock mound constructed along an excavated blister. The mound is built with stacked cobbles two to three courses high. The cobbles appear to derive from the pahoehoe excavation.

FEATURE E: Mound
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.60 m by 0.80 m
DESCRIPTION: Feature E is 3.0 m at 215 degrees Az. from Feature D. It is a rock mound consisting of irregular stacked cobbles. Boulders are at the base of Feature E with smaller cobbles stacked on top.

FEATURE F: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.60 m by 1.40 m by 0.65 m
DESCRIPTION: Feature F is situated 2.00 m at 215 degrees Az. from Feature E. It is faced with large upright boulders with cobble fill, three to four courses high.

FEATURE G: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.30 m by 2.00 m by 1.00 m
DESCRIPTION: Feature G is 6.0 m at 40 degrees Az. from Feature H. It is semicircular shape in plan and is constructed with large boulders, some upright, surrounding the base. Cobbles are used as interior fill.

FEATURE H: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.30 m by 1.60 m by 0.45 m
DESCRIPTION: Semicircular shape in plan, it is constructed with stacked boulders and cobbles one to two courses high.

FEATURE I: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.24 m by 1.40 m by 0.80 m
DESCRIPTION: Circular in shape at the base, it narrows at the top. Large boulders are at the base with cobbles piled and stacked on top, two courses high. Feature I is built on top of a natural pahoehoe flow.

SITE NO.: State: 13430 PHRI: T-213
SITE TYPE: Complex (15 Features)
TOPOGRAPHY: The terrain consists of a smooth pahoehoe flow.
VEGETATION: Christmas-berry, lantana, wild 'ilima, and koa-haole.
ELEVATION: c. 549-550 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 24.5 m at 245 degrees Az. by 6.50 m. Three structures were given feature designations. They consist of a platform (Feature A) and two mounds (Features B and C). In addition to the measured features, six mounds, a collapsed blister and five pahoehoe excavations were enumerated. The features are patterned in a linear formation, oriented NE-SW.

FEATURE A: Platform
FUNCTION: Possible habitation/agriculture
DIMENSIONS: 4.90 m by 4.30 m by 0.60 m
DESCRIPTION: Rectangular shape in plan, it is outlined with large boulders and filled with cobbles and pebbles. A soil deposit is visible in the center of the platform. On the southwest edge are pahoehoe slabs extending the length of the feature.

FEATURE B: Mound
FUNCTION: Indeterminate/agriculture
DIMENSIONS: 1.60 m by 1.35 m by 0.70 m
DESCRIPTION: Feature B consists of slab boulders and large cobbles, stacked three to four courses high in an irregular fashion. To the south of the mound (1.50 m) is a small rock pile that measures 1.30 by 1.10 m. Another rock pile or possible alignment is 3.00 m to the southwest; it measures 2.10 m (N-S) by 1.0 m (E-W). A collapsed blister with some piled rock is 6.00 m southwest. Surrounding this collapsed blister are several pahoehoe excavations.

FEATURE C: Mound
FUNCTION: Possible agriculture
DIMENSIONS: 2.00 m by 1.90 m by 0.95 m
DESCRIPTION: The mound is roughly faced on the southeast side. It is constructed with boulders and cobbles stacked five courses high. Large boulders (some upright)

surround the base; cobbles are used as interior fill. Within a 10.0 m range are additional features consisting of five pahoehoe excavations and four rock mounds.

SITE NO.: State: 13431 PHRI: T-214
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: The terrain consists of a pahoehoe flow that has been extensively altered by agricultural activities
VEGETATION: Christmas-berry, koa-haole, lantana, and kiawe.
ELEVATION: c. 540 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 20.0 m at 65 degrees Az. by 24.40 m. This site consists of a blister type cave with modifications (Feature A), two enclosures (Features B and C), a pahoehoe excavation (Feature E) and a terrace (Feature F). Portable remains consisting of Cypraeidae, Isognomonidae, kukui nut shell fragments, coral and charcoal were observed in Feature A. In addition there are c. 5-7 pahoehoe excavations within a 10.0 m range around the complex.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 4.40 m by 3.30 m by 1.08 m
DESCRIPTION: The overall feature measures 8.00 by 3.30 m. The interior dimensions are 4.4 m (N-S) by 3.3 m (E-W) with an average ceiling height of 0.95 m.

Preceding the entry of the cave is a paved area that measures 3.60 m by 3.00 m. The entry is partially closed with stacked pahoehoe boulders. It is 0.90 m wide, 1.00 m high and faces 250 degrees Az. Immediately to the right of the entry is a small shelf constructed of pahoehoe boulders and paved with small cobbles.

The rear of the cave has been modified with large pahoehoe boulders and small cobbles. To the right rear of the cave is a small enclosure measuring 1.13 m by 0.70 m. It is constructed with large boulders and small cobbles with the floor covered with large cobbles. At the left rear of the cave is a collapsed enclosure of pahoehoe cobbles. The floor of this enclosure is covered with a sandy gravelly loam with kukui nuts. This area measures 1.20 m by 0.85 m.

Portable remains observed in the cave include Cypraeidae and Isognomonidae shells, coral and a partially burned piece of wood, in addition to the kukui nut shell.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 11.00 m by 5.40 m by 0.60 m
DESCRIPTION: The enclosure is adjacent to Features A and C. It is oval to rectangular shape in plan. The wall of the enclosure is built with stacked pahoehoe boulders for an average width of 0.20 m. The interior of the enclosure is covered with a gravelly loam and scattered cobbles. The southern end of the enclosure wall rests on top of Feature A entrance. The western wall is shared with the Feature C enclosure. This shared wall is presently higher and in better condition compared with the remaining walls.

FEATURE C: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 12.50 m by 10.00 m by 0.80 m
DESCRIPTION: Oval shape in plan, it is constructed with large pahoehoe boulders and slabs with cobble fill. It is two to three courses high and the wall is approximately 0.40 m wide. The floor interior contains a 0.03 to 0.04 m thick deposit of sandy, gravelly loam with scattered pahoehoe boulders and cobbles.

The northwest section of this enclosure seems to be leveled with smaller cobbles and gravel. Within this area are 5 to 6 filled depressions/possible pahoehoe excavations ranging in size from 0.70 m to 1.50 m across.

FEATURE D: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.30 m by 2.85 m by 0.55 m
DESCRIPTION: A cleared blister type pahoehoe excavation. It is bordered on the north by the Feature C enclosure wall. The quarried boulders have been removed from the excavation, with several remaining around the perimeter. Small cobbles remain in the bottom of the excavation.

Directly west at 0.60 m is another blister type pahoehoe excavation. It is 1.40 m wide and 0.50 m deep.

FEATURE E: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.80 m by 4.00 m by 0.57 m
DESCRIPTION: A blister type pahoehoe excavation. The excavated boulders and cobbles have been haphazardly strewn in the immediate excavated area. An upright is present next to the excavation.

FEATURE F: Terrace and alignment
FUNCTION: Agriculture
DIMENSIONS: 11.05 m by 38.00 m by 0.42 m
DESCRIPTION: Feature F consists of a circular aligned

paved terrace. It measures 4.28 m at 115 degrees Az. by 1.20 m. The paved area is filled with cobbles and gravels and may be a filled blister. An alignment made up of large pahoehoe boulders and aa cobbles, stacked two courses high, is connected to the terrace. It is oriented N-S and collapsed along sections.

SITE NO.: State: 13432 PHRI: T-215
SITE TYPE: Mound
TOPOGRAPHY: Pahoehoe finger flows.
VEGETATION: Christmas-berry, fountain grass, and koa-haole.
ELEVATION: c. 227 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 1.60 m by 1.60 m by 0.70 m
DESCRIPTION: This site consists of a rock mound with an associated pahoehoe excavation. The rock mound is constructed with loosely piled pahoehoe boulders and is situated 6.00 m east of the excavation.

SITE NO.: State: 13433 PHRI: T-216
SITE TYPE: Cairn
TOPOGRAPHY: Smooth pahoehoe flow and an aa flow southeast of the site.
VEGETATION: Fountain grass, air plants, and Christmas-berry.
ELEVATION: c. 520 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate marker
DIMENSIONS: 0.66 m by 0.54 m by 0.48 m
DESCRIPTION: An oval shaped cairn that is stacked two courses high. Large pahoehoe boulders and cobbles make up the structure. It is collapsing along the north side. The total area of scattered rocks measures 1.69 by 0.92 m.

SITE NO.: State: 13434 PHRI: T-217
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: The terrain consists of aa flows surrounding the complex area with large mounds of aa and large aa boulders.
VEGETATION: Christmas-berry, laua'e fern, air plant, lantana, and koa-haole.
ELEVATION: c. 552 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 46.40 m at 170 degrees Az. by 18.0 m. The site consists of three circular faced mounds (Features A, B and D) and a pahoehoe excavation (Feature C).

FEATURE A: Faced Mound
FUNCTION: Agriculture
DIMENSIONS: 1.50 m by 1.30 m by 0.80 m
DESCRIPTION: It is constructed with a stacked and faced perimeter of pahoehoe boulders, two to three courses high. Cobbles are used as interior fill.

The northern quarter of the mound was disassembled in order to determine if subsurface features were present. The fill was determined to be undifferentiated cobbles, placed directly on an artificially built-up surface of aa pebbles and cobbles. This surface was penetrated and found to be 0.68 m thick, overlying a 0.02 m thick deposit of loamy soil with aa pebbles intermixed. A 0.10 m thick layer of coarse soil and disintegrating pahoehoe bedrock was beneath this soil/pebble layer. No portable remains or cultural deposits were observed. A sample of the soil was collected for further analysis (see subsurface findings).

FEATURE B: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.00 m by 1.00 m by 0.70 m
DESCRIPTION: Feature B is located 8.00 m at 105 degrees Az. from Feature A. It is constructed with large pahoehoe boulders stacked two to three courses high in a circular fashion. Smaller cobbles are used as interior fill.

FEATURE C: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.40 m by 3.10 m by 0.35 m
DESCRIPTION: Oval shaped in plan, it contains aa cobbles on the floor and in the surrounding area. Portions of the excavation look natural.

A mound is located 2.40 m north of the excavation. It measures 4.30 m by 3.8 m and 1.13 m in height. The mound is loosely constructed with large aa and some pahoehoe cobbles. The northern portion of the mound is collapsing.

FEATURE D: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.20 m by 1.00 m by 0.69 m
DESCRIPTION: Circular shape in plan, it is constructed with aa boulders at the base and aa cobbles as interior fill. The mound is stacked three courses high.

SITE NO.: State: 13435 PHRI: T-218
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: The terrain consists of gently sloping to irregular pahoehoe and aa flows.
VEGETATION: Lantana, Christmas-berry, agave, guava, koa-haole, kolu, grass, and numerous sisal plants.
ELEVATION: c. 580-600 feet
CONDITION: Good
INTEGRITY: Unaltered to possibly altered by road construction
PROBABLE AGE: Historic/possibly prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 147.90 m N-S by 36.00 m E-W. The site consists of seven enclosures (Features A-F and Feature J), a L-shape wall (Feature G), and modified outcrops (Features H and I). The enclosures are all built using a similar construction technique. Features A- F abut the retaining wall of the Site 13426 roadbed which defines either the east or west side of each enclosure. Some (or all) of these features appear to have been constructed after the roadway was built. There may be additional features in the area; vegetation is extremely thick.

The location of this site is very near the mapped location of a commercial sisal mill which operated during the late nineteenth and early twentieth centuries. The enclosures may be associated with this mill.

FEATURE A: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 4.80 m by 3.80 m by 0.70 m
DESCRIPTION: This enclosure is east and adjacent to the old Palani Roadbed (Site 13426). The wall is constructed with loosely stacked boulders and cobbles, two to three courses high and two to three wide. Feature B is directly west on the other side of the roadbed. Inside the enclosure is a deposit of reddish brown silty loam mixed with aa pebbles.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 16.50 m by 7.20 m by 1.70 m maximum height
DESCRIPTION: The enclosure is built abutting the west side of the old Palani Roadbed. It is keyhole shape in plan, with the narrow section at the southern end. This portion measures 5.20 m long by 2.20 m wide. The walls at the narrow end are 0.85 m high and 1.10 m wide. At the wider section, the enclosure is 7.20 m wide and 1.70 m high. At the northern end is another narrow section 7.00 m long. Near the center of the northern narrow section is an oval hole with the perimeter outlined with boulders. The hole measures 2.50 m across by 1.20 m deep. The construction of all walls are loosely stacked. The roadbed retaining wall here is 1.70 m high. The enclosure walls here are intact up to and against the retaining wall.

FEATURE C: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 24.00 m by 6.20 m by 1.40 m
DESCRIPTION: Feature C also abuts the western side of the old roadbed, and is immediately south of Feature B. It is similar in plan to Feature B, with minor variation. There is a wide central section and narrow extensions to the north and south. The extensions are 5.00 m long, 1.20 m wide with 1.00 m wide walls. At the northern end of the northern extension is an area of rock fill, which extends nearly to the edge of Feature B. The wall is open at the south end, with a c. 1.00 m wide gap between the end of the wall and the roadbed retaining wall.

The main section of the enclosure is 14.00 m long, 6.20 m wide and averages 1.40 m high. The wall in this section includes some massive boulders, and wall width is up to 2.38 m in places. The interior surface of the enclosure is 2.00 m below the level of the roadbed.

FEATURE D: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 9.50 m by 2.40 m by 1.30 m
DESCRIPTION: Feature D is located 20.00 m south of Feature C, along the west side of the old Palani Roadbed. It consists of a sectioned enclosure that connects with a larger enclosure (Feature E) immediately to the south. The northernmost section is 4.50 m long and 2.40 m wide, with an average wall width of 0.60 m, and an exterior wall height of 0.90 m. The south section is 5.00 m long and 1.80 m wide with an interior wall height of 1.30 m. the northern end of the enclosure is intact up to and against the roadbed retaining wall; the south end is open. The area between the Feature D and E enclosures is filled with cobbles and boulders, as is the opening in the enclosure D wall.

FEATURE E: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 11.30 m by 7.10 m by 0.70 m
DESCRIPTION: Feature E abuts the west side of the old roadbed, and is situated between Features D and F. Overall shape of the enclosure is keyhole, with a narrow extension to the south side. This enclosure wall is double faced and core filled, unlike Features A-D. It is built with aa boulders and cobbles, and the wall averages 2.50 m wide and 0.70 m high. The interior is divided into two sections by a low wall.

0.40 m high, that is oriented perpendicular to the old roadbed. The narrow extension of this feature is joined to a simila r narrow extension of Feature F to the south by a 2.20 m wide area of rock fill. The filled area is flat and ramp-like, and slopes downhill from the roadbed surface, permitting access from the road to both Features E and F. One broken green bottle base (c. 1920- 1940) was observed on the roadbed near the ramp.

FEATURE F: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 12.40 m by 6.65 m by 1.20 m
DESCRIPTION: Generally keyhole shape in plan, it is located 5.00 m north from the shoulder rip-rap of the existing Palani Highway, and abuts the old Palani Roadbed. The walls are constructed with stacked boulders and cobbles five courses high, and 0.75 m wide.

FEATURE G: L-shape wall
FUNCTION: Agriculture (probably recent)
DIMENSIONS: 2.80 m by 1.77 m by 1.20 m
DESCRIPTION: Feature G is c. 8.00 m east of the old Palani Roadbed and is probably not functionally related to the enclosure features built along the road. The wall is loosely stacked along perimeter the of a pahoehoe outcrop, abutting high areas of pahoehoe and forming a small enclosed area. This enclosed area is 3.20 m (N-S) by 5.30 m (E-W). It is constructed with generally squarish blocks of pahoehoe, loosely stacked, with some sections along the interior faced.

A rock pile is located at the east end interior of the enclosed area. It is c. 1.45 m in diameter at the base, with a maximum height of c. 0.5 m at the center. The pile is haphazard with some cobbles scattered around the base.

A deposit of black loam resembling potting soil is present, and arrears to have been brought to the site. Several plastic plant bags (some containing soil), buckets, water containers and a gardening trowel were found in the immediate area.

FEATURE H: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 4.50 m by 2.50 m by 2.29 m
DESCRIPTION: Feature H consists of cleared aa under a natural overhang with a loosely stacked wall. The cleared area is 0.450 m deep from the ground surface. Aa boulders and cobbles have been cleared away and piled to the south in a crude wall- like formation abutting the natural outcrop face. The wall measures 2.40 m (NE-SW) by 1.60 m. The west side is faced two to four courses with a maximum height of 0.70 m. A tin can was found inside the cleared area. This feature is adjacent to the east side of the old roadbed, across from Feature C.

FEATURE I: Modified outcrop
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 3.50 m by 2.10 m by 1.20 m
DESCRIPTION: This modified outcrop is immediately adjacent to the east side of the old Palani Roadbed, between Features A and H. It appears to be a quarry site, possibly used during construction of the roadbed. Chunks of rough pahoehoe and aa are cleared out along face of an outcrop. A small overhang occurs along the south and east sides of the clearing with a crawlspace underneath the overhang. The crawlspace has a floor of aa pebbles. A pile of cobbles and boulders are against the interior north side of the clearing. Other boulders are loosely stacked in a linear pile along the exterior northern perimeter of the clearing. In addition there is a rock pile inside of the clearing that measures 1.06 m (E-W) by 1.20 m (N-S) and 0.30 m in height. Approximately 12 rusted tin cans, a broken food jar and a tobacco can are scattered in the feature.

FEATURE J: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 8.90 m by 7.00 m by 1.57 m
DESCRIPTION: Feature J is 2.50 m north from Feature A, on the east side of the old Palani Roadbed. The enclosure is roughly C-shape in plan with the major axis oriented N-S. The walls are constructed with large stacked boulders and average 1.20 m in width. Wall height varies from 1.57 m along the northeast side to 0.85 m along the west side. The northeast portion of the wall (4.90 m long) connects to the entrance of a 3.71 m wide overhang. Ceiling height in the shallow overhang is 1.61 m. Extending east is an overhang ceiling which is 1.61 m. There is a shelf inside of the overhang which is 0.39 m in height and 0.64 m in length and filled with basalt gravels. A 0.10 m thick deposit of brown silty loam is present; no portable remains were observed.

SITE NO.: State: 13436 PHRI: T-219
SITE TYPE: Wall
TOPOGRAPHY: Irregular pahoehoe with a relatively steep slope.
VEGETATION: Sisal, Christmas-berry, guava, koa-haole, lantana, and various grasses.
ELEVATION: c. 605 feet
CONDITION: Poor-fair
INTEGRITY: Unaltered except by roadway construction
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Land division
DIMENSIONS: 134.80 m by 1.30 m by 0.60 m
DESCRIPTION: This site is a bifaced and core filled wall.

It is constructed with stacked boulders, one to six high, and cobble filled. The height varies from 0.30 m to 1.30 m, and width averages 0.60 m. Both ends of the wall have been terminated at the shoulder of the existing Palani Highway. The road is oriented generally NE-SW and roughly parallels the old Palani Roadbed, located c. 12.00 m to the east. There are four minor angles (20-40 degrees) along the length of the wall. Pahoehoe excavations occur c. 2.0-3.0 m to the east of the wall and may be a probable source for building material.

SITE NO.: State: 13437 PHRI: T-220
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Undulating pahoehoe and aa surface f lows.
VEGETATION: Christmas-berry, lantana, air plants, and laua'e.
ELEVATION: c. 515-518 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-marker
DESCRIPTION: The overall complex area measures 56.40 m at 330 degrees Az. by 24.00 m. The site consists of a stepped terrace (Feature A), a pavement (Feature B), a faced outcrop (Feature C), a terrace (Feature D), and three cairns (Features E-G).

FEATURE A: Stepped terrace
FUNCTION: Agriculture
DIMENSIONS: 45.90 m by 13.58 m by 1.48 m
DESCRIPTION: The terrace is oriented NW-SE. It begins as a single stacked wall and then it proceeds to five courses then seven courses high. The stepped terrace is constructed with pahoehoe and aa boulders and cobbles and paved with angular aa gravel. Portions of the retaining wall are stacked and portions are collapsed.

The northernmost and upper terrace measures 45.90 m by 4.20 m. The retaining wall is raised on the south side and is stacked three to six courses high for a maximum height of 0.94 m. The lower and southernmost terrace measures 34.20 m by 9.30 m. It is stacked six courses high, and is 1.10 m in height, where it joins with the upper terrace.

FEATURE B: Pavement
FUNCTION: Agriculture
DIMENSIONS: 7.80 m by 3.80 m by 1.50 m
DESCRIPTION: This pavement is east of and adjacent to Feature A. It is constructed with rough cobbles and outlined with aa cobbles that are stacked in places. North and adjacent to the paved area is a depression bordered on three sides by the built-up area and on the fourth side by a rock ledge. The depression measures 5.00 m by 3.00 m and is 1.80 m deep. The base of the depression is cleared and has a 0.02 m thick soil deposit that covers an area 2.80 m by 0.90 m.

FEATURE C: Faced outcrop
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 0.00 m by 1.00 m
DESCRIPTION: Feature C is 22.00 m south and 5.70 m east of Feature A. It consists of a natural ledge that has been stacked with aa boulders and cobbles to form a crude retaining wall. In areas along the natural ledge occasional cobbles can be found placed along the top edge.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 14.00 m by 10.00 m by 0.80 m
DESCRIPTION: This terrace is in the immediate vicinity of Features A and B. Large pahoehoe boulders are stacked two to three courses high around the perimeter, with smaller pahoehoe cobbles filling the interior. This terrace is roughly L-shaped with the major axis oriented E-W, and the extension to the south at the east end. The extension is 4.00 m N-S and 3.50 m E-W. On the west end of the terrace is a small circular platform, constructed on the edge and on top of the perimeter wall. It is 0.70 m in diameter and two courses (0.38 m) high. A 0.08-0.10 m thick deposit of sandy loam is present on the terrace.

FEATURE E: Cairn **FUNCTION:** Marker
DIMENSIONS: 0.85 m by 0.85 m by 0.65
DESCRIPTION: This cairn is the westernmost of an alignment of three cairns (with F and G). It is 10.00 m south from the west end of Feature D. It is circular at the base and constructed with aa boulders and cobbles with three courses of single pahoehoe cobbles on top. To the north of the cairn alignment is a linear rock mound that extends 11.50 m at 100 degrees Az.

FEATURE F: Cairn
FUNCTION: Marker
DIMENSIONS: 0.85 m by 0.85 m by 0.70 m
DESCRIPTION: Circular at the base and constructed with aa boulders and cobbles with three courses of single pahoehoe cobbles on top. Feature F is the center cairn. Feature E and Feature G are in line at 100 degrees Az. and are on either side of Feature F, which is 4.20 m from Feature E and 3.80 m from Feature G.

FEATURE G: Cairn
FUNCTION: Marker
DIMENSIONS: 0.90 m by 0.90 m by 0.85 m

DESCRIPTION: Circular at the base and constructed with aa boulders and cobbles with three courses of single pahoehoe cobbles on top. Feature G is the easternmost cairn.

SITE NO.: State: 13438 PHRI: T-221
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Aa flows with some pahoehoe.
VEGETATION: Christmas-berry, lantana, air plant, ferns, grass, and noni.
ELEVATION: c. 529 feet
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Historic/Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-transportation
DESCRIPTION: Overall complex area measures 200.0 m (N-S) by 40.0 m (E-W). The site consists of four terraces (Feature A, Features C and D and Feature F), two mounds (Features B and I), three terraces (Features C, D and Feature F), a pahoehoe excavation (Feature E), a trail (Feature G), a roadbed (Feature H) and a cairn (Feature J).

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.10 m by 5.00 m by 0.50 m
DESCRIPTION: The terrace wall is built with stacked aa cobbles and the surface interior is paved with aa gravels. The terrace boundary is distinguished by large cobbles and boulders to the north and the south and by a downward slope to the east. In addition, there is an oval shaped, cleared aa depression west and adjacent to the terrace wall.

FEATURE B: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 2.40 m by 0.70 m
DESCRIPTION: This mound is 5.00 m north from Feature A. It is built with a loosely stacked perimeter of aa cobbles and filled with gravel and a few cobbles.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 7.50 m by 2.30 m by 0.65 m
DESCRIPTION: The terrace is 14.80 m west from Feature B. It is roughly rectangular shape, and raised on the southwest side. The riser wall is constructed with stacked aa boulders and cobbles and the terrace surface is paved with cobbles and gravels. It is collapsing at the southeast end where collapse extends 1.80 m to the exterior of the terrace wall.

Immediately to the northeast of the terrace are two cleared depressions in the natural aa flow. The largest of these is at the northern edge of the terrace; it is 3.90 by 2.20 m and 1.05 m deep. The second depression is 2.00 m to the south. It is 2.90 by 1.60 m and 0.75 m deep.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 4.00 m by 0.20 m
DESCRIPTION: Feature D is in the immediate vicinity of Feature C. It is an oval shaped terrace with a perimeter of large aa cobbles, and is filled with aa gravels. The surface is level and flat. The perimeter may have been stacked at one time, but it is presently collapsed.

FEATURE E: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.70 m by 2.00 m by 0.90 m
DESCRIPTION: An excavated pahoehoe ledge with stacked angular pahoehoe boulders and cobbles on top of the ledge. Smaller cobbles cover the interior. On the eastern ledge of this feature is a rock mound that measures 1.20 m by 1.00 m by 0.40 m high. Large pahoehoe boulders are at the base with smaller cobbles on top, two to three courses high.

FEATURE F: Terrace
FUNCTION: Agriculture
DIMENSIONS: 8.40 m by 3.30 m by 1.20 m
DESCRIPTION: This terrace is adjacent to Features C and D, and the east end abuts the retaining wall of the old Palani Roadbed (Feature H). The terrace is roughly crescent shape in plan and constructed with a perimeter of large aa boulders stacked two to three courses high. It is filled with aa gravel.

FEATURE G: Trail
FUNCTION: Transportation
DIMENSIONS: 50.00 m by 1.20 m
DESCRIPTION: The trail section is oriented northwest and west from the Feature F terrace. It has a flattened, packed surface of aa gravel and a perimeter of larger aa cobbles. The trail alignment is nonlinear.

FEATURE H: Roadbed
FUNCTION: Transportation
DIMENSIONS: 200.00 m by 4.30 m by 2.00 m
DESCRIPTION: This feature is an abandoned section of Palani Road. It is identical in construction to the section described above (SIHP Site 13426). The south end of this section is at the shoulder riprap of the existing Palani Highway alignment. The north end is terminated at Site 13434.

FEATURE I: Mound
FUNCTION: Indeterminate

DIMENSIONS: 7.30 m by 2.00 m by 1.00 m
DESCRIPTION: The rock mound is located 10.00 m west from Feature E. It is generally linear in plan and constructed with boulders from an adjacent pahoehoe flow. Height varies from 0.50 to 1.00 m. A somewhat discrete rock concentration occurs at the southeast end of this linear mound. The concentration is 1.20 m by 0.90 m and is two courses high.

FEATURE J: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.60 m by 0.55 m by 0.70 m
DESCRIPTION: Feature J is situated 8.0 m west of Feature E. It is built with two stacked pahoehoe boulders. The top boulder is slighlty smaller than the boulder base.

SITE NO.: State: 13439 PHRI: T-222
SITE TYPE: Cairn
TOPOGRAPHY: The terrain consists of aa and pahoehoe flows.
VEGETATION: Christmas-berry, air plants, and grass.
ELEVATION: c. 555 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate marker
DIMENSIONS: 1.15 m by 1.00 m by 1.00 m
DESCRIPTION: The cairn is constructed with stacked aa cobbles.

SITE NO.: State: 13440 PHRI: T-223
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Irregular and undulating terrain consisting of aa and pahoehoe flows.
VEGETATION: Christmas-berry, koa-haole, lantana, and fountain grass.
ELEVATION: c. 506 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 23.0 m at 330 degrees Az. by 13.20 m. The site consists of a terrace (Feature A), a filled crevice (Feature B) and a pahoehoe excavation (Feature C).

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 4.20 m by 3.40 m by 0.00 m
DESCRIPTION: A terrace built up on the edge of a pahoehoe outcrop with pahoehoe boulders and cobbles.

FEATURE B: Filled crevice
FUNCTION: Agriculture
DIMENSIONS: 3.40 m by 1.60 m by 0.00 m
DESCRIPTION: Feature B is located 5.60 m northwest from Feature A. The crevice is filled with pahoehoe boulders and cobbles.

FEATURE C: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 13.20 m by 2.60 m by 0.00 m
DESCRIPTION: Located 16.20 m northwest from Feature A. Pahoehoe cobbles and gravels are haphazardly strewn in a concave area along a pahoehoe flow edge. In the southwest end of the feature is a circle of pahoehoe boulders on the north flow edge measuring 1.90 m (N-S) by 1.20 m (E-W). A loam deposit is present 1.00 m north; it covers an area 2.50 by 1.2 m (N-S).

SITE NO.: State: 13441 PHRI: T-224 *(Figure A-42)*
SITE TYPE: Complex (20+ Features)
TOPOGRAPHY: Undulating pahoehoe with some natural disturbance.
VEGETATION: Thick Christmas-berry, lantana, kolu, koa-haole, and fountain grass.
ELEVATION: c. 470-480 feet
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures c. 108.0 m (E-W) by 88.0 m (N-S). The site consists of 20 principal features and additional modified outcrops and pahoehoe excavations. The principal features include seven platforms (Features A, C, D, J, K, N and O), five terraces (Feature B and Features E-H), a wall remnant (Feature I), a wall (Feature L), a mound (Feature M), a cave (Feature P) and an enclosure (Feature Q). The Feature Q enclosure surrounds the complex. The site is very unique in its containment and high concentration of highly structured features.

FEATURE A: Platform
FUNCTION: Habitation/agriculture
DIMENSIONS: 12.00 m by 7.70 m by 0.90 m
DESCRIPTION: Feature A is a platform constructed of stacked and faced basalt blocks and surfaced with ai pebble pavement. It is in fairly good condition and is situated immediately west of Feature B. There appears to be a single posthole in the northwest corner of the platform, formed by four basalt blocks. The possible posthole measures 0.36x0.32x0.50 m.

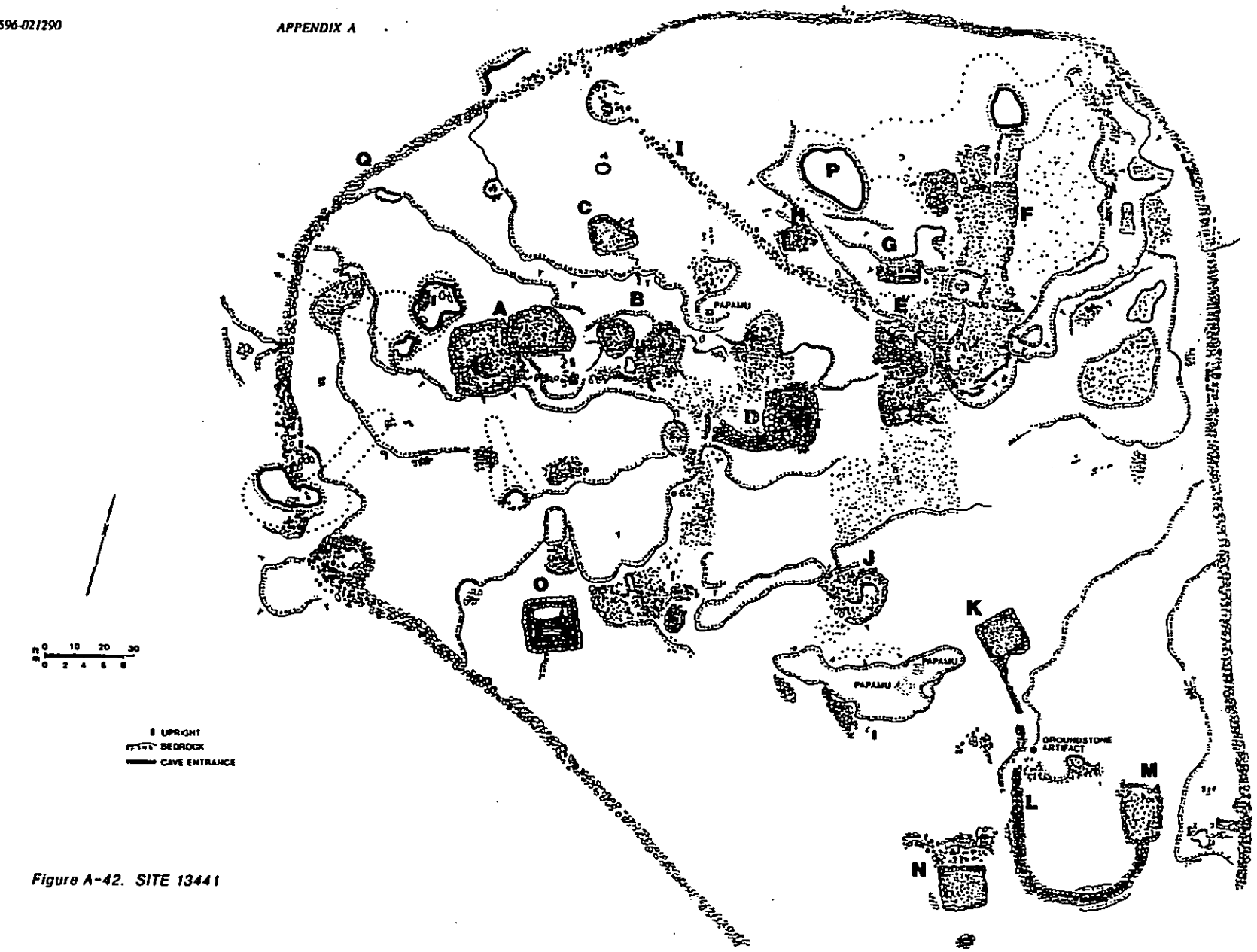


Figure A-42. SITE 13441

The platform adjoins and is roughly level with a pahoehoe outcrop. One upright basalt is located 2.00 m from the western edge of the platform, roughly in the center of the N-S axis. There is a possible papamu present on the pahoehoe outcrop at the eastern edge of the platform.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.10 m by 3.90 m by 0.40 m
DESCRIPTION: The terrace is constructed with basalt blocks ranging in size from pebbles to large boulders. They are in a pile that measures 5.1 m (E-W) by 3.9 m (N-S).

To the east and southeast of the pile, is a pavement that measures 5.60 m (N-S) by 4.80 m (E-W). The pavement consists of generally fist sized basalt rocks with some boulders (measuring c. 0.3 m) and one large basalt block, which is 0.76 m by 0.56 m by 0.22 m. At the south edge of the pavement, extending west, is an alignment (possible collapsed wall) of basalt blocks constructed with a maximum of two courses. The blocks range in length from less than 0.10 m to 0.75 m by 0.42 m by 0.19 m. The alignment measures 3.62 m (NE-SW) with a maximum height of 0.4 m.

FEATURE C: Platform **(Figure A-43)**
FUNCTION: Agriculture
DIMENSIONS: 10.0 m by 6.0 m by 0.54 m
DESCRIPTION: This low, D-shaped platform is constructed with large basalt cobbles that are loosely stacked along the sides, and is filled with gravel to boulder size basalt ranging in size from less than 0.05 m in diameter to 0.34 by 0.30 m by 0.21 m. The surface is irregularly paved with scattered pebbles.

A 1.00 by 1.00 m square test unit was excavated in the center of the feature, in order to better determine its function. The paving was found to consist of only one layer of pebbles, overlying a cobble fill that had pebbles intermixed. The fill layer in the test unit was 0.56 m thick, and rested on a 0.10 m thick layer of pebbles and soil intermixed. The pebble/soil layer was directly on pahoehoe bedrock. A single kukui nut in three fragments was located in the soil layer. No other portable remains or cultural deposits were observed. A sample of the soil was collected for further analysis.

FEATURE D: Platform
FUNCTION: Habitation
DIMENSIONS: 6.50 m by 5.40 m by 1.11 m
DESCRIPTION: The platform perimeters consist of large basalt blocks that are stacked and faced up to six courses high. The interior is filled with boulders and cobbles. The platform surface is level; the western portion of covered with a single layer of closely fitted pahoehoe slabs. The eastern portion is paved with pebble-size pieces of pahoehoe. There are two both subsurface features resembling post holes in the platform. These are aligned along the boundary of the slab and pebble pavements. A small step-like protrusion is exterior to the south wall; it is 0.50 m high.

In addition, a low linear ramp-like platform projects westward from the southwest corner of the platform. Its dimensions are 6.20 m (E-W) by 3.40 m (N-S). It may be a partially collapsed ramp or stepped entrance path.

FEATURE E: Terrace (4)
FUNCTION: Agriculture
DIMENSIONS: 18.00 m by 14.00 m by 1.90 m
DESCRIPTION: Feature E consists of four terraces on a south facing slope of a hill, just below the crown of the hill. All terraces are raised along the south side. Below the terraces to the south and west is an unbordered pavement which covers an area 10.00 m (N-S) by 14.00 m (E-W). The first terrace above the pavement measures 5.00 m (N-S) by 10.00 m (E- W); the second terrace above the pavement measures 4.00 m (N-S) by 8.00 m (E-W); the third terrace above the pavement measures 4.50 m (N-S) by 9.00 m (E-W). Large and small basalt blocks are used to construct the retaining walls. Some sections are collapsed and slope into each other.

Portions of the terraces incorporate natural pahoehoe outcrops. Other sections require the construction of up to six courses of basalt blocks to roughly level the terrace in relation to the outcrop. The lowest terrace is somewhat informal as compared with the upper levels. The west side of the lower terrace ends 2.00 m east of Feature D.

FEATURE F: Terrace
FUNCTION: Agriculture
DIMENSIONS: 29.00 m by 7.00 m by 1.00 m
DESCRIPTION: The long axis of Feature F is oriented NW-SE along the northeast crown of the hill, upslope from Feature E. It is raised on the east side and slighlty raised on the south side. Basalt blocks are used to construct the retaining wall, which is a maximum of six courses stacked and faced. The retaining wall edge is constructed of basalt blocks as large as 1.00 x 0.70 x 0.30 m. The interior is filled with small basalt blocks and pebbles.

FEATURE G: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.30 m by 2.90 m by 0.55 m

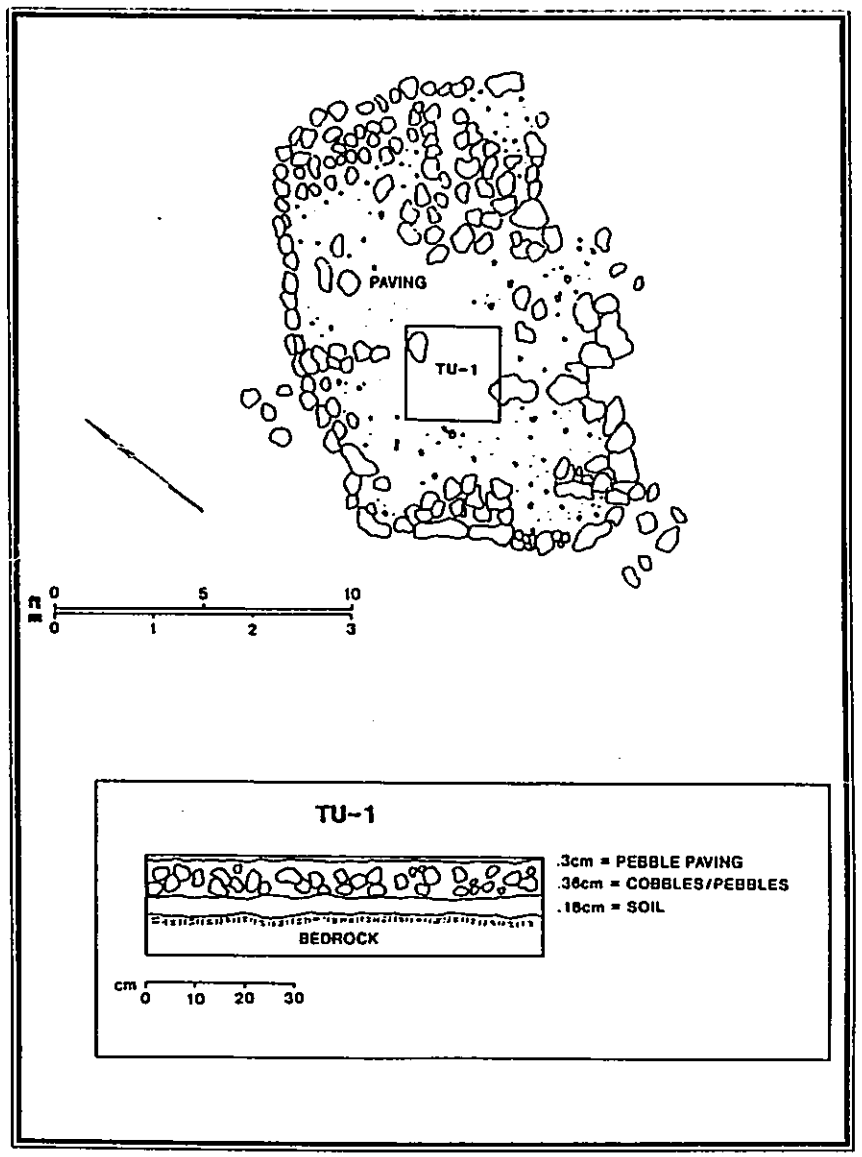


Figure A-43. SITE 13441, FEATURE C

Situated on the south facing slope near the crown of the hill, it is raised on one side. The retaining wall consists of a maximum of three courses of basalt blocks, and filled with small basalt blocks and pebbles. The feature abuts a pahoehoe outcrop to the north.

FEATURE H: Terrace
FUNCTION: Agriculture
DIMENSIONS: 4.00 m by 3.50 m by 1.50 m
DESCRIPTION: Feature H is raised on three sides and constructed with basalt blocks stacked and faced to a maximum of four courses high. It is partially collapsed in sections. Most of the basalt blocks are large, with the largest measuring 0.80 x 0.50 x 0.30 m. The interior consists of large medium and small basalt blocks and slabs.

FEATURE I: Wall remnant
FUNCTION: Indeterminate
DIMENSIONS: 25.00 m by 1.00 m by 0.50 m
DESCRIPTION: Feature I is constructed with medium to large basalt blocks and with eight upright slabs. It is mostly collapsed except for the upright basalt slabs and a small section near Feature H. The wall is oriented NW-SE, and the northwest end is at the complex enclosure wall (Feature Q).

FEATURE J: Platform
FUNCTION: Habitation/agriculture
DIMENSIONS: 6.60 m by 5.40 m by 0.70 m
DESCRIPTION: Raised on four sides it appears to be bilevel with a smaller and higher portion on the north side. It is constructed with basalt blocks and slabs. The higher portion has a small paved area measuring 2.90 m (E-W) by 1.90 m (N-S). A pahoehoe outcrop forms part of the higher area. The structure is not presently faced.

FEATURE K: Platform *(Figure A-44)*
FUNCTION: Habitation/agriculture
DIMENSIONS: 5.25 m by 4.70 m by 0.95 m
DESCRIPTION: The platform is raised on four sides with portions faced on the northwest and southwest sides. The sides are generally six courses high. The interior of the structure is filled with medium to small blocks and pebble sized basalts. There is a small shallow depression near the center of the platform that measures 1.60 m (E-W) by 1.20 m (N-S).

A 1.00 by 1.00 m sq test unit was excavated into the depression, in order to better determine feature function, and to determine if subsurface features, such as human interments, were present. A concentration of 6-7 small kiawe trees were growing in the depression, at the time of excavation. The uppermost layer encountered consisted of a humus/duff soil layer intermixed with small cobbles and pebbles. This layer varied in thickness from 0.29 to 0.35 m. Beneath Layer I in the southeast quarter of the unit was a dark grayish brown silty loam which was 0.06 m thick. In the remainder of the unit, Layer I continued to the bedrock surface, encountered 0.35 m below surface. No portable remains or cultural deposits were encountered in the unit. A soil sample was collected for further analysis (see subsurface findings).

FEATURE L: Wall
FUNCTION: Indeterminate
DIMENSIONS: 34.00 m by 0.80 m by 0.90
DESCRIPTION: The wall adjoins Feature K at its north corner and proceeds at an angle of 140 degrees Az. for 5.00 m, where there is a 2.00 m break. It continues again for 12.00 m and turns to 360 degrees Az. for 5.0 m and joins the southwest corner of Feature M. Basalt blocks and slabs ranging from pebble to large blocks are used in the construction of Feature L. The wall width ranges from 0.90 to 2.00 m. Some portions of the wall are collapsed and it does not appear to have been entirely faced.

FEATURE M: Mound
FUNCTION: Agriculture
DIMENSIONS: 5.30 m by 3.20 m by 0.65 m
DESCRIPTION: Feature M is connected to Feature L near the south corner. It is an unfaced rubble mound with no distinct coursing. The mound is constructed with basalt gravel to medium size basalt blocks. The highest portion is near the north edge where several large blocks sit atop the rubble. Otherwise, the center would be the highest point with the mound gradually tapering to ground level along all sides.

FEATURE N: Platform
FUNCTION: Habitation/agriculture
DIMENSIONS: 7.10 m by 4.40 m by 0.85 m
DESCRIPTION: Feature N is raised on four sides with stacked basalt blocks ranging in size from 0.52 x 0.50 x 0.20 m to less than 0.10 m in diameter. A portion of the southwest side is faced, the southeast side is coursed with a maximum of two courses evident, and the northwest and the northeast sides are collapsed. The interior is filled with pebbles to medium sized basalt blocks. A depression is present in the northeast quad of the platform surface. It is 0.30-0.40 m deep and measures 2.00 by 2.00 m.

FEATURE O: Platform *(Figure A-45)*
FUNCTION: Agriculture
DIMENSIONS: 5.90 m by 4.50 m by 1.05 m

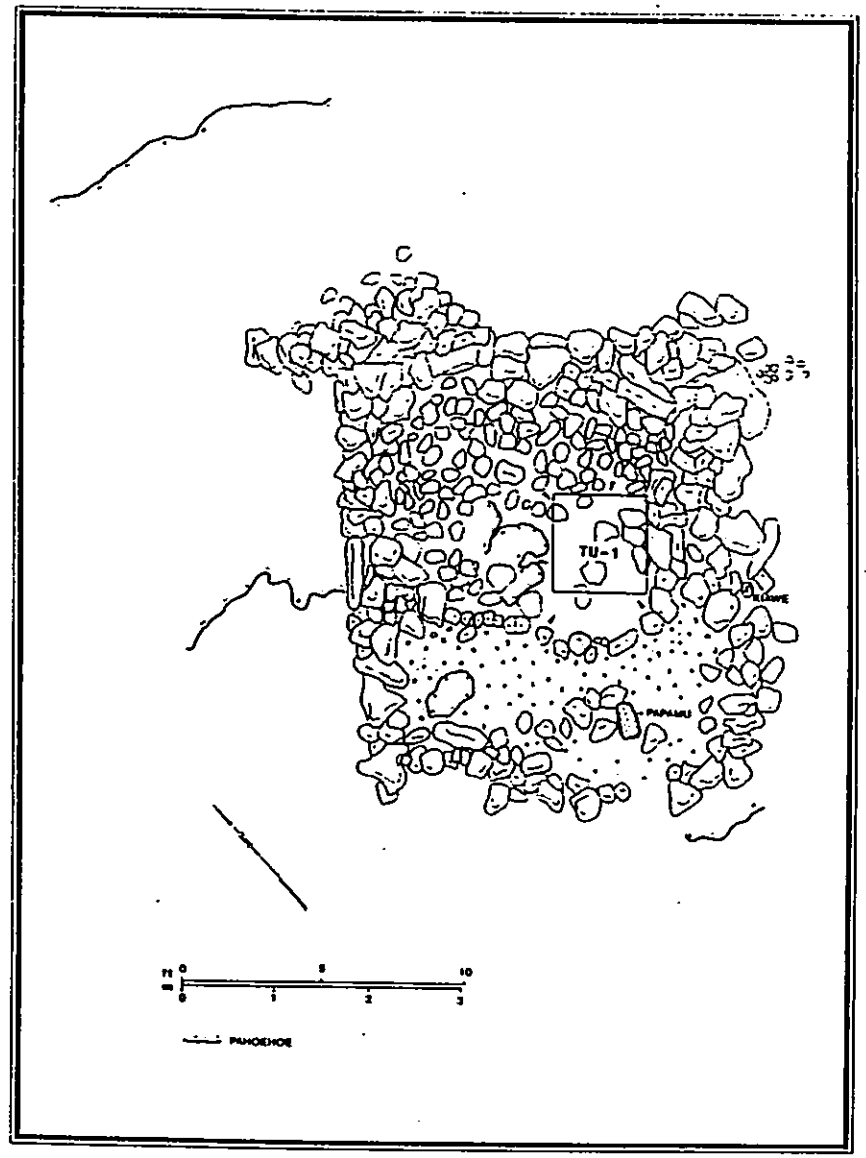


Figure A-44. SITE 13441, FEATURE K

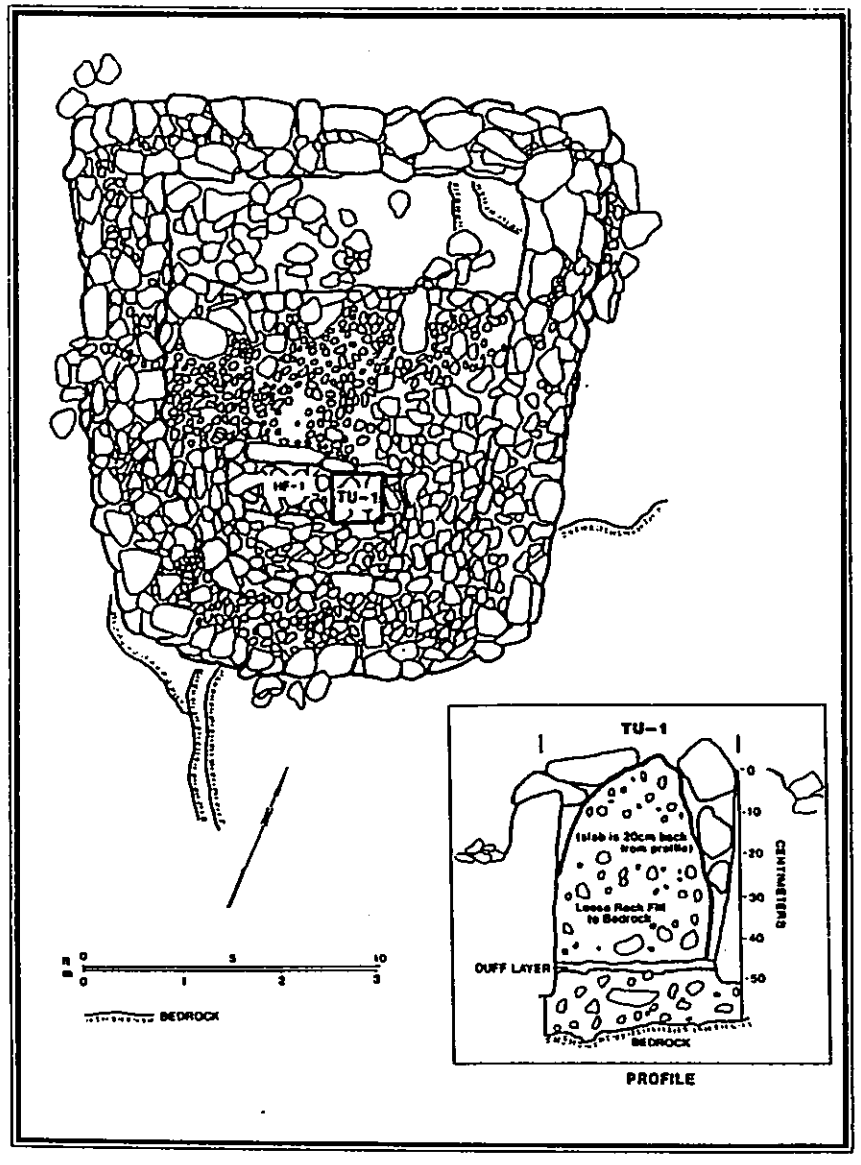


Figure A-45 SITE 13441, FEATURE O

Square to rectangular shape in plan it is constructed with pahoehoe slabs and blocks, many of which appear to be quarried. The perimeter wall is double faced along the north half, where both sides are visible. Several large slabs are set on side or upright along the interior and exterior of the wall. The wall is core-filled with cobble size pieces and covered with slabs along portions. Average wall width is 0.70 m.

The interior of the perimeter wall is partially filled with slabs and cobbles to form the platform. The north portion inside of the wall is left open with the original ground surface visible. A slab-lined, rectangular pit (1.25 by 0.45-0.63 m by 0.50 m deep) is present near south end of the platform. The pit walls are vertical, and formed with single large slabs on the sides. The pit measures resembles a open burial crypt. Some collapse has fallen into the pit.

The platform fill at the south end is level with the top of the perimeter wall, which has collapsed onto the platform surface in places. The south surface of the platform is sloping from the top of the wall toward the tops of the slab-lined pit liners. This is partially attributable to wall collapse to the interior. The fill surface steps down 0.30 m at 1.7 m from the north wall. The lower level platform is 0.90 m wide and extends across the interior area, from wall to wall. The open, unfilled area at the north end steps down 0.40 from the lower platform level. Pahoehoe with excavated face is present on the surface of the open area.

A 0.50 by 0.50 m square test unit was excavated into the center of the stone-lined pit, in order to determine if it contained a human interment. The pit was filled to the top of the liners with a loosely thrown-in layer of boulders and cobbles. This layer was 0.45 m thick and was set on an old duff (O Horizon) layer. None of the stones intruded into the level surface of the duff layer, which was a maximum of 0.02 m thick. A scatter of charcoal fragments was encountered on the duff layer surface. These fragments were collected for age determination analysis.

Beneath the duff was a deposit of loose, black loam with scattered pebbles, which directly overlaid the unbroken pahoehoe bedrock surface. This deposit was 0.07 to 0.16 m thick. A single Cypraeidae shell fragment and a kukui nut shell fragment were recovered from this layer.

FEATURE P: Cave *(Figure A-46)*
FUNCTION: Habitation
DIMENSIONS: 29.00 m by 10.00 m by 2.20 m
DESCRIPTION: Feature P is located at the northern edge of the complex, just inside the enclosure wall. It is a long lava tube with three vertical entrances, located at the two ends and near the center, along the major axis (NE-SW). The largest entrance is at the southwest end of the tube formation and consists of an oval collapse 9.00 by 5.80 m across. The interior, open area in the collapse is modified with leveled and filled areas, and arrangements of the roof collapse. There is a protected overhang area under the southwest rim of the opening. This area is 6.00 m wide, 2.00 m deep and has a ceiling height of 1.39 m at the dripline. A soil deposit is present in this overhang.

The cave is entered under the northeast rim of the collapsed blister. The entrance is 3.70 m wide and the ceiling is 1.43 m high. The tubular chamber opens to an average width of 5.00 m. The floor is cleared of rubble for a distance of 8.00 m from the entrance, and is covered with a soil/midden deposit containing charcoal, fire-cracked basalt, marine shell, kukui nut shell, and mammal bone (including feral goat). A small paved area occurs along the south wall in this chamber. The pavement is 2.50 m from the entrance, and is c. 1.50 m square.

The second cave entrance is 12.20 m northeast from the first entrance. It is a vertical opening in the top of the tube, 3.50 by 2.80 m across and 1.26 m ceiling height. A depression in the floor beneath the opening has been filled with wall collapse, an a quantity of the collapse has been arranged in a linear mound across the tube, to the southwest of the entrance. The tube is 5.00 m wide at this point.

From the second opening, the cave continues northeast 8.50 m and gradually becomes narrower, ending at a third opening. A rubble wall occurs in the southern side of the tube between the second and third opening. The wall is L-shaped, with the long axis 5.50 m and the short extension 1.50 m in length. Inside the third opening is a small square paved area (1.10 m square) and a deposit of soil. The tube is 2.80 m wide where the soil and paved area occur. Ceiling height in this area is 2.20 m.

A 1.00 by 1.00 m square test unit (TU-1) was excavated into the midden/soil deposit at the southwest end of the cave, 2.00 m in from the main entrance. The deposit here was found to be a maximum of 0.05 m thick. This homogenous fill was screened through 1/8" mesh. Marine shell fragments, charcoal, fish and mammal bone, and basalt gravels were recovered. A bulk sample for age determination analysis was also collected.

