JOHN WAIHEE
GOVERNOR

08

ESTHER UEDA
EXECUTIVE OFFICER

→ Jeyan JN
Betty

STATE OF HAWAII

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

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September 27, 1994

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

Dear Sir:

Subject: LUC Docket No. A93-701/Kaupulehu Developments

At its meeting on September 22, 1994, the Land Use Commission accepted the Final Environmental Impact Statement (FEIS) required for the petition under the subject docket.

In accordance with the EIS rules, one copy of the Commission's Order Accepting the FEIS will be forthcoming.

If you have any questions on this matter, please feel free to call me or Kathy Yonamine of our office at 587-3822.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:KY:th

cc: Hawaii County Planning Dept.
Office of State Planning
R. Ben Tsukazaki, Esq.

Sept. 1994 FEIS
Kaupulehu Resort

Kaupulehu Resort Expansion

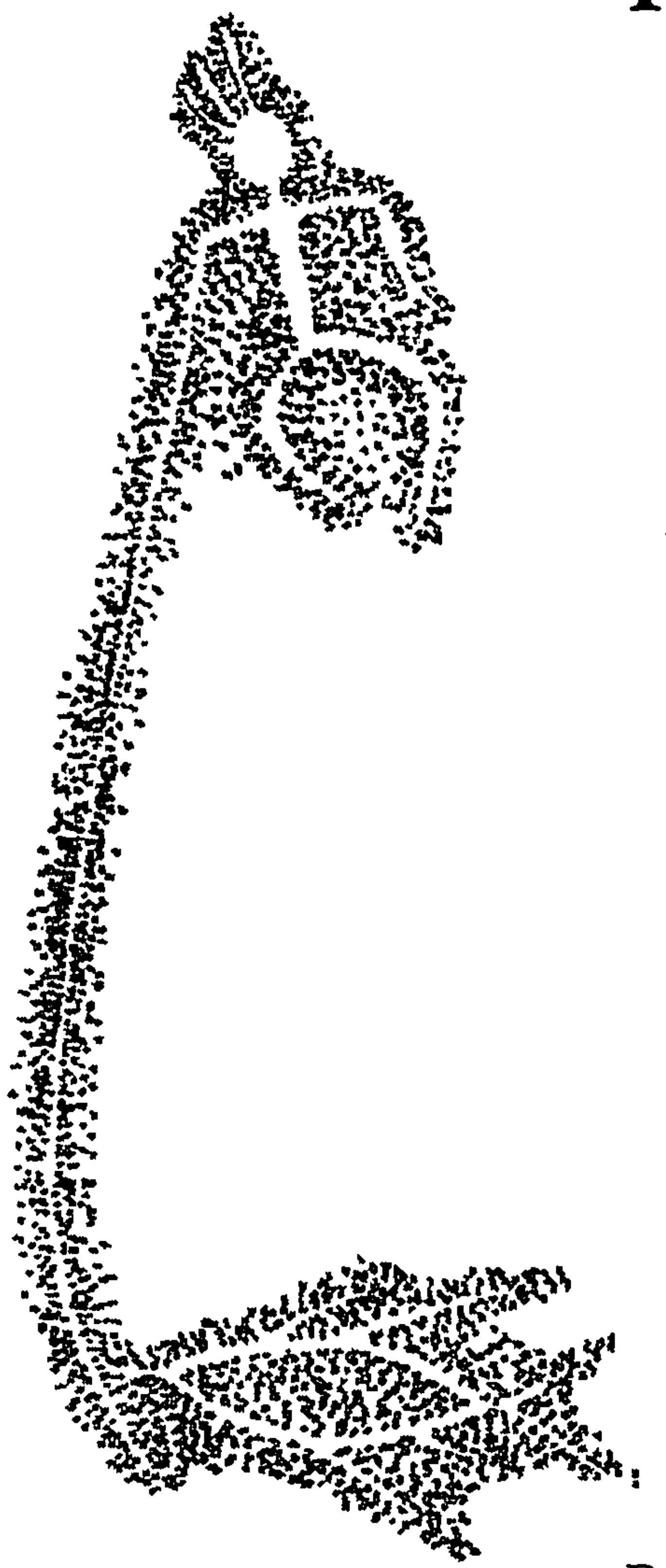
Final Environmental Impact Statement

Kaupulehu
DEVELOPMENTS

September 1994

Kaupulehu Resort Expansion

Final Environmental Impact Statement



Prepared for:

Kaupulehu
DEVELOPMENTS

Prepared by:
Belt Collins Hawaii, September 1994

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CHAPTER 6 EXISTING INFRASTRUCTURE AND PUBLIC SERVICES, ENVIRONMENTAL CONSEQUENCES, AND MITIGATION MEASURES

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[Ed. Note: The formal name of the project has evolved as the project concept has been refined. Thus, what was originally referred to as "Lot 4" became "Phase 2", then "Phase II", and finally "Kaupulehu Resort Expansion". All the reports identified below were prepared specifically for this EIS.]

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Chapter 1

Introduction and Summary

CHAPTER 1 INTRODUCTION AND SUMMARY

1.1 Overview

This Environmental Impact Statement addresses the identified environmental impacts that will result from the development of a 1,120-acre area as a recreation/residential community. The project is hereinafter referred to as the Kaupulehu Resort expansion. However, it should be understood at the outset that the proposed project does not include any hotel development. Rather, it represents the recreation/residential expansion component of the adjacent Kaupulehu Resort and will include dwelling units, commercial development, and recreational uses. It is envisioned that the project will become part of the Kaupulehu Resort destination community.

1.2 Identification of Applicant

The Applicant is KAUPULEHU DEVELOPMENTS (hereinafter "the applicant" or "the Petitioner"), a Hawaii general partnership that leases the subject property from the Estate of Bernice Pauahi Bishop.

1.3 Requested Government Action

The requested government action is an amendment of the Land Use Commission's district classification for 1,010 acres of the subject property from the Conservation District to the Urban District. It should be noted that the development area contains a total of 1,120 acres. However, only 1,010 acres are proposed for reclassification to the Urban District. Of the 1,120 acres comprising the development area, 65 acres are already classified as Urban District. Another 45 acres, identified as archaeological preserve, will retain their Conservation District classification.

1.4 Purpose and Need for Action

Development in the project area dates back to 1959 when Johnno Jackson leased land adjacent to Kahuwai Bay from the Estate of Bernice Pauahi Bishop to construct the Kona Village Resort. A detailed history of development on Kaupulehu lands is contained in the 1986 Kaupulehu Resort EIS, prepared as part of Kaupulehu Development's petition to the State Land Use Commission, which ultimately approved a land use designation change from Conservation to Urban and Urban to Conservation. That boundary amendment allowed for the development of the 624-acre Kaupulehu Resort and an additional 54 units at Kona Village Resort.

Since the 1986 State land use boundary changes, new visitor units have been built at Kona Village Resort, and the developer of Kaupulehu Resort has obtained the necessary government permits and approvals and is proceeding with the construction of that portion of Kaupulehu Resort. The approvals include County zoning changes, Special Management Area Use Permits, a Shoreline Setback Variance, State Conservation District Use Permits (for offsite infrastructure), Plan Approval and various grading permits. Kaupulehu Land Company, a general partner of the entity developing the 624-acre area previously reclassified, has recently received approval from the Hawaii County Council for a zoning adjustment to accommodate its revised master plan for that portion of Kaupulehu Resort being developed as a planned resort/residential destination. The first of two planned golf courses, a Jack Nicklaus designed championship course, is under construction, as are the 250-unit Four Seasons Hotel and resort infrastructure. In addition to the second golf course, a variety of resort/residential units are planned, most in the high quality to luxury category.

At the time of the 1986 State land use change, Kaupulehu Developments presented a conceptual plan for urban development (condominiums and a marina) and another golf course between Kona Village Resort and the northwest property, to be built once development of Kaupulehu Resort was underway. The plan for the expansion area has since been refined to adapt to the projected market and to complement the portion under construction. The current Petition proposes a land use change that will accommodate this refined plan as shown in this EIS document.

A market study was prepared by The Hallstrom Group to address demand for residential, golf course, and commercial uses within a recreation/residential expansion of Kaupulehu Resort. The study concluded that there exists a demand for the project, as described below, within a 20-year absorption schedule. The infrastructure would be essentially constructed within the first 5 years of project development. Market demand is further detailed in Section 5.1.3 of Chapter 5 of this EIS.

1.5 Statement of Objectives

The primary objective of the proposed project is to accommodate, with a viable master plan and common infrastructure, future growth of the Kaupulehu Resort community by offering complementary products to those planned at the portion of the resort now under construction. The Kaupulehu Resort expansion project is intended to enhance the economic viability of the entire Kaupulehu Resort community and contribute to the long-term viability of the West Hawaii region.

1.6 Project Setting

The Petition Area consists of approximately 1,010 acres and is generally described as an irregular crescent-shaped parcel which extends from a point adjacent to the Queen Kaahumanu Highway to the ocean and then curves to the northeast along the ocean until it reaches the eastern boundary of the Kaupulehu ahupua'a. The property is located in the North Kona District of the Island of Hawaii. It is identified as Tax Map Key 7-2-03: portion 1 (see Figure 1-1). It is situated within the makai (seaward) portion of the Kaupulehu ahupua'a about six miles northeast of Keahole Airport (see Figure 4-1 in Chapter 4).

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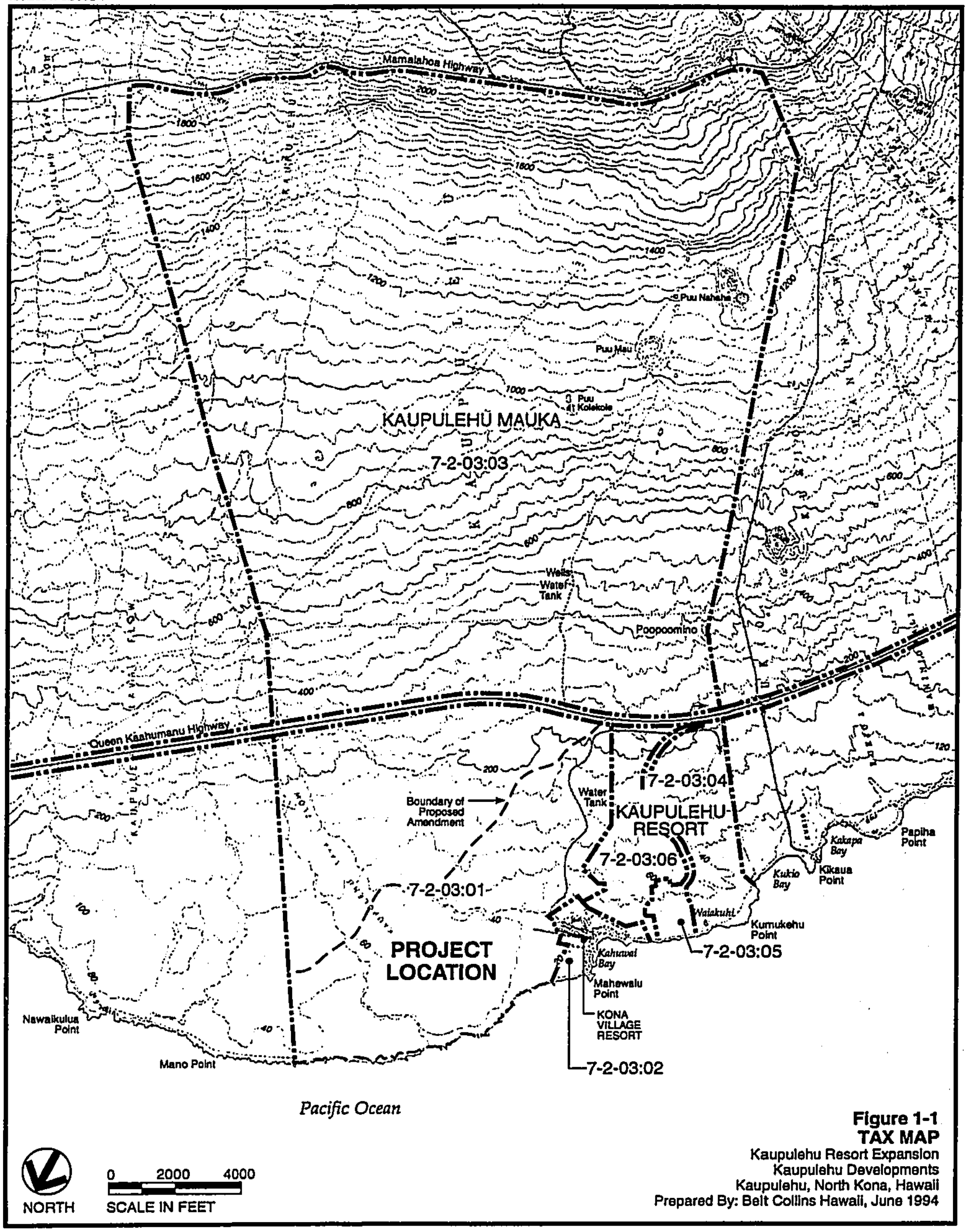


Figure 1-1
TAX MAP
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

The Petition Area is situated within the State Conservation District. It surrounds a 65-acre area classified as Urban District which fronts the shoreline about 1,500 feet from the Petition Area's eastern boundary (see Figure 7-1 in Chapter 7). The Petition Area also abuts the Kona Village Resort and the under-construction portion of Kaupulehu Resort, both of which are situated within the Urban District.

The Petition Area is included by the Office of State Planning as part of the West Hawaii Regional Plan's "Kaupulehu Resort Destination Node" (see Figure 7-3 in Chapter 7). The Petition Area is designated as Urban Expansion and Open in the Hawaii County General Plan (see Figure 7-4 in Chapter 7). The entire Petition Area is zoned by Hawaii County as Open and is situated within the County's Special Management Area (SMA).

1.7 Project Description

1.7.1 Proposed Development

The Kaupulehu Resort expansion area consists of approximately 1,120 acres, 1,010 of which are the subject of the current petition. It will include 65 acres of existing Urban classified land and approximately 45 acres of land to remain in the Conservation District. Within this latter district will be two areas containing groupings of significant archaeological sites recommended for preservation by the consulting archaeologist.

The overall density of the residential development, both single-family lots and multifamily units, will be far below the level approved for other projects in the market study area. Each development pod will have direct golf course frontage and the project will include some 50 oceanfront homesites. Commercial development will be within a neighborhood commercial village and a residents club will provide residents a water-oriented amenity.

Although new on-site infrastructure will have to be developed for the project, significant savings will be realized by sharing off-site infrastructure with the initial portion of Kaupulehu Resort. By doing so, the proposed expansion project will enhance its competitive position and be able to offer oceanfront lots in the less than luxury range, a product not now readily available in West Hawaii. Following is a discussion of the specific project components identified in Figure 2-1 in Chapter 2.

1.7.1.1 Golf Course

A championship 36-hole golf course (sequentially developed as two 18-hole golf courses) is planned on 415 acres, with a clubhouse which will serve as an entryway facility to the resort expansion community. The golf facilities are expected to attract both residents and visitors, including those staying at the adjacent Kona Village Resort. The golf clubhouse will constitute a secondary retail, restaurant and service complex for the resort expansion area.

1.7.1.2 Residential Lots and Units

Single-family development will be on 530 planned homesites on 220 acres, with approximately 50 having ocean frontage. The remaining sites will have golf frontage. There ultimately will be 500 multifamily units on 94 acres in low-density, low-rise projects spread across interior golf course fronting sites.

1.7.1.3 Commercial Land Uses

An 11-acre neighborhood commercial center will offer products and services oriented toward the resident in facilities spanning 45,000 square feet of leasable space. It is anticipated that destination restaurants and shops will also attract some off-site patrons.

1.7.1.4 Recreational Facilities

A 3-acre area is set aside as a club which will serve as a water-oriented recreational amenity for project residents, members and guests. A 70-acre recreation area adjacent to State lands will serve both resort residents and the general public. Although the plan for the expansion area is still in the concept stage, it is envisioned that the recreation area will have facilities such as picnic and active recreation areas in a shoreline park setting.

1.7.1.5 Public Access

Public facilities will include pedestrian shoreline access, parking, restrooms, showers and picnic areas within the 70-acre recreation area. It is expected that details of a public access plan will be presented to and approved by the County during future project permitting at the County level.

Preliminary discussions with staff of the State Parks Division of the State Department of Land and Natural Resources suggest the possibility of partnering with the State in providing public facilities at the recreation area which would serve those using the shoreline trail all along the West Hawaii coast. Existing shoreline access along the shoreline of the subject property will be maintained by the developer.

1.7.1.6 Preservation Areas

Several significant archaeological sites have been recommended for preservation by the consulting archaeologist. These recommendations will be reviewed by the Historic Preservation Division of the State Department of Land and Natural Resources. The Petitioner intends to preserve these sites with the appropriate treatment and buffers. Clusters of significant sites will be preserved within two archaeological preserves.

1.7.2 Proposed Infrastructure

All the necessary on-site infrastructure, including roadways, water and wastewater treatment and transmission facilities, will be privately developed as project components. Off-site infrastructure, where feasible, will be developed and shared with the area of the resort complex presently under construction. A Resort Service Area is included as a possible site for facilities such as a plant nursery, golf maintenance area, and wastewater treatment plant.

1.7.3 Phasing of Development

The Kaupulehu Resort expansion project will be master planned and implemented by a developer team, including the Petitioner. Substantial infrastructure improvements are expected to be provided during the initial five years once the required government approvals have been secured. Initial sales are also expected during this period. Full buildout of the project is projected over 20 years, generally according to Table 2-2 in Chapter 2.

1.8 Summary of Impacts and Proposed Mitigation Measures

Impacts to the physical and social environment will result from development of the proposed project. Potential significant adverse impacts will be mitigated. Following is a summary of identified significant short- and long-term adverse impacts, as well as recommendations for mitigation measures.

1.8.1 Potential Significant Short-Term Adverse Impacts

- Increases in air-borne particulate matter (*fugitive dust*) and exhaust emissions from onsite construction activity.
- Increases in noise during construction activity.
- Increases in surface water runoff and drainage due to replacement of existing lava with soil.
- Presence of construction activity adjacent to the Kona Village Resort will result in the loss of the "remote" character and theme that the resort formerly experienced.

1.8.2 Potential Significant Long-Term Adverse Impacts

- Permanent changes to the topography due to grading and site improvements.
- Increases in storm runoff to the increase of impermeable surfaces.
- Changes in the visual character of the site from that of a barren lava field to a landscaped low-density residential community situated within a 36-hole golf course.

- Loss of existing vegetation due to grading and introduction of exotic and indigenous plant species.

- Loss of some archaeological sites after implementation of archaeological mitigation plan.

- Increases in public access to the shoreline and a potential loss of marine biota popular among subsistence food gatherers; limu, crab, and opihi.

- Potential biological resource depletion resulting from increased fishing activities resulting from increased public access.

- Increases in vehicular traffic.

- Consumption of potable water resources.

- Utilization of non-potable water resources

- Increased consumption of electrical energy to serve new development.

- Operation of resort/residential and recreational activities adjacent to the Kona Village Resort will result in a loss of the "remoteness" and exclusivity the resort formerly experienced.

1.8.3. Summary of Key Mitigation Measures

Mitigation measures to reduce potential adverse environmental and social impacts include the following:

- Performance of construction activities (clearing, grading and grubbing) in compliance with applicable air and noise quality regulations to minimize fugitive dust and noise impacts on adjacent developed areas.

- Implementation of grading plan to prevent short- and long-term increases in surface runoff from impacting coastal waters.

- Adherence to appropriate building codes and standards and the inclusion of evacuation routes and a civil defense warning system to address natural hazard concerns.

- Preparation and implementation of a shoreline management plan and public access plan to mitigate the loss of marine biota resulting from increased public access to and use of the project's coastal resources.

- Use of native plants in landscaping and retention of natural areas wherever practicable.

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

- Creation of a protective buffer around an identified endangered 'ohai plant.

- Private funding and development of on-site infrastructure including wastewater collection and treatment, drainage systems, and roadways.

- Private funding and development of source wells for potable and non-potable water within the Kaupulehu ahupua'a.

- Compliance with Department of Health conditions for new golf course development.

- Utilization of treated effluent to supplement irrigation water demand on the proposed 36-hole golf course.

- Encouragement of the utilization of energy saving devices in residential units.

- Development setbacks and generous open space corridors in golf or other open space uses will buffer the adjacent Kona Village Resort from potential impacts due to the expansion project.

1.9 Summary of Alternatives Considered

The primary project objective is to accommodate, with a viable master plan and common infrastructure, future growth of the Kaupulehu Resort community by offering complementary products to those planned at the portion of the resort now under construction. The action should allow the economic viability of the entire Kaupulehu Resort community to be enhanced and contribute to the long-term viability of the West Hawaii region. Of the alternatives considered, the proposed action best meets the project objectives.

A "no-action" alternative is to not seek a land use designation change from the State Land Use Commission and to not develop the 65-acre existing Urban parcel. Under this alternative, no additional financial benefits would accrue to the Petitioner or government. No new employment opportunities would be created, natural and historic resources would not be enhanced and protected, and public access would not be improved. However, marine food sources would not be depleted as quickly as under the preferred alternative. This alternative does not meet the project objectives.

A variation of this alternative is also to not seek a land use designation change from the State Land Use Commission. However, it would entail developing land currently designated Urban according to the expansion concept as originally planned in the mid 1980s. Figure 3-1, April 1986 Concept Plan, from the 1986 Kaupulehu Resort EIS shows an 18-hole golf course and a marina and condominium development in the existing 65-acre Urban District.

The marina/condominium alternative would complement the portion of Kaupulehu Resort now under construction. However, this earlier concept, before its refinement into the current proposed plan, does not meet current and projected market demand and might not be financially viable without an expanded golf course and single-family residential product. In addition, the environmental impacts of marina construction and operations are potentially more severe than those without the marina.

A higher density development with essentially the same types of facilities and amenities proposed in the preferred alternative would contribute additional product to the resort under construction. However, a more dense expansion project would not be as compatible with the low-density Kaupulehu Resort, a portion of which is under construction. Nor would it be compatible with the neighboring Kona Village Resort, upon which it would have greater impact. With a more disparate resort expansion, the objective of economic viability of the entire Kaupulehu Resort community, and in turn its contribution toward the long-term viability of the West Hawaii region, would not be met as effectively. More jobs would be created and higher revenues would accrue to the State and County, but these benefits would most likely be offset by increased government spending for services, additional impacts to the environment, increased traffic, and a potentially lower return for the developer.

Of the alternatives considered, the proposed action best meets the project objectives. It allows for a measured approach to long-range planning and development of Kaupulehu Resort, while meeting projected market demand. Fewer adverse environmental and public cost impacts would be associated with the preferred alternative, as opposed to the marina concept or the higher density alternative.

1.10 Summary of Unresolved Issues

The Queen Kaahumanu Highway is planned for widening to four lanes by the State DOT. At the writing of this EIS, the actual date of implementation of this project is unknown. In a similar vein, the timing of other government capital improvement projects in West Hawaii may impact the proposed project. However, the extent to which this may occur is presently unknown.

The proposed project could have a negative impact upon the availability of boat slips at public small boat harbors in West Hawaii because it may contribute to the already existing demand for the limited supply of slips. This issue cannot be resolved by the applicant. The future provision of public boat slips to satisfy demand is ultimately a capital improvement issue that must be addressed by the State Legislature.

The provision of affordable housing in conjunction with the project is also unresolved. As of the writing of this document, both the State and County are reviewing their affordable housing policies. Consequently, the specific affordable housing requirements that they each will enact are not yet known. The applicant is, however, committed to compliance with applicable affordable housing requirements.

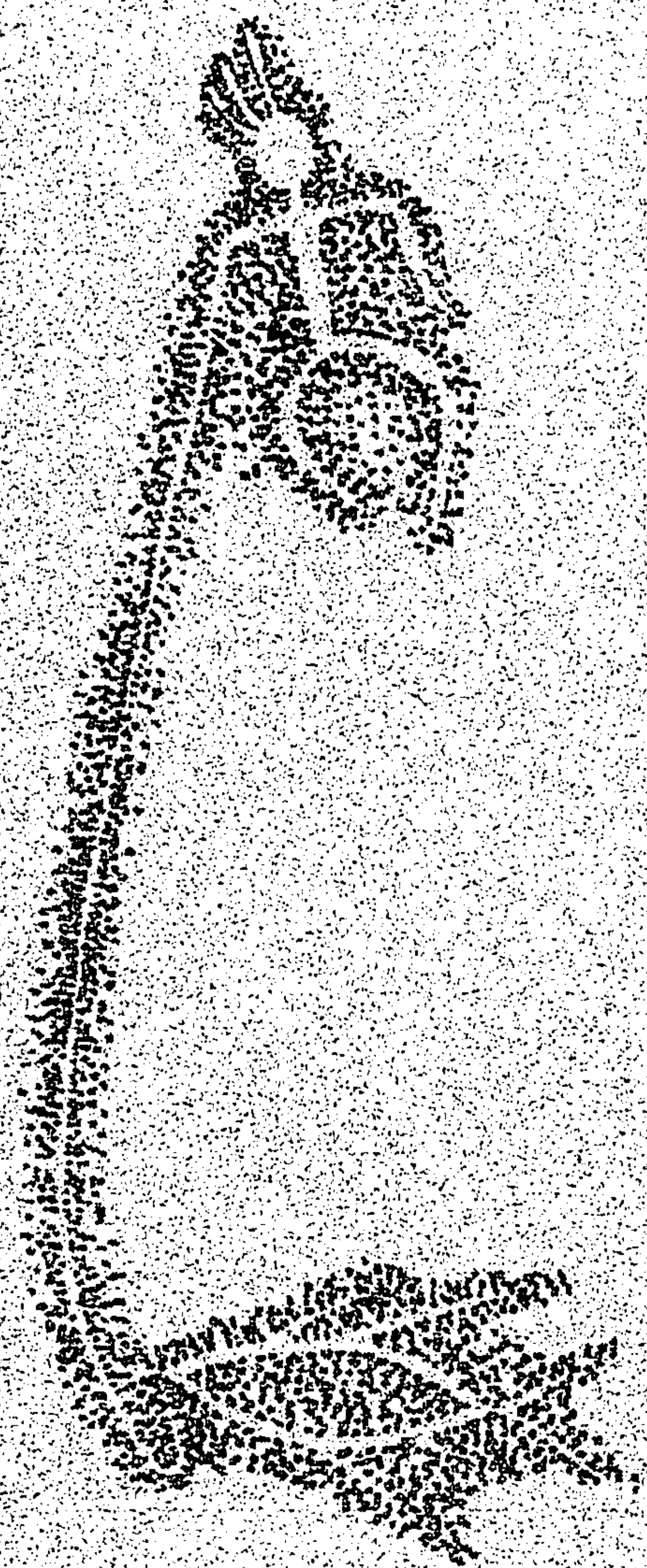
1.11 Summary of Compatibility with Land Use Plans and Policies

The proposed project is consistent with all applicable state and county plans and land use policies, including the Hawaii State Plan and Functional Plans, the West Hawaii Regional Plan, the Hawaii County General Plan, and Chapter 205A, Hawaii Revised Statues, pertaining to the Special Management Area.

1.12 Necessary Approvals and Permits

Following is a list of major approvals and permits required for implementation of the proposed project. Additional permits and approvals will be necessary but are too numerous to mention here.

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



Chapter 2

Description of the Proposed Action

CHAPTER 2 DESCRIPTION OF THE PROPOSED ACTION

2.1 Overview and Regional Setting

The Kaupulehu Resort expansion area is a 1,120-acre portion, or about half of a 2,200-acre parcel (Lot 4) adjacent to the Kaupulehu Resort (now under construction) and to the established Kona Village Resort. The Petition Area constitutes approximately 1,010 acres of the project area; 65 acres of the project property are currently classified as Urban District and approximately 45 acres will remain as archaeological preservation areas within the Conservation District.

The project area is located within the ahupua'a of Kaupulehu in the North Kona District of the Island of Hawaii. It is identified as Tax Map Key 7-2-03: portion of 1, Third Division. Situated approximately 6 miles northeast of Keahole Airport, the project area is an irregular crescent shaped parcel, extending from a point adjacent to Queen Kaahumanu Highway to the ocean, then curving to the northeast along the ocean until it reaches the eastern boundary of the Kaupulehu ahupua'a (see Figure 2-1: Concept Plan).

The Petition Area is included in the area designated by the Office of State Planning as the "Kaupulehu Resort Destination Node" in the West Hawaii Regional Plan. It is generally designated as Urban Expansion and Open in the Hawaii County General Plan. The entire Petition Area is zoned Open by the County and is situated within the Special Management Area (SMA).

The district of North Kona encompasses the coastal and inland area from just south of Keauhou Resort to the south, to the South Kohala District boundary at the Waikoloa Beach Resort to the north. About 12 miles south of the Petition Area is the major population and commercial center of the district, the town of Kailua-Kona. The Petition Area is situated roughly halfway between Kailua-Kona and Waikoloa.

The North Kona and South Kohala Districts continue to thrive as the center of resort activity and residential population. The coastal portions of these abutting districts have long been designated by the State and County of Hawaii in various plans as a resort destination region. As such, it has benefitted from substantial public and private expenditures for the infrastructure necessary to support such resort and associated residential and commercial development.

Vehicular access to the major developed areas along the coast, and those under development, is mainly via the Queen Kaahumanu Highway, which opened in 1975 and connects Kailua-Kona with Kawaihae, the only deep water harbor in West Hawaii.

2.2 Existing and Surrounding Uses

To the northwest of the project site are undeveloped State of Hawaii lands which are designated in long-range State plans for park or recreational use. The area proposed for Kaupulehu Resort expansion is currently undeveloped and generally unused. Occasional recreational fishermen and others reach the shoreline area by walking from the Kona Village Resort's public access area or sometimes by traversing a portion of the site by four-wheel drive. The Kona Village access road was recently constructed and put into operation, pursuant to a Conservation District Use Permit, as part of the development plan for the portion of Kaupulehu Resort under construction. This new roadway crosses the site in its southwestern portion and passes near a Kona Village Resort water tank which is located in the project area.

2.3 Project Background and Need

The 2,200-acre portion of the Kaupulehu makai lands in which the Petition Area is located, as described above, is leased by Kaupulehu Developments from the Estate of Bernice Pauahi Bishop, the fee simple owner of the property.