A 0.50 by 0.50 m square test unit (TU-2) was excavated into the soil deposit at the northeast end of the cave. The deposit here was found to be a maximum of 0.03 m thick and consist of sterile brown loam. A sample of the soil was collected for further analysis.

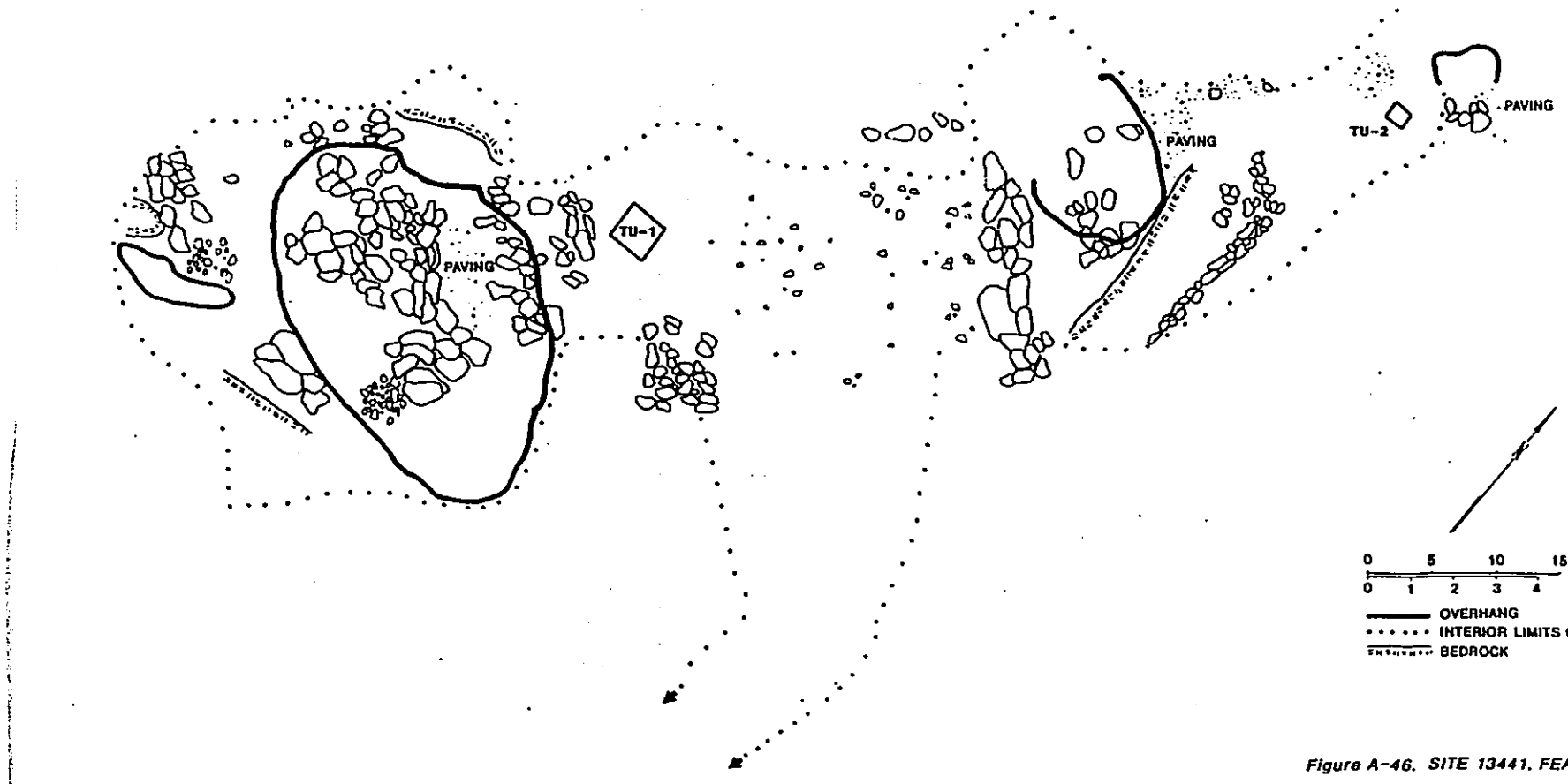


Figure A-46. SITE 13441, FEATURE P

FEATURE Q: Enclosure
FUNCTION: Agriculture-habitation
DIMENSIONS: 110.00 m by 94.00 m by 1.00 m
DESCRIPTION: The enclosure wall forms the perimeter around Site Complex 13441, Features A-P. The enclosure is roughly three sided in plan, but exhibits squared or angular corners. It follows and incorporates a few outcrops, mostly on the surface of the smooth pahoehoe. Most sections appear to have been originally double-faced and core filled. Nearly all portions have been knocked down and some stones removed.

The average wall width is 0.80 m and the height varies from 0.30 to 1.00 m. Large pahoehoe slabs are used for sides, many have been set upright and/or on sides. Some sections are single course of these large slabs, up to 1.00 m high. Portions of the enclosure wall with core fill present consist mostly of cobble size pieces of pahoehoe.

The wall has one obvious opening at the west end, near a small abutting enclosure and collapsed blister with cave. All other open areas are where the wall was knocked down or robbed of stones. The poor condition of this feature contrasts with generally very good condition of the other interior features.

It does appear to define the complex boundaries. However, a few pahoehoe excavations and agriculture mounds were observed outside, within a 10-15 m distance away from the wall. The construction with upright slabs is similar to the construction of several of the platform and terrace faces. There is no evidence suggesting where the robbed stones were taken, but many sections have both sides present, with the core fill missing.

No portable remains are in direct association with Feature Q; however, an adze, a waterworn basalt hammerstone, and scattered marine shell fragments were observed on the surface inside the enclosure.

SITE NO.: State: 13442 PHRI: T-225
SITE TYPE: Alignment
ELEVATION: c. 477 feet
FUNCTIONAL INTERPRETATION: Indeterminate

SITE NO.: State: 13443 PHRI: T-226
SITE TYPE: Complex (16 Features)
TOPOGRAPHY: Undulating pahoehoe with some natural disturbance
VEGETATION: Thick Chrismas-berry, lantana, and grasses.
ELEVATION: c. 479 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 36.00 m at 20 degrees Az. by 16.00 m. Features identified include twelve rock mounds, one linear mound, two cairns and an alignment. The mounds are unfaced and loosely stacked with no formal structure. Most are constructed on or abutting pahoehoe outcrops or around cleared areas. Shallow soil is present in low areas and under the pebble fill on outcrops.

A representative mound is situated at the northwest edge of the site. It is stacked against an outcrop in a semicircular plan. This mound measures 2.90 m by 1.85 m and it is 0.90 m high from the base on the south side. The north side is level with the ground surface. Approximately half of the observed mounds are larger than this specimen.

The linear mound is 10.00 m long and curves around a pahoehoe clearing. It has an average height of 0.40 m.

SITE NO.: State: 13444 PHRI: T-227
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe finger flows.
VEGETATION: Christmas-berry, lantana, and fountain grass.
ELEVATION: c. 471 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 45.50 m at 215 degrees Az. by 8.70 m. The site consists of a pahoehoe excavation (Feature A) and four mounds (Feature B).

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 0.97 m by 0.79 m by 1.80 m
DESCRIPTION: An excavated pahoehoe blister with rocks stacked two courses and outlining the circular excavation. The blister excavation is not completely cleared but is filled half way with cobbles. Directly to the northwest of the blister are scattered cobbles on an apparent pavement. The pavement consists of angular pahoehoe gravels and cobbles; it covers an area 2.95 by 1.75 m.

A 3.45 m long alignment extends north from the blister. It turns to the east and continues an additional 13.25 m. The alignment is constructed with boulders and cobbles, one to four courses, depending on the extent of collapse.

FEATURE B: Mound (4)
FUNCTION: Agriculture
DESCRIPTION: Feature B consists of four rock mounds constructed with large and medium pahoehoe boulders loosely stacked on top of pahoehoe finger flow. the cluster is c. 20.00 m northeast from Feature A. The first mound measures 2.00 by 1.37 m by 0.3 m high. It is loosely stacked in a circular arrangement with a square upright boulder separated 0.34 m from the mound at the east end. The second mound is 1.54 by 0.84 m and 0.35 m high. Small boulders are placed to form a flat and almost ovoid shaped mound. The third mound measures 1.18 by 0.95 m by 0.55 m high. Various sized rocks are loosely placed on top of each other to form the mound. The fourth mound measures 4.00 by 2.20 m by 0.70 m high. It is a triangular shaped mound with large and medium sized boulders. An outer rim of lichen faced boulders appears to have fallen from their original position on the mound and are presently positioned on the periphery.

SITE NO.: State: 13445 PHRI: T-228
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Genly sloping pahoehoe flow that has been extensively modified, excavated and cleared.
VEGETATION: Christmas-berry, succulents, grass, and ferns.
ELEVATION: c. 474 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Habitation-recreation
DESCRIPTION: The overall complex area measures c. 21.0 m at 340 degrees azimuth by 10.0 m. The site consists of two caves (Features A and B), a papamu and trail section (Feature C) and a platform (Feature D).

There are numerous modifications around these features consisting of mounds, pahoehoe clearings, excavations, alignments etc. This complex is adjacent to and surrounded in part by Site 13446 features.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 19.20 m by 6.20 m by 1.65 m
DESCRIPTION: The cave entrance faces south and opens to a 4.00 by 1.40 m chamber that has an average ceiling height of 1.30 m. A tube extension continues 15.20 m east from the front chamber. The tube has an average width of 3.30 m and an average ceiling height of 1.20 m. A hearth feature is present in the front chamber, directly to the west of the tube. It is presently covered by boulders. Portable remains observed include Conidae, Cypraeidae, mammal bone, kukui, charcoal and coral. The cave contains only minor modifications.

FEATURE B: Cave
FUNCTION: Habitation
DIMENSIONS: 37.00 m by 7.00 m by 1.20 m
DESCRIPTION: Feature B is 9.70 m northeast from Feature B. The cave entrance faces the north and measures 3.60 m wide and 1.10 m high. It is situated along the edge of a blister and exhibits minor modifications. Portable remains observed in the features occur within 10.00 m of the entrance. They include kukui nut shell and a thick, green bottle glass sherd.

FEATURE C: Papamu and trail section *(Figure A-47)*
FUNCTION: Recreation
DIMENSIONS: 0.47 m by 0.46 m by 0.13 m (papamu)
DESCRIPTION: Feature C is situated on a small rise to the southeast and above Features A and B. The papamu consists of 31 small circular depression engraved in a pattern of six rows and five columns. The stone is cracked into two pieces; both are still in association.

The trail section is immediately south of the papamu and measures 7.0 m in length with an average width of 0.9 m. Generally, it is paved with cobbles and with some basalt slabs as steppingstones. It appears to connect the two cave shelters.

FEATURE D: Platform
FUNCTION: Habitation
DIMENSIONS: 4.30 m by 3.80 m by 0.35 m
DESCRIPTION: The platform is rectangular shape in plan. The perimeter is defined by stacked, roughly faced pahoehoe slabs, averaging two courses high. The interior is filled with cobbles and pebble size pieces of pahoehoe. The surface is relatively level with a paved appearance. The surface interior fill is slightly below the tops of the perimeter stones. Most of the platform surface is free of large boulders except for a seven at the north end, just inside of the perimeter. These seven boulders are arranged in a square formation, a single course high.

There is a filled blister at the north end of the platform that is semicircular in shape and abutting the platform wall. The width ranges from 1.20 m to 4.20 m. The fill is primarily large blocks of pahoehoe. Another filled pahoehoe blister is immediately to the west of the west wall of the platform. Adjoining the filled blister is Feature C (trail section).

Figure A-47. SITE 13445, FEATURE C. View to Northwest (PHRI Neg. 1247-10)

SITE NO.: State: 13446 PHRI: T-229
SITE TYPE: Complex (37 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe finger and surface flows.
VEGETATION: Christmas-berry, fountain grass, and lantana.
ELEVATION: c. 465 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 58.0 m by 49.5 m at 260 degrees Az. Two of the structures were given feature designations; an alignment (Feature A) and a terrace (Feature B). In addition to these features, eight rock mounds, 17 modified blisters, nine pahoehoe excavations and a terrace were enumerated.

FEATURE A: Alignment
FUNCTION: Agriculture
DIMENSIONS: 51.85 m by 1.96 m by 0.70 m
DESCRIPTION: Feature A is located near the center of the complex area. Generally oriented NE-SW, it is constructed with uprights, boulders and cobbles, and outlines an irregular, natural pahoehoe flow edge.

FEATURE B: Terrace
FUNCTION: Agriculture-habitation
DIMENSIONS: 6.20 m by 4.70 m by 0.90 m
DESCRIPTION: Feature B abuts a natural pahoehoe outcrop. The west and northwest sides are raised and faced with stacked, pahoehoe slabs, five courses high. The interior floor is filled with smaller cobble size pieces of pahoehoe. The major filled area of the terrace is C-shaped, and conforms with the outcrop edge. Shallow fill is placed on the slope of outcrop, giving the structure an overall rectangular surface form. The fill is level with the top of the perimeter walls. The N-S wall along the west face is 5.10 m long, the E-W wall along north face is 3.00 m long. Rock mounds are immediately to the east side, behind the terrace.

A small terrace occurs at the base of the northwest corner; it is semicircular and measures 1.75 m (E-W) by 1.0 m (N-S). It has stacked perimeter slabs two courses high and pebble/cobble-sized fill (leveled). Average height is 0.30 m and it abuts the higher, faced wall of the main terrace.

The second low terrace off the north wall is semicircular in plan. It measures 1.80 by 1.80 m and is constructed with a single-course boulder perimeter and has pebble fill. The surface is below the tops of the perimeter stones.

SITE NO.: State: 13447 PHRI: T-230
SITE TYPE: Complex (19 Features)
TOPOGRAPHY: Pahoehoe finger flows.
VEGETATION: Christmas-berry, lantana, grasses, guava, and koa-haole.
ELEVATION: c. 475 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible habitation
DESCRIPTION: Overall area of this complex is 68.00 m (E-W) by 40.00 m (N-S). Features identified at the site include a platform (Feature A), six pahoehoe excavations, three modified blisters, and nine filled blisters.

FEATURE A: Platform
FUNCTION: Habitation
DIMENSIONS: 4.60 m by 4.30 m by 0.50 m
DESCRIPTION: Feature is a platform with a large upright in the northwest corner. The perimeter consists of single pahoehoe boulders. The platform is roughly paved with pahoehoe cobbles and gravels. A pahoehoe excavation is located 2.00 m south of the platform. Also, piled pahoehoe boulders are 4.00 m to the southwest of the platform.

SITE NO.: State: 13448 PHRI: T-231
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: A flat to gentle westward sloping terrain consisting of pahoehoe outcroppings.
VEGETATION: Christmas-berry, koa-haole, various grasses, lantana, and guava.
ELEVATION: c. 485 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of a series of five interconnecting and two separate pahoehoe excavations. The five connecting pahoehoe excavations are cleared hollows in an area covered by large pahoehoe blocks and small boulders.

These five features are located on the south side of the complex. The overall measurement is 8.50 m at 290 degrees Az. by 10.00 m. The excavations range in size from 0.90 by 0.70 m to 2.00 by 0.90 m. Some visible pavement of pebbles and at least 0.14 m of soil are present within the excavations.

An L-shaped pahoehoe ledge excavation consists of some pahoehoe blocks placed along the upper pahoehoe flow. The interior is paved with pebbles and small cobbles.

It measures 9.00 m at 18 degrees Az. by 4.5 m. The thickness of the excavated pahoehoe layer is 0.30 m and the maximum depth of the excavation is 0.53 m. Soil is visible at the base.

Another pahoehoe excavation is lined and filled with large pahoehoe cobbles and small boulders. It measures 4.60 m at 304 degrees Az. by 7.6 m. Soil is present in a small paved area on the west side of the Feature.

SITE NO.: State: 13449 PHRI: T-232
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Gentle sloping pahoehoe and aa flows.
VEGETATION: Christmas-berry, kiawe, koa-haole, ferns, air plants, and lantana.
ELEVATION: c. 480 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-transportation-possible agriculture
DESCRIPTION: The overall complex area measures 50.00 m NE-SW by 12.0 m NW-SE. The site consists of a lava tube cave (Feature A), a cairn (Feature B) and a steppingstone trail (Feature C).

FEATURE A: Lava tube cave
FUNCTION: Habitation
DIMENSIONS: 50.00 m by 5.00 m by 2.00 m
DESCRIPTION: Feature A is a lava tube with three caved-in areas that serve as openings. Oriented in a SW direction, it extends to Site 13458. The width of the cave varies between 3.00-5.00 m and the height varies between 0.60-2.00 m.

A small retaining wall crosses part of the northeast end of the northeast chamber. The retaining wall is oriented at 125 degrees Az. and measures 3.60 m by 0.60 m and 0.45-1.12 m in height. It is constructed with stacked pahoehoe slabs and boulders.

Portable remains consists of Echinoidea and marine shell fgagments.

FEATURE B: Cairn
FUNCTION: Possible agricultural mound
DIMENSIONS: 3.20 m by 2.20 m by 1.10 m
DESCRIPTION: Circular shape in plan, the outer edges are constructed with pahoehoe boulders stacked three to four courses high. Four large upright pahoehoe boulders are built into the cairn exterior wall, extending the full height of the feature and evenly spaced apart. The interior of the cairn consists of pahoehoe cobbles and gravels filled to the top of the feature.

FEATURE C: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 18.28 m by 0.55 m
DESCRIPTION: The trail is oriented NW-SE. It consists of 21 pahoehoe slabs of various sizes and shapes placed across an aa flow. From its northwestern end, the runs 7.7 m at 160 degrees Az.. It makes a slight curve and continues 10.34 m at 150 degrees Az. The southeastern end is at a pahoehoe cobble field.

SITE NO.: State: 13450 PHRI: T-233
SITE TYPE: Steppingstone trail
TOPOGRAPHY: The terrain consists of smooth and ropy pahoehoe flows.
VEGETATION: Christmas-berry and koa-haole.
ELEVATION: c. 499 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 14.45 m by 0.36 m
DESCRIPTION: The steppingstone trail is oriented N-S. Nineteen pahoehoe slabs of various sizes and shapes make up the trail, which is identifiable only across an aa flow. In addition, there are scattered excavated pahoehoe blocks in the area.

SITE NO.: State: 13451 PHRI: T-234
SITE TYPE: Cave
TOPOGRAPHY: Smooth and ropy pahoehoe surface and finger flows.
VEGETATION: Christmas-berry, koa-haole, and lantana.
ELEVATION: c. 492 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 15.5 m by 9.00 m
DESCRIPTION: The site consists of three lava tube caves, all of which open to a central collapsed blister. The blister area has been modified with two circular alignments of cobbles that are paved on the interior. The pavements cover areas of 1.64 by 1.20 m and 2.28 by 0.92 m respectively.

Two of the tubes extend southwest from the collapsed blister. They are parallel to one another, 3.00 m apart, and have lengths of 11.10 m and 8.00 m respectively. At the end of the longest tube is a wall constructed of large roof-fall boulders, which may be blocking a continuation of the tube. The wall is oriented NW-SE; it is 4.90 m long and 1.21 m wide, with an average height of 0.95 m. A short extension of the wall continues 1.31 m to the southwest.

The third tube extends 4.60 m to the northeast from the main blister. At the end of this tube is a second collapsed blister, with the tube continuing to the northeast. There are three additional collapses along the alignment of this tube, none of which appear to have been utilized or modified.

Portable remains observed in the two southwestern tubes and collapsed blister include pieces of waterworn coral, waterworn basalt cobbles, kukui nut shell, charcoal flecks, and a waterworn basalt canoe breaker. A 0.06 m thick deposit of silty gray soil is present in the two southwestern chambers.

SITE NO.: State: 13452 PHRI: T-235
SITE TYPE: Paved trail
TOPOGRAPHY: Smooth to undulating pahoehoe surface and ledge flows.
VEGETATION: Christmas-berry and koa-haole.
ELEVATION: c. 486 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/possible historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 18.30 m by 2.53 m
DESCRIPTION: The paved cobble trail is oriented roughly N-S. The trail is graded on the downhill side and slopes to the south in a ramp-like manner. The northern end of the identified section is on a smooth pahoehoe ledge. The west side is built up with a retaining wall of stacked and faced pahoehoe slabs. The the east side abuts the surface of the pahoehoe ledge. As it continues downslope, the trail widens. The western side gradually grades into a surrounding ledge, which forms a natural edge for the lower portion of the trail. The trail surface is paved with angular pahoehoe pebbles and small cobbles.

SITE NO.: State: 13453 PHRI: T-236
SITE TYPE: Pavement
TOPOGRAPHY: Smooth and ropy pahoehoe flow.
VEGETATION: Christmas-berry, lantana, koa-haole, and fountain grass.
ELEVATION: c. 466 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 4.80 m by 3.67 m by 0.00 m
DESCRIPTION: Rectangular shape in plan, the pavement has a distinct perimeter alignment of small angular pebbles. There are a few cobbles in the middle of the paved area. At the southern corner, there is an alignment of cobbles oriented northwest.

SITE NO.: State: 13454 PHRI: T-237
SITE TYPE: Complex (14 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe flows.
VEGETATION: Christmas-berry and air plants.
ELEVATION: c. 460 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 5.98 m at 260 degrees Az. by 2.47 m. The complex consists of 11 pahoehoe excavations and three rock mounds. No cultural deposits or portable remains were observed. Five of the eleven pahoehoe excavations are into blisters, one is along a crevice and five are surface excavations.

FEATURE - : Mound
FUNCTION: Agriculture
DIMENSIONS: 1.76 m by 2.10 m by 1.40 m
DESCRIPTION: A boulder and cobble mound is stacked six courses high on a smooth pahoehoe flow on the eastern corner of the site. There are many scattered excavated blocks and cobbles in the immediate surrounding area.

FEATURE - : Mound
FUNCTION: Agriculture
DIMENSIONS: 0.95 m by 0.85 m by 1.20 m
DESCRIPTION: This mound is 2.00 m west of the above feature. It is constructed with stacked boulders, three courses high, with a pahoehoe slab on top. At present, it is collapsed. There are scattered excavated blocks and cobbles within the immediate area.

SITE NO.: State: 13455 PHRI: T-238
SITE TYPE: Complex (13+ Features)
TOPOGRAPHY: Gently sloping pahoehoe.
VEGETATION: Thick Christmas-berry, lantana, koa-haole, and grasses.
ELEVATION: c. 440 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: A modified outcrop, cairn, a minimum of six rock mounds and five pahoehoe excavations were identified within an area of 30.00 m at 110 degrees Az. by 25.00 m. None of the features show formal construction and all have been previously represented. This site appears to be the continuation of a large agricultural complex that covers much of the ahupua'a at this elevation.

SITE NO.: State: 13456 PHRI: T-239
SITE TYPE: Terrace
ELEVATION: c. 452 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13457 PHRI: T-240
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: A gentle westward slope of disturbed pahoehoe.
VEGETATION: Koa-haole, Christmas-berry, lantana, and tall grasses.
ELEVATION: c. 445 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-possible habitation
DESCRIPTION: The overall complex area measures 8.6 m at 50 degrees Az. by 7.3 m. The site consists of a cairn (Feature A), an enclosure (Feature B), a terrace (Feature C) and a cupboard (Feature D). No portable remains or cultural deposits were observed; however, soil deposits were present in Feature D, a cupboard.

FEATURE A: Cairn
FUNCTION: Agriculture
DIMENSIONS: 1.12 m by 1.12 m by 0.71 m
DESCRIPTION: Boulders and large cobbles are loosely stacked on pahoehoe bedrock, four courses high. There is no evidence of core filling. The cairn is located at the northern corner of the enclosure, just outside the wall.

FEATURE B: Enclosure
FUNCTION: Possible habitation
DIMENSIONS: 8.60 m by 7.30 m by 0.50 m
DESCRIPTION: The enclosure is made of stacked pahoehoe boulders, 2-4 courses high. The walls are 0.70 m wide. The interior consists of a pahoehoe flow with an excavated ledge, a terrace (Feature C), and a cupboard (Feature D).

FEATURE C: Terrace
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 4.50 m by 2.90 m by 0.00 m
DESCRIPTION: It is constructed with large pahoehoe boulders, one to two courses high along the south and west walls, and filled with cobbles and gravels. The terrace abuts the E-W wall (interior side) of the enclosure.

FEATURE D: Pahoehoe excavation and cupboard
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 0.90 m by 0.55 m by 1.00 m
DESCRIPTION: The cupboard is built into the SW wall of Feature B, Enclosure. It is c. 3.8 m from the southern corner of the enclosure. An excavated ledge is situated north of the cupboard.

SITE NO.: State: 13458 PHRI: T-241
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Pahoehoe and aa flows.
VEGETATION: Christmas-berry, koa-haole, noni, air plant, lantana, low ferns, and moss.
ELEVATION: c. 445 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-recreation
DESCRIPTION: The overall complex area measures 50.0 m at 200 degrees Az. by 5.00 m. Features present include a large lava tube divided into four cave area by natural collapse, and two papamu stones. The cave ceiling heights range from 0.75 m to 1.5 m. The first cave contains an area of stacked pahoehoe slabs measuring 1.90 m by 0.80 m and 0.94 m high. The second cave has a terrace area along the north wall. The terrace measures 5.10 m by 1.50-4.20 m and 0.10-0.39 m in height. One of the papamu is located in this tube; the other is one the surface, near the opening.

Several hearths, marine shell midden, ground stone tools, worked bone, echinoid abraders, kukui nut shell, charcoal, bamboo and coconut shell were observed in the caves.

SITE NO.: State: 13459 PHRI: T-242
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe finger and surface flows.
VEGETATION: Christmas-berry, kiawe, low ferns and lantana.
ELEVATION: c. 455 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DESCRIPTION: The site complex consists of a cave (Feature A) and a modified outcrop (Feature B). The cave is a blister type that is situated in a depression with excavated blocks scattered throughout the area. The depression area measures 13.00 m at 335 degrees Az. by 10.90 m.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 6.80 m by 1.60 m by 0.72 m
DESCRIPTION: The interior of the cave has little

modifications. A possible distal end of a femur and a rib from an unidentified mammal was observed. A soil deposit of 0.02 m is present on the floor interior. At the eastern exterior corner of the cave is a faced wall. It is stacked six courses high at 0.97 m in height.

FEATURE B: Modified outcrop
FUNCTION: Habitation
DIMENSIONS: 5.40 m by 3.20 m
DESCRIPTION: Exterior of Feature A is a modified outcrop. It contains a filled and slightly paved area with pahoehoe slabs and cobbles.

SITE NO.: State: 13460 PHRI: T-243
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Along a raised pahoehoe tube formation.
VEGETATION: Thick Chrismas-berry, lantana.
ELEVATION: c. 435 feet
CONDITION: Good to fair
INTEGRITY: Feature A partially collapsed
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Three faced mounds, in varied stages of construction, and a cave shelter were identified at this site. There are probably additional features.

FEATURE A: Faced Mound
FUNCTION: Agriculture
DIMENSIONS: 1.55 m by 1.75 m by 1.10 m
DESCRIPTION: Feature A is a squarish faced mound, constructed on the crest of a pahoehoe tube ridge. The perimeter of the mound is formed from large pahoehoe blocks and slabs, stacked and faced up to five courses high. The interior is filled with smaller cobbles and pieces of pahoehoe. The sides of the mound slope inward toward the top. The southeastern third of the mound has collapsed, and is currently 0.30 m high.

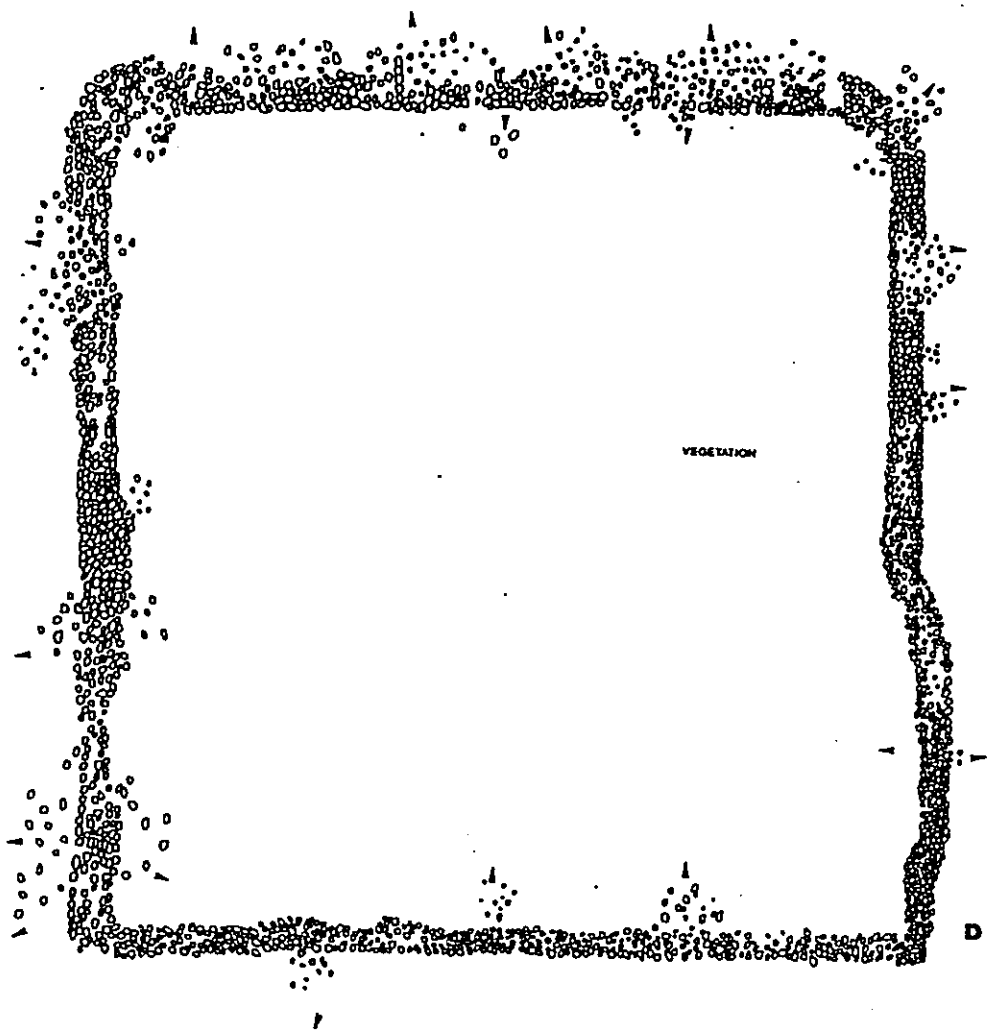
A 1.0 by 1.0 m test unit was excavated into the collapsed section of the mound, in order to insure that it contained no internal features. In this lower section of the mound, fill was not differentiated by size, as indicated in the intact upper portion. There were relatively few small rocks at the base of the fill, and very little soil. The soil deposit consisted of duff, that appeared to have blown in, under the rocks. It was less than 0.01 m thick and was in quantities too small too collect. No portable remains were located.

Two additional faced mounds are located c. 10.0 m to the south of Feature A. To the east of these is cave shelter which opens to the east. The cave has not been recorded to date.

SITE NO.: State: 13461 PHRI: T-244
SITE TYPE: Stepped terrace
TOPOGRAPHY: Pahoehoe and aa flows.
VEGETATION: Koa-haole, kiawe, air plant, lantana, and Christmas-berry.
ELEVATION: c. 420 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 9.00 m by 6.20 m by 0.90 m
DESCRIPTION: The terrace consists of two levels, both of which are raised along the north side. The lower level terrace has a surface area of 3.10 (E-W) by 3.10. The riser consists of pahoehoe boulders and cobbles, stacked three courses high (0.40-0.60 m) high. The wall is 9.0 m long and extends beyond the terrace surface, where it is 0.70 m wide. The upper level rises 0.40 m above the lower level and is retained by a wall stacked one to two courses high. A deposit of loam, 0.02 to 0.05 m thick is present on the terrace surface.

SITE NO.: State: 13462 PHRI: T-245 *(Figure A-48)*
SITE TYPE: Complex(4 Features)
TOPOGRAPHY: The terrain consists of a gentle slope of pahoehoe and aa flows.
VEGETATION: Kukui, Chrismas-berry, lantana, koa-haole, kiawe, fountain grass, and elephant grass.
ELEVATION: c. 425 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible habitation
DESCRIPTION: The overall complex area measures 62.00 m (N-S) by 40.00 m (E-W). The site consists of a modified outcrop (Feature A), a rock alignment (Feature B), a C-shaped wall (Feature C), and an enclosure (Feature D). It is situated 35.00 m at 225 degrees Az. from Site 13468. Recent historic trash was noted on top of Feature A.

FEATURE A: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 11.10 m by 11.00 m by 4.00 m
DESCRIPTION: The feature is on a large bedrock outcrop that is elevated 4.00 m above the other features in the site complex. A cobble filled pahoehoe boulder wall, three to five courses high, is situated on the southwest side of the modified outcrop. It measures 10.40 m by 0.90 m by 0.60 m high. On the north side of the feature is a rubble wall. It measures 7.20 m by 1.20 m and 0.40 m high. The interior of Feature A appears to be cleared of rubble.



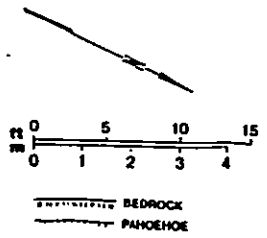
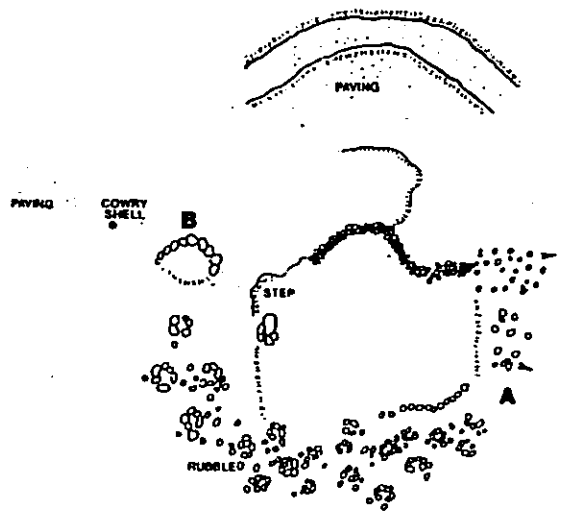


Figure A-48. SITE 13462, FEATURES A-D



FEATURE B: Alignment
FUNCTION: Agriculture
DIMENSIONS: 2.00 m by 2.00 m by 0.50 m
DESCRIPTION: Circular in plan view, Feature B is a rock ring surrounding a kukui nut tree. It is constructed with pahoehoe boulders and cobbles and is 4.80 m south of Feature A. A weathered cowrie shell was found 2.00 m to the southeast.

FEATURE C: C-shape wall
FUNCTION: Agriculture
DIMENSIONS: 15.60 m by 6.00 m by 1.30 m
DESCRIPTION: The C-shape consists of stacked pahoehoe boulders, slabs and cobbles, two courses high. The northwest area of the wall extends into a natural pahoehoe and aa flow. The wall is 1.00 m wide and the heights range from 0.52-1.30 m. The open area between the two ends of the wall measures 9.80 m. Northeast of Feature C at 1.00 m are two small terraces that rise up towards Feature A.

FEATURE D: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 32.00 m by 32.00 m by 1.50 m
DESCRIPTION: Rectangular in plan view, it consists of stacked pahoehoe boulders, slabs and cobbles, stacked four to six courses high, and with cobble fill. The wall is 1.00 m wide and faced along the interior and exterior sides. No cultural deposits or portable remains were visible, however, scattered loam deposits 0.02-0.05 m thick were present. There are at least seven pahoehoe excavations located within the enclosure.

SITE NO.: State: 13463 PHRI: T-246
SITE TYPE: Complex(5 Features)
TOPOGRAPHY: Aa flow within the immediate area; pahoehoe surface and finger flows adjacent.
VEGETATION: Christmas-berry, koa-haole, and fountain grass.
ELEVATION: c. 450 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Burial-habitation/ possible ceremonial
DESCRIPTION: Overall complex area measures 22.0 m at 65 degrees Az. by 17.5 m. The site consists of an enclosed platform (Feature A), a modified cave (Feature B), a cave with human remains (Feature C), a footpath (Feature D), and a pavement (Feature E).

FEATURE A: Enclosed platform
FUNCTION: Habitation/possible ceremonial
DIMENSIONS: 13.70 m by 4.30 m by 1.80 m
DESCRIPTION: Rectangular in plan view, the platform is paved with pahoehoe slabs, aa pebbles and cobbles. The western corners have collapsed slightly but appear to have been stacked with aa cobbles and boulders, four to eight courses high. The platform is enclosed except for an apparent entrance at the southeast side. The entrance opening measures 0.59 m by 0.43 m and is 0.34 m high.

Abutting the platform entrance to the southeast is a paved surface area that measures 4.75 m by 3.30 m and is 0.60 m above the surrounding aa floor. This paved area fronts the platform and is built with aa pebbles and steppingstones consisting of various sizes of pahoehoe slabs. The steppingstones lead from the east corner of the paving to the platform entrance. Directly below and adjacent to the paving is another pavement / modified area (Feature E).

FEATURE B: Cave
FUNCTION: Habitation
DIMENSIONS: 4.00 m by 3.65 m by 1.90 m
DESCRIPTION: A modified blister cave with a paved surface, modified entry and a tube on the SW side of the chamber. The blister entrance measures c. 1.82 m wide and 1.53 m high. The paved area is semicircular shape in plan and is located in the northwest area of the chamber. It measures 2.91 m by 1.76 m and is cobble lined with aa gravel paving.

The NE side of the chamber floor has been paved with pahoehoe slabs, however, collapse has interfered with the arranged pattern at the NE corner. In the middle of the chamber is an alignment oriented NW-SE. It measures 1.65 m by 0.40 m and is 0.50 m in height. It is built with cobbles and a pahoehoe boulder and appears to be a division between the paved areas. Cobbles and pahoehoe slabs make up the southwest side of the paved area with slight collapse at the southwest corner. A very small blister opening is at the southwest corner of the cave, above the natural bedrock shelf, and a small tube opening is directly below.

FEATURE C: Cave
FUNCTION: Burial
DESCRIPTION: The cave entrance measures 1.84 m by 1.56 m and 1.3 m in height. The skeletal remains of a child, consisting of a mandible fragment showing 1st and 2nd molar and a bud of 3rd, skull fragments and a pelvis

fragment were observed in an area 3.00 m from the entrance. The remains are disturbed and in very poor preservation.

FEATURE D: Trail
FUNCTION: Transportation
DIMENSIONS: 13.00 m by 0.50 m by 0.00 m
DESCRIPTION: Feature D is a footpath that appears to be cleared of large aa cobbles and consists of crushed aa gravel. It extends south through the aa flow, splits and leads to the northern and eastern corners of Feature A.

FEATURE E: Pavement
FUNCTION: Indeterminate
DIMENSIONS: 10.00 m by 9.00 m by 0.75 m
DESCRIPTION: It is directly below and adjacent to Feature A. Feature E is raised 0.60-0.75 m above the surrounding aa flow. Southeast is another paved area. It measures 2.30 m by 1.00 m with an opening at the southeast end 0.43 m wide and 0.41 m high. The paved area is outlined with aa cobbles and boulders and is filled with aa pebbles.

SITE NO.: State: 13464 PHRI: T-247
SITE TYPE: Complex(8 Features)
TOPOGRAPHY: Pahoehoe flows
VEGETATION: Christmas-berry, kiawe, lantana, fountain grass, and morning glory.
ELEVATION: c. 446 feet
CONDITION: Fair
INTEGRITY: Unaltered to partially altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 65.00 m NW-SE by 30.0 m NE-SW. The site consists of a rock alignment (Feature A), two enclosures (Feature B), a cairn (Feature C), three pahoehoe excavations (Feature D) and a rock mound (Feature E).

FEATURE A: Alignment/wall
FUNCTION: Agriculture
DIMENSIONS: 60.00 m by 0.90 m by 0.60 m
DESCRIPTION: Feature A is mostly an alignment of single boulders, but in five places it resembles a rubble wall of loosely stacked boulders and cobbles. The width is variable, with a maximum of 0.90 m. The Feature E mound is present 1.60 m from the northwest end of the alignment.

FEATURE B: Enclosure (2)
FUNCTION: Agriculture
DIMENSIONS: 8.30 m by 4.70 m by 0.80 m
DESCRIPTION: Feature B consists of two enclosures adjacent to each other. The northern enclosure is kidney shape in plan. It measures 6.40 m at 40 degrees Az. by 3.0 m. This enclosure is constructed with pahoehoe boulders, stacked 2-4 courses high. It appears to be filled with pahoehoe boulders from a surrounding wall. The southern enclosure is smaller and measures 2.0 by 1.7 m. It is constructed with pahoehoe boulders, two to three courses high with smaller cobbles and gravels as core fill.

FEATURE C: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 2.00 m by 0.60 m by 0.45 m
DESCRIPTION: The cairn is constructed with pahoehoe cobbles, two courses high. It is presently collapsed. It is in the immediate vicinity of the enclosures.

FEATURE D: Pahoehoe excavation (3)
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 1.20 m by 0.32 m
DESCRIPTION: A lava bubble with the top portion removed. There is 0.02-0.11 m of organic loam at the base of the excavations. The first pahoehoe excavation is 30.0 m at 10 degrees Az. from Feature A. It measures 1.20 m (E-W) by 0.70 m (N-S) and 0.28 m deep. Six small rocks are lining the west edge. The second pahoehoe excavation is 0.94 m east from the first excavation. It measures 0.75 m (N-S) by 0.64 m (E-W) and is 0.32 m deep. The third excavation is 4.07 m at 53 degrees Az. from the first excavation. It measures 1.11 m (E-W) by 0.87 m (N-S) and is 0.29 m deep.

FEATURE E: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.80 m by 1.50 m by 0.60 m
DESCRIPTION: It is situated 1.6 m from Feature A.

SITE NO.: State: 13465 PHRI: T-248 *(Figure A-49)*
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Smooth and ropy pahoehoe surface and finger flows. Excavated blocks are scattered throughout the entire area.
VEGETATION: Christmas-berry, lantana, koa-haole, and kiawe.
ELEVATION: c. 401 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ habitation/possible ceremonial
DESCRIPTION: The overall complex area measures 25.25 m at 230 degrees Az. by 16.4 m. The site consists of a platform (Feature A), a terrace with an upright (Feature B), two wall remnants (Features C and D), a pavement with an

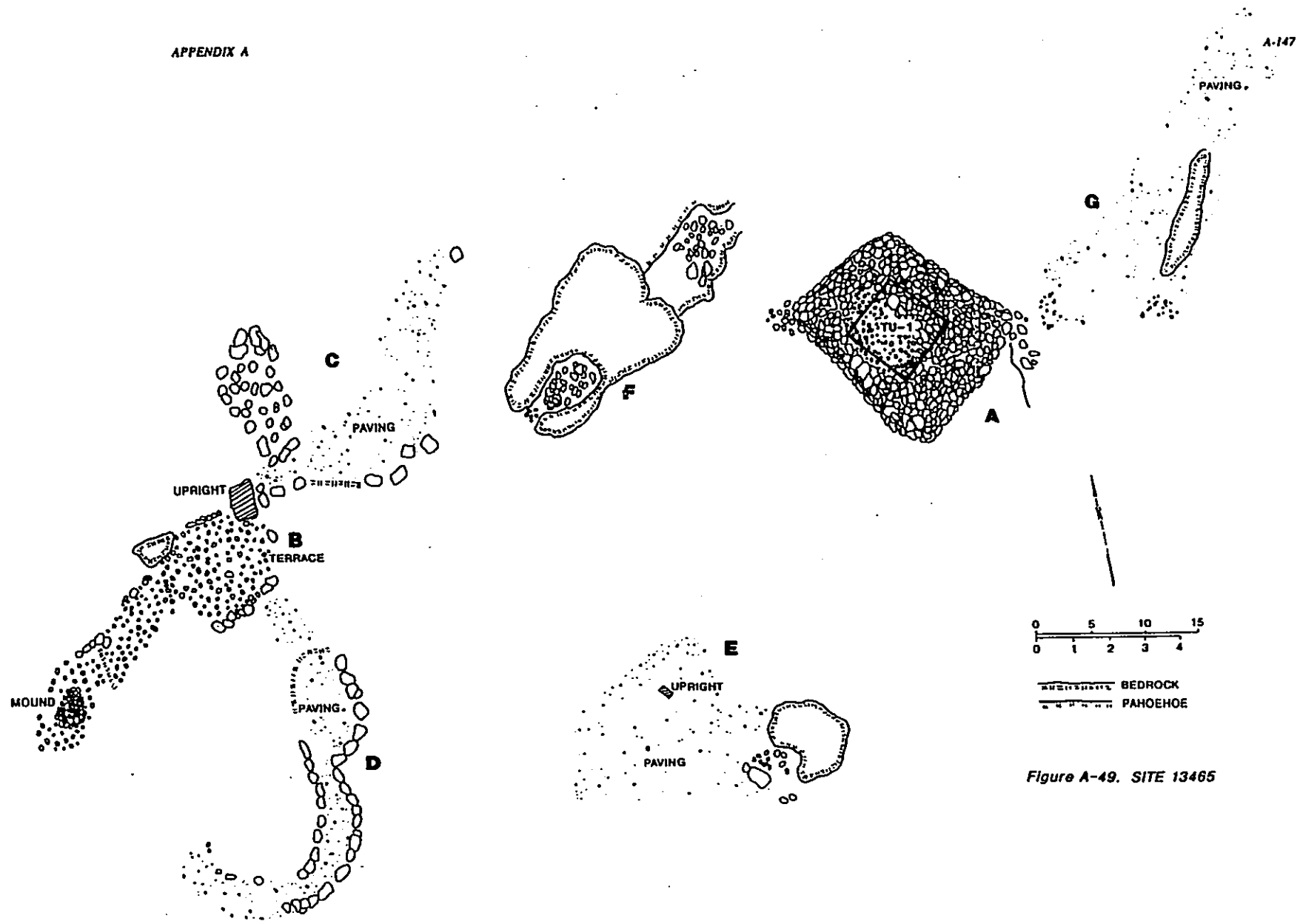


Figure A-49. SITE 13465

upright (Feature E), a pahoehoe excavation and lava tube (Feature F) and a pavement (Feature G). A minimum of four pahoehoe excavations, four excavated pebble aggregates (core filled), and one rock mound were identified within a 10.0 m range around the site complex.

FEATURE A: Platform
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 5.50 m by 3.85 m by 1.22 m
DESCRIPTION: Rectangular shape in plan, it is raised on all four sides and faced, up to six courses high. Pahoehoe boulders are used for the perimeters, and small boulders and cobbles used as fill. The surface is fulled up to the top of the perimeter stones. The east and west corners have collapsed. A portion of the surface near the center (3.10 by 1.28 m area) is paved with small cobbles and pebbles. The remainder of the surface exhibits the cobble and boulder fill, and is scattered with loose cobbles and boulders that appear to have been thrown onto the original surface. The area of smaller pavement appeared to represent a possible excavation into the platform.

A test unit was excavated into the center of the platform, in order to determine if it contained an internal feature, such as a human interment. The unit was begun at the surface as a 2.00 by 2.00 m unit and decreased in size with depth, in order to minimize disturbance to the feature. At ending depth, the test unit measured 0.75 by 0.50 m. The surface pavement of small cobbles and pebbles was found to be only a single layer thick (0.02 m), over undifferentiated cobble and boulder fill. This fill was 0.35 to 0.64 m thick overlying a sloping pahoehoe blister surface. Deposits of soil occurred in crevices in the bedrock, to a maximum depth of 1.16 m below the top of the platform (beginning at 1.10 m below surface). No portable remains or cultural deposits were located. A soil sample was collected for further analysis (see subsurface findings).

FEATURE B: Terrace with upright
FUNCTION: Habitation/ceremonial
DIMENSIONS: 5.40 m by 3.60 m by 0.52 m
DESCRIPTION: Medium sized boulders are used at intervals along the perimeter of the terrace. The center area is paved with pebbles. At the northwest corner is a large upright slab measuring 0.60 m high by 0.27 m deep and 0.64 m wide. A paved area is situated along the southeast side of the terrace. This paving connects Feature B with Feature D, a crescent shaped wall remnant. The south side of Feature B terrace is another paved area that leads to a rock mound that is 0.43 m high.

FEATURE C: Wall remnant
FUNCTION: Habitation/agriculture
DIMENSIONS: 8.00 m by 6.40 m by 0.40 m

FEATURE D: Wall remnant
FUNCTION: Habitation/agriculture
DIMENSIONS: 7.40 m by 4.00 m by 0.45 m

FEATURE E: Pavement with upright
FUNCTION: Habitation/ceremonial
DIMENSIONS: 5.50 m by 4.00 m by 0.35 m

FEATURE F: Pahoehoe excavation and lava tube
FUNCTION: Habitation/agriculture
DIMENSIONS: 8.40 m by 3.70 m by 0.00 m

FEATURE G: Pavement
FUNCTION: Indeterminate
DIMENSIONS: 11.00 m by 3.70 m by 0.10 m

SITE NO.: State: 13466 **PHRI:** T-249
SITE TYPE: Terrace
ELEVATION: c. 416 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13467 **PHRI:** T-250
SITE TYPE: Complex (9+ Features)
TOPOGRAPHY: Gently sloping pahoehoe flows.
VEGETATION: Kiawe, koa-haole, Christmas-berry, air plants, and lantana.
ELEVATION: c. 407 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 30.0 m at 240 degrees Az. by 20.0 m. The site complex consists of at least six pahoehoe excavations (Feature A), two terraces (Features B and C), and four rock mounds (Feature D).

FEATURE A: Pahoehoe excavation (6+)
FUNCTION: Agriculture
DIMENSIONS: 20.00 m by 5.00 m by 1.30 m
DESCRIPTION: The excavations consists of excavated pahoehoe ledges with the quarried material piled or scattered in the nearby area. Three of the excavations have small deposits of loam, c. 0.02-0.03 m thick, within the interiors. The depths of the excavations vary between 0.30 m to 1.3 m.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.00 m by 4.20 m by 0.25 m
DESCRIPTION: The terrace utilizes the pahoehoe flow with rocks stacked one to two courses around the exterior and filled with cobbles and gravels. A cleared area is adjacent to the southwest and below the terrace. The cleared area has a stacked pahoehoe boulder wall on the northwest side extending the length of the feature. The southeast side of the feature has what looks like the remains of a pahoehoe cobble/boulder barrier or wall. Between these two walls lies cobbles and clinkers strewn throughout the interior.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.10 m by 0.65 m by 0.81 m
DESCRIPTION: Feature C is located 1.0 m north of Feature D. The terrace retaining wall is oriented at 250 degrees Az. It is constructed with stacked pahoehoe boulders, slabs and cobbles.

FEATURE D: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.40 m by 1.44 m by 0.73 m
DESCRIPTION: Roughly circular shape in plan, the central portion is presently stacked. It is collapsed along the southeast and southwest sides.

SITE NO.: State: 13468 **PHRI:** T-251
SITE TYPE: Enclosure
TOPOGRAPHY: The terrain consists of pahoehoe surface and finger flows.
VEGETATION: Koa-haole, kiawe, lantana, and Christmas-berry.
ELEVATION: c. 409 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 12.35 m by 5.40 m
DESCRIPTION: The site consists of a rectangular shaped enclosure with a paved area at the southern corner extending into two rock mounds, and a filled pahoehoe blister excavation on the southeast side of the enclosure. In addition, a minimum of 22 rock piles and three modified outcrops were identified within a 10.0 m range surrounding the area.

The enclosure is oriented NE-SE. It is constructed with three courses of pahoehoe, roughly faced, but it is presently collapsing along the perimeter. An upright is placed in the middle of the enclosure wall and measures 0.69 m by 0.20 m and 0.6 m in height.

In the central area of the enclosure there is a NW-SE oriented alignment of pahoehoe cobbles and core filled with pebbles. It extends 3/4 of the way and measures 2.7 m at 325 degrees Az. by 0.72 m and 0.38 m in height.

Another alignment is present at the SW area of the enclosure, oval shape in plan and adjoining the enclosure walls. It is constructed with pahoehoe cobbles, stacked one course high, and measures 3.74 m by 1.06 m and 0.4 m in height.

At the southern corner of the enclosure is a core filled area of cobbles and pebbles measuring 1.50 m by 1.28 m. It leads to a rock mound of pahoehoe cobbles measuring 3.20 m by 3.30 m. To the west at 275 degrees and 0.66 m is another rock pile measuring 2.60 m by 1.50 m. The pahoehoe excavation located on the southeast side of the enclosure measures 1.52 m by 1.24 m.

SITE NO.: State: 13469 **PHRI:** T-252
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Pahoehoe finger and surface flows. Scattered boulders and cobbles are in the area.
VEGETATION: Dense vegetation consisting of air plants.
ELEVATION: c. 390 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate marker
DESCRIPTION: The site complex consists of six aligned cairns (Features A-F) that are oriented 130 degrees Az. (NW-SE). The overall area measures 14.4 m by 2.12 m.

FEATURE A: Cairn
FUNCTION: Marker
DIMENSIONS: 1.10 m by 0.94 m by 0.91 m
DESCRIPTION: Feature A is situated at the northwest corner of the complex. It is constructed with pahoehoe cobbles at the base, forming a wide circular structure. Stacked eight courses high, it is centrally raised.

FEATURE B: Cairn
FUNCTION: Marker
DIMENSIONS: 1.21 m by 1.20 m by 1.15 m
DESCRIPTION: Feature B is 1.53 m at 130 degrees Az. from Feature A. It is constructed with boulders at the base and narrowing at the top with cobbles. It is presently collapsing along the northeast corner.

FEATURE C: Cairn
FUNCTION: Marker

DIMENSIONS: 0.78 m by 0.66 m by 0.69 m
DESCRIPTION: Feature C is 2.50 m at 130 degrees Az. from Feature B. The cairn is constructed with pahoehoe cobbles at the base and a large pahoehoe boulder at the top.

FEATURE D: Cairn
FUNCTION: Marker
DIMENSIONS: 1.12 m by 0.89 m by 0.87 m
DESCRIPTION: Feature D is 1.34 m at 130 degrees Az. from Feature C. The cairn is constructed with pahoehoe cobbles. It is wide at the base and centrally raised.

FEATURE E: Cairn
FUNCTION: Marker
DIMENSIONS: 1.10 m by 0.60 m by 0.89 m
DESCRIPTION: Feature E is 1.21 m at 130 degrees Az. from Feature D. Feature E is constructed with boulders and cobbles. It is wide at the base and narrows at the top.

FEATURE F: Cairn
FUNCTION: Marker
DIMENSIONS: 0.70 m by 0.66 m by 0.52 m
DESCRIPTION: Feature F is 1.37 m at 130 degrees Az. from Feature E. Feature F is built with pahoehoe cobbles. The top area is collapsed.

SITE NO.: State: 13470 **PHRI:** T-253
SITE TYPE: Petroglyph
TOPOGRAPHY: Pahoehoe finger and surface flows.
VEGETATION: Christmas-berry, koa-haole, and lantana.
ELEVATION: c. 350 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Rock art
DIMENSIONS: 0.51 m by 0.17 m by 0.00 m
DESCRIPTION: The name HANA is pecked into a pahoehoe slab. The letters are formed by a series of closely spaced circular pecks, c. 0.05 m deep.

SITE NO.: State: 13471 **PHRI:** T-254
SITE TYPE: Complex(3 Features)
TOPOGRAPHY: Pahoehoe finger and surface flows.
VEGETATION: Christmas-berry, lantana, kiawe, koa-haole, and laua'e
ELEVATION: c. 346 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation/agriculture/ceremonial
DESCRIPTION: The complex consists of upright (Feature A), a platform (Feature B) and a modified blister cave (Feature C). The overall site area measures 26.75 m at 253 degrees Az. by 16.15.