Development in the area dates back to 1959 when Johnno Jackson leased land adjacent to Kahuwai Bay from the Estate of Bernice Pauahi Bishop to construct the Kona Village Resort. A detailed history of development on Kaupulehu lands is contained in the 1986 Kaupulehu Resort EIS, prepared as part of Kaupulehu Development's petition to the State Land Use Commission, which ultimately approved a land use designation change from Conservation to Urban and Urban to Conservation. That boundary amendment allowed for the development of the 624-acre Kaupulehu Resort and an additional 54 units at Kona Village Resort.

Since the 1986 State land use boundary changes, new visitor units have been built at Kona Village Resort, and the developer of Kaupulehu Resort has obtained the necessary government permits and approvals and is proceeding with the construction of that portion of Kaupulehu Resort. The approvals include County zoning changes, Special Management Area Use Permits, a Shoreline Setback Variance, State Conservation District Use Permits (for offsite infrastructure), Plan Approval and various grading permits.

Kaupulehu Land Company, a general partner of the entity developing the 624-acre area previously reclassified, has recently received approval from the Hawaii County Council for a zoning adjustment to accommodate its revised master plan for that portion of Kaupulehu Resort being developed as a planned resort/residential destination. The first of two planned golf courses, a Jack Nicklaus designed championship course, is under construction, as are the 250-unit Four Seasons Hotel and resort infrastructure. In addition to the second golf course, a variety of resort/residential units are planned, most in the high quality to luxury category.

At the time of the 1986 State land use change, Kaupulehu Developments presented a conceptual plan for urban development (condominiums and a marina) and another golf course between Kona Village Resort and the northwest property, to be built once development of Kaupulehu Resort was underway. The plan for the expansion area has since been refined to adapt to the projected market and to complement the portion under construction. The current Petition proposes a land use change that will accommodate this refined plan as shown in this EIS document.

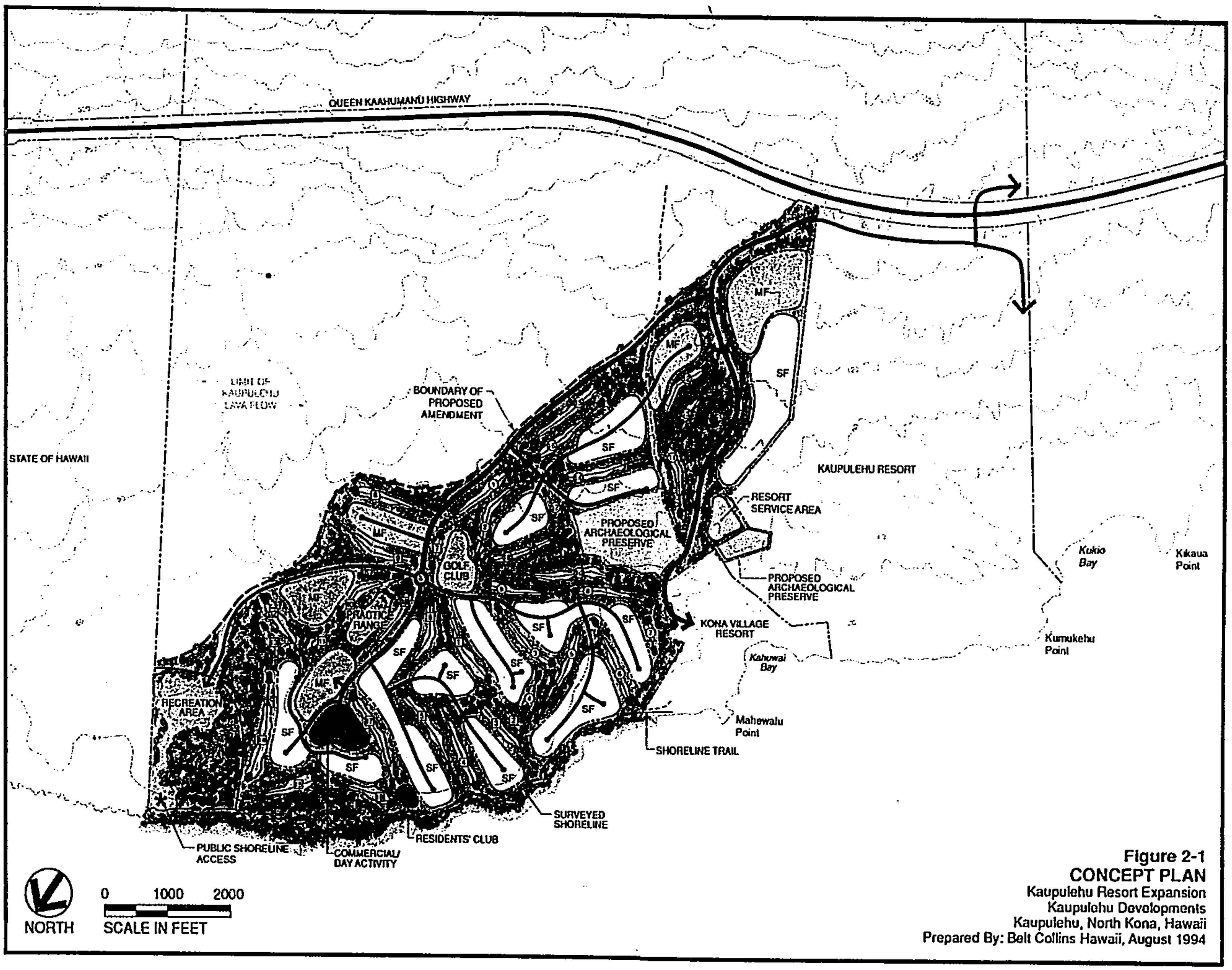


Figure 2-1
CONCEPT PLAN
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, August 1994

A market study was prepared by The Hallstrom Group to address demand for residential, golf course, and commercial uses within a recreation/residential expansion of Kaupulehu Resort. The study concluded that there exists a demand for the project, as described below, within a 20-year absorption schedule. The infrastructure would be essentially constructed within the first 5 years of project development. Market demand is further detailed in Section 5.1.3 of Chapter 5 of this EIS.

2.4 Statement of Objectives

The primary objective of the proposed project is to accommodate, with a viable master plan and common infrastructure, future growth of the Kaupulehu Resort community by offering complementary products to those planned at the portion of the resort now under construction. The Kaupulehu Resort expansion project is intended to enhance the economic viability of the entire Kaupulehu Resort community and contribute to the long-term viability of the West Hawaii region.

2.5 Development Concept

As presented in Figure 2-1, the Kaupulehu Resort expansion project is envisioned as a recreation/residential oriented development which will complement the uses at the resort/residential oriented portion of Kaupulehu Resort under construction. A low-keyed atmosphere will be maintained within a low density residential development focused on golf and the shoreline area. The expansion project would share infrastructure, but have a separate, complementary identity from the portion of the resort complex under construction.

The target market of the expansion project is the moderate- to high-quality residential segment, as opposed to the high-quality to luxury market envisioned for the initial portion of Kaupulehu Resort development.

Development setbacks and generous open space corridors in golf or other open space uses will buffer the adjacent Kona Village Resort from potential impacts due to the expansion project.

2.6 Project Description

The Kaupulehu Resort expansion area consists of approximately 1,120 acres, 1,010 of which are the subject of the current petition. It will include 65 acres of existing Urban classified land and approximately 45 acres of land to remain in the Conservation District. Within this latter district will be two areas containing groupings of significant archaeological sites recommended for preservation by the consulting archaeologist.

The land uses, by acreage, are presented in Table 2-1. The overall density of the residential development, both single-family lots and multifamily units, will be far below the level approved for other projects in the market study area. Each development pod will have direct golf course frontage and the project will include some 50 oceanfront homesites.

Commercial development will be within a neighborhood commercial village and a club facility will provide residents a water-oriented amenity.

Table 2-1: Kaupulehu Resort Expansion Land Use Table

Land Use	Area (Acres)	Units
Single-family residential	220	530
Multifamily residential	94	500
36-hole golf course	415	
Golf clubhouse	12	
Commercial	11	
Residents' club	3	
Recreation area and public beach access	70	
Roads/open space/buffers	296	
Total	1,121	1,030

Although new on-site infrastructure will have to be developed for the project, significant savings will be realized by sharing off-site infrastructure with the initial portion of Kaupulehu Resort. By doing so, the proposed expansion project will enhance its competitive position and be able to offer ocean-front lots in the less than luxury range, a product not now readily available in West Hawaii.

2.6.1 Golf Course

A championship 36-hole golf course (developed sequentially as two 18-hole courses) is planned on 415 acres, with a clubhouse which will serve as an entryway facility to the resort expansion community. The golf facilities are expected to attract both residents and visitors, including those staying at the adjacent Kona Village Resort. The golf clubhouse will constitute a secondary retail, restaurant and service complex for the resort expansion area.

2.6.2 Residential Lots and Units

Single-family development will be on 530 planned homesites on 220 acres, with approximately 50 having ocean frontage. The remaining sites will have golf frontage. There ultimately will be 500 multifamily units on 94 acres in low-density, low-rise projects spread across interior golf course fronting sites.

2.6.3 Commercial Land Uses

An 11-acre neighborhood commercial center will offer products and services oriented toward the resident in facilities spanning 45,000 sf of leasable space. It is anticipated that destination restaurants and shops will also attract some off-site patrons.

2.6.4 Infrastructure Development

All the necessary on-site infrastructure, including roadways, water and wastewater treatment and transmission facilities, will be privately developed as project components. Off-site infrastructure, where feasible, will be developed and shared with the area of the resort complex presently under construction. A Resort Service Area is included as a possible site for facilities such as a plant nursery, golf maintenance area, and wastewater treatment plant.

2.6.5 Recreational Facilities

A 3-acre area is set aside as a club which will serve as a water-oriented recreational amenity for project residents, members and guests. A large 70-acre recreation area adjacent to State lands will serve both resort residents and the general public. Although the plan for the expansion area is still in the concept stage, it is envisioned that the recreation area will have facilities such as picnic and active recreation areas in a shoreline park setting.

2.6.6 Public Access

Public facilities will include pedestrian shoreline access, parking, restrooms, showers and picnic areas within the 70-acre recreation area. It is expected that details of a public access plan will be presented to and approved by the County during future project permitting at the County level.

Preliminary discussions with staff of the State Parks Division of the State Department of Land and Natural Resources suggest the possibility of partnering with the State in providing public facilities at the recreation area which would serve those using the shoreline trail all along the West Hawaii coast. Existing shoreline access along the shoreline of the subject property will be maintained by the developer.

2.6.7 Preservation Areas

Several significant archaeological sites have been recommended for preservation by the consulting archaeologist. These recommendations will be reviewed by the Historic Preservation Division of the State Department of Land and Natural Resources. The Petitioner intends to preserve these sites with the appropriate treatment and buffers. Clusters of significant sites will be preserved within two archaeological preserves.

2.6.8 Development Schedule and Construction Cost

The Kaupulehu Resort expansion project will be master planned and implemented by a developer team, including the Petitioner. Substantial infrastructure improvements are expected to be provided during the initial five years once the required government approvals have been secured. Initial sales are also expected during this period. Full buildout of the project is projected over 20 years, generally according to the schedule in

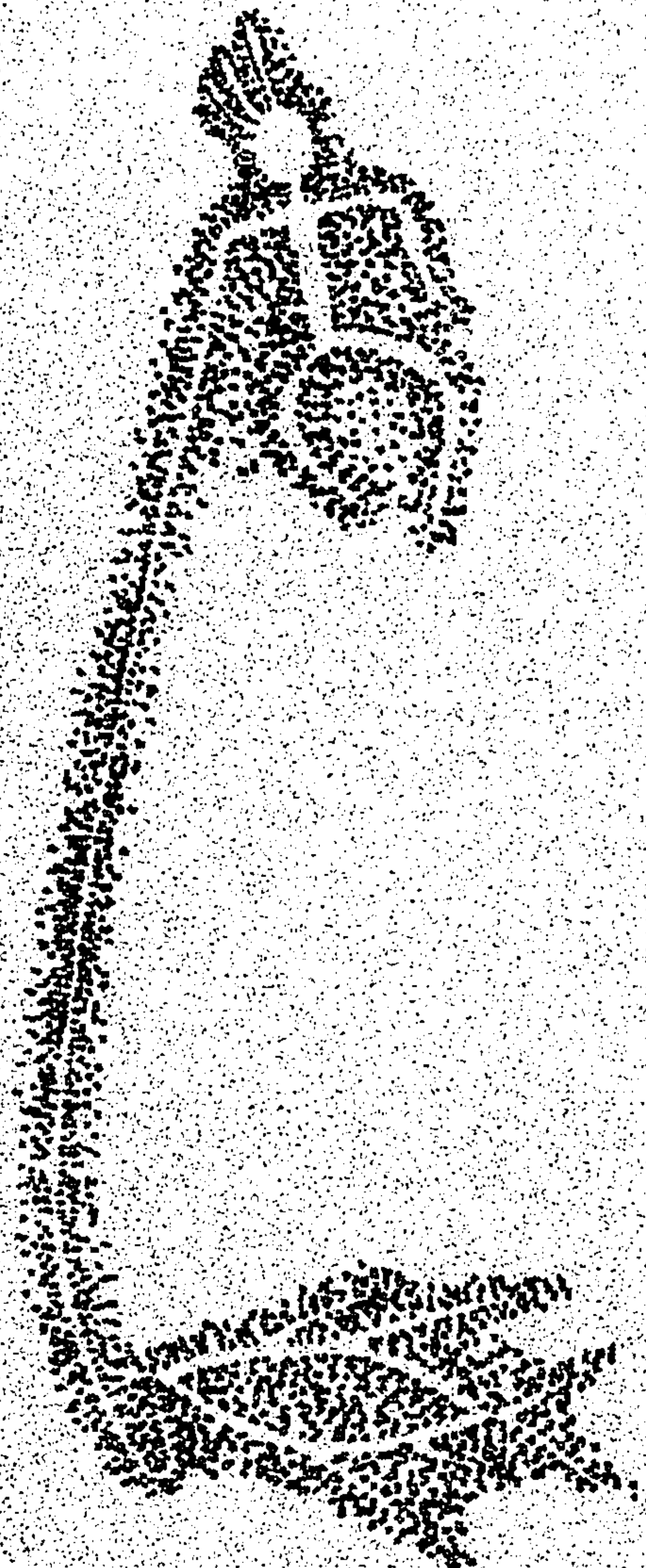
Table 2-2. The project construction cost is expected to exceed $100-million in 1994 dollars.

Table 2-2: Project Development/Sales

Year	Number of Multifamily Units Sold Resident	Resort	Total	Number of Single Family Units Sold (1) Resident	Resort	Oceanfront	Total	Other Components
1								(2)
2								
3	6	9	15	5	5	6	16	(3)
4	7	12	19	7	8	8	23	
5	7	15	22	7	15	10	32	(4)
6	7	20	27	7	20	10	37	
7	7	23	30	7	22	10	39	(5)
8	7	23	30	7	22	6	35	
9	7	23	30	7	22		29	(6)
10	7	23	30	7	22		29	
11	7	23	30	7	22		29	
12	7	23	30	7	22		29	
13	7	23	30	7	22		29	
14	7	23	30	7	22		29	
15	7	23	30	7	22		29	
16	7	23	30	7	22		29	
17	7	23	30	7	22		29	(7)
18	7	23	30	7	22		29	
19	7	23	30	7	22		29	
20	7	20	27	7	22		29	

(1) Purchasers are shown divided between "residents", or buyers from the West Hawaii area and elsewhere on the island who would consider the unit their full-time or primary family home; and "resort", or buyers/investors who select the subject unit from among statewide resort/residential alternatives and who would consider their unit as a second/vacation home, rental unit or long-term investment.
(2) Project permitting will take place during first two project years followed by construction of infrastructure. Unit construction will not begin until year 3.
(3) First 18-hole golf course and clubhouse open.
(4) Second 18-hole golf course opens.
(5) Development of infrastructure for entire project area is completed.
(6) Initial phase of shopping village opens.
(7) Final phase of shopping village opens.

Source: The Hallstrom Group, Inc. 1994 and Belt Collins Hawaii, 1994.



Chapter 3

Description of Alternatives

CHAPTER 3 DESCRIPTION OF ALTERNATIVES

3.1 Introduction

The provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), require that known alternatives which could feasibly attain the objectives of the action be examined. These include alternatives that might enhance environmental quality or those that reduce or eliminate environmental risks or costs. In compliance with the applicable rules, the alternatives have been evaluated relative to their capacity to meet these requirements.

As stated in Chapter 2 of this document, the primary project objective is to accommodate, with a viable master plan and common infrastructure, future growth of the Kaupulehu Resort community by offering complementary products to those planned at the portion of the resort now under construction. The action should allow the economic viability of the entire Kaupulehu Resort community to be enhanced and contribute to the long-term viability of the West Hawaii region.

Of the alternatives considered, the proposed action best meets the project objectives.

3.2 Alternatives

3.2.1 Proposed Action: Development of Kaupulehu Resort Expansion

The proposed project is a low-density recreation/residential development with a 36-hole golf course and clubhouse, 530 single-family lots, 500 multifamily units, a commercial neighborhood center, a residents club, a 70-acre recreation area for picnic and active recreational use, archaeological preserves, public access, and associated infrastructure. With its moderate to high-quality residences and low-keyed open space recreational character, the Kaupulehu Resort expansion will complement yet add different products to the hotel and other resort facilities at Kaupulehu Resort now under construction, making the entire resort more competitive within its market segment.

In addition to meeting the project objectives, the proposed action is expected to result in beneficial environmental and socioeconomic effects. Significant archaeological resources have been identified in an extensive archaeological survey and study and are planned for preservation within the resort expansion plan. The on-site candidate endangered species, *Sesbania tomentosa* ('ohai), has been identified and will be buffered and preserved. Under this plan, public shoreline access will be enhanced and new public amenities such as rest rooms and parking provided. New jobs will be created and additional revenues will accrue to both the County and State.

3.2.2 "No-Action" Alternative 1

This "no-action" alternative is to not seek a land use designation change from the

State Land Use Commission and to not develop the 65-acre existing Urban parcel. Under this alternative, no additional financial benefits would accrue to the Petitioner or government. No new employment opportunities would be created, natural and historic resources would not be enhanced and protected, and public access would not be improved. However, marine food sources would not be depleted as quickly as under the preferred alternative. This alternative does not meet the project objectives, as stated above.

3.2.3 "No-Action" Alternative 2

This "no-action" alternative is also to not seek a land use designation change from the State Land Use Commission. However, it would entail developing land currently designated Urban according to the expansion concept as originally planned in the mid 1980s. Figure 3-1, April 1986 Concept Plan, from the 1986 Kaupulehu Resort EIS shows an 18-hole golf course and a marina and condominium development in the existing 65-acre Urban District.

The marina/condominium alternative would complement the portion of Kaupulehu Resort now under construction. However, this earlier concept, before its refinement into the current proposed plan, does not meet current and projected market demand and might not be financially viable without an expanded golf course and single-family residential product. In addition, the environmental impacts of marina construction and operations are potentially more severe than those without the marina.

3.2.4 Higher Density Development

A higher density development with essentially the same types of facilities and amenities proposed in the preferred alternative would contribute additional product to the resort under construction. However, a more dense expansion project would not be as compatible with the low-density Kaupulehu Resort, a portion of which is under construction. Nor would it be compatible with the neighboring Kona Village Resort, upon which it would have greater impact.

With a more disparate resort expansion, the objective of economic viability of the entire Kaupulehu Resort community, and in turn its contribution toward the long-term viability of the West Hawaii region, would not be met as effectively.

More jobs would be created and higher revenues would accrue to the State and County, but these benefits would most likely be offset by increased government spending for services, additional impacts to the environment, increased traffic, and a potentially lower return for the developer.

3.3 Evaluation of Alternatives

Of the alternatives considered, the proposed action best meets the project objectives. It allows for a measured approach to long-range planning and development of

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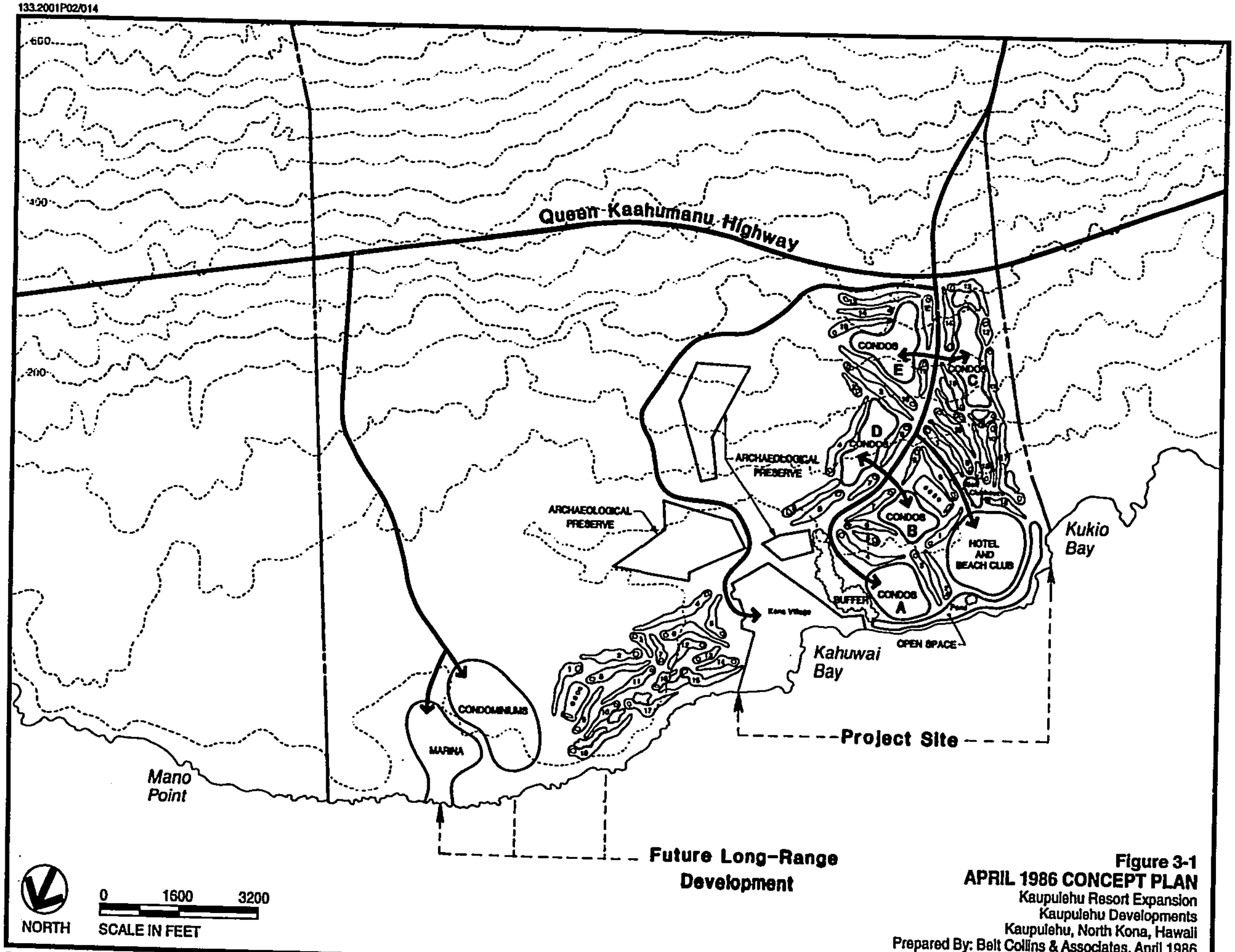


Figure 3-1
APRIL 1986 CONCEPT PLAN
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins & Associates, April 1986

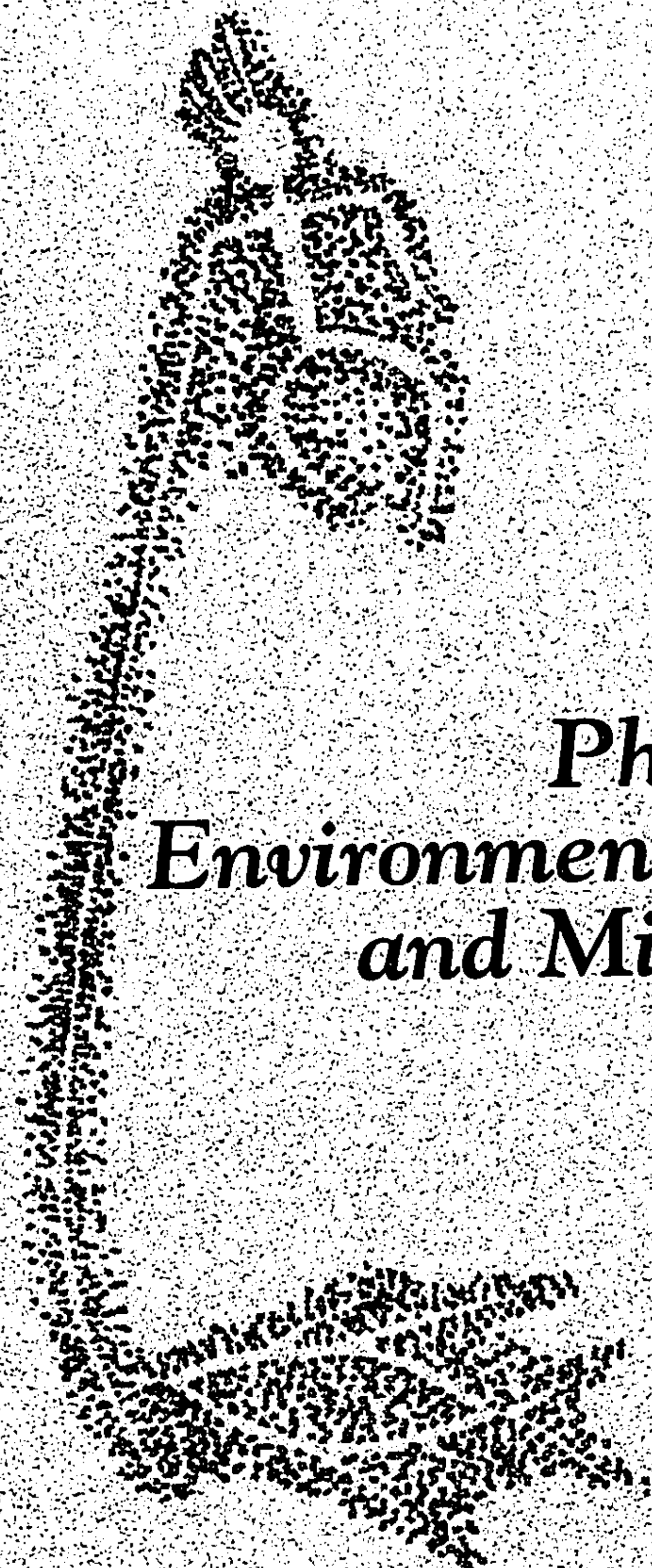
Source: Belt Collins & Associates, *Kaupulehu Resort Final Environmental Impact Statement*, June 1986

Kaupulehu Resort, while meeting projected market demand.

The low-density character of the resort expansion and its breadth contribute toward making the entire resort more competitive with other West Hawaii coastal resorts, which are larger than the 624-acre portion now in its initial stages of construction. As opposed to the "no action" alternative 2, the added residential acreage makes the resort expansion a more economically viable development. More acreage is available for recreational uses (70-acre recreation area and another 18 holes of golf), and opportunities exist for sharing infrastructure costs.

Fewer adverse environmental and public cost impacts would be associated with the preferred alternative, as opposed to the marina concept or the higher density alternative.

Chapter 4



Existing Physical Conditions, Environmental Consequences, and Mitigation Measures

CHAPTER 4 EXISTING PHYSICAL CONDITIONS, ENVIRONMENTAL CONSEQUENCES, AND MITIGATION MEASURES

4.1 Overview of the Environmental Setting

The 2,123 acre property is located in the North Kona District of the Island of Hawaii. It is situated within the makai (seaward) portion of the Kaupulehu ahupua'a about six miles northeast of Keahole Airport (see Figure 4-1).

The Petition Area consists of approximately 1,010 acres and is generally described as an irregular crescent-shaped parcel, which extends from a point adjacent to the Queen Kaahumanu Highway to the ocean and then curves to the northeast along the ocean until it reaches the eastern boundary of the ahupua'a. The Petition Area measures about 14,000 feet in length and is about 5,500 feet wide at its widest point. It is bounded by the Kaupulehu Resort and Kona Village Resort to the west, the ocean to the north, the vacant state-owned Puuwaawaa ahupua'a to the east, and the vacant Kaupulehu ahupua'a to the southeast and south (see Figure 4-2).

4.2 Climate and Meteorology

The State of Hawaii is located at the edge of the Tropical Zone within the belt of cooling northeasterly trade winds. Its climate is mild throughout the year. Northeasterly trade winds prevail approximately 80 percent of the year, particularly from February to November. Moderate to strong southerly (Kona) winds associated with low-pressure fronts originating to the west of the state occur more frequently between November and March. In well-exposed areas, the trade winds average under 15 miles an hour. They are slightly stronger in summer than in winter. A speed of 31 miles an hour is exceeded only about 2 percent of the time by the trades and 3 percent of the time by winds from other directions.

The seaward portion of the Kaupulehu ahupua'a receives less than 20 inches of precipitation annually. The mean annual temperature is about 78° F, with relatively small daily and seasonal fluctuations. Daytime temperatures above 88°F or nighttime temperatures below 63°F are rare. Daytime temperatures along the Kona coast range from 80° to 90°F, although at surface level the barren lava flows of Kaupulehu are often warmer.

4.3 Topography, Geology, and Soils

4.3.1 Existing Conditions

The Petition Area is situated at the base of the western slope of Hualalai and generally consists of sparsely vegetated pahoehoe lava flows and a barren a'a lava flow. The pahoehoe flows ages are up to about 3,000 years before present while the a'a flow is approximately 190 years old. The geologic base of the entire site is comprised of lava from the Hualalai Volcanic Series.

The Petition Area is generally flat and rises gently from sea level to an elevation of

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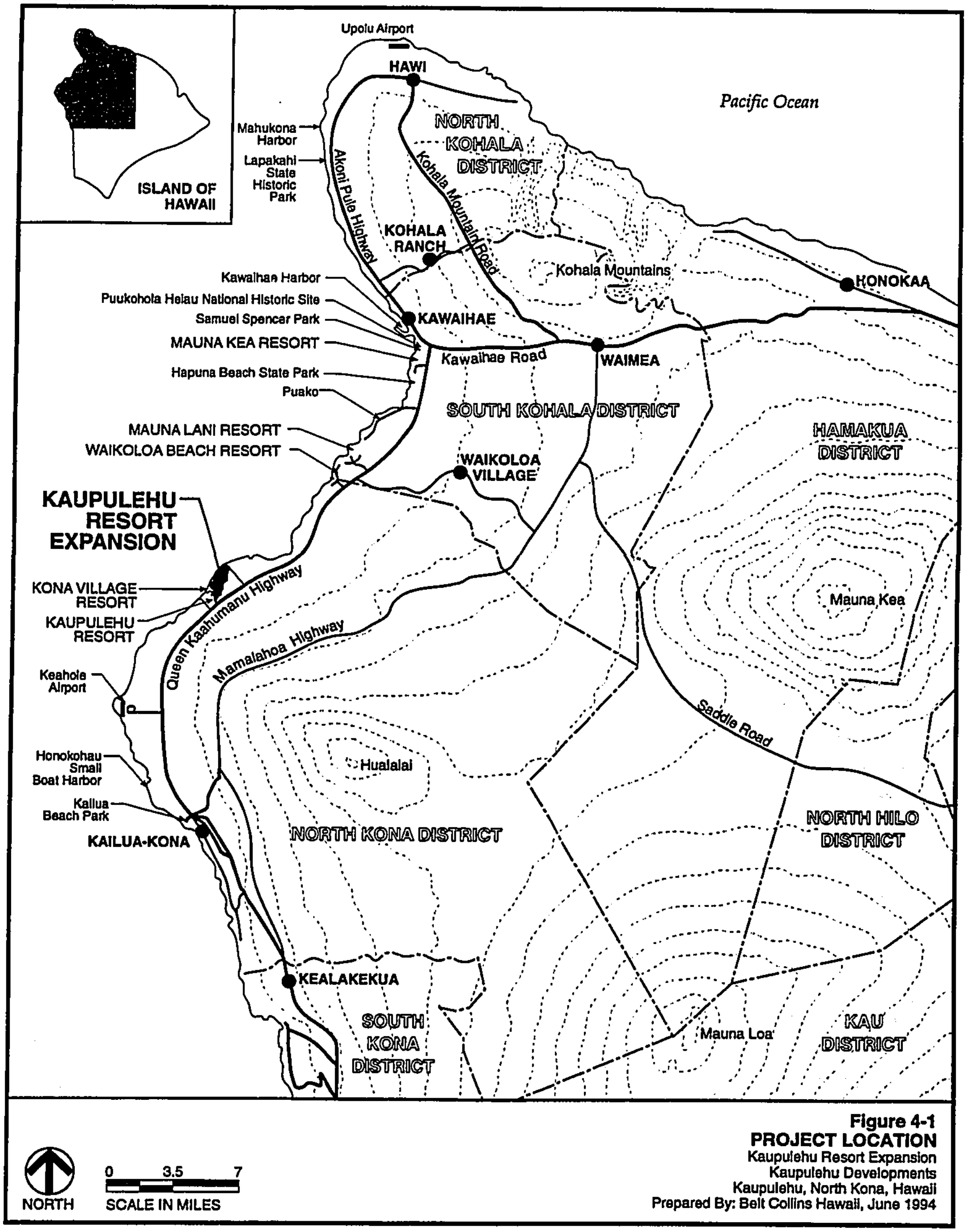

Figure 4-1
PROJECT LOCATION
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

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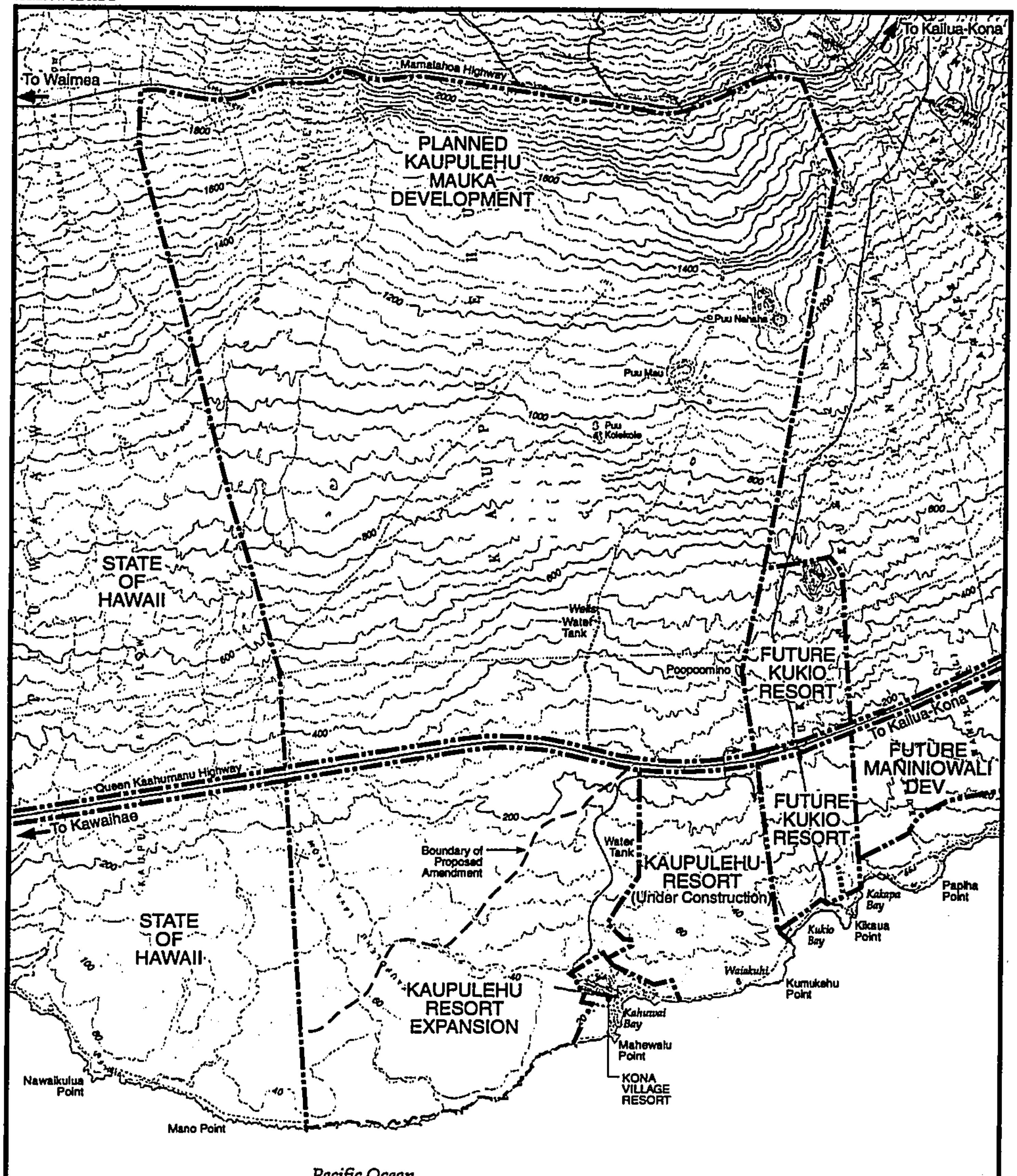

Figure 4-2
SURROUNDING USES
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

about 220 feet above mean sea level at the property boundary closest to the Queen Kaahumanu Highway. It has an overall average slope of about 4%.

The topography of the Petition Area is dominated by a branch of the 1800-1801 historic Kaupulehu Lava Flow (see Figure 4-3). This a'a flow extends through the center of the Petition Area to the ocean and constitutes about half of its total area. The a'a rubble rises from 10 to 20 feet above the older pahoehoe lava flows on either side of it. The a'a flow covers the entire western half of the Petition Area's shoreline; creating a relatively steep and rocky coast. The seaward-facing cliff at the shoreline is pock-marked with several caves and exposed lava tubes. The eastern half of the shoreline is a tidal pool shelf consisting of a broad expanse of pahoehoe strewn with a'a clinkers and coral rubble, and covered in some areas with up to about 5 inches of sand. According to the U.S. Soil Conservation Service, four soil associations are represented within the Petition Area (see Figure 4-4). These are summarized as follows:

(1) A'a Lava Flows (rLV). This lava has practically no soil cover and is generally bare of vegetation. The surfaces of a'a flows are masses of clinkery, hard, sharp pieces piled in tumbled heaps that are difficult 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 four inches in size. At the Petition Area, a'a lava flows constitute about 60% of the site (50% attributable to the 1800-1801 historic flow and an additional 10% consisting of other a'a flows).

(2) Pahoehoe Lava Flows (rLW). Pahoehoe lava flows, similar to the a'a flows, are a miscellaneous land type with meager soil covering. The surface of pahoehoe lava is generally much smoother than the a'a lava. The only soil in this land type is found in cracks and depressions, having been transported there by wind and storm runoff. At the Petition Area, pahoehoe lava flows constitute about 30% of the site.

There is practically no soil cover on the lava flows and the a'a flows are bare of vegetation. Portions of the pahoehoe flows are covered with sparse scrub vegetation. Both types of lava are highly porous and surface water percolates through them rapidly.

(3) Rock Land (rRO). Rock land is another miscellaneous land type that consists of pahoehoe bedrock covered in places with a thin layer of transported soil. The little soil that is present is generally confined to holes and cracks in the bedrock. Lava outcrops are exposed over 50 to 90 percent of the surface. At the Petition Area, rock land lava flows constitute about 2% of the site.

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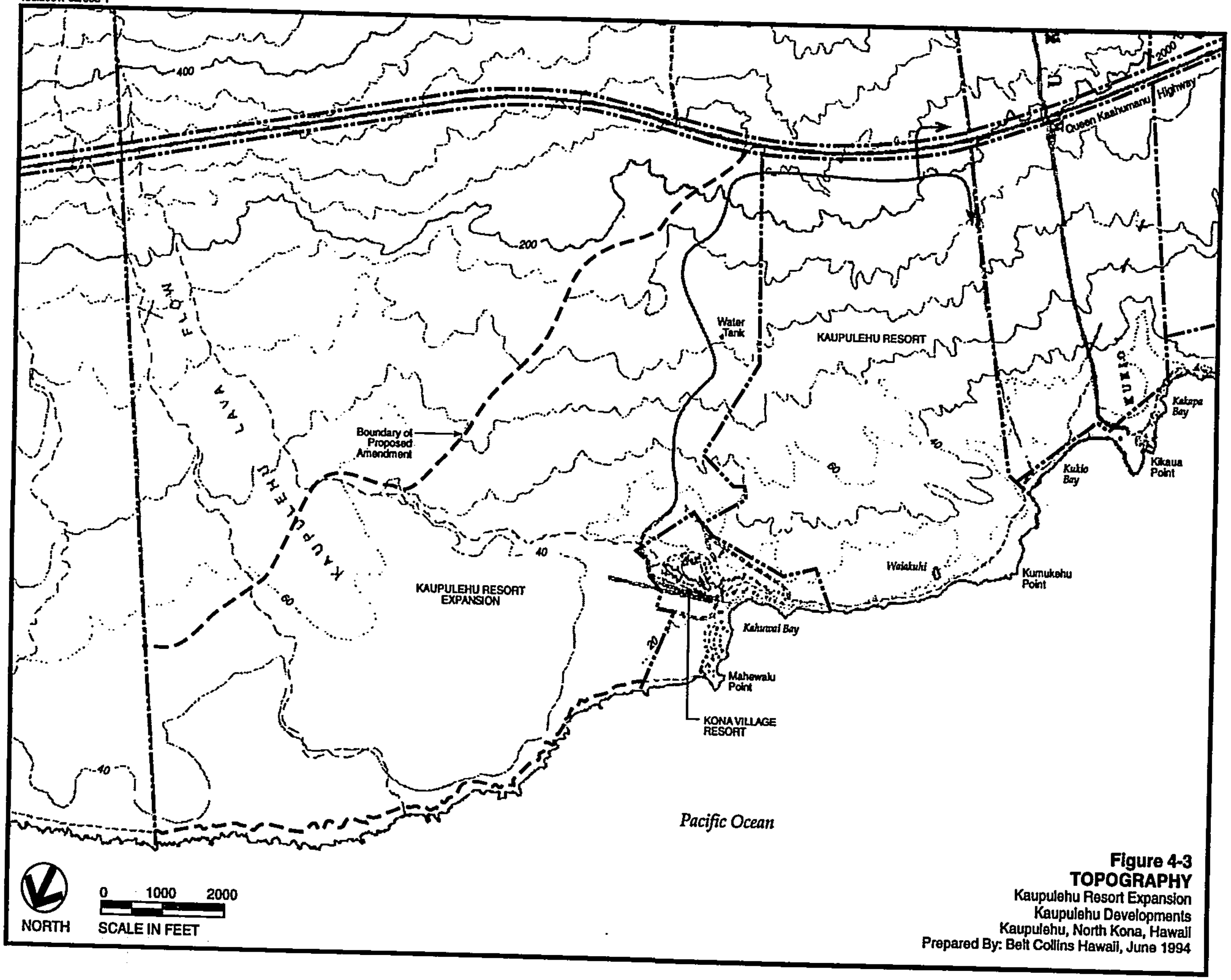


Figure 4-3
TOPOGRAPHY
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

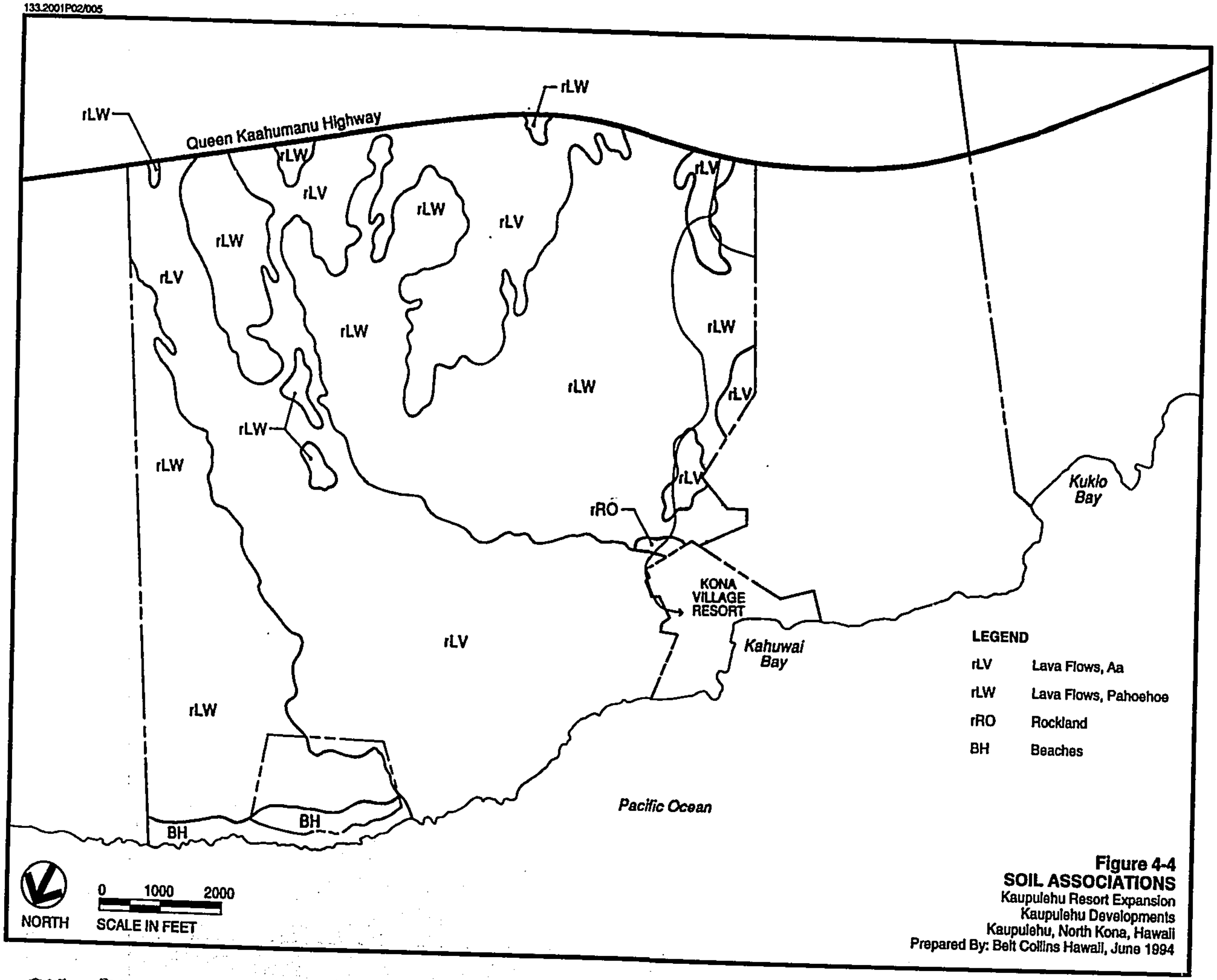


Figure 4-4
SOIL ASSOCIATIONS
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

(4) Beach Land (BH). Beach land is a typically long, narrow, sloping area of sand and gravel along the coastline of the island. The sand and gravel vary in color according to the material from which they formed. Yellowish or white sand forms from coral and sea shells, black sand forms from lava rocks, and green sand forms from olivine. At the Petition Area, beach land constitutes about 8% of the site.

4.3.2 Potential Impacts

Construction of the proposed project will not impact the geology of the project site or its topography. Grading and some cut and fill will be necessary to prepare development sites and roadways; however, it will not significantly alter the topographical character of the area. Because no development is proposed seaward of the shoreline setback area or certified shoreline, caves and lava tube openings identified in the shoreline cliffs will not be impacted.

Existing soil classifications will be impacted by the importation of top soil which is necessary for the golf courses and landscaped areas of the project. Portions of existing soil types will be buried beneath the imported soil.

During construction, the grading and contouring of imported top soil for the golf course and landscaped areas may have a short-term impact on air quality in the area and offshore water quality by generating increased levels of dust (wind transport). Increased amounts of soil in surface runoff could occur during grading and construction and before golf course turf has taken root. This could result in an increase to the turbidity of the coastal areas; constituting a secondary impact. Coastal waters could also be impacted by infiltration to groundwater resulting in increased sedimentation, nutrient enrichment, and the introduction of biocides.

Potential impacts to the ocean resulting from sedimentation, runoff, and biocide contamination are also discussed in detail in Section 4.8.1.2 below.

4.3.3 Proposed Mitigation

Although the source of the top soil to be imported has not yet been identified, it will likely come from a location on the Island of Hawaii. Imported soil would, therefore, be transported to the site by truck. Trucks will be covered to minimize soil loss during transportation. During dumping, stockpiling, and grading, imported soil will be regularly sprayed with water to control dust and particulate emissions.

Erosion from surface runoff will be minimized by ensuring that development sites are graded in a manner that would prevent off-site runoff and retain runoff on site. This measure will prevent the degradation of coastal waters from increased levels of turbidity and nutrients. However, because of the area's characteristically low levels of annual rainfall, surface runoff is not anticipated to be a significant concern. Coastal degradation from particulate and nutrient bearing groundwater will be prevented through the proper preparation of development sites. By layering development sites with decreasing sized aggregate rock, soil will be prevented from working itself down to the water table and being transported to the shoreline where it is extruded. Moreover, the application of biocides on the proposed golf courses will be carefully regulated and monitored to prevent biocides from entering the groundwater.

4.4 Agricultural Potential

4.4.1 Existing Conditions

Important agricultural lands in the State of Hawaii are identified and classified by the Department of Agriculture using a system called Agricultural Lands of Importance to the State of Hawaii (ALISH). This system identifies three classes of agriculturally important lands: (1) Prime Agricultural Land; (2) Unique Agricultural Land; (3) Other Important Agricultural Land. Due to a lack of soil, a lack of potable water, and an overall unsuitability for agricultural use, none of the land within the project site is classified in the ALISH system.

The state also utilizes a land classification system devised in the early 1970s at the University of Hawaii's Land Study Bureau to identify valued soils. This system uses an alpha-beta code to label soil types of diminishing quality (A = best, E = worst). Soils at the project site are all coded as "E" under this system and are, therefore, considered to be of no practical value for agriculture.

4.4.2 Potential Impacts

Because of the site's lack of agricultural potential, the project will have no negative impact upon agricultural productivity. A secondary impact of the project will involve its impact upon population growth in the region. The provision of up to 1,030 housing units will result in a potential increase in demand for local agricultural products which will, in turn, expand the market for products grown in the agricultural areas of the Big Island and increase revenues for island farmers.

4.4.3 Proposed Mitigation

No mitigation measures are warranted.

4.5 Drainage

4.5.1 Existing Conditions

Due to the site's relatively flat topography and the highly porous character of the lava, no defined drainage ways exist on site. The area is characterized as being well drained. There are no streams, ponds, anchialine ponds, or surface water bodies within the Petition Area. With the exception of a strip along the coastline approximately 50-feet wide which is designated as Zone VE (Coastal flood area with velocity hazard elevation determined at 9 feet) the entire property is designated as Zone X (areas determined to be outside of the 500-year flood plain) according to the Federal Insurance Rate Maps (FIRM). The FIRM flood boundaries are presented in Figure 4-5.

4.5.2 Potential Impacts

As the proposed project is developed, the lava flows will be altered to support the construction of residential subdivisions, roadways, parking areas, commercial centers, and two 18-hole golf courses. The addition of topsoil and the development of impermeable surfaces will significantly alter the surface drainage flow from the site. Surface water runoff will increase and there will be a greater potential for surface water to impact coastal waters.

4.5.3 Proposed Mitigation

To mitigate the potential impact of surface water runoff and drainage, including storm drainage, on coastal resources, all components of the proposed development will be designed to retain surface drainage on-site consistent with all applicable county standards. Direct discharge to the ocean will be minimized or avoided.

4.6 Groundwater Resources

4.6.1 Resource Description

The general character of the groundwater in the Kona region may be classified in three types: basal groundwater, brackish basal groundwater, and dike-impounded perched groundwater. Rainfall in the region recharges the basal aquifer, which extends from the upper slopes of Hualalai to the shoreline. Seawater intrusion near the shoreline creates brackish water. The extent of brackish groundwater inland is dependent upon the rainfall patterns, specific terrain, and geological formations. However, due to the proximity of the petition lands to the ocean, no potable water sources are present on-site.

The Kaupulehu region can be divided into three hydrological sectors. Sector 1 lies between the Queen Kaahumanu Highway and the coast. Sector 3 lies within the Hualalai rift zone in the upper elevations of the ahupua'a. Sector 2 lies between Sectors 1 and 3. Groundwater in Sectors 1 and 2 is brackish and groundwater in Sector 3 is potable.

The groundwater in Sector 3 is restrained and its flow is impeded by geologic structures associated with the rift zone. This causes the groundwater level to build up, creating a fresh water core in the basal lens. The sustainable yield in Sector 3 is estimated at 3.4 million gallons per day (GPD). In Sectors 1 and 2, the groundwater is unrestrained, and the head (or buildup) is low. The rate of groundwater extrusion along the Kaupulehu coastline is estimated to be about two and a half million gallons per day per coastal mile.

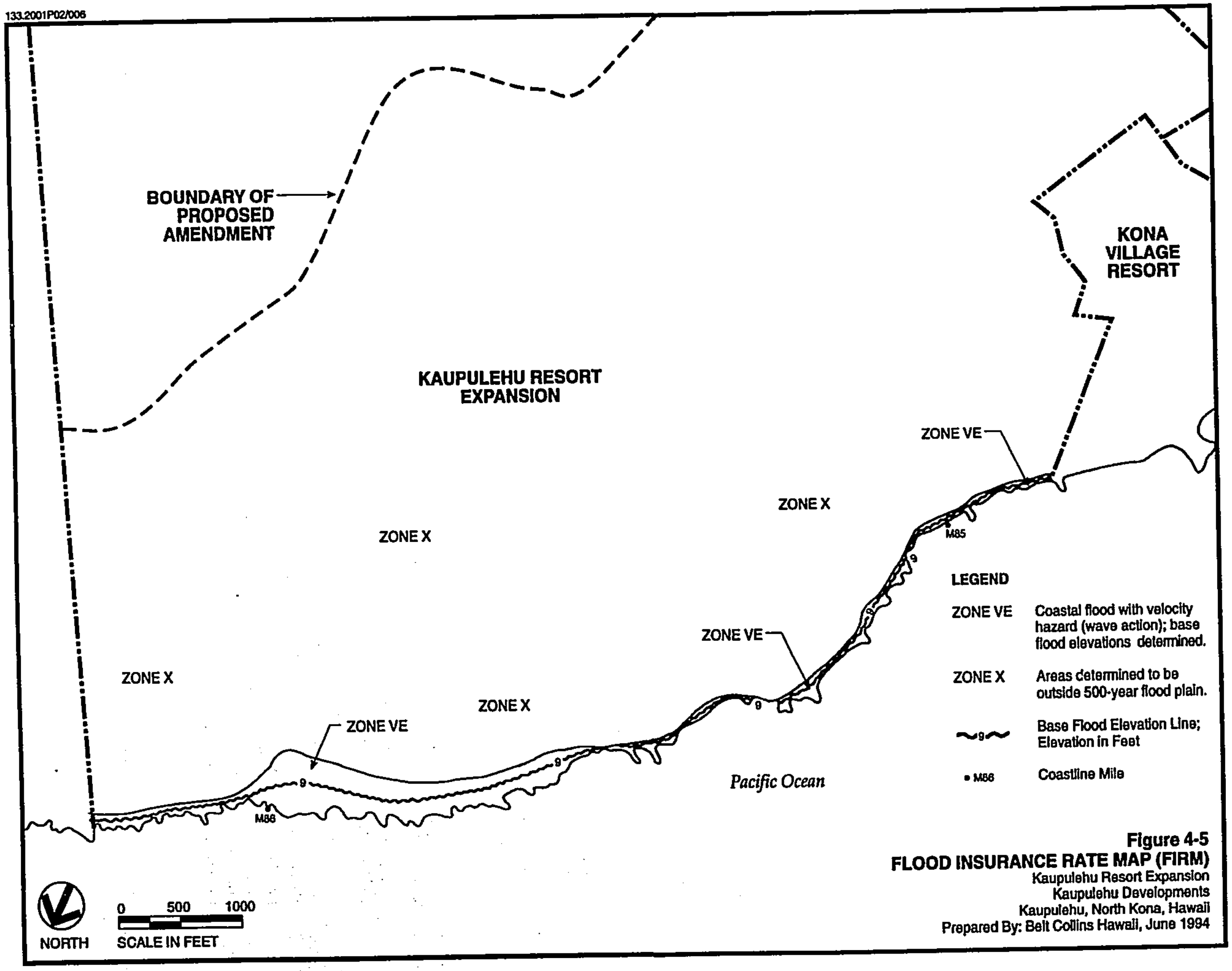


Figure 4-5
FLOOD INSURANCE RATE MAP (FIRM)
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

The basal lens in Sector 1 (under the Petition Area) consists of brackish groundwater with a maximum head of about two feet near the highway and average of one to two feet within the sector. The resource is a continuation of the basal lens in Sector 2 but receives virtually no recharge from the scanty local rainfall. Groundwater flux passing into Sector 1 under natural conditions is on the order of 6 million gallons per day. The aquifer is highly permeable and the brackish lens is thin.

A total of five wells are presently situated within the ahupua'a. Two of them are non-potable wells and are located about three miles inland at about 850 feet above mean sea level. These wells are capable of producing brackish water which is of acceptable quality for irrigation use. Two potable water wells have also been drilled at the 1,400 foot elevation within the Kaupulehu ahupua'a. The fifth well is an exploratory well which has recently been completed within the Kaupulehu Resort's Urban District near the Queen Kaahumanu Highway.

In Sector 3, the recommended total draft from the two existing wells is 1.3 mgd. As discussed above, the estimated sustainable yield of this sector is 3.4 mgd, leaving a 2.1 mgd surplus. Additional wells would have to be drilled to take advantage of this surplus. In Sectors 1 and 2, brackish groundwater can be developed for non-potable purposes. As a general rule, the degree of brackishness diminishes with distance inland, but beyond a mile or so little change takes place until the head rises high enough to sustain a fresh water core in the lens.

Kona Village Resort currently acquires its water from two non-potable wells situated at an elevation of about 850 feet above mean sea level and two potable wells at 1,400 feet above mean sea level. These wells provide approximately 100,000 gpd to the resort. A portion of the water from these wells is treated by electrodialysis for potable consumption.

Potential average water demand for the 624-acre Kaupulehu Resort is estimated to be approximately 836,243 gpd for potable water. The resort's potential demand for non-potable water has not yet been determined. Once the resort's golf course design plans are completed, demand for non-potable irrigation water can be calculated.

4.6.2 Potential Impacts

The proposed project will require potable water for consumption and non-potable water for irrigation. The groundwater resources with the Kaupulehu ahupua'a are considered to be adequate to meet the demand of the proposed project. This takes into account the existing demand of the Kona Village Resort and the project demand of the Kaupulehu Resort. The potable and non-potable requirements of the proposed project are presented in Section 6.1.4.

An assessment of the potential impacts of fertilizers and pesticides to be used on the proposed 36-hole golf course was conducted by Charles Murdoch, Ph.D. and Richard Green, Ph.D in January 1994, and is attached to this EIS as Appendix A and summarized here.

Dr. Murdoch and Dr. Green noted that the only surface water subject to contamination at the project site is the coastal water. They stated that the absence of significant runoff most of the year and the dynamic mixing of turbulent shoreline water by wave action preclude any adverse effect of chemical use on the project if adequate care is taken in irrigation and in fertilizer and pesticide practices. Likewise, according to their report, groundwater quality will not be adversely affected if recommended chemical application and irrigation practices are followed. Given the brackish nature of the groundwater at the site, the groundwater quality is of concern only as it impacts coastal water quality. The combined goals of water conservation and sustained coastal water quality will be well served by careful control of the amounts of irrigation and agricultural chemicals required.

4.6.3 Proposed Mitigation

With regard to water supply, the proposed water wells will be limited to a daily pumpage of approximately 400 gallons per minute. These yields are based upon the calculated sustainable yield of the area's groundwater resources.