FEATURE A: Upright (+)
FUNCTION: Possible ceremonial
DIMENSIONS: 0.96 m by 0.45 m by 1.40 m
DESCRIPTION: A large, upright, an slab with excavated cobbles piled at the front of and to each side of the upright. Southwest at 0.40 m is another upright. This upright measures 0.50 m by 0.20 m and 0.47 m in height. Within the immediate area but away from the upright is an area measuring 2.35 m by 1.50 m of scattered cobbles. In addition, south and southwest of the area are scattered excavated boulders and cobbles and an excavated blister.

FEATURE B: Platform *(Figure A-50)*
FUNCTION: Agriculture
DIMENSIONS: 4.65 m by 3.75 m by 0.80 m
DESCRIPTION: The platform is roughly rectangular shape in plan and is built on top of smooth to ropy pahoehoe. It is raised on all four sides with the western and eastern corners collapsing at present. It is constructed with boulders and cobbles at the base and stacked four courses high on the western corner. The surface interior of the platform has been filled with angular pahoehoe pebbles, and slabs of pahoehoe surround this paved interior area. The area of the paved surface is 2.20 m by 1.70 m.

A 1.00 by 1.00 m square test unit was excavated into the center of the platform, in order to determine if it contained internal features, such as a human interment. The fill in the test unit was found to be undifferentiated cobbles and some pebbles, which ranged in thickness from 0.35 to 0.48 m. The fill was deposited directly on a sloping pahoehoe blister, the crest of which is at the center of the platform. Very thin soil deposits was located in crevices in the bedrock; the thickest of which was 0.04 m. A sample of the soil was collected for further analysis (see subsurface findings). No portable remains or cultural deposits were located in the test unit.

FEATURE C: Cave
FUNCTION: Habitation
DIMENSIONS: 6.20 m by 1.85 m by 1.50 m
DESCRIPTION: A collapsed blister type shelter cave oriented N-S. It is partially excavated on the west side with cobble rubble present on the floor and at the entrance. There is a possible hearth in the northern tube consisting of cobbles and pebbles surrounding the ash deposit area.

Portable remains observed consist of vegetal and kukui nut fragments. A 0.05 m thick deposit of gray ashy soil occurs in the southern tube and a 0.06 m deposit of ash occurs in the northern tube.

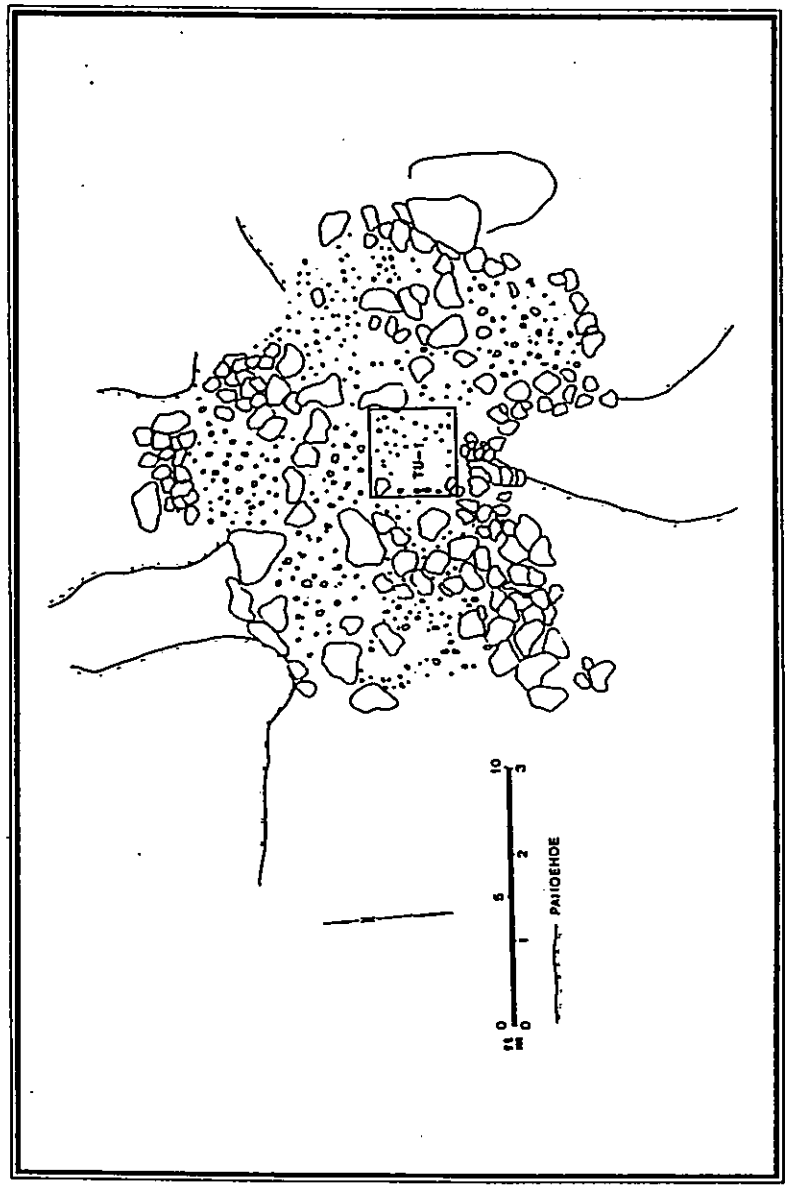


Figure A-50. SITE 13471, FEATURE B

SITE NO.: State: 13472 PHRI: T-255
SITE TYPE: Complex (164 Features)
TOPOGRAPHY: The site is situated along a prominent E-W pahoehoe ridge. Small aa pockets are present especially along the west facing lower slope of the ridge.
VEGETATION: Predominantly Christmas-berry with thick kiawe, 'akia; scattered grasses and 'ilima.
ELEVATION: c. 352 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall area that was inventoried measures 60.0 m (N-S) by 60.0 m (E-W). The area is a continuous carpet of agricultural features. It extends into Site 13473 to the east and Site 13471 to the west. All are part of an unbroken area of features. The site consists of at least 115 agricultural features along the south facing ridge slope in an area measuring c. 60.0 m by 30.0 m. These features are principally pahoehoe excavations, filled depressions, some terrace-like modified outcrops.

The pahoehoe blisters are excavated and cleared, or backfilled with pahoehoe cobbles. Natural depressions are filled with pebbles and cobbles over gravel-size basalt. There are some crude terraces with cobble perimeters around the outcrops.

Many features form a continuous line or cluster with scattered stones throughout area. No large mounds or linear mounds are present, rather, there are many small "plots" in close vicinity. No modifications were noted in three aa pocket areas.

Features along the north side of the baseline consist of 15 small excavations with large boulders, 17 small excavations with cobbles, five large excavations with boulders, seven large holes with cobbles, one area of two large uprights, one solitary block, a small rock mound with one modified upright (0.47 m high by 0.62 m wide); a C-shape alignment of five boulders, one arrangement of boulders, and one small mound. A total of 49 were enumerated in the north half of the site, and 115 features in the south half.

SITE NO.: State: 13473 PHRI: T-256
SITE TYPE: Complex (73 Features)
TOPOGRAPHY: Generally west facing to north facing slope with some micro-variation. The terrain is undulating and somewhat disturbed pahoehoe especially at the north half of the site; not a prominent ridge area compared with adjacent Site 13472.
VEGETATION: Very thick Christmas-berry, 'akia, kiawe, and lantana.
ELEVATION: c. 359 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site is basically a sampled portion of a large expanse of agricultural features. The boundaries were arbitrary for the purposes of determining feature density and types present. Sites 13471 and Site 13472 are parts of the same complex.

An E-W baseline was established, beginning at 60.00 m on the Site 13472 baseline. The area inventoried measures 60.00 m (E-W) by 60.00 m (N-S). Feature counts were taken on both sides of the line, 30.00 m to the north and 30.00 m to the south.

On the south side (60.00 m by 30.00 m), are 32 pahoehoe excavations with associated rock piles, two low amorphous mounds and one crude terrace. On the north side (60.0 m by 30.0 m) of the baseline, are seven small pahoehoe excavations with boulders, three large excavations with large boulders, six large excavations with cobble/pebble fill, plus an area of very large pahoehoe blocks (averaging 0.62 m x 0.60 m) along the base line. A large upright with small excavation also present in the area. There are natural variations in the pahoehoe along the north side.

The predominant bedrock modification technique represented is breakage of the pahoehoe blisters and outcrop edges. In addition, there is associated filling of clearings and depressions, and construction of low mounds and terrace-like formations of boulders and cobbles. No formalized construction or faced terraces were observed. Soil pockets occur in clearings, under the pebbles and cobbles, and in low areas. No modifications after abandonment are indicated.

SITE NO.: State: 13474 PHRI: T-257
SITE TYPE: Modified cave
ELEVATION: c. 365 feet
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 55.00 m by 3.20 m by 0.00 m

SITE NO.: State: 13475 PHRI: T-258
SITE TYPE: Cleared blister
TOPOGRAPHY: The terrain consists of pahoehoe flow.
VEGETATION: Koa-haole, Christmas-berry, and air plants.
ELEVATION: c. 424 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture

DIMENSIONS: 5.60 m by 5.10 m
DESCRIPTION: A collapsed blister that has been cleared with pahoehoe boulders loosely stacked around the northwest edge. Small cobbles are at the bottom of the blister.

SITE NO.: State: 13476 PHRI: T-259
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Pahoehoe finger flows.
VEGETATION: Christmas-berry, kiawe, lantana, grasses, and koa-haole.
ELEVATION: c. 411 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site complex consists of ten pahoehoe excavations within an area 40.00 by 8.50 m. All of the excavations have been cleared and lined with small pahoehoe cobbles. The excavation at the far eastern end of the site is a long excavated blister with pahoehoe boulders and cobbles mounded up at one end. The central excavation has boulders stacked along its northern edge. No portable remains or cultural deposits were observed, however brownish loam deposits were observed.

SITE NO.: State: 13477 PHRI: T-260
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: The terrain is generally flat pahoehoe flow with outcroppings.
VEGETATION: Christmas-berry, lantana, kiawe, and grasses.
ELEVATION: c. 421 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ possible habitation
DESCRIPTION: The site complex consists of two adjacent enclosures (Feature A), a C-shape wall (Feature B) and a rock mound (Feature C). The overall complex area measures 46.00 m (N-S) by 13.00 m (E-W). No cultural deposits or portable remains were observed.

FEATURE A: Enclosure (2)
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 11.30 m by 10.60 m by 0.97 m
DESCRIPTION: Feature A consists of two adjacent circular enclosures with one common wall. The northernmost enclosure is the largest. It measures 7.20 m (E-W) by 5.90 m (N-S) and is 0.97 m high. The northern enclosure is constructed with loosely piled pahoehoe boulders with a 1.17 m wide opening at the north end. The southern and smaller enclosure measures 4.70 m (N-S) by 4.10 m (E-W) and is 0.83 m high.

FEATURE B: C-shape wall
FUNCTION: Indeterminate
DIMENSIONS: 4.70 m by 2.80 m by 0.65 m
DESCRIPTION: Feature B is located 6.00 m southwest from Feature A. It is a C-shaped wall consisting of pahoehoe cobbles stacked two to three courses high, on and around a pahoehoe ledge.

FEATURE C: Mound
FUNCTION: Indeterminate
DIMENSIONS: 2.00 m by 1.20 m by 0.70 m
DESCRIPTION: Feature C is adjacent to and north of Feature A. It is constructed with loosely stacked pahoehoe boulders two to three courses high.

SITE NO.: State: 13478 PHRI: T-261
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: The terrain consists of pahoehoe flows.
VEGETATION: Christmas-berry, koa-haole, grass, and kiawe.
ELEVATION: c. 405 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 16.50 m at 220 degrees Az. by 14.50 m. The site complex consists of a platform (Feature A), a terrace (Feature B), an enclosure and a rock mound (Feature C), a filled pahoehoe excavation (Feature D) and a wall (Feature E).

FEATURE A: Platform
FUNCTION: Agriculture
DIMENSIONS: 4.90 m by 4.40 m by 0.55 m
DESCRIPTION: Generally circular shape in plan, it is raised on all edges. The platform is constructed of pahoehoe boulders and cobbles loosely stacked and crumbling at the edges. The interior surface is not smooth or level; the middle area is lower than the edges and may have been mined for material. A small stacked bench on the west side of the platform may have been some type of step. This bench measures 1.12 m (N-S) by 1.03 m (E-W).

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.80 m by 3.80 m by 0.60 m
DESCRIPTION: This rectangular terrace is 2.00 m south from Feature A. It is constructed with a perimeter of stacked

pahoehoe boulders and cobbles, raised on the east side. The terrace interior is paved with small pahoehoe cobbles. No cultural deposit present but a dark brown loam, 0.02-0.04 m thick, was visible under the pavement.

FEATURE C: Enclosure and mound
FUNCTION: Agriculture
DIMENSIONS: 4.30 m by 3.00 m by 0.30 m
DESCRIPTION: The enclosure is immediately west of Feature B. It is constructed with loosely stacked pahoehoe cobbles and boulders. The southwest wall of the enclosure has large pahoehoe boulders which could have been upright, suggesting a higher wall. The rock mound measures 3.7 m by 1.90 m and is 1.30 m high. It is built with large pahoehoe cobbles and boulders.

FEATURE D: Filled pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 1.30 m by 1.10 m by 0.60 m
DESCRIPTION: Feature D is located adjacent to the north side of Feature C. It consists mostly of excavated pahoehoe blocks that have been haphazardly scattered and filled with pahoehoe cobbles.

FEATURE E: Wall
FUNCTION: Boundary
DIMENSIONS: 6.70 m by 1.20 m by 0.70 m
DESCRIPTION: Feature E is immediately west of Feature C. It is oriented N-S and constructed with pahoehoe cobbles and boulders, stacked three to four courses high.

SITE NO.: State: 13479 **PHRI:** T-262
SITE TYPE: Wall
TOPOGRAPHY: Gently sloping pahoehoe
VEGETATION: Kiawe, lantana, and Christmas-berry
ELEVATION: c. 390 feet
CONDITION: Fair
INTEGRITY: Good
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Land division
DIMENSIONS: 50.00 m by 0.70 m
DESCRIPTION: This loosely stacked wall is oriented NW-SE.

SITE NO.: State: 13480 **PHRI:** T-35
SITE TYPE: C-shape
TOPOGRAPHY: Broken pahoehoe
VEGETATION: Sparse 'ilima and grasses.
ELEVATION: c. 15 feet
CONDITION: Poor
INTEGRITY: Collapsed and ill-defined
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation/ agriculture
DESCRIPTION: This C-shape is in very poor condition; measurements have not been obtained to date.

SITE NO.: State: 13481PHRI: T-65
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 67 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 3.00 m by 2.00 m by 0.00 m

SITE NO.: State: 13482PHRI: T-87
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 194 feet
FUNCTIONAL INTERPRETATION: Quarry

SITE NO.: State: 13483 PHRI: T-92
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 230 feet
FUNCTIONAL INTERPRETATION: Quarry

SITE NO.: State: 13484 **PHRI:** T-108
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Gentle north to south slope with bedrock outcropping.
VEGETATION: Thick elephant and another specie of grass.
ELEVATION: c. 125-130 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 28.40 m at 102 degrees Az. by 18.65 m. Features identified include a terrace (Feature A) and five modified outcrops. The modified outcrops have been excavated in many places around the edges. Angular cobbles and boulders have been stacked on the sides and top of the outcrops. Some of the areas appear to have been paved or with leveled tops.

Portable remains consists of a small waterworn basalt cobble.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.38 m by 4.42 m by 0.75 m
DESCRIPTION: The terrace is rectangular shape in plan. It is constructed on the west side and abutting a large outcrop. Utilizing the exposed bedrock, the east border of the feature is a high wall of bedrock, partially excavated to create a more vertical face. Portions of the north and south boundaries are small to large angular cobbles and boulders stacked on exposed bedrock. The west boundary consists of medium to large angular boulders aligned and stacked with small cobbles used as fill on top of and along the interior edge. The west wall is quite collapsed, but remnants of facing is still evident.

The terrace itself is raised above the natural ground surface 0.60-0.85 m and has a thick soil deposit (c. 0.20 m) with charcoal flecks. The terrace soil area measures 3.25 m (N-S) by 1.96 m (E-W).

SITE NO.: State: 13485 **PHRI:** T-110
SITE TYPE: Mound
ELEVATION: c. 163 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13486 **PHRI:** T-111
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 160 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13487 **PHRI:** T-125
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: The terrain consists of updrust of pahoehoe forming tube or ridgeline.
VEGETATION: Fountain grass, 'ilima, Christmas-berry, and sparse kiawe.
ELEVATION: c. 12 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area is estimated at 40.0 m (N-S) by 10.0 m (E-W). Five pahoehoe excavations were identified. The site in proximity to SIHP Site No. 13287, a cave site.

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 1.30 m by 0.51 m by 0.50 m
DESCRIPTION: A linear excavation along a crack at the base of pahoehoe tumulus. It is located at 3.00 m at 226 degrees Az. to Feature B and 40.00 m at 310 degrees Az. from SIHP Site No. 13287 (cave entrance). Feature A is a shallow excavation with the quarried material removed except for one block which may possibly be collapse from above.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.05 m by 0.70 m by 0.68 m
DESCRIPTION: Feature B is a linear excavated edge of a shallow lava blister. A small scattering of excavated cobbles and small boulders are present at the down slope edge of the excavation. A kukui nut shell and a waterworn basalt pebble were noted 3.5 m (inside of the blister) from the excavated edge.

The lava blister is at the base of the pahoehoe tumulus. It is very low, 0.26 to 0.50 m interior height, and extends for 8.00 m around the base of the tumulus. No structural modifications were noted within the blister.

FEATURE C: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 1.25 m by 0.60 m by 0.60 m
DESCRIPTION: A blister type of pahoehoe excavation situated at the base of pahoehoe tumulus in the center of a fairly flat lava slab. It is 40.0 m at 310 degrees Az. from SIHP Site No. 13287. Feature C is a shallow excavation with many small blocks and cobbles at the bottom of the excavation. Moist dark brown soil also present in the excavation.

FEATURE D: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.10 m by 1.25 m by 0.73 m
DESCRIPTION: An excavation quarried at the base of a pahoehoe tumulus into a smooth pahoehoe surface adjacent to a small patch of ropy pahoehoe. The excavated materials are scattered on the surface primarily to the south and east end of the excavation. The excavated thickness is 0.30-0.45 m.

FEATURE E: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.10 m by 1.30 m by 0.55 m
DESCRIPTION: A blister type pahoehoe excavation with the quarried boulders piled primarily on the southwest side. A 0.10 m thick deposit of small cobbles and pebbles mixed with a reddish organic silt is present on the downslope (northwest) side of the excavation. The depth at the northwest corner is 0.31 m; depth is 0.46 m at the southeast corner and 0.55 m at the southwest corner.

SITE NO.: State: 13488 PHRI: T-131
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Pahoehoe flow.
VEGETATION: Grass, kiawe, koa-haole, succulent, and lantana.
ELEVATION: c. 210 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Overall complex area measures 7.60 m at 228 degrees Az. by 3.60 m. A pahoehoe excavation (Feature A) and a paved area (Feature B) were identified.

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 5.60 m by 1.65 m by 0.28 m
DESCRIPTION: An excavated pahoehoe ledge filled with pahoehoe cobbles and pebbles. It is northeast and adjacent to Feature B.

FEATURE B: Paved area
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 3.60 m by 0.00 m
DESCRIPTION: Feature B is a pavement consisting of a single layer of pahoehoe cobbles and gravel. It has no perimeter definition.

SITE NO.: State: 13489 PHRI: T-145
SITE TYPE: Terrace
TOPOGRAPHY: Gently sloping pahoehoe
VEGETATION: Thick Christmas-berry, lantana, grasses
ELEVATION: c. 304 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 1.75 m by 1.00 m by 0.50 m
DESCRIPTION: The terrace is situated on the northwest side of an outcrop.

SITE NO.: State: 13490 PHRI: T-146
SITE TYPE: Pahoehoe excavation
ELEVATION: c. 315 feet
FUNCTIONAL INTERPRETATION: Agriculture

SITE NO.: State: 13491 PHRI: T-147
SITE TYPE: Complex (8 Features)
ELEVATION: c. 319 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: This site complex consists of eight pahoehoe excavations. The quarried material is piled into mounds nearby or adjacent to the excavations.

SITE NO.: State: 7276
SITE TYPE: The Great Wall of Kuakini
TOPOGRAPHY: Undulating terrain
VEGETATION: Koa-haole, kiawe, and grasses
CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Agriculture/land division
DIMENSIONS: 300.0 m by 200.0 m by 1.5-2.5 m height (approx.)
DESCRIPTION: This wall is a portion of the Great Wall of Kuakini. "The Great Wall (Hawaii State Register of Historic Places Site No. 50-10-xx-7276) is a historic period structure built at the direction of Kuakini, Governor of Hawaii Island, during the period A.D. 1830-1840...it extends c. 5.6 miles (9.0 KM.) from the nearby land of Keahuolu to the north, to the land of Kahaluu to the south" (Rosendahl 1979:2).

The Great Wall appears to originate along the SSE portion of the project area and is situated between 220-300 ft elevation. Beginning c. at the 220 ft elevation level, it extends east for c. 300.0 m. At the 290 ft elevation level, it turns south for c. 200.0 m and continues beyond the southern boundary of the project area.

The wall is consists of stacked large angular and sub-angular boulders. It is faced along the interior and exterior faces and is collapsed and broken along some sections.

APPENDIX B

HISTORICAL DOCUMENTARY RESEARCH

by Helen Wong Smith, B.A.

The project area is located in the ahupua'a of Keahuolu. Pukui et al. (1974:101) gives the literal translation of Ke-ahu-o-Lu as "the heap of Lu." Although there is no explanation, we can assume "Lu" is a person's name and that the heap may refer to an altar (another meaning of ahu). Emerson surveyed the area in the 1880s, and his map (Reg. Map 1280) denotes "rough pahoehoe, little vegetation" in Keahuolu ahupua'a. Probably the place name refers to one of the many rock piles scattered throughout the region.

The project area is owned by Liliuokalani Trust. The Trust was established on Dec. 2, 1909 by the last reigning Queen of Hawaii, Liliuokalani, to provide care for orphans and destitute children in Hawaii. The Deed of Trust was amended on Oct. 11, 1911, and again on Sept. 2, 1915. The purpose of the Trust, as amended, is as follows:

> ...All the property of the trust estate, both principal and income, which shall not be required for any of the special provisions or payments in this instrument before mentioned, shall be used by the Trustees for the benefit of orphan and other destitute children in the Hawaiian Islands, the preference to be given to Hawaiian children of pure or part aboriginal blood (Liliuokalani Children's Center 1981b).

The original Corpus of the Trust consisted principally of real estate in Hawaii with a market value at date-of-grant of $328,000.00. Income of the Trust is derived principally from rentals received from long-term leases and gain on condemnation or sale of such real estate. The Trust is exempt from Federal income tax under Section 501 (c) (3) of the IRS Code, but is subject to a 2% excise tax based on net investment income, which is imposed on private foundations by Section 4940 of the Code (Liliuokalani Children's Center 1981a).

Legendary references to Keahuolu are few. In his report on a reconnaissance survey of the Old Kona Airport area, which is now a state park in Keahuolu, Neller cites one:

> The area around the old Kona airport may also have some connection with the legendary Hawaiian chief Kuali'i. He was said to have been born at Kalapawai in Kailua, and defied the oppression of Lono-ikaika during the dedication of the heiau at Kawaluna. He is associated with Ku-kaili-moku, the god of victory in battle. Perhaps by coincidence, all of these place names are found in the beach park area (Neller 1980).

Handy writes of the Kona district:

> The most interesting mythological and legendary materials relating to Kona have to do directly or indirectly with Lono....The story of the origin of the Makahiki rain and harvest festival, bring Lono from Kahiki, whither he returns. From Kona we have the written record of a myth of Kumuhonua, [Earth Foundation, 36 generations before Wakea and Papa, who was the first man fashioned by the gods] whose writer says that Lono was a fisherman and yet ends his story by stating that the events related occurred before men peopled the earth. Lono is credited with introducing the main food plants, taro, breadfruit, yams, sugar cane and bananas to Hawaii and also 'awa. Hogs were likewise identified with Lono, but there is no mention of his having brought them to Hawaii (Handy and Handy 1972:522).

Two archaeological surveys conducted in the earlier part of the century describe several prehistoric sites in and around the project area. During a reconnaissance survey of Keahuolu, J.F.G. Stokes located the following religious structures:

> Ko'a of Kalepau, in Halepa'u Section, Land of Keahuolu, North Kona. A small fishing heiau on the pahoehoe, 100 feet north-west of Keahuola. Well preserved walls, 4 feet high. (Site #10-27-2139.)

> Heiau of Kawaluna, land of Keahuolu, North Kona, on the beach, a quarter mile from the boundary of Lanihau, in a section (iii) called Pawai. An enclosure, the walls of which have been carefully rebuilt, without opening. The interior was filled with loose stones piled up without arrangement. The local informant stated that an old fisherman was in the habit of offering fish in this heiau. Asked as to the resulting luck, the answer was that it was not as much as that of other fishermen, perhaps because the offering was made at a heiau instead of the ko'a (Halepa'u) nearby.

Heiau of Palihiolo, at Waikilohi, at or near the boundary of Keahuolu and Lanihau, North Kona; on the beach in an old coco-palm grove; this is an insignificant pen, 25 by 29 feet in size with small, thin walls built on the upper slopes of the beach. Coral has been spread over the floor as a paving. The only interest attaching to the place is the account given by a very old native living in the grove. He said that Palihiolo was formerly a heiau for human sacrifice, and that it was rebuilt by Kalakaua's orders before the latter left for the United States (about 1890). The old native also said that Kalakaua promised to have a sacrifice at Palihiolo on his return from America, but that he died in that country. The old native was very insistent on the truth of his statements. It might be mentioned that the surrounding grove of palms is where Kalakaua's grandfather was hanged for murder. Other information from the old native is given here for convenience, that this king ordered the rebuilding of the two heiaus of Kawaluna and Palihiolo where human sacrifices were formerly offered, and the ko'as of Halepa'u and Maka'eo....It might be remarked that these four structures have the appearance of having been rebuilt in recent times (Stokes 1919).

In reference to heiau committed to human sacrifice, Kamakau (1976) writes that these 'ohi'a ko "...would...cause holding the breath (in fear)."

An island-wide description of sites was published by Henry Kinney in the earlier part of this century. He writes of the shoreline of Keahuolu as follows:

> From the point where the Honokohau Trail leaves Kailua a poor trail leads makai over the lava to the lighthouse. Hence it continues along the beach for a couple of miles. After passing several old stone mausoleums, the trail passes an abandoned grass house where is a stone wall, the remnants of the heiau Keohuulu. Still further north is a cocoanut grove, where there were several heiau, notably that of Palihiole. There were several kuula here, one particularly powerful one, the idol of which is still remembered as having been in a fair state of preservation, only one arm missing, when a Christian priest took it from the cave where it was kept. Since then, say the inhabitants, the fishing has been comparatively poor. In the grove are two cocoanut stumps which served as gallows for the first execution conducted by hanging in Hawaii. A chief, Kekuakahaku, was the victim.
>
> Beyond the main [coconut] grove are a few isolated trees near the edge of the flow. Here was the heiau of Pauai, and here the trail ends (Kinney 1913).

The area in which the Pauai heiau is located is known as Pawai. John Clark (1985) believes that the original name for the bay was Papawai, but attempts to substantiate this name have been futile.

MAHELE LAND OWNERSHIP AND CULTIVATION

During the reign of Kamehameha III, the most important event in the reformation of the land system was incorporated. "The Great Mahele" separated and defined the undivided land interests of the King and the high-ranking chiefs and konohiki (originally konohiki referred to the person in charge of a tract of land on behalf of the king or a chief; in the later statutes, the chiefs or landlords were referred to as "konohikis") (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 Jan. 27, 1848 by Kamehameha III, and for Princess Victoria Kamamalu 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 any title to any land. The chiefs and konohiki were required to present their claims to The Land Commission and to receive awards for the lands quitclaimed to them by Kamehameha III. Until an award for these lands was issued, title remained with the government. Because there were few surveyors at the time of the Mahele, the lands were divided by name only, with the understanding that the ancient boundaries would remain in effect until a survey of such lands could be made in the future. This was done to expedite the work of the Land Commission in awarding lands to the chiefs and konohiki. However, these chiefs and konohiki were still required to pay commutations to the government for them to receive Royal Patents on their awards. These lands awarded to the chiefs and konohiki became known as Konohiki Lands (Chinen 1961:13).

Lands were identified and separated in 1848 as 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). These rights were brought into question when the King, the government, and konohiki began selling off parcels of land. To clarify the situation, the Privy Council, on December 21, 1849,

adopted four resolutions as a means of protecting the rights of native tenants (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. Except for the houselots located in the districts of Honolulu, Lahaina, and Hilo, these awards were to be free of commutation (ibid).

Before receiving awards for their lands from the Land Commission, the native tenants were required to prove that they actually cultivated those lands for a living. They were not permitted to acquire waste lands or lands which they cultivated "with the seeming intention of enlarging their lots." Once confirmed, the lands were required to be surveyed before the Land Commission was authorized to issue any award. These lands became known as "Kuleana Lands" (Chinen 1958:30). 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 ahupua'a of Keahuolu was awarded to Ane Keohokalole (d. 1857), who numbered among her offspring King David Kalakaua, Queen Lydia Liliuokalani, and William Pitt Leleiohoku (who was adopted by Ruth Keelikolani). Her youngest daughter, Miriam Likelike, was the mother of Kaiulani, who was proclaimed heir apparent in 1891 after her aunt, Liliuokalani, took the throne following the death of Kalakaua. Keohokalole was the great-granddaughter of Kameeiamoku, one of the most important of the chiefs supporting Kamehameha I. Approximately half of the lands that Keohokalole received in the Mahele were on the island of Hawaii, and two-thirds of those were lands in Kona District (Kelly 1983:31).

Part of the project area is a portion of LCA 8452, Apana 12 (Royal Patent 6851). This parcel had a total area of 4.071 acres. Keohokalole commuted some of her holdings in order to keep certain lands, including Keahuolu. Excerpts from her correspondence with the Minister of the Interior provide us with this information:

> To Highness, John Young
> Minister of Interior
>
> Greetings:
>
> This is to inform you and the Privy Council of my desire to convey some of my lands for the Governments one third in the land which remain as mine. Grant me this, of course, with the approval of the Privy council. Below is a list of the lands I wish to convey to the government (Native Test. 10:326).
>
> To Your Highness, John Young
> Minister of Interior
>
> Greetings:
>
> Here is a list of names of my lands which has been left for me pending for an approval of its distribution.
> ...Keahuolu ahupuaa, Kona, Hawaii...
>
> With appreciation,
> A. Keohokalole (Native Test. 10:327)

The following testimony was given by Awahua, to verify Keohokalole's holdings for this LCA in Kona:

> Awahua, sworn, says he knows the house lots claimed by Keohokalole at Kaawaloa, Hawaii. The first one is fenced all round with a stone wall. It is bounded makai by the sea shore, on Kailua side by the Government land, mauka by the land of Nahaku, and Awahua, and on the other side by the road. Claimant derived this lot from her ancestors, who held it from very ancient times. There is a stone house and several grass houses in it belonging to claimant, besides a tomb.
>
> The second lot is called "Awili," and is fenced all round. It is bounded makai by government road, on Kailua side by the same, mauka the same, on the side next the pali by the road.
>
> Claimant derived this lot from her ancestors, who held it from older times.
>
> Witness knows the three house lots in Kealakekua, claimed by Keohokalole. The first lot is called "Kuloa" and is fenced in. It is bounded makai by the sea beach, Kaawaloa side by government land, mauka by the road, south Kona side by a lot belonging to T. Cummings.
>
> The second lot is called "Kaahaloa" [and] it is enclosed all round, and bounded on Kona Hema by a lot belonging to T. Cummings, mauka by the lot of Nakoko, North Kona by an old heiau, makai by the road.

The third lot is called "Wailokoalii" and is bounded on the South Kona side by an old Heiau, mauka by a Government lot and the lot of Ialua, makai by the sea beach, on the other side by a pali.

Claimant inherited these lots from her ancestors by the mother's side, who possessed them from ancient times. Kekaalua, sworn, says he knows these lots perfectly and confirms in full the testimony by Awahua (Foreign Test. 3:573).

Whenever ali'i procured an entire ahupua'a, they were bound to respect the rights of the existing tenants. These tenants, if they filed a claim to The Board of Commissioners to Quiet Land Titles, could continue to cultivate and reside on their parcels. The following testimonies are for awards that were granted within Keahuolu (Board of Commissioners 1929):

LCA 11071, to Aki for .60 acres - Native Test. 4:527 - Kuia sworn, He has seen Aki's land that which he had cultivated himself, it is in the ili land of Pauaiki of Keohoeolu [sic] ahupua'a in Hawaii. Section 1, 5 cultivated kihapais. Section 2, 1 kihapai not cultivated. Section 6, 4 cultivated kihapai. Section 7, 1 cultivated kihapai. These interest have been made from Kaea, Nahaaluulu and Kalekahi at the time of Kamehameha I.

LCA 10303, to Maa for 2.25 acres - Native Test. 4:526 - Mahu sworn, He has seen a whole section of land, however, it is just as he has indicated in his claim in that there are 11 taro kihapais, and 10 potato kihapais in the ili land at Maili of Keahuolu ahupuaa. That land is not cultivated completely, but, Maa had planted 7 palm trees. The fruit is for Samuela, both Maa and Samuela have joint interest in the 7 fan palm trees. There is also a coconut grove which had been planted by Maa's grandparents for the Chings who owned the land, they were the caretakers. The same had applied to Maa's parents and to him at the present time. The coconuts went to Keohokalole upon the death of Keoua and it has been that way to the present time.

One whole section is salt land and it is still yielding salt...Land passed down to Maa's parents, these to him now. Maa's grandparents received the ili land Maili of Keahuolu during the time of Kamehameha I. Kamauoha had given to Maa the land section of Lanihau ahupuaa in 1848, no one had objected to him.

LCA 10345, to Nahaaluulu (Naahualu) for 2 acres - Native Test. 4:527 - Kuia sworn, He has seen (Naaluulu) place that he had cultivated himself in the ili land of Puuokaliu of Keahuolu ahupuaa in Hawaii. Section 1 (boundaries given) 1 section cultivated. Section 2, 4 cultivated kihapais, Section 3, 1 cultivated kihapai, Section 4, 4 cultivated kihapais....

LCA 10198, to Hailewalewa (Kailewalewa) for 1.30 ac - Native Test. 4:525 - Mahu sworn, He has seen the place on which Hailewalewa had cultivated with his own hands, it is in Ulelele ili of Keahuolu ahupuaa. Section 1 Taro. Section 2, Kaluulu. Land has been cultivated, 1 land section. On land from Hailewalewa's parents to him. Uncertainty for 1 section.

LCA 8812, to Apiki for 1.10 acre - Foreign Test. 8:676 - Mahu, sworn, says he knows the kuleana of Claimant in Kailua, Kona. It consists of 5 patches of Kalo and a lot of patches of potatoes. The kalo patches form 1 piece, bounded on Kau side by Lanihau, Makai by Papaula's land, Kohala side the same, mauka by Hai's land. The potato land is bounded mauka by Haino's land, Kau side by Lanihau, makai by Kahili's land, Kohala side the same. Claimant derived the land from the Konohiki, before the death of Kuakini, and has held it ever since without disputes.

LCA 7351, to Kahuanui for 2.90 acres - Foreign Test. 8:682 - Papaula, sworn says I know the claim of Kahuanui. It is in the ahupuaa of Keahuolu, Kona. It consists of one piece of kalo land, 5 patches—all lying together. One of these patches is planted with coffee. It is bounded mauka by the land of Kahookohukaneole, Kau by Lanihau, Makai by the land Nahaalualu, Kohala by the konohiki. Claimant received this land from his brother in 1846, and his title has never been disputed.

Correspondence to the Minister of the Interior often provides us with insights concerning land use and transactions. In a report by J.H. Kalaiheana, dated April 25, 1866, Keahuolu is said to belong to Keohokalole. In a letter dated July 8, 1869, from David K. Kalakaua to his sister, Liliuokalani, a detailed description of Keahuolu is provided. Kalakaua writes:

This land is situated in the District of North Kona, bounded by the ahupuaa of Lanihau (in Kailua) belonging to Prince Lunalilo on the Ka'u side, and on the Kohala side, by Kealakehe, a government land and Honokohaniki belonging to Keelikolani. Keahuolu runs clear up to the mountains and includes a portion of nearly one half of Hualalai mountains. On the mountains the koa, kukui and ohia abounds in vast quantities. The upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, bananas &c. Breadfruit trees grow wild as well as the Koli oil seed. The lower land is adopted for grazing cattle, sheep, goat, &c. The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grows on it and [it is] suitable for feed of sheep and goats. It is estimated at 15,000 to 20,000 acres or more.

A letter written by Liliuokalani to the Minister of the Interior, dated Oct. 6, 1894, gives permission for a road to run through Keahuolu, and includes orders for the Government to fence in both sides of this road.

On a map drafted by J.S. Emerson in the 1880s (Reg. Map 1280), a narrow band of shading that runs in a north-south direction crosses through Keahuolu. This band is at an approximate elevation of 6,250 to 7,250 ft. In Emerson's Field Notebook sketches, this line is identified as the "Commencement of the Forest." The notebook notes that mauka of the forest line, the land is "lava covered with scattering forest and dense masses of ki [ti] root" (Kelly 1983:58).

In his reconnaissance survey of Keahuolu, Rosendahl (1972) notes: "...the Great Wall of Kuakini...is a historic period structure built during the period A.D. 1830-1840 at the direction of Kuakini, Governor of the Island of Hawaii..." Kelly writes of this Kuakini Wall:

> It has long been presumed that this wall was built sometime during the governorship of John Adam Kuakini (1820-1844) to protect the cultivated uplands from the depredations of cattle. However, as the wall is at all points less than a mile from the seacoast, only the food plots in the coastal region would have been protected by it. It probably would have only kept cattle and horses grazing on the kula away from the houselots and small gardens along the shoreline (1983:75).

> ...the Kuakini wall may have been the Pa'aina named as the makai boundary in several claims to land along its course. At times, the wall reaches a height of 8 or 9 feet, which seems unnecessarily high as a barrier to roaming cattle or pigs...The fact that the term used in the register of claims in "papipi," which refers to a wall or enclosure for cattle, not pigs, should answer the question of what kind of animal the wall was meant to restrict in the 1840s. Perhaps in more recent years it served other purposes. Why it is located between the coast and the gardens, instead of between the grazing land and the gardens, or why it is so high in places, we can only surmise (1983:76).

In this century there existed a small village of 'opelu fishermen who resided at a coconut grove in Keahuolu. Behind this village, known as Makaeo, were several large brackish water ponds where 'opae 'ula thrived. These shrimps were used to mix in the palu or chum, used for catching 'opelu. Several springs and one well provided potable water. The village, coconut grove, and all the pools but one were destroyed during the construction of the Old Kona Airport (Clark 1985:110).

Cartographic material depicting Keahuolu was sought at the State Department of Accounting and General Services, Survey Division. Reg. Map 512 (c.1875) shows only a kukui tree and coconut grove at Pohakuloa. A 1929 U.S.G.S. topographic quadrangle, however, indicates a sisal mill located in Keahuolu (See Figure B-1). Kelly briefly discusses this crop in her history of the Gardens of Kona (1983:89). She places its cultivation in Kona with the following quote from Thrum (1905:185): "The McWayne sisal tract consisted of about 500 acres at or near Kailua." Kelly adds, "...how much of this acreage was actually planted in sisal is unclear." In an attempt to locate the cultivated area, various articles were consulted and informant interviews conducted.

Early periodical reports concentrate on sisal cultivating efforts on Oahu. The earliest mention of McWayne found is in "History from our Files," which reports for 1918 that "[t]en tons of baled sisal, first of an estimated crop of 200 tons from the McWayne Estate, Kailua, Kona, reached Honolulu for transshipment to San Francisco" (Advertiser July 31, 1948: editorial page). Herman D. Nichols, vice president of Tubbs Cordage Co., suggested in an editorial that utilization of sisal fiber of wild plants throughout the Territory be explored (Advertiser Sept. 20, 1949).

Mr. Minoru Inaba worked at the sisal mill after finishing the 8th grade, in 1920 and 1921. He said that the mill was

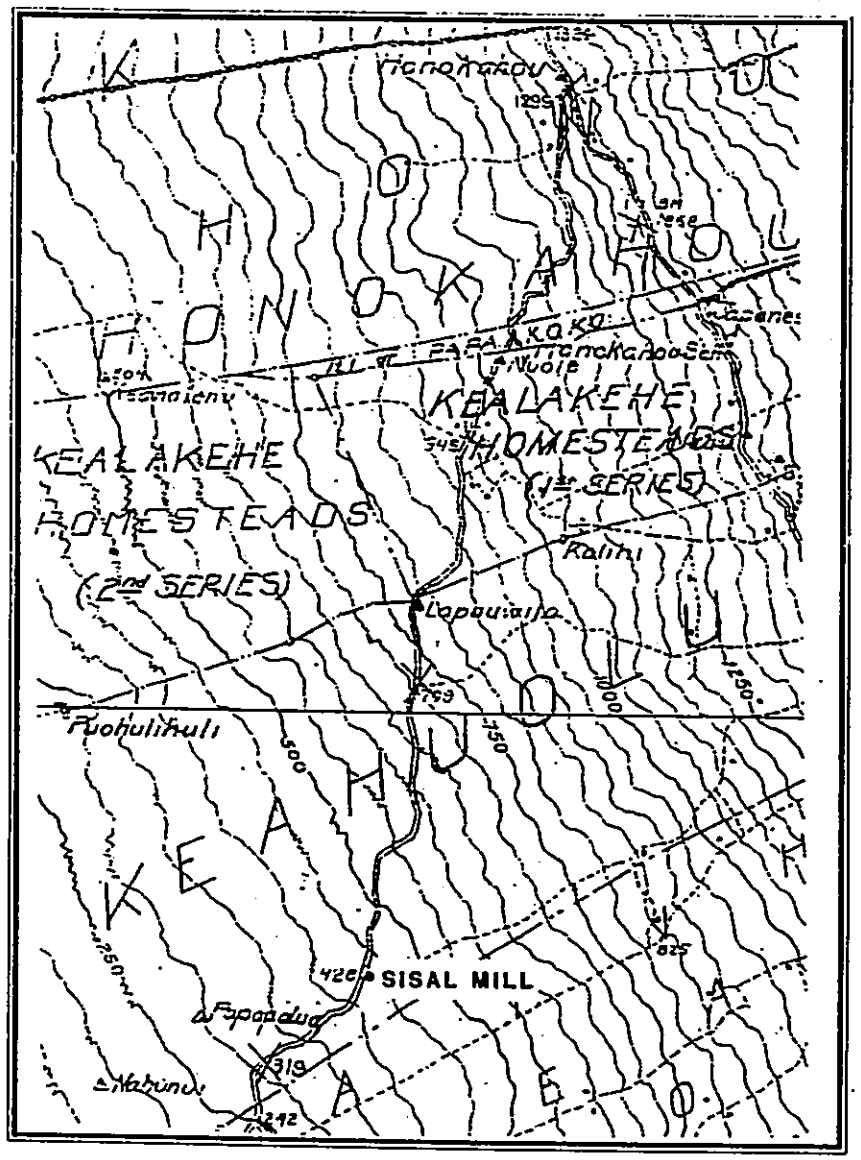


Figure B-1. U.S.G.S. TOPOGRAPHIC MAP SHOWING SISAL MILL

owned and operated by Luther S. Aungst from 1917 to its closing in 1924. He recollects that there were over 1,000 acres in cultivation in the ahupua'a of Kealakehe and Keahuolu. The mill, abutting Palani Road, was surrounded by the sisal fields. The main problem, Mr. Inaba said, was getting the sisal from the fields to the mill, as it was very bulky and sharp. Field workers would cut the sisal in the field, then bundle and transport it on donkeys to the mill. At the mill the sisal was thrashed, dried, and baled. From Kailua Bay, the bales of dried sisal would be sent to San Francisco on steamers.

Mr. Inaba's job was to throw away the by-products. Working with the sisal "made his skin itchy," and he had to wear protective clothing.

According to Inaba, Mr. Aungst played an important role in the development of the Kona district. He started the telephone company that connected Kona with Waimea, and later added Volcano to its line. This phone system was eventually sold to Mutual Telephone Co. Aungst was also the postmaster, and owned a garage in Kona (pers. comm. 2/1/90 and 2/8/90).

Bill Kawahara, a farmer in Waiaha, knows a Mr. Johnnie Long, who was involved in the cultivation of sisal; he hopes to interview Mr. Long for a forthcoming newspaper article. Kawahara noted that McWayne resided at Honokohau, and Aungst at Holualoa. Which of the two owned the mill, and for what years, he did not know (pers. comm. 2/1/90). It is possible that McWayne sold his interests in sisal and the mill to Aungst. A title search for the mill and the areas of cultivation would settle this question.

In a perusal of Tax Map Branch History Sheets dated 1950 to 1983, a navigation easement is noted for TMK 3-7-8:Por. 2 (1950). In 1953, an agreement was made by the trustees to enter the land for purposes of securing the needed engineering and surveying data. For TMK 3-7-8-:Por. 12, an access road to a proposed Kealakehe School Site is listed (1966). In 1969, a centerline for a 10-ft. sewer easement is noted. In 1972, a setup for a 325-ft elevation reservoir site is noted. The Kona Industrial Subdivision appears in 1973, for an area of 22.981 acres. In 1975, a lease to Pay 'N Save Corp., et.al., commences for a period of twenty years.

In the 1981 Status Report for the Trust, expansion of the industrial section is discussed:

> A two-year option agreement with Kuakini Corp., which was selected in May as having the most attractive proposal of the five submitted to develop 100 acre expansion of the industrial area, was executed Dec. 8, 1981. The Trust received $50,000 in payment for the option which allows the developer to prepare his plans to create approximately 76 one-acre industrial lots and to apply to the County for rezoning.

In 1985, the Trust's 74th Annual Report gives an update for Keahuolu (Liliuokalani Children's Center 1985):

> The survey of the mauka Kona farmlots was completed by Austin, Tsutsumi & Assoc. As the leased areas on the map differ from the property description in most of the leases, the lessees will be asked to confirm the area leased so that new leases can be prepared.
>
> There were only two responses to the Trustees' request for proposals to develop the entire Keahuolu parcel. The proposal by Santa Cruz Properties, Inc. for a residential development was rejected by the Trustees. It was agreed that a proposal made by the Gentry Companies was unique and that discussions regarding their proposal should continue.
>
> The Kona Industrial Subdivision Unit 5 area was cleared and grubbed, which created a renewed interest in the five unleased lots.

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APPENDIX C

SUMMARY OF IDENTIFIED SITES AND FEATURES

*SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	#CRM Value Mode Assess. R	I	C	+Field Work Tasks DR	SC	EX
00002	Manalahoa Trail	Transportation	M/H	H	M	+	-	+
07276	Great Wall of Kuakini	Agriculture-land division	M/H	H	M	+	-	+
13255	Mound	Agriculture	L	L	L	-	-	-
13256	Pahoehoe excavation	Quarry	L	L	L	-	-	-
13257	Filled crevice	Indeterminate	L	L	L	-	-	-
13258	Complex (2)**	Habitation	M	L	L/H	+	+	+
A	Overhang							
B	Cupboard							
13259	Rock scatter	Indeterminate	L	L	L	-	-	-
13260	Complex (6)	Habitation-quarry water catchment	M	M	L	+	+	+
A	Wall							
B	Wall							

*State Inventory of Historic Places (SIHP) numbers. SIHP numbers are four- and five- digit numbers prefixed by 50-10-27 (50=State of Hawaii; 10=Island of Hawaii; 27=USGS 7.5' series quad map ["Keahole Pt., Hawaii"]).

#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

**Number of component features within complex.

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13260 (cont.)								
C	Pahoehoe excavation							
D	Pahoehoe excavation							
E	Filled crevice							
F	Overhang							
13261	Enclosure	Agriculture	M	L	L	-	-	-
13262	Complex (2)	Habitation/ agriculture	M	L	L	+	+	+
A	L-shape wall							
B	Pahoehoe excavation							
13263	Overhang	Possible habitation	L	L	L	-	-	-
13264	Complex (6)	Agriculture	L	L	L	-	-	-
A	Mound							
B	Pahoehoe excavation							
C-F	Mound (4)							
13265	Mound	Agriculture	L	L	L	-	-	-
13266	Complex (3)	Habitation	L	L	L	-	-	-
A	Wall							
B	Alignment							
C	Cave							
13267	Complex (3)	Quarry	L	L	L	-	-	-
A	Pahoehoe excavation							
B	Mound							
C	Mound							
13268	Complex (6)	Habitation-agriculture	M	L	L	+	-	+
A	Enclosure							
B	Terrace							
C	Paved area							
D	Paved area							
E	Walled sinkhole							
F	Filled crevice							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13269	Alignment	Indeterminate	L	L	L	-	-	-
13270	Pahoehoe excavation	Possible quarry	L	L	L	-	-	-
13271	Alignment	Indeterminate	L	L	L	-	-	-
13272	Complex (36+)	Agriculture-quarry	M	L	L	+	-	-
A-P	Pahoehoe excavation (16)							
Q	Mound							
R-X	Pahoehoe excavation (7)							
Y	Terrace							
Z	Boulder concentration							
Aa-Da	Pahoehoe excavation (4)							
Ea	Petroglyph							
Fa	Pahoehoe excavation							
Ga	Mound							
Ha-Ja	Pahoehoe excavation (3)							
13273	Mound	Agriculture	L	L	L	-	-	-
13274	Complex (6)	Agriculture-quarry	M	L	L	+	+	+
A	Pahoehoe excavation							
B	Alignment							
C	Pahoehoe excavation							
D	Pahoehoe excavation							
E	Mound							
F	Pahoehoe excavation							
13275	Cave	Burial	M	M	H	+	+	+
13276	Complex (2)	Quarry	L	L	L	-	-	-
A	Pahoehoe excavation							
B	Pahoehoe excavation							
13277	Complex (8)	Quarry/agriculture	M	L	L	+	+	-
A-H	Pahoehoe excavation							
13278	Complex (2)	Agriculture/quarry	L/M	L	L	-	-	-
A	Mound							
B	Pahoehoe excavation							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13279	Complex (4)	Quarry/agriculture	M	L	L	+	-	+
A-D	Pahoehoe excavation							
13280	Complex (26+)	Temporary habitation-quarry-rock art	M	L	L/M	+	+	+
A	Cave							
B-D	Pahoehoe excavation (3)							
E	Petroglyph							
F	Alignment							
G-L	Pahoehoe excavation (6)							
M-P	Petroglyph (4)							
R	Petroglyph							
S	Petroglyph							
T	Enclosure							
U	Petroglyph							
V	Petroglyph							
W	Mound							
X-Z	Pahoehoe excavation (3)							
Aa	Petroglyph							
13281	Complex (2)	Ceremonial-possible temporary habitation	H	M	M/H	+	-	-
A	Enclosure							
B	C-shape							
13282	Alignment	Indeterminate	L	L	L	-	-	-
13283	Complex (5)	Indeterminate-agriculture	L	L	L	-	-	-
A	Alignment							
-	Pahoehoe excavation (4)							
13284	Complex (4)	Possible marker/agriculture	L	L	L	-	-	-
A-D	Rock concentration							
13285	Complex (12)	Quarry/agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13286	Complex (13)	Marker-agriculture	L	L	L	-	-	-
A	Alignment of cairns (4)							
B	Mound							
C	Alignment							
D	Rock concentration							
E	Mound							
F	Wall							
G	Boulder concentration							
H	Rock concentration							
I	Cairn							
J	Rock concentration							
13287	Cave Complex (6)	Temporary habitation	H	L	L	+	+	+
A	Circular alignment (hearth)							
B	Midden concentration							
C	Midden scatter							
D	Circular alignment (possible hearth)							
E	Midden scatter							
F	Terrace							
13288	Retaining wall/ terrace	Loading ramp	L	L	L	-	-	-
13289	Complex (15)	Quarry/agriculture	M	L	L	+	-	-
A-O	Pahoehoe excavation							
13290	Complex (6)	Quarry/agriculture	M	L	L	+	-	-
A-F	Pahoehoe excavation							
13291	Complex (6)	Quarry/agriculture	M	L	L	+	-	-
A-F	Pahoehoe excavation							
13292	Complex (18)	Quarry/agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13293	Complex (9)	Quarry/agriculture	L	L	L	-	-	-
A	Alignment							
-	Pahoehoe excavation (8)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13294	Complex (73)	Agriculture	M	L	L	+	+	+
A	Cairn							
B	Alignment							
C-E	Pahoehoe excavation (3)							
F	Block pile							
G-I	Pahoehoe excavation (3)							
-	Pahoehoe excavation (64)							
13295	Complex (10)	Quarry	M	L	L	+	-	-
A-I	Pahoehoe excavation (9)							
J	Displaced quarried rocks							
13296	Complex (13)	Quarry	L	L	L	-	-	-
-	Pahoehoe excavation							
13297	Complex (9)	Quarry	L	L	L	-	-	-
-	Pahoehoe excavation							
13298	Complex (7)	Agriculture/ quarry	M	L	L	-	-	-
A	Cairn							
B	Rubble concentration							
C	Linear mound							
D	Filled crevice							
E	Pahoehoe excavation							
F	Linear mound							
G	Filled crevice							
13299	Terrace	Agriculture	M	L	L	-	-	-
13300	Complex (18)	Temporary habitation-quarry/agriculture	M	L	L	-	+	+
A	Enclosure (4)							
B	Overhang							
C	Modified sinkhole							
D	Overhang							
E	Overhang							
-	Pahoehoe excavation (10)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13301	Complex (2)	Agriculture	L	L	L	-	-	-
A	Terrace							
B	Angular cobble concentration							
13302	Complex (7)	Habitation-quarry	L/M	L	L	+	-	-
A	Cave							
B	Overhang							
C	Overhang							
-	Pahoehoe excavation (4)							
13303	Cave	Storage	L	L	L	-	-	-
13304	Pahoehoe excavation	Quarry	L	L	L	-	-	-
13305	Pahoehoe excavation	Quarry	L	L	L	-	-	-
13306	Complex (12)	Agriculture	L/M	L	L	+	-	-
-	Pahoehoe excavation							
13307	Pahoehoe excavation	Possible agriculture	L	L	L	-	-	-
13308	Trail	Transportation	L	L	L/M	+	-	-
13309	Terrace	Agriculture	M	L	L	+	-	-
13310	Alignment	Indeterminate	L	L	L	-	-	-
13311	Complex (2)	Possible agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13312	Terrace	Agriculture	L	L	L	-	-	-
13313	Pecking marks	Indeterminate	L	L	L	-	-	-
13314	Pahoehoe excavation	Quarry/ possible agriculture	L	L	L	-	-	-
13315	Rubble wall	Indeterminate	M	L	L	+	-	-

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13316	Complex (8)	Quarry	L	L	L	-	-	-
-	Pahoehoe excavation							
13317	Pavement	Indeterminate	L	L	L	-	-	-
13318	Modified blister	Possible agriculture	L	L	L	-	-	-
13319	Pahoehoe excavation	Quarry	L	L	L	-	-	-
13320	Modified blister	Indeterminate	L	L	L	-	-	-
13321	Boulder concentration	Indeterminate	L	L	L	-	-	-
13322	Trail section	Transportation	M	L	L	+	-	-
13323	Trail	Transportation	M	L	L	+	-	-
13324	Complex (10)	Quarry	M	L	L	+	-	-
-	Pahoehoe excavation							
13325	Terrace	Agriculture	M	L	L	-	-	-
13326	Platform	Agriculture	M	L	L	-	-	-
13327	Complex (2)	Quarry	L	L	L	-	-	-
-	Pahoehoe excavation							
13328	Cave	Habitation	M/H	L	L/M	+	+	+
13329	Complex (2)	Habitation-agriculture	L	L	L	-	-	-
A	Cave							
B	Enclosure							
13330	Complex (11)	Agriculture-modern habitation	L/M	L	L	+	-	-
-	Cave							
-	Pahoehoe excavation (10)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13331	Complex (33)	Agriculture	M	L	L	+	-	+
-	Pahoehoe excavation (24)							
-	Wall							
-	Linear mound (7)							
-	Pahoehoe excavation							
13332	Complex (12)	Agriculture	M	L	L	+	-	+
-	Pahoehoe excavation (5)							
-	Mound (2)							
-	Alignment (5)							
13333	Wall	Possible agriculture	M	L	L	+	-	-
13334	Complex (24+)	Agriculture	M	L	L	+	+	+
A	Cairn, terrace (3)							
-	Modified outcrop (16+)							
-	Modified blister (4+)							
13335	Complex (18)	Ariculture	M	L	L	+	-	-
A	Terrace							
B	Platform							
-	Modified outcrop (11)							
-	Mound (5)							
13336	Complex (30+)	Agriculture	M	L	L	+	-	+
-	Modified outcrop (25)							
-	Pahoehoe excavation (5+)							
13337	Complex (34+)	Agriculture	M	L	L	+	-	+
A	Modified outcrop (5)							
B	Platform							
C	Modified outcrop							
D	Modified outcrop							
-	Modified outcrop (26+)							
13338	Complex (4)	Agriculture	L	L	L	-	-	-
-	Modified outcrop (2)							
-	Modified blister							
-	Terrace							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13339	Complex (36+)	Agriculture-habitation	M	L	M	+	+	+
A	Platform with terrace							
B	Stepped terrace							
C	Excavated blister							
D	Double terrace							
E	Terrace							
F	Wall							
G	Terrace							
H	Rubble mound							
I	Platform with enclosure							
J	Cave							
K	Terrace							
-	Pahoehoe excavation (25+)							
13340	Complex (7)	Agriculture-habitation-poss. ceremonial	M	L	L/H	+	+	+
A	Terrace							
B	Upright (3)							
C	Enclosure							
D	Terrace							
E	Modified blister							
F	Terrace							
G	Platform							
13341	Modified outcrop complex	Agriculture	L	L	L	-	-	-
13342	Complex (5)	Agriculture-habitation	L/M	L	L	+	-	+
A	Mound							
B	Paved area (3)							
C	Terrace							
13343	Complex (3)	Agriculture-habitation/possible burial	M/H	L/M	M	+	-	+
A	Pahoehoe excavation							
B	Pahoehoe excavation							
C	Platform							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13344	Complex (3)	Agriculture	L/M	L	L	+	-	+
A	Pahoehoe excavation with alignment (2)							
B	Pahoehoe excavation							
13345	Complex (2)	Agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
-	Alignment							
13346	Complex (13)	Agriculture	M	L	L	+	-	-
A-H	Mound (8)							
I-M	Pahoehoe excavation (5)							
13347	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13348	Complex (5+)	Quarry-marker-recreation-transportation-temporary habitation	M	L	L	+	+	+
A	Pahoehoe excavation							
B	Cairn (2)							
C	Papamu							
D	Paved pathway							
E	Cave							
13349	Wall	Land division	M	M	M	+	-	-
13350	Complex (11)	Habitation-burial	H	M	H	+	+	+
A	Large blister cave							
B	Terrace							
C-E	Cave (3)							
F	Enclosure							
G	Enclosure							
H	Cave							
I	Enclosure							
J	Terrace							
K	Enclosure							
13351	Complex (6+)	Quarry	M/H	L	L	-	+	+
A	Cave							
B	Pahoehoe excavation							
C	Pahoehoe excavation (5)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13351 (cont.)								
D	Pahoehoe excavation (3)							
E	Pahoehoe excavation							
F	Pahoehoe excavation							
13352	Complex (10)	Quarry/agriculture	M	L	L	+	+	+
A	Pahoehoe excavation							
B	Pahoehoe excavation							
C	Mound							
D-J	Pahoehoe excavation (7)							
13353	Complex (3+)	Rock art-agriculture-bathing	M	L	L	+	-	-
A	Petroglyph (+)							
B	Modified pond							
C	Modified pond							
13354	Pahoehoe excavation	Agriculture/quarry	L	L	L	-	-	-
13355	Complex (3)	Possible quarry-agriculture	M	L	L	+	-	-
A	Cairn							
B	Pahoehoe excavation							
C	Modified outcrop							
13356	Pahoehoe excavation	Agriculture	L/M	L	L	+	-	-
13357	Complex (8)	Agriculture	M	L	L	+	-	-
-	Cairn							
-	Cave							
-	Pahoehoe excavation (6)							
13358	Complex (3)	Agriculture/quarry	M	L	L	+	-	-
-	Pahoehoe excavation							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13359	Complex (3)	Burial/habitation-agriculture	M	L	H	+	+	+
A	Cave							
B	Cave							
C	Modified outcrop							
13360	Complex (5)	Burial-quarry	M	L	H	+	+	+
A	Cave							
B	Pahoehoe excavation (4)							
13361	Modified outcrop	Agriculture	L/M	L	L	-	-	-
13362	Complex (35+)	Agriculture	M	L	L	+	-	-
-	Modified outcrop complex (24+)							
-	Pahoehoe excavation (9+)							
-	Wall section (2)							
13363	Complex (11)	Agriculture	L	L	L	-	-	-
-	Modified outcrop (8)							
-	Rubble concentration (2)							
-	Pahoehoe excavation							
13364	Complex (10)	Agriculture/ poss. habitation	M	L	L	+	+	+
A	Platform							
-	Modified outcrop (6)							
-	Pahoehoe excavation (2)							
-	Mound							
13365	Complex (4)	Agriculture-habitation	M	L	L	+	-	+
A	Terrace							
B-D	Mound (3)							
13366	Complex (7)	Agriculture	L	L	L	-	-	-
-	Modified outcrop (5)							
-	Linear mound (2)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13367	Terrace	Agriculture	L	L	L	-	-	-
13368	Complex (45)	Agriculture/ poss burial - transportation	M	L	M	+	-	+
A	Terrace							
B	Terraced outcrop							
C	Wall							
D	Modified outcrop/terrace							
E	Wall							
F	Trail section							
G	Trail section							
-	Modified outcrop (26)							
-	Mound (8)							
-	Pahoehoe excavation (4)							
13369	Complex (7)	Agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13370	Mounded wall [P]@	Agriculture	M	L	M	+	-	-
13371	Platform [P]	Possible habitation	M/H	M	M	+	-	+
13372	Complex (10) [P]	Agriculture-habitation-quarry	H	M	H	+	+	+
A	Platform							
B	Enclosure							
C	Cairn							
D	Mound (3)							
E	Pahoehoe excavation							
F	Terrace							
G	Pahoehoe excavation							
H	Pahoehoe excavation							
13373	Complex (10+) [P]	Agriculture-habit.-poss. ceremonial-poss. burial	H	M/H	M/H	+	-	+
-	Enclosure							
-	C-shape wall							
-	Midden scatter							
-	Terrace							
-	Mound (2)							
-	Wall							
-	Mound (2)							

@[P]=Site located within boundaries of preserve area, feature-specific recording not conducted during this project.