Conservation will be emphasized at the proposed project as a means of limiting demand for both potable and non-potable water. Potable water can be conserved in the proposed residential units by utilizing water conservation devices such as low-volume shower heads and by minimizing its use for irrigation purposes. The principal method for non-potable water conservation will be to utilize treated effluent from the Kaupulehu Wastewater Treatment Plant to supplement irrigation water intended for use on the 36-hole golf course. The average volume of effluent projected to be available to supplement irrigation requirements is 0.404 million gpd, with a maximum flow of 1.571 mgd and a peak flow of 1.996 mgd. In addition to the use of treated effluent for golf course irrigation, salt-tolerant species of turf grass are being considered for use on the proposed golf courses. The use of such turf grass will enable relatively high saline content brackish water to be utilized for irrigation.

Dr. Green and Dr. Murdoch indicate in their report that irrigation practices may have a large influence on the movement of soluble nitrogen fertilizers in the soil. If excessive irrigation water is applied soon after the application of soluble nitrogen sources, the likelihood of runoff or leaching of nitrogen below the root zone is increased. Basing irrigation scheduling on water use rates and leaching requirements will result in large savings of water and also reduce the likelihood of chemicals being leached from the root zone. Fertilizer applications should, therefore, be scheduled so that additional water is not applied soon after soluble nitrogen fertilizers are applied. Use of only slow-release nitrogen sources will ensure minimum nitrogen leaching.

Potential pesticide contamination of the groundwater is not considered to be a problem because actual pesticide use is projected to be very low, given the climatic conditions at the Petition Area. Pesticide use may be reduced by utilizing an Integrated Pest Management (IPM) approach to pest control. The IPM approach involves applying pesticides only when pest populations reach levels which are causing unacceptable damage. It includes monitoring for pest populations and determining the level of individual pests required to produce unacceptable damage. All known methods of pest control are utilized, including selection of turf grass cultivars resistant to pests, cultural practices which decrease susceptibility to pests, applying the most effective pesticide and timing applications to improve pesticide efficiency, etc. According to Murdoch and Green, properly utilized IPM reduces, but does not eliminate, the use of pesticides.

According to Green and Murdoch, mitigation of adverse coastal water quality effects due to applied nutrients and pesticides can be accomplished by insuring an adequate depth of surface soil in any areas planted to turf, use of slow-release nitrogen fertilizers (or light applications of soluble ones), selection of pesticides which are effective against the pests but which are not likely to move from the site of application, and implementation of integrated pest management. Normal precautions in the use of pesticides registered for turf will also preclude negative impacts on wildlife (particularly birds) and air quality. The importance of good management requires the expertise of a well qualified Golf Course Superintendent. The Petitioner concurs with the recommendations of Murdoch and Green.

4.7 Natural Hazards

The proposed project area may be potentially impacted by four principal forms of natural hazards: flooding from storm wave inundation, tsunami inundation, lava flow inundation, and seismic activity.

4.7.1 Flooding

4.7.1.1 Existing Conditions

As discussed in Section 4.5, the Petition Area is generally not subjected to flood conditions. However, because the Petition Area extends along approximately 8,400 linear feet of coastline, the seaward portions of the property are occasionally subjected to wave runup. Under normal climatic conditions, the natural topography of the site prevents ocean waves and swells from impacting land inland of the certified shoreline. The relatively steep face of the a'a lava flow that covers nearly half of the Petition Area has been eroded by wave action and stands up to twenty feet above mean sea level in some areas. However, along the coastal strand which fronts the property on both sides of the 65-acre Urban parcel, there are no sea cliffs and a wide expanse of pahoehoe tidal pool shelf rises only a few feet above mean sea level. Within a small portion of the Urban area, wave runup associated with normal ocean swells occasionally results in a ponding of ocean water in a depression about 200 feet inland behind the beach.

During storm conditions, wave heights of 8 or more feet can occur. These higher waves are capable of washing over the flat coastal strand and increasing the volume of seawater ponded behind the tidal pools. Tropical storm and/or hurricane conditions could result in significant storm surge that not only impacts the coastal strand area with runup but is also capable of depositing coral rubble and debris on the shelf above the certified shoreline, and at the same time, removing accumulated sand.

4.7.1.2 Potential Impacts

Although the proposed development will cause a significant increase in the impermeable surface area at the site, resulting from the construction of roads, sidewalks, driveways, and parking lots, it is not likely that this will create a significant flooding hazard. The porous character of the lava ensures virtually no off-site runoff and on-site runoff will be dispersed into undeveloped lava fields where it will be absorbed before it can reach coastal waters.

With regard to flooding generated by storm wave run-up, development situated near, but mauka of the certified shoreline could potentially be impacted. Such conditions could result in localized flooding to individual structures. It should be noted, however, that no habitable structures are presently proposed in areas that may potentially be impacted by storm water runup. Thus, development that may be impacted would be limited to landscaped areas, coastal access trails, and golf course fairways.

4.7.1.3 Proposed Mitigation

A storm drainage system will be installed as part of the development project to prevent the accumulation of water within roadways and parking areas. The drainage system will be designed to contain all runoff within the Petition Area and prevent it from impacting surrounding properties and land uses. To minimize the impacts of storm wave runup, the foundations of any development proposed near the certified shoreline boundary will be elevated sufficiently to prevent flooding. It should be noted, however, that no habitable structures are presently proposed in areas that may be subjected to potential storm water runup.

4.7.2 Tsunamis

4.7.2.1 Existing Conditions

Tsunamis may be characterized by two types: those that are generated anywhere within the Pacific Rim and those that are generated locally. The significance of this distinction is associated with the length of warning time following a tsunami generating event. A tsunami generated by an earthquake in Chile may take up to 15 hours to reach Hawaii, while a local tsunami generated by an earthquake can be almost instantaneous.

A tsunami inundation area has been defined for the shoreline of the Petition Area. The determination of the size of the potential inundation area is based upon historical occurrences and topographic limitations. The identification of a tsunami inundation area is utilized for informative purposes as a means to alert area residents to the potential risk.

The actual occurrence of a tsunami cannot be predicted. Once a tsunami is generated anywhere in the Pacific Rim, its height can be monitored as it approaches land masses. However, the actual height of tsunami at landfall will vary, based upon specific differences in the topography of the shoreline and the depth of the near shore waters.

4.7.2.2 Potential Impacts

As the result of their unpredictability, the actual impacts of a tsunami cannot be estimated beyond the fact that large tsunami waves can cause considerable damage. The ability of a structure to withstand the destructive force of a tsunami is dependent upon a combination of factors including: the size of the wave, the number of waves, the type of structure impacted, the structure's distance from the shoreline, the topography of the impacted area, and the amount of debris suspended in the waves impacting the structure.

4.7.2.3 Proposed Mitigation

To assure that future area residents of the entire project area are alerted to the destructive potential of tsunamis, a number of measures can be undertaken. First, all prospective homeowners within the general vicinity of the coastline will be provided with informative material at the time they purchase their home. Second, an evacuation plan will be prepared to identify the location of evacuation routes, evacuation procedures, and the location of emergency shelters. Third, a tsunami warning siren system will be installed within the proposed project as a means of informing area residents of an impending threat. The warning system will be linked to the statewide civil defense system and will be activated directly by the Hawaii County Civil Defense Agency.

4.7.3 Volcanic Eruptions

4.7.3.1 Existing Conditions

Because the Petition Area is situated at the base of the western slope of Hualalai, the mountain serves as a barrier protecting the project site from potential lava flow inundation generated by Mauna Loa. Nevertheless, the project area could suffer from lava flow inundation, tephra falls, volcanic gas emissions, or some combination of the three. Although Hualalai is much older than Mauna Loa, it is still considered to be an active volcano. However, its eruptions occur much less frequently than Mauna Loa or Kilauea. About 25% of the mountain is covered by flows less than 1,000 years old. For comparative purposes, over 40% of Mauna Loa's surface is covered by lava flows less than 1,000 years old.

Hualalai last erupted in 1800-1801 from several vents along the northwestern rift zone. One of the flows generated during this eruptive series crossed the Petition Area and constitutes about 50% of the total project site. Utilizing a hazard zone scale from 1 to 9 (where 1 represents the greatest hazard and is associated with rift zones and active vents), the United States Geological Service (USGS) identifies the entire Hualalai mountain as Zone 4. According to the USGS, "the flanks of [Hualalai] do not have a distinctively lower hazard than its rift zones because the distance from the vents to the coast is short and the slopes are steep." (USGS, 1990)

4.7.3.2 Potential Impacts

The potential impacts of lava flow inundation are usually catastrophic and irreversible. Structures that lie in the direct path of flow are either destroyed by fire or partially or completely covered with molten rock. Impacted areas require several weeks or longer for the lava to cool to the point where the area is accessible. In addition, a'a lava flows can be quite massive in size and height and completely alter the existing topography of an area. However, in Hawaii the loss of life due directly to lava flow inundation is extremely rare. This is due to the fact that there is usually adequate warning of an impending threat to allow the evacuation of an area.

Although the loss of residential structures is a considerable hardship, an additional consequence of lava flow inundation is the potential disruption of infrastructure. In the case of the project area, it is possible that a lava flow could inundate the project's wells and water transmission lines or the Queen Kaahumanu Highway (all of which are located mauka of the Petition Area) without directly impacting the project site.

Due to the relative proximity of the project site to the summit and northwest rift zone of Hualalai, in the event of an eruption, the Petition Area could also possibly be impacted by tephra falls (falling ash and lava projectiles) and/or volcanic gas emissions.

4.7.3.3 Proposed Mitigation

As is the case with tsunamis, due to the uncertainty of volcanic eruptions, the most practical mitigative measure is the provision of a early warning alert system that will warn area residents of an impending threat. Together with a comprehensive evacuation plan, a warning system will be implemented to ensure that loss of life does not occur. The evacuation plan will be submitted to the county for approval.

4.7.4 Earthquakes

4.7.4.1 Existing Conditions

The Island of Hawaii experiences thousands of earthquakes each year—most are so small that they can only be detected by instruments, but some are strong enough to be felt by people and a few cause minor to moderate damage. Most of the island's earthquakes are directly related to volcanic activity concentrated beneath Kilauea and Mauna Loa, particularly beneath the south flanks of both volcanoes and the Koiki region between them. Although originating in the volcanically active areas, these earthquakes can have widespread damaging effects. A few earthquakes are less directly related to volcanism and originate in zones of structural weakness at the base of the volcanoes or deep within the earth beneath the island. (USGS, 1990)

Seismic tremors associated with volcanic activity on the island of Hawaii are known as *basal slip quakes*. These tremors are relatively shallow in depth and tend to be focused in the vicinity of the rift zones of Hawaii's active volcanoes. They are believed to be capable of generating localized tsunamis.

Lithospheric quakes occur at much greater depths below the earth's surface than basal slip quakes and are believed to be the result of the earth's crust sagging and shifting under the weight of Hawaii's volcanoes. These quakes are generally not associated with tsunamis.

The largest earthquake recorded during historical times in the vicinity of the project was situated beneath Puuwaawaa on the north facing slope of Hualalai, about 10 miles east-south-east of the Petition Area. It occurred on October 5, 1929 and its intensity is estimated to have been about 6.5 on the Richter scale. This earthquake was believe to be a lithospheric quake and did not generate a tsunami. However, during the period from September 21, 1929 to October 16, 1929, over 6,000 tremors occurring at Hualalai were recorded at the Hawaii Volcanic Observatory at Kilauea. (Personal Communication; Hawaii Volcanoes Observatory, 1994)

4.7.4.2 Potential Impacts

The (Uniform) Building Code designates the entire Island of Hawaii in Earthquake Zone 3 and contains certain structural requirements to address the relative seismic hazards. Since the majority of the structures to be built at the project area will not exceed two stories in height, there are no special concerns associated with falling debris during a major seismic event. However, during a major earthquake (7+ on the Richter scale), significant property damage could occur, including the destruction of building foundations and disruption of infrastructure such as sewer and water transmission lines.

In addition, the impacts of an earthquake are determined to some extent by the character of an area's surface and subsurface. Loose soils or fills are known to "liquefy", shift, or slide during a moderate to severe earthquake. This can result in significant damage to foundations, roads, and transmission lines.

A major earthquake is also capable of generating a localized tsunami, especially if shoreline subsidence or collapse occurs in direct response to the event. The extent of impact of a local tsunami upon the Petition Area is entirely dependent upon the size of the earthquake and the extent of any subsidence associated with it.

4.7.4.3 Proposed Mitigation

Because the entire project area consists of a'a and pahoehoe lava, loose soils and fill would not present a significant problem during an earthquake. To minimize structural damage, all structures will be built to comply with the uniform building code to ensure that they are able to withstand a moderate earthquake event.

4.8 Marine Environment

Marine waters off Kaupulehu's coastline are classified as open coastal, Class AA according to Title 11 Chap. 54, State DOH, Water Quality Standards. Class AA waters must remain in their natural pristine state as nearly as possible. Uses to be protected in Class AA are oceanographic research, support and propagation of shellfish and other marine life, conservation of coral reefs, compatible recreation, and aesthetic enjoyment.

In mid-September 1993, Dr. Steven Dollar of Marine Research Consultants conducted a baseline marine assessment of the Petition Area's coastal resources. Reconnaissance surveys were conducted from the coastline out to the limits of coral reef formation. Based upon initial observations made during the reconnaissance surveys, four quantitative transect sites were selected offshore of the development area to inventory marine biota and collect water chemistry samples. Full descriptions of the methodologies employed and the findings for the marine biota analysis and water chemistry monitoring are presented as Appendix B in this document. The results are summarized below.

4.8.1 Physical Composition and Coral Communities

4.8.1.1 Existing Conditions

Beyond the shoreline of the Petition Area, the structure of the offshore environment generally conforms to the physical characteristics of much of the coast of west Hawaii. It consists of three predominant zones. Beginning at the shoreline and moving seaward to a depth of about 20 feet, the shallowest zone is comprised of a seaward extension of a basaltic ledge of pahoehoe lava and scattered basaltic boulders that have entered the ocean after breaking off from the shoreline. *Pocillopora meandrina*, a sturdy hemispherical coral, is the dominant colonizer of this nearshore zone. This species is able to flourish in areas that are physically too harsh for most other species, particularly due to wave stress. Other common species in this zone are *Pocillopora lobata, Montiporra verrucosa,* and *Pavona varians*.

Seaward of the nearshore boulder zone, bottom structure is composed of a gently sloping basalt reef bench interspersed with lava extrusions and sand channels. Fine-grained calcareous sediment also comprises a component of the bottom cover. Water depth in this mid-reef zone ranges from about 20 to 50 feet. Because wave stress in this zone is considerably less than in shallower areas, and suitable hard substrata abound, the area provides an ideal locale for colonization by attached benthos, particularly reef corals. Dominant coral species include *P. lobata* and *Porites compressa. P. lobata* occurs in various growth forms including flat encrustations and large dome-shaped colonies.

The seaward edge of the reef platform (at a depth of about 50 feet) is marked by an increase in slope to an angle of approximately 20 to 30 degrees. In this deep slope zone, substratum changes from the solid continuation of the island mass to an aggregate of unconsolidated sand and rubble. The predominant coral cover in this zone is typically interconnected mats of "finger coral" (*Porites compressa*), which grow laterally over unconsolidated substrata. Unlike many areas of West Hawaii, however, the predominant cover consists of living coral colonies. This indicates that the area has not been subjected to the force of destructive storm waves that have occurred in many other areas of West Hawaii in the past decade. Coral settlement and growth ceases at a depth of approximately 80 feet. Beyond this depth, the bottom consists mostly of sand, with occasional basaltic outcrops.

In general, coral diversity is highest in the shallow or mid-depth zone and lowest in the deep slope zone. In total, twelve species of "stony" corals and two "soft" corals were observed throughout the study area. *P. lobata* accounted for about 52% of total coral cover, and about 29% of all bottom cover. The second and third most abundant species, *Porites compressa* and *Pocillopora meandrina* accounted for about 39% and 4% of coral cover, and 22% and 2% of total bottom cover, respectively. Thus, these three species comprised about 95% of living coral cover and 53% of all bottom cover. In total, living coral cover accounted for about 66% of all bottom cover.

4.8.1.2 Potential Impacts

Implementation of the proposed project will involve changes to the existing environment on land, including grading, vegetation removal, and new construction. The project includes no proposals or plans for alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment can only be considered from activities on land that may result in the delivery of materials to the ocean through infiltration to groundwater, changes in surface runoff, and wind transport.

A potential mechanism for negative impact to marine systems is increased sedimentation from wind or runoff. However, at the study area, the potential for negative impact is considered to be low, due to the existing character of the offshore area. Large regions of sand cover in mid-reef zone and deep slope zones indicate that the coral communities are presently adapted to extremes in sediment stress from natural conditions.

According to Dr. Dollar, corals and other reef organisms are capable of removing sediment suspended by natural phenomena, up to threshold levels of deposition where cleaning mechanisms are overwhelmed and organisms become buried. Organisms in the study area are therefore capable of withstanding the stress associated with large natural sediment loads. In comparison to the frequent natural sediment resuspension within the study area, any additional input from land resulting from construction activity would probably not have the potential to accumulate to the point where organisms could be buried.

As with sedimentation, it is not expected that runoff during construction would provide any negative stimulus to the marine environment. The climate of the North Kona district is one of the driest in the Hawaiian Islands; therefore substantial rainfall causing sheet flow to the ocean during construction is unlikely. Even in the event of heavy rainfall, the porous nature of the lava and soil ground cover is such that sheet flow carrying suspended sediment toward the ocean would be absorbed rapidly. Thus, most rainwater that would enter the ocean as runoff would do so following percolation through the surface rock layers to the water table, followed by groundwater extrusion at the shoreline.

Normal volumes of groundwater extrusion in the Kaupulehu area are estimated to be in the range of 3-6 million gallons per day (mgd) per mile. Results of water chemistry surveys conducted in the study area have shown that a surface layer of low salinity, high nutrient groundwater occurs in the nearshore area (within 50 meters of the shoreline) as a result of groundwater efflux. An increase in the volume of groundwater extrusion and resulting change in water chemistry owing to changes resulting from land development is likely to be insignificant. As an example, a study of development at Waikoloa (about 10 miles up the coast from the study area) estimated the <u>annual</u> discharge of stormwater runoff was roughly equivalent to the amount of groundwater which enters the ocean <u>daily</u> (U.S. Army Corps of Engineers, 1985).

Use of treated sewage effluent for irrigation of the proposed golf course, as well as use of fertilizers and pesticides could possibly impact the aquatic ecosystem. When subjected to substantial increases in nutrients, the response of some marine and freshwater systems is termed "eutrophication" and consists of increased growth of a portion of the community (phytoplankton) that is able to directly utilize the nutrients, generally at the expense of normal community integrity.

No such impacts, however, are anticipated at the study area for several reasons. Most importantly, the unrestricted circulation of the offshore zone by tidal and wind-driven currents, meso-scale eddies, and wave action promotes rapid dilution and water exchange. Residence time of a parcel of water fronting the development is probably on the order of hours, so buildup of any nutrient is unlikely.

In addition, much of the nutrient load provided in effluent and fertilizers is taken up by vegetation on the golf course. Chang and Young (1977) reported that on a golf course on Oahu irrigated with treated sewage effluent, 98% of the total nitrogen and 100% of the total phosphorus was taken up by the soil-plant surface layer. While the underlying substrata on the Oahu course may differ from the substrata at Kaupulehu, the soil mantle, where most of the chemical uptake and absorption occurs, should be similar at the two locations. Murdoch and Green (1987) also investigated the influence of golf course irrigation and pesticide application to nearshore marine waters. After 23 years of operation, material used to fertilize the golf course at the Mauna Kea Resort could not be detected in the ocean.

The secondary level of sewage treatment commonly used by resort developments is an additional factor to be considered. Studies done at several ocean discharges on Oahu (Dollar 1987) show that intentional discharges of greater volumes of secondary-treated sewage into marine environments caused no detrimental effects whatsoever. It should, therefore, be noted that wastewater at the project is proposed for treatment to the secondary level.

As discussed in section 4.6.2 above, the potential for negative alteration to marine ecosystems owing to pesticides and herbicides also seems to be nil. Golf courses in Hawaii typically do not utilize substantial quantities of pesticides, and only very small applications of herbicides are periodically made to the greens. Such small quantities do not appear to be of a magnitude great enough to leach through the soil and lava, be carried to the ocean via groundwater extrusions, and then accumulate to the point of producing a noticeable effect. To date, there have been no substantiated instances of detection of golf course biocides in any marine biota in Hawaii.

4.8.1.3 Cumulative Impacts

Protection and preservation of the marine ecosystem is of particular importance to the Petitioner, especially in light of the various developments planned at Kaupulehu. In addition to the 36-hole golf course and 1,030 residential units proposed at the Kaupulehu Resort Expansion, the adjacent Kaupulehu Resort is allowed under its current zoning to construct 250 hotel units, two golf courses, and up to 1,000 resort/residential units. The Kona Village Resort is permitted a maximum of 150 units. Thus, full buildout of the projects currently proposed for the makai lands of Kaupulehu will result in a total of 400 hotel units, 4 golf courses, and about 2,000 residential units. Therefore, the cumulative impact of full buildout must be considered.

Four existing factors suggest that cumulative development will not result in a significant negative impact upon the biological performance of the marine ecosystem. First, of the three separate projects, none include substantial or significant alterations to the shoreline or coastal resources. The only offshore work planned is a public safety and beach improvement project fronting Kaupulehu Resort. Four small beach areas along the shoreline will be impacted in order to make the beach areas safer for swimmers. The work will involve the mechanical removal of lava rock boulders from the beach and the near shore waters. No blasting is proposed and no coral reef structure will be removed. The depth of the swimming area between the beach and the landward edge of the coral reef will be increased by approximately two feet (from a depth of two feet to a new depth of four feet). These safety improvements have been mandated by Hawaii County as a condition of a Special Management Area permit.

The low level of coastal alteration ensures that the natural off-shore conditions will not be physically altered or compromised. Water residence times will remain unchanged. Wave action will not be altered. Bottom-disturbing activities which could result in the destruction of coral and increased turbidity will not occur.

Second, the existing wave regime and healthy coral community together indicate that increased runoff and sedimentation is likely to have no significant impact upon marine conditions. Nutrient loading is unlikely given the low residence time of water along the Kaupulehu coast. In addition, the existing coral communities are already adapted to wave stress and currently high levels of groundwater extrusion (and subsequently, the nutrients it contains). Any cumulative increases resulting from the three development areas are still within the "acceptable" range when considering the dynamics of the natural system.

Third, the naturally dry climate of the region and general lack of rainfall, combined with the flat topography of the area will greatly reduce the propensity for increased sheet flow and runoff, regardless of the cumulative area of hardscape surfaces proposed in the three development areas.

Fourth, modern golf course management is much more sophisticated than in times past. Pesticides and herbicides are used sparingly, and only by licensed personnel, as discussed in the analysis by Murdoch and Green (see section 4.6.2). Wastewater from all three projects will be treated to a secondary level at a single treatment plant and the treated effluent will be combined with brackish water to irrigate all four proposed golf courses. The new golf courses will be constructed to prevent excessive drainage and maximize the efficient uptake of irrigation water by turf and plants. This is accomplished through the careful layering of aggregate under the greens, tees, and fairways. In addition, the installation of lysimeters during golf course construction will ensure that irrigation is controlled to prevent excessive use of water and increased runoff. Lysimeters also provide a mechanism for monitoring biocide and fertilizer application to prevent excessive use and possible negative impacts upon the groundwater and marine ecosystem.

For these reasons, no negative cumulative impacts upon the biology of the marine ecosystem are anticipated. However, the cumulative impact of population expansion at Kaupulehu may have a *significant negative impact upon the populations of marine biota* popular among subsistence gatherers; limu, opihi, and crab. This will be the result of increased public access to the Kaupulehu shoreline. Because access to the coastal area is presently limited by a lack of public roadways, Kaupulehu is presently not subjected to the same level of exploitation as other more accessible coastal areas. Based on the experience of other West Hawaii resort areas, this may change with the implementation of the Kaupulehu Resort project and the subject project. Public shoreline accesses will be provided, as required by State and County policy, and human activity in the coastal area will increase. The result may be a significant depletion of limu, crab, opihi, and fish. Increased fishing from the shoreline could also deplete offshore fish populations.

4.8.1.4 Proposed Mitigation

As implied above, mitigation measures to prevent significant negative impacts upon the physical marine environment are generally systemic by nature. In other words, the various attributes of the proposed project, including project design and layout, grading plans, construction techniques, drainage systems, wastewater treatment, golf course operation and maintenance, and a commitment to resource monitoring all combine to ensure that negative impacts to the physical marine environment are minimized.

To address the impacts of greater public access, the Petitioner will prepare a shoreline management plan in an effort to mitigate biological resource depletion.

Specific provisions of the plan will be coordinated with the zoning and Special Management Area permit processes.

4.8.2 Nearshore Water Quality

4.8.2.1 Existing Conditions

A phased monitoring program for water chemistry was begun in August 1993 offshore from the Petition Area. Its findings indicate that water chemistry constituents that are found in high concentration in groundwater (silicone, nitrate, and phosphate) were substantially elevated in samples collected within 50 meters of the shoreline. Beyond this distance, mixing of groundwater and ocean water was sufficient to dilute all groundwater nutrients to near background concentrations. This suggests a substantial amount of groundwater extrusion. A buoyant surface lens consisting of elevated groundwater nutrients and decreased salinity was also apparent in the area out to a distance of 50 meters from shore.

Water chemistry parameters such as turbidity, chlorophyll, and temperature displayed no distinct patterns. In general, the concentrations of these constituents showed no patterns with respect to shoreline or vertical gradients. Also, no nitrate, phosphorus, or ammonia is being added to nearshore waters as the result of activities on land. Based upon comparisons of measurements of water chemistry parameters to Department of Health standards, it has been determined that the natural input of nitrate (in groundwater) can result in concentrations exceeding DOH limits, especially in areas near the shoreline.

The results of monitoring six months later (January 1994) revealed no substantial change in water chemistry, with two minor exceptions. First, comparing samples of the two surveys indicated that substantially more mixing of the entire water column occurs during the winter than during the summer. Calm conditions that occurred during the summer sampling resulted in substantially greater horizontal and vertical gradients of chemical materials that enter the ocean at the shoreline through groundwater efflux. Second, DOH standards for nitrate were exceeded again in January 1994, but not as frequently as during the previous August.

4.8.2.2 Potential Impacts

The impacts of the proposed project upon the water chemistry of ocean waters fronting the Petition Area are addressed above in sections 4.8.1.2 and 4.8.1.3.

4.8.2.3 Proposed Mitigation

See section 4.8.1.4 for a discussion of mitigation measures.

4.8.3 Marine Biota

Section 4.8.1.1 addressed the physical composition of the Petition Area's marine resources, and included a discussion of coral communities. This discussion focuses on other benthic macroinvertibrates, the reef fish community, endangered and threatened species.

4.8.3.1 Existing Conditions

Aside from the coral communities, the dominant group of macroinvertibrates are sea urchins (Class Echinoidea). The most common urchin are *Echinometra matheai*, which occur in all three reef zones. *E. matheai* are small urchins that are generally found within interstitial spaces bored into basaltic and limestone substrata. *E. matheai* are most abundant in the study area at the mid-reef zone and are least abundant in the slope zone where solid substrata is not common. *Tripneustes gratilla* and *Heterocentrotus mammillatus* are other species of urchins that occur commonly on reef surfaces in many regions of the study area.

Sea cucumbers (Holothurians) observed during the survey included three species, *Holothuria atra*, *H. nobilis*, and *Actinopyga obesa*. Individuals of these species were distributed sporadically across the mid-reef and deep reef zones. The most common starfish observed on the reef surface were *Linckia spp*. Several crown-of-thorns starfish (*Acanthaster planci*) were observed feeding on colonies of *Pocillopora meandrina* and *Montipora verrucosa*. Numerous sponges were also observed on the reef surface, often under ledges and in interstitial spaces.

Frondose benthic algal zonation was not apparent at the study area. However, encrusting red calcareous algae (*Porolithon spp*., *Peysonellia rubra*, and *Hydrolithon spp*.) were common on the boulders and exposed rocks throughout the study area. These algae were also abundant on bared limestone surfaces, and on the non-living parts of coral colonies. Frondosa algae observed on the reef included *Varlonia spp*., *Lyngbya majuscula*. *Halimeda spp*., *Sargassum spp*., and *Galauxura spp*. All of these plants occurred sporadically, and did not constitute a major component of the benthic biota. Also observed was an as of yet unidentified benthic organism that may be chains of benthic diatoms. These organisms appear as stringy yellow-brown wisps that are delicately attached to the bottom. Only slight water motion is sufficient to dislodge the mats and scatter the wispy material in the water column. Mats of these organisms are often observed in west Hawaii growing in areas of bared substratum in calm water.

The design of the reef survey was such that no cryptic organisms or species living within interstitial spaces of the reef surface were enumerated. Since this is the habitat of the majority of mollusks and crustacea, detailed species counts were not included in the survey. No dominant communities of these classes of biota were observed during the reef survey.

With regard to the reef fish community, a total of 1,719 individuals representing 89 species were recorded during the survey. No significant pattern is evident, however, with respect to distribution of fish species, number and diversity by depth or location. The reef fish community is typical of that found along most of the Kona coast.

Three species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly along the Kona coast and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) is seen infrequently in the waters off the Kona coast. Several green sea turtles were sighted on the surface and underwater during the baseline survey.

Populations of endangered humpback whale (*Megaptera movaeangliae*) are known to winter in the Hawaiian Islands from December to April. The baseline survey was conducted in September, when whales are not present in Hawaiian waters.

4.8.3.2 Potential Impacts

Because there is no plan for any work in the nearshore region of the Kaupulehu Resort Expansion Area, there is no potential for blasting or excavation that might affect behavior of whales and other marine animals. Short-term changes in water quality resulting from construction would also not be of a magnitude great enough to affect the behavior of sea turtles that might inhabit the reefs off the Petition Area. Increased access to the shoreline, once development is underway, might affect resident turtles because these animals often do not remain in areas frequented by humans. However, the potential for impact is considered to be very slight, especially because of the rocky character of the coastline and the lack of swimming areas.

The potential for impacts to marine communities as a result of development activities appears to be minimal. None of the development activities will have the potential to induce long-term changes in physio-chemical water quality parameters of a magnitude sufficient to cause changes in biological community structure. Marine environments are routinely subjected to naturally occurring stresses that can be much more destructive than the incremental changes related to development activity.

If some unexpected event related to development activity does occur, the resulting alterations to marine community structure would probably be reversible and recovery rapid once the stress factor is mitigated. Tolerance to such changes appears to already be part of the physiological range of the community.

However, as discussed in section 4.8.1.3, the project may have a significant impact as well as a cumulative impact upon marine biota that are popular with subsistence gatherers. Increased public access to the coastal area may result in the significant depletion of certain types of marine biota, including limu, crab, and opihi.

4.8.3.3 Proposed Mitigation

As long as reasonable steps are taken in construction practices, and operational procedures for near shore projects do not involve substantial changes in material delivery to the nearshore ocean, there should be no adverse impacts to the marine environment.

However, regardless of how unlikely, there is always the potential for an unexpected event. Consequently, the development will include a time-course monitoring program. If any development activities cause changes in physical-chemical parameters which lead to changes in environmental integrity, these effects could be quantified through time-series monitoring surveys. Such changes in water quality would be indicative of potential changes to marine community structure. Thus, any changes in water quality owing to shoreline development would trigger mitigative action, hopefully at a level below that capable of inducing change in biotic structure.

As discussed in section 4.8.1.4, impacts to marine biota resulting from the provision of greater public access to the shoreline will be mitigated through the preparation of a shoreline management plan in conjunction with the project's zoning and Special Management Area permit processes.

4.9 Air Quality

An Air Quality Impact Report was prepared for the proposed project by J.W. Morrow and is attached to this EIS as Appendix C. Following is a summary of its findings.

4.9.1 Existing Conditions

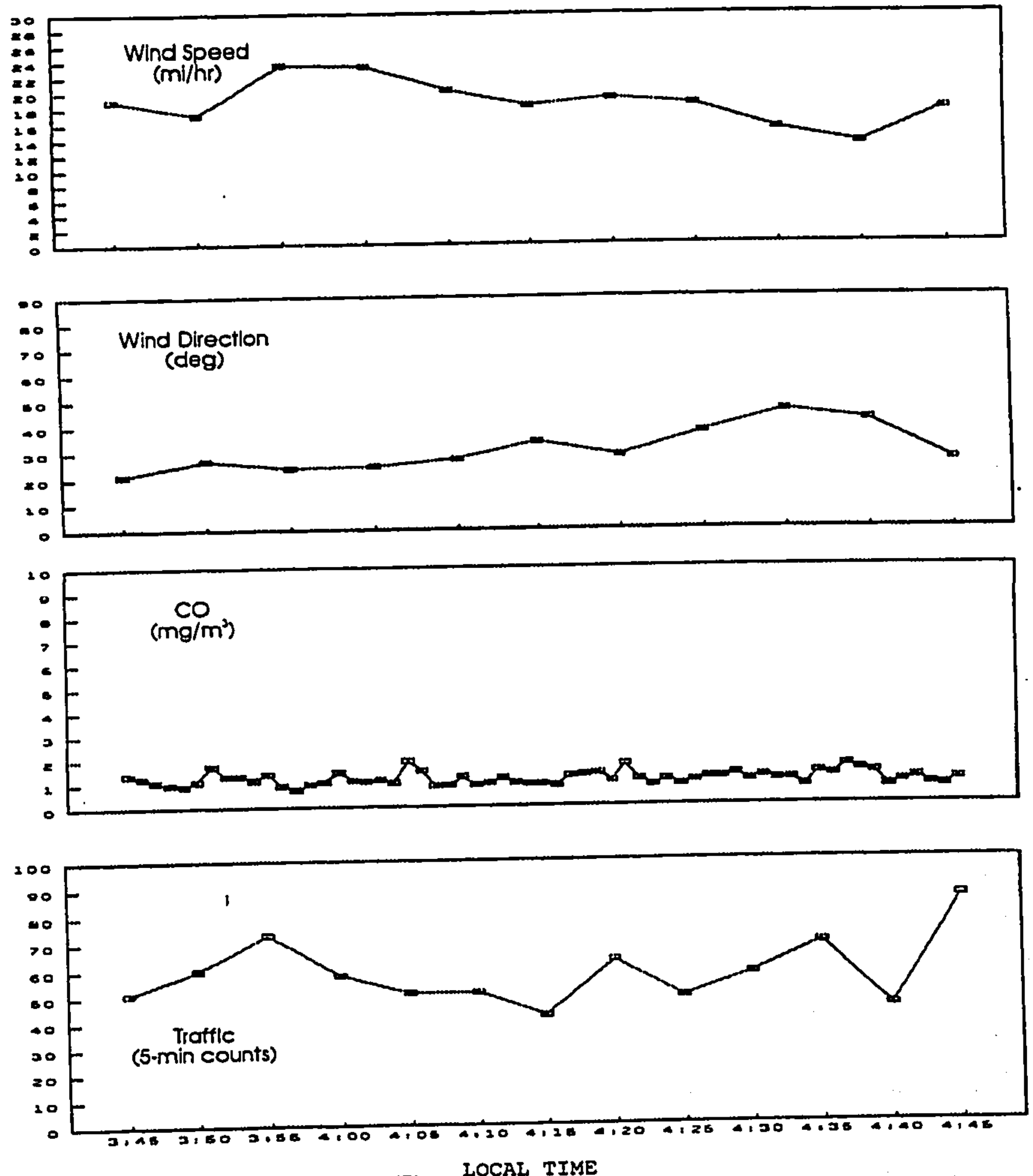
Since 1985 when the State Department of Health reduced its monitoring network on the neighbor islands, there has been no permanent monitoring of regulated pollutants (particulate matter [PM_{10}], total suspended particulate matter [TSP], sulfur dioxide [SO_2], carbon monoxide [CO], and ozone [O_3]) in Hilo or West Hawaii. However, due to public concern about volcanic air pollution (VOG), a special monitoring study was conducted during the 1985-86 period in Kailua-Kona. The results of that study indicate very low levels of TSP and SO_2. Both State and Federal air quality standards appear to be met. Unfortunately, and despite growing population in Kona, the principal mobile source pollutants, CO and NO_2 are not routinely monitored in West Hawaii.

The worst air pollution episodes experienced in Hawaii County are due to the infrequent and unpredictable volcanic eruptions. While volcanic eruptions are somewhat variable and have not been fully characterized, it is well known that visibility is affected by the presence of fine particulates resulting directly from volcanic activity as well as secondarily from forest fires caused by lava flows.

In conjunction with the current study, air sampling was conducted in May 1994 along Queen Kaahumanu Highway in the Kaupulehu area. The sampling site was within 10 meters of the road edge on the mauka (east) side. A continuous carbon monoxide (CO) instrument was set up and operated during the AM and PM peak traffic hours. An anemometer and vane were installed to record onsite surface winds during the air sampling. A simultaneous manual count of traffic was also performed. The variability of each of the parameters measured during the peak hours is clearly seen in Figures 4-6 and 4-7

133.2001P02/009-1

P.M. PEAK HOUR CONDITIONS
QUEEN KAAHUMANU HIGHWAY
25 MAY 1994

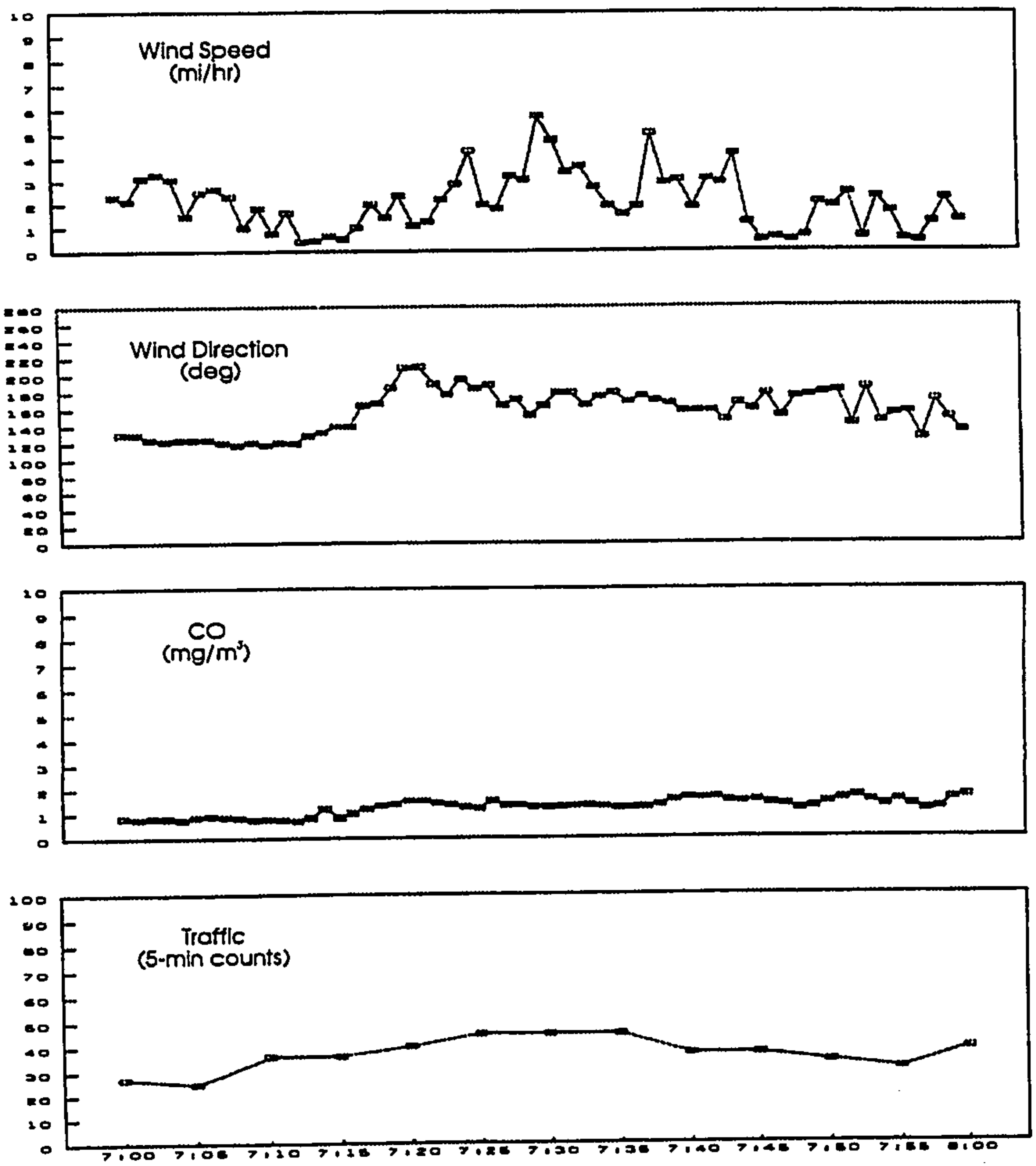


Source: J.W. Morrow, *Air Quality Impact Report (AQIR) Kaupulehu, Resort - Phase 2*, June 13, 1994

Figure 4-6
AIR QUALITY MONITORING – 5/25/94
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

133.2001P02/009-2

A.M. PEAK HOUR CONDITIONS
QUEEN KAAHUMANU HIGHWAY
26 MAY 1994



LOCAL TIME

Source: J.W. Morrow, *Air Quality Impact Report (AQIR) Kaupulehu, Resort - Phase 2*, June 13, 1994

Figure 4-7
AIR QUALITY MONITORING -- 5/26/94
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

Onsite weather conditions during the afternoon of May 25th were strong northeasterly winds with a neutral atmosphere. Traffic counts were somewhat lower than the peak volumes reported in the Traffic Impact Analysis conducted for the project (see Appendix D). Carbon Monoxide concentrations were of the same order of magnitude as computer-predicted concentrations conducted for the analysis.

On the morning of May 26th, winds were less than 5 mph and generally southerly in direction. Atmospheric stability was neutral throughout most of the time, but gradually became slightly unstable as the sun rose. Traffic counts were again comparable to the Traffic Impact Analysis and the CO level was low

4.9.2 Potential Impacts

The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along Queen Kaahumanu Highway as well as in the vicinity of the project site itself. Because of the moderate level of existing traffic volumes, the additional construction vehicle traffic will not likely exceed road capacities, although the presence of large trucks can reduce a roadway's capacity as well as lower average travel speeds. Site preparation and earth moving will create particulate emissions as will building and onsite road construction. Construction vehicles' movement on unpaved onsite roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and a precipitation evaporation (P/E) index of 50 [Ed. note: the site's P/E is rated at 12 - arid.].

Since the site is currently lava covered with little or no exposed soil, soil will be brought to the site. Some of these soils are likely to have silt contents greater than the 30% cited above. In conjunction with the arid local climate, this suggests a potential for somewhat greater fugitive dust emissions.

In addition to the onsite impacts attributable to construction activity, there will also be offsite impacts due to the operation of concrete and asphalt concrete batching plants needed for construction. It is too early, however, to identify the specific facilities that will be providing these materials, and thus, the discussion of these air quality impacts is somewhat generic.

It was possible, however, to estimate ambient air impact using design and operating features of a typical concrete batching plant capable of producing up to 100 cubic yards of concrete per hour. Assuming 8 hours/day operation and published EPA emission factors for both direct plant emissions and fugitive dust emissions, estimates of worst case ambient impact were derived using the PTPLU screening model. Assuming that the plant would be located near the project site, existing data from the Kailua-Kona site were considered. Adding the second highest TSP concentration from the 1985-86 DOH data, the yield of the plant was below State and Federal 24-hour PM_{10} standards.

Design and operating data for a typical asphalt concrete batch plant with a production capacity of 186 tons/hour were also obtained and reviewed. The estimated TSP and SO_2 concentrations were well below State and Federal standards.

The Traffic Impact Analysis referred to above served as the basis for a mobile source impact analysis. Automotive emissions factors for CO were generated for calendar years 1994 and 2015. Modeling was performed for the intersection of Queen Kaahumanu Highway and the Kona Village Access Road (with and without the project). The results of the modeling indicate an increase over time in ambient CO levels close to the highway but demonstrate existing and future compliance with State and Federal standards for both 1-hour concentrations and 8-hour concentrations.

Table 4-1: Estimates of Annual Emissions due to Electrical Generation

Pollutant	Emissions (Tons/Year)	Percent of 1980 Emissions Inventory
Nitrogen oxides (NOx)	158	2.75
Carbon monoxide (CO)	41	0.06
Sulfur oxides (SO_x)	18.9	0.42
Total hydrocarbons (THC)	4.1	0.06
Particulate matter (PM)	1.5	0.25

Finally, in view of the project's electrical energy requirements, a review of annual emissions due to electrical generation was conducted. Because of anticipated growth in the region, the Hawaii Electric Light Company has already applied to the Public Utilities Commission to expand its Keahole Station by 56 megawatts. The estimated emissions resulting from fuel burned to provide the power needed by the Kaupulehu project are presented in Table 4-1 above. The estimated emissions represent relatively small increases over the latest available county emissions inventory.

4.9.3 Proposed Mitigation

Since there is a potential for fugitive dust due to the dry climate and fine soils, adequate dust control measures will be employed during the construction period. Dust control measures will include frequent watering of unpaved roads and areas of exposed soil. Soil transported to the site will be contained in covered trucks to minimize fugitive dust during transportation. The phased grading of areas will reduce the amount of exposed soil and landscaping will be implemented in completed areas as soon as it is practicable.

Due to the lack of significant impacts, no mitigation measures are warranted for vehicular emissions.

Until other nonpolluting means of generating electricity are developed or higher efficiency control technologies are applied, such increases in emissions are inevitable.

Electrical demand, fuel consumption, and emissions can be reduced by energy conservation measures such as the use of solar water heaters, heat pumps, proper design of buildings to reduce air conditioning needs, and the use of low-energy light fixtures. The HELCO facility providing the power must demonstrate compliance with all applicable ambient air quality standards and control regulations in order to retain its operating permit.

4.10 Noise Characteristics

An Acoustic Study for the proposed project was conducted by Y. Ebisu and Associates and is presented as Appendix E to this EIS. Following is a summary of the consultant's findings.

4.10.1 Existing Conditions

The existing noise environment of the Petition Area consists of ambient noise levels controlled by wind and foliage, surf, birds, and intermittent flyby events of helicopters and aircraft. Measured background ambient noise levels in vacant interior areas ranged from 40 to 50 weighted decibels[1] (dBA). At 100 feet from the edge of the surf, measured ambient noise levels ranged from 50 to 65 dBA for one- to three-foot waves. These levels are in the "Minimum Exposure, Unconditionally Acceptable" category (with the high surf noise levels excluded).

Helicopter and light aircraft flyby events (no overflights observed) ranged from 55 to 70 dBA. Distant jet aircraft noise (probably from aircraft operating to and from Keahole Airport ranged from 45 to 55 dBA.

The only significant impacts upon the ambient noise environment result from traffic along Queen Kaahumanu Highway and activities at the Kona Village Resort. Existing traffic noise levels are in the "Minimal Exposure, Unconditionally Acceptable" category, with traffic noise below 55 Day-Night Sound Level (Ldn) at approximately 150 feet or greater setback distances from the highway's center line.

Estimated background noise levels in the populated areas of the Kona Village Resort probably range from 50 to 55 Ldn.

4.10.2 Potential Impacts

Future traffic noise levels along the primary access roadways to the proposed project were calculated for the year 2015 following build-out of the proposed development. Along Queen Kaahumanu Highway, traffic noise levels are expected to increase by approximately

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[1]Decibels (dB) are an absolute measurement of sound. However, the human ability to detect sound varies from person to person. Weighted decibels (dBA) are used to transform the sound measurement to a uniform scale.

5.8 to 6.2 dB above existing noise levels between 1994 and 2015. Due to its relatively low volume when compared to existing non-project related traffic along the highway, project traffic is predicted to cause an insignificant portion (0.3 to 0.6 dB) of the total increases in traffic noise along the highway.

Due to setbacks integrated into the proposed development plan, noise levels at the project's housing units should not exceed the 65 Ldn FHA/HUD noise standard, and are expected to be approximately 55 Ldn or less.

The proposed development would increase the existing background ambient noise levels in the environs of the project due to the proposed urbanization of presently vacant lands. This increase in background ambient noise levels may result from golf course maintenance activities, as well as from normal residential activities at the project's housing units. These increases are unavoidable. Therefore, administrative controls (such as noise curfews) may be required to minimize their impact on noise sensitive receptors.

A potential for complaints regarding audible sounds from the Kona Village Resort luau show does exist due to the planned location of new single family residences near the northeast boundary of the Kona Village Resort. The golf course should provide about 300 to 400 feet of buffer space, but amplified music and crowd noise from the luau may still be audible at the planned residences due to the low nighttime background ambient noise levels in the project area.

Temporary noise impacts may occur during construction of the proposed project and are considered to be unavoidable. The quality of the acoustic environment may be degraded to unacceptable levels during periods of construction.

4.10.3 Proposed Mitigation

Mitigation measures to reduce construction noise to inaudible levels may not be practical in all cases. Therefore, construction activities are predicted to be audible at the adjoining Kona Village Resort, some portions of the neighboring Kaupulehu Resort project, and at surrounding residences during later development phases of the proposed project. To minimize construction noise impacts, the use of quiet equipment and construction curfew periods, as required under the State Department of Health noise regulations on the island of O'ahu, will be considered. The early phasing of the landscaped buffers and berms between noise sensitive receptors and the job sites of later construction phases will also be considered as a mitigation measure. Prospective clientele of both the existing Kona Village Resort and the proposed project will be advised of any ongoing construction activity within audible distances.

With regard to potential complaints concerning the sound levels generated by the Kona Village luau show, adequate disclosure of the music or other sounds emanating from entertainment activities at the Kona Village Resort will be provided to prospective tenants of the project's dwelling units.

4.11 Flora

A field study to assess the botanical resources of the Petition Area was conducted by Char & Associates in February 1994. The primary objectives of the field study were to: 1) provide a general description of the major vegetation types; 2) inventory the flora; 3) search for threatened, endangered, rare, and vulnerable plants; and 4) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures. Following is a summary of the final report of the field study, which is attached to this EIS as Appendix F.

4.11.1 Existing Conditions

Scrub vegetation covers approximately half of the Petition Area. Vegetation coverage occurs generally on the pahoehoe lava flows and on rock-land (mapped as "rLW" and "rRO" respectively in Figure 4-4). The Kaupulehu lava flow of 1800 ("rLV") which covers the remaining half of the Petition Area is barren except along its edges where there is sparse scrub vegetation. Where the 1800 lava flow meets the sea, there are barren, jagged, heaps of a'a lava rubble with small pockets of beach. Along the coastline, there is a narrow band of coastal strand vegetation on areas with pahoehoe lava flow. For purposes of analysis, vegetation in the Petition Area can be divided into two groups: coastal strand vegetation and scrub vegetation.

Of a total of 44 species inventoried in the Petition Area, 28 (64%) are introduced or alien species; 2 (4%) are originally of Polynesian introduction; and 14 (32%) are native. Of the native plants, half are native only to the Hawaiian Islands (endemic), and half are native to the Hawaiian Islands and also elsewhere (indigenous).

Coastal Strand Vegetation: Along the entire coastline where the 1800 lava flow meets the sea, there is one small patch of beach morning glory vine or pohuehue (*Ipomoea pes-caprae*). It is located on the black sand beach closest to the Kona Village Resort side of the flow. Aside from this area, the remainder of the coastal strand vegetation is situated along the northern portion of the coast extending from the edge of the 1800 lava flow to the Petition Area boundary. Within this area, the substrata is 3,000 to 5,000 year old pahoehoe lava flows. The flat sandy areas are covered with low, tangled mats of beach morning glory. Also found in these areas are plants of pluchea (*Pluchea symphytifolia*), 'uhaloa (*Waltheria indica*), fountain grass (*Pennisetum setaceum*), 'aheahea (*Chenopodium murale*), nena or kipukai (*Heliotropium curassavicum*), and 'ilima (*Sida fallax*). A few trees of tree heliotrope (*Tourneforthia argentea*) also occur here. Behind the coastal strand, there is a dense thicket of kiawe trees (*Prosopis pallida*). These trees stand up to 25 feet in height. Although there is no ground cover beneath them, there is a thick layer of organic material consisting of decayed leaves. It should be noted that the majority of kiawe tree thicket is situated within the 65-acre parcel that is classified as Urban District, and is, therefore, technically not part of the Petition Area.

Scrub Vegetation: This vegetation type consists of scattered patches of plants on pahoehoe lava flows. Fountain grass is the most abundant of the grasses, although in low-lying places or swales Natal redtop grass (*Rhynchelytrum repens*) may be locally common. Two native subshrubs, 'ilima and 'uhaloa, are abundant. Other shrubs found here occasionally include pluchea, noni (*Morinda citrifolia*), indigo (*Indigofera suffruticosa*), and nehe (*Lipochaeta lavarum*). A'ali'i shrubs (*Dodonaea viscosa*) are less frequently noted and occur on the mauka most portion of the Petition Area. Scattered trees of kiawe are of short-stature (6-12 feet tall) and form only about 3-5% of the vegetative cover. Smaller herbaceous material found among the scrub vegetation include *Portulaca pilosa*, coatbuttons (*Tridax procumbens*), hairy spurge (*Chamaesyce hirta*), *Eragrostis tenella*, and threadstem carpetweed (*Molluga cerviana*). A small, annual, endemic grass, *Panicum pellitum*, is uncommon in the Petition Area. According to the botanist, most of the vegetation shows browsing damage from feral donkeys and goats. Donkey droppings are a common sight.

One plant of the 'ohai (*Sesbania tomentosa*), a proposed endangered species, occurs on the project site at about the 120 foot elevation, approximately 600 feet north of the Kona Village Resort water tanks, on a weathered pahoehoe lava flow with open scrub and scattered kiawe trees. This single plant was found during a survey conducted in 1985, but no seedlings or saplings were observed. During the current survey, the single plant was once again identified. An intensive search was made of the Petition Area, with special attention to areas with similar aged pahoehoe lava flows, but no other 'ohai plants were found. Again, no seedlings or young plants were observed, although it produces fruit readily. Mature fruits were collected for distribution later to the National Tropical Botanical Garden. A main branch of the plant appeared to have fallen over since 1985, but in general the plant appeared to be healthy and was flowering.

Two Category 2 candidate endangered species were also found in the Petition Area. Category 2 plants are species for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at this time. The native caper or maiapilo (*Capparis sandwichiana*) was found mauka of the Kaupulehu landing strip. A few plants of *Fimbristylis hawaiiensis* were found scattered throughout the scrub vegetation. No other listed, proposed, or candidate threatened or endangered species were found during the field study.

4.11.2 Potential Impacts

Development of the Petition Area for residential, commercial, and recreational uses will result in the loss of existing vegetation. However, because the existing vegetation is primarily composed of wide-spread species, the proposed development is not expected to have a significant negative impact on these botanical resources. The existing 'ohai plant will be preserved and, therefore, will not be impacted by development.

4.11.3 Proposed Mitigation

As recommended by the botanist, the size of a buffer area to be established around the 'ohai plant will be determined as the result of consultation with the Fish and Wildlife Service. Figure 4-8 presents the location of the 'ohai plant. Dust screens will be utilized if necessary during construction to ensure that the plant is not impacted by construction vehicle-generated dust. In addition, a management/horticultural plan will be prepared for the propagation of additional 'ohai plants and maiapilo plants. These cultivated plants could be used for landscaping.

4.12 Fauna

4.12.1 Existing Conditions

A two-day bird and mammal survey was conducted on the property in early February, 1994 by Phillip Bruner. The results of the survey are included in this EIS as Appendix G and are summarized below. The objectives of the survey were to:

- Document what bird and mammal species occur on the property or may likely be found there given the type of habitats available;
- Provide some baseline data on the relative (estimated) abundance of each species;
- Determine the presence or likely occurrence of any native birds, particularly any that are listed as "Endangered" or "Threatened"; and
- Identify any sites or habitat that may be unique or of special importance to native wildlife.

According to Bruner, no endemic (native to the Hawaiian Islands) birds were observed during the survey. Due to the absence of wetland in the area, no resident waterbirds or seabirds were observed. Four species of migratory shorebirds were observed; all common migrants to the Pacific. Thirteen species of exotic birds were identified during the survey. Relative abundance data for these species were comparable to that gathered on nearby lands during surveys conducted by Bruner from 1989 to 1992. Table 4-2 summarizes Bruner's survey of avifauna at the property.

With regard to feral mammals, small Indian Mongoose (*Herpestes auropunctatus*) were observed on site. Skeletal remains and scats of feral goats (*Capra hircus*) were noted throughout the mauka sections of the property. Feral donkeys (*Equus asinus*) were seen on both survey days, with one particular herd containing over 20 animals. No rats, mice, or cats were observed during the survey but likely do occur on or near the project site.

Although no Hawaiian Hoary Bats (*Lasiurus cinereus semotus*) were seen on the survey, an employee of the Kona Village Resort reported seeing a bat emerge from a lava tube near the petroglyph field just mauka of the village about one year ago. No particularly special or unique bird or mammal habitats were discovered on the subject property during the course of Bruner's survey.

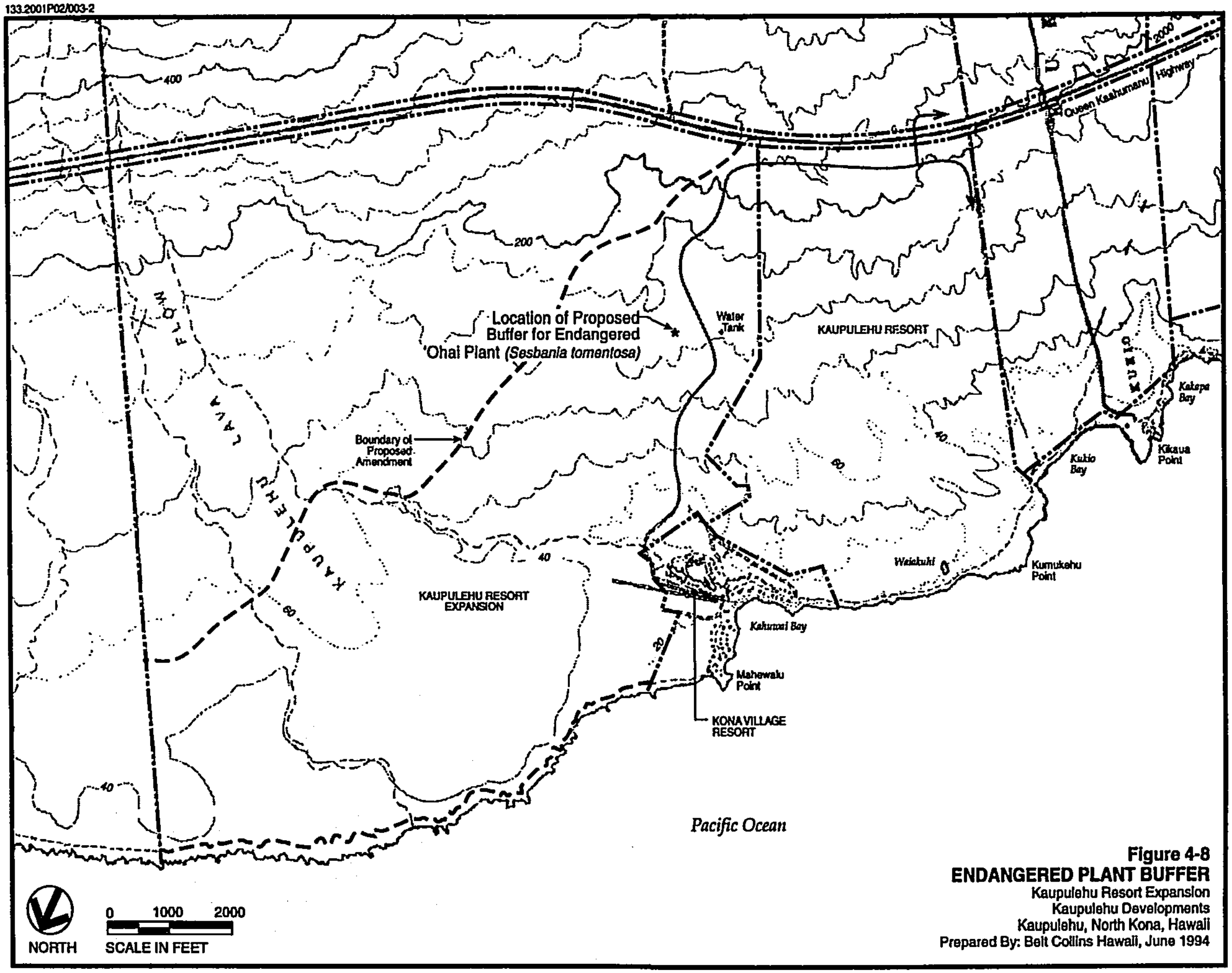

Figure 4-8
ENDANGERED PLANT BUFFER
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

Table 4-2: Avifauna Identified Onsite

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
(Resident Endemic)		
Short-eared Owl/Pueo	*Asio flammeus sandwichensis*	0
Hawaiian Hawk/I'o	*Buteo solitarius*	0
(Migratory Indigenous)		
Pacific Golden Plover	*Pluvialis fulva*	R=15
Ruddy Tournstone	*Arenaria interpres*	R=4
Wandering Tattler	*Heteroscelus incanus*	R=10
Sanderling	*Calidris alba*	R=1
(Resident Waterbirds)		
None		
(Exotic)		
Gray Francolin	*Francolinus pondicerianus*	U=4
Spotted Dove	*Streptopelia chinensis*	R=3
Zebra Dove	*Geopelia striata*	C=9
Common Myna	*Acridotheres tristis*	C=8
Northern Cardinal	*Cardinalis cardinalis*	R=4
Yellow-billed Cardinal	*Paroaria capitata*	C=6
Japanese White-Eye	*Zosterops japonicus*	C=7
Yellow-fronted Canary	*Serinus mozabicus*	R=8
Nutmeg Mannikin	*Lonchura punctulata*	A=12
Warbling Silverbill	*Lonchura malabarica*	C=9
Saffron Finch	*Sicalis flaveola*	R=2
House Finch	*Carpodacus mexicanus*	U=4
House Sparrow	*Passer domesticus*	R=3
Barn Owl	*Tyto alba*	0
Ring-necked Pheasant	*Phasianus colchicus*	0
Black Francolin	*Francolinus francolinus*	0
Northern Mockingbird	*Mimus polyglottus*	0
Lavender Waxbill	*Estrilda caerulescens*	0

*Relative Abundance = The number of times observed during surveys or average number on eight-minute counts in appropriate habitat.