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13373 (cont.)								
-	Additional rock mound (+)							
-	Pahoehoe excavation (+)							
13374	Complex (2) [P]	Agriculture/ land division	M	M	M	+	-	-
-	C-shape wall							
-	Wall							
13375	Complex (3) [P]	Agriculture/ habitation	H	M	M	+	-	+
A	Platform							
B	Platform							
C	Terrace							
13376	Platform [P]	Habitation/ possible burial	H	M	M/H	+	-	+
13377	Complex (3)	Habitation-burial	H	L	H	+	+	+
A-C	Lava tube cave							
13378	Complex (2)	Agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13379	Complex (8+)	Agriculture-possible burial	M	L	M	+	-	-
A	Modified outcrop							
B	Pahoehoe excavation							
C	Modified outcrop							
D	Terrace (2)							
E	Pahoehoe excavation							
F	Alignment							
G	Terrace							
H	Wall							
13380	Complex (5) [P]	Agriculture-habitation	H	M	M	+	+	+
A	Platform							
B-D	Wall (3)							
E	Cave							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13381	Enclosure [P]	Agriculture	M	M	M	+	-	-
13382	Enclosure [P]	Agriculture	M	M	M	+	-	-
13383	Complex (3) [P]	Habitation/ agriculture	H	M	M	+	-	+
A	Platform							
B	Enclosure							
C	Wall							
13384	Complex (3) [P]	Habitation/ agriculture	H	M	M	+	-	+
A	Platform							
B	Wall							
C	Wall							
13385	Wall [P]	Land division	M	M	M	+	-	-
13386	Complex (49)	Agriculture/ poss. habitation	M	M	L	+	-	-
A	Walled overhang							
B	Cave							
C	Cairn							
D	Cairn							
E	Modified blister							
-	Pahoehoe excavation (44)							
13387	Complex (3)	Habitation	H	L	L	+	+	+
A-C	Cave							
13388	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13389	Complex (2)	Agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13390	Complex (15) [P]	Agriculture-habitation	H	M/H	M/H	+	-	+
A	Platform							
B	Enclosure							
C	Wall							
D-F	Terrace (3)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13390 (cont.)								
G	Mound (4)							
H	Terrace							
I	Platform							
J	Linear mound (3)							
13391	Lava tube cave [P]	Habitation	H	L	L	+	+	+
13392	Platform [P]	Possible burial	H	M	M/H	+	-	+
13393	Platform [P]	Habitation	H	M	M	+	-	+
13394	Alignment [P]	Indeterminate	M	L	M	+	-	-
13395	Platform [P]	Possible burial	H	M	M/H	+	-	+
13396	Platform [P]	Habitation	H	M	M	+	-	+
13397	Complex (5) [P]	Agriculture	M	L	M	+	-	-
A-E	Terrace							
13398	Complex (4) [P]	Habitation/ agric./poss. burial	H	M	M/H	+	-	+
A	Platform							
B	Wall							
C	Cairn							
D	Cairn							
13399	Terrace [P]	Agriculture	M	L	M	+	-	-
13400	Complex (2) [P]	Agriculture/ land division	M	M	M	+	-	-
A	Wall							
B	Enclosure							
13401	Complex (2) [P]	Agriculture/ land division	M	M	M	+	-	-
A	Wall							
B	Terrace							
13402	Wall [P]	Land division	M	L	M	+	-	-

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13403	Modified cave	Habitation	H	L	L	+	+	+
13404	Enclosure	Agriculture/ possible habitation	M	M	M	+	-	+
13405	Complex (15+)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation							
13406	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13407	Complex (2) [P]	Agriculture	M	L	L	+	-	-
A	Mound							
B	Pahoehoe excavation							
13408	Complex (19+) [P]	Agriculture- poss. hab./ poss. ceremonial	H	M/H	M/H	+	+	+
A	Platform							
B	Terrace							
C-E	Wall (3)							
F	Enclosure							
G	Enclosure							
H	Wall							
I	Wall							
J	Pahoehoe excavation (10+)							
13409	Complex (9) [P]	Agriculture/ habitation/poss. burial	H	H	M/H	+	-	+
A	Platform							
B	Wall							
C	Enclosure							
D-F	Terrace							
G	Platform							
H	Platform							
I	Wall							
13410	Platform [P]	Habitation	H	M	M	+	+	+
13411	Complex (4) [P]	Agriculture/ land division	M	M	M	+	-	-
A	Wall							
B	Wall							
C	Mound							
D	Wall							

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13373 (cont.)								
-	Additional rock mound (+)							
-	Paboehoe excavation (+)							
13374	Complex (2) [P]	Agriculture/ land division	M	M	M	+	-	-
-	C-shape wall							
-	Wall							
13375	Complex (3) [P]	Agriculture/ habitation	H	M	M	+	-	+
A	Platform							
B	Platform							
C	Terrace							
13376	Platform [P]	Habitation/ possible burial	H	M	M/H	+	-	+
13377	Complex (3)	Habitation-burial	H	L	H	+	+	+
A-C	Lava tube cave							
13378	Complex (2)	Agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13379	Complex (8+)	Agriculture-possible burial	M	L	M	+	-	-
A	Modified outcrop							
B	Pahoehoe excavation							
C	Modified outcrop							
D	Terrace (2)							
E	Pahoehoe excavation							
F	Alignment							
G	Terrace							
H	Wall							
13380	Complex (5) [P]	Agriculture-habitation	H	M	M	+	+	+
A	Platform							
B-D	Wall (3)							
E	Cave							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13381	Enclosure [P]	Agriculture	M	M	M	+	-	-
13382	Enclosure [P]	Agriculture	M	M	M	+	-	-
13383	Complex (3) [P]	Habitation/ agriculture	H	M	M	+	-	+
A	Platform							
B	Enclosure							
C	Wall							
13384	Complex (3) [P]	Habitation/ agriculture	H	M	M	+	-	+
A	Platform							
B	Wall							
C	Wall							
13385	Wall [P]	Land division	M	M	M	+	-	-
13386	Complex (49)	Agriculture/ poss. habitation	M	M	L	+	-	-
A	Walled overhang							
B	Cave							
C	Cairn							
D	Cairn							
E	Modified blister							
-	Pahoehoe excavation (44)							
13387	Complex (3)	Habitation	H	L	L	+	+	+
A-C	Cave							
13388	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13389	Complex (2)	Agriculture	L	L	L	-	-	-
-	Pahoehoe excavation							
13390	Complex (15) [P]	Agriculture-habitation	H	M/H	M/H	+	-	+
A	Platform							
B	Enclosure							
C	Wall							
D-F	Terrace (3)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13390 (cont.)								
G	Mound (4)							
H	Terrace							
I	Platform							
J	Linear mound (3)							
13391	Lava tube cave [P]	Habitation	H	L	L	+	+	+
13392	Platform [P]	Possible burial	H	M	M/H	+	-	+
13393	Platform [P]	Habitation	H	M	M	+	-	+
13394	Alignment [P]	Indeterminate	M	L	M	+	-	-
13395	Platform [P]	Possible burial	H	M	M/H	+	-	+
13396	Platform [P]	Habitation	H	M	M	+	-	+
13397	Complex (5) [P]	Agriculture	M	L	M	+	-	-
A-E	Terrace							
13398	Complex (4) [P]	Habitation/ agric./poss. burial	H	M	M/H	+	-	+
A	Platform							
B	Wall							
C	Cairn							
D	Cairn							
13399	Terrace [P]	Agriculture	M	L	M	+	-	-
13400	Complex (2) [P]	Agriculture/ land division	M	M	M	+	-	-
A	Wall							
B	Enclosure							
13401	Complex (2) [P]	Agriculture/ land division	M	M	M	+	-	-
A	Wall							
B	Terrace							
13402	Wall [P]	Land division	M	L	M	+	-	-

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13403	Modified cave	Habitation	H	L	L	+	+	+
13404	Enclosure	Agriculture/ possible habitation	M	M	M	+	-	+
13405	Complex (15+)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation							
13406	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13407	Complex (2) [P]	Agriculture	M	L	L	+	-	-
A	Mound							
B	Pahoehoe excavation							
13408	Complex (19+) [P]	Agriculture- poss. hab./ poss. ceremonial	H	M/H	M/H	+	+	+
A	Platform							
B	Terrace							
C-E	Wall (3)							
F	Enclosure							
G	Enclosure							
H	Wall							
I	Wall							
J	Pahoehoe excavation (10+)							
13409	Complex (9) [P]	Agriculture/ habitation/poss. burial	H	H	M/H	+	-	+
A	Platform							
B	Wall							
C	Enclosure							
D-F	Terrace							
G	Platform							
H	Platform							
I	Wall							
13410	Platform [P]	Habitation	H	M	M	+	+	+
13411	Complex (4) [P]	Agriculture/ land division	M	M	M	+	-	-
A	Wall							
B	Wall							
C	Mound							
D	Wall							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13412	Complex (2) [P]	Agriculture	M	M	M	+	-	-
A	Enclosure							
B	Terrace							
13413	Platform [P]	Habitation	H	M	M	+	-	+
13414	Complex (20+)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation							
13415	Terrace	Agriculture	M	L	L	+	-	-
13416	Complex (2)	Agriculture	M	L	L	+	-	+
-	Rubble wall with terrace							
-	Wall							
13417	Pahoehoe excavation	Agriculture	M	L	L	+	-	-
13418	Pahoehoe excavation	Agriculture	M	L	L	+	-	-
13419	Pahoehoe excavation	Agriculture	M	L	L	+	-	-
13420	Complex (8)	Agriculture	M	L	L	+	-	-
-	Rock mound							
13421	Complex (18+)	Agriculture-habitation	M	L	L	+	-	-
A-C	Cairn (3)							
D	Cave							
-	Pahoehoe excavation (10+)							
-	Paved area (4)							
13422	Complex (8+)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation (7+)							
-	Cairn							
13423	Complex (80)	Agriculture-temporary habitation	H	M	M	+	+	+
-	Mound (59)							
-	Pahoehoe excavation (8)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13423 (cont.)								
-	Modified outcrop (8)							
-	Alignment (2)							
-	Overhang							
-	Modified cave							
-	Modified pahoehoe blister							
13424	Complex (3)	Agriculture	L	L	L	-	-	-
A	Pahoehoe excavation							
B	Modified outcrop							
C	Cairn							
13425	Complex (4)	Agriculture-habitation	M	L	L	+	-	+
A	Modified blister							
B	Modified outcrop							
C	Cave							
D	Mound							
13426	Roadbed	Transportation	L	L	L	-	-	-
13427	Complex (17)	Agriculture	M	L	L	+	-	-
A-C	Mound (3)							
-	Pahoehoe excavation (10)							
-	Mound (4)							
13428	Complex (43)	Agriculture	M	L	L	+	-	-
A-E	Faced mound (5)							
F	Alignment							
G	Platform							
H	Terrace							
-	Pahoehoe excavation (25)							
-	Mound (10)							
13429	Complex (9)	Agriculture	M	L	L	+	-	+
A	Terrace							
B	Terrace							
C	Modified blister							
D-I	Mound (6)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13430	Complex (15)	Agriculture-habitation	M	L	L	+	-	+
A	Platform							
B	Mound							
C	Mound							
-	Pahoehoe excavation (5)							
-	Mound (6)							
-	Collapsed blister							
13431	Complex (6)	Agriculture-habitation	M/H	M	M	+	+	+
A	Cave							
B	Enclosure							
C	Enclosure							
D	Pahoehoe excavation							
E	Pahoehoe excavation							
F	Terrace and alignment							
13432	Mound	Agriculture	L	L	L	-	-	-
13433	Cairn	Indeterminate marker	L	L	L	-	-	-
13434	Complex (4)	Agriculture	M	L	L	-	-	-
A	Faced mound							
B	Faced mound							
C	Pahoehoe excavation							
D	Faced mound							
13435	Complex (10)	Agriculture	M	M	M	+	-	+
A-F	Enclosure (6)							
G	L-shape wall							
H	Modified outcrop							
I	Modified outcrop							
J	Enclosure							
13436	Wall	Land division	M	M	M	+	-	-
13437	Complex (7)	Agriculture-marker	M	M	M	+	-	+
A	Stepped terrace							
B	Pavement							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13437 (cont.)								
C	Faced outcrop							
D	Terrace							
E-G	Cairn (3)							
13438	Complex (10)	Agriculture-transportation	M	M	M	+	-	+
A	Terrace							
B	Mound							
C	Terrace							
D	Terrace							
E	Pahoehoe excavation							
F	Terrace							
G	Trail							
H	Roadbed							
I	Mound							
J	Cairn							
13439	Cairn	Indeterminate marker	L	L	L	-	-	-
13440	Complex (3)	Agriculture	M	L	L	+	-	-
A	Terrace							
B	Filled crevice							
C	Pahoehoe excavation							
13441	Complex (20)	Agriculture-habitation	H	H	M	+	+	+
A	Platform							
B	Terrace							
C	Platform							
D	Platform							
E	Terrace (4)							
F-H	Terrace (3)							
I	Wall remnant							
J	Platform							
K	Platform							
L	Wall							
M	Mound							
N	Platform							
O	Platform							
P	Cave							
Q	Enclosure							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13442	Alignment	Indeterminate	L	L	L	-	-	-
13443	Complex (16)	Agriculture	M	L	L	+	-	-
-	Large mound (5)							
-	Small mound (7)							
-	Cairn (2)							
-	Linear mound							
-	Alignment							
13444	Complex (5)	Agriculture	M	L	L	-	-	-
A	Pahoehoe excavation							
B	Mound (4)							
13445	Complex (5)	Habitation-recreation	H	M/H	M/H	+	+	+
A	Cave							
B	Cave							
C	Papamu and trail section							
D	Platform							
13446	Complex (37)	Agriculture-habitation	M	L	L	+	-	-
A	Alignment							
B	Terrace							
-	Mound (8)							
-	Modified blister (17)							
-	Pahoehoe excavation (9)							
-	Terrace							
13447	Complex (19)	Agriculture-poss. habitation	M	L	L	+	-	+
A	Platform							
-	Filled blister (9)							
-	Pahoehoe excavation (6)							
-	Modified blister (3)							
13448	Complex (7)	Agriculture	M	L	L	+	-	+
-	Pahoehoe excavation							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13449	Complex (3)	Habitation-transportation-possible ceremonial	M	L	M	+	-	+
A	Lava tube cave							
B	Cairn							
C	Steppingstone trail							
13450	Steppingstone trail	Transportation	M	L	M	+	-	-
13451	Cave	Habitation	M	L	L	+	+	+
13452	Paved trail	Transportation	M	L	M/H	+	-	-
13453	Pavement	Agriculture	L	L	L	-	-	-
13454	Complex (14)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation (11)							
-	Mound (3)							
13455	Complex (13+)	Agriculture	M	L	L	+	-	-
-	Modified outcrop							
-	Mound (6+)							
-	Pahoehoe excavation (5+)							
-	Cairn							
13456	Terrace	Agriculture	M	L	L	+	-	-
13457	Complex (4)	Agriculture-possible habitation	M	L	L	+	-	+
A	Cairn							
B	Enclosure							
C	Terrace							
D	Pahoehoe excavation and cupboard							
13458	Complex (5)	Habitation-recreation	H	M	M	+	+	+
-	Lava tube cave (3)							
-	Papamu (2)							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13459	Complex (2)	Habitation-possible burial	M	L	L/H	+	+	+
A	Cave							
B	Modified outcrop							
13460	Faced mound	Agriculture	M	L	L	+	-	-
13461	Stepped terrace	Agriculture	M	L	L	-	-	-
13462	Complex (4)	Agriculture-possible habitation	M	L	L	+	-	+
A	Modified outcrop							
B	Alignment							
C	C-shape wall							
D	Enclosure							
13463	Complex (5)	Ceremonial-burial-temp. hab-transportation	H	H	H	+	-	+
A	Enclosed platform							
B	Cave							
C	Cave							
D	Trail							
E	Pavement							
13464	Complex (8)	Agriculture	M	L	L	+	-	-
A	Alignment/wall							
B	Enclosure (2)							
C	Cairn							
D	Pahoehoe excavation (3)							
E	Mound							
13465	Complex (8)	Habitation/ agric./ceremonial	H	M	M	+	-	+
A	Platform							
B	Terrace with upright							
C	Wall remnant							
D	Wall remnant							
E	Pavement with upright							
F	Pahoehoe excavation and lava tube							
G	Pavement							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13466	Terrace	Agriculture	M	L	L	+	-	-
13467	Complex (9+)	Agriculture	M	L	L	+	-	-
A	Pahoehoe excavation (6+)							
B	Terrace							
C	Terrace							
D	Mound							
13468	Enclosure	Agriculture	M	L	L	+	-	-
13469	Complex (6)	Indeterminate marker	L	L	L	-	-	-
A-F	Cairn							
13470	Petroglyph	Rock art	L	L	L	-	-	-
13471	Complex (3)	Agriculture-temp. habitation	M	L	L	+	-	+
A	Upright (+)							
B	Platform							
C	Cave							
13472	Complex (164)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation (144)							
-	Modified blister (16)							
-	Mound (3)							
-	Alignment							
13473	Complex (73)	Agriculture	M	L	L	+	-	-
-	Pthh. exc. with associated rock pile (68)							
-	Linear mound (2)							
-	Terrace							
-	Filled blister							
-	Upright							
13474	Modified cave	Habitation	M	L	L	+	-	+
13475	Cleared blister	Agriculture	L	L	L	-	-	-

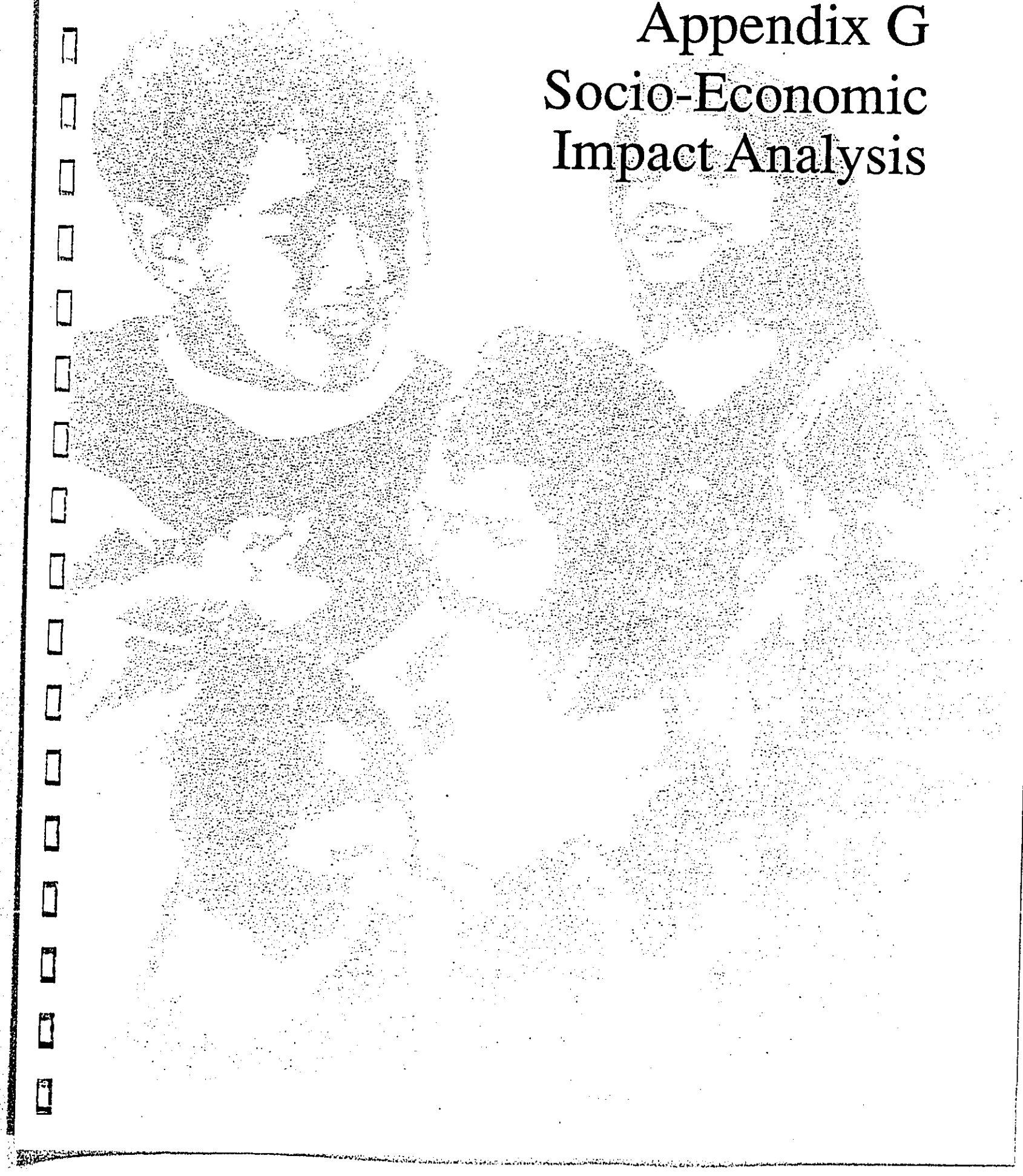
SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13476	Complex (10)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation							
13477	Complex (4)	Agriculture/ poss. habitation	M	L	L	+	-	+
A	Enclosure (2)							
B	C-shape wall							
C	Mound							
13478	Complex (6)	Agriculture	M	L	L	+	-	+
A	Platform							
B	Terrace							
C	Enclosure and mound							
D	Filled pahoehoe excavation							
E	Wall							
13479	Wall	Land division	M	L	M	+	-	-
13480	C-shape	Habitation	L/M	L	L	-	-	-
13481	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13482	Pahoehoe excavation	Quarry	L	L	L	-	-	-
13483	Pahoehoe excavation	Quarry	L	L	L	-	-	-
13484	Complex (6)	Agriculture	M	L	L	+	-	+
A	Terrace							
B-F	Modified outcrop (5)							
13485	Mound	Agriculture	L	L	L	-	-	-
13486	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13487	Complex (5) .	Agriculture	L/M	L	L	-	-	-
A-E	Pahoehoe excavation							
13488	Complex (2)	Agriculture	M	L	L	+	-	-
A	Pahoehoe excavation							
B	Paved area							

SUMMARY OF IDENTIFIED SITES AND FEATURES (cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13489	Terrace	Agriculture	M	L	L	-	-	-
13490	Pahoehoe excavation	Agriculture	L	L	L	-	-	-
13491	Complex (8)	Agriculture	M	L	L	+	-	-
-	Pahoehoe excavation with associated mound							

Appendix G
Socio-Economic Impact Analysis



SOCIO-ECONOMIC IMPACT ASSESSMENT OF PROPOSED KEAHUOLU LANDS DEVELOPMENT, NORTH KONA, HAWAII

-- December 1989

Prepared for:

Belt Collins & Associates

and

Queen Liliuokalani Trust

Prepared by:

Community Resources, Inc.

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1.0 INTRODUCTION

1.1 THE PROPOSED PROJECT

The Queen Liliuokalani Trust (QLT) plans to develop about 1,135 acres of its lands in Keahuolu, North Kona, Hawaii. (See Figure 1 for location of the project.) The proposed development -- referred to as the "Keahuolu Lands" project -- consists of three sections, in adjacent sites (in Figure 2):

- About 470 acres mauka of Queen Kaahumanu Highway would be developed as a regional center for West Hawaii -- an expanded "Downtown" area including commercial/retail space, private office space, government facilities, and perhaps other land uses, such as a hospital and light industry; and

- Mauka of the proposed regional center is an area of about 350 acres slated for residential development (including single-family and elderly housing); and

- About 200 acres makai of the Highway, extending to the State-managed portion of Old Kona Airport Park would be developed for low density uses including commercial or office use, and possibly recreational activity. No resort or light industry would be located in this parcel. (NOTE: This parcel does not include any ocean frontage.)

It is expected that the State Housing and Finance Development Corporation (HFDC) will ultimately acquire most of the Keahuolu Lands intended for residential development. The State would incorporate these parcels into its planned Kealakehe housing project, just north of the Keahuohu Lands above the highway. However, unless and until title has been transferred, the intended residential parcels remain part of QLT's project for land use application purposes.

The development has been planned to serve needs of a growing West Hawaii population as these emerge over time. Construction would proceed over many decades, until 2020 or later.

The planned development includes new roads and improvements:

- Additional setback for the Queen Kaahumanu Highway;

- Inclusion of a mid-level road, parallel to Queen Kaahumanu Highway in its Keahuolu segment (which presumably would connect with the Queen Kaahumanu Highway further north and further south); and

- construction of new mauka/makai roads to relieve traffic congestion on Palani Road.

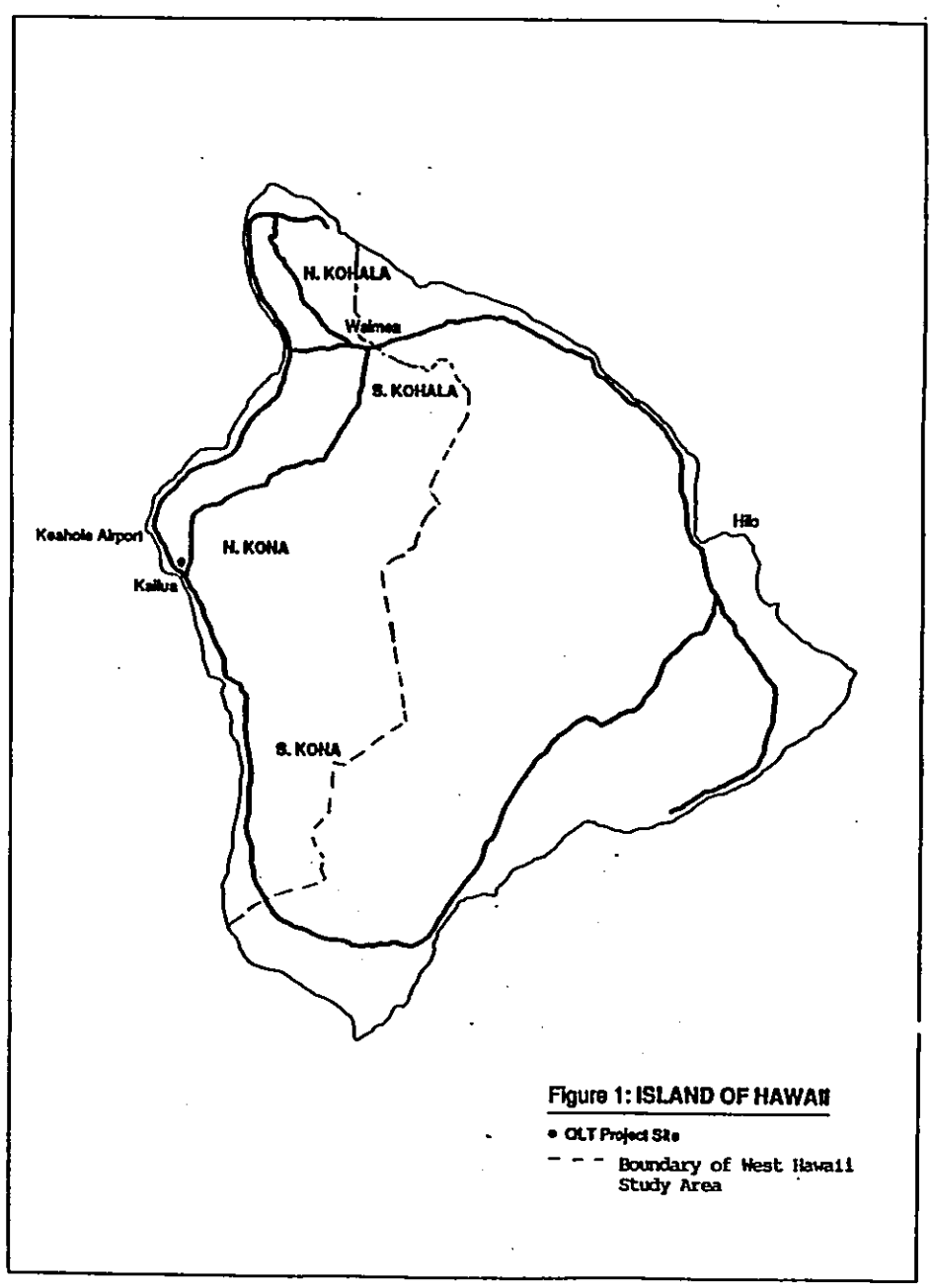

Figure 1: ISLAND OF HAWAII

- OLT Project Site
- Boundary of West Hawaii Study Area

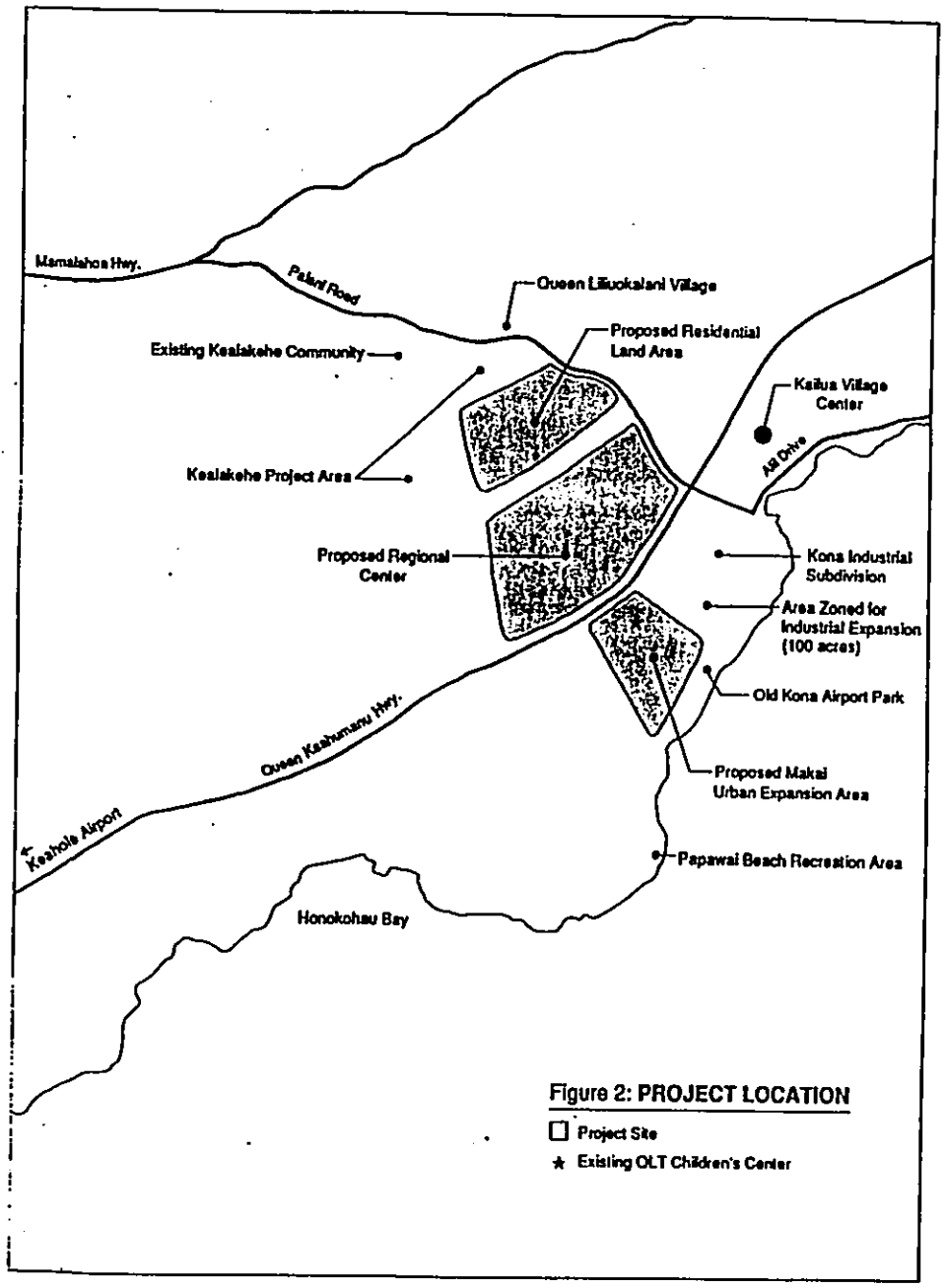

Figure 2: PROJECT LOCATION

- Project Site
- Existing OLT Children's Center

Additionally, it is assumed that a new "shoreline drive" envisioned by the State and County governments would be constructed with public funds at some point in the future. This would traverse the makai parcel near the Old Kona Airport.

The Trust owns other lands in the Keahuolu ahupuaa. The following are not part of the project:

- The existing Kona Industrial Subdivision.
- A 100-acre parcel, already zoned for future business expansion, between the Kona Industrial Subdivision and the makai section of the development.
- About 200 acres north of the makai section of the project, including the beach area used for the Trust's Family Camping Program.
- A parcel of about 90 acres makai of Palani Road and mauka of the project area, which is already designated as Urban. This parcel is not included in the Trust's land use applications. This land, along with another 60 acres treated as part of the QLT project in this study, is to be purchased by the State of Hawaii for residential development, as part of the Kealakehe affordable housing project.
- Queen Liliuokalani Village, an existing residential area.

The Queen Liliuokalani Children's Center, one of nine QLT service centers statewide, is located in the makai section of the project site. Development of that section would be compatible with the Children's Center. A mixture of low-density commercial and recreational uses is anticipated. In the next few decades, no impact of the project on the Children's Center is expected, because makai section development is forecast to occur only after 2020.

The project will provide needed revenues to support QLT programs for orphaned Hawaiian children, on the Big Island and elsewhere in Hawaii. It will further provide a planned regional center for West Hawaii, facilitating the orderly development of the region and its infrastructure.

1.2 DEFINITION OF THE STUDY AREA

The project is located immediately north of Kailua-Kona and near existing North Kona residential subdivisions. It is planned to serve as an urban center for a larger area than North Kona, however -- it is to serve all of West Hawaii.

In this report, attention is paid to:

- West Hawaii as a broad area; and
- North Kona in particular, as the district in which the project is sited and where the project's impacts are expected to be most immediately felt.

("West Hawaii" is defined as the four judicial districts of North Kona, South Kona, North Kohala, and South Kohala. Reference will be made to specific trends in the judicial districts, as appropriate, to Kona -- including both North and South Kona, and to "the Kona area," a less well-defined region, centered on Kailua-Kona, perceived by members of the community as a single unit.)

1.3 PURPOSE AND SCOPE OF THIS REPORT

This report is an assessment of the socio-economic impacts of the proposed Keahuolu Lands project. It has been prepared for Belt Collins & Associates, for inclusion in the Environmental Impact Statement being written for the Queen Liliuokalani Trust.

Social impact assessments are made in order to identify and disclose information of use to decision-makers and citizens, as they evaluate the implications of proposed developments.

The impacts of a project must be judged in relation to the surrounding area at the time the project would take effect. Hence a project is considered in relation to probable future conditions, not just the situation existing at the time of the report. The present project is likely to be built out over a period of thirty years or longer, so long-term growth trends in West Hawaii form the context for its assessment.

This report has four main sections:

- This section includes introductory material;
- The second section deals with the current situation at the project site and in the surrounding area, and with major trends likely to affect the area in the coming decades;
- The third section reports on the issues and concerns expressed by members of the community in the study area with regard to their area's future and to the project; and
- The final section identifies socio-economic impacts of the project. Where appropriate, possible mitigating measures are noted.

2.0 EXISTING AND ANTICIPATED CONDITIONS

This first part of this section provides an overview of past and present socio-economic conditions, while the remainder of the section examines anticipated future conditions over the next several decades.

2.1 OVERVIEW OF EXISTING CONDITIONS

Existing conditions are analyzed in terms of (1) historic and geographic factors; (2) economic base and employment; (3) population; (4) housing patterns; and (5) lifestyle and values.

2.1.1 Historic and Geographic Factors

North and South Kona: Kailua-Kona (located on the coast of North Kona) was one of the centers of government for all of Hawaii during the rule of the Kamehameha dynasty. In the later years of the Hawaiian Kingdom, it receded in importance and became a small fishing village again. With the emergence of the sugar industry, Hilo (in East Hawaii) became the predominant population and political center for the island of Hawaii.

Unlike many other rural parts of Hawaii, Kona's social and economic systems did not depend on a few large employers. During much of this century, economic activity in the Kona area centered around small-scale ranching and coffee farming.

Much of Kona's land area consists of steep upland terrain on the slopes of Mount Hualalai and Mauna Loa. The vast majority of the population has always lived in a string of settlements along the coast or on the lower mountain slopes. When agriculture dominated the economy, most people lived in areas about 1,000 to 2,500 feet above sea level. The majority of these mauka settlements were in the southern part of North Kona or in South Kona.

In the 1960's, Kailua-Kona began to emerge as a new economic and population center as the visitor industry developed along the West Hawaii coast. While the first major luxury hotel, the Mauna Kea, was in South Kohala, North Kona soon became the most developed site of hotels and resort condominiums on the Big Island. (In the 1980's, new hotel development shifted from North Kona to South Kohala, but condominium construction continued in Kona.) Consequently, there has been more recent population growth in the coastal resort areas of Kailua and neighboring Keauhou.

However, South Kona has remained relatively undeveloped, with little in the way of direct resort activity. The indirect effects of North Kona's visitor industry growth have produced more population in South Kona villages, but many residents are still involved in farming or fishing.

Kona has been somewhat isolated from Hilo by a road system that depends on belt roads around the island, rather than a central connector across the island. Until recently, much of the road was narrow with many sharp curves or in poor condition, greatly increasing the length of the trip to Hilo.

Communications with Hilo and the rest of the state have improved due to public investment:

- A major airport facility at Keahole linked Kailua-Kona to the rest of the state, ending the need to fly in through Hilo;
- Hamalahoa Highway, which circles the island, was upgraded, greatly improving the access from Kailua to Hilo, Waimea, and other tourist attractions -- while access to Volcano National Park is still constrained by a narrow, winding section of highway in South Kona;
- The Queen Kaahumanu Highway linked Kona with the South Kohala resort areas, existing and planned, and the port of Kawaihae.

South Kohala: The Kohala Mountains divide both South and North Kohala into a "dry side" and a "wet side." For much of the past century, the majority of South Kohala's sparse population lived in or around the cool mauka town of Waimea (also called Kamuela), which straddles the South Kohala wet side/dry side boundary.

Until the mid-1960's, South Kohala's economy centered on truck farming and ranching, particularly the sprawling Parker Ranch headquartered in Waimea. In 1965, tourism began to bring economic prominence to the dry coastal region with the opening of the 310-room Mauna Kea Beach Hotel. The 1970's saw construction of the Queen Kaahumanu Highway to Kona; development of the Lalamilo water system; expansion of the Waikoloa resort-residential subdivision south of Waimea; and the establishment of numerous second homes and an observatory basecamp in Waimea.

The 1980's brought new resort hotel operations to South Kohala: the 543-room Sheraton Royal Waikoloa (now the Royal Waikoloan) opened in 1981; the 351-room luxury Mauna Lani Bay Hotel started operations in 1983; and the mammoth 1,250-room Hyatt Regency Waikoloa opened in late 1988. At all three major South Kohala resort destinations (Waikoloa, Mauna Lani, and Mauna Kea), new condominium and second-home projects -- most in the luxury price range -- also came on line. There was continued population growth in the Waikoloa residential area mauka of Waikoloa Resort, as well as some growth in the non-resort coastal communities of Puako and Kawaihae.

North Kohala: This district is a peninsula formed by the Kohala Mountains. Until very recently during historic times, the western, "dry side" mountain slopes and coast have been almost unpopulated, except by a few cattle ranch employees. Human settlement has been concentrated in villages located in the "wet side," on the northeastern part of the peninsula. The road comes to an end at Pololu Valley, which marks the beginning of a series of steep cliffs and valleys that render the rest of the eastern coast basically uninhabitable for significant numbers of people.

Thus, the settled parts of North Kohala have historically been isolated from the rest of the island.

Until 1975, the district's economy was dominated by sugar cane. The settled "wet side" area is actually comprised of six villages (Hawi, Kapaau, Halaula, Makapala, Halawa, and Niulii) and during the past hundred years hosted a number of sugar mills. As was the case with most sugar plantations throughout Hawaii, waves of immigrants were brought in to cultivate the cane in North Kohala, resulting in an ethnically varied population.

With the closing of Kohala's last mill in 1975, the sugar era ended, leaving an aging population of longtime residents. Some newcomers -- including retirees from other islands and younger people from the Mainland -- have moved in to balance the ongoing out-migration of younger people growing up in North Kohala. Today, economic activity in the area is limited to some ranching and small-scale retail or agricultural activities. Many people commute to resort jobs in South Kohala or Kona.

In the 1980's, there has been some modest growth in the population of subdivisions located in the "dry side" between Hawi and Kawaihae, as well as a few new mauka "wet side" subdivisions.

2.1.2 Current Economic Base and Employment

Major Industries: The current principal economic activities in West Hawaii are the visitor industry, construction, diversified agriculture and ranching, and high technology activities in astronomy and ocean science. The visitor industry is the most important of these, in economic terms.

- The visitor industry on the Big Island enjoyed one of the best years on record in 1988 with sharp increases in visitor expenditures. Hotel occupancies declined, however, due to the substantial increase in hotel room inventory. Visitor arrivals in the first 11 months of 1989 were 25 percent higher than during the same portion of the year for 1988.

About 84% of Hawaii County's hotel rooms and resort condominium units are located in West Hawaii. Nearly half the County inventory is in the Kona region, and over a third is in Kohala.

- Construction activity driven by the boom in resort development in West Hawaii has increased steadily since 1985. The massive Hyatt Regency Waikoloa project was completed in October 1988. Currently, construction of three more luxury hotels is underway, with a fourth scheduled to begin next year. Substantial resort condominium and commercial development projects are also underway in West Hawaii.

  Construction put in place in Hawaii County in 1988 was valued at over $152,750,000. This is the highest value for the industry in the county to date, and an increase of 26.6% over 1987.

- The principal diversified agricultural activities in West Hawaii are coffee and macadamia nut farms and ranching. Both Kona coffee and Hawaii's macadamia nut products command premium prices due in part to their exotic Hawaiian image. The value of diversified agricultural products has grown steadily in recent years. In 1987, the value of Hawaii County's agricultural production (excluding sugar and pineapple) was nearly $120 million (Hawaii State Department of Business and Economic Development, 1988), including:

Coffee	$4.8 million
Macadamia nuts	$34.5 million
Cattle sales	$25.9 million

- High technology activities at the Hauna Kea astronomy complex and the Natural Energy Laboratory of Hawaii (NELH) at Keahole Point have received public and private support as a way to reduce the dependency of the Big Island economy on tourism. New ventures include:

  - Construction of new telescope facilities and supporting infrastructure, and expansion of operations on Mauna Kea. This has provided a steady flow of income for the Big Island and direct continuing employment for almost 200 people, most of whom live in West Hawaii.

  - Ocean science industries at the NELH and its associated Hawaii Ocean Science Technology (HOST) Park have yet to progress much beyond the pilot research project stage. There are 152 people employed at the Keahole site, 20 at NELH, and the rest employed by the private tenants of HOST Park. Four of the 17 tenants of the park are now producing a commercial product.

Labor Force and Employment: West Hawaii employers report a labor shortage, particularly among skilled construction workers and entry level service workers for restaurant, retail, and resort operations.

The most recent available unemployment and workforce estimates from the Department of Labor and Industrial Relations (DLIR) (personal communication, Manuel Fragrante, Researcher, Research and Statistics Office, Hawaii State DLIR, December 15, 1989) are:

	1988 Annual Average		August 1989	
	Civilian Labor Force	Unemp. Rate	Civilian Labor Force	Unemp. Rate
North Kona	9,776	3.7%	10,645	2.1%
South Kona	3,778	4.0%	4,108	2.4%
North Kohala	1,795	6.6%	1,929	3.9%
South Kohala	2,819	4.4%	3,060	2.6%
West Hawaii	18,168	4.3%	19,742	2.4%
Hawaii County	54,676	5.0%	59,206	2.9%

(NOTE: DLIR estimates for sub-county areas are based on 1980 census shares, hence usually under-estimate numbers for high-growth areas like West Hawaii. Based on actual population and labor force participation rates, CRI would estimate West Hawaii's 1988 civilian labor force as about 19,100 -- a figure to be used later in this section for forecasting purposes.)

The most recent detailed analysis of occupational patterns is provided by the 1980 Census. Table 2-A shows selected data from the 1980 and 1970 Censuses. Some important conclusions from this table:

- Compared to workers countywide or statewide, employed residents of North Kona, North Kohala, and South Kohala were much more likely to be in tourism-related occupations or industries in 1980.
- In North Kohala, there was a dramatic 1970-80 shift from agriculture to tourism-related work, due to the sugar phaseout. Many such tourism jobs were located outside North Kohala, as indicated by high average commute times.
- South Kona's workforce was more involved in agricultural occupations and industries than was the case elsewhere in West Hawaii or the rest of the county, on average.
- South Kona and North Kohala had relatively low proportions of managerial/professional workers.

TABLE 2-A: LABOR FORCE SIZE AND CHARACTERISTICS -- STATE AND COUNTY OF HAWAII, AND WEST HAWAII DISTRICTS, 1970 AND 1980

	STATE OF HAWAII		COUNTY OF HAWAII		NORTH KONA		SOUTH KONA		SOUTH KOHALA		NORTH KOHALA	
	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980
POTENTIAL LABOR FORCE (aged 16+)	522,018	723,479	43,075	67,205	3,632	10,115	2,629	4,265	1,446	3,290	2,240	2,256
not in labor force	34.1%	31.7%	39.5%	38.7%	44.3%	27.8%	41.6%	33.8%	34.2%	35.9%	38.4%	39.8%
armed forces	9.5	8.1	0.4	0.3	0.0	0.1	0.0	0.0	0.0	0.0	1.1	1.0
civil. labor force	56.4	60.2	60.1	61.0	55.7	72.1	58.4	66.2	65.8	64.1	60.5	59.3
CIVILIAN LABOR FORCE(CLF)	294,484	435,780	25,889	41,006	2,022	7,293	1,535	2,823	951	2,110	1,355	1,355
unemployed	3.0%	4.7%	2.7%	7.0%	4.8%	5.2%	2.3%	5.7%	4.1%	6.3%	1.9%	9.2%
EMPLOYED CLF	285,556	415,181	25,180	38,150	1,925	4,913	1,500	2,662	912	1,978	1,330	1,230
OCCUPATION	%	%	%	%	%	%	%	%	%	%	%	%
service	15.4	17.9	16.3	16.5	19.3	21.5	16.0	17.3	15.9	18.0	25.9	34.2
manager./profes.	NC	23.5	NC	20.0	NC	21.2	NC	13.6	NC	20.6	NC	15.2
technical, sales & admin'n.	NC	32.0	NC	28.1	NC	28.2	NC	24.8	NC	19.2	NC	13.7
farm/fish/forest	NC	3.4	NC	10.3	NC	7.1	NC	19.5	NC	14.0	NC	14.2
precision, craft, repair	NC	11.6	NC	12.7	NC	12.1	NC	14.8	NC	16.5	NC	9.7
operators, fabricators, laborers	NC	11.7	NC	14.4	NC	9.9	NC	10.0	NC	11.8	NC	12.9
INDUSTRY (selected)												
agric., mining	4.7	3.6	12.5	11.2	N/A	6.2	N/A	19.4	N/A	16.8	N/A	8.1
construction	9.3	7.2	10.6	9.1	23.6	11.2	20.4	14.3	13.6	12.3	2.6	5.0
manufacturing	10.9	7.9	15.0	8.3	1.0	1.9	3.2	1.2	2.3	5.1	29.3	8.1
retail trade	17.4	19.9	14.8	17.5	13.1	23.6	8.9	18.4	15.9	13.8	2.9	7.0
financ., real estate	5.0	7.6	2.8	5.7	4.0	8.6	3.5	4.5	3.5	7.6	1.1	2.3
personal, entertain. & recreat. services	8.5	9.2	11.2	10.9	N/A	20.7	N/A	15.2	N/A	16.0	N/A	31.4
health, edu, & professional	17.2	17.7	14.1	16.7	7.8	11.4	18.3	13.1	13.9	14.8	14.7	20.5
public admin'n.	11.4	10.0	6.5	7.3	4.2	2.7	3.7	4.8	3.1	2.1	5.5	8.1
COMMUTE TO WORK												
45 minutes or more	N/A	13.5	N/A	6.0	N/A	4.8	N/A	6.8	N/A	13.9	N/A	22.6
mean travel (min.)	N/A	21.5	N/A	16.5	N/A	16.4	N/A	20.6	N/A	21.7	N/A	24.1

NOTES: All figures based on 15 sample; hence, numbers represent estimates.
"N/A" = "not available" in published form. "NC" = 1970 categories or bases "not comparable" to 1980 Census.

SOURCES: U.S. Bureau of the Census, 1970 Census of Population and Housing--Census Tracts--Honolulu, Hawaii, PHC(1)-88; 1980 Summary Tape File 3-A; State of Hawaii, 1973, Community Profiles for Hawaii.