A = abundant (average 10+) U = uncommon (average less than 5)
C = common (average 5-10) 0 = not seen, but presence likely due to character of area

R = recorded (seen or heard at times other than on 8-minute counts or on one count only). Number which follows is total number seen or heard over duration of survey.

4.12.2 Potential Impacts

Due to the apparent absence of significant wildlife habitats within the Petition Area, development of residential areas and golf courses is not expected to result in negative impacts to most area fauna. Although existing populations may be temporarily displaced as construction of individual project elements begins, this is considered to be a short-term impact with no significant adverse consequences. The identified bird and mammal populations are considered to be resilient species and will be able to endure short-term displacement.

From a long-term perspective, development of the proposed project will replace a relatively barren lava field with a variety of new habitat opportunities, especially for avifauna. In addition, landscaping associated with the proposed residential and recreational land uses will have a positive impact upon avifauna by providing new foraging areas. The size of avifaunal populations, especially the exotic species, will likely increase as trees and lawns within the project area mature. Avifauna could also be impacted by the improper use of pesticides upon the proposed golf courses and from misuse by homeowners on residential properties.

Goats and donkeys will be permanently displaced by the proposed development. This is considered to be an unavoidable consequence of the project. However, because neither of these imported species are considered to be endangered and both constitute a nuisance from the perspective of their continuing threat to native plant life, displacement does not constitute a significant negative impact.

4.12.3 Proposed Mitigation

Fences will likely be constructed to ensure that goats and donkeys are prevented from grazing in residential areas and on the proposed golf course. Cattle crossings may also be installed on certain roadways to prevent these animals from entering residential areas. Because both species are characteristically wary of humans and human activity, they will not likely be endangered by the increased volume of vehicular traffic associated with the proposed development. It is expected that they will generally avoid roadways.

To minimize the potential impact of pesticides on the avifaunal population of the area, the use of pesticides on the proposed golf course will be minimized wherever and whenever practicable (see Appendix A). In addition, when the use of pesticides is determined to be necessary, they will be applied according to their labeled specifications and their application will be restricted to maintenance employees who are properly certified by the State Department of Agriculture to engage in such activity. However, similar requirements and precautions cannot be made applicable to private homeowners. Consequently, any adverse impacts resulting from the misuse of pesticides by private homeowners cannot be mitigated.

4.13 Archaeology

An archaeological inventory survey of the subject property was conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in two phases between 1991 and 1994. The survey covered approximately 2,184 acres at Kaupulehu and generally consisted of all the land within the ahupua'a of Kaupulehu, makai of the Queen Kaahumanu Highway, that is presently contained within the Conservation District. Phase I of the survey (Smith and Rosendahl, 1991) consisted of an initial identification process to locate any existing archaeological sites. Phase II (Head and Rosendahl, 1994) evaluated the potential significance of all identified sites and defined the general scope of subsequent mitigation work that may be needed. Because the findings of the Phase I survey are contained in the Phase II report, the Phase I report is not presented as a part of the document but is available for review upon request. The main body of the Phase II report is included in this environmental impact statement as Appendix H. Three appendices (A, B, and C) attached to the Phase II report are not included in this document due to their size (299 pages total). However, the Phase II report appendices are available for review upon request and are available for review at the Hawaii County Planning Department, the Hilo Regional Library, the Kailua-Kona Library, Hamilton Library at the University of Hawaii-Manoa, and the State Historic Preservation Division of the DLNR. Following is a summary of the Phase II report.

4.13.1 Existing Conditions

A total of 185 sites, consisting of 633 discrete features, were recorded during the survey. Of these sites, 45 are located outside of the Petition Area, and two of the 45 are located just outside the property boundary of Kaupulehu. None of the sites identified within the Petition Area are located on the Kaupulehu flow of 1800.

The archaeological sites consist of both multiple and single component sites, and their physical condition ranges from poor to good. Formal feature types identified in the survey included petroglyph, shaped wall, cairn, enclosure, mound, modified lava tube with utilization, pahoehoe excavation, lava tube with cultural material, modified outcrop, terrace, modified lava tube, trail, and modified depression. Feature types have also been assigned probable functions by the archaeologists. The most common functional types are temporary habitation, indeterminate (sites for which a definite function could not be determined), marker, communication (petroglyphs), transportation (trails), and long-term habitations. Other less common functional types include agriculture, recreation, burial, storage, ceremonial, and multi-function sites.

Based upon radiocarbon age determinations taken during the current survey, initial occupation of the makai Kaupulehu area is believed to have occurred as early as AD 1441. However, the results of a 1988 study conducted by Walker and Rosendahl at a coastal site near the Petition Area indicated initial occupation occurred at Kaupulehu between AD 1030 and AD 1290. The most permanent settlement of the area is believed to have occurred near the coast because of the ocean and coastal resources that were available.

Twenty-one probable radiocarbon age determinations taken during four separate studies in the makai area indicate the most common occupation ranging from 1580 to 1784. This corresponds to the general theory of population expansion on the island. Initial occupation of West Hawaii remained fairly stable and low until about AD 1200, when population pressures forced generally uneven increases at favored locations through AD 1600.

Based upon what has been discovered at Kaupulehu, it is believed that there was a substantial population in the area in the late 16th century. Inhabitants probably lived at least semi-permanently along the coast and were primarily engaged in marine exploitation and small-scale gardening. Population pressures also forced people into the upland areas and a considerable movement occurred between these two population centers as cultivated crops and products were exchanged for ocean resources. Consistent with this theory, the midland areas between the coastal region and the upland areas are relatively devoid of long-term habitations but are frequently occupied by trails, temporary habitations and the related functions that would typically accompany them.

Rosendahl hypothesizes that Kaupulehu and its surrounding area is relatively unique because of the impacts that geologic events had upon the traditional use of the land. The areas covered by the Kaupulehu lava flow from Hualalai in 1800, the Hualalai flow of 1801 to the south, and the Pu'uanahulu flow of 1959 from Mauna Loa all became essentially uninhabitable when large areas of vegetation were buried. As a result, occupation of the area declined dramatically in the 1800s.

It is also theorized by Handy and Handy that the lands (and corresponding usage) of Kaupulehu and the surrounding area were considerably different before they were inundated with lava and vegetation was depleted by cattle introduced in the 1800s. As a result of these events, the climate may have become much drier. Without a vegetative cover on the lower slopes of Hualalai, heat is reflected from the lava flows back and dries the air above, reducing rainfall. Less vegetation also results in windier conditions. Thus, the area that is today viewed as a barren, inhospitable wasteland may once have been capable of sustaining a considerable population.

Based upon settlement and density patterns observed during the present survey, it is believed that the Kaupulehu flow of 1800 left only a part of what Kaupulehu must have looked like before the natural disaster occurred and the remaining forests were subsequently degraded by grazing animals. This does not suggest, however, that the makai portions of Kaupulehu were probably ever a "garden". Rather, legendary accounts indicate that Kaupulehu may have been once used as an oasis and sanctuary for canoe travelers. The uplands were more likely heavily cultivated and the oceans provided ample resources which provided the basis for a healthy economic system of trade.

4.13.2 Potential Impacts

Grading of the project area for development of the project's residential, commercial and recreational components will result in the reshaping of the natural topography. This will result in the displacement of certain mitigated archaeological sites not identified for preservation. Those archaeological sites identified for preservation may be impacted as a result of increased access by the general public. This impact is offset to some degree by the opportunities for cultural and educational enrichment that accompany site preservation. If the importance and significance of preserved sites are appropriately identified for the public, the likelihood of adverse impacts resulting from public access are reduced to some degree.

4.13.3 Proposed Mitigation

In order to mitigate the potential negative impact of development upon the identified archaeological sites, the general significance of all identified sites has been determined as part of the inventory survey. PHRI has evaluated the sites under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) utilizing three value modes: Research value, Interpretive value, and Cultural value. Research value refers to the potential of archaeological resources for producing information useful for understanding culture history, past lifeways, and cultural processes at the local, regional, and inter-regional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value refers to the potential of archaeological resources to preserve and promote cultural and ethnic identity and values.

Based on these federal criteria, of the 187 sites identified in the study area (2,184 acres), 75 are recommended for no further work. It has been determined that these sites lack cultural deposits and portable remains; they have been measured, described, and photographed, and their locations have been plotted. The data collected from them during the present survey are considered sufficient recovery of significant information. Of the 112 remaining, fifty-two sites are assessed as significant solely for information content and are recommended for further data collection. Of the remaining 60 significant for multiple criteria, one site is significant for information and cultural values and is recommended for data collection only. The remaining 59 sites have been recommended for some form of preservation. Forty-one of these sites were assessed as significant for information content and as excellent examples of site types. These 41 sites are recommended for further data collection followed by preservation with interpretive development. However, with regard to site1489-2, should further data collection reveal the presence of human remains, the site will be recommended as signficant for cultural value and preservation "as is" with no interpretive development.

Eight sites were assessed as significant for information value and for cultural value. They are recommended for further data collection followed by preservation "as is". Seven of these eight are multi-component sites and have assessments based on the presence of identified human burials at specific features within overall site complexes. Other features within the complexes warrant additional data collection and data recovery work, based on the presence of accumulated midden and the need for more detailed mapping and other recording. The eighth site has been included in this category based on the presence of a possible shrine or other ceremonial feature.

Five sites were assessed as significant for information content and for cultural value but are recommended for preservation "as is" only. These are single-component sites that were identified as containing human burials. Because they have been mapped, recorded, photographed, and their locations accurately plotted, no further work is recommended.

Three sites were assessed as significant for information content, as excellent examples of site types, and as having cultural value. They are recommended for further data collection, to be followed by preservation "as is". The assessment of cultural value and recommendation for preservation "as is" are based on the presence of identified human burials or human skeletal remains at specific features within the site complexes.

Two trail sites (19124 and 19193) are major trails and are also assessed as signficant for information, site type, and cultural values. Site 19193, the coastal trail, is recommended for preservation with interpretive development. Preservation with interpretitive development is also recommended for site 19124, but not for the entire trail. This trail will not be preserved for access purposes, but portions would be preserved because the trail is a good example of a probable prehistoric trail thought to have been used until the incursion of the AD 1800 Kaupulehu lava flow. It is recommended that distinctive portions of this mauka-makai trail be preserved (e.g. segments in especially good physical condition, as well as those portions of the trail clearly associated with other preservation sites and areas). Exactly which segments of the trail are to be preserved will be determined as the development concept is refined and revised, and moves to the actual design stage. The actual segments to be preserved will be specified later in the detailed Archaeological Mitigation Plan that is anticipated will be required as part of the regulatory review and permitting process.

The final site (#1138/1141) is assessed as significant for information and cultural values, but is recommended for further data collection only. This site is a short trail segment across the AD 1800 Kaupulehu Lava Flow.

Of the 59 sites recommended for preservation, 38 are wholly contained within a designated preserve area (see Figure 4-9) which will be approximately 34 acres in size. Five more are situated outside of the preserve area but within the Petition Area. One of these five is Site 19124, the trail discussed above. Two sites are recommended for inclusion in the designated preserve. The remaining 14 of the 57 sites recommended for preservation are located outside of the Petition Area. A complete listing of all site numbers and corresponding significance evaluation is presented in Table 12 of the inventory survey report which is attached to this environmental impact statement as Appendix H. Some additional sites will be considered for inclusion into development landscaping.

4.14 Visual Characteristics

4.14.1 Existing Conditions

From the Queen Kaahumanu Highway, the Petition Area appears as a relatively

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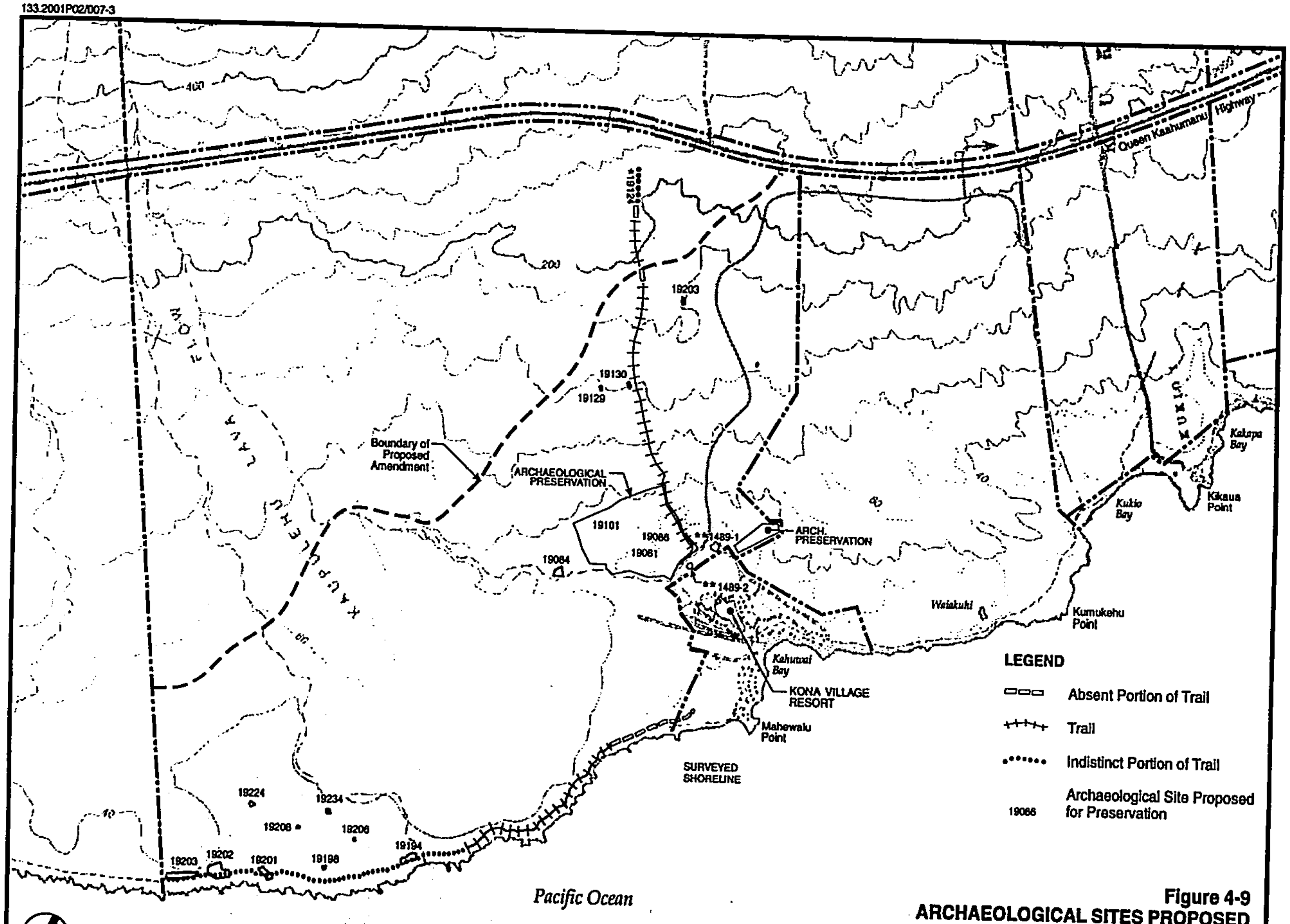


Pacific Ocean

* Portions of the trail (#19124) will be preserved. Specific segments to be indentified in future mitigation plan.

** PHRI temporary field numbers.

Figure 4-9
ARCHAEOLOGICAL SITES PROPOSED FOR PRESERVATION
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

Source: Paul H. Rosendahl, Ph. D., Inc. (PHRI), *Archaeological Inventory Survey, Kaupulehu Makai–Lot 4*, June 1994.

flat lava field extending from the highway to the sea. The dominant visual feature is the Kaupulehu lava flow of 1800, which covers approximately half of the site. As discussed above, the lava is sparsely vegetated with grasses, shrubs, and small kiawe trees. The general visual impression is that of a barren, arid lava field. There are no distinguishing lava formations or topographic features within the Petition Area.

4.14.2 Potential Impacts

Due to the flat topography of the Petition Area, the proposed development project will be visible to motorists approaching from the east or west along the Queen Kaahumanu Highway. The project will appear as a broad landscaped area within the lava field. The golf courses will be visible, as will many single-family and multifamily residential units. The most prominent features on the horizon will be coconut palms and other trees utilized to landscape the Petition Area. At night, low intensity street lights will illuminate the residential areas. No lights are proposed for the golf courses. At full buildout of the proposed project and the adjacent Kaupulehu Resort, the makai area of the Kaupulehu ahupua'a will appear as a continuous low-density urbanized area.

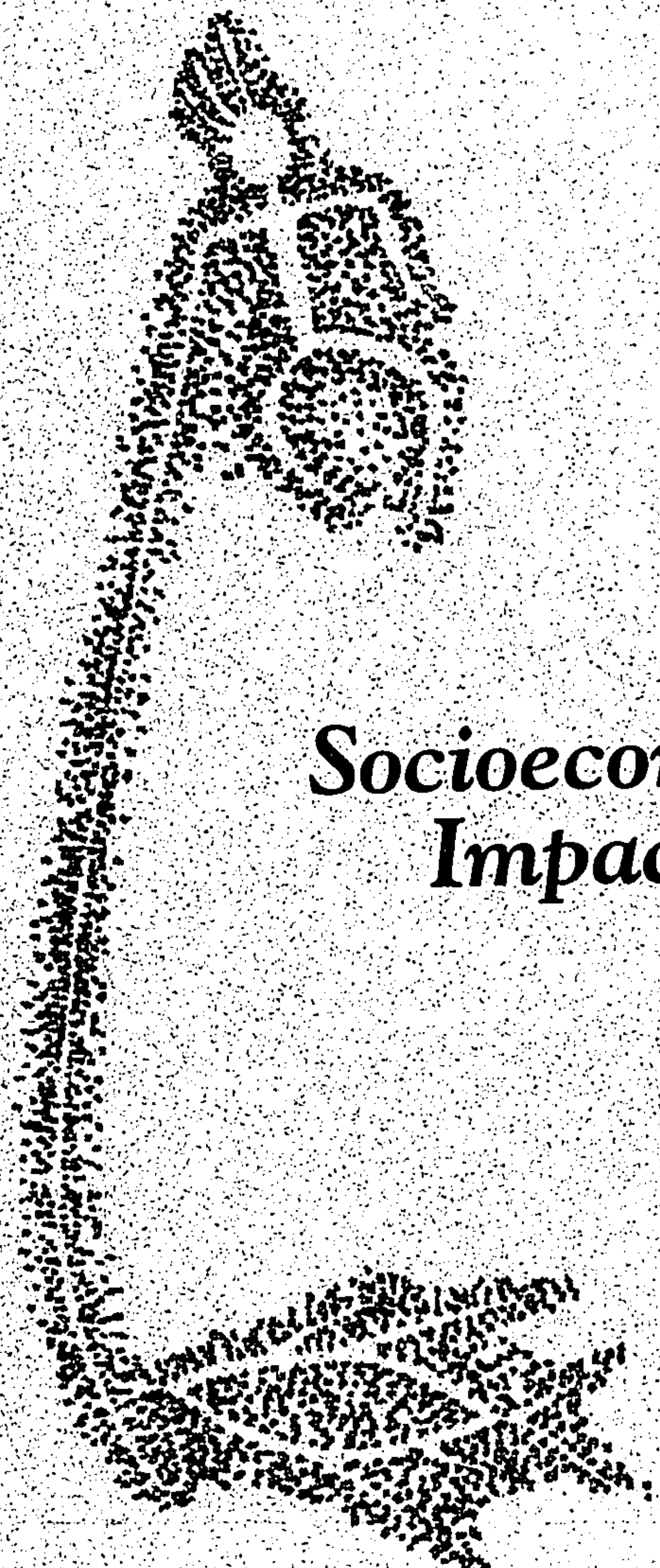
Views of the proposed project from the existing Kona Village Resort property will be generally limited to visitors and employees utilizing the resort's tennis court facilities, the parking area, the coastal trail along the eastern end of the resort property, and to vehicles utilizing the Kona Village Access Road. From these areas, the proposed project will appear as a landscaped area. Some residential structures may be visible, as will portions of the proposed 36-hole golf course.

4.14.3 Proposed Mitigation

The visual impact of the proposed project must be evaluated in a larger context. Because it is located adjacent to an existing Urban district, the proposed project will ultimately appear as an extension of the Kaupulehu Resort development, rather than as an intrusion into an otherwise pristine landscape. The cumulative visual impact of the two developments will change the appearance of the area. Whether the proposed project will, however, create a negative visual impact or a positive impact is entirely subjective.

For those who value the appearance of the barren lava fields, the project could appear as a visual intrusion and a reminder of continued population expansion in the North Kona region. For those who desire to live in this area or who value the economic benefits of population growth, the project could appear as a landscaped residential community with no significant negative visual impact.

From a purely technical perspective, views of the entire project from the Queen Kaahumanu Highway could be obscured by planting a large hedge along the makai side of the highway from the crest of the highway near Kiholo to the Kailua-side of Kaupulehu ahupua'a. Or, as an alternative, a lava berm could be constructed. The same could be done to mitigate visual impacts on the Kona Village Resort. However, either of these mitigation measures would also result in the loss of ocean views from the highway and mountain views from the Kona Village Resort. Thus, no specific measures are recommended to mitigate the project's visual impact. However, in the case of the Kona Village, development setbacks and generous open space corridors in golf or other open space uses will aid in buffering from some visual impacts due to the expansion project.



Chapter 5

Existing Socioeconomic Conditions, Impacts and Mitigation Measures

CHAPTER 5 *EXISTING SOCIOECONOMIC CONDITIONS, IMPACTS AND MITIGATION MEASURES*

5.1 Socioeconomic Environment

The Petition Area is located within the northern half of Census Tract 215.01, one of five census tracts comprising the North Kona district. Census Tract 215.01 is the second largest tract in North Kona in terms of 1990 population (6,486) households (2,166) and overall size, and includes the area makai of Mamalahoa Highway extending generally from Honokohau Harbor to Kiholo Bay. With the exception of the Kona Village Resort and a few homes located along Mamalahoa Highway however, the northern half of the census tract is virtually uninhabited. Population in the southern half of the census tract consists mainly of three residential subdivisions situated between Queen Kaahumanu Highway and Mamalahoa Highway: Kalaoa, Kona Palisade Estates, and Kona Hills Estates.

The Office of State Planning has identified the Kaupulehu area of North Kona as one of four "resort destination nodes" in West Hawaii. Thus, although existing resort development at Kaupulehu is presently limited to the 115-unit Kona Village Resort, it is planned for eventual development on the scale of the resort destination nodes of Mauna Kea and Mauna Lani/Waikoloa. The initial development of the Kaupulehu Resort, situated on 624 acres abutting the Petition Area, represents the focus of the Kaupulehu resort destination node.

The following discussion concerning existing conditions of population, employment, and housing is quoted from a report entitled <u>Kailua-Kona Master Plan: Summary of Inventory, Research, and Analysis</u> prepared by R. M. Towill for the County of Hawaii Planning Department in June 1992. Discussions of impacts are derived from a market study and economic impact analysis conducted by The Hallstrom Group for the project. The Hallstrom reports are presented as Appendices I and J, respectively.

5.1.1 Population
5.1.1.1 Existing Conditions

"[Hawaii County's population] has grown rapidly since 1970. In the ten-year period between 1970 and 1980, the resident populations [sic] increased by 45 percent from 63,470 to 92,050. This growth has continued into the 1980s with further growth of 30.7 percent from 1980s to 1990. In 1990 the resident population for the County was 120,317 (U.S. Bureau of the Census, 1991).

Population growth in the West Hawaii Region is largely responsible for this increase. The population of the region increased by 156 percent from 1970 to 1986. The North Kona district, the most populous place on the island after the South Hilo District experienced a 308 percent increase between 1970 and 1986. Population there was estimated at 19,700 in 1986 (West Hawaii Regional Plan, Office of State Planning, 1989). Between 1986 and 1990, North Kona's resident population increased another 13 percent, with the population in 1990 estimated at 22,284 (U.S. Bureau of the Census, 1991). Kailua

Village's population in 1990 was 9,126 (ibid). The County of Hawaii projects that this population trend in West Hawaii will continue. According to the County Planning Department's projections[,] by the year 2010 the North Kona district population is expected to exceed 52,600. This represents a projected 136 percent increase, and comprising [sic] approximately 25.5 percent of the entire island's resident population. Kailua Village is projected to have a population of 20,637, which represents a predicted 126 percent increase over the next 18 to 20 years." (R. M. Towill, 1992, p.17)

5.1.1.2 Potential Impacts

Actual occupancy of residential units at the project will occur in year 3 of the 20 year project, with the first two years being devoted to construction. However, because the project will be phased, as shown in Table 5-1, the full impact of development will not manifest until the twentieth year.

Table 5-1: Population Impacts

	Cumulative Residential Unit Development			Cumulative De facto Resident/Guest Population			Res.
Year	Single Family	Multi-Family	Total	Single Family	Multi-Family	Total	Pop.*
1	0	0	0	0	0	0	
2	0	0	0	0	0	0	
3	16	15	31	25	22	47	23
4	39	34	73	60	50	110	55
5	71	56	127	110	82	192	96
6	108	83	191	167	122	289	145
7	147	113	260	228	166	394	197
8	182	143	325	282	218	492	246
9	211	173	384	327	254	581	290
10	240	203	443	372	298	670	335
11	269	233	502	417	342	759	379
12	298	263	561	462	386	847	424
13	327	293	620	507	430	936	468
14	356	323	679	552	474	1,025	513
15	385	353	738	596	518	1,114	557
16	414	383	797	641	562	1,203	601
17	443	413	856	686	606	1,292	646
18	472	443	915	731	650	1,381	690
19	501	473	974	776	694	1,470	735
20	530	500	1,030	821	733	1,555	777

* Resident Population means Full-Time Residents only.

Upon full build-out (assuming 100 percent occupancy), the residential components of the project could generate a population of 2,743, based on typical household sizes of 3.1 persons for single family homes and 2.2 persons for multi-family units. The population will be made up of a combination of full-time residents and part-time residents (second home purchasers) and their guests.

5.1.1.3 Proposed Mitigation

The daily population of the proposed project at build-out will be mitigated, to a large extent, by the percentage of part-time residents and non-resident unit purchasers. It is estimated that 25 percent of the 530 single-family units, or about 133 homes, will be occupied by full-time residents. The remaining homes will be occupied by part-time (second home) residents approximately one-third of the time.

With regard to the multi-family units, 33 percent of the units are projected to be occupied by full-time residents, and 67 percent will be occupied by part-time (second home) residents approximately 50 percent of the time. Non-resident purchasers are unlikely to occupy their homes for more than a few months each year. It is conservatively estimated that they will represent approximately 6 to 8 percent of the total unit purchasers at the proposed project.

The sum effect will be a substantially lower average daily census at full build-out than what could occur if the project were oriented entirely to owner occupants. It is projected that the average daily de facto population of the project will be 1,555 at full build-out (as opposed to 2,743 at 100 percent occupancy), with residents totalling 777 persons.

5.1.2 Employment and Income
5.1.2.1 Existing Conditions

"Employment trends in the County generally parallel population growth. The county-wide annual job count increased by 62 percent between 1970 and 1987. Between 1980s and 1987, the job count increased by 21 percent from 38,200 to 46,050. Jobs in the service and retail sectors have contributed substantially to the increased overall job count. The service sector jobs increased by 35 percent and retail sector jobs increased by 49 percent between 1980 and 1987 ("West Hawaii Regional Plan", Office of State Planning, 1989).

The 1989 [islandwide] job count totalled 56,900 with an average unemployment rate of 3.9 percent. The sources of income were as follows: finance, insurance, real estate, hotels, [and] other services (14,550), wholesale retail trade (11,400), government (8,000), agriculture (5,850), manufacturing (2,350), and construction (2,400) (County Planning Department).

The service and retail sectors are dominated by lower wage jobs. Per capita personal income for the County increased 19 percent between 1980 and 1986, from $9,682 to

$11,553. During the same period, the per capita personal income for the State increased 38 percent. The slower rate of increase in the County is due primarily to rapid population growth and relatively fewer numbers of higher paying jobs (ibid). The median family income in the County of Hawaii in 1990 was $32,000 (for family of four) (County of Hawaii Department of Housing and Community Development).

Patterns of population settlement and growth are defined primarily by an area's economic opportunities. In this respect, the West Hawaii region already has the foundation for providing an economic base as diverse as the island's environmental and climatic conditions. The region has many opportunities to sustain a stable and diversified economy supported by energy resources, high technology research and development, aquaculture, diversified agriculture, commercial and sport fishing, seafood marketing and ocean research. Expansion in these areas will increase job choice and the availability of higher paying jobs.

In North Kona, the visitor industry provides the major source of economic activity and is expected to expand at a rapid rate. According to the County of Hawaii General Plan (1989), the expansion of the visitor industry in this district has been occurring primarily in Kailua Village. There are now more than 4,500 hotel and condominium visitor units in the district. In fact, as of 1989, there were 4,748 visitor units." (R. M. Towill, 1992, p.19)

5.1.2.2 Potential Impacts

Table 5-2 summarizes the on-site employment created by the proposed project and presents them as full-time equivalent jobs. In addition, the table identifies the number of off-site jobs generated by the project. As indicated in the table, significant off-site employment will be created by on-site construction and maintenance workers. A multiplier of 1.75 off-site jobs per on-site position was used in the Economic Impact Analysis to determine the number of off-site jobs.

During the 20-year projection period covering the 1,120 acre project, the number of full-time equivalent jobs directly created on- and off-site varies from 165 to 1,209 positions annually. The total number of worker-years generated during the development time-frame is 16,547. On a stabilized basis after completion of construction, the project will generate some 1,103 permanent employment opportunities; 333 on-site and 770 elsewhere on the island. A description of the formulae used in making these job estimates and the source of the data used for the individual assumptions is presented in the Economic Impact Analysis.

According to the Economic Impact Analysis, during the first increments of the project, the labor force required to construct and operate improvements would be drawn from the existing West Hawaii and (to a lesser degree) islandwide worker pool. Due to the steep decline in construction activity over the past three years, the number of contract construction jobs on the Big Island has decreased by more than 23 percent since the peak of 1989-90. As a result, existing construction workers will strongly benefit from the near- to mid-term opportunities arising from the infrastructure and unit development at the project.

Table 5-2: Employee Job Count by Development Year

Year	Construction: Infra-structure	Construction: SFU	Construction: MFU	Construction: Golf Course	Construction: Comm.	Operation: Golf Course	Operation: Comm.	Operation: Maint.	Off-Site Jobs	TOTAL JOBS
1	30			30					105	165
2	30			30					105	165
3	20	36	23	20		60		3	282	443
4	10	52	29	15		60		6	300	471
5		72	33	5		85		10	359	565
6		83	41			85		5	374	588
7		88	45		13	85		11	422	663
8		79	45		5	85	60	16	508	798
9		65	45			85	100	21	553	870
10		65	45			85	100	26	562	883
11		65	45			85	100	31	570	896
12		65	45			85	100	35	579	910
13		65	45		10	85	100	40	605	950
14		65	45		4	85	140	45	673	1,058
15		65	45			85	180	45	736	1,156
16		65	45			85	180	50	744	1,169
17		65	45			85	180	55	753	1,183
18		65	45			85	180	60	761	1,196
19		65	45			85	180	64	769	1,209
20		65	41			85	180	69	770	1,209
Stabilized						85	180	69	770	1,103

Notes:
1. All job counts are expressed as "full-time" equivalent positions.
2. The columns labeled "Golf Course" includes both golf courses with clubhouse and tennis center, and a beach oriented clubhouse.
3. The column labeled "Off-Site Jobs" includes all off-site jobs created by work efforts at the project; direct and indirect.

Over time, as the project matures, additional workers would be obtained through apprenticeship of younger, entry-level tradesmen and the re-training of displaced agricultural employees.

As the regional economy recovers later in the decade, and construction activity increases at the many existing and proposed projects around the island, including Kaupulehu, workers will again become in high demand and the availability of jobs will attract laborers from off-island (in conjunction with the quality of lifestyle of the region). At first, most will likely in-migrate from the neighbor islands, followed by mainland individuals. This movement is in keeping with the employment and population trends projected in state and county plans for the region over the past decade. From a geographic perspective, it is anticipated that workers in the initial phases would be drawn from a triangular area defined by Captain Cook, Honokaa, and Hawi, or within a 40-mile radius of the project. As the Kailua-Kona region continues its multi-decade infilling process, a smaller radius of community workers would be expected.

5.1.3 Market Demand

Following is a summary of the findings of the Market Study prepared by The Hallstrom Group. Refer to Appendix I for a description of the study's methodology and detailed explanations of its findings.

5.1.3.1 The General Sector

During the 1980s, West Hawaii was the focus of a bulk land investment, development and planning surge unprecedented in the State of Hawaii. As the regional and worldwide economies recovered from the recession of 1980-82, the Kona and Kohala districts of the Big Island, typified by vast raw lava and bunch grass holdings became the "gold coast" long envisioned by public and private planners. Tens of thousands of acres were transacted at rapidly appreciating prices, the subject of master planning, entitlement and/or active development efforts between 1984 and 1991. Although founded on a quality climate and solid transportation systems (as well as a scarcity of quality lands elsewhere in the neighbor islands), the surge was primarily a coalescence of external factors, notably the explosion of Pacific tourism and the Japanese economy. Virtually every major landholding in the region was the topic of some activity across the user-type spectrum. The resort, residential, recreational, commercial, and industrial sectors all increased in size dramatically during the period, laying the groundwork for development in West Hawaii until the mid-21st century.

Since the onset of global recession in late 1990, the market has slumped significantly, although recovery is anticipated to be underway by mid-decade. Few analysts anticipated the hyper-appreciation and wide-ranging opportunities associated with the "feeding frenzy" of the last decade to be repeated in West Hawaii in the short term. However, the mid- to long-term prospects for the region remain fundamentally strong.

5.1.3.2 The Primary Economic Sector

The 28 mile coastal corridor extending from Kailua-Kona to Kawaihae, stretching from the shoreline inland to about the 3,000-foot elevation, has been the crux of investor and planning attention. Prior to 1980, the area had only two hotels (housing 410 total rooms), a single destination resort, fewer than 5,000 residents, and minimal long-range residential expansion plans outside of the Waikoloa Village lands.

By the end of 1993, six hotels with 3,122 rooms were in operation (with two more under construction), six resort projects were in development or approved, the resident population had doubled, and major mixed-use communities were proposed at Keahuolu, Kealakehe, Kaloko, Puako, Kawaihae, and elsewhere. More than 30,000 resort units (hotels, condominium, and resort/residential) were proposed from the mid-1970s through 1990, of which about two-thirds have been approved. Some 25,000 residential units were proposed during that period; most of which have received approvals. More than 20 golf courses were developed or announced, and upwards of 400 acres were master planned for commercial and industrial development.

Further, the escalation in the real estate market created demand vectors previously unseen on the leeward side of the Big Island. Gentlemen/equestrian estates, gated subdivisions, modern shopping centers, technology parks, and extensive golf course construction bore evidence of an evolutionary movement in the greater West Hawaii economy. The resulting lifestyles have move away from the area's agrarian past towards a tourism/service based future.

5.1.3.3 Regional Land Use Plans

In response to the emerging development pressures, governmental planning agencies expended considerable effort in attempting to formulate workable plans setting forth development guidelines and implementing strategies. The Office of State Planning's *West Hawaii Regional Plan* (1989) was the definitive document, calling for the establishment of four resort destination "nodes" along the Kona/Kohala coastline (one of which is centered at Kaupulehu), containing up to 28,233 visitor-oriented units, and a series of support and general residential communities encompassing up to 15,000 housing units. The State's Plan affirmed the then-considered highly aggressive Hawaii County *General Plan* (drafted in 1986, adopted in 1989), which forecast a three-fold increase in the area's economy as a result of tourism and population growth over the ensuing two decades. The County's General Plan designates the Kaupulehu node as an intermediate resort and urban expansion area.

Judging the lands just north of Kailua-Kona to be the central resident serving expansion area, the County completed the *Keahole to Kailua Development Plan* in 1989, covering 17,000 acres between Kailua and the Keahole airport. According to the "K to K" plan, by 2010 there would be a resident population of 16,800 persons, a 200-acre regional civic and commercial center, 200 acres of industrial development, 575 acres of parks and recreational facilities, and 280 acres of educational institutions in the area beginning eight miles south of the Petition Area.

A 1991 study undertaken for the State Land Use Commission as part of a periodic District Boundary Review cited the need for 3,658 (net) acres of additional residential development in West Hawaii by the year 2010 beyond those developed and approved at the time. It also identified the need for up to 334 more acres for commercial uses, 239 acres of new industrial lots, and 968 acres of resort lands.

This visionary stance of state and county agencies was unparalleled for the neighbor islands and matched only by the Ewa/Kapolei regional planning efforts on urbanized O'ahu. Community and landowner support was strong for the most part, and investment capital flowed into West Hawaii based on the land use base being created.

5.1.3.4 The West Hawaii Housing Market

Although the construction surge of the last decade coupled with the recession of recent years has served to lessen the historically chronic and severe undersupply of housing units available for West Hawaii residents, mid- to long-term forecasts still project the need for an exceptional number of new units to be constructed over the next two decades if the anticipated demand created by a growing local residential market is to be reasonably met. In order to achieve stability in the sector, a wide spectrum of inventory types must be made available, ranging from affordable rental units to upscale estate opportunities. This diversity is necessary for the housing base to efficiently reflect and service the evolving West Hawaii economic and population structure. Should the market fail to service one or more of the pronounced regional demand segments, the dysfunctions seen in the past will rise again; specifically a shortage of units, an erratic pricing structure, and the domination of the local housing market by non-resident purchasers.

Using the standard housing unit demand formulae, it is estimated that West Hawaii will require an additional 25,214 to 31,231 new housing units by the year 2015 if a healthy market status is to be achieved with sufficient allowances made for vacancies, aging/dilapidated units, and the unavoidable incursion of non-residential purchasers into the general market place. These forecasts are extrapolations consistent with published state and county projections made to years 2005 and 2010. Of the demand, approximately 54 percent will fall into a bracket having a current price of less than $250,000, with the remainder being focused towards "market" priced units. At present, there are some 25,700 total units under construction or approved in West Hawaii, with up to 3,000 others being considered in long-range plans. These units will provide a broad range of model and pricing types, with a significant number oriented towards the moderate to lower end of the price spectrum.

However, it is highly unlikely that all of these homes will be built in a timely manner. Many of the major developments (Waikoloa Village, Puako Residential Golf Community, Parker 2020 and others) have development time-frames which extend far beyond the projection period. Others are experiencing severe financial difficulties and the likelihood of their actualization is minimal. Further, many of the approved "residential" units are actually in resorts (notably Waikoloa Beach, Mauna Lani, and Mauna Kea Beach) not significantly oriented towards local resident purchase. The final densities achieved in most developments will undoubtedly be less than the total approved.

Therefore, it is concluded that fewer than 80 percent of the total number of housing units approved for West Hawaii, or less than 21,000, have a reasonable chance of being constructed during the next 22 years. This will be insufficient, by 4,000 to more than 10,000 units, to fully service the regional market needs over the study period. By offering a low-intensity, moderately priced, near shoreline, amenitied setting, it is believed that the proposed project will prove desirable to a pronounced segment of regional households to a far greater degree (by design and default) than other West Hawaii ocean front communities.

5.1.3.5 Statewide Resort/Residential Homesite Sector Market Demand

The resort/residential homesite sector was among the fastest growing of any use-type in Hawaii over the past decade, with inventory expanding nearly three-fold since the mid-1980s. A variety of factors, notably the 1986 Income Tax Reform Act, contributed to the golf course subdivision movement which soon became a focal point of destination community construction throughout the state. At present, there are some 1,859 subdivided lots in the eight existing major neighbor island resort projects and golf course developments, of which more than 95 percent have been successfully marketed. Current prices range from a low of $120,000 for an interior lot at Princeville to a maximum of $4 million-plus along the shoreline at Mauna Lani. Most parcels are priced from $275,000 to $500,000.

At the peak of the market in 1988-89, sales activity among all properties totalled about 400 original and resale transactions annually. However, over the past 15 recessionary months, sales have slumped by more than 70 percent. With the exception of selected lots being discounted for sale by owners under duress, prices have not shown significant abatement from the strong years, although selling prices as a ratio of list price have dropped nominally, and some programs offering lots for original sale are readily discounting prices by three to five percent.

It is anticipated that it will take several more years (or until mid-decade) for this market segment to begin notable recovery, increasing strongly thereafter until stabilization of demand is reached shortly after the turn of the century. The Market Study's projections call for cumulative demand for 6,700 additional new resort/residential lots throughout the neighbor islands by the year 2015. Of this demand, about 55 percent, or 3,700 lots, are forecasted to be oriented towards West Hawaii. Currently, there are some 10,073 new competitive lots being proposed at neighbor island locales, or more than double the number needed to satisfy demand levels. But, many of these are in unproven locations (Molokai and Lanai), are in projects currently experiencing severe financial difficulties or not yet under construction (Kohanaiki, Kukio Beach, and others), or within developments anticipated to extend well beyond the projection time frame (Mauna Lani, Mauna Kea Beach, and Princeville).

About 46 percent of the proposed inventory, or 4,617 homesites, is planned for leeward Hawaii at the present time. However, it is believed that it will be highly unlikely that more than 50 percent (or about 2,700 units) will be manifest during the study time frame. Mauna Kea Beach is notably conservative in its development speed, and along with Mauna Lani, has consistently sought much lower densities than permitted. Further, several of the projects will lack ocean front, amenities and comprehensive support services, which will decrease their competitive appeal. Many developments are additionally having difficulty "breaking ground" and moving towards inventory offering.

It is therefore concluded that, despite the recent downturn in the sector, the mid- to long-term prospects for the Petition Area under its proposed development plan remain favorable. The actual competitive inventory likely to be built in the highly desirable

West Hawaii vacation area over the next two decades will be limited despite the gross level of regional inventory proposed. It is unlikely sufficient lots will be developed to service all demand sectors, particularly for moderately priced lots (with current average non-ocean front prices of about $325,000). Single family lots in the Petition Area will allow the expanded Kaupulehu Resort community to offer a comprehensive diversity of residential product.

5.1.3.6 Statewide Resort/Residential Condominium Market Demand

Following meteoric growth in the mid- to late-1970s, the resort condominium sector underwent fundamental change during the past decade, with major evolutions in design and marketing thrust. Yet, with the exception of a brief high activity period at the peak of the recent boom market, development interest, construction levels, and price appreciation (although strong) never sufficiently recovered to move this sector back into the dominating position it once held in the industry; a status lost to the resort homesite sector.

The evolution in condominium design was predicated by a scarcity of quality beach front sites (which historically were the most favored locations), major changes in the tax code, the focusing of investor/speculator capital into other resort products, and the stabilization of the condominium versus hotel transient rental populations. Today's Hawaii resort condominium is typically on the interior of the destination community, fronting a golf course, in low-rise, low-density buildings, with larger units and a distinct "residential feel". The more spacious, better appointed, higher amenitied town homes generally came with prices previously reserved for on-water projects.

At present, there are some 6,387 finished condominium units in the eight major neighbor island resorts, of which 93 percent have been absorbed to date. Only about 65 percent of those developed over the last five years have been successfully closed (Waikoloa Beach having the largest segment of unsold inventory). Over the last four years, prices for units ranged from a low of $120,000 for an older, studio unit at Keauhou to $2,000,000-plus for a 3,000 square-foot residence at Mauna Lani or Wailea. Most newer units range in size from 1,300 to 2,000 square feet and achieve prices from $275,000 to $600,000.

In the late 1970s, sales of resort multifamily units (original and resales) averaged more than 1,400 units per year. During the early to mid-1980s, transactions declined by about 80 percent, until regaining momentum by late decade to reach an average of some 506 unit sales annually since 1987. Over the past 15 months, activity has once again slowed, and sales have occurred at the cumulative rate of about 125 units per year. The number of units being sold on a duress basis appears to be greater than the homesite sector, and commensurately, there have been greater price fluctuations for resales. Asking prices for original (new) units have softened considerably during the last 30 months.

It is forecast that the total demand for resort condominium units will reach 8,900 units over the next 22 years, the vast majority (74 percent) occurring after the turn of the century. While this demand figure is higher on a gross basis than the forecast demand for homesites, the condominium demand figure represents slightly more than a doubling of the existing inventory, while the lot demand projection is more than a tripling of the in-place inventory. Of the total condominium unit demand to the year 2015, it is projected that about 4,500 units will be directed towards West Hawaii (50 percent of the total).

There are up to 15,647 total additional competitive neighbor island resort units proposed/approved, of which upwards of 8,000 to 10,000 are envisioned for construction during the period of 1994 to 2010. As with resort homesites, it would appear the gross level of supply will outpace demand quotients. Again, however, it is doubtful if all the projects will be built, or built to approved density limits, or be competitive in the market. Therefore, it is concluded that if actualized as low-density units, the Petition Area's inventory will prove successful in the regional market, particularly as the amount of alternative supply in the area which will actually be available to meet this price-sensitive demand is questionable at this time.

5.1.3.7 West Hawaii Golf Course Market Demand

Golf courses are considered a vital amenity for resort and master planned community development, offering recreational opportunities and desirable frontage attributes. Historically, they were considered as a necessary "loss leader"; a concept which changed with the meteoric rise in market demand during the later years of the 1980s. With the economic downturn, the market has essentially reverted to its original form.

At present there are eleven operating golf courses in West Hawaii, or a slight to moderate oversupply relative to quantified demand levels which place current market requirements at about 9.5 courses. This conclusion is supported by the operational experience of the existing facilities. An additional 23 courses are proposed and have some level of approval, most as part of destination resort or master planned developments.

It is anticipated that the oversupply condition will continue in the short to mid-term, until the visitor market recovers and resort and residential unit construction resumes a more vibrant pace. As retiree and "white-collar" sectors expand in the region, demand by residents will increase substantially, and the need for additional courses will be created. From a tourism perspective, more courses mean an enhanced standing in the market place, particularly among Japanese/Asian visitors who seek a disproportionally high number of golfing opportunities, and course experiences. Given the vast expanses of raw land, scarcity of quality sand beaches, and minimalist support communities, golf will be a vital contributor to the visitor plant amenity base.

The analysis indicates that a total of 37 courses will be required by the year 2015, or three more than the current level of existing, under-construction, and proposed/approved supply. As with the residential projects, it is highly unlikely all of these courses will be built as planned in the foreseeable future.

5.1.3.8 Neighborhood Commercial Market Demand

The Petition Area's master plan contains approximately 11 acres (gross) of commercial lands, well located at the hub of the community along the neighborhood's major entryway. The site could support upwards of 120,000 square feet of finished floor space, if developed at typical construction standards, using conservative floor-area ratios. However, in keeping with the low density nature of the Kaupulehu Expansion area master plan, the developer proposes a significantly smaller center having some 45,000 square feet of floor space within a highly amenitied, easily accessible shopping village.

The designated commercial parcel, which enjoys favorable access and exposure characteristics, would be used for development of a neighborhood retail/service center meeting the daily household shopping needs of Kaupulehu community residents (primary and second-home owners) and guests, and tourists visiting the Four Seasons complex.

Additional consumer demand at the Petition Area's shopping village would be provided by golfers at Kaupulehu courses and guests/users/residents of the other regional resort developments, as well as future expansions of the greater coastal corridor community. Tertiary demand groups would include Queen Kaahumanu Highway passersby and workers or others employed at or using Kaupulehu community facilities.

Demand for this subject component can be best quantified as a function of per capita spatial levels associated with the resident population of the effective neighborhood being serviced (Kaupulehu Resort) and for secondary center patrons. Based on this method, which provides for resident shopping/service needs outside of neighborhood businesses and the capture of only a portion of on-site visitor expenditures, it is estimated that use by the greater Kaupulehu population, community workers/visitors, by-pass travelers and regional residents would create demand for 45,000-plus square feet over the coming two decades. This is more than adequate to fill the effective gross leasable center space proposed.

A two-phased center development plan would appear most reasonable, with an initial increment of 25,000 square feet by the fifth or sixth year of subject inventory sale, which is a balance between the desire to have the amenity immediately available for servicing the first residential offerings and the need to have an established nucleus of consumers in order to support commercial tenants. The second phase of 20,000-plus square feet (in accordance with community needs) would follow about eight years later.

5.1.4 Housing

5.1.4.1 Existing Conditions

"According to the U.S. Census Bureau, there were 9,990 housing units in the North Kona district in 1990 (see Table 5-3). Assuming a population of 9,126 in Kailua Village alone, and 2.8 persons per unit average, there were 3,259 housing units in [Kailua Village]. The County of Hawaii Planning Department has estimated that by the year 2010, Kailua Village will have a housing inventory of 8,286 units -- this is expected to account for about 41 percent of the North Kona district housing inventory of 20,344 units (Draft projections, County Planning Department, 7/17/89).

Table 5-3: Housing Unit Projections 1990 - 2010

Place	1990	1995	2000	2010
North Kona district	9,990	11,266	13,957	20,344
Kailua Village	3,259	4,281	5,420	8,286

Sources: U.S. Bureau of the Census, 2/91, and County of Hawaii Planning Dept., 7/89.

In 1990, the median house value in North Kona was $113,000 and the median rental unit price was $428.00 (County of Hawaii Department of Housing & Community Development." (R. M. Towill, 1992, p.18)

5.1.4.2 Potential Impacts

The proposed project will add 1,030 units at build-out to the West Hawaii housing inventory. The project will be composed of 530 single family homesites and 500 multifamily units. The single family homesites will be situated on 220 net acres of land, with approximately 50 homesites having direct ocean frontage and virtually all of the remainder having golf course frontage. The multifamily units will be distributed among 94 acres in low density projects spread across the interior golf course-fronting sites.

The overall density ratio of the project averages about .93 units per acre over the entire project site. The finished site density ratio is well below regional market standards, with subdivided single family lots averaging 2.33 units per acre and multifamily units averaging 5.26 units per acre.

5.2 Projected Public Facility Costs and Benefits

The following discussion is presented in The Hallstrom Group's Economic Impact Analysis which is attached to this EIS as an appendix. The purpose of this section is to delineate the areas in which the proposed project will potentially impact public agency resources, and to quantify (where possible) the costs of providing expanded services to the project, versus the economic benefits that accrue to the community through an increase in tax revenues and fee payments.

Some cost/benefit issues are considered to be off-setting, as the cost of the services to the government is theoretically directly reimbursed in the form of user fees. Building permits and utility hook-up fees are two prime examples. Such items are excluded from consideration here.

A major concern of this analysis is the integration of the Petition Area into the overall West Hawaii regional plan. The 1,030 units of the Petition Area, while seemingly a large number, represent a minor component of the entire existing and proposed regional inventory. Given the vast number of units approved in leeward Hawaii, it is difficult to say that of themselves the subject homes will create the need for significant amounts of expanded public services. However, the need for enhancing services is a cumulative effect, each project adding to the community base until a "need threshold" is reached.

In regards to some services, the effective impact from a cost perspective may not be readily apparent, but merely creates greater stress on existing agencies and facilities. In order to realistically depict the true cost, a moderate perspective is taken: the subject development should be a proportionate contributor to the needed regional public service and facility net, including expansion costs which may or may not be actually incurred.

5.2.1 Public Costs

Potential costs to governmental agencies and programs include police protection, fire protection, emergency and long-term public health services, recreational demands, educational needs, public facility costs, and various other services and financial commitments. Public costs also include capital improvements for new infrastructure.

Governmental costs assessments are based on the per capita expenditures incurred by the State of Hawaii and County of Hawaii in accordance with the de facto population of the area. According to the Tax Foundation of Hawaii, the state spent a total of $4,459,808,000 on services, salaries, infrastructure and financing in 1991 (the most recent year data was available), up more than 12 percent from 1990.

The total de facto population in the state on an average daily basis in 1991 was 1, 277,600 persons, including residents, visitors and military personnel. The per capita expenditure by the state was thus $3,490 in 1991, an increase of 19.03 percent from the 1990 figure of $3,184 per person. From 1979 to 1991, costs increased at the range of 7.5 percent annually compounded.

It could be argued that there should be a division of costs between full-time residents and visitor populations; however, this would be considered to be highly speculative. While visitors may not avail themselves of every government service, they enjoy the benefits of the services and infrastructure which are provided to the general community.

Escalating the 1991 costs forward to year-end 1993 at a rate of six percent yearly compounded, the per capita state expenditure as of the study date would be some $3,925 (rounded). This figure is then multiplied by the estimated population of the Petition Area. In the first year of occupancy (third project year), state costs would be $183,659, increasing to a level of $6,101,684 by build-out in year 20 of the project life span.

Similarly, the County of Hawaii spend a total of $103,791,000 in 1991, also representative of a major increase of 32.16 percent from the 1990 levels. The de facto population for those two years on the Big Island was at 138,000 and 147,300 respectively. The resulting net per capita county expenditure was therefore $705 in 1991, a substantial jump from the $569 figure for 1990.

From 1984 through 1991, county expenditures grew at a compounded annual rate of just over four percent. Application of a five percent compounded growth rate to the 1991 total results in an estimated per capita expense of $775 in 1993. The total county cost, on a constant dollar basis, associated with the Petition Area would be $36,264 in year 3, escalating to $1,204,791 by the end of the study period.

Based on this analysis, the reasonable gross annual cost to the public from the proposed subject project, expressed in 1993 dollars, would range from $219,922 effective in year 3 (at the commencement of residential occupancy) to $7,306,475 by the end of the study period. Over the two decade development time frame (from the beginning of infrastructure emplacement until all homes are built), the entire direct cost to the public purse resulting from implementation of the Kaupulehu Resort Expansion area master plan would be $67,477,840.

5.2.2 Public Benefits

Tax benefits to the state and county coffers will flow from four major sources: real property taxes, gross excise tax receipts, state income taxes, and sales conveyance taxes.

5.2.2.1 Real Property Taxes

Property taxes paid by landowners in the subject project were calculated using the 1993-94 tax rates for both land and buildings, improved and unimproved. Assessed values are based on the estimated average sales cost for the single family ($700,000 per home) and multifamily ($325,000 per unit) components. The commercial product assessment is based on its reproduction cost and each golf course is valued at $50 million. The taxes are applied against the developed units effective as of the date of sale, which is anticipated to be commensurate with their completion date.

Prior to the development and/or sale of the components, the entire 751 acre usable subject holding area (all lands except open space and set-asides) is assumed to be assessed at an approximate market value of $50,000 per acre, or $37,550,000 overall. The size of the base holding and its assessment diminishes as it decreases in area subject to development of the various project phases. All real property value of the subject holding is assumed to be vested in the subdivided sites, with no assessment placed against open spaces, parks, or other community systems.

The total real property tax paid to the County of Hawaii in 1993 dollars ranges from $375,000 in Year 1 to $11,019,315 at build-out. The aggregate sum of taxes paid over the study time frame is $120,778,523.

5.2.2.2 State Income Tax

The state will receive income taxes from three sources:

- the wages of the workers associated with the construction, operation and maintenance of the Kaupulehu Resort Expansion master plan components;
- the household income of the development's full-time residents; and
- the corporate profits from contractors and suppliers serving the construction phase of the development, and the operating businesses and facilities in the completed project.

The effective tax rate for the personal income (wages) generated by the project is estimated at 5.0 percent of gross wages. The effective tax rate for the corporate income is estimated at 7.5 percent of gross operating profits, which is assumed to be ten percent of the forecasted gross revenues.

The total income tax revenues received by the state are projected at $597,366 in year 1 of development, increasing to a maximum level of $3.63 million. Over the study period, the cumulative income taxes paid are estimated at $49.87 million. It should be noted that corporate income or other taxes will be paid by the development venture or commercial tenant businesses.

5.2.2.3 State Conveyance Tax

A conveyance tax of one dollar ($1.00) per $2,000 of the estimated unit purchase prices were allocated for this revenue item. Over the 18 year residential product absorption period, this fee will total $187,250. The maximum annual amount will be $10,675.

5.2.2.4 State General Excise Tax

A four percent expenditures tax was applied against the total estimated construction costs, the golf facility commercial tenant operation revenues, and the discretionary expenditures of the resident population of the Petition Area. The state excise tax receipts arising from development of the Petition Area range from an estimated $320,000 to a peak of $6,291,644 towards the end of the projection time-frame. Over the study period, the receipts total $61.57 million. Not included in this figure are any excise tax revenues associated with "multiplier effect" expenditures throughout the Big Island.

5.2.2.5 Total Public Benefits

In 1993 dollars, the aggregate annual tax revenues flowing from the subject development will range from:

- $375,000 to $11,019,315 per year for the County of Hawaii, totalling $120,778,523 over the projection time-frame.
- $917,366 to $8,931,064 annually for the State of Hawaii, cumulatively at $111,629,700 over the two decade build-out period.

- $1,292,866 to $19,950,379 per year total tax receipts (county and state), totalling $232.4 million during the study time frame.

5.2.2.6 Correlation of Costs and Benefits

The net aggregate benefit to local governmental agencies is estimated to be $109.65 million for the County of Hawaii and $55.27 million for the State of Hawaii, with a cumulative "profit" figure of $164,930,383.

5.3 Indirect Economic Impacts

These figures are somewhat problematic to quantify due to their nature, but will undoubtedly be substantial. There are three basic types of indirect economic impacts:

- household income flowing to the full-time residents of the development, generally in the form of wages;
- discretionary expenditures by the de facto population of the project; and
- the capital multiplier effect in the community as these introduced funds pass through various businesses on the island.

An issue in quantifying expenditures of the resident and guest/consumer population of the Petition Area is whether these monies would be spend on the Big Island if the project master plan was not implemented; i.e., if the project was not pursued, would these dollars flow to other regional developments or go elsewhere in Hawaii, or outside the state?

As the purchasers of the Petition Area's units would be of the middle- to high-income sectors, the amount of discretionary expenditures would be high relative to the number of units built. Conservative extrapolation of studies indicates the average resident in a moderate to upscale community on the Big Island spends some 60 percent of total net wages in discretionary funds for food, beverages, services, recreation and goods. Full-time project resident incomes were estimated at $110,000 annually per household in year-end 1993 dollars. These totals equate to three times the median Big Island household income for 1993, placing these households in the upper 20 to 25 percent of island families which is the target market.

The de facto population of the Petition Area will be made up of a combination of full-time residents and part-time second home purchasers and their guests. The average number of persons daily residing in the community would increase from an estimated 47 by the end of the third year of development, to 1,555 persons by the end of the projection period. Roughly, 47 percent would be in the multifamily units and 53 percent in the single family homes. In year-end 1993 dollars, the total annual discretionary expenditures from this population would range from a low of $770,664 to $25,603,756 by the end of the study period. The average full-time resident household income would reach a yearly level of $21,330,023 by the end of the project build-out.