Continuing West Hawaii resort development would suggest even more concentration in tourism today, as well as more intensive use of available workers. Preliminary results of the 1988 "Tourism Impact Management System" survey by the Department of Business and Economic Development (1989) indicate:

- The percentage of employed workers who consider themselves "in the visitor industry" was around 40% in Kona and 35% in Kohala, compared to an islandwide figure of just 25%.
- North Kona's civilian labor force participation rate is now close to 80% -- i.e., four out of every five potential workers aged 15 or above now holds a job or is actively seeking one.
- West Hawaii workers (particularly those in North Kona) are more likely than those in East Hawaii to work more than 48 hours a week and to work standard evening and/or weekend hours.

2.1.3 Population Levels and Composition

West Hawaii has been one of the fastest growing areas in the State of Hawaii. As shown in Table 2-B, its population nearly tripled from 1970 to 1988 (from 14,500 to 40,700). The growth rates have been particularly high in North Kona and South Kohala, sites of major resort development in the 1970's and 1980's. Growth in South Kona has essentially just matched the islandwide rate. In North Kohala, there was no growth from 1970 to 1980 and only modest estimated population increases since 1980.

As of 1980, North Kona was the only district in Hawaii County where a majority of the population consisted of Caucasians. (See Census data in Table 2-C.) Nearly a quarter of North Kona's population at that time had been living on the Mainland five years previously, and 40% had been Mainland-born -- much larger percentages than for the county as a whole.

Substantial in-migration from the Mainland is also apparent in the 1980 Census data for South Kohala. By contrast, South Kona and North Kohala had a more ethnically mixed population, including more people born in Hawaii (more than 70% each).

Although there have been anecdotal reports of a surge of retirees moving to West Hawaii in the 1980's, the earlier Census data indicate that North Kona and South Kohala had relatively few senior citizens in 1980. The more youthful North Kona/South Kohala population was better educated, on average, than populations elsewhere on the Big Island. By contrast, the aging North Kohala population had lower than average educational levels.

TABLE 2-B: POPULATION TRENDS, STATE OF HAWAII, COUNTY OF HAWAII, AND STUDY AREA, 1970 - 1988

	April 1, 1970	April 1, 1980	Est. July 1, 1988
North Kona District	4,832	13,748	21,600
South Kona District	4,004	5,914	7,500
South Kohala District	2,310	4,607	7,900
North Kohala District	3,326	3,249	3,700
Total West Hawaii Study Area	14,472	27,518	40,700
County of Hawaii	63,468	92,053	117,500
State of Hawaii	769,913	964,691	1,098,200

	AVERAGE ANNUAL RATE OF GROWTH		
	1970-1980	1980-1988	1970-1988
North Kona District	11.0%	5.6%	8.6%
South Kona District	4.0%	2.9%	3.5%
South Kohala District	7.1%	6.8%	7.0%
North Kohala District	-0.2%	1.6%	0.6%
Total West Hawaii Study Area	6.6%	4.9%	5.8%
County of Hawaii	3.8%	3.0%	3.4%
State of Hawaii	2.3%	1.6%	2.0%

Source: Hawaii State Department of Business and Economic Development, 1988, and unpublished tables for the 1989 Data Book.

TABLE 2-C: TOTAL POPULATION AND DEMOGRAPHIC BREAKDOWNS -- STATE AND COUNTY OF HAWAII, AND WEST HAWAII DISTRICTS, 1970 AND 1980

	STATE OF HAWAII		COUNTY OF HAWAII		NORTH KONA		SOUTH KONA		SOUTH KOHALA		NORTH KOHALA	
	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980
	#	#	#	#	#	#	#	#	#	#	#	#
TOTAL POPULATION	769,913	964,691	63,468	92,053	4,832	15,748	4,004	5,914	2,310	4,607	3,326	3,249
	%	%	%	%	%	%	%	%	%	%	%	%
ETHNICITY:												
Caucasian	38.8	34.4	28.8	35.0	44.0	53.8	17.7	30.0	39.2	44.5	25.6	27.8
Japanese	28.3	24.9	37.5	26.6	23.1	11.8	39.6	27.5	24.4	14.6	23.8	14.1
Chinese	6.8	5.8	2.9	1.7	3.7	1.6	0.8	0.8	1.3	1.4	4.3	1.0
Filipino	12.2	13.7	16.5	15.9	8.4	7.2	24.2	13.0	6.6	5.6	29.2	24.0
Hawaiian	9.3	12.3	12.3	18.8	19.3	22.1	14.7	25.5	24.4	28.5	13.3	26.7
Other	4.6	9.0	2.0	4.1	1.5	3.5	1.0	3.2	2.0	3.4	1.7	6.4
AGE												
Less than 5 yr.	9.2	8.1	8.6	9.1	9.1	9.1	9.0	9.8	9.3	10.2	10.0	9.2
5 - 17 yr.	26.6	20.5	27.8	21.5	27.0	20.3	29.8	20.7	28.3	23.6	29.4	22.9
18 - 64 yr.	58.5	63.5	54.4	59.2	55.7	63.9	48.9	58.8	54.1	58.6	51.1	54.4
65 or more yr.	5.8	7.9	9.2	10.2	8.2	6.7	12.4	10.6	8.4	7.7	9.5	13.6
Median age (yr.)	25.0	28.4	28.9	29.6	28.6	28.9	29.7	29.7	28.1	29.3	27.3	31.9
PLACE OF BIRTH												
Hawaii	NC	57.8	NC	70.5	NC	54.4	NC	71.2	NC	64.9	NC	75.6
Other U.S.**	NC	28.0	NC	20.0	NC	39.9	NC	20.8	NC	30.4	NC	13.6
Foreign country	NC	14.2	NC	9.6	NC	5.7	NC	7.8	NC	4.7	NC	10.8
RESIDENCE 5 YRS. PREVIOUS* (people aged 5+)												
Same house	44.0	49.3	42.5	52.9	51.1	38.8	54.1	57.4	45.6	50.7	49.9	48.9
Same island	NC	25.2	NC	24.9	NC	28.1	NC	22.9	NC	17.3	NC	12.1
Different island	NC	2.8	NC	8.1	NC	7.0	NC	6.5	NC	14.9	NC	4.4
Different state	NC	16.9	NC	11.1	NC	23.1	NC	10.7	NC	16.4	NC	11.6
Different country	NC	5.9	NC	3.1	NC	3.0	NC	1.2	NC	0.7	NC	3.1
EDUCATION (people aged 25+)												
0-8 years only	24.8	16.2	37.2	20.1	28.9	8.0	26.1	25.6	24.1	8.6	44.2	29.0
Hi school only	35.9	35.1	31.6	35.5	44.0	40.9	21.9	33.8	34.2	37.0	30.0	39.0
College, 4+ yr.	14.0	20.3	7.5	15.2	8.8	18.8	6.4	12.4	13.1	20.7	5.9	8.1

Notes: *Figures based on 15% sample; hence, numbers represent estimates.
**Including persons born in U.S. territories, and persons born abroad or at sea to American parents/a.
"NC" = 1970 categories or bases "not comparable" to 1980.

Sources: U.S. Bureau of the Census, 1970 Census of Population and Housing--Census Tracts--Honolulu, Hawaii, PHC(1)-88; 1980 Summary Tape Files 1-A and 3-A; State of Hawaii, 1973, Community Profiles for Hawaii.

2.1.4 Housing Stock

Housing in West Hawaii (with the possible exception of North Kohala) is now considered to be in very short supply, leading to crowding and to high rentals and sales costs.

During the 1980's, the West Hawaii housing inventory grew more slowly than the resident population, meaning that more people must share living quarters. From 1980 - 1988, population increased by more than 48% (Table 2-B). However, County figures in Table 2-D indicate that, even by March 1989, the total West Hawaii housing unit inventory had increased by only 26%. Moreover, over 40% of the new units were visitor units. In the rest of Hawaii County, proportionate growth in housing units more closely matched growth in population.

Furthermore, Hawaii Visitors Bureau data indicate that nearly 2,000 of the 16,000 West Hawaii housing units are actually condominiums for visitor use. (Condominiums in resort areas may be made available for visitor use during peak travel years, then revert to long-term residential rentals when tourism declines.) An unknown number of West Hawaii single-family homes may also now be reserved for visitor rentals or second homes.

In 1988, the average resale price for a single-family home was about $160,000 in West Hawaii, but less than $95,000 in the rest of the county. Of all Hawaii County single-family homes sold for $175,000 or more in 1988, 89% were in West Hawaii (Neighbor Island Multiple Service Data Base).

Table 2-E contains additional descriptive information from past Censuses:

- o High housing costs in West Hawaii are not new. North Kona rentals and median values were already about 50% higher than countywide figures in 1980. (However, North Kohala housing costs were lower than average for the Big Island in 1980.)
- o Available rentals were also in relatively short supply in most of West Hawaii ten years ago. (North Kona's apparently high proportion of units available for rental reflects the inventory of visitor-oriented condominiums, as opposed to residential properties.)
- o Crowding and plumbing-deficient houses were most apparent in South Kona, due in part to the aging housing stock there.

2.1.5 Lifestyle and Values

Historically, the Kona Coast has been populated by highly independent and individualistic people.

TABLE 2-D: HOUSING UNIT INVENTORY, COUNTY OF HAWAII AND WEST HAWAII DISTRICTS, 1980 AND 1989

	1980	1989	% Change, 1980-1989
WEST HAWAII			
North Kona			
-- Single-Family	4,105	5,322	29.6%
-- Duplex	122	146	19.7%
-- Multi-Family	2,934	4,109	40.0%
-- Other	379	N/A	
-- District Total, All Units	7,540	9,577	27.0%
South Kona			
-- Single-Family	1,631	1,974	21.0%
-- Duplex	28	34	21.4%
-- Multi-Family	48	88	83.3%
-- Other	15	N/A	
-- District Total, All Units	1,722	2,096	21.7%
North Kohala			
-- Single-Family	1,092	1,235	13.1%
-- Duplex	12	14	16.7%
-- Multi-Family	7	7	0.0%
-- Other	11	N/A	
-- District Total, All Units	1,122	1,256	11.9%
South Kohala			
-- Single-Family	1,692	2,236	32.2%
-- Duplex	10	84	740.0%
-- Multi-Family	511	653	27.8%
-- Other	5	N/A	
-- District Total, All Units	2,218	2,973	34.0%
TOTAL STUDY AREA			
-- Single-Family	8,520	10,767	26.4%
-- Duplex	172	278	61.6%
-- Multi-Family	3,500	4,857	38.8%
-- Other	410	N/A	
-- TOTAL, ALL UNITS	12,602	15,902	26.2%
REST OF COUNTY			
-- TOTAL, ALL UNITS	22,370	26,287	17.5%
HAWAII COUNTY			
-- TOTAL, ALL UNITS	34,972	42,189	20.6%

NOTE: "N/A" -- Category no longer used by County.

SOURCE: Data file, Land Use Inventory, County of Hawaii Planning Department, March 1989

TABLE 2-E: HOUSING STOCK AND CHARACTERISTICS -- STATE AND COUNTY OF HAWAII; AND WEST HAWAII DISTRICTS, 1970 AND 1980

	COUNTY OF HAWAII		NORTH KONA		SOUTH KONA		NORTH KOHALA	
	1970	1980	1970	1980	1970	1980	1970	1980
TOTAL YEAR-ROUND HOUSING UNITS	18,939	33,954	1,975	6,894	1,131	2,052	796	1,959	941	1,121
	%	%	%	%	%	%	%	%	%	%
vacant (total)	9.0	13.9	27.4	33.3	6.4	9.7	18.5	24.3	6.6	8.6
vacant for sale	0.6	1.3	3.2	3.2	0.0	2.9	0.1	2.9	0.7	0.3
vacant for rent	2.0	5.5	8.3	18.9	0.3	2.1	1.9	4.1	1.1	1.6
TOTAL YEAR-ROUND OCCUPIED UNITS	17,260	29,237	1,431	4,602	1,059	1,853	650	1,483	879	1,022
TENURE	%	%	%	%	%	%	%	%	%	%
owner-occupied	56.9	60.6	44.7	55.1	36.9	52.7	48.8	59.3	66.6	67.7
renter-occupied	43.1	39.4	55.3	44.9	63.1	47.3	51.2	40.7	33.4	32.2
SELECTED CONDITIONS										
lacking some or all plumbing	17.1	6.4	26.3	7.3	55.8	28.4	15.4	2.0	17.6	7.3
1.51 or more persons/room	6.5	5.0	14.1	6.1	13.1	10.1	8.2	5.3	9.7	3.1
PERSONS/HOUSEHOLD	3.61	3.09	3.36	2.92	3.71	3.14	3.51	3.07	3.75	3.16
1980 MEDIAN RENT (renter-occupied)	N/A	$225	N/A	$331	N/A	$200	N/A	$307	N/A	$153
1980 MEDIAN VALUE* (owner-occupied)	N/A	$70,300	N/A	$114,000	N/A	$102,600	N/A	$95,700	N/A	$64,200

NOTES: * Median values are for non-condominium housing units.
N/A: "not available."

SOURCES: U.S. Bureau of the Census, 1970 Census of Population and Housing--Census Tracts--Honolulu, Hawaii, PHC(1)-86; 1980 Summary Tape File 1-4; State of Hawaii, 1973, Community Profiles for Hawaii.

The "City of Refuge" National Park was the site of one of several havens for breakers of ancient Hawaiian kapu's. In the late 19th and early 20th centuries, people fleeing plantation labor contracts elsewhere on the island often fled to Kona. In the mid-20th century, small family-farm operators and fishermen maintained the tradition of independent lifestyles.

By contrast, neighboring South Kohala was historically a much more close-knit community, following establishment of the Parker Ranch in the 1800's. In the manner of the times, Ranch managers exercised paternalistic control over many aspects of employees' lives, including provision of housing and health care.

In the past several decades, the transition from an agricultural to a service-based economy -- along with substantial in-migration and demographic shifts -- has modified these patterns. South Kohala's social fabric has become more diverse and independent, while Kona residents now are somewhat more likely to belong to some common social or economic institutions (e.g., labor unions at major hotels).

Nevertheless, Kona residents are still regarded as very different in lifestyle and values from the more populous East Hawaii area, where plantation life has left a legacy of more communal values. Some of Kona's characteristics include:

- A tradition of more political conservatism than found elsewhere on the island, as indicated by a heavier Republican vote;
- A residential pattern of small villages -- with no one major urban center -- generally removed from the major employment centers in the coastal resorts;
- A wide diversity of community associations, service organizations, and business groups, with few common linkages (although a "Greater Kona Community Council" has just been initiated in late 1989).

Some quantified indications of lifestyle and values are provided by preliminary results of a 1988 State survey with separate samples for North Kona, Kohala, South Kona/Ka'u, and other Big Island areas. Asked why they chose to live in their part of the island, North Kona residents were much more likely than other Big Island residents to talk about "convenient location," "climate," or Kona's "outdoor character" -- much less likely to refer to family or other longtime "roots" (Table 2-F).

TABLE 2-F: REASONS FOR CHOOSING TO LIVE IN VARIOUS PARTS OF THE BIG ISLAND

Question: "Why did you choose to live in THIS PART of the island?"

(Answers were given in respondents' own words, then later coded into categories. Percentages sum to more than 100% because more than one answer could be given.)

	North Kona	N. & S. Kohala	S. Kona Ka'u	Hawaii County
convenient/close to jobs, schools, shopping, etc.	34%	27%	22%	27%
climate/health	31%	25%	13%	16%
family/roots in area	21%	39%	37%	32%
lack of congestion, traffic	20%	24%	27%	24%
outdoor character of area	15%	23%	8%	10%
social character of area	12%	8%	3%	6%
(no sense of choice)	8%	5%	10%	9%
housing value/affordability	5%	3%	3%	11%
like neighborhood character	1%	1%	2%	1%
non-replies	2%	1%	1%	3%
Survey Base:	168	152	155	789

SOURCE: Hawaii State Department of Business and Economic Development, Tourism Branch, 1989. (Preliminary Results)

2.2 FORCES FOR CHANGE

Following is a review of future changes expected to occur with or without the proposed QLT Keahuolu Lands project.

2.2.1 Quantitative Projections

Countywide: The State of Hawaii's official "M-K Series" forecast for the period through year 2010 (as shown in Table 2-G) indicate substantial economic and population growth for Hawaii County:

- Resident population increasing by 75% over the estimated 1988 figure of 117,500, to reach 180,800 persons by the year 2005 and 206,100 by year 2010;
- The visitor count more than tripling, to reach 36,900 in 2010;
- An ongoing shift in the distribution of jobs, with fewer people working in agriculture and more in tourism (hotels, eating and drinking);
- Per capita personal income increasing by 40% from 1990 to 2010, to an average of $13,600 (1982 dollars).

West Hawaii: Projected massive growth in West Hawaii's visitor industry is expected to produce major increases in employment and population.

For example, the West Hawaii Regional Plan (Office of State Planning, 1989) estimated current West Hawaii "resort units" (hotel plus condominiums) at 7,429 -- a figure which would increase to 39,009 if all planned and proposed resort developments were to build out. (The report assumes the actual build-out figure by the year 2005 would be just 25,279 units, which is still nearly three and a half times the existing inventory.)

Unpublished projections made by the Hawaii County Planning Department in April 1989 assumed only slightly slower growth -- a total of about 26,000 visitor units (13,600 hotel rooms plus 12,400 resort condominiums) by the year 2010. More than 60% of these are assumed to be located in North Kona; most of the rest in South Kohala; and only a handful in South Kona or North Kohala.

In terms of population and employment, the State's M-K projections apply only to the county level. However, several other documents (all roughly compatible with the M-K projections at the countywide level) do give forecasts for West Hawaii in particular. These include:

TABLE 2-G: OFFICIAL STATE POPULATION AND ECONOMIC PROJECTIONS FOR HAWAII COUNTY, 1990 - 2010

	1990	1995	2000	2005	2010
Resident Population	124,600	142,500	160,400	180,800	206,100
Average Daily Visitor Population	11,400	17,900	24,700	32,600	39,600
Civilian Jobs:	50,800	59,300	68,200	78,300	89,800
Jobs in Selected Industries: *	%	%	%	%	%
Agriculture	8.6%	7.5%	6.6%	5.8%	5.2%
Construction	3.7%	3.7%	3.7%	3.6%	3.6%
Trade (excluding eating/drinking)	16.9%	16.7%	16.8%	16.8%	16.7%
Eating and Drinking	8.8%	9.8%	10.7%	11.7%	12.5%
Banking, Finance	3.9%	3.7%	3.7%	3.8%	3.8%
Services	26.9%	28.7%	30.0%	30.9%	31.8%
-- Hotels	--12.1%	--12.4%	--12.5%	--12.7%	--12.8%
Government	18.8%	18.3%	18.0%	17.5%	17.1%
Personal Income (millions of 1982 dollars)	1,328	1,643	1,965	2,342	2,812
Per Capita Income (1982 dollars)	10,700	11,500	12,300	13,000	13,600

NOTE: * Percentages of wage and salary workforce (excluding the self-employed).

SOURCE: Hawaii State Department of Business and Economic Development, 1988.

(1) The Hawaii County Planning Department's General Plan contains three series of population and visitor industry projections. The lowest of these ("Series A," the current basis for County infrastructure planning) indicates a year 2005 countywide population of 173,000, slightly lower than the M-K figure of 180,800. Projected distribution of this total population is:

North Kona	43,250	25%
South Kona	10,899	6%
South Kohala	19,203	11%
North Kohala	5,363	3%
(West Hawaii Subtotal)	(78,715)	(46%)
South Hilo	44,115	26%
Puna	39,790	23%
Rest of East Hawaii	10,380	6%
COUNTY TOTAL	173,000	100%

Additionally, the County Planning Department's unpublished April 1989 projections anticipate that about 53% of the island's employment will be located in West Hawaii (primarily North Kona and South Kohala) by the year 2010.

(2) The Office of State Planning's West Hawaii Regional Plan also extends to the year 2005. It projects a year 2005 countywide population of 170,400 and a West Hawaii population of 79,000 -- figures highly compatible with the General Plan "Series A" and preliminary draft M-K forecasts. The plan also assumes 25,900 new countywide jobs resulting from West Hawaii resort development, but does not attempt to predict what portion of these jobs will be in West Hawaii.

(3) The market assessment for QLT's Keahuolu Lands project (Natelson, Levander, Whitney, Inc., 1989) is based on the final M-K projections, extrapolated to the year 2020, with additional assumptions and projections for West Hawaii. It projects a slightly higher year 2005 West Hawaii resident population (87,005) than do the West Hawaii Regional Plan or the County Series A projections, but is otherwise consistent with them. That is, all three assume the West Hawaii population will, roughly, double by 2005.

Table 2-H contains a summary of key assumptions and results from this market assessment.

Based primarily on Table 2-H and the M-K projections, as well as current employment estimates, Community Resources Inc. (CRI) has developed some additional projections of future West Hawaii jobs and labor supply, for the years 2005 and 2020. These are shown in Table 2-I.

TABLE 2-H: PROJECTED WEST HAWAII SOCIAL AND ECONOMIC TRENDS

	1990	1995	2000	2005	2010	2015	2020
Resident Population							
-- North Kona	24,276	31,966	40,798	52,069	61,830	72,292	84,416
-- South Kona	7,853	8,885	10,053	11,373	13,397	15,741	18,466
-- North Kohala	3,892	4,416	4,996	5,653	6,492	7,346	8,310
-- South Kohala	8,641	11,026	14,072	17,960	21,641	26,818	32,975
-- West Hawaii Total	44,662	56,293	69,919	87,055	103,359	122,197	144,167
Share of Total County Resident Population	35.8%	39.5%	43.6%	48.1%	50.2%	52.4%	54.7%
Average Daily Visitor Population	13,578	17,192	21,411	25,486	29,664	34,397	39,842
Cumulative Demand for New Housing (since 1988)							
Residents	1,778	6,449	11,902	18,730	25,233	32,728	41,452
Visitors	619	1,643	2,838	3,992	5,176	6,517	8,059
Total	2,397	8,092	14,740	22,722	30,409	39,245	49,511
Total Resident Demand for Retail Goods (as % of 1988 demand)	114%	156%	209%	281%	359%	457%	580%
Per Capita Resid. Demand for Retail Goods (1988 = 100)	103	112	120	130	140	151	162
Total Visitor Demand for Retail Goods (as % of 1988 demand)	120%	153%	190%	226%	263%	305%	354%
Per Capita Visitor Demand for Retail Goods (1988 = 100)	120	120	120	120	120	120	120
Resident Share of Retail Demand	41%	43%	45%	48%	50%	53%	55%

Note: "West Hawaii" includes North Kohala, South Kohala, North Kona, and South Kona. (These projections deal with a larger area than the State's West Hawaii Plan, which excludes South Kona.)

Source: Natelson, Levander, Whitney, Inc., 1989.

TABLE 2-1: NATURAL GROWTH AND IN-MIGRATION OF LABOR FOR WEST HAWAII, 1988-2020

West Hawaii	1988	Projected 2005	Projected 2020	1988-2005 Change	2006-2020 Change	1988-2020 Change
Natural Increase in Population						
Projected by:						
Growth Rate Trend Model (1)	40,700	48,201	55,960	7,500	7,800	15,300
Age-Cohort Model (2)	40,700	50,055	54,518	9,400	4,500	13,900
Average of Methods	40,700	49,100	55,200	8,400	6,100	14,500
Hawaii County Civilian Jobs (3)	54,600	78,300	118,400	23,700	40,100	63,800
Civilian Jobs Located in West Hawaii (4)	20,000	37,500	65,200	17,500	27,700	45,200
Required Labor Force (at 0.9525 workers/job, 5% unemployment, as per M-K assumptions)	20,100	37,600	65,400	17,500	27,800	45,300
Natural Increase in Labor Force in West Hawaii (5)	19,100	21,400	24,600	2,300	3,200	5,500
Assumed Net In-Commuters	1,000	1,000	1,000	0	0	0
Required Net In-Migrant Labor	0	15,200	39,800	15,200	24,600	39,800
Percentage of Total New West Hawaii Jobs Filled by:						
-- Natural Increase, 1988 Population				13.1%	11.5%	12.1%
-- Net In-Migration				86.9%	88.5%	87.9%

NOTES:

(1) Natural growth rate of 10 per 1000 persons characteristic of West Hawaii trends, 1980-88.

(2) CRI Age-Cohort Model, December 1989.

(3) 2005 figure from M-K County Projections and 2020 figure extrapolated. 1988 figure estimated from DLIR data on employed workforce.

(4) Figure for 1988 is CRI estimate, adjusting DLIR figures for actual growth. Future years based on projected share of new population: 74% for 1988-2005; 69% for 2006-2020. Matelson-Levander-Whitney, Inc., 1989, p. 42.

(5) Based on natural increase in population and using a labor force per 1,000 population rate of 43.5% for 2005 and 44.5% for 2020.

These figures may somewhat overestimate the amount of net in-migrant labor required. The M-K County projections assume much lower labor force participation rates for Hawaii County than for other counties. If the 2005 participation rate for the Big Island matches that projected by the M-K model for Maui, the proportion of new jobs to be filled by net-inmigrants would drop from 87% to 60%.

The CRI analysis results in a total projected West Hawaii jobcount of 37,500 for the year 2005 and 65,200 for 2020. New labor supply resulting from natural increase (excess of births over deaths) in the existing West Hawaii population -- as measured by two separate methods producing highly similar results -- would be able to fill only about 13% of the new jobs from now until 2005 and a little under 12% of the projected new jobs from 2006 to 2020. If there is no increase in commuting from East Hawaii, the remaining 88% of the new jobs would have to be filled by net in-migration (that is, more people moving into West Hawaii than moving away).

As the table notes, however, the actual proportion of jobs going to net in-migrants may be somewhat lower, perhaps only 60% by 2005. That is because the analysis is based primarily on M-K assumptions for Hawaii County, and these assumptions include very low rates of labor force participation compared to other counties. If existing residents and their children absorb more jobs, fewer in-migrants will be needed.

The analysis deals with a long period, and does not distinguish recent in-migrants from ones who have lived in the area for decades. If in-migrants come to take West Hawaii jobs at a constant pace, recent in-migrants, who have lived 5 years or less in West Hawaii, would account for about 16% of the 2005 workforce, and 10% of the 2020 workforce.

2.2.2 Qualitative Changes in West Hawaii

The social impacts of the preceding quantitative changes will depend in large part on (1) geographical distribution of growth; (2) location and timeliness of development of infrastructure (including housing); and (3) characteristics of in-migrant workers.

Geographical Distribution of Growth: This is still being determined through the government land use process, but several documents provide indications of broad policies. First, both the County and market assessment projected distributions of population indicate that West Hawaii growth will be concentrated primarily in North Kona and secondarily in South Kohala. Second, the West Hawaii Regional Plan calls for development of a major new support community in Kealakehe (just north of the mauka Keahuolu Lands), as well as South Kohala development at Waikoloa, Lalamilo, and Kawaihae. Third, the Hawaii County Planning Department's Draft Keahole to Kailua Development Plan (focusing only on North Kona from Palani Road to the airport) envisions four new "residential villages," separated by greenbelts, at Kealakehe and points north, substantially mauka of the Queen Kaahumanu Highway. An open space greenbelt would separate the new residential areas from Kailua Village.

The foregoing addresses distribution of residential growth only. The West Hawaii Regional Plan calls for resort development to be distributed among various coastal "nodes" -- two in North Kona (Keahole-Keauhou and Kaupulehu-Kukio) and two in South Kohala (Mauna Kea and Waikoloa-Mauna Lani). This is roughly consistent with County General Plan designations.

The geographical location of new commercial/office space is the final major land use issue to be decided. The QLT Keahuolu Lands proposal for a Regional Center represents one alternative.

The Draft Keahole to Kailua Development Plan suggests another possible location for a Regional Center -- just north of Keahuolu, on the lower part of the State's Kealakehe lands, just mauka of the highway from the Honokohau Harbor. However, County officials have acknowledged that this location must be shifted in order for the State's proposed Kealakehe development to proceed. Another possibility is that no Regional Center will be created; rather, future commercial/office development might be dispersed rather than concentrated in West Hawaii.

Infrastructure Development (location and timeliness) is the second major qualitative determinant of West Hawaii's future. As discussed further in the following section on resident issues and concerns, lack of affordable housing and congested highways are already major sources of unhappiness in the Kona area, contributing to a sense of declining quality of life despite economic advances. The magnitude of growth now being planned for West Hawaii could intensify these social impacts, unless solutions are found.

Both the State and County governments are currently in the process of exploring various mechanisms (impact fees, taxing authority, etc.) to assure that physical and social infrastructure development no longer lags far behind population growth in the future. For purposes of this impact assessment, it must be assumed that some solution to the timeliness problems will be found; otherwise, the projected growth is unlikely to occur.

In terms of location for new affordable housing and roads:

- State and County planners are currently debating new North Kona road alignments. One aspect of the Draft Keahole to Kailua Development Plan is a new shoreline road from Honokohau Harbor through QLT lands (including the Keahuolu Lands) to Kailua Village. The plan also calls for a new Queen Kaahumanu bypass road and a Palani bypass road, each to loop mauka of the present roads.

- The State's proposed Kealakehe development represents the major current initiative to provide below-market housing. Conceptual plans call for eventual development of 3,000 to 4,000 new units, of which at least 60% would meet legal definitions of "affordable."

Characteristics of New In-Migrant Population comprise the third major determinant of social impacts from future West Hawaii growth. Two components may be identified:

- Relatively affluent retirees and second-home owners could increase the gap between "have's" and "have-not's" in West Hawaii, although they may also contribute to local charities and cultural facilities (as has recently occurred in Maui).

  The West Hawaii Regional Plan estimates that under ten percent of resort-induced population growth will be on-site resort residents, whose isolation from the general community would probably reduce any impacts, positive or negative. Undetermined, however, is the likely future number or geographic distribution of off-resort wealthy in-migrants, who would have more direct impacts on residential real estate values and the fabric of community life.

- In-migrant workers, as earlier noted, will be required to fill anywhere from 60% to 90% of new West Hawaii jobs. The question remains as to where these in-migrant workers will come from. Two deliberately extreme scenarios illustrate the range of possible futures:

  -- All future in-migrants are from the Mainland. The ethnic distribution in West Hawaii would probably be concentrated even more heavily among Caucasians. Since previously discussed projections assume that West Hawaii residents will comprise a majority of the Big Island population in about 20 years, the socio-political impacts could be islandwide. As noted below, the M-K forecasts also imply some eventual net in-migration to East Hawaii, but a much lower level. Thus, it may be expected that there previously discussed differences in values and lifestyles between East and West Hawaii residents would grow even greater.

  -- All future in-migrants are from Hawaii. This would substantially mitigate some of the social impacts of rapid population growth.

  However, the methods used for the labor supply analysis in Table 2-I would also indicate that projected new jobs in East Hawaii -- while fewer in number than in West Hawaii -- will (1) absorb all or most of natural increase in labor supply through 2005, and (2) require net in-migration to East Hawaii after 2005.

  Thus, any future "Hawaii in-migrants only" scenario must assume substantial migration from Oahu to both

West Hawaii and also the rest of the Big Island. The M-K model projects future Oahu job growth at a rate slightly less than observed natural population increase during the 1980's, so there is the possibility of some surplus labor from Oahu. However, it must be recognized that the three Neighbor Island counties would be in competition for any Oahu surplus, since the State M-K model estimates that 50% to 60% of the statewide population growth by 2010 will be due to net in-migration from outside Hawaii.

In reality, West Hawaii in-migrant workers will probably come from a variety of locations, including as well some returning former Hawaii residents, foreign nationals, Pacific Islanders, and non-Caucasian Mainlanders. (In fact, deliberately imported laborers to Neighbor Islands in recent months have included Micronesian and Mexican-American agricultural workers.) And, while not desired, setbacks in other parts of the economy -- such as sugar in East Hawaii or military-related employment on Oahu -- could also provide additional labor supply for West Hawaii.

In short, the exact composition of the in-migrant workforce 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 overall population composition over the next 15 to 30 years.

3.0 COMMUNITY ISSUES AND CONCERNS

This section documents contemporary community issues and concerns of direct or indirect relevance to the proposed project:

- o Background issues independent of the project, but which may affect both community response and actual social impacts;
- o Project-specific preliminary concerns raised by some 73 community leaders interviewed for this study.

3.1 METHODS

Conclusions in this section are based on:

(1) Secondary data such as community surveys or published newspaper articles;

(2) Original community interviews conducted for this study (primarily in the North Kona area).

Most of the community interviews actually involved response to two separate but adjacent projects: QLT's proposed Keahuolu Lands project and the State's proposed Kealakehe housing development to the north. Because portions of these two projects are adjacent and because CRI was separately contracted to conduct social impact assessments for both, the two clients (QLT and the State Housing and Finance Development Corporation) agreed to the simultaneous community interview process.

During the interview period, it was assumed that all residential construction would be part of the Kealakehe project. The land area allocated for single-family residential use in the QLT project was treated as part of an affordable residential development, so Kona residents did comment on possible residential development of that acreage.

Appendix A lists the 73 "key informants" who were interviewed. These individuals were selected on the basis of knowledge of the community and/or being tentatively identified as belonging to some potentially affected interest group such as nearby residents, business operators, Hawaiians and community leaders. Appendix A lists organizational affiliations in order to indicate some of the networks or interests of those interviewed. However, informants spoke as individuals and not as representatives of their organizations.

The purpose of the interviews, conducted in October and November 1989, was to identify major community issues and concerns (on a preliminary basis, since many planning details for both projects had yet to be finalized). It was not a random public opinion survey, and no attempt was made to measure the extent of project support or opposition.

Interviews were loosely structured, usually beginning with questions about background issues and them moving to the specifics of the two projects (to the the extent they were known at the time). Informants were told that overall input would be summarized in the social impact reports for the two EIS's, but that individual comments would remain confidential.

3.2 BACKGROUND ISSUES INDEPENDENT OF PROJECT

3.2.1 Information from Surveys and Other Secondary Sources

The most recent community survey shedding light on major issues in West Hawaii was the State Tourism Impact Management System (TIMS) study conducted in latter 1988. Preliminary results shown in Table 3-A indicate that:

- Lack of affordable housing was the top issue throughout the island, but was ranked even more highly in West Hawaii -- and particularly in North Kona, where 76% said it was a "big problem" for that part of the island.

- Cost of food/clothing and traffic congestion were the next most important North Kona issues, rated as "big problems" by nearly 50%.

  For virtually all the issues on the list (except lack of jobs or urban amenities), North Kona residents were more likely than people elsewhere on the island to feel there was a serious problem. However, the gap was particularly large for traffic. The proportion of North Kona residents saying this was a "big problem" was twice as much as the rate for the island as a whole.

- Lack of sports/recreation facilities was also counted as a major problem by more than 50% of both North Kona and South Kona/Ka'u residents. This was of much less concern in areas such as Kohala or East Hawaii, where plantations and large ranches built gymnasiums and playing fields in earlier years.

- Environmental and/or crowding concerns (rapid population growth, crowded parks, destruction of natural beauty, pollution) were counted as "big problems" by more than a third of North Kona residents -- higher than in most other parts of the island.

- Overall quality of life was felt to have grown worse over the past five years by about a third of North Kona residents -- compared to only 18% islandwide. (However, 36% of North Kona residents felt it had grown better. Statewide, North Kona was the only heavily resort-

TABLE 3-A: GENERAL COMMUNITY ISSUES AND ATTITUDES, PRELIMINARY 1988 SURVEY RESULTS

	North Kona	N. & S. Kohala	S. Kona Ka'u	Hawaii County
COMMUNITY ISSUES -- %'S RATED "BIG PROBLEM IN YOUR PART OF ISLAND"				
Cost of housing	76%	60%	63%	48%
Cost of food and clothing	58%	41%	57%	44%
Traffic	56%	16%	32%	28%
Not enough sports and recreation facilities	52%	22%	52%	33%
Population growing too fast	43%	31%	29%	22%
Beauty of area being destroyed by development	38%	27%	29%	20%
Pollution of oceans or natural areas	34%	24%	20%	26%
Crowded beach parks	34%	22%	23%	21%
Crime	22%	7%	22%	22%
Lack of nearby jobs	18%	26%	46%	33%
Not enough nearby stores, restaurants, entertain.	12%	22%	24%	18%
Problems between people of different backgrounds	10%	4%	14%	7%
Too many tourists	8%	2%	10%	4%
QUALITY OF LIFE "IN THIS PART OF THE ISLAND" VS. FIVE YEARS AGO				
Today is ... Better	36%	39%	37%	35%
Worse	32%	15%	18%	18%
Same	29%	43%	41%	45%
Not Sure	3%	4%	4%	2%
TOURISM GROWTH -- %'S AGREEING WITH VARIOUS STATEMENTS				
In my part of the island, it's more important to keep things like they are than to have more tourism jobs.	56%	56%	63%	53%
It is time to stop building new hotels on this island.	54%	49%	53%	48%
We need more tourism jobs on this island.	44%	50%	53%	57%
Survey Base:	168	152	155	789

SOURCE: Hawaii State Department of Business and Economic Development, Tourism Branch, 1989. (Preliminary Results)

impacted area in which a few more people felt life had grown "better" rather than "worse." By comparison, in West Maui 63% said "worse" vs. just 16% "better.")

- o Negative attitudes toward further tourism growth were prevalent throughout the island (and the state), but even more so in West Hawaii than elsewhere in Hawaii County. Statewide preliminary TIMS results indicate such attitudes largely reflect growth-related problems.

Both the TIMS survey and a recent study by the University of Hawaii School of Social Work (Matsuoka et. al., 1988) found that most Kona respondents thought tourism impacts to date had been, on balance, very positive because of the economic benefits. There were, however, strong concerns about continued growth.

The UH Social Work study -- which focused on particular groups rather than the Kona population at large -- also found significant attitudinal differences between business/developer interests on the one hand and environmentalists or human service professionals on the other hand. Longtime Kona residents engaged in farming or fishing were neither as negative as the environmentalists and social workers nor as positive as the business/developer group.

Surveys such as the TIMS study indicate broad background issues for entire populations. Specific controversies may involve a more limited group of people not necessarily representative of the entire population, but these individualized issues are often related to the more general themes.

A review of major Big Island publications (particularly the newspapers West Hawaii Today and the Hawaii Tribune-Herald) indicate a great variety of such issues and controversies relating to the North Kona area. A sampling from the latter part of 1989 would include:

- o Plans for a commercial rocket launching facility in Ka'u produced strong public reaction in Kona. Some residents expressed concern with impacts on air quality, and consequently health, plant life, and the visitor industry. Another issue was the possibility of the island becoming a military target.

- o A proposal to build a gymnasium on the State-managed part of the Old Airport Park and the subsequent decision by the County to build it on the County-leased section of the park were debated. Many thought that accessible sports facilities are much needed, and the Old Airport Park is a good site for these. Others thought the Park should remain dedicated to passive uses.

- o The police in the Kona Station have complained that fumes from the adjacent dump enter the station and affect their health. (Community interviewees cited this as an example of poor government planning in Kona. See Sections 3.2.2 and 3.3.)

- o The County review of the ohana zoning law responded to complaints in Kona that developers were creating double density, residential condominiums. Residents were concerned that developers are able to sell many extra units, straining the infrastructure.

3.2.2 Information from Community Interviews for This Study

As previously discussed, community interviews for this study included questions about issues and concerns independent of (although potentially related to) the proposed QLT project.

The major issues emerging from these interviews were all generally linked to rapid growth and its control or management. They can be classified into three broad categories:

- o Physical planning and infrastructure;

- o Social infrastructure; and

- o Socio-political concerns.

Physical Planning and Infrastructure

(1) General Patterns of Future Growth: County and State planning efforts have focused community attention on broad questions about patterns of future urbanization. There were different views about how Kona should grow, but most people seemed to feel that Kailua and areas north to the airport would be and/or should be a major focus of growth. There was a feeling that past growth around Kailua has been unplanned and haphazard.

(2) Preserving Coastal Areas for Public Use: A frequent theme during interviews was opposition to any substantial private development of coastal areas (whether sand beach or lava cliffs) north of Kailua.

(3) Traffic and Transportation Planning: A number of people suggested that traffic congestion is now the Number One problem in the Kailua area. Palani Road was felt to be particularly overburdened, and it was predicted that "people would start shooting" if there were any disruption to or further crowding of Palani Road.

Informants had many suggested solutions, including new roads in various locations, bike lanes, and public transportation.

However, there was sharp disagreement between those who felt public buses were badly needed for the elderly and/or school children and those who said public transportation would surely fail because of Kona residents' love affair with automobiles.

(4) Water and Sewer Capacity: In addition to recognizing the key role of such infrastructure in guiding future growth, many informants expressed concern about the true extent of water resources -- either total capacity or government resources for maintenance and delivery. There were concerns about water contamination (or simple poor taste) from development-caused runoff.

Social Infrastructure

(1) Lack of Affordable Housing remains among the most pressing of Kona concerns. Community informants report that costs continue to escalate for both fee-simple and rentals, with some people in the real estate field claiming that rentals have as much as doubled in some areas during the last year alone.

Residents reportedly cope with the housing crisis primarily by taking extra jobs to earn more money, illegal rentals (e.g., converted garages or partitioned houses), and/or sharing housing units with other families. Crowded housing conditions, worker exhaustion, and increased physical and mental health problems were seen as more prevalent due to the situation. Some believed that social ills such as child abuse and incest are also more likely under these conditions.

(2) Lack of Child Care and/or Youth Recreational Opportunities: There are few child care centers for infants or pre-schoolers, although the demand is rising because of the increasing numbers of families in which all parents must work. Older children have few after-school recreational programs, in part due to the lack of gymnasiums and playing fields in the Kona area.

(3) Social Service Overload was reported by government case-workers and administrators who cannot find additional staff to deal with the previously described problems. Educators said that most Kona schools are overcrowded.

Socio-Political Issues

(1) Lifestyle: The transition from an agricultural to a service economy -- coupled with strains from rapid growth -- has resulted in a split between older retirees with the resources for a leisurely life and younger families who must work long hours in relatively low-paying jobs.

Many informants felt that Kona no longer has the "slow-paced" lifestyle which was once central to its charm.

(2) Lack of Community Cohesion: Kona residents often characterize themselves as socially fragmented and contentious. They feel there is no single cohesive "core community," but a series of disconnected groups divided by geography, ethnicity, income, or age. Residents of the "mauka communities" south of Kailua are sometimes seen as more cohesive due to longer years in the community and some shared institutions (clubs, churches, etc.), but these residents constitute a smaller portion of the population as time goes by.

A few of those interviewed expressed optimism that Kona is pulling itself together through efforts such as the new "Greater Kona Community Council."

(3) Government Credibility: A number of informants were frankly suspicious of both State and County government. They questioned government's competence, integrity, and the ability of the State and County to work effectively with one another. The wisdom and effectiveness of recent government planning decisions were held in particular question.

Some longtime Kona residents felt that newcomers can be impatient with the lack of government services, not understanding the economic and logistical difficulties of service delivery to relatively small populations spread out over large distances. However, some people felt government officials "just don't like Kona people" for cultural or political purposes, and deliberately withhold quality service for such reasons.

(4) Queen Liliuokalani Trust Performance: A number of issues were raised concerning the quality and nature of the work the Trust is doing in Kona. People commented unfavorably on maintenance and the appearance of the Queen Liliuokalani Village and the industrial area. They held the Trust responsible for current conditions at those sites.

Some people also felt QLT is not doing enough in the community, particularly when compared to the level of programs several years ago.

3.3 COMMUNITY ISSUES AND CONCERNS WITH REGARD TO THE PROJECT

Table 3-B summarizes the issues raised in the interview. The following text provides a general overview first, followed by more detailed discussion of individual issues and concerns.

TABLE 3-8: COMMUNITY ISSUES AND CONCERNS

CONTEXT FOR EVALUATING THE PROJECT

Rapid Future Growth

Inadequate Infrastructure (Roads, Water, Waste Disposal)

Inadequate Recreational Opportunities

	SPECIFIC ISSUES AND CONCERNS		
	Primary	Secondary	Occasional
The Project as a Planned Development			
	Best alternative for locating regional center		Site thought too close to Kailua village
	Infrastructure work needed early to minimize traffic tie-ups during and after construction		Project differs from the County's plan
	Opportunity for a well designed center for for residents to use	Project could help to revitalize and preserve existing Kailua Village	
	Center could provide residents a greater sense of community	Project keeps Kailua as service center for the West Hawaii region	
	Concern for locating historic sites		
Keahuolu Makai Property			
	Opposition to hotels or resorts in makai section		
	Interest in recreational uses	Concern for keeping open view planes	
Reaction to Specific Proposed Components			
A. Commercial Development	More shops will bring better mix of goods, better prices	Demand for retail thought insufficient; nearby merchants could be harmed	Center location is convenient to other shopping areas
			Build housing first, to increase demand

(Continued)

TABLE 3-8 (Cont.)

	Primary	Secondary	Occasional
B. Office Space	Government office center needed		State has land -- why rent office space?
C. Hospital		Not a good site, too close to Kailua, needs more room	As good a site as any other
D. Business Hotel		Has no impact	Reduces demand for existing Kailua rooms
E. Residential Areas		Must be affordable and price integrated	Elderly housing needed
Anticipated Impacts on Adjacent Uses			
A. Kona Industrial Area	Concern that increased traffic flow will aggravate the entry intersections		
	Area is unattractive, not really industrial, will need improvement to be compatible with the project		
B. Old Airport Park		Need adequate buffer between park and makai parcel	
Queen Liliuokalani Children's Center, Liliuokalani Trust			
	OLT shouldn't sell land		
	OLT's failure to inform community causes rumors	Current programs should be continued - Child welfare services - Papawai Beach camping program	

A wide range of Kona residents was asked to name the issues and concerns important to the local community, and to identify community concerns about the proposed project.

Issues and concerns listed under the heading "PRIMARY" were the most frequently raised comments within the horizontal categories. The number of responses in each category differed. Nearly all commented on the first set of project-specific issues above. Fewer comments were made about each subsequent category. The "SECONDARY" column lists those issues (within a category) that were raised less often, or were considered less significant to the respondents. Issues and concerns listed in the "OCCASIONAL" column were raised by at least three different individuals.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

TABLE 3-8: COMMUNITY ISSUES AND CONCERNS

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Concern for locating historic sites		
Keahuolu Makai Property		
Opposition to hotels or resorts in makai section		
Interest in recreational uses	Concern for keeping open view planes	
Reaction to Specific Proposed Components		
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Queen Liliuokalani Children's Center, Liliuokalani Trust		
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A wide range of Kona residents was asked to name the issues and concerns important to the local community, and to identify community concerns about the proposed project.

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3.3.1 Overview and Context for Evaluation

The preceding discussion of "Background Issues" provides the broad context in which interviewees responded to the Keahuolu Lands proposal. However, three particular issues seemed critical for people: Kona's rapid growth, its infrastructure problems, and the need for more recreational opportunities.

Rapid Growth: Kona area residents largely evaluated the project in the context of future population growth. They viewed continuing growth as inevitable. Most saw the project as an opportunity for a well planned development, which they preferred to unplanned growth.

Once the project's planned nature was recognized, most people interviewed felt the project's location was a valuable asset. The majority of informants preferred a commercial/office complex to develop in a way which expanded Kailua-Kona, rather than being located elsewhere in West Hawaii.

Only a few people had heard about any specific components of the project, although most were aware that QLT was planning a large urban development. Many community leaders and real estate personnel viewed the QLT project and the State's Kealakehe housing project as naturally fitting together. They expected the State and the Trust would cooperate in the development of the two different projects.

Infrastructure: With very few exceptions, the first concern raised by the project was traffic congestion. People expected too many cars on just two routes into Kailua, Palani Road, and Queen Kaahumanu Highway. Many went on to describe the area's infrastructure -- referring mainly to roads, water and waste disposal -- as inadequate for the present population. Concerns were raised about the current Kailua landfill and the County's limited ability to maintain roads and facilities.

Recreation: The lack of recreational opportunities for residents in North Kona (or West Hawaii generally) was often stressed by residents. Responding to the project's inclusion of the makai parcel of land between the Old Kona Airport Park and the Queen Kaahumau Highway, they noted the lack of places for current children to play, as well as the expected future increase in families with children. Many wanted this makai parcel utilized for some sort of resident recreational use, although few people had specific ideas at this early stage.

3.3.2 Specific Concerns

The specific concerns mentioned in the interviews fall into five broad sets of issues. These are listed in Table 3-B in order of frequency -- the topics listed near the beginning of the table were discussed by more informants than the topics listed near the end. (Within each section, views expressed by informants are also grouped by order of frequency.)

The five sets of issues (and various sub-issues) were:

(1) The Project as a Planned Development

Best Location for Regional Center: Most interviewees believed that Kailua would continue to experience rapid growth. They thought the bulk of future growth would be in the area between Kailua and the airport. Therefore they saw the project site as being the most natural, logical, and/or convenient place for such a development.

When questioned about the idea of a possible new urban center located even farther north of Kailua, people said a new urban development needed to be near support services to make it useful to them. They felt a center farther from Kailua would take longer to develop and would tend to duplicate Kailua, rather than provide a larger urban center.

A small number of respondents thought the urban center might be better located in a more northern site. Their reasons included curbing Kailua growth, providing open area around Kailua and a concern that the QLT site may not be large enough in the long run to serve a much larger population.

A few people liked the County's proposal (in the "Keahole to Kailua Development Plan") for an urban center in Kealakehe.

Traffic/Infrastructure: When people saw the proposed plans, their first reaction was concern over the demands the project would place on Palani Road and the Queen Kaahumanu Highway. They were insistent that the project's infrastructure must be built before people began to use the facilities. They raised concerns about construction vehicles blocking the roads, and objected to any obstruction of Palani Road for laying down water lines. They expressed skepticism as to whether improvements to the infrastructure could be carried out without overtaxing the existing systems and jeopardizing current service levels.

Opportunities for Residents: After commenting on infrastructure concerns, most of those interviewed said that a development like the project, if correctly planned, was appealing. Many people felt the project signaled a new phase of urban growth. They foresaw new opportunities for shopping and urban convenience.

People were almost unanimous in projecting that urban development at the QLT site would mean a natural allocation of resident functions to the new site and visitor uses to the Kailua village core. Most people welcomed the idea of not having to go into the village core for errands or business, and many people said they already avoid the area for those purposes.

Some residents thought an urban center would contribute to a greater sense of community in Kona. They felt the project would contribute to a "central" Kona feeling as opposed to earlier feelings of rivalry between the more mauka, southern Kona communities and the Kailua area. A few people suggested that the project and the State's proposed Kealakehe residential development could foster a new sense of pride in residents, if the planning and execution were "done right."

Existing Kailua Village: One anticipated impact of the project was enhancement of the attractiveness of the Kailua village core. "The village" could be quaint, sleepy, low key, or much as it was in the past, if many urban activities were located in the new center. Some saw the new development as a force to upgrade the Alii Drive strip and keep it from being "tacky."

Merchants and others did not think Alii Drive stores would suffer from the competition of new stores in the project, although some concern was expressed about the more resident-oriented businesses on the Kailua end of the Kuakini Highway and the changed atmosphere of Alii Drive, if residents no longer go there.

Many residents thought the project would strengthen Kailua's role as the supplier of goods and services for the entire leeward side of the island. They mentioned that, with more commercial offerings, Kailua could attract Waimea residents who might otherwise shop in Hilo.

Historic Sites: Almost all of the members of the Hawaiian community expressed concern that a thorough survey be done to identify historical sites on the property and to preserve those of value.

(2) <u>The Makai Keahuolu Property</u>

Opposition to Resort Use: Commonly, respondents reacted to the idea of developing the QLT makai property by stressing that it should be used for resident recreation, not for hotels. People often mentioned wanting to see the area used for beach, park and athletic facilities benefiting children. Others favored nearly any use that would keep the viewplanes open.

People felt not enough information was available to identify concerns about specific impacts of development in the makai section. Members of the Hawaiian community and other community leaders anticipated an unfavorable community reaction if activities at the Children's center were curtailed because of development plans.

(3) <u>Reactions to Specific Proposed Components</u>

Commercial Development: Interviewees generally supported additional commercial development. People said they cannot conveniently find all of the things they need in Kona. With more shopping options, there would be less need for shopping trips to Hilo.

Some retailers said they welcome the additional competition. A few others were concerned that there might be insufficient demand to support a major increase in retail space in Kona in the next few years. The Prince Kuhio shopping center in Hilo was brought up as an example of oversupply. Retailers concerned about low demand expected that demand would be sufficient to support the project's commercial component once more housing was built in the Kealakehe area.

Office space: Many respondents reacted favorably to the idea of a State and County office complex at the project. People liked the idea of the offices being all together, easy to locate, and in permanent sites.

No reactions were voiced concerning other professional offices at the project. A few residents did question why the State would put its own offices on land it did not own, especially since the State has other property nearby.

Hospital: There was concern that the QLT site may not be the best for a regional medical center. People familiar with the recently completed study of anticipated needs faulted the QLT site as:

- congested, with persons going to the hospital competing with others for limited parking;
- not as close to the airport as desirable (for medical evacuations); and
- not as accessible for South Kohala residents as a site further north, closer to the airport.

Business Hotel: Hotel managers in Kailua did not think a business-oriented hotel would affect their own level of business. They estimated that only a few of their guests now are business travelers. They thought a substantial business market was far in the future. When such a market develops, the QLT project would also benefit existing hotels.

However, a few other residents (who were not hoteliers) thought a business hotel at the project would reduce demand for hotel rooms in Kailua.

Residential Areas: A large majority of those interviewed acknowledged a shortage of affordable housing near Kailua. People expressed concern that any proposed affordable housing:

- o Be available to those who cannot otherwise afford to buy their own homes;
- o Include housing at various prices, not just the lowest level, and mix together affordable and market units; and
- o Have community residents' associations to enforce standards of appearance.

Several individuals mentioned that elderly residents of Kona need housing where they could live with varying degrees of independence.

(4) Anticipated Impacts on Adjacent Uses

Kona Industrial Area: Residents voiced considerable concern about the current industrial area at the northern edges of Kailua. It was widely acknowledged that the area is now far more commercial than industrial. Many think it is unattractive and that traffic flow at its entry on Queen Kaahumanu Highway is poor.

Concerns about the proposed project focused on the possibility of further aggravating the traffic in and out of the industrial area.

Also, some felt that the proposed urban development across the highway from the area would force existing commercial concerns to upgrade their appearance in order to compete for customers.

Old Airport Park: The nearby community views this site as their only major park. While some think the park should be developed further with better natural and man made amenities and others think the park should remain passive. Both groups see the park is a resource deserving protection. People asked whether there would be a buffer zone between the park and any development in the makai parcel.

Opinions were mixed as to whether a proposed shoreline road on the boundary of the park and the QLT makai property would be a good buffer or a source of much noise and visual distraction for parkgoers.

(5) Queen Liliuokalani Trust/Children's Center

Land Sale: Several people commented that they thought QLT should not sell its land (or else should sell it for a higher profit margin than the State is apparently willing to pay). Others questioned the idea of the State buying land from Queen Liliuokalani Trust, when it already has much land in Kona.

Lack of Information: Kona respondents, particularly in the Hawaiian community, expressed concern about the lack of information supplied to the public about the project. They said that there were many rumors about the development and that the lack of information raised suspicions of land swaps, sales, and political deals.

Current QLT Programs: As previously indicated, there were concerns about continuation of current Children's Center programs on the site, as well as implications for camping at Papawai Beach. However, because few details were yet available and because people were told that any development on the makai parcel would be compatible with the existing Center, these concerns were not strongly articulated.

3.3.3 Interest Groups with Distinctive Concerns

Most concerns were shared by nearly all those interviewed. However, merchants and real estate professionals showed more interest than others in the project's possible impact on retail and industrial areas. Members of the Hawaiian community and several other community leaders were most likely to mention concerns about use of the makai parcel and the activities of the Trust. Hawaiian respondents were also more likely than others to express concern over potential historic sites on the property.

4.0 SOCIO-ECONOMIC IMPACTS

This section presents a consultant assessment of both quantifiable changes (e.g., employment and residential population) as well as more qualitative (social) impacts associated with the proposed project.

(NOTE: The preceding section on Community Issues and Concerns should also be considered an aspect of the "Social Impact Assessment," since the affected community is often the best judge of qualitative impacts. The qualitative social impacts discussed in this section are based partly on community input and partly on consultant judgment based on knowledge of the West Hawaii area.)

Included in this section are:

- Discussion of the definition of "Impact" in relation to the Keahuolu Lands project;
- Quantitative effects;
- Impacts on QLT operations and progams;
- Impacts the overall West Hawaii region;
- Impacts of specific project components.

Many of the impacts or effects associated with the project are positive. However, as appropriate, the section also includes some discussion of ways to mitigate negative effects and/or enhance positive ones.

4.1 CONCEPT OF "IMPACT" AS APPLIED TO KEAHUOLU LANDS

In socio-economic impact assessment, an "impact" is usually not defined as the difference between existing conditions and the future with the proposed project. Rather, it is defined as the difference between two possible futures: future conditions which will occur even without the project, and future conditions with the project.

Section 2.2 examined projected West Hawaii future conditions expected to occur whether or not the Keahuolu Lands project is developed. That future included:

- An expected boom in visitor industry construction, with the West Hawaii resort unit inventory at least quadrupling by the year 2005.
- Resident population roughly doubling by the year 2005, then nearly doubling again by 2020.

- Major in-migration of workers (as well as full-time resort residents and hotel visitors), resulting in substantial socio-political change.

The latter effects are all consequences of the first point, the expected rapid growth of West Hawaii tourism. A few other activities may generate some employment and population growth -- ocean science, agriculture, retirees -- but their impacts are expected to be very minor compared to tourism growth.

Similarly, the Keahuolu Lands project will be, for the most part, a consequence of tourism growth, not something independent of it. The project's commercial, office, and housing components will all be responses to growth, not causes of growth.

If it is assumed that the employment and population growth outlined in Section 2.2 will definitely occur, then commercial, office, and residential housing support development is needed to support the new population. The "impact" of Keahuolu Lands development is a matter of where such development takes place in West Hawaii, not whether it takes place. If the support activity does not take place at Keahuolu, it must occur at other locations.

Arguably, preventing support activities could prevent tourism growth by interfering with labor supply. Few workers might move to West Hawaii without places to live or shop. However, many of the resorts already have their approvals and can be expected to proceed with development even if it is necessary to attract workers with makeshift solutions (e.g., dormitories). Building new resorts without providing support services for new population would produce extreme negative impacts on cost of living and quality of life for existing residents.

Therefore, the major socio-economic impacts of the project (and particularly of the Regional Center) will involve location: effects of concentrating future retail and commercial activities in such a way as to expand and re-organize the existing Kailua Village.

The alternative future, for comparison's purpose, would generally be an unplanned and dispersed development of such urban support activities.

It should be noted that alternative commercial, office, and light industrial zoned lands do exist in other West Hawaii locations. Depending on the effectiveness of QLT marketing and development decisions, it is possible that the Keahuolu project could capture less than its anticipated share of development. However, this scenario is just another version of the "dispersed development" future. Impact assessments are expected to consider maximal effects of project approval. The maximal socio-economic effects of the project will occur if it builds out rapidly, in such a way as to create a new Regional Center for West Hawaii.

4.2 QUANTITATIVE EFFECTS

Given the preceding discussion, it could be argued that the Keahuolu Lands project will have no real "impact" on West Hawaii jobs, population growth, or housing. That is, the various jobs which may be sited at Keahuolu would simply be located somewhere else, if the project does not take place. Previous Environmental Impact Statements for resort activities have all contained estimates of the off-site support jobs created by new resorts, and these estimates would include jobs at Keahuolu.

This would be technically accurate. However, to permit full understanding of project implications, the following analysis presents:

- Employment associated with the project;
- Population supported by these jobs, plus on-site population;
- Housing units occupied by employees and dependents.

4.2.1 Employment

Broad estimates of the phasing of development at the project site can be derived from the market assessment (Natelson, Levander, Whitney, Inc., 1989). That study identifies markets for various project elements in the period ending in 2005, and in the period ending in 2020. Remaining project elements are expected to be built in a third period, beginning in 2021. That period is likely to be longer than the preceding periods, and its exact length cannot be specified.

As Table 4-A shows, over half the project area could likely be developed in the first period. Development would continue in the remaining periods. Consequently, both construction and operational jobs will be generated on-site in each period.

Construction Employment: Construction activity in the 15-year period 1991-2005 is expected to generate over 8,600 jobs. (See Table 4-B). The annual average number of construction jobs for the project in that period is under 600 jobs.

(The annual average figure provides only a rough estimate of the actual construction workforce at any point in the period. The pace of construction will likely vary during each period. Also, the number of workers involved in any construction project changes during the course of the project. Furthermore, the number of workers on-site is smaller than the total number of workers employed in construction on a project, as some construction activities are performed off-site.).

TABLE 4-A: KEAHUOLU LANDS PROJECT LAND USE ABSORPTION, 1990 TO BUILDOUT

Land Use by Type	Proposed Acreage	Proposed Density Per Acre	Land Use Absorption 1991 - 2005(1) Total Units	Land Use Absorption 2006 - 2020(1) Total Units	2021 Remaining Acreage	Land Use Absorption 2021 - Buildout Acres	Land Use Absorption 2021 - Buildout Total Units
Residential							
Single Family	352	6 Homes	2,112 Homes	0 Homes	0	0	0 Homes
Elderly	24	10 Apts.	240 Apts.	100 Apts.	10	0	0 Apts.
Total Residential	376		2,352 Units	100 Units	10	0	0 Units
Retail	48	8,712 Sq. Ft.	420,000 Sq. Ft.	540,000 Sq. Ft.	62	96	836,672 Sq. Ft.
Business Expansion	0	8,712 Sq. Ft.	0 Sq. Ft.	0 Sq. Ft.	0	163	1,420,056 Sq. Ft.
Office							
Civic Center (2)	30						
Other	103						
Total Office	133	8,712 Sq. Ft.	24 210,000 Sq. Ft.	109 270,000 Sq. Ft.	31	78	678,696 Sq. Ft.
Hotel	16		10 160 Rooms	6 108 Rooms	4	0	0 Rooms
Hospital	35		35 120 Beds	0 0 Beds	0	0	0 Beds
Total Acreage (3)	969		493	446	109	337	337

NOTES:
(1) Natelson-Levander-Whitney, Inc., 1989.
(2) Not all the Civic Center acreage will be used for office. Other potential uses include a fire station, a library, courts, a police station, and a jail.
(3) Acreage shown in this table does not include area devoted to parks, infrastructure, or the existing QLT Children's Center. Total acreage is consequently smaller than the total acreage of the project site.

SOURCE: Proposed acreages from Belt Collins & Associates transmittal to Community Resources, Inc., December 13, 1989.

TABLE 4-B: KEAHUOLU LANDS PROJECT JOB CREATION, 1990 TO BUILDOUT

Land Use by Type	Jobs Per Unit (1) Construction	Jobs Per Unit (1) Operations	Total Units Developed 1991 - 2005	Total Jobs Created 1991 - 2005 Constr.(2)	Total Jobs Created 1991 - 2005 Operat.(3)	Total Units Developed 2006 - 2020	Total Jobs Created 2006 - 2020 Constr.(2)	Total Jobs Created 2006 - 2020 Operat.(3)	Total Units Developed 2021 - Buildout	Total Jobs Created 2021 - Buildout Constr.(2)	Total Jobs Created 2021 - Buildout Operat.(3)	Total Operations Jobs Available On-Site At Buildout
Residential(Units)												
Single Family	2.000	0.010	2,112	4,224	21	0	0	0	0	0	0	21
Elderly	0.700	0.040	240	168	10	100	70	0	0	0	0	14
Total Residential			2,352	4,392	31	100	70	4	0	0	0	35
Retail (Sq. Ft.)	0.006	0.003	420,000	2,520	1,200	540,000	3,240	1,543	834,672	5,008	2,385	5,128
Business Expansion	0.006	0.003	0	0	0	0	0	0	1,420,056	8,520	4,057	4,057
Office (Sq. Ft.)	0.006	0.004	210,000	1,260	913	270,000	1,620	1,174	678,696	4,072	2,951	5,038
Hotel (Rooms)	0.500	0.900	140	80	144	108	54	97	0	0	0	241
Hospital (Beds)	2.375	3.707	120	309	445	0	0	0	0	0	0	445
Infrastructure (4) ($1,000s)	0.009		$11,000	100		50	0		$7,000	64		
Total Jobs				8,661	2,733		4,984	2,818		17,664	9,393	14,943
Annual Average				577	2,733		332	2,818		N/A	9,393	14,943

NOTES:

(1) Jobs per unit based on experience of similar existing and proposed projects, and and Hatelson, Levander, Whitney, Inc. (1989) analysis of Hawaii County office and retail patterns.

(2) Construction jobs are total Full Time Equivalent (FTE) person-years created by construction activities at the project site for each period. Total construction jobs in any given year during each period will depend on the phasing and rate of development.

(3) Operations jobs are new annual FTE person-year positions created by retail, office, hotel, and hospital operations at the project site by the end of the period. The actual year when the jobs become available will depend on the phasing and rate of development.

(4) Infrastructure costs for all roadways above Queen Kaahumanu Highway assigned to initial development period (1990-2005). Road development for the Business Expansion area assigned to the 2021-Buildout period.

N/A: No annual average can be provided for construction in the last phase, as the exact length of the last phase is not known.

In the second period, construction work is expected to generate nearly 5,000 jobs, yielding an annual average jobcount over 300. In the last period, the total construction jobcount would rise to over 17,000 jobs. (No annual average jobcount can be estim

Operational Employment: Table 4-B shows operational employment as well as construction employment. By the end of the first period, over 2,700 jobs are likely to be created on-site at the Keahuolu Lands project. By the end of the second period, an additional 2,800 jobs would be created. By the final buildout of the project, the total operational workforce on-site would reach nearly 15,000 persons.

In each period, the leading source of new operational jobs is commercial operations. Offices on-site are projected as employing about a third of the total operational labor force.

Indirect and Induced Employment: As noted above, the Keahuolu Lands project is responsive to anticipated growth in West Hawaii, rather than a major cause of growth. The jobs created on-site are hence largely indirect and induced employment impacts of income brought to Hawaii by new resorts. The State's West Hawaii Regional Plan estimates that nearly 26,000 new jobs will be created in Hawaii County by 2005. The construction and operational jobs projected as existing on-site by 2005 amount to about 12% of those new jobs.

Indirect and induced employment effects of the project can be estimated. These must be understood not to be impacts of the project, since the project is not expected to attract new capital from out-of-state. Tables 4-C and 4-D provide information on direct, indirect, and induced employment associated with the project.

(Direct employment consists of work on the construction of a project, and operational work on-site at the project. Indirect employment consists of jobs created as establishments that receive income from a project purchase goods and services in Hawaii. Induced employment consists of jobs created as the employees of a project spend their wages and pay their taxes, and hence support both private sector and government jobs.)

Combining the analyses of construction and operational employment in Tables 4-C and 4-D, the direct, indirect, and induced employment effects of the project are estimated to be, for the following points in time:

	2005	2020	Buildout
Direct Employment	3,300	5,800	14,900
Indirect and Induced Employment, On-Island	800	1,900	3,900
Total Indirect and Induced	2,500	3,400	9,000

TABLE 4-C: PROJECTED DIRECT, INDIRECT, AND INDUCED EMPLOYMENT FROM CONSTRUCTION OF THE KEAHUOLU LANDS PROJECT

Type of Employment	1991 - 2005 Total	1991 - 2005 Annual Average	2006 - 2020 Total	2006 - 2020 Annual Average	2021 - Buildout Total	2021 - Buildout Annual Average
Direct Construction Employment (1)						
Single-Family Residential	4,220	280	0	0	0	N/A
Elderly Residential	170	10	70	0	0	N/A
Retail, Office, Hotel, & Hospital	4,270	280	4,910	330	17,660	N/A
Total Direct	8,660	560	4,980	330	17,660	N/A
Indirect and Induced Employment						
On-Island(2)	3,460	230	1,990	130	7,060	N/A
Elsewhere in State	14,080	890	6,830	440	23,980	N/A
Total Indirect & Induced	17,540	1,120	8,820	570	31,040	N/A
Total Direct, Indirect, and Induced Employment(3)	26,200	1,700	13,800	900	48,700	N/A

NOTES:

(1) As shown in Table 4-B.

(2) Estimated at 40% of direct employment, based on Anders on et al, 1975, p. 134.

(3) Total direct, indirect, and induced employment estimated using the Hawaii State 1982 Input-Output Model (unpublished tabulations, Hawaii State Department of Business and Economic Development, Research and Economic Analysis Division). Multipliers used:

Single-family residential construction:	3.29
Elderly residence construction:	3.17
Other construction (Commercial, office, hotel, hospital, and infrastructure)	2.76

TABLE 4-D: PROJECTED DIRECT, INDIRECT, AND INDUCED EMPLOYMENT FROM OPERATIONS AT THE KEAHUOLU LANDS PROJECT

Type of Employment	By 2005 Direct (1)	By 2005 Indirect & Induced (2) On-Island(3)	By 2005 Indirect & Induced (2) Rest of State	By 2005 Indirect & Induced (2) State Total	By Buildout Direct (1)	By Buildout Indirect & Induced (2) On-Island(3)	By Buildout Indirect & Induced (2) Rest of State	By Buildout Indirect & Induced (2) State Total
Residential								
Single Family	20	0	20	40	20	0	20	40
Elderly	10	0	10	20	10	0	10	20
Total Residential	30	0	30	60	30	0	30	60
Retail	1,200	410	270	1,880	2,740	1,750	1,170	5,660
Business Expansion	0	0	0	0	0	0	0	0
Office (4)								
Government	210	0	0	0	480	0	0	0
Health Industry	320	40	340	380	720	100	980	1,080
Financial	110	60	60	120	240	100	380	480
Other	280	20	120	140	640	160	960	1,120
Total Office	910	120	520	640	2,090	360	2,320	2,680
Hotel	140	30	100	130	240	50	170	220
Hospital	440	50	470	520	440	50	470	520
Total Jobs	2,700	600	1,400	2,000	5,500	2,310	5,100	7,410

NOTES:

All employment is the level projected for the end of each period.

(1) Direct employment from Table 4-B above.

(2) Estimated with Type 2 Employment Multipliers for Retail (1.57), Government Services (0.0), Health Services (2.19), Banking and Finance (2.07), Business Services (1.50), and Hotels (1.90) from the 1982 Hawaii State Input-Output Model.

(3) Estimated from direct employment based on on-island employment multipliers from Anderson et. al., 1975, p. 134: Residential Services (0.09 of direct), Retail (0.34), Government (0.0), Health Industry (0.11), Financial Industry (0.56), Other Office (0.07), and Hotel (0.20).

(4) Office employment by industry estimated based on share of total acreage allocated to each industry.

4.2.2 Population

The size of two population groups associated with the project can be calculated:

- o People staying on-site; and
- o People living in the area who depend on jobs at the project.

Most of the population living on-site at the Keahuolu Lands project will consist of residents. In addition, visitors at the hotel and patients staying in the hospital are part of the continuing on-site population.

Table 4-E shows the population staying on-site for three points in time. Project residents are expected to number about 6,500 by 2005, approximately 8% of the West Hawaii population at that time (Office of State Planning, 1989). Over time, the project population will amount to a smaller fraction of the regional population, as little further residential construction is slated for the project site after 2005.

A few visitors would be on-site by 2005, at the business hotel located in the project. They would form a very small part of the visitor population in West Hawaii.

Employees of the project and project construction workers will support a population estimated to number about 8,400 in 2005, as shown in Table 4-F. The population supported by employment at the project is forecast as growing to 14,600 by 2020. Eventually, it could reach over 36,000.

4.2.3 Housing

The project will include 2,112 single-family housing units and 340 residential units for the elderly. In light of current and anticipated demand for housing in the study area, all of these except 100 units for the elderly are projected to be built by 2005, as shown in Table 4-A.

Project employees (operational and construction) are expected to need about 2,100 housing units in 2005. (See Table 4-G.) Many or most will already have homes in the area, and will not need new housing. Still, the project will provide housing equivalent to all the demand generated by employees in 2005, and about half the demand associated with project employment in 2020.

When the project is viewed along with the State's Kealakehe project, to be built on adjacent land, the net result of new development in the area is an increase of housing well beyond that needed by the on-site workforce in the next three decades.

TABLE 4-E PROJECTED RESIDENT AND VISITOR POPULATION AT THE KEAHUOLU LANDS PROJECT

Population Groups	2005	2020	BY BUILDOUT
Residents in			
Single Family Units (1)	6,120	5,910	5,910
Elderly Units (2)	360	510	510
Total Resident Population	6,480	6,420	6,420
Average Daily Visitors in Hotel Units (3)	240	400	400
Average Daily Patients in Regional Hospital (4)	90	90	90

NOTES:

For phasing of construction of residential areas, hotel, and hospital, see Table 4-A.

(1) Household size assumed to be 2.9 persons/unit in 2005, then 2.8 persons/unit in 2020 and subsequently, based on historic trends in Hawaii County.

(2) Household size assumed to be 1.5 persons/unit.

(3) Party size assumed to be 1.85 persons. Occupancy rate assumed to be 80%.

(4) Occupancy assumed to average 72 percent, based on West Hawaii Health Conference Task Force Report (1989).

TABLE 4-F: PROJECTED HOUSEHOLD POPULATION SUPPORTED BY PROJECT EMPLOYMENT, KEAHUOLU LANDS PROJECT

Population Groups	2005	2020	At Buildout
Construction			
Annual Average Jobs (1)	580	330	0
Workers	580	330	0
Dependents (2)	1,100	630	0
Total in all Construction Worker Households	1,680	960	0
Operations			
Total Operations Jobs (1)	2,730	5,550	14,940
Workers	2,730	5,550	14,940
Dependents (2)	3,990	8,112	21,835
Total in all Operations Worker Households	6,720	13,662	36,775
Both Groups			
Total in All Households (3)	8,400	14,622	36,775

NOTES:

(1) From Table 4-B.
(2) Household size projected at 2.9 in 2005 and 2.8 in 2020 based on historical Hawaii County experience. Number of workers per household estimated as 1.3 (affecting number of dependents per worker).
(3) Construction workforce is based on an average over the periods ending in 2005 and 2020, while operational employment is calculated on the basis of the number of jobs created on-site by those points, so the combined figure is necessarily inexact.

TABLE 4-G: PROJECTED HOUSING DEMAND OF KEAHUOLU LANDS PROJECT WORK FORCE

Supply and Demand Factors	2005	2020	By Buildout
Demand			
Total Operations Employees	2,730	5,550	14,940
Total Employee Households (1) (Housing Unit Demand)	2,100	4,270	11,490
Supply			
Affordable Housing Units Provided:			
In Keahuolu Lands Project (2)	2,112	2,112	2,112
In Kealakehe (3)	2,870	3,715	3,715
Total (4)	4,622	5,467	5,467
Supply as a Percent of Demand	220%	128%	48%

NOTES:

(1) Households estimated based on 1.3 workers per household.
(2) Based on assumption of 100% affordable housing, Natelson, Levander, Whitney, Inc., 1989.
(3) Midpoint of KPMG Peat Marwick estimate of affordable units (both owner-occupied and renter-occupied) in State Housing Finance Development Corporation project at Kealakehe (estimate of December 1989).
(4) Total is less than the sum of the units in the two projects because one section of the Keahuolu Lands is expected to become part of the Kealakehe Project. Units in that section are treated here as within Kealakehe.

4.3 IMPACTS ON QLT OPERATIONS AND PROGRAMS

The project's impact on the Trust is expected to be positive, as the project will provide a new source of revenue:

- o Increased revenue will support existing programs of the Trust statewide; and

- o The Trust will be able to develop new programs. Plans for these are now under review by the Trust. The Trust is likely to enter new ventures cautiously in the coming years, "building on small successes based on community needs" (personal communication, Charles M.L.S. Nekoa, Executive Director, Queen Liluokalani Children's Center, Liliuokalani Trust).

At this time, the Trust has made no definitive commitments to particular new programs. New initiatives under study include day care programs, after school programs with an emphasis on cultural education, and a family life education program.

As few details of the project have been announced, many Kona residents are concerned that the project would negatively affect QLT programs in Kona, notably the existing Children's Center and the family campground. However, the Trust is committed to maintaining its Kona operations, and the development of the makai section of the project will be compatible with continuing activity at the Children's Center (situated in that section) and the campground (outside the project site).

With or without the project, a major influx of non-Hawaiians from Oahu and the Mainland United States will occur in West Hawaii. Under the circumstances, some Hawaiians are likely to be concerned that major social changes provide them with little beyond inconvenience. The project, by assuring funding for QLT programs, will be able to stand out as a development that is of benefit to the Hawaiian people in West Hawaii.

4.4 IMPACTS ON THE WEST HAWAII REGION

Regional growth, of which this project will be an important, but limited, component, must be taken as a baseline condition in assessing impacts of the project. The project is not a motor for growth but an opportunity to organize development and to plan for future developments, on-site and off-site.

Impacts of a planned development, rather than unplanned growth, include:

- o Creation of a regional center will make (a greater) Kailua into an urban area meeting both resident and visitor needs.

- o West Hawaii's settlement pattern was one of widely separated villages in the recent past. Kailua-Kona has increasingly served residents as a center, but to a limited extent. With the creation of a planned regional center:

  - The region's villages will be increasingly viewed as satellites to Kailua, rather than independent urban areas;

  - Residents will be increasingly likely to shop and socialize in major public areas, rather than in village centers; and

  - Specialized small businesses in West Hawaii villages will be at a disadvantage due to location, and may lose customers.

- o The project will provide a home for more government services in a single place than now is found in West Hawaii. The region's status in the County is likely to increase as both demands for services and the delivery of services are centralized.

- o By concentrating services to residents at the site, the project will encourage residents and visitors to patronize separate areas;

- o The project, as part of a larger planning effort in which the State and County are involved, will lead to more coherent development of Kailua region lands, and hence to less likelihood that growth will bring problems of infrastructure capacity;

- o Conversely, the centralization of functions at one site makes the need to solve local infrastructural problems -- notably, traffic congestion at the intersection of Palani Road and Queen Kaahumanu Highway -- all the more acute; and

- o The development of a planned urban center will counter the trend towards strip development along the major roads in the Kona area.

Historically, politics in Kona was dominated by the mauka villages. Kailua-Kona has gained in importance in recent years. The project will tend to concentrate power further in the Kona area.

4.5 IMPACTS ON NEARBY AREAS

The project will tend to mitigate the impacts of growth for the Kailua area. It will encourage redevelopment of Kailua

Village and will make it possible for other nearby areas to be integrated into a larger urban system.

4.5.1 Impacts on Kailua Village

Over the long term, the project promises to replace Kailua Village as the major urban area of West Hawaii. Kailua would retain importance and activity, but would no longer function as both a seaside town with an ambience attractive to residents and visitors and as a center where all sorts of business are done.

Particular impacts that seem likely as the project is developed include:

- With residents' urban functions largely met upland (in the project site and elsewhere), Kailua Village can be redeveloped as a center for visitor activities, much as Lahaina has developed as a town appealing to the visitors staying along a coastal area; and

- Redirection of traffic upland will help to develop a "walker-friendly" village atmosphere in Kailua Village and along Alii Drive.

4.5.2 Other Residential Areas

The project site is near the Queen Liliuokalani Village residential area and the State's proposed Kealakehe housing area. Further upland along Palani Drive are several subdivisions. Likely impacts of the project include:

- For nearby residents, convenient services, entertainment, and (in many cases) work; and

- With improved facilities in the area, the desirability and value of nearby residential tracts will increase.

These upland areas will increasingly be seen as part of a Kailua urban area as the project develops, rather than as subdivisions dispersed in the landscape.

4.5.3 Industrial/Commercial Areas

The project adjoins the QLT industrial area. Other areas considered in assessing potential impacts of the project were the Kaloko industrial area, Lanihau Center, and the North Kona Coast Shopping Center on Palani Road. Likely impacts include:

- Development of urban center will provide more customers for nearby businesses, and will hence have a positive effect on tenants of existing industrial and commercial areas;

- Mix of uses in nearby QLT industrial area has been changing from industrial to commercial; with the (eventual) development of the commercial area in the project, the existing area may be less competitive as a site for the operations its operators now seek;

- With increased traffic on Queen Kaahumanu Highway, the Kaiwi Street intersection, already considered hazardous by many, will become more difficult to use. Hence the project could aggravate the problem of access to the QLT industrial area.

  (Road improvements are included in the project plans. Setbacks along Queen Kaahumanu Highway may improve passage along the road and turns into the side street.)

4.5.4 Recreational Areas

The project is contiguous with Old Airport Park, although no development of land adjoining the park is planned for the next few decades. On QLT land to the north, the Trust has developed a camping area at Papawai. Over the long term, project impacts will likely include:

- Need for increased maintenance of both areas due to increased population in the immediate area;

- Need for increasing security at Papawai, as others will also use its access road;

- Noise and light from the project site could be noticeable in at least part of the camping area.

The project's timeframe extends for decades, and no changes in land use near existing recreational areas is planned to occur in this century. Commercial, not residential or resort, uses are indicated for the land nearest the camping area. Consequently, the foreseeable impacts of development near recreational areas are small.

4.6 IMPACTS OF SPECIFIC PROJECT COMPONENTS

4.6.1 Residential

Demand for housing in the Kona area is great. The project and the State's proposed Kealakehe development will go a long ways toward meeting that demand, but will not exhaust it.

The project will supply about 13% percent of the new housing units estimated as needed by residents in West Hawaii by the year 2005, and 6% of the units needed by 2020 (according to estimates by Natelson, Levander, Whitney, Inc., shown in Table 2-H.)

4.6.2 Commercial

The project will greatly increase the commercial and office space available in Kona. Developers of commercial and office segments of the project will implement the project plans over a period of decades, so no abrupt changes in the amount of commercial space are likely.

Orderly development of commercial space at the project will encourage development of a more segmented market for commercial space in the Kona area, with less mingling of specialized retail, general retail, and other businesses. As a result, commercial/industrial areas will aim increasingly at distinct market niches. This process should help businesses and landholders to plan commercial development economically.

4.6.3 Hotel

The hotel proposed for the project site is intended to attract business travelers, a small segment of the existing West Hawaii hotel market. Its location will bar the hotel from competing with coastal and resort hotels for the bulk of the visitor market. The hotel is accordingly expected to have little or no impact on other hotels.

4.6.4 Hospital

The development of a community hospital at the project site would pre-empt other sites now under consideration. Other sites are viewed as more accessible to the community and to the airport. Also, a site apart from large-scale urban development would presumably offer more opportunity for expansion over time than a site within a larger project.

The project will allocate some 35 acres to the hospital. That area will provide some room for expansion, if needed.

Also, development of a hospital at the project site, near professional offices, will facilitate use of the hospital by private medical practitioners.

4.6.5 Civic Uses

The development of a government office complex is expected to improve the delivery of services to West Hawaii's citizens.

Again, access to government offices is likely to become easier and more convenient.

The development of new government offices will free up space in existing sites. That space could then be allocated to programs still based in existing offices.

APPENDIX A: LIST OF PEOPLE INTERVIEWED FOR REPORT

(Note that those interviewed provided their comments as individuals and not as representatives of their organizations. Organizational affiliations are provided only to indicate some of the networks and interests of those interviewed.)

Pamela Burla Acoba	Realtor, Ron Burla and Associates
Robert Aeder	President, Kona Heavens Homeowners Association
Joe Almeida	General Manager, Kona Palisades
Joseph W. Augustine	Realtor, dh Realty, Inc.
Fanny Au Hoy	Curator, Hulihee Palace Member, Hawaiian Civic Clubs
Alan Beall	Restaurant developer
Teresa Nakama Bellah	Clerk typist, Kamehameha Investment Corporation
Scott Berg	Owner, Scott's Pet and Feed Shop, Scott's Knife Center Kona Acres resident
Ian Birnie	District Manager, Harbors Division, Department of Transportation
John F. Burns	Owner, McDonald's Restaurants
Thea Brown	Owner, Honokohau Marine Services
Connie Charles	Executive Director, Kona Kohala Chamber of Commerce Member, West Hawaii Regional Health Center Task Force
Jill T. Chavez	Branch Manager, Pioneer Federal Savings and Loan
Keola Childs	Developer
Irma Chillingworth	Member: Hawaiian Civic Club, Ahahui Kaahumanu Group, Daughters of Hawaii Founder, West Hawaii Today

Lisa Choquette	Owner, Dive Makai Treasurer, The Ocean Recreation Council of Hawaii
Jeanne Comer	Member, Hawaii Planning Commission Queen Liliuokalani Village Resident
Bill Crockett	General Manager, Lanihau Center Secretary, Kailua Village Improvement Association Member, County Board of Ethics
Wanda Dettling	President, The Greater Kona Community Association Council Realtor-Associate, Bradley Properties Ltd.
John P. Dinmore	Architect Member, Chamber of Commerce Planning Group Resident, Palani Road
Reed Flickinger	Reporter, West Hawaii Today
Jo Ann Freed	Program Director, West Hawaii Family Support Services
Joseph Fagundes, III	Attorney Past President, Hawaii State Bar Association
Rose Fujimori	President, Hawaiian Civic Club
Halle Ladd Galvin	Administrative Assistant, Kona Family YMCA Kalaoa resident
Michael Galvin	West Hawaii Program Manager, Classroom Training Project, Kalaoa resident
Mary Green	Member, Kai Opua Canoe Club, Azabu Cultural Advisory Committee, La Hui O Hawaii
James Greenwell, Jr.	Lanihau Corporation
R. Kelly Greenwell	Landscape Contractor
Helene Hale	Member, Hawaii County Council

R.T. "Doc" Halliday	Principal Broker, "Doc" Halliday Realty
Harry Hasegawa	President and Principal Broker, A'ala Realty and Management Inc. Business Manager, Local 5 AFL-CIO Kainaliu farmer
Virginia Isbell	Member, Hawaii State House of Representatives
David W. Jennings	President, West Hawaii Youth Council
Hai Kamakau	Regent, Daughters of Hawaii Volunteer, Hulihee Palace Member, Napoopookakeei Honaunau Community Association, Friends of Kealakekua Bay
Russell Kokubun	Chairman, Hawaii County Council
William Kowalski	President: Hawaii Fish Distributors Inc., Transpacific Ventures Inc.
Kiyono Kunitake	Founder, Friends of Old Kona Airport State Beach Park Keopu farmer
Walter Kunitake	Director of University of Hawaii - Hilo, West Hawaii Member, Friends of Old Kona Airport State Beach Park
Scott Leithead	Director, Hawaii County office of Housing and Community Development
Andrew Levin	Member, Hawaii State Senate
H. Peter L'Orange	President, Hawaii Leeward Planning Conference
Ruby Keanaaina McDonald	Liaison - West Hawaii, Office of Hawaiian Affairs
Hugh MacIssac	Mental Health Supervisor, Adult Services, Department of Health

Michael Mackin	Realtor, dh Realty, Inc.
Greg Mooers	Development Manager, Nansay Hawaii
Reginald Morimoto	Branch Manager, First Hawaiian Bank
Marge Mulhall	Member, League of Women Voters, Business and Professional Women of Kona
Roy Mushrush	President, Kona Palisades Homeowners Association
Wally Nakamoto	Businessman Board Member, Kona Coffee Festival Member, Kainaliu Business and Professional Association
Osamu Otsuka	Managing Broker, Gold Coast Realty
Paul Pastoor	General Manager, Hotel King Kamehameha
Patricia Provalenko	Assistant Property Manager, Bedford Properties
Robbie Robertson	Governor's Liaison, West Hawaii
Jerry Rothstein	President, Public Access Shoreline Hawaii, Kahakai Neighborhood Association
Norman Sakata	Supervising Investigator Department of Commerce and Consumer Affairs President, Kona Lions Club
Sue Sanders	Realtor, Bradley Properties Inc.
Robert G. Salomone	General Manager, Kona Hilton Resort Member, Kailua Village Improvement Association
Lori Sasaki	Kealakehe resident
Liz Smith	Owner, King Kamehameha Divers
Mike Sohriakoff	Realtor, Mike Sohriakoff Realty

Joseph K. Spencer III	Resort Manager, Kamehameha Investment Corporation
Leon K. Sterling	Pastor, Kauwa No Ka Kino O Kristo Church Member, Kona Hospital Advisory Board, Kona Hawaiian Civic Club, West Hawaii Housing Foundation, Kona Coffee Festival
Judy Sweeney	Program Coordinator, West Hawaii Pilot Project, Department of Human Services
Larry Tanimoto	Deputy Managing Director for West Hawaii, County of Hawaii
Robert D. Triantos	Attorney Member, Kailua Village Design Commission
Rebecca Transue	Community Coordinator, Child and Family Services
Mark Van Pernis	Attorney
Debbie Wiley	Assistant Supervisor, Public Health Nursing, Department of Health
Ross Wilson, Jr.	Assistant Vice President, Manager, First Federal Savings and Loan Association
Jennie S. Wung	Administrator, Kona Hospital
Mae Yamasaki	Principal, Konawaena High School
Kenny Young	Realtor, K.M. Young and Associates

APPENDIX B: REFERENCES

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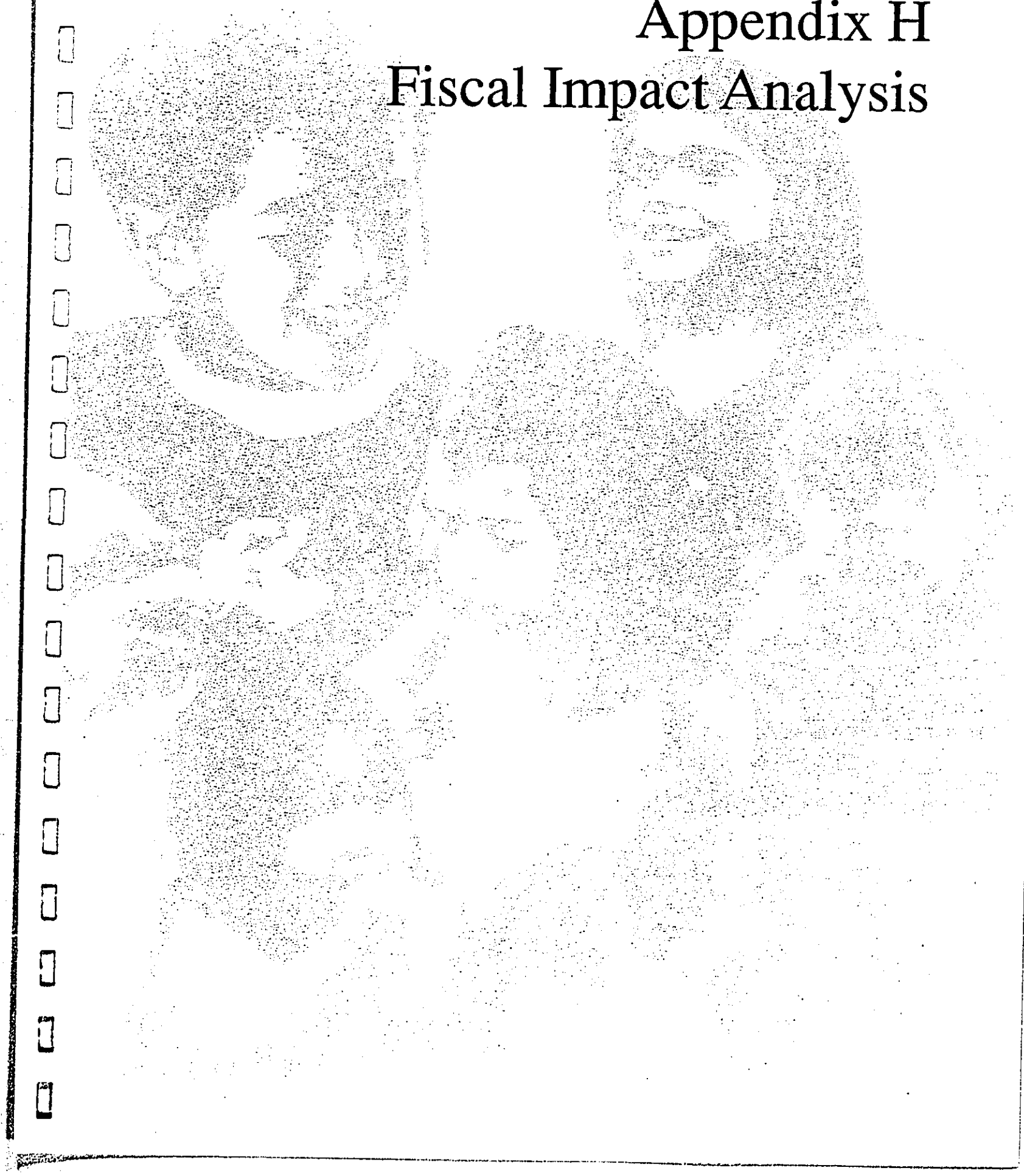
Appendix H
Fiscal Impact Analysis



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PUBLIC REVENUE - COST

AND ECONOMIC IMPACT ANALYSIS

FOR

QUEEN LILIOUKALANI TRUST PROPERTY

NORTH KONA, ISLAND OF HAWAII

March 1990

TABLE OF CONTENTS

QUEEN LILIOUKALANI TRUST PROPERTIES
KONA, HAWAII

Public Revenue-Cost
and Economic Impact Analysis

SUMMARY AND CONCLUSIONS

Description of Project

The proposed project consists of approximately 1,135 acres in North Kona belonging to the Queen Lilioukalani Trust (QLT). The property is bordered by Palani Road and the existing Kona Industrial area to the south, Queen Lilioukalani Village to the east, and the ahupua'a of Kealakehe to the north, and the old Kona Airport State and County Park to the west.

The long-range master plan envisions a new urban region-serving town center to be developed over a thirty year period. Major project features include a regional shopping center, a civic/cultural center, a region-serving hospital, office and commercial complexes, a business hotel, residences, an elementary school, and open recreation areas.

Public Revenue-Cost Analysis

For the QLT Property, the cumulative discounted public revenues totalled $382.5 million in constant 1990 dollars. The cumulative discounted public costs totalled $39.4 million in constant 1990 dollars. This represents a revenue-cost ratio of 9.7 to 1.0.

This study concludes that an additional $9.70 in public revenue benefits would accrue to the State of Hawaii and the County of Hawaii for every dollar of public cost caused by the proposed development. This would be a definite financial gain to the State and to the County of Hawaii, should this project be implemented. As a standard of comparison, for its civil projects, the U. S. Army Corps of Engineers recommends proceeding with a project if there is unity (1.0 to 1.0) or greater.

As a general rule, a ratio greater than 4.0 to 1.0 is considered high. The unusually high revenue-cost ratio of 9.7 to 1.0 for this project is attributable to the proposed mix of commercial and business economic activities which tend to generate large tax revenues and require relatively little public support. For example, the shopping centers will generate nearly $140 million in tax revenues annually by the year 2020; however, they do not require educational support and only minimal fire and police services.

The State Legislature is currently considering granting the counties the authority to levy a 1/2% excise tax. If this authority is granted by 1995, the counties will derive an additional $39 million in tax revenues (discounted to the 1990 baseline). This additional revenue will change the overall revenue-cost ratio for this project from 9.7 to 1.0 to 10.7 to 1.0. The County of Hawaii revenue-cost ratio will increase significantly from 1.15 to 1.0 to 4.3 to 1.0.

A summary of the itemized results of the present value analysis is presented in the table that follows:

SUMMARY - REVENUES AND COSTS

TAX REVENUE CATEGORIES	STATE REVENUE (NPV)	COUNTY REVENUE (NPV)	TOTAL REVENUE (NPV)
GENERAL EXCISE TAX - CONSTRUCTION	$6,893,174		$6,893,174
GENERAL EXCISE TAX - OPERATIONS	$307,640,569		$307,640,569
CORPORATE INCOME TAX	$34,544,072		$34,544,072
PERSONAL INCOME TAX	$19,127,260		$19,127,260
PROPERTY TAX		$14,167,599	$14,167,599
HOTEL ROOM TAX	$155,523		$155,523
TOTAL REVENUE	$368,360,598	$14,167,599	$382,528,197

GOVERNMENT SUPPORT COSTS	STATE COSTS (NPV)	COUNTY COSTS (NPV)	TOTAL COSTS (NPV)
LOWER EDUCATION	$9,702,101		$9,702,101
HIGHER EDUCATION	$1,151,214		$1,151,214
HEALTH SERVICES	$2,014,148		$2,014,148
TRANSPORTATION SERVICES		$35,327	$35,327
FIRE SERVICES		$3,367,491	$3,367,491
POLICE SERVICES		$4,136,339	$4,136,339
PUBLIC FACILITIES	$14,218,559	$4,739,520	$18,958,078
TOTAL COSTS	$27,086,022	$12,278,677	$39,364,698
REVENUE TO COST RATIO	13.60	1.15	9.72

Impact Analysis

By the year 2020, it is estimated that the project will generate an average direct sales and rental income of $3,582 million per year, in constant 1990 dollars, from the operation of the shopping centers, office complexes, hotel, hospital, and retirement village. It is estimated that the project would generate an average direct personal income of $106 million per year in constant 1990 dollars and 5600 direct jobs per year.

These results are order-of-magnitude estimates that may exist should this project be undertaken. The following summarizes the results:

Impacts	Totals
Construction Costs (millions)	$644.6
Sales Revenues (millions)	$3,582
Employment (jobs)	5600
Employee Income (millions)	$106

PUBLIC REVENUE-COST ANALYSIS

Introduction

Any economic activity results in certain gains and losses to the economy. In particular, an economic activity provides the public sector with additional sources of revenues and simultaneously, increases the burden on the available public resources. In order to assess the impact of this project, an estimate of the incremental revenues and costs was made, and fully charged to the project in order to calculate the revenue-cost ratio.

The approach employed in conducting the revenue-cost analysis included:

(1) Identification of the kinds of revenue and cost elements to consider

(2) Estimation of the dollar amount that should be associated with each revenue and cost element; and

(3) Comparison of the discounted present values of the various revenue and cost totals.

The objective of this analysis was to determine whether the additional government revenues generated as a result of the project would be sufficient to offset the additional costs incurred.

Study Parameters

Study Time Period

Based upon the draft marketing study of the project conducted by Natelson-Levander-Whitney, Inc. for Belt Collins & Associates, the start of the project will be 1990 and the end year will be 2020.

Discount Rate

A 10% discount rate was selected to convert all the revenue and cost flows estimated to occur during this study period into a common value. This rate represents the estimated average rate of return for private investments before taxes and after

inflation, as prescribed by the U. S. Office of Management and Budget, under Circular No. A-94, dated March 27, 1972.

Time Schedule

The timing of the various flows of revenues and costs was based upon the draft marketing study and information provided by Belt Collins & Associates. It was assumed that the construction phase would begin in 1995.

For purposes of cash flow timing, multi-year activities, such as the hotel construction were averaged among the construction years.

Employee Schedule

The following employment schedule, based on the market study and data from Belt, Collins and Associates, was used to estimate employment:

Land Use Category	Employees Per Unit
Commercial	3 per 1000 SF
Office	1 per 230 SF
Hotel	0.9 per unit
Civic & Cultural Center	4 per 1000 SF
Regional Hospital	3.71 per unit
Residential	0.1 per unit

Revenue and Cost Variable Selection and Estimation

For purposes of this study, financial impacts likely to occur as a result of this project were considered to be relevant variables. Those likely to produce a significant impact on public sector revenues and costs were estimated in this study.

Determination of which revenues and costs to consider was made after examination of the financial reports and other data sources of the State of Hawaii and the County of Hawaii. Each category listed was examined to determine whether or not a significant change was likely to occur as a direct result of the project, all other things being equal. Since the activities in the QLT Property will be new or additional to activities already taking place in the State of Hawaii and the County of Hawaii, if it was determined that a change was likely to occur and likely to produce a significant impact, its incremental amount was then estimated and fully charged to the project in order to calculate the revenue-cost ratio.

The values attached to each of the variables were calculated in a manner closely approximating the actual valuation approach. This was a difficult area in the project, due to the number of unknowns that exists, principally the composition of firms and the nature of their "business" character. The actual application of these calculations can really only be determined on a case by case basis, under actual operating conditions. Because of this, certain assumptions had to be made for this analysis on a generalized basis. This was done after consultation with the respective local government agencies.

Present Value Estimation Procedure

Public revenue and cost estimates for each of the study variables were distributed over time according to the assumtions presented above. Each of these variables were estimated in constant 1990 dollars.

In order to evaluate the flow of dollars over time, a method of "compressing" or "reducing" these numbers was needed. Additionally, even without inflation, a dollar 10 years from now will not be worth the same as today. To account for this "time value of money", as well as to "compress" the flow of dollars, "discounting" must be used.

To accomplish this, a standard discounting technique, known as present value analysis, was used. Basically, the value at some time period in the future is "brought back" to a base period, in this case 1990, by use of a "present worth factor". This can be represented mathematically as follows:

$$PV = P(1+r)^{-t}$$

where

PV = present value of cash flow at the base year
P = value of the cash flow at the year of occurence
r = discount rate (time value of money)
t = years between base year and year of occurence

Once all of these calculations were completed for the cash flows for each year, the results were summed to represent the cumulative effects of the project over time.

The revenue variables were added together as well as the cost variables. Then, the ratio of the total revenues to the total costs was calculated. This ratio is referred to as the "Revenue-Cost ratio". This ratio of revenues to costs provides a relative measure of the dominance of either revenues or costs to the expected net effect of the project in total. A revenue-cost ratio of 2.0 to 1.0, for example, would imply that for every $2.00 in public revenues generated by the project, there will be an additional public cost of $1.00. A revenue-cost of 0.5 to 1.0, on the other hand, would imply that only $0.50 would be gained through public revenues for every dollar of public costs incurred. A ratio of 1.0 to 1.0 would indicate unity or a "breakeven" situation.

In its civil projects, the U.S Army Corps of Engineers recommends proceeding with a project if there is unity or greater in the calculated revenues-costs ratio.

Study Variables

This section details the various variables which this study assessed in detail which would produce financial impacts on public sector revenues and costs. Each of the revenue and cost variables are discussed with regard to the nature of the variable, the rationale for its inclusion or exclusion, estimation procedure, and critical assumptions that were made.

2Public Revenue Variables

General Excise Tax/Construction. This variable was included to reflect the revenue generation that would occur as a result of the development activities. The legal basis is derived from the Hawaii Revised Statutes, Chapter 237. Under HRS 237-13(3)(B), an outside contractor would be levied a 4% general excise tax. Should the developer wish to self-contract, the same 4% general excise tax assessment would be made under HRS 237-13(3)(D).

An excise tax rate of 1/2% levied against the material incorporated into the construction was also included. The material component was estimated to be 60% of the total construction cost.

General Excise Tax/Gross Revenues. The gross income derived from retail sales and rental income at the shopping centers, office complexes, hospital, hotel, and retirement village would be general excise taxes under Hawaii Revised Statutes, Chapter 237.

Commercial spaces were assumed to produce average monthly sales volume of $370 per SF, similar to other retail spaces in the vicinity. Rental income was assumed to be 5% of sales volume plus common area maintenance fees, association dues, and property tax.

Gross revenues derived from office spaces were based on average annual sales per employee of $37,700. Rental income for office spaces were estimated to be $1.50 per SF.

Corporate Income Tax. Average profit margins before taxes for various industries were based on Troy's Almanac of Business and Industrial Financial Ratios. Profit margins were expressed as a percent of gross sales.

A corporate income tax rate of 6.4% was applied to the estimated profit. The corporate tax structure specifies a 4.4% rate on the first $25,000 of taxable income, a 5.4% rate on the next $75,000 of taxable income, and a 6.4% rate on taxable income in excess of $100,000. This study applied the highest rate, 6.4%, to all profit generated from the various business activities due to the magnitude of the income. It was considered that the results of a more detailed breakdown would be arbitrary and would not significantly alter the results in

the aggregate. In addition, it was assumed that the business profits derived from this project would, in the main, be incremental to profits derived from already existing enterprises. For example, candidate tenants such as Liberty House would earn their first $100,000 in taxable income from existing branches; profits from retail spaces in this project would therefore be taxed at the higher rate.

Personal Income Tax. The project will generate 5600 direct jobs and an additional 650 jobs in the construction industry by the end of this study period. Employees will pay personal income taxes on wages earned.

The employment created by the project would absorb labor from one or more of the following: existing employed labor pool, the unemployed labor pool, or external labor pool. In all cases, the assumption that the wage earnings would be "new" to the economy is valid. This is based on the following: if the employees were hired from the local unemployed labor pool, these individuals would then be put to productive use rather than on unemployment compensation or welfare. On the other hand, if these individuals transferred from an existing job, then the job left would now be vacant for hiring, possibly from the unemployed labor pool.

The average salaries of the employees were derived from historical data provided by the State of Hawaii 1988 Data Book and the Bank of Hawaii 1989 Annual Economic Report, then escalated to 1990 rates:

Job Classification	Annual Wages
Retail Sales	$13,977
Business Services	$21,537
Hotel	$16,180
Housekeeper/Groundskeeper	$16,542
Health Care	$29,942

Personal income taxes were estimated based on the following employee profile: he/she will file a joint tax return, is married to a spouse with similar income, has two dependents, and takes the standard deduction rather than itemize deductions.

Based on the principle of conservatism, this study underestimates the impact of personal income to some extent by assuming that all personal income earned will be spent on goods and services at the project's commercial and office businesses, and are therefore already accounted for in the study model. However, if 30% of the income were spent in businesses outside of the project, it would result in approximately $1.2 million annually in additional state personal income tax revenues.

Property Tax. The reclassification and rezoning of the property would increase the relative value of the land. In addition, the improvements would also have value. This study assumed that the current assessed land values will increase to that of the higher land use upon obtaining the new zoning classification. The increased value due to improvements will be in proportion to the levels of construction completed.

A survey of 1989 assessed value of property in the project vicinity, was the basis for estimating land value changes. Land values ranged from $147,000 per acre for residential to $308,000 per acre for commercial properties. The net change from the existing classification (agriculture and conservation) to the higher classifications was estimated and used to calculate tax revenues.

The land portion would be taxed at the rate of $10.00 per $1000 of assessed value. The improvements portion would be taxed at $8.50 per $1000 of assessed value.

Hotel Room Tax. Effective January 1, 1987, hotel room rentals are subject to a 5 percent hotel room tax. This source of revenue was incorporated into the analysis. The hotel's average rack rate was assumed to be $100 per day after considering possible corporate discount rates and other "package" rates which may be used. Furthermore, an average occupancy rate of 80% was assumed, based on NLW's market study.

County Excise Tax. The State Legislature is currently considering granting the counties the authority to levy a 1/2% excise tax. If this authority is granted by 1995, the counties will derive an additional $39 million in tax revenues (discounted to the 1990 baseline). This additional revenue will change the overall revenue-cost ratio for this project from 9.7 to 1.0 to 10.7 to 1.0. The County of Hawaii revenue-cost ratio will increase significantly from 1.15 to 1.0 to 4.3 to 1.0.

Public Cost Variables

Lower Education. The increase in employment population may increase public education costs if additional teachers, supplies, etc. are needed beyond the level currently being planned. Whether the incremental cost will rise proportionally with the additional population, is uncertain. If the majority of the direct labor required could be adequately absorbed through the local labor supply, then under such a scenario, it is expected that the actual cost increase realized will be much smaller. This is based on the premise that existing households would not necessarily move to the new area, but would commute to the new workplace. Therefore, total marginal increase in cost would be minimized. However, with in-migration of the labor force required to staff the operations still a reasonable possibility, an average cost allocation to the project was made.

Although an elementary school will be constructed on this project, its full cost was not charged as a public cost arising from the project. The existing Kealakehe Elementary School is already considered to be at maximum capacity and another school is needed whether or not this project is constructed.

Higher Education. The increase in the number of households within the project area will increase the demands on the higher education services. Although there is no concrete evidence to indicate the proper amount to be charged to the project, the average costs for educating a typical undergraduate at the University of Hawaii at Manoa were charged to the residential households of this project.

Health Services. This variable includes the emergency medical services and the Honokaa, Kohala, and Kona Hospital components. The health services were allocated to the residential households of this project.

Transportation Services. The existing city bus services are basically intercity, rather than local street service. Furthermore, it is estimated that only 3 - 4% of the population uses public transportation. The incremental transportation burden created is therefore minimal. The average variable cost was estimated to be approximately $2 per resident.

Police Services. The residences in the project area will require police services at an estimated cost of $136 per person.

It was assumed that the project's non-residential uses will provide its own security services and that the incremental public cost will be minimal. However, the employment created through the project will potentially add to the workload for police services. An allowance of $27 per employee (20% of the unit cost per resident) was therefore included.

Fire services. The residences in this project may require the services of the County Fire Department. An average per capita cost of $204 was therefore included. The unit cost includes an additional allowance of 50% to account for the services that will be required for the other proposed land uses in the project.

Public Facilities. This project includes the capital cost for a public facility/civic center. This analysis overestimates the public cost to the extent that the public facilities are not in direct support of this project, but is a regional-serving function. It is charged against the project as a public cost, based on the principle of conservatism. The cost of the capital cost is allocated 75% to the State and 25% to the County.

The cost of operating the public facility/civic center were not charged directly against the project. The QLT property's "fair share" is already included in the individual public services breakdown.

Excluded Variables

Certain variables, such as highway construction and maintenance, airport expansion and utilities, were excluded from this analysis. Although these variables might be affected by the project, they are paid through special funds which are kept solvent through user fees. This also includes capital improvement projects, which are funded directly through bond issues and the costs are paid through these special funds. Therefore, the inclusion of these costs, along with the assessed user fees, would result in a "wash".

Results of the Present Value Analysis

The revenue-cost analysis identified the kinds of revenue and cost elements, estimated the dollars associated with each revenue and cost element, and compared the discounted present value of the various revenue and cost totals.

For the Queen Lilioukalani Trust Property, a revenue-cost ratio of 9.7 to 1.0 was attained. This indicates that an additional $9.70 in public revenue benefits would accrue to the State of Hawaii and the County of Hawaii for every dollar of public cost caused by the proposed development. This would be a definite financial gain to the State and the County of Hawaii, should this project be implemented. As a standard for comparison, in its civil projects, the U.S. Army Corps of Engineers recommends proceeding with a project if there is unity (1.0 to 1.0) or greater. The summary of the itemized results of the present value analysis is presented in the table that follows.

The cumulative discounted public revenues totalled $382.5 million in constant 1990 dollars. Of these variables, the combined "general excise tax" variables contributed over $314.5 million, approximately 82% of the total. This is followed by the "corporate income tax" variable which contributed $34.5 million, approximately 9% of the total.

The cumulative discounted public costs totalled $39.4 million in constant 1990 dollars. The largest single cost is the capital cost for the public facility/civic center variable, $19 million. The next highest cost is lower education, $9.7 million.

SUMMARY - REVENUES AND COSTS

TAX REVENUE CATEGORIES	STATE REVENUE (NPV)	COUNTY REVENUE (NPV)	TOTAL REVENUE (NPV)
GENERAL EXCISE TAX - CONSTRUCTION	$6,893,174		$6,893,174
GENERAL EXCISE TAX - OPERATIONS	$307,640,569		$307,640,569
CORPORATE INCOME TAX	$34,544,072		$34,544,072
PERSONAL INCOME TAX	$19,127,260		$19,127,260
PROPERTY TAX		$14,167,599	$14,167,599
HOTEL ROOM TAX	$155,523		$155,523
TOTAL REVENUE	$368,360,598	$14,167,599	$382,528,197

GOVERNMENT SUPPORT COSTS	STATE COSTS (NPV)	COUNTY COSTS (NPV)	TOTAL COSTS (NPV)
LOWER EDUCATION	$9,702,101		$9,702,101
HIGHER EDUCATION	$1,151,214		$1,151,214
HEALTH SERVICES	$2,014,148		$2,014,148
TRANSPORTATION SERVICES		$35,327	$35,327
FIRE SERVICES		$3,367,491	$3,367,491
POLICE SERVICES		$4,136,339	$4,136,339
PUBLIC FACILITIES	$14,218,559	$4,739,520	$18,958,078
TOTAL COSTS	$27,086,022	$12,278,677	$39,364,698
REVENUE TO COST RATIO	13.60	1.15	9.72

ECONOMIC IMPACT ANALYSIS

Introduction

As with any economic activity, the injection of dollars into the economy will result in direct impacts through the purchase of various goods and services from other industries. The additional purchases made will, in turn, cause these industries to purchase more goods and services from other industries. The result is a chain reaction of purchases, or a "multiplier" effect produced by the original increase in purchases.

The Basic Theory

The simplest way to understand the multiplier effect is to consider what would happen if you were given a "brand new dollar". It is likely that you would spend part of it and save the rest. Let's say you spend $0.80 of that dollar. For simplicity, assume that individuals and businesses were equal entities in their economic behavior. This $0.80 then, was again partially spent with the remainder saved. If this ratio was assumed to remain constant, then $0.64 would be spent and the remaining $0.16 saved, and so on. If this process were to continue until all the money was either spent or saved in this proportion, the "injection" of this additional dollar would ultimately yield $5.00 in output for our simple economy. In other words, a multiplier effect of 5 had occurred. In essence, then, not only the direct effect of the additional dollar "injected" must by analyzed, but also the indirect effects.

Hawaii's Input-Output Model

In 1972, the Department of Planning and Economic Development (DBED) published the State's updated Input-Output Model. This model summarized the economic activities of the State at a given moment in time, providing information on the inter-relationships between all sectors within the economy. Its most useful application was the formulation of output, income, and employment multipliers. Type I multipliers provided information on the direct-plus-indirect impacts due to changes in final demand. Type II multipliers, on the other hand, described the direct-plus-indirect-plus-induced effects due to a change in final demand. The major assumption made in using these multipliers was that technology and factor prices remained relatively stable.

The Input-Output Model is constantly being updated, but has not been republished. At the current time, only employment multipliers were available for the economic activities to be located on the QLT Property.

Technical Considerations

Direct output dollars were presumed to be primary or "new" due to the following factors:

1. During the development stages, the capital required to fund this project will more than likely find its sources outside of the Hawaiian economy;

2. The expected operations of the business hotel will find its clientele base largely from westbound tourist traffic and from westcoast buyers.

3. A portion of the commercial revenue will be from visitors and that their spending in this project's stores will not detract from other retail areas of the state.

Detailed Analysis

Definitions

There are three effects which are relevant: the direct effects, the indirect effects, and finally, the induced effects. The direct effect is the immediate and primary impact of a given project upon the economy. For this project, an example would be the hotel rental fees charged.

The indirect effect, on the other hand, is the secondary impact that would be felt within the economy. It is useful to think about indirect effects in the following manner: in order for the hotels to provide the various services and amenities to their guests, they must purchase various other goods and services such as water, electricity, transportation, etc. The changes that occur in these "support" industries and the employment it creates is the indirect effect.

Finally, the induced effect is the subsequent rounds of changes in the economy which is "time-compressed" into a single value. The "new" income received by the various households employed by the project will trigger increased spending. These increased purchases will deplete existing inventory, and thus, must be restocked by their various suppliers. This, in turn, informs the various producers to increase their production through their own increases in orders. The sectors within the economy affected could include supermarkets, theaters, arcades, etc. Also, the effects would be found in the business sectors, influencing increased purchases of supplies and raw materials to provide needed complementary services.

Analysis of Impacts

This study describes the impacts that are expected to occur throughout the economy, as well as the relevant parameters used to calculate them. These results should be viewed as the relative magnitudes that may exist should this project be undertaken. This is due in part to the inherent assumptions built into the input-output model and various estimation errors, such as sampling errors, rounding errors, etc. As such, this is not a prediction. In addition, the effects analyzed in this section were made at the point in time when the project would be in full operation.

Direct Effects. The impacts represent the changes that could occur to the Gross State Product, that is, the effect on the total value of the goods and services produced within the State's economy.

Upon full operation in the year 2020, it is estimated that the project will generate an average direct sales and rental income of $3,582 million per year, in constant 1990 dollars, from the operation of the shopping centers, office complexes, business hotel, hospital, and retirement village. It is estimated that the project would generate an average direct personal income of $106 million per year in constant 1990 dollars and 5600 direct jobs per year.

Indirect and Induced Effects. Employment opportunities should be enhanced by this proposed project. The DBED estimates that a new job is created for every $120,000 in construction. This project can create up to 5300 jobs, averaging 210 per year over the life of the project construction period. Since construction is not a primary industry, there is no multiplier effect.

The Center Development Corporation estimates that 40% of the retail sales and jobs are attributable to visitor spending. The DBED model projects that an additional 0.6 jobs are created for every job created through retail sales to out-of-state visitors. Based on these assumptions, the commercial enterprises proposed for this project will generate 540 jobs in addition to the 2240 direct employees. The multiplier effect for retail operations was not available.

Finally, the DBED model projects that approximately 0.9 jobs are created in the State economy for every direct job in the hotel, assuming that all customers will be out-of-state visitors. It is therefore estimated that the project will generate an additional 200 jobs in addition to the direct 240 jobs in the business hotel.

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Appendix I
Transportation Impact Analysis

TRANSPORTATION ANALYSIS

KEAHUOLU LANDS DEVELOPMENT
NORTH KONA DISTRICT, HAWAII

Prepared for

BELT COLLINS & ASSOCIATES

By

Wilbur Smith Associates

August 1990

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SUMMARY

The proposed Keahuolu Lands development is located on an 1,135 acre portion of the Queen Liliuokalani Trust property in the North Kona district of Hawaii County, extending generally north from Palani Road and east from the Old Kona Airport Park. The site lies primarily in the State Land Use Agriculture District, and is zoned "Unplanned" under County Zoning. This report addresses impacts of development which would result from a change in designation of a portion of the Keahuolu Lands area.

The site area has been identified in the Hawaii County General Plan as "Alternate Urban Expansion," and is intended to provide a focal point for the West Hawaii area, which is already in the midst of rapid development. As such, the site is planned to contain a regional shopping center, a civic and cultural center, business and financial center, affordable housing, and other supportive land uses. The magnitude of the project, together with other rapid growth in the area (including proposed development of the adjacent Kealakehe Lands) will add significant amounts of traffic to the area's roadways.

This study is designed to address various issues related to development of the Petition Area within the context of West Hawaii Growth, including an assessment of the magnitude of future traffic, identification of a circulation and access plan for the development, and identification of strategies for mitigating project impacts.

Existing Conditions

The petition area is largely vacant, unimproved land, except for the Queen Liliuokalani Children's Center and the Kona Industrial Subdivision on the makai portion of the site and the Queen Liliuokalani Village residential development at the mauka edge of the site. Downtown Kailua is located approximately one-fourth mile from the site. Existing roadways serving the site include Queen Kaahumanu Highway, the major roadway serving the area for travel to the north and south, as well as through traffic; Palani Road, a mauka-makai connector between downtown Kailua and the Hawaii Belt Road; and Mamalahoa Highway, an inland north-south route. Kealakehe Parkway, Kaiwi Street and Kuakini Road also provide connections to the Honokohau Boat Harbor, Kona Industrial Park and residential areas south of Downtown Kailua, respectively.

Traffic volumes in excess of 20,000 vehicles daily are found on Kuakini Road and Alii Streets south of Palani road in Kailua; adjacent to the petition area, daily traffic volumes run as high as 15,500 on Queen Kaahumanu Highway north of Palani Road, and 13,500 on Palani Road mauka of Queen Kaahumanu Highway.

Only two key intersections in the vicinity of the site are signalized (the intersections of Palani Road with Queen Kaahumanu Highway and with Kuakini Highway); all others are currently stop sign controlled. Existing levels of service at key intersections have been measured as low as "F" at the intersection of Queen Kaahumanu Highway and Kaiwi Street during the PM peak hour. Elsewhere, existing levels of services range from "B" to "D" during morning and afternoon peak periods. (The level of service concept is described in detail in this report).

Forecast of Future Conditions

A proprietary sub-regional traffic model (ASSIGN) was used to model future traffic for a number of future scenario, using the traditional three-step process of trip generation based on standard trip generation factors; trip distribution based on a gravitational model; and traffic assignment to assumed roadway networks based on shortest paths. Non-project traffic generation for future conditions was based on Hawaii County projections of employment and residential development for North Kona in the year 2010, and on latest plans for the adjacent Kealakehe development.

Year 2010 Conditions Without the Project

Year 2010 conditions without the project were forecast for a roadway network which assumed upgrading of Queen Kaahumanu Highway to a controlled access highway with an interchange at Kealakehe Parkway, an overcrossing at Kaiwi Street, and frontage roads along both sides. Other assumed improvements included a Kealakehe Parkway mauka extension to Mamalahoa Highway and a new Alii Highway paralleling Alii Drive from Kuakini Highway south of downtown Kailua to the Keahou area.

Projections of future traffic growth included approximately 58,500 new daily trips from the Kealakehe Lands development, (4,200 during the PM peak hour) and approximately 500,000 new trips from other new North Kona development (50,000 during the PM peak hour).

When this traffic was distributed to the assumed roadway network, traffic along Queen Kaahumanu Highway was projected to reach 3,000 vehicles per hour in each direction during the PM peak period. The intersections of Palani Road at Queen Kaahumanu Highway and Palani Road at Kuakini Highway were projected to operate at Level of Service "F". Analyses indicated that for the Queen Kaahumanu Highway/Palani Road intersection to continue to operate as an at-grade intersection, six to seven approach lanes (including turn lanes) would be required at each approach to the intersection to achieve acceptable levels of service.

Keahuolu Project Impacts

After establishing Year 2010 conditions without the project, the traffic model was run with the Keahuolu Lands Project and related roadway improvements. The project was assumed to consist of a 500,000 square foot regional shopping center, four office developments on sites ranging from 10 to 17 acres in size, 360 residential dwelling units, 30 acres of civic/cultural facilities and a 150 bed hospital by the horizon year.

This development was estimated to generate approximately 39,000 daily trips, with 3,800 occurring during the PM peak hour. Trips generated by the Keahuolu Lands project were estimated to amount to 4.8 percent of all North Kona Traffic in the Year 2010, or 7.0 percent of all new traffic.

Key roadway improvements assumed in the model for this scenario included a new mauka-makai roadway (referred to as Liliuokalani Boulevard) extending from Palani Road to Queen Kaahumanu Highway in the vicinity of the Kaiwi Street; a southward extension of

Kealakehe Parkway to Kuakini Highway at Kaiwi Street, and a new mid-level roadway mauka of Queen Kaahumanu highway, passing through the project.

Development of the Petition Area is projected to increase PM peak hour traffic by 3,500-3,600 trips in each direction south of Palani Road for the Queen Kaahumanu-Kuakini-Alii corridor as a whole, and by approximately 2,600 to 3,000 in each direction north of the site in the Queen Kaahumanu-Mid-Level Road corridor. Localized impacts would include a reduction of traffic on Palani Road and on Queen Kaahumanu Highway near the site, compared with the without-project scenario, due to the redistribution of traffic by the new Mid-Level Roadway and Liliuokalani Boulevard.

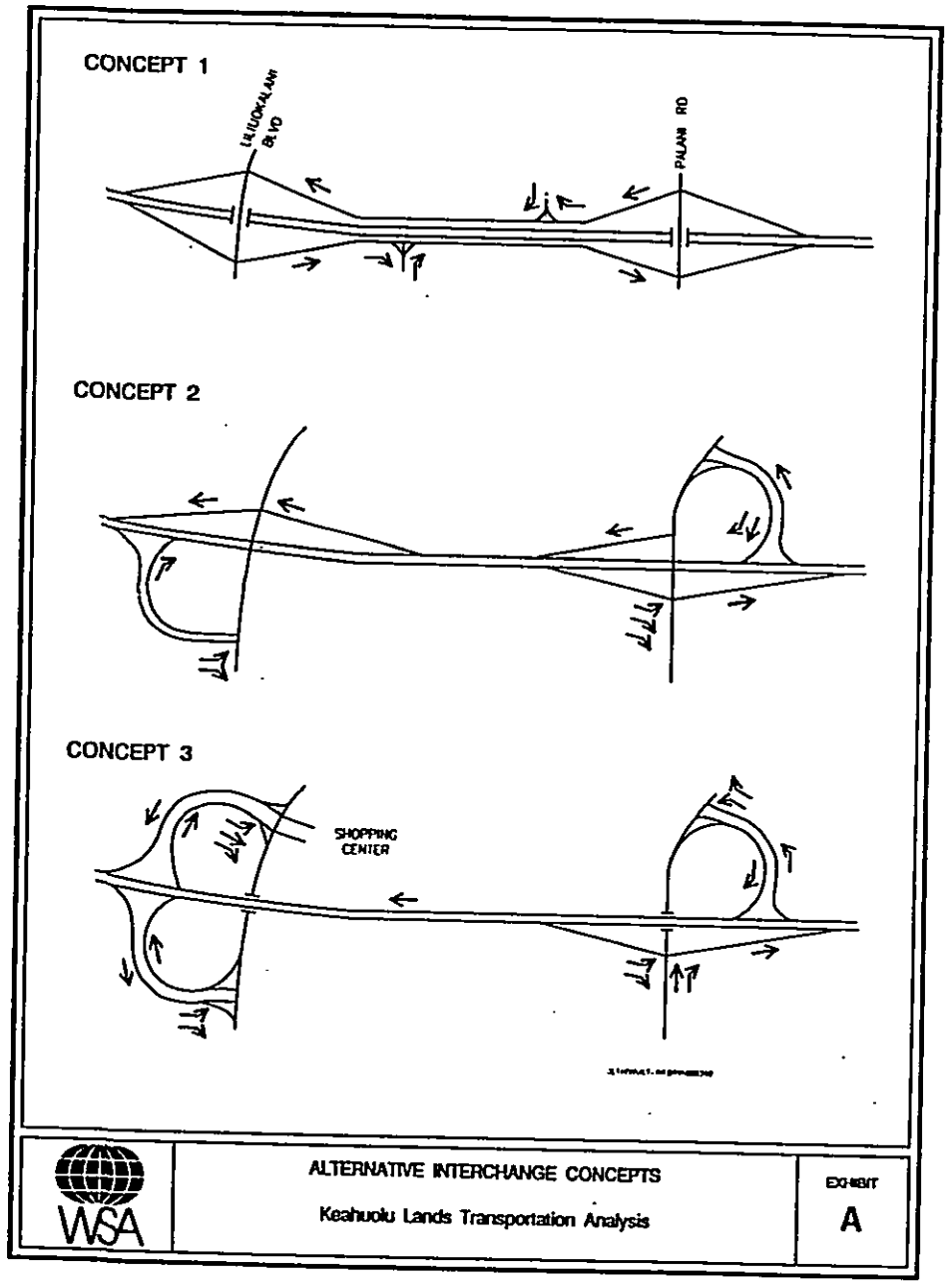
Alternative Queen Kaahumanu Highway Improvement Concepts

Because of the burden placed on the intersection of Queen Kaahumanu Highway and Palani Road under future conditions (both with and without the Project), an alternative network concept was modeled which included interchanges on Queen Kaahumanu Highway at both Palani Road and the new Liliuokalani Boulevard. The proximity of these two interchanges to each other required careful attention to operational issues, and once traffic was projected for this alternative, three different design concepts were investigated for the two interchanges, as shown in Exhibit A. These three concepts, described in detail in the report, were subjected to operational and volume/capacity analyses first using minimum geometric configurations, then with mitigation measures in the form of additional lanes of travel. Findings of this analysis can be summarized as follows:

- Concept 1 was found to be relatively inexpensive in principle, but volume-capacity analyses indicated that exceptionally long or wide (multi-lane) storage sections would be required, increasing structural costs. This concept also would create the most indirect travel paths for drivers.

- Concept 2 would provide uninterrupted flow for more movements, and less intersection impacts at ramp junctures with surface streets. The proximity of the northbound Palani Road on-ramp to the northbound Liliuokalani Boulevard off-ramp would provide marginally acceptable levels of service for weaving traffic in the year 2010, but leave little capacity for traffic increases in the years beyond.

- Concept 3 would be the most expensive of the three due to land and structure costs, but would provide the best levels of traffic service overall, considering both ramp intersection traffic and weaving traffic, and provide the most reserve capacity for traffic growth beyond the Year 2010.



TRANSPORTATION ANALYSIS

KEAHUOLU LANDS DEVELOPMENT

NORTH KONA DISTRICT, HAWAII

Prepared for

Belt Collins & Associates

Prepared by

Wilbur Smith Associates

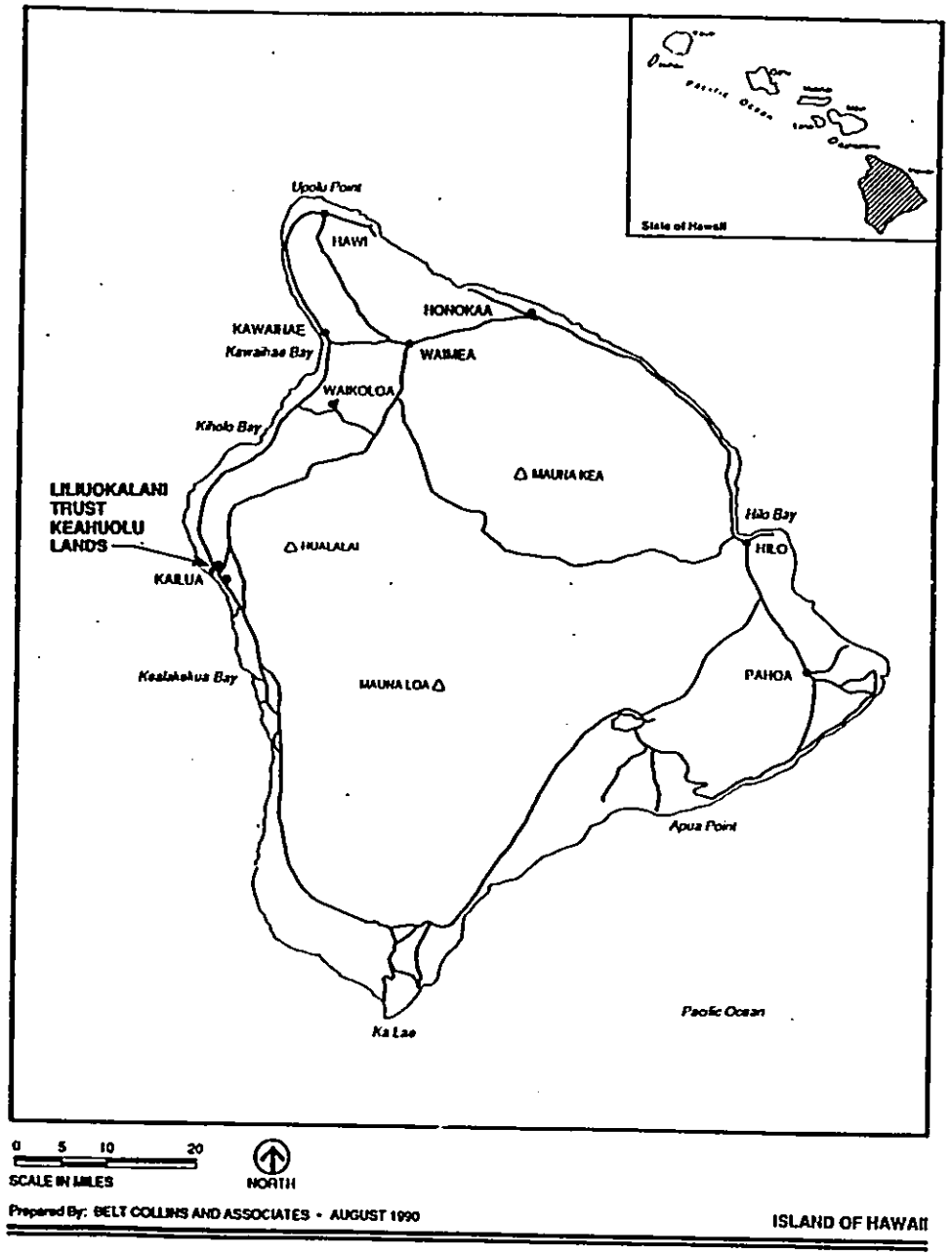
August, 1990

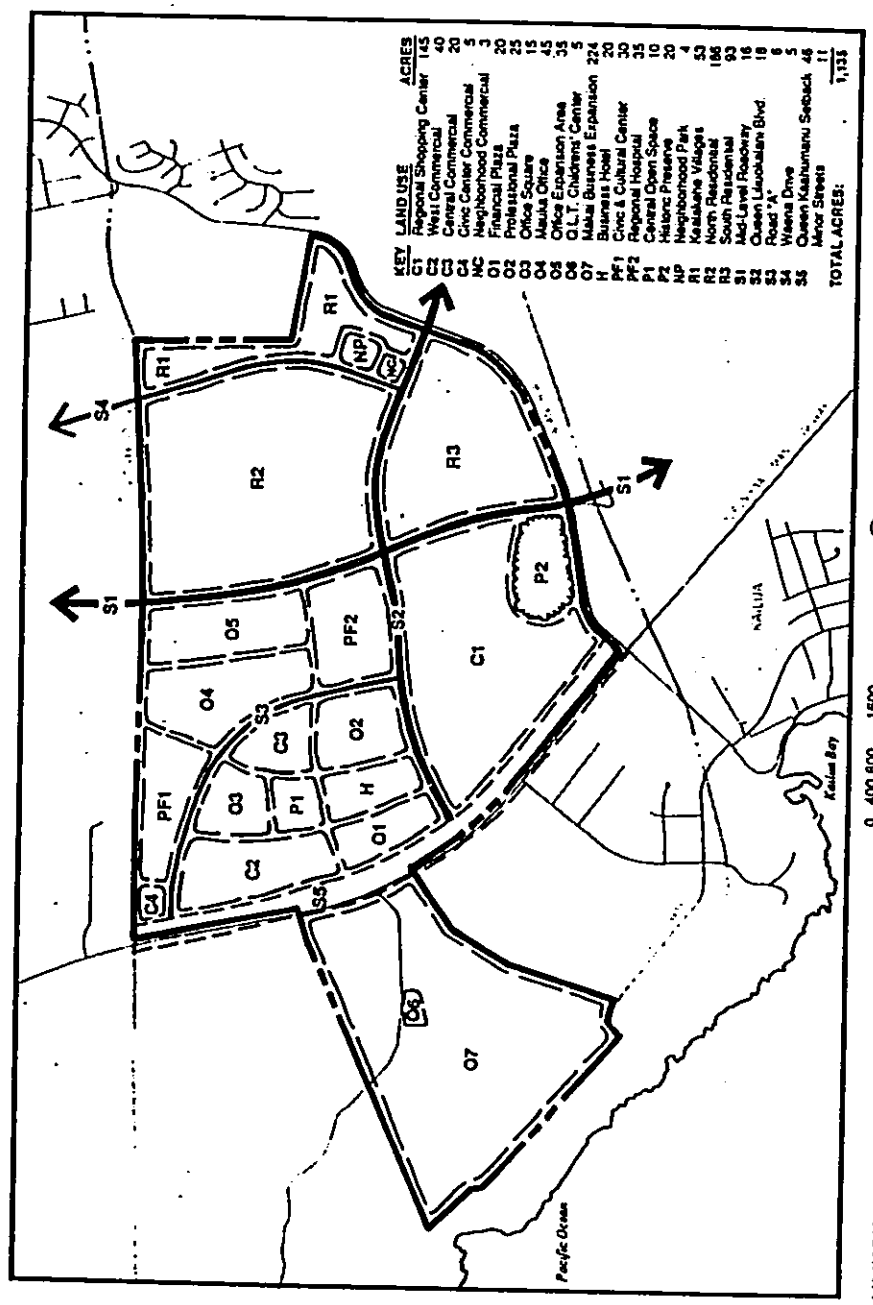
I. INTRODUCTION

This report presents an analysis of the travel demands and transportation system needs which could occur with the proposed development of the Queen Liliuokalani Trust property in the Keahuolu ahupua'a in the North Kona district of Hawaii County. The subject development area is an 1,135 acre portion of the Keahuolu ahupua'a bounded approximately by Palani Road and the Kona Industrial Subdivision on the south; Queen Liliuokalani Village to the east, the Kealakehe ahupua'a to the north and the Old Kona Airport Park tothe west. The major portion of the development is currently in the State Land Use Agriculture District and is zoned "Unplanned" under County Zoning. However, portions of the property have already been approved for urban development. This report addresses impacts related to a change in land use designation for the balance of the project area, subsequently referred to as the "petition area". Figure 1 depicts the location of the Keahuolu Lands.

The West Hawaii area where the petition area site is located is in the midst of rapid development including resort, commercial, housing and supporting industrial types of development. The petition area itself has been identified in the Hawaii County General Plan as Alternate Urban Expansion, with portions of the site designated as High Density Urban, Low Density Urban and Conservation and Industrial.

The proposed development is intended to provide a focal point for the rapidly growing West Hawaii area, and is planned to include a regional shopping center, a civic and cultural center, business and financial centers, affordable housing and, ultimately, supportive uses such as neighborhood commercial developments and a health care center. The magnitude of the project, along with other rapid growth in the area (including potential development of the neighboring Kealakehe ahupua'a) will add significant amounts of traffic to the area's already heavily utilized roadways, necessitating major improvements to regional transportation linkages. Figure 2 depicts the proposed conceptual land use plan for the Keahuolu Lands project area.


State of Hawaii
Upolu Point
HAWI
HONOKAA
KAWAIHAE
Kawaihae Bay
WAIMEA
WAIKOLOA
Kiholo Bay
LILIUOKALANI TRUST KEAHUOLU LANDS
MAUNA KEA
HUALALAI
Hilo Bay
HILO
KAILUA
Kealakekua Bay
MAUNA LOA
PAHOA
Apua Point
Pacific Ocean
Ka Lae
0 5 10 20
SCALE IN MILES
NORTH
Prepared By: BELT COLLINS AND ASSOCIATES - AUGUST 1990
ISLAND OF HAWAII


KEY LAND USE ACRES
C1 Regional Shopping Center 145
C2 West Commercial 40
C3 Central Commercial 20
C4 Civic Center Commercial 5
NC Neighborhood Commercial 3
O1 Financial Plaza 20
O2 Professional Plaza 25
O3 Office Square 15
O4 Mauka Office 45
O5 Office Expansion Area 35
O6 O.L.T. Childrens' Center 5
O7 Makai Business Expansion 224
H Business Hotel 20
PF1 Civic & Cultural Center 30
PF2 Regional Hospital 35
P1 Central Open Space 10
P2 Historic Preserve 20
NP Neighborhood Park 4
R1 Kaiakaina Village 53
R2 North Residential 186
R3 South Residential 93
S1 Mid-Level Roadway 16
S2 Queen Liliuokalani Blvd. 18
S3 Road "A" 6
S4 Waena Drive 5
S5 Queen Kaahumanu Setback 46
Minor Streets 11
TOTAL ACRES: 1,135
R1
NP
NC
S4
R2
R3
S1
O5
PF2
S2
C1
P2
O4
S3
O2
PF1
O3
P1
H
O1
C4
S5
O6
O7
KAILUA
Kailua Bay
Pacific Ocean
NORTH
0 400 800 1600
SCALE IN FEET
Prepared by: BELT COLLINS & ASSOCIATES
Date: AUGUST 1990
CONCEPT PLAN
LILIUOKALANI TRUST
KEAHUOLU LANDS
ENVIRONMENTAL IMPACT STATEMENT

Scope of Study

This Transportation Analysis is designed to address several issues surrounding development of the Keahuolu Lands within the context of West Hawaii growth:

- Assessment of magnitude of traffic increases in the area resulting from the proposed project as well as other development;
- Identification of a circulation plan for the development which will provide the necessary traffic-carrying capacity and minimize disruption to surrounding communities;
- Evaluation and planning for access to the Queen Kaahumanu Highway;
- Evaluation and planning for a proposed mid-level road which would provide an alternative to Queen Kaahumanu Highway; and
- Identification of other measures or strategies for mitigation of traffic impacts on access routes to the project.

Relationship to Island-Wide Planning

As noted above, rapid growth is already occurring in West Hawaii and a number of ongoing studies are being prepared regarding the traffic impacts and transportation plans for this area, including the major studies discussed below.

County-Wide Transportation Plan -- This joint study by the State of Hawaii and Hawaii County, currently in progress, includes the development of a regional model (TRANPLAN) for the entire island. Using zonal forecasts of growth in residential units and jobs, the study is oriented toward providing an overview of the island's transportation needs. Growth forecasts for zones in the North Kona and adjacent districts were utilized in projecting future non-project traffic in the present study.

Keahole to Kailua Development Plan – This study by Hawaii County recognized that the area from Keahole to Kailua is a prime candidate for urbanization to meet the needs of West Hawaii. It is intended to provide overall guidelines for development of the area, and to define

infrastructure needs such as a Queen Kaahumanu Highway bypass roadway. It also provided a context for highway improvement assumptions in this study.

Kealakehe Community Plan -- A study by the State of Hawaii Housing Finance and Development Corporation is developing a land use plan for a major residential-oriented community, the Kealakehe Lands development immediately north of the Keahuolu development. This development is currently at the planning stage, although impact studies have yet to be prepared. Because of its magnitude and proximity to the Keahuolu lands, detailed estimates of trip generation of this development were prepared in this study.

The Keahuolu Lands Transportation Analysis is designed to be part of a coordinated planning effort. As such, it incorporates all data available from other recent impact studies, such as those described above. For the Kealakehe Lands project, for example, trip generation and distribution were projected at a level of detail similar to the Keahuolu Lands project.

The traffic estimation effort represented in this report is also intended to be integrated with the island-wide TRANPLAN travel forecasting model now under development. However, as of this writing, neither outputs or network input data (except zonal employment and population forecasts) for this model have been provided to Wilbur Smith Associates. Therefore, in order to provide analyses in a timely manner for the Land Use Boundary Amendment application, a proprietary small-area model (ASSIGN) has been used to evaluate traffic impacts in the immediate vicinity of the project site. This quick-response microcomputer model uses a conventional node and centroid approach to network construction which will facilitate later incorporation of the analysis network into the TRANPLAN model.

II. EXISTING CONDITIONS

The Keahuolu area is largely undeveloped at present. Roadway access to the area is via the Queen Kaahumanu Highway and Palani Road. Current land uses and roadways within or adjacent to the development area are described in the following sections.

Existing Land Uses

The Keahuolu Lands area proposed for development is located immediately north of Palani Road, extending approximately one and one-third miles northward along Queen Kaahumanu Highway. Mauka of Queen Kaahumanu Highway, the area extends approximately 1.5 miles at its widest, while makai of Queen Kaahumanu Highway it extends approximately two-thirds of a mile to the vicinity of the Old Kona Airport State Park.

The petition area, for the most part, consists of vacant, unimproved land with sparse vegetation. Exceptions to this are the Queen Liliuokalani Children's Center facility and the Kona Industrial Subdivision on the portion of the site makai of Queen Kaahumanu Highway, and the Queen Liliuokalani Village residential development at the extreme mauka end of the site.

Significant existing land uses in the immediate vicinity of the Keahuolu Lands include downtown Kailua, currently the commercial and tourism focus for West Hawaii, approximately one-fourth mile from the southernmost boundary of the site; the Honokohau Boat Harbor makai of Queen Kaahumanu Highway north of the petition area; and the Kealakehe and Queen Liliuokalani residential developments immediately north of the mauka portion of the site. More remote, but significant from the standpoint of traffic generation, is the Keahole Airport, approximately five miles north of the Keahuolu Lands.

Existing Roadway Network

Queen Kaahumanu Highway is the major roadway serving the petition area. This roadway is a State Highway, connecting the Kailua area with Keahole Airport, South Kohala resorts areas, Kawaihae, and various coastal properties along North Kona. North of downtown Kailua, Queen Kaahumanu Highway is a limited access highway designed for 70 miles per hour speeds. The existing right-of-way varies from 80 feet in the vicinity of the Keahuolu ahupua'a to 300 feet. The facility currently provides one travel lane in each direction and paved shoulders on both sides.

Queen Kaahumanu Highway extends south of Palani Road to connect with Kuakini Highway. The road continues south as the Hawaii Belt Road and is the primary regional north-south route serving Captain Cook and South Kona communities, as well as traffic destined for Puna and South Hilo Districts.

Palani Road, which abuts the petition area on the south, provides the only mauka-makai connection to the Hawaii Belt Road in the vicinity of the site. Palani Road is a two-lane facility extending from downtown Kailua four miles in generally northward direction mauka of Queen Kaahumanu Highway to a point where it merges with Mamalahoa Highway (also known as the Hawaii Belt Road). Palani Road provides a linkage from Kailua and other North Kona coastal areas and the Waimea-Hilo area as well as for tourists circling the island. Makai of downtown Kailua, Palani Road channels traffic directly into Alii Drive, which serves coastal destinations south of downtown Kailua.

Mamalahoa Highway, in addition to providing through traffic service between Palani Road and the north, provides an alternative link to the south, bypassing Kailua and rejoining the Hawaii Belt Road at Honalo, approximately ten miles to the south of Kailua. Mamalahoa Highway provides one travel lane in each direction.

Kaiwi Street, a mauka-makai connector makai of Queen Kaahumanu Highway approximately 2200 feet north of Palani Road, provides a link between Queen Kaahumanu Highway and Kuakini Road. The two-lane street primarily serves Kona Industrial Park traffic.

Kuakini Road, which becomes Kuakini Highway south of downtown Kailua, provides an important north-south route through the Kailua Area. South of Palani Road, Kuakini Highway provides access to developing residential areas and connects with the Hawaii Belt Road.

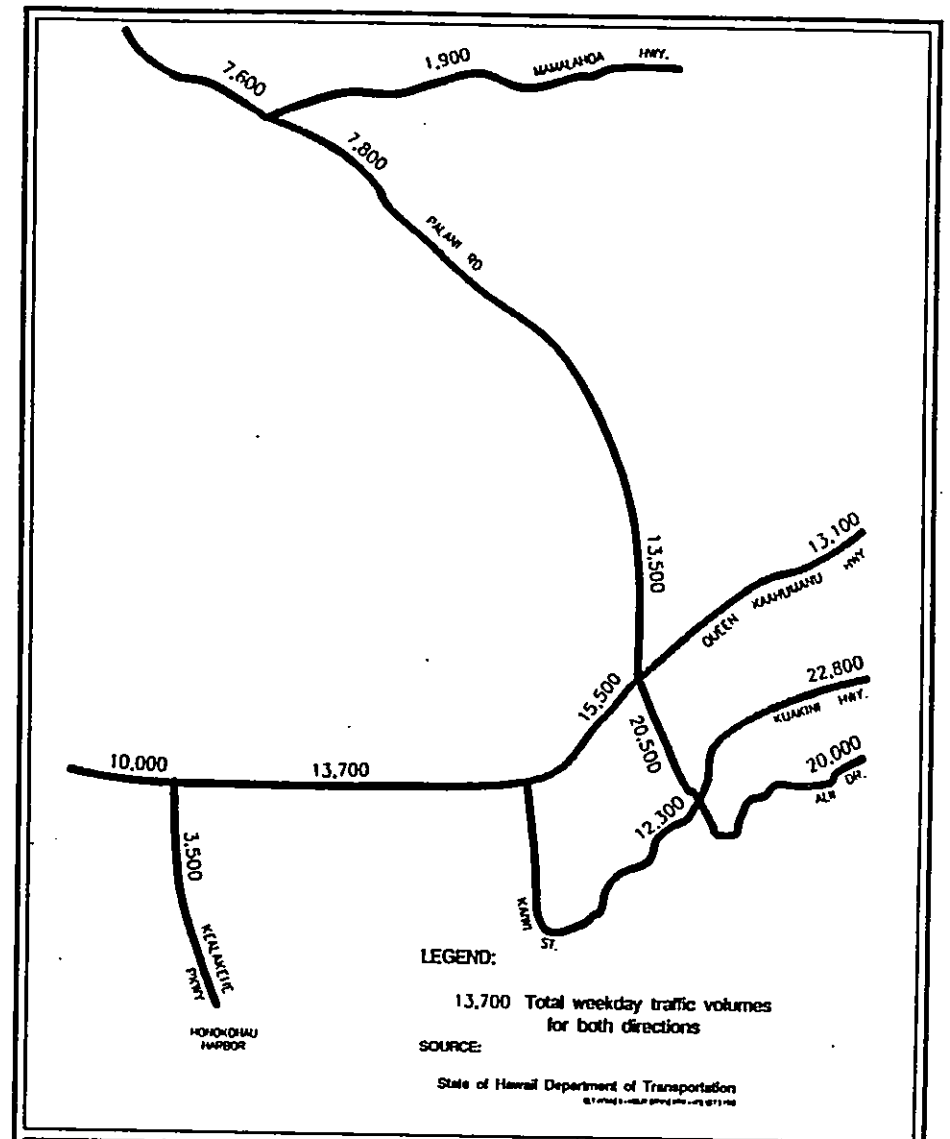
Kealakehe Parkway, located north of the Keahuolu area, is a second mauka-makai connecter road on the makai of Queen Kaahumanu Highway. The road serves the Honokohau Boat Harbor.

Existing Traffic Volumes

Figures 3, 4 and 5 depict the existing roadway network and weekday, morning (AM) peak and afternoon (PM) hour traffic volumes, respectively, based on counts by the Hawaii Department of Transportation and by Wilbur Smith Associates. These figures depict the current orientation of traffic in the study area toward Kailua, with volumes decreasing as the distance from Kailua increases. The highest 24-hour volumes in the vicinity are found on Kuakini Highway and Alii Drive south of Palani Road, with more than 20,000 vehicles using each of these streets daily. Another 13,000 daily vehicles traverse Queen Kaahumanu Highway south of Palani Road. Altogether, traffic volumes south of the Keahuolu Lands area are five to six times larger than north of the site.

As shown in Figure 4, AM peak hour traffic volumes are considerably lower than PM peak hour volumes. For this reason, analyses if traffic impacts in this report focus on the PM peak hour period.

The PM peak hour traffic volumes depicted in Figure 5 also are heavily oriented toward the south, in terms of total volumes. However, directional splits indicate a relatively balanced traffic pattern, with approximately 55 percent southbound and 45 percent northbound on the most heavily traveled north-south streets in the vicinity of Kailua, compared with a 60 percent/40 percent directional split generally considered "typical" of commute hour traffic.



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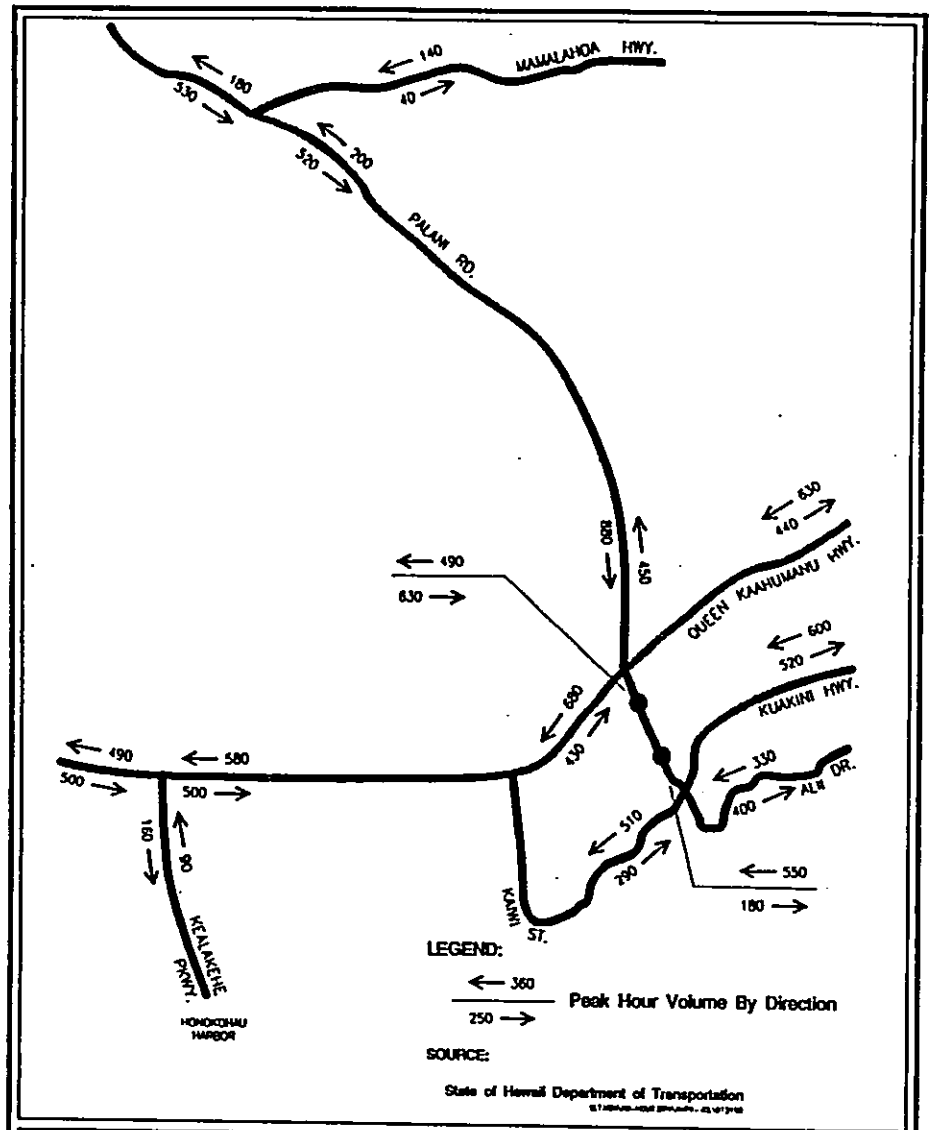
EXISTING AVERAGE WEEKDAY TRAFFIC VOLUMES

Keahuolu Lands Transportation Analysis

3



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EXISTING MORNING PEAK HOUR TRAFFIC VOLUMES

Keahuolu Lands Transportation Analysis

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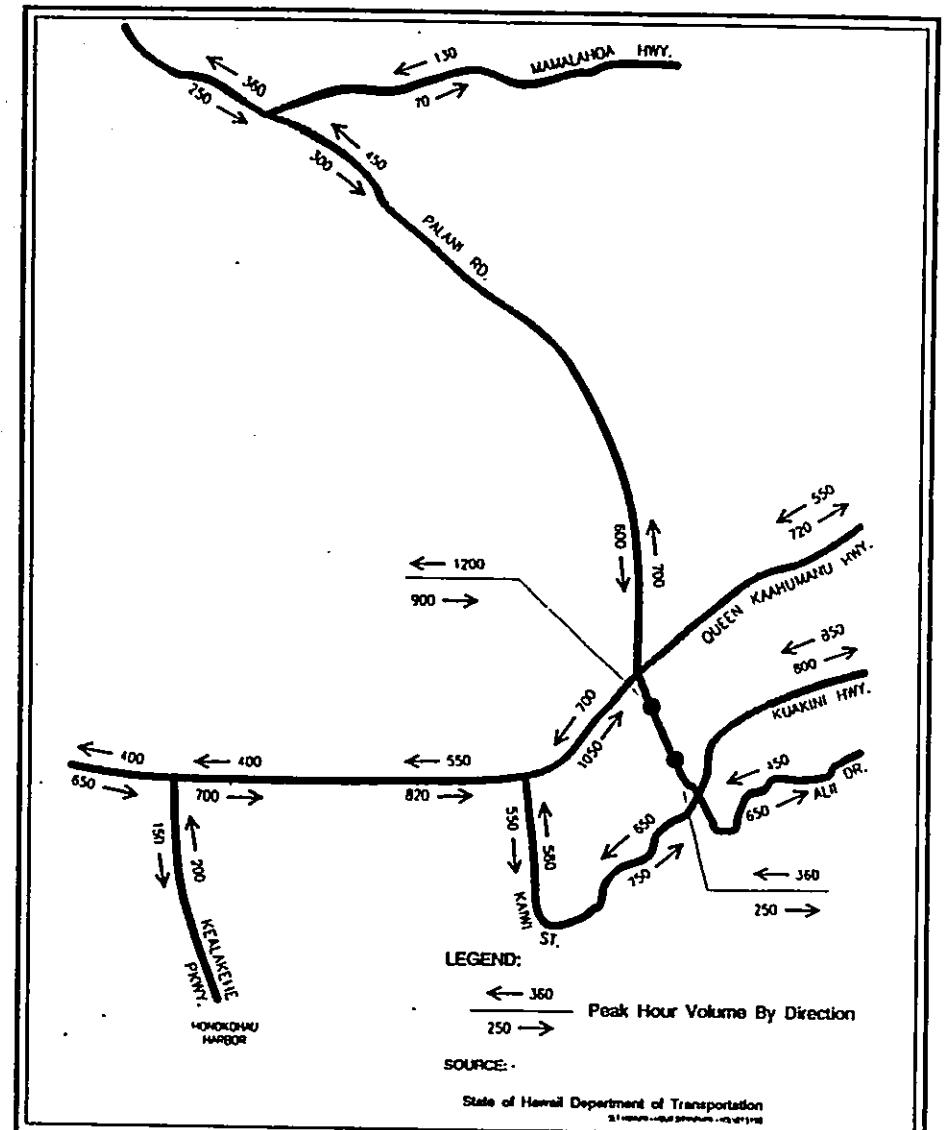


WSA

EXISTING AFTERNOON PEAK HOUR TRAFFIC VOLUMES

Keahuolu Lands Transportation Analysis

5

Along Palani Road mauka of Queen Kaahumanu Highway, traffic volumes during the PM peak hour are heavier in the mauka direction (i.e. headed away from Kailua), consistent with the residential nature of areas served by Palani Road mauka of Queen Kaahumanu Highway.

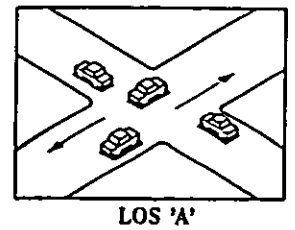
Existing Traffic Conditions

Of the key intersections analyzed in this report, two (Queen Kaahumanu Highway at Palani Road, and Palani Road at Kuakini Highway) are controlled by traffic signals, while the others are stop sign controlled.

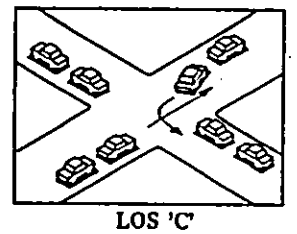
Volume/capacity and level of service analyses for PM peak hour traffic conditions using standard (*1985 Highway Capacity Manual*) methods were drawn from previous studies or calculated for this study. Figure 6 depicts the Level of Service concept for intersections. The intersection of Queen Kaahumanu Highway and Palani Road has been determined to be currently operating at Level of Service "D", indicating substantial delays to traffic. Side street traffic at the stop sign controlled Queen Kaahumanu/Kealakehe Parkway intersection is also subject to Level of Service "D" conditions, while Kaiwi Road traffic at Queen Kaahumanu Highway was been determined to operate at Level of Service "F" (unacceptably long delays) under present conditions in a previous study by Parsons Brinckerhoff for the Eho Street shopping center. The Palani Road/Kuakini Highway intersection is estimated to operate at Level of Service "F". Table 1 summarizes traffic controls and existing levels of service at key intersections in the study area.

Existing traffic volumes depicted in Figures 3 through 5 represent traffic counts taken during various times of the year, and cannot be considered to represent average conditions, because of seasonal variations. Although no comprehensive data is available on seasonal variation, information on tourist visitation to Kona provided by the Hawaii Visitors' Bureau indicates that visitation in a peak month may be nearly 20 percent higher than an "average" month, while low season visitation may be nearly 20 percent lower than in an "average" month.

LEVEL OF SERVICE "A" - V/C = 0 TO 0.60
Describes operations with very low delay, i.e., less than 5 seconds per vehicle. This occurs when signal progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all.

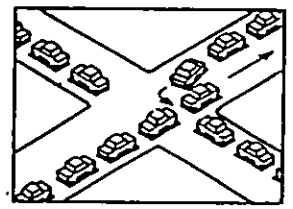

LOS 'A'

LEVEL OF SERVICE "B" - V/C = 0.61 TO 0.70
Describes operations with delays in the range of 5 to 15 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS "A", causing higher levels of average delay.

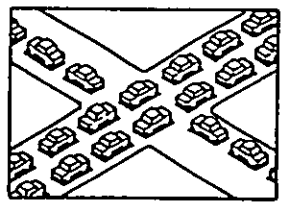

LOS 'C'

LEVEL OF SERVICE "C" - V/C = 0.71 TO 0.80
Describes operation with delay in the range of 15 to 25 seconds per vehicle. Occasionally vehicles may wait more than one red signal phase. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

LEVEL OF SERVICE "D" - V/C = 0.81 TO 0.90
Describes operations with delay in the range of 25 to 40 seconds per vehicle. At LOS "D", the influence of congestion becomes more noticeable. Many vehicles stop, and the proportion of vehicles not stopping declines. Noticeable numbers of vehicles fail to clear signal during the first green phase.


LOS 'D'

LEVEL OF SERVICE "E" - V/C = 0.91 TO 1.00
Describes operations with delay in the range of 40 to 60 seconds per vehicle. These high delay values generally indicate poor progression, long cycle lengths, and high V/C ratios. Vehicles frequently fail to clear the signal during the first green phase.


LOS 'F'

LEVEL OF SERVICE "F" - V/C GREATER THAN 1.00
Describes operations with delay in excess of 60 seconds per vehicle. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection.

SOURCE: Highway Capacity Manual, 1985.

WSA

INTERSECTION LEVEL OF SERVICE CONCEPTS

Keahuolu Lands Transportation Analysis

6

Table 1
EXISTING TRAFFIC CONTROLS AND LEVELS OF SERVICE
Keahuolu Lands Transportation Analysis

LOCATION	TRAFFIC CONTROL	AM PEAK VOLUME/ CAPACITY RATIO	AM PEAK LEVEL OF SERVICE	PM PEAK VOLUME/ CAPACITY RATIO	PM PEAK LEVEL OF SERVICE
Queen Kaahumanu Highway/ Keaiakehe Parkway	Stop Sign	N/A	D	N/A	D
Queen Kaahumanu Highway/ Palani Road	Signal	0.67	B	0.80	C
Queen Kaahumanu Highway/ Kaiwi Street	Stop Sign	No Data	-	N/A	F
Palani Road/ Kuakini Highway	Signal	0.52	A	0.89	D

Note: V/C Ratio not relevant for Stop Sign Controlled Intersection

Source: Wilbur Smith Associates, May 1990

III. FORECAST METHODOLOGY AND ASSESSMENT OF FUTURE CONDITIONS WITHOUT KEAHUOLU DEVELOPMENT

This chapter presents a description of the methodology and assumptions used in establishing future conditions in the Keahuolu Lands study area. A horizon year of 2010 was assumed for this purpose, consistent with other planning efforts underway in Hawaii County. Analyses presented in this chapter focus on future conditions without the Keahuolu development; projected impacts of the project are presented in Chapter IV.

Analysis Methodology

Projection of Year 2010 traffic in the vicinity of the proposed Keahuolu Lands project was accomplished using a traditional three-step modeling approach:

1) Trip generation of future land uses was projected based on historic trip generation studies for respective uses;

2) Trip distribution of future traffic was estimated based on a gravitational model;

3) Projected traffic was assigned to logical paths for assumed future roadway networks, based on time and distance considerations.

Because the Island-wide TRANPLAN traffic model being developed for Hawaii is not yet completed and was not furnished to Wilbur Smith Associates, a proprietary sub-regional model (ASSIGN) was used to forecast impacts of future traffic. Methodologies and assumptions are described in more detail in the following sections.

Land Use and Trip Generation – The proposed Keahuolu Lands Development is one of several projects currently being planned or proposed in the immediate vicinity, and is in the midst of a region for which significant overall growth is anticipated by the year 2010. Trip generation

was projected separately for the Keahuoku Lands project, the adjacent Kealakehe Lands project and other nearby development. Growth in traffic generation in other areas of North Kona was projected based on Year 2010 development assumptions provided by Hawaii County.

For each of the proposed land uses in the various planned developments in the area, suitable trip generation rates were selected based on historical studies of traffic generation. These rates were derived from several standard sources, including *Trip Generation*, by the Institute of Transportation Engineers; *Traffic Generators*, prepared by the San Diego Association of Governments; and *Trip Generation Research*, published by the California Department of Transportation. (Historical Hawaii traffic counts were also used in establishing trip generation rates for resort hotels in other areas of North Kona.)

Table 2 presents the trip generation rates for the various land uses. Trip generation of individual components of the Keahuolu, Kealakehe and other nearby developments are discussed later in this chapter and presented in an appendix to this report.

Other North Kona Traffic Growth – Projections of residential and employment data for Year 2010, as well as a base year (1987) were provided for each of 50 Kona planning zones by Hawaii County. These data were used to develop estimates of total existing traffic generation within North Kona and total Year 2010 traffic generation external to the Keahuolu and Kealakehe projects. (The County's Year 2010 projections do not envisage development of the petition area.) After converting employment figures to equivalent square footages, trip generation rates were applied to residential and employment land uses forecast by the County. For the modeling effort described later in this report, projected future traffic generation by zone was subsequently aggregated by external corridor for all zones not falling within the study area.

Trip Distribution – An important part of the traffic modeling effort is determination of trip distribution. Because no origin-destination survey data was available for the West Hawaii area, trip distribution was established by developing a gravity model based on existing trips and calibrating the output of an assignment network to field counts. Trip generation projected for existing land uses was aggregated into corridors, and a conventional gravity model was implemented using an electronic spreadsheet. Predicted corridor-to-corridor travel was assigned

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Table 2
TRIP GENERATION RATES
Keahuolu Lands Transportation Analysis

LAND USE	UNIT	VEHICLE TRIPS PER UNIT						
		DAILY	AM IN	AM OUT	AM TOT	PM IN	PM OUT	PM TOT
Regional Shopping Center	1000 sq. ft.	39.81	0.64	0.28	0.92	1.57	1.77	3.34
Neighborhood Commercial	1000 sq. ft.	58.93	0.92	0.40	1.32	2.11	2.38	4.49
Home Improvement Retail	acres	545.77	8.08	3.46	11.54	24.35	27.45	51.80
Banking	acres	1000.00	28.00	12.00	40.00	48.00	32.00	80.00
Office	acres	195.57	23.67	2.06	25.73	3.60	20.39	23.99
Light Industrial	acres	51.80	6.42	1.31	7.73	1.63	5.80	7.43
Hospital	beds	11.75	0.77	0.30	1.07	0.46	0.76	1.22
SF Residential	dwelling units	10.06	0.20	0.55	0.75	0.63	0.37	1.00
MF Residential	dwelling units	6.10	0.10	0.43	0.53	0.48	0.21	0.67
Business Hotel	rooms	7.27	0.34	0.24	0.58	0.37	0.25	0.62
Civic/Cultural	1000 sq. ft.	25.00	2.00	0.25	2.25	0.89	1.97	2.86
Church/Day Care Center	1000 sq. ft.	67.00	6.03	5.34	11.37	5.90	6.40	12.30
Elementary School	acres	60.00	9.38	6.24	15.60	0.90	2.10	3.00
High School	acres	50.00	8.00	2.00	10.00	2.10	4.90	7.00
Rec Center	acres	300.00	7.20	4.80	12.00	16.20	10.80	27.00
Golf Course	acres	8.32	0.22	0.05	0.27	0.03	0.36	0.39
Park	acres	5.00	0.10	0.10	0.20	0.20	0.20	0.40

to a simple network, and successive adjustments were made to attraction factors between groups of zones until model outputs closely imitated existing traffic counts on a "cut line" basis. These attraction factors were then used as the basis for predicting the distribution of future traffic.

Traffic Assignment – For the purpose of assigning future traffic, a node-and-centroid network was developed with centroids representing discrete components of developments in the immediate area, and for approach corridors for other North Kona Traffic. A depiction of the 23-zone network utilized is presented in the appendix to this report.

Once a zone and centroid system was established, other key model inputs were developed. Future projected trip productions and attractions were submitted to gravity modeling to determine zone-to-zone travel, and paths were developed for candidate highway network alternatives, including multiple paths in many cases. (The ASSIGN model permits any number of alternative paths between zones with predetermined weights to be applied). Inbound and outbound PM peak traffic was provided for each traffic zone.

Once the above model inputs were developed, the ASSIGN model distributed traffic among zones, and assigned and aggregated projected travel by link and turning movement.

Year 2010 Conditions without the Keahuolu Lands Project

This section presents an analysis of year 2010 conditions without the Keahuolu lands project based on the traffic modeling process described above.

The basic future network modeled included assumptions of several improvements to the areawide highway network, independent of those planned to serve the project itself. These improvements were identified from on-going planning studies including the draft *Keahole to Kailua Development Plan* and are described below.

Queen Kaahumanu Highway Improvements -- Queen Kaahumanu Highway was assumed to have received with the following improvements:

- Upgrading to a full control of access status;
- An interchange at Kealakehe Parkway;
- Frontage roads along both sides; and
- An overcrossing at Kaiwi Street.

Other Highway Improvements – In addition to the Queen Kaahumanu Highway improvements, a number of other improvements were assumed for the "No Project" alternative, including:

- Extension of Kealakehe Parkway from Queen Kaahumanu Highway to Mamalahoa Highway at a point north of the existing Palani Road/ Mamalahoa Highway intersection; and
- A new Alii Highway paralleling Alii Drive from the Keauhou area to connect with Kuakini Highway south of downtown Kailua.

A midlevel roadway passing through the application area was not assumed for this scenario, nor was a Kealakehe Parkway extension to Kuakini Drive. It should also be noted that no particular assumptions were made regarding roadway cross-sections in the modeling effort. The model was run as an unconstrained model, which ignores the possible impact of traffic congestion in selection of paths by drivers.

Year 2010 Vehicle Trip Generation -- The proposed Kealakehe development, immediately north of the Keahuolu site, is currently envisaged as providing approximately 4,500 new dwelling units by the year 2010, as well as 23 acres of community and neighborhood commercial land uses, 30 acres of new civic and cultural facilities, a high school, a golf course and other supporting uses. This development is projected to generate approximately 58,500 new daily vehicle trips, 4,200 during the afternoon peak hour. The portion of the Keahuolu Lands development already approved for development would add approximately 5,200 daily trips, 700 during the PM peak. Other new North Kona growth, based on Hawaii County land use projections would account for the major portion of increases in vehicle trip generation, adding approximately 500,000 new daily trips, or over 50,000 during the PM peak. Details of trip

generation by the various land uses in the Year 2010, including the petition area, can be found in Chapter IV and in Appendix B to this report.

Year 2010 Traffic Volumes -- Figure 7 presents a representative depiction of directional PM peak hour traffic for Year 2010 without the Keahuolu Lands project. Overall PM peak hour traffic is projected to grow by approximately 2,800 to 3,200 trips in each direction south of the site in the Queen Kaahumanu-Kuakini-Alii corridor; and by approximately 2,600 to 2,800 in each direction north of Palani Road. Peak volumes for a single roadway are projected at approximately 3,000 in each direction along Queen Kaahumanu Highway.

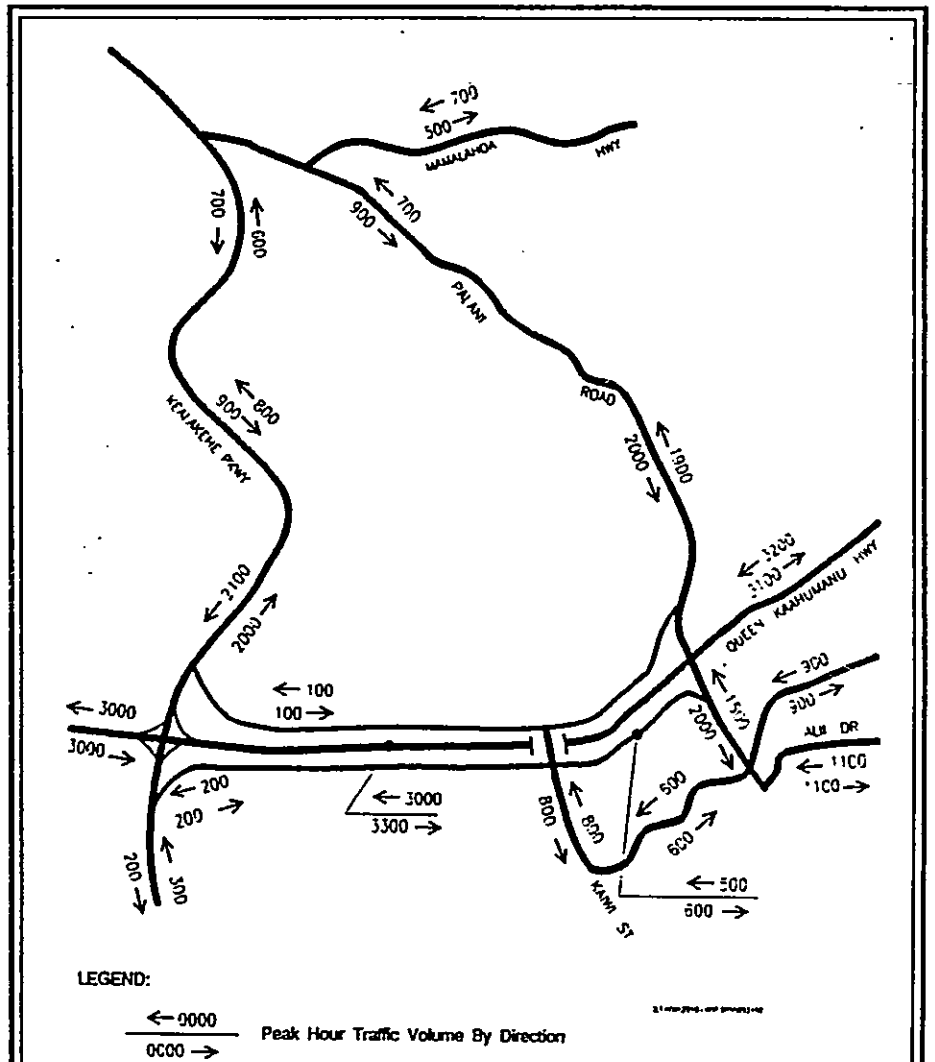
It should be noted, however, that the magnitude of the volumes on Kealakehe Parkway and Palani Road is influenced by network coding assumptions for major residential developments within the Kealakehe project located between these two roadways. Actual circulation and access plans for these developments could lead to less traffic on Palani Road and more on Kealakehe Parkway, or vice versa.

Traffic Impacts -- Volume/capacity calculations were performed for two key intersections for year 2010 conditions without the Keahuolu Lands project, Palani Road at Queen Kaahumanu Highway, and Palani Road at Kuakini Highway. Queen Kaahumanu Highway was assumed to have a four-lane cross-section. Palani Road and Kuakini Highway were assumed to have the same geometrics as currently exist. Table 3 below summarizes the results of this analysis.

Table 3
Volume/Capacity Ratios and Levels of Service
Year 2010 Without Keahuolu Lands Project

Intersection	V/C	LOS
Palani Rd. at Queen Kaahumanu Highway	2.39	F
Palani Road at Kuakini Highway	1.81	F

Wilbur Smith Associates; August 1990.

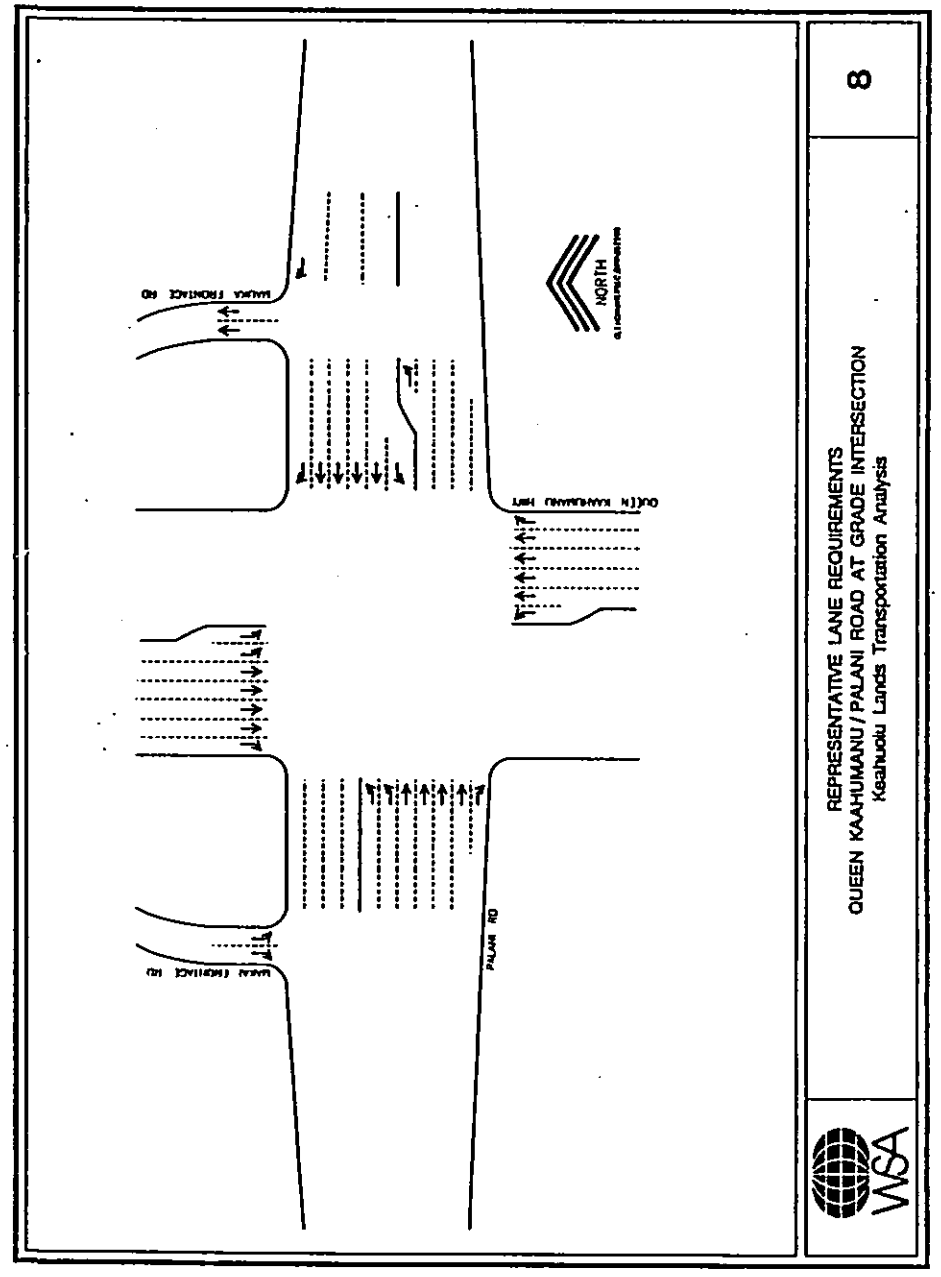


Future Roadway Requirements -- As noted above, modeling efforts did not assume a freeway interchange at Queen Kaahumanu Highway and Palani Road. Volume/capacity analyses under Year 2010 conditions were undertaken of an at-grade intersection at this location with an array of different through and turning lane assumptions. This analysis indicated that six or seven approach lanes, including turn lanes, would be required at each of the intersection approaches to accommodate the forecast volumes.

Figure 8 depicts representative geometric requirements of the extent which would be necessary to maintain at-grade operation of the Queen Kaahumanu Highway/Palani Road intersection. In order to maintain minimally acceptable (Level of Service "E") operating levels, both Queen Kaahumanu Highway and Palani Road would require four approach lanes for through traffic, as well as separate left-turn and right-turn legs for each direction of approach. Dual left turn lanes would be required for southbound Queen Kaahumanu Highway traffic and makai-bound Palani Road traffic. In addition to the indicated lane requirements, the close spacing of the three signalized intersections (including the frontage road intersections with Palani Road) would pose operational problems.

If an interchange is provided, a minimum of two through lanes in each direction would be required for Queen Kaahumanu Highway. Actual lane requirements for Palani Road in this vicinity would depend on the ramp configuration of such an interchange.

Palani Road mauka of Queen Kaahumanu Highway would require a six-lane cross-section as would Kealakehe Parkway immediately mauka of Queen Kaahumanu Highway.



IV. KEAHUOLU PROJECT IMPACTS

The proposed Keahuolu Lands Development is designed to be a commercial focal point for west Hawaii. Full development of the petition area will likely extend 30 years or more. Those key components of the project which are planned to be in place by the year 2010 are:

- o A regional shopping center with a gross floor area of 500,000 sq. ft.;
- o Four office developments on sites ranging from 10 to 17 acres;
- o 360 residential dwelling units;
- o A 150 bed hospital; and
- o 30 acres of Civic and cultural facilities.

Two neighborhood parks and a historic park are also planned for the project.

Ultimate development of the petition area also may include a business hotel, a new light industrial park and expansion of the existing business park makai of Queen Kaahumanu Highway. These components, however, are expected to occur beyond the year 2010 horizon year used for this transportation analysis. Figure 2 of this report depicts the location of the various land uses of the Keahuolu Lands development.

Trip Generation of Proposed Project

The petition area is projected to generate approximately 39,000 daily trips by the year 2010, of which 3,800 are projected to occur during the PM peak hour, as summarized in Table 4. Approximately 50 percent of the trip generation will result from the regional shopping center, with another 25 percent from office uses. The portion of Keahuolu Lands already approved for development by the year 2010 will also generate 5,200 trips daily, or 750 during the PM peak hour.

Table 4
KEAHUOLU LANDS PROJECT TRIP GENERATION
Keahuolu Lands Transportation Analysis

ZONE	LAND USE		ADT	AM IN	AM OUT	AM TOT	PM IN	PM OUT	PM TOT
	Makai Portion of Petition Area								
1	Regional Shopping Center	500 ksf	19905	322	138	460	784	885	1670
	Historic Park	20 acres	100	2	2	4	4	4	8
2	Office Park	11.7 acres	2288	276	24	301	42	238	280
	Banking	3.9 acres	3900	109	46	156	187	124	312
	Office	10 acres	1955	236	20	257	35	203	239
	Park	10 acres	50	1	1	2	2	2	4
	Hospital (35 acres)	150 beds	1762	115	44	160	69	113	183
	Office	16.7 acres	3286	395	34	429	60	340	400
3	Civic/Cultural	30 acres	3250	280	32	292	115	256	371
	Office	13.4 acres	2620	317	27	344	48	273	321
	SUBTOTAL		39098	2033	368	2405	1346	2438	3788
	Mauka Portion of Petition Area								
4	Residential	55 acres	4221	165	259	426	235	154	390
	Park	5 acres	25	0	0	1	1	1	2
	SUBTOTAL		4246	165	259	427	236	155	392
	Previously Approved Portion								
5	Industrial Subdivision Expansion	100 acres	5180	641	131	773	163	579	743
	SUBTOTAL		5180	641	131	773	163	579	743
	TOTAL		48522	2839	758	3605	1745	3172	4923

Source: Wilbur Smith Associates, May 1990

Under ultimate buildout conditions, the petition area is estimated to generate a total of 105,000 daily trips, or 10,500 during the PM peak traffic period, in addition to the 5,000 daily trips which will be generated by the currently approved portion of the project.

Table 5 presents a comparison of traffic generation for 1987 and 2010 for the entire North Kona area, separated by component. (Details of the trip generation by various land uses are presented in the appendix to this report.) As can be seen in Table 5, total traffic generation for North Kona is projected to more than triple, from 276,000 daily trips in 1987 to 894,000 daily trips in 2010. The Kealakehe and Keahuolu Lands petition area projects are estimated to account for approximately 9.5 and 7.0 percent of the traffic growth respectively, or 6.5 and 4.8 percent, respectively of all year 2010 traffic.

Detailed trip generation of individual land uses for the Year 2010 scenario and for the buildout scenario is also presented in the Appendices B and C of this report, respectively.

Roadway System Assumed in Analysis

The basic future network used in this analysis included assumptions of several improvements to the areawide highway network, independent of those designed to serve the project itself, in addition to those described for future conditions without the Project, as described in Chapter III. Assumed additional improvements included:

- A new mauka-makai roadway (herein referred to as Liliuokalani Boulevard) extending from Palani Road to the Queen Kaahumanu Highway mauka frontage road in the vicinity of the Kaiwi Street overcrossing;
- Extension of Kealakehe Parkway southward from the Honokohau Boat Harbor to connect with Kuakini Highway at Kaiwi Street; and
- A new mid-level north-south roadway located mauka of Queen Kaahumanu Highway passing through the project area.

No particular assumptions were built into the model regarding an interchange at Queen Kaahumanu Highway and Palani Road. Requirements for an at-grade intersection for future condition without the Project were described in Chapter III; for future traffic including traffic

Table 5
COMPONENTS OF YEAR 2010 NORTH KONA TRAFFIC GENERATION
Keahuolu Lands Transportation Analysis

	ESTIMATED DAILY TRAFFIC GENERATION	PERCENT OF YEAR 2010 TRAFFIC	PERCENT OF NEW TRAFFIC
1. Existing (1987) Land Uses	276,000	30.9%	N/A
2. Future Without Petition Area			
Keahuolo Lands Development	5,200	0.6%	0.8%
Kealakehe Lands Development	58,500	6.5%	9.5%
Other New North Kona Development	511,000	57.2%	82.7%
SUBTOTAL	574,700	64.3%	93.0%
3. Keahuolu Lands Petition Area	43,300	4.8%	7.0%
TOTAL	894,000	100.0%	100.0%

Source: Wilbur Smith Associates, May 1990

generated by the Keahuolu Lands project, various interchange configurations were tested once traffic turning movements were initially assigned. As was the case for the "No Project" alternative, frontage roads and a Kaiwi Street overcrossing were assumed in the network.

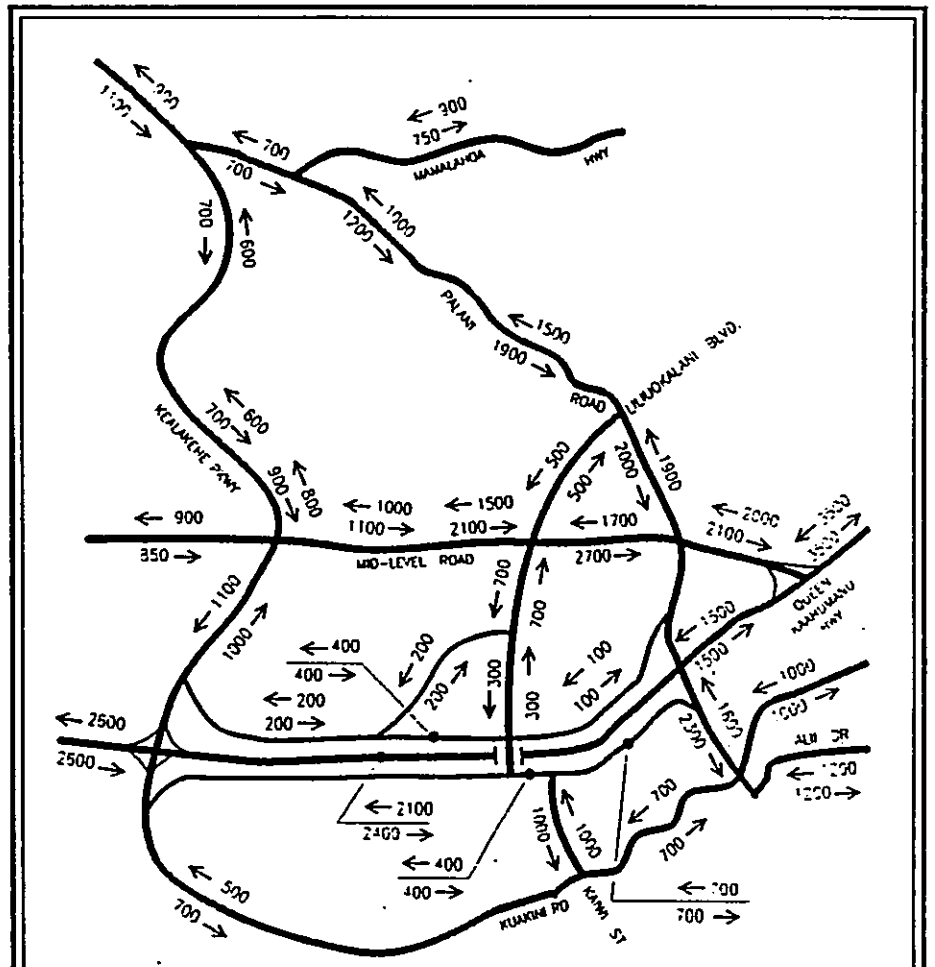
As noted for the no-project alternative, no particular assumptions were made regarding roadway cross-sections in the travel forecasting effort. Therefore, the forecast traffic volumes are unconstrained by roadway capacities.

Year 2010 Traffic Conditions With Keahuolu Lands Project

Figure 9 presents a summary of PM peak hour traffic volumes by travel direction for year 2010 with the Keahuolu project. Overall, PM peak hour traffic is projected to grow by approximately 3,500-3,800 trips in each direction south of the Palani Road in the Queen Kaahumanu-Kuakini-Alii corridor, and by approximately 2,800 to 3,000 in each direction north of the site in the Queen Kaahumanu-Mid-Level Road corridor. Highest volumes for a single roadway are projected at approximately 3,500 in each direction on the Queen Kaahumanu Highway Extension south of the point where Queen Kaahumanu Highway and the Mid-Level Road merge. This is based on the future Alii Drive-Kuakini Highway connector intersecting Queen Kaahumanu Highway further south than this juncture. Peak loads for the Mid-Level Road are projected just north of Palani Road, with approximately 2,700 vehicles using this segment in the southbound direction during the PM peak hour. A Kealakehe Parkway-Kuakini Highway connector is projected to carry 500-700 vehicles per direction in Year 2010 with the project.

Roadway network improvements assumed in conjunction with the project will also have the effect of significantly reducing traffic on some roadway segments, compared with the scenario modeled for future traffic without the project. Most notably, Kealakehe Parkway mauka of Queen Kaahumanu Highway would carry approximately 1,000 fewer vehicles in each direction, and Queen Kaahumanu Highway itself would experience a reduction of similar magnitude between Kealakehe Parkway and Palani Road.

Major intersection impacts of the project itself will also be felt at the Palani Road/Queen Kaahumanu interchange, where the project is projected to contribute approximately 800 new afternoon peak hour trips, in addition to the traffic projected by other new North Kona development described in the previous chapter.



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YEAR 2010 AFTERNOON PEAK HOUR TRAFFIC WITH PROJECT

Keahuolu Lands Transportation Analysis

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V. ALTERNATIVE IMPROVEMENT CONCEPTS FOR QUEEN KAAHUMANU HIGHWAY

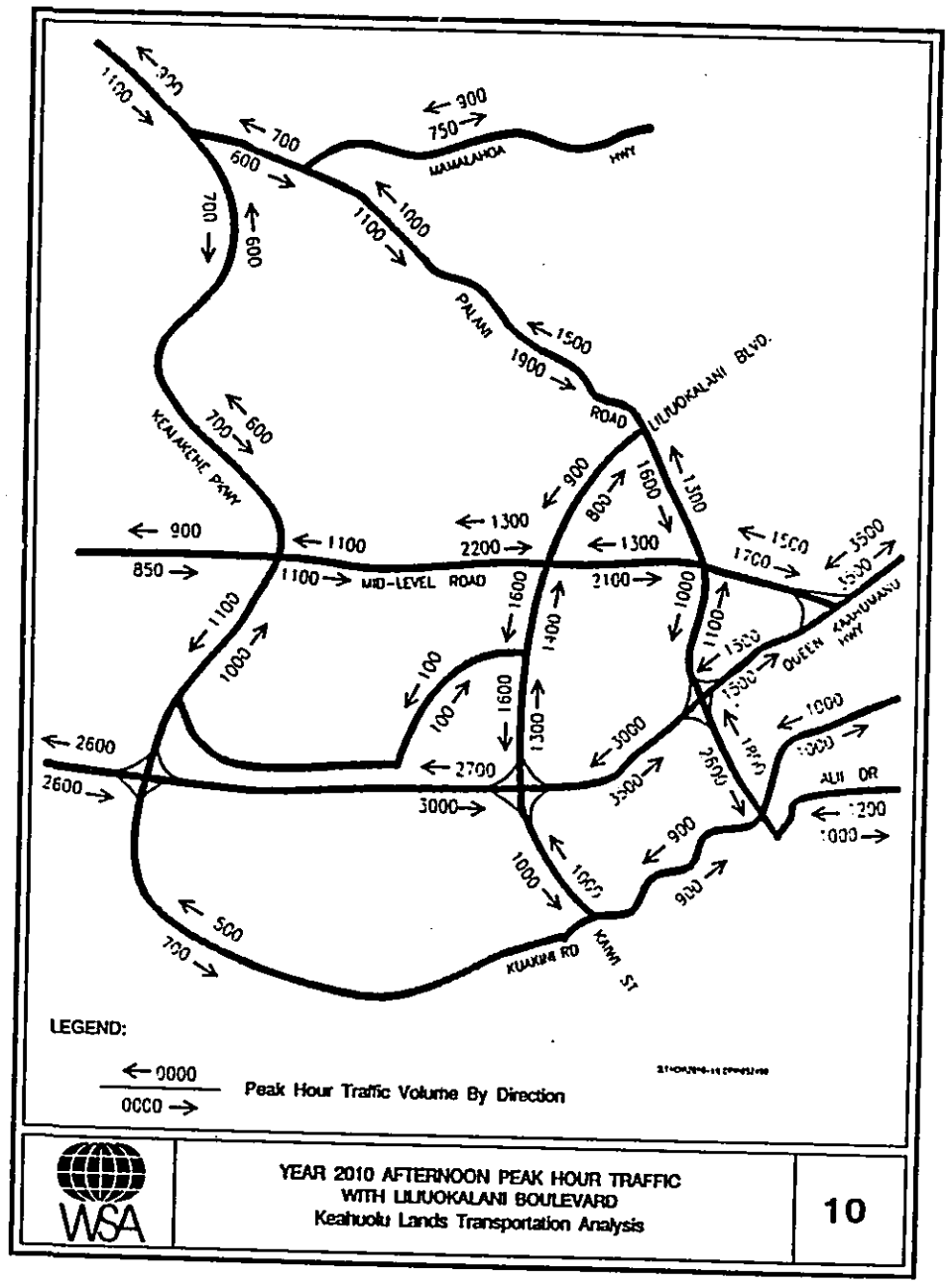
Because of capacity and operational problems which the Queen Kaahumanu Highway/-Palani Road intersection would face if maintained as an at-grade intersection, an alternative network concept was developed which featured freeway interchanges at both Queen Kaahumanu Highway and the new Liliuokalani Boulevard serving the project area. This alternative also assumed no frontage roads along Queen Kaahumanu Highway in the vicinity of the project site. Because of the proximity of these two roadways to each other (approximately 3,800 feet), a variety of configurations for the weaving section between the two interchanges were also investigated.

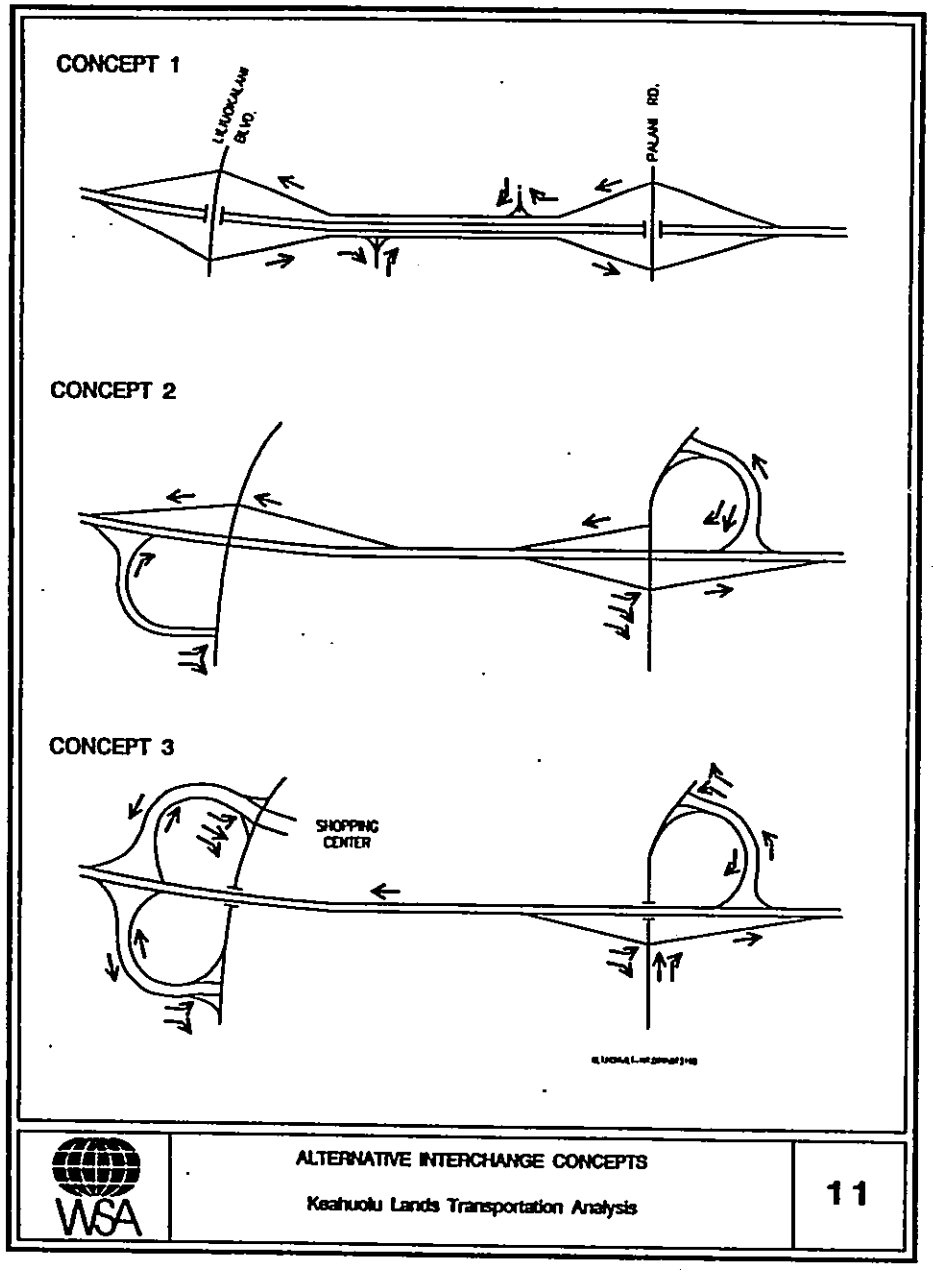
Year 2010 Traffic with Liliuokalani Boulevard Interchange

Figure 10 presents PM peak hour directional traffic projected for the alternative network with an interchange located to serve the project area. Addition of the Queen Liliuokalani Boulevard interchange would reduce traffic on the Mid-Level Road and Palani Road, and increase volumes on Queen Kaahumanu Highway in the vicinity of the site. The section of Palani Road between the Mid-Level Road and Queen Kaahumanu Highway, in particular, would have approximately 1,200 fewer vehicles in the PM peak hour. Volumes on Queen Kaahumanu Highway north of Kealakehe Parkway and south of the Queen Kaahumanu Highway-Mid-Level Road juncture are not projected to be change significantly with the addition of the Liliuokalani Boulevard interchange.

Alternative Interchange Concepts

Because of the proximity of the proposed Liliuokalani Boulevard to Palani Road, a number of interchange concepts were investigated to minimize potential weaving problems. Three representative concepts are depicted in Figure 11 and discussed in the following sections.





ALTERNATIVE INTERCHANGE CONCEPTS

Kealuolu Lands Transportation Analysis

11

Concept 1 – Split Diamond Concept – This concept utilizes half-diamond interchanges at Palani Road and Liliuokalani Boulevard, connected by a pair of frontage roads, making the two interchanges in effect a single long interchange. This concept is relatively inexpensive in principle, and the one-way frontage road streets would provide high capacity. However, large volumes of left-turning vehicles from bridge sections to on-ramps could require exceptionally long or wide (multi-lane) storage sections, to provide the necessary storage capacity for left-turning vehicles, which could contribute to the cost of overall right-of-way and/or structural improvements. This concept would require northbound drivers traveling to Liliuokalani Boulevard and southbound drivers desiring to use Palani Road to exit Queen Kaahumanu Highway well in advance of those cross streets, and travel via the frontage road.

Concept 2 – Single Loop Ramps with Mauka-Side Diamond Ramps – Concept 2 would provide loop ramps for the heavy left-turn movements, and by providing uninterrupted flow for these movements would impact traffic operations on Palani Road and Liliuokalani Boulevard less than Concept 1. It would also be less costly than Concept 3, described in the next section. Analyses of weaving movements, however, show that the proximity of the northbound Palani Road on-ramp to the northbound Liliuokalani Boulevard off-ramp would result in marginally acceptable levels of service for weaving traffic in the year 2010, but leave little capacity for traffic increases beyond that time.

Concept 3 – Half Cloverleaf with no Mauka Diamond Ramps – This concept, requiring three loop ramps, would be the most expensive of the three options due to greater land costs and structure requirements. By eliminating the diamond ramps, however, weaving traffic in the section would operate at an acceptable level of service under year 2010 conditions, with capacity for traffic increases beyond that time period.

Traffic Levels of Service

Table 6 depicts volume/capacity ratios and traffic levels of service at key intersections for the Year 2010 afternoon peak traffic hour. These analyses assume a basic six-lane cross section for the new Midlevel and Liliuokalani Roadways, and a basic four-lane cross section for Palani Boulevard. In this analysis, all freeway off-ramps were assumed to be limited to three lanes including flared turn lanes at approaches to city streets.

As can be seen from Table 6, three Queen Kaahumanu ramp intersections would operate at unacceptable levels of service under interchange Concept 1, and one intersection (Queen Kaahumanu Southbound Ramps at Palani Road) would reach Level of Service "F" under all three concepts. Assuming no improvements to the existing geometrics at the intersection of Palani Road and Kuakini Highway, this intersection would operate at level of service "F" during the PM peak hour in the year 2010.

Table 7 shows a level of service analysis for the same intersections with mitigation measures. These mitigation measures represent improvements which can be implemented while maintaining the basic cross-sections described above for surface streets, and limiting on-ramps to two lanes. Analyses indicated that for Concepts 2 and 3, addition of a single lane for the single heaviest critical turning movement would be sufficient to effect a LOS "D" or better at all intersections, and that under Concept 1 V/C ratios could be brought to 1.00 or lower within the constraints mentioned above. Under Concept 1, any further significant mitigation would require either bridge widening to accommodate additional lanes at both locations, or four lanes of travel in each direction on the frontage roads.

Weaving Analysis

The various interchange concepts and variations investigated were subjected to weaving section analysis using Highway Capacity Manual software (HCS). The *Highway Capacity Manual* definitions of levels of service for weaving sections is presented in the appendix to this report. Results for Concepts 2 and 3 are depicted in Table 8 for AM and PM peak hour conditions. It should be noted that AM volumes assumed in the analysis are conservatively high estimates

Table 6
YEAR 2010 LEVELS OF SERVICE WITH KEAHUOLU LANDS PROJECT
Afternoon Peak Hour
Keahuolu Lands Transportation Analysis

LOCATION	VOLUME/ CAPACITY RATIO	LEVEL OF SERVICE
Queen Kaahumanu Highway NB Ramps/ Palani Boulevard		
With Concept 1	1.32	F
With Concept 2	0.81	D
With Concept 3	0.81	D
Queen Kaahumanu Highway SB Ramps/ Palani Boulevard		
With Concept 1	1.14	F
With Concept 2	1.00	F
With Concept 3	1.00	F
Queen Kaahumanu Highway NB Ramps/ Liliuokalani Blvd.		
With Concept 1	1.00	F
With Concept 2	0.86	D
With Concept 3	0.86	D
Queen Kaahumanu Highway SB Ramps/ Liliuokalani Blvd.		
With Concept 1	1.57	F
With Concept 2	0.67	B
With Concept 3	0.67	B
Liliuokalani Boulevard/ Mid-Level Road	0.89	D
Mid-Level Road/ Palani Road	0.89	D
Palani Road/ Kuakini Higway	1.91	F

Source: Wilbur Smith Associates, May 1989

Table 7
YEAR 2010 LEVELS OF SERVICE WITH KEAHUOLU LANDS PROJECT
WITH MITIGATED GEOMETRY
Afternoon Peak Hour
Keahuolu Lands Transportation Analysis

LOCATION	VOLUME/ CAPACITY RATIO	LEVEL OF SERVICE
Queen Kaahumanu Highway NB Ramps/ Palani Boulevard		
With Concept 1	1.00	F
With Concept 2	0.54	A
With Concept 3	0.54	A
Queen Kaahumanu Highway SB Ramps/ Palani Boulevard		
With Concept 1	0.84	D
With Concept 2	0.81	D
With Concept 3	0.81	D
Queen Kaahumanu Highway NB Ramps/ Liliuokalani Blvd.		
With Concept 1	0.88	D
With Concept 2	0.86	D
With Concept 3	0.86	D
Queen Kaahumanu Highway SB Ramps/ Liliuokalani Blvd.		
With Concept 1	0.99	E
With Concept 2	0.61	B
With Concept 3	0.61	B
Liliuokalani Boulevard/ Mid-Level Road	0.89	D
Mid-Level Road/ Palani Road	0.89	D
Palani Road/ Kuakini Higway	1.91	F

Source: Wilbur Smith Associates, May 1989

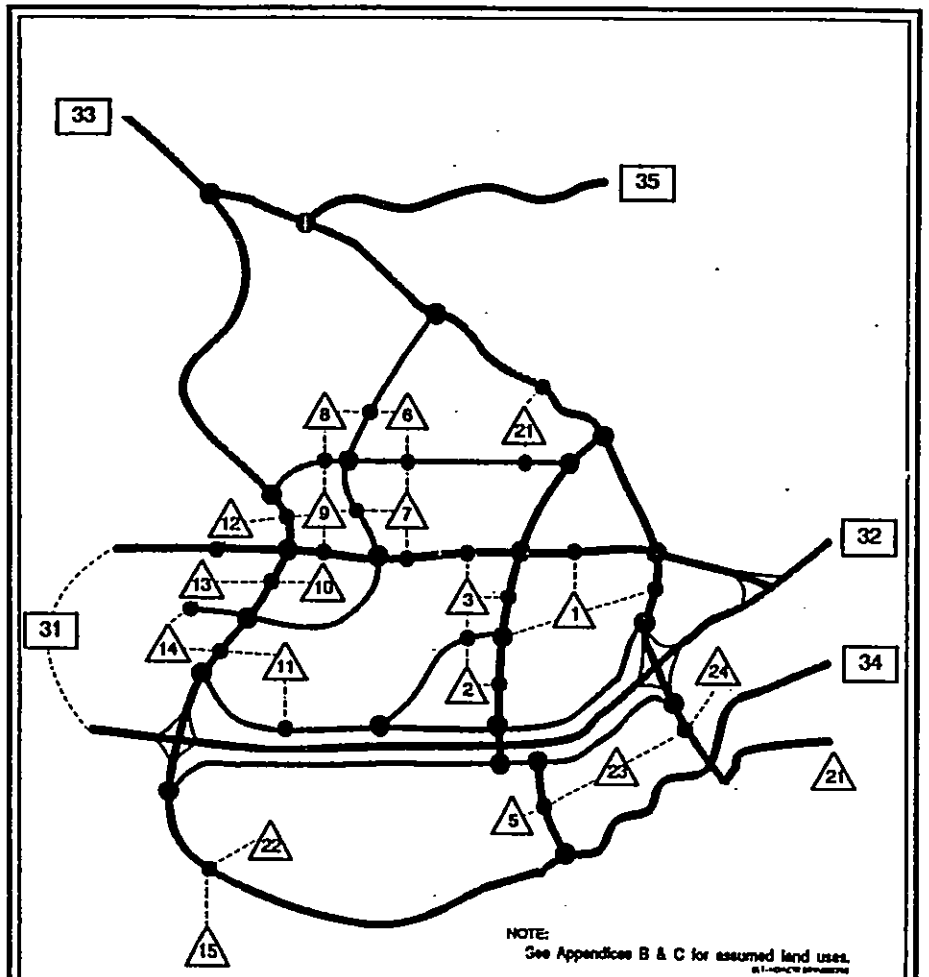
Table 8
SUMMARY OF WEAVING ANALYSIS -- Year 2010 with Project
Keahuolu Lands Transportation Analysis

CONCEPT	SECTION		LOS FOR WEAVING VEHICLES	LOS FOR NON-WEAVING VEHICLES	WEAVING SECTION LENGTH	NUMBER OF WEAVING VEHICLES
2	Palani NB On-Ramp to 2nd NB On-Ramp	AM	E	E	700'	1950
		PM	E	E	700'	1350
	Palani 2nd NB On-Ramp to Liliuokalani Blvd. Off-Ramp	AM	D	C	1200'	2550
		PM	D	D	1200'	1100
	Liliuokalani SB On-Ramp to Palani SB Off-Ramp	AM	C	C	2300'	1800
		PM	D	D	2300'	2700
3	Palani NB On-Ramp to Liliuokalani Blvd Off-Ramp	AM	D	C	3200'	3000
		PM	C	B	3200'	1800
	Liliuokalani SB On-Ramp to Palani SB Off-Ramp	AM	C	C	2300'	1800
		PM	D	D	2300'	2700

Notes: Weaving analysis not appropriate for Concept 1
LOS = level of service (Highway Capacity Manual Definition)
as described in Appendix D
Source: Wilbur Smith Associates, May 1990

based on reversing the direction of PM peak hour flows projected by the model. As shown, Concept 2, with the two closely-spaced on-ramps, is estimated to provide Level of Service "E" conditions for both weaving and non-weaving vehicles on the freeway during both AM and PM peak periods in the northbound direction between the first and second on-ramps. Other sections are projected to operate at LOS "D" or better during all both time periods under both concepts.

APPENDICES



NETWORK AND ZONE CENTROIDS
Keahuolu Lands Transportation Analysis

APPENDIX
A

Appendix B
YEAR 2010 TRIP GENERATION SUMMARY
Keahuolu Lands Transportation Analysis

ZONE LAND USE		ADT	AM IN	AM OUT	AM TOT	PM IN	PM OUT	PM TOTAL
I. Keahuolu								
1 Regional Shopping Center	500	19905	322	138	460	784	885	1670
Historic Park	20	100	2	2	4	4	4	8
2 Office Park	11.7	2288	276	24	301	42	238	280
Banking	3.9	3900	109	46	156	187	124	312
Office	10	1955	236	20	257	35	203	239
Park	10	50	1	1	2	2	2	4
Hospital (35 acres)	150	1762	115	44	160	69	113	183
Office	16.7	3266	395	34	429	60	340	400
3 Civic/Cultural (30 acres)	130	3250	260	32	292	115	256	371
Office	13.4	2620	317	27	344	48	273	321
4 Residential (45 acres)	360	3621	72	197	270	226	133	360
Park	5	25	0	0	1	1	1	2
Elementary School	10	600	93	62	156	9	21	30
5 Industrial Subdivision Expansion	100	5180	641	131	773	163	579	743
SUBTOTAL		54305	3536	932	4477	1956	3809	5772

Appendix B (Continued)
YEAR 2010 TRIP GENERATION SUMMARY
Keahuolu Lands Transportation Analysis

ZONE LAND USE		ADT	AM IN	AM OUT	AM TOT	PM IN	PM OUT	PM TOTAL
11 Keslakehe								
6 Neighborhood Park	6	30	0	0	1	1	1	2
MF Residential	240	1464	22	104	127	109	51	160
SF Residential	382	3842	77	209	286	240	141	382
SF Residential	660	6639	133	361	495	415	244	660
7 Uhi Uhi Preserve	5	25	0	0	1	1	1	2
MF Residential	360	2196	34	156	190	164	77	241
SF Residential	450	4527	91	246	337	283	166	450
8 Archaeological Preserve	18	90	1	1	3	3	3	7
SF Residential	254	2535	51	139	190	160	93	254
9 MF Residential	180	1098	17	78	95	82	38	120
SF Residential	243	2444	49	133	182	153	89	243
Rec Center	3	900	21	16	36	48	32	81
Neighborhood Park	6	30	0	0	1	1	1	2
High School	30	1500	240	60	300	63	147	210
Church/Day Care Center (3 acres)	6	402	36	32	68	35	38	73
10 Neighborhood Commercial (3 acres)	33	1361	21	9	30	48	54	103
Church/Day Care Center (3 acres)	13	871	78	69	147	76	83	159
MF Residential	185	1128	17	80	98	84	39	123
SF Residential	318	3199	64	174	238	200	117	318
11 Golf Course	166	1381	35	8	44	5	59	64
Civic (30 acres)	130	3250	260	32	292	115	256	371
SF Residential	403	4054	81	220	302	253	149	403
Landfill Park	15	75	1	1	3	3	3	6
MF Residential	269	1640	25	116	142	122	57	180
12 MF Residential	60	366	5	26	31	27	12	40
SF Residential	81	816	16	44	60	51	29	81
13 SF Residential	156	1569	31	85	117	98	57	156
MF Residential	91	535	8	39	48	41	19	60
14 Community Commercial (20 acres)	220	9075	142	60	203	324	366	691
SF Residential	101	1016	20	55	75	63	37	101
MF Residential	67	408	6	29	35	30	14	44
SUBTOTAL		58504	1582	2580	4177	3298	2473	5787

APPENDIX C
BUILDOUT TRIP GENERATION SUMMARY
Keahuolu Lands

LAND USE		ADT	AM IN	AM OUT	AM TOT		PM IN	PM OUT	PM TOTAL
Regional Shopping Center	500 ksf	19905	322	138	460		784	885	1670
Hospital (35 acres)	150 beds	1782	115	44	160		69	113	183
Office	30 acres	5867	710	61	771		107	611	719
Historic Park	20 acres	100	2	2	4		4	4	8
Neighborhood Commercial (12 acres)	125 ksf	5156	80	34	115	0	184	208	392
Home Improvement	14 acres	7640	113	48	161		340	384	725
Light Industrial	14 acres	725	89	18	108		22	81	104
Business Hotel	201 Rooms	1461	68	47	116		74	49	124
Office	18 acres	3520	426	37	463		64	367	431
Office	24 acres	4693	568	49	617		86	489	575
Neighborhood Commercial	10 acres	4125	64	27	92	0	147	166	314
Office Park	21 acres	4106	497	43	540		75	428	503
Banking	7 acres	7000	196	84	280		336	224	560
Park	10 acres	50	1	1	2		2	2	4
Civic/Cultural (30 acres)	130 ksf	3250	260	32	292		115	256	371
Neighborhood Commercial (5 acres)	55 ksf	2268	35	15	50	0	81	91	172
Residential (130 acres)	750 du's	7545	151	410	562		472	277	750
Residential (157 acres)	1122 du's	11287	227	614	841		706	415	1122
Church/Day Care Center (4 acres)	8 ksf	536	48	42	90		47	51	98
Residential (45 acres)	270 du's	2716	54	147	202		170	99	270
Elementary School	10 acres	600	93	62	156		9	21	30
Park	5 acres	25	0	0	1		1	1	2
Neighborhood Commercial (3 acres)	33 ksf	1361	21	9	30	0	48	54	103
Business Park Exp.	168 acres	8702	1077	220	1298		274	973	1248
Industrial Subdivision Expansion	100 acres	5180	641	131	773		163	579	743
SUBTOTAL		109580	5858	2315	8184		4380	6828	11221

LEVEL-OF-SERVICE CRITERIA

Levels of service in weaving areas are directly related to the average running speeds of weaving and nonweaving vehicles. A level of service is separately assigned to weaving and nonweaving vehicles to reflect cases in which significant differences in the speed of component flows exist, as well as those in which balanced operation occurs. The criteria are given in Table 4-6.

Unlike basic freeway sections, in which speed is insensitive to flow rates up to approximately 1,600 pcphpl, speed in weaving areas is sensitive to flow rates throughout the range of stable flows. This is due to the additional turbulence caused by weaving vehicles and their lane-changing maneuvers.

In general, speed of weaving vehicles is expected to be somewhat lower than that of nonweaving vehicles even when balanced or unconstrained operation occurs. This difference tends to get smaller as speeds get lower. This is reflected in the criteria defined in Table 4-6.

Level-of-service F is defined as any speed below 35 mph for either weaving or nonweaving vehicles when computed speeds are used. This is a result of the speed prediction equations used in this chapter. The equations tend to somewhat overpredict low speeds, and predictions of lower than 30 mph are difficult to obtain, even where the average flow rate per lane is in excess of 1,900 pcphpl. The use of 35 mph as the boundary for level-of-service F adjusts for this characteristic of the equations, and results in the more accurate identification of cases in which breakdowns will occur. When LOS criteria are to be compared to measured speeds, a 30-mph value is used.

The speed criteria for any given level of service are generally several mph lower than similar criteria for a basic freeway section with a 70-mph design speed. This allows for reasonable consistency with the levels of service defined in Chapter 3. It is possible, however, that a given weaving section will operate at a better LOS than a basic freeway section with equal flows and the same number of lanes because of the lower speed criteria for weaving sections. This is an unusual result, and is consistent with the LOS definitions established in Chapter 3 and herein.

TABLE 4-6. LEVEL-OF-SERVICE CRITERIA FOR WEAVING SECTIONS

LEVEL OF SERVICE	MIN. AVG. WEAVING SPEED, S_w (MPH)	MIN. AVG. NON-WEAVING SPEED, S_{nw} (MPH)
A	55	60
B	50	54
C	45	48
D	40	42
E	35/30 *	35/30 *
F	< 35/30 *	< 35/30 *

* The 35-mph boundary for LOS E/F is used when computing an estimated speeds using the equations of Table 4-3. The 30-mph boundary is used for comparisons to field-measured speeds.

SOURCE: Highway Capacity Manual, 1985

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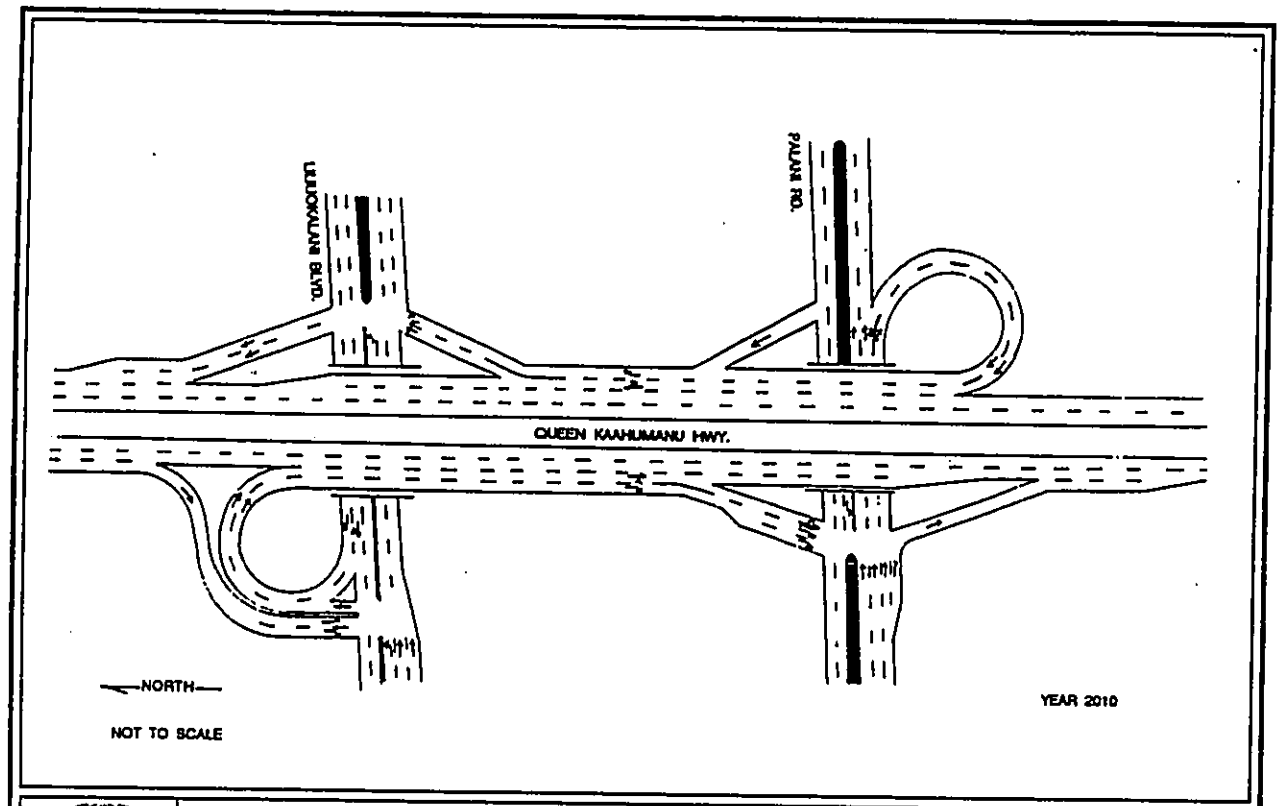
LEVEL OF SERVICE DEFINITION FOR
WEAVING SECTIONS
Kaahuolu Lands Transportation Analysis

APPENDIX
D



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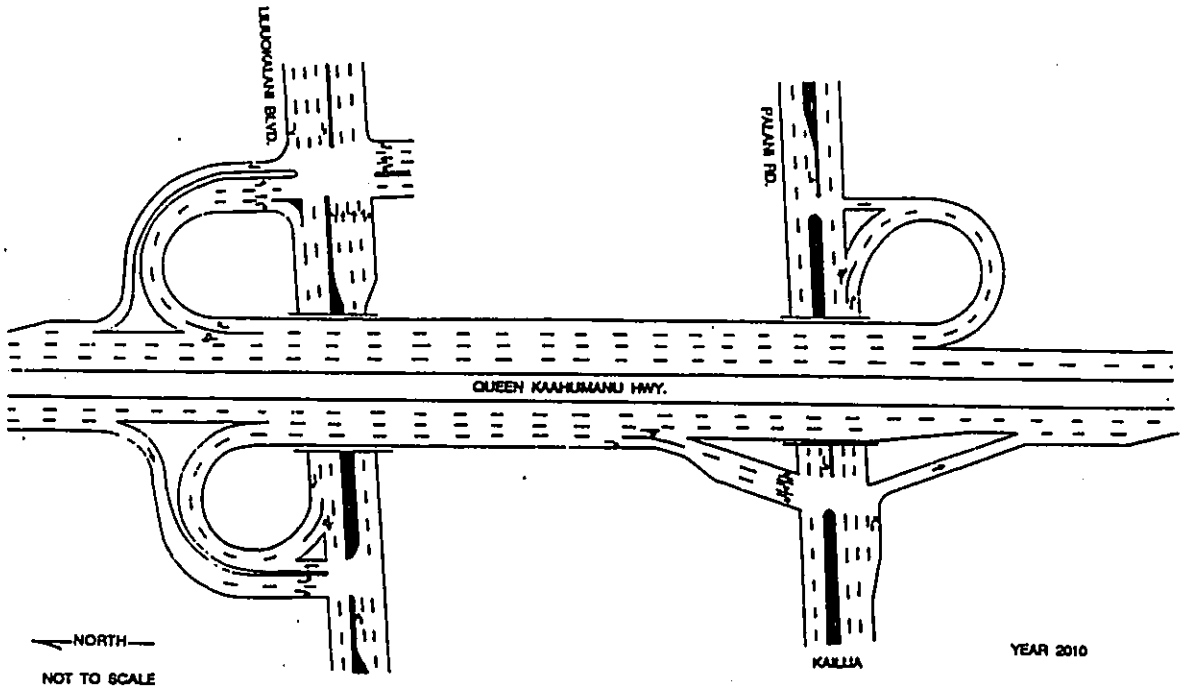
INTERCHANGE CONCEPT 2
Kaahuolu Lands Transportation Analysis

APPENDIX
E



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INTERCHANGE CONCEPT 3

Keahuolu Lands Transportation Analysis

APPENDIX

F