The capital multiplier effect of all the direct and indirect expenditures as they flow through the Big Island and statewide economies cannot be precisely quantified, as a myriad of unknown factors must be considered. However, First Hawaiian Bank studies indicate the multiplier for resident consumer dollars in Hawaii ranges from 1.2 to 3.5 times in accordance with community structure. It is believed that a multiplier effect rate of 2.0 times the base expenditures is appropriate for the Petition Area. These base expenditures include the total wages, contractors' and suppliers' profits, and subject population discretionary expenditures.

5.4 Total Economic Impacts

The various economic impacts which will flow to the effective market region as a result of the proposed project are presented in Table 4 of the Economic Impact Analysis. The total base economic impact increases from $14,447,320 in the first year of construction to a high of $123.15 million (in 1993 dollars). Fueled by the household income levels, the estimated stabilized annual on-site impact after completion of development would be more than $31 million. Over the 20-year study period, the total base impact is $791.4 million.

Application of the multiplier effect ratio results in a total overall economic impact of $28.9 million in the first year of the project, increasing to a maximum of $123.15 million development in year 20 and stabilizing thereafter at over $60 million.

5.5 Social Impacts

Because the coastal region makai of Queen Kaahumanu Highway extending north from Keahole Airport to Kiholo is uninhabited, there is no existing community that would be directly impacted by the proposed project. However, the Kaupulehu property is not devoid of human activity. As discussed at the beginning of this chapter, the Kona Village Resort, adjacent to the Petition Area, has existed as a secluded resort destination for over 30 years. In addition, the kiawe thicket area that corresponds to the existing 65-acre Urban classification fronting the shoreline within the subject property is also visited by fishermen, campers, and food-gatherers who access the area on foot or using a 4-wheel drive to traverse the property from Queen Kaahumanu Highway. The following discussion is, therefore, divided into two parts corresponding to the two principal social "groups" that will be impacted by the proposed project.

5.5.1 Social Impacts on the Kona Village Resort

The presence of the Kona Village Resort adjacent to the Petition Area creates the potential for negative impacts resulting from construction and operation of the proposed project. In the past, Kona Village Resort has capitalized on the theme and ambiance of a remote Hawaiian village. Development of the proposed project could impact this theme and ambiance. Instead of driving through a barren lava field to an "oasis" of thatched bungalows, future Kona Village Resort guests will pass by portions of a landscaped golf course and residential area. The feeling of remoteness could be compromised. In addition, as discussed in previous sections of this EIS, ambient noise levels, night-lighting, and views of the proposed project will all serve as subtle reminders of the presence of a neighboring community.

5.5.2 Measures to Mitigate Social Impacts on the Kona Village Resort

Representatives of the Petitioner and Kona Village Resort have together reviewed the project's initial concept plans and have discussed issues and concerns pertinent to Kona Village Resort. Based upon such discussion, the project's conceptual plans have been revised to provide for certain development setbacks next to Kona Village Resort and its access road. Similar joint efforts and agreements occurred in conjunction with the 1986 boundary amendment proceeding which established the Urban District for the first portion of Kaupulehu Resort which is now under construction. The Petitioner anticipates that further joint planning with Kona Village Resort will occur as plans continue to be refined.

5.5.3. Social Impacts on Property Users

In an effort to identify potential social impacts on current or future users of the subject property's coastal area that might arise from implementation of the proposed project, employees of the Kona Village Resort, fishermen, campers, and people raised in the area prior to its abandonment in the late 1940s, were interviewed during June 1994. Following is a summary of the concerns raised. At the request of the interviewees, names have been withheld to protect their privacy.

Person's Affiliation	Comments
Kona Casting Club	The Kiawe thicket area is used by weekend campers and the entire coastline is used by fishermen, and commercial and subsistence food gatherers. Concerned about impact of project upon availability of ocean resources. Ocean resources could be impacted by chemical runoff. Increased access will deplete the fishing grounds and limu, opihi, and crab resources unless an effective management program could be implemented.
Kaupulehu Kupuna	Ka Lae Mano was used extensively for certain types of food gathering and specifically for the gathering of salt. The coastal trail was part of the mauka access from Kaupulehu to Puuanahulu. Travelers hiked from Kaupulehu to Kiholo and Puuanahulu. People had to carry their water because the few water holes in the area have been covered by sand. The Kiawe stand is one of the last places where the Kona Nightingales (donkeys) can get feed makai. The ocean resources need to be managed. The resources are currently being depleted because people are harvesting to sell, not for subsistence. If the area is made more accessible, it would encourage more pressure on the ocean resources. Possible negative impacts could include chemicals from the project causing Ciguatera, and collapse of underwater caves due to development.

Kona Village Resort	The area is used for traditional salt, limu, and opihi gathering, fishing, and teaching family values and cultural beach living. Recalls as a child, watching his/her parents hunt donkey and goats.
Kona Resident	Prior to the 1940s large quantities of salt were gathered and bagged for community residents both shoreline and mauka. Today, a road over the lava has been established by the local fishermen that is accessible by 4-wheel drive only. Fishermen with boats also access the area. Resources of the area include salt (puakai), tea (hina-hina, at one time), seaweed (limu), and coral (ina, medicine used for burns). Concerned that development will impose limitations on access, on marine life quality, shoreline structure, and ocean water quality.
Former Kaupulehu Resident	Area was used traditionally for salt gathering and hunting. The area was frequented during winter months. Supplies were left at shoreline cave (called 'ana') and camp was made. Recalls riding donkeys to Kalaemono for salt gathering. Development will not benefit the people in Kona. It will allow the public to "misuse its traditions and natural resources".
Kona Resident	Area used for fishing and opihi gathering. A positive impact of the development will be to open up the shoreline area more. Increased access could be bad if not properly managed and controlled. Area should be preserved in pristine state as much as possible. Restrooms would be okay, but no showers. Gravel road would be okay. Don't care about the tourists; if no 4-wheel drive to go down, tough! Concerned about burials in the area. It would be ideal if they could be preserved in place. Burials need protection and good management.

5.5.4 Measures to Mitigate Social Impacts on Users of Project Area's Coastal Resources

The comments of the persons interviewed are generally consistent in the concern for the project's impact upon coastal resources. The matter of how increased public access to the coastal area resulting from the proposed development (as well as implementation of already approved development plans for surrounding areas) is a significant concern to those who presently use the shoreline. These impacts have been addressed in section 4.8.1.3. To mitigate concerns about increased public access, the Petitioner will prepare a shoreline management plan in conjunction with the zoning and Special Management Area permit processes. With regard to the concerns about feral donkeys, sections 4.12.2 and 4.12.3 address the project's impacts upon them and proposed mitigation measures.

5.6 Social Impacts on Neighboring Kaupulehu Resort

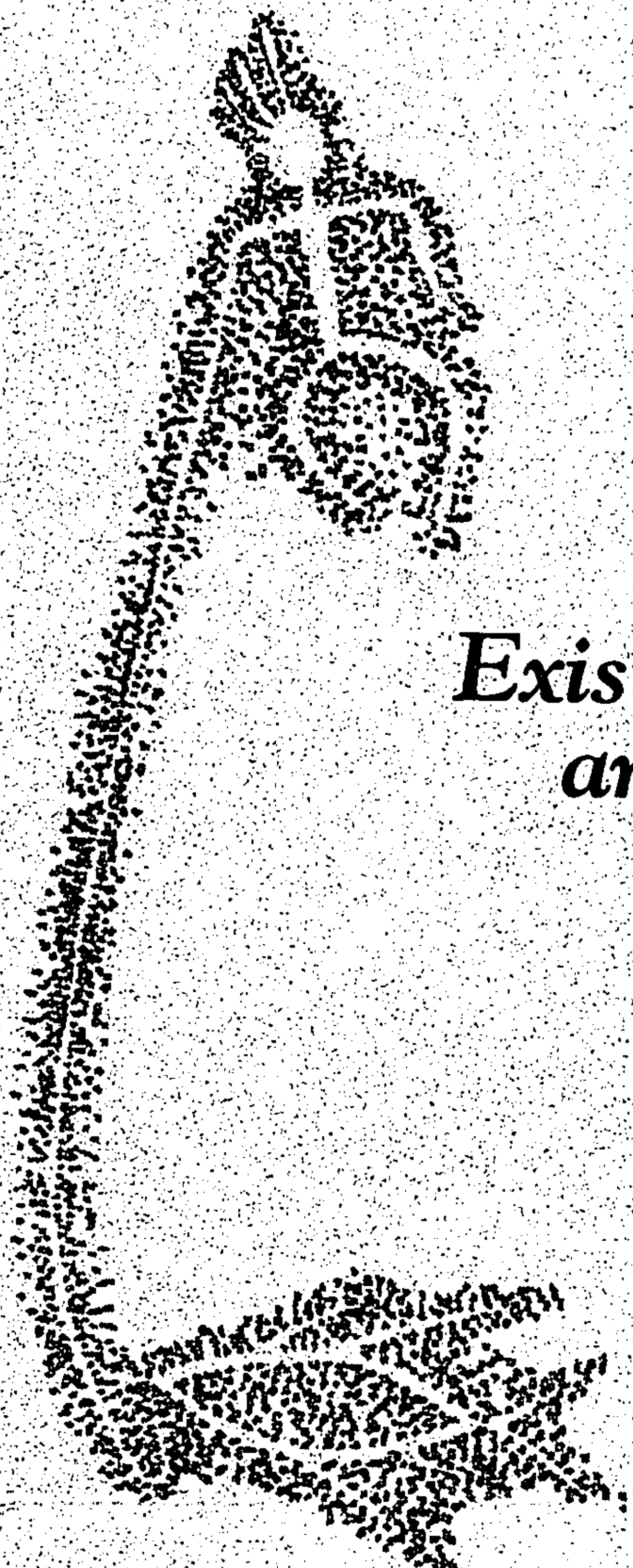
As discussed in Chapters 1, 2, and 3, as the proposed project is implemented, it will become a part of the Kaupulehu Resort Destination community. Because it will contain resort/residential and recreational uses that will complement the hotel now under construction, it will generally appear as an integral part of the overall development. Thus, social impacts on the neighboring resort development will be generally limited to those specific physical impacts resulting from the phased construction of project components and the corresponding increase of the residential population.

5.7 Secondary and Cumulative Social Impacts

Development of the Petition Area will occur within the context of major population growth in West Hawaii over the next twenty years. It may be said that this growth is the result of a statewide policies implemented over 30 years ago to redirect growth from O'ahu to the neighbor islands. With West Hawaii being now identified by the State as a key growth area and the lands of Kaupulehu as a resort destination node, those 30-year old policies are manifesting their impacts in West Hawaii.

The transformation of West Hawaii over the coming years will undoubtedly change the social character of the area, just as it will change the physical environment. At a regional level, as populations increase, land use densities and traffic increase. Familiar land uses are often replaced and buildings are renovated or replaced, resulting in a noticeable change of appearance or character.

As a matter of cumulative impacts to the region, the ability of existing community members and neighbors to know everyone living around them is complicated. The loss of personalized relationships with neighbors, and the resulting increase of anonymity in the community, seems to undermine the general feeling of "neighborhood" or "community". Where neighbors used to watch out for other neighbors and collectively monitor the neighborhood children, rapid population increases makes this difficult and often impractical. Community safety concerns increase. Because strangers are harder to identify in the community (as opposed to recent arrivals), acts of social non-conformance and crime are not as easily regulated by social mores. Homogenous communities become heterogenous and familiar traditions begin to disappear. As populations increase, historical uses of vacant properties are restricted or regulated and long-time residents experience a loss of freedoms. The sum result is the natural process of community evolution. The proposed project will contribute to this ongoing change.



Chapter 6

Existing Infrastructure and Public Services, Environmental Consequences, and Mitigation Measures

CHAPTER 6 *EXISTING INFRASTRUCTURE AND PUBLIC SERVICES, ENVIRONMENTAL CONSEQUENCES, AND MITIGATION MEASURES*

6.1 Infrastructure
6.1.1 Roads and Traffic

A traffic impact analysis was conducted for the proposed project by TMC in March 1994 and is attached to this EIS as Appendix D. Following are the findings of this analysis. It should be noted that for the purpose of the analysis, access to the Petition Area is assumed to be provided by a signalized, at-grade intersection on Queen Kaahumanu Highway at or near the existing intersection of the Kona Village Resort access road and Queen Kaahumanu Highway. Furthermore, the analysis assumes the future existence of a mauka-makai roadway planned by Kaupulehu Resort to link Queen Kaahumanu Highway to Mamalahoa Highway, beginning at the project access intersection and extending mauka through the Kaupulehu ahupua'a to Mamalahoa Highway. Although this mauka-makai roadway is not part of the proposed project, its future existence will impact traffic conditions along Queen Kaahumanu Highway. For this reason, it is included in the analysis.

6.1.1.1 Existing Conditions

Queen Kaahumanu Highway is the primary arterial highway in the region. It is a high quality, two-lane, two-way State Highway connecting Kawaihae and Kailua-Kona. The highway is situated approximately 600 feet inland of the furthest inland portion of the Petition Area.

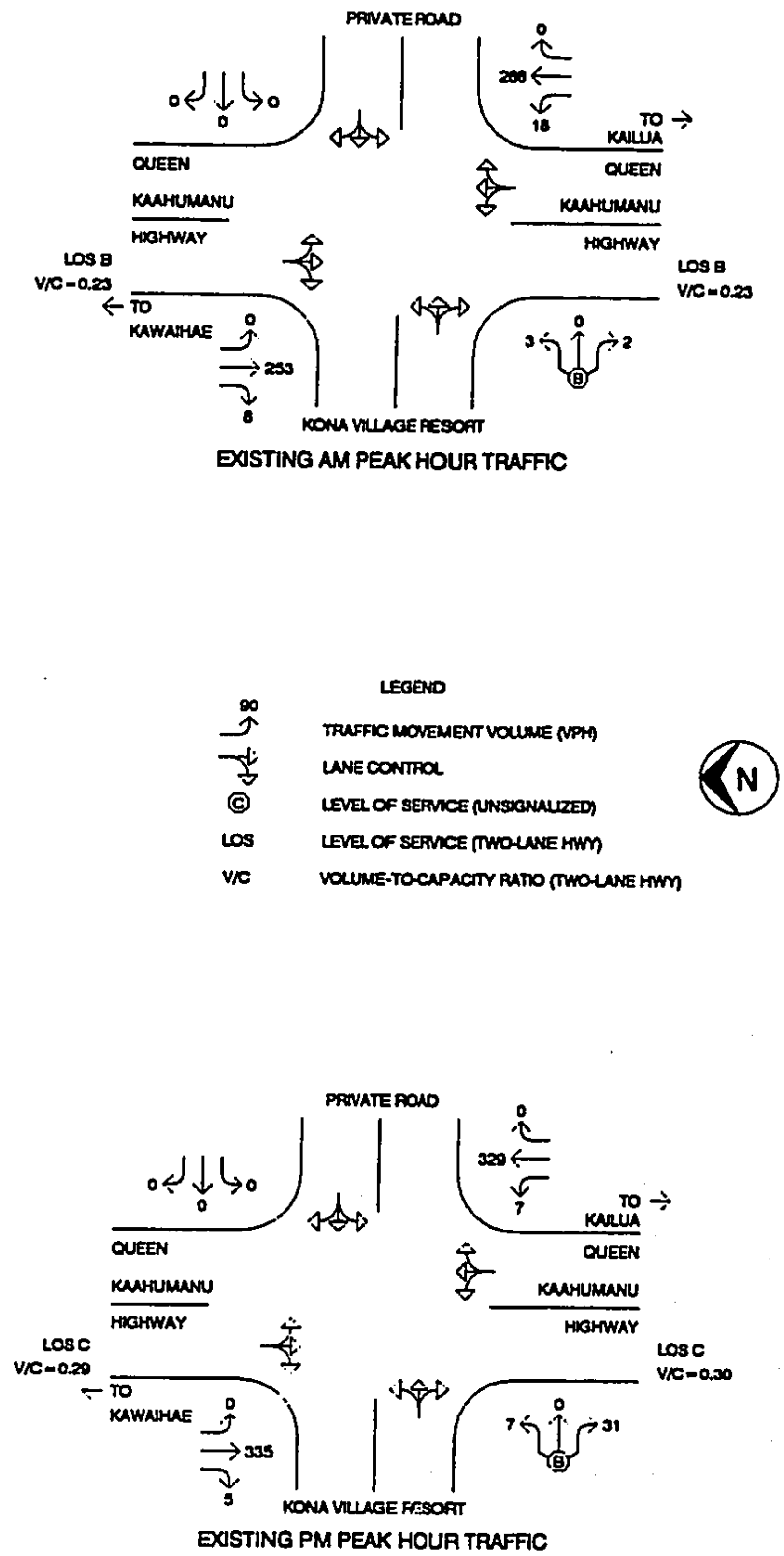
Mamalahoa Highway is a two-lane, two-way County highway located approximately 3.5 miles inland and up slope from Queen Kaahumanu Highway and is aligned roughly parallel to it. The only existing mauka-makai corridors between the two highways in the general region of the Petition Area are located at Waikoloa and Keahole.

The AM peak hour of traffic on Queen Kaahumanu Highway in the vicinity of the Petition Area occurs between 7:00 AM and 8:00 AM. The PM peak hour of traffic occurs between 3:30 PM and 4:30 PM. Figure 6-1 shows the existing peak hour traffic and results of the capacity analysis.

6.1.1.2 Potential Impacts

The proposed project is expected to generate a total of 571 vehicles per hour (vph) during the AM peak hour of traffic; 326 vph entering the site and 245 vph exiting the site. During the PM peak hour of traffic, the project is expected to generate a total 705 vph; 374 entering the site and 331 vph exiting the site. Table 6-1 summarizes the project's trip generation characteristics.

133.2001P02/009-3m



Source: The Traffic Management Consultant, *Traffic Impact Analysis Report*, June 6, 1994

Figure 6-1
EXISTING AM AND PM PEAK HOUR TRAFFIC
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

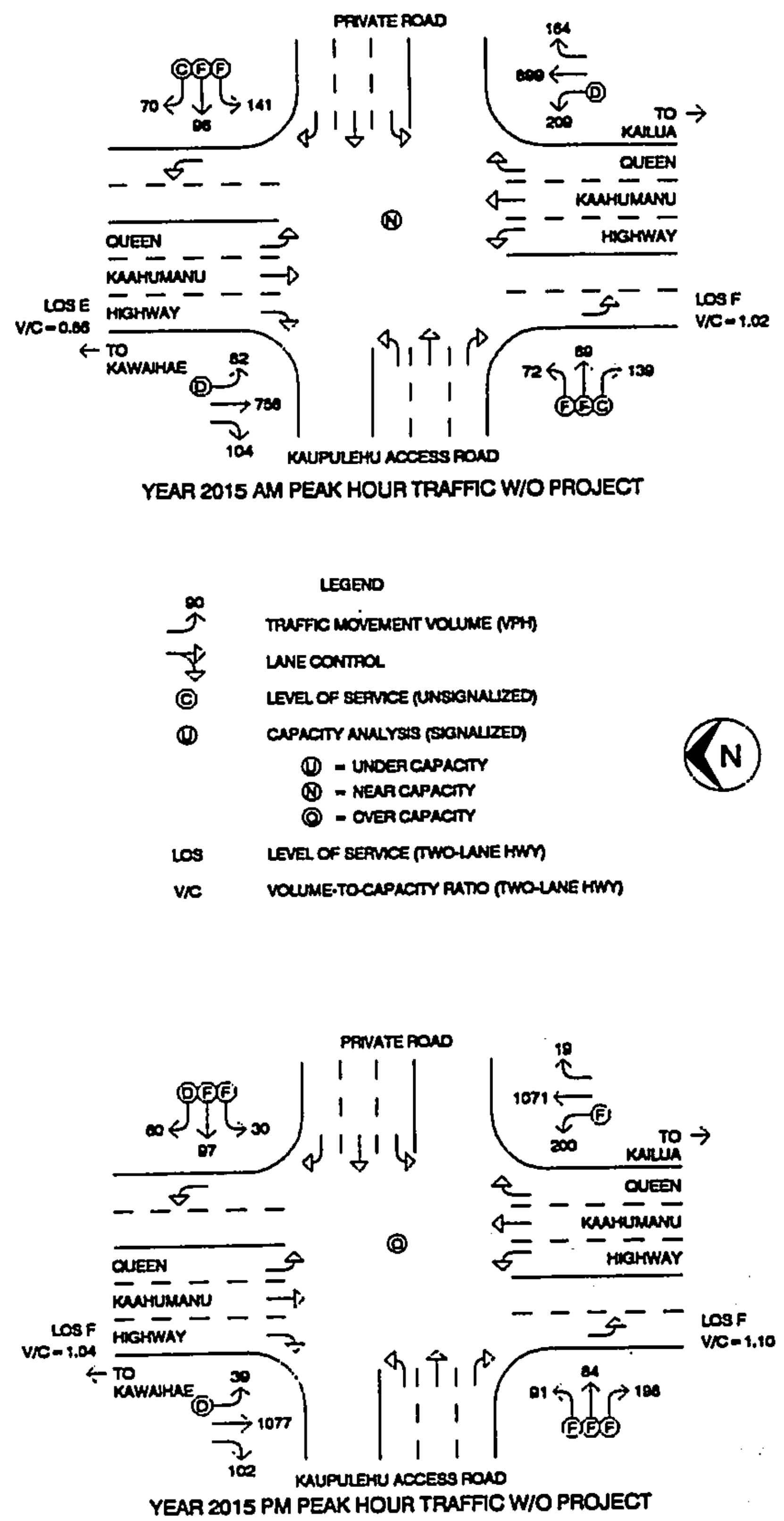
Table 6-1: Trip Generation Summary

Land Use	No. of Units	AM Peak Hour Traffic (vph) Enter	Exit	Total	PM Peak Hour Traffic (vph) Enter	Exit	Total
Single Family Residential	133	27	76	103	91	49	140
Multi-Family Residential	165	13	63	76	62	32	94
Recreational Homes	732	78	39	117	78	112	190
Golf Course (Holes)	36	144	29	173	64	59	123
Retail (1,000 GSF*)	45	64	38	102	79	79	158
Total Trips		326	245	571	374	331	705

The impact of the proposed project is determined by comparing the projected traffic conditions for the area with and without the project. The year 2015 was selected as the planning horizon because it corresponds with full build-out of the project. The State Department of Transportation (DOT) and the County of Hawaii projected in their 1991 "Island of Hawaii Long Range Highway Plan a 7.24% average annual growth rate in traffic for the region. This average annual rate includes traffic impacts projected in 1991 by the DOT for both Kaupulehu and Kukio. In addition to the DOT's projections, the current analysis also utilizes traffic projections developed in 1991 for the Maniniowali residential community.

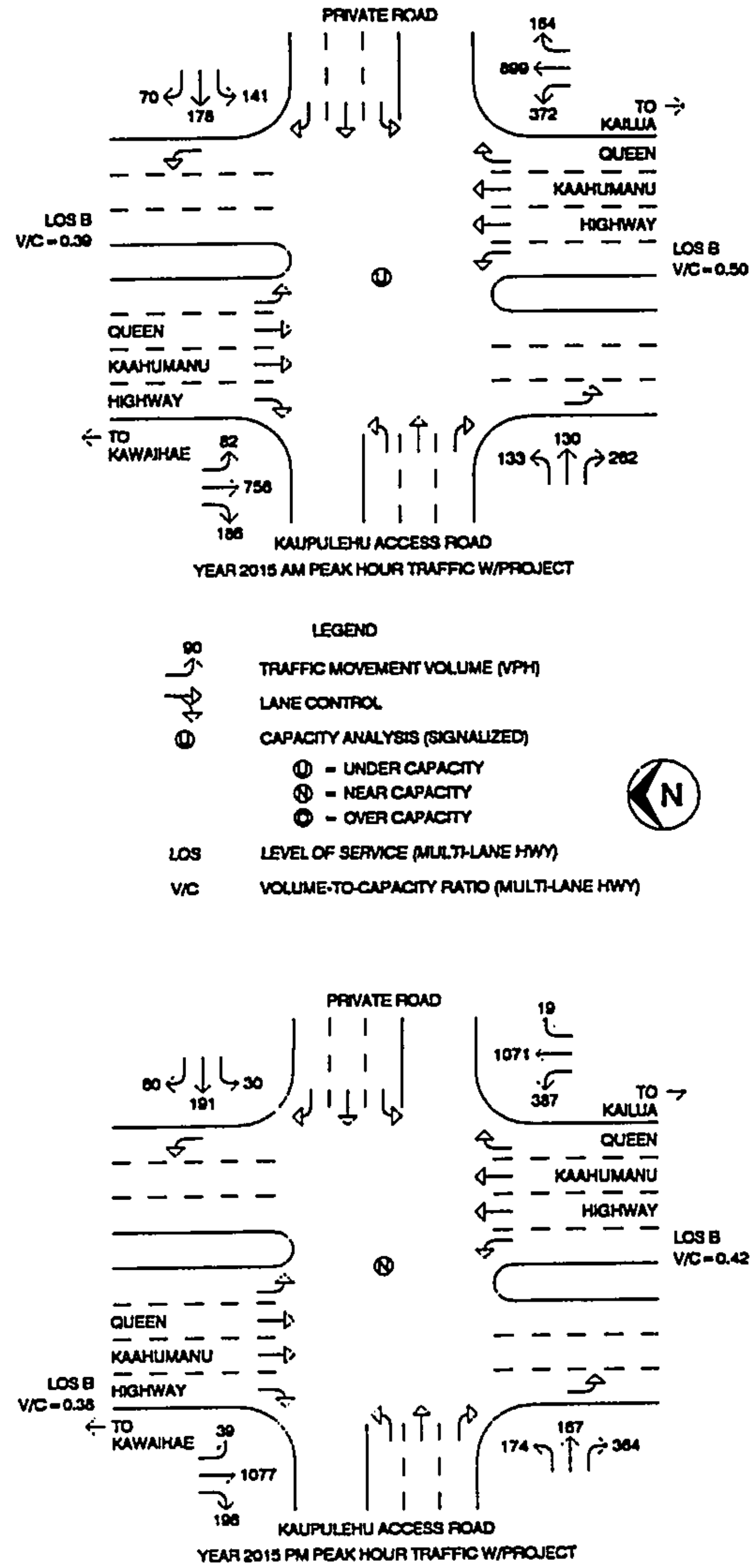
At year 2015 without the project, AM peak hour traffic at the intersection of Queen Kaahumanu Highway and Kaupulehu Access Road is expected to operate at near-capacity conditions under signalized conditions. The highway would operate at Level of Service "F" with a volume-to-capacity (v/c) ratio of 1.02. During the PM peak hour period, the intersection would operate at over-capacity conditions under signalized conditions. Level of Service would remain at "F" with a v/c ratio of 1.10. Figure 6-2 shows the year 2015 AM and PM peak hour traffic movements and capacity analysis without the project.

At year 2015 with the project, assuming that Queen Kaahumanu Highway is widened to a four-lane divided highway by the State DOT to mitigate project Level of Service "F" conditions without the project, the intersection of Queen Kaahumanu and



Source: The Traffic Management Consultant, *Traffic Impact Analysis Report*, June 6, 1994

Figure 6-2
AM AND PM PEAK HOUR TRAFFIC WITHOUT PROJECT
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994



Source: The Traffic Management Consultant, *Traffic Impact Analysis Report*, June 6, 1994

Figure 6-3
AM AND PM PEAK HOUR TRAFFIC WITH PROJECT
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

Kaupulehu Access Road is expected to operate at under-capacity conditions during the AM peak hour. Northbound traffic on the highway would operate at Level of Service "B" with a volume-to-capacity (v/c) ratio of 0.50. During the PM peak hour period, the intersection would operate at near-capacity conditions. Northbound traffic on the highway would operate at Level of Service "B" with a v/c ratio of 0.42. Figure 6-3 shows the year 2015 AM and PM peak hour traffic movements and capacity analysis with the project.

6.1.1.3 Proposed Mitigation

Based on the traffic analysis for the project, the following improvements should be considered to accommodate year 2015 highway deficiencies that will exist without the project:

a. The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road should be upgraded to a fully channelized intersection, providing exclusive left-turn storage lanes and right-turn deceleration lanes on Queen Kaahumanu Highway in both the northbound and southbound directions. Kaupulehu Resort is in the process of implementing this improvement.
b. Queen Kaahumanu Highway should be widened to provide a four-lane, divided highway, as proposed in the State DOT Long Range Highway Plan.
c. The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road should be signalized, when warranted.
d. Kaupulehu Access Road and the mauka-makai road should include separate right-turn, through, and left-turn lanes.

Together, these improvements will provide sufficient capacity to mitigate the traffic impacts of the proposed project.

With the implementation of these improvements, the proposed project should not have any significant impacts on traffic within the planning horizon. An at-grade, traffic-signalized, fully channelized intersection should accommodate the project's access needs through the year 2015.

It is anticipated that Queen Kaahumanu Highway would initially be widened to a four-lane, divided highway with at-grade signalized intersections at warranted locations. As traffic continues to increase, grade-separated interchange facilities and a frontage road system would be constructed as warranted. An interchange is expected to be located at the access to Kaupulehu Resort, which would also provide access to nearby developments such as Kukio and Maniniowali, via a frontage road system. The preliminary engineering study for the highway, conducted by the DOT, is expected to determine the access requirements for each of the proposed projects that would provide direct access via an interchange or connect to the frontage road system leading to the nearest interchange. The study should also determine how the frontage road system would collect and distribute traffic to and from the interchanges.

6.1.2 Harbors

6.1.2.1 Existing Conditions

There are four harbors serving West Hawaii: Kailua-Kona harbor, about 15 miles south of the Petition Area, Honokohau Small Boat Harbor, about 8 miles south, and Kawaihae Harbor, about 16 miles north, which includes a small boat harbor and commercial harbor. The former three are primarily recreational boat harbors, while the latter is the only deep draft harbor serving West Hawaii.

In 1989, Kawaihae Commercial Harbor received over 732,000 short tons of freight (excluding military cargo). This represented a 12 percent increase over the previous year and a 39 percent increase over 1985. Cargo transhipping through the harbor included building materials, consumer goods, large equipment and machinery, household effects, and provisions and supplies to service the resort industry in West Hawaii.

The Harbors Division of the State Department of Transportation has developed a long-range master plan to guide improvements to the Kawaihae Harbor facilities. These include an Army Corps of Engineers plan for the extension of the existing small boat harbor breakwater and construction of an additional breakwater at the small boat harbor, and the State's plan for the relocation of the existing Young Bros. interisland barge operation from the northern end to the southern end of the commercial harbor basin. The Harbors Division is also reconvening its harbor task force to, among other things, reevaluate the Kawaihae Harbor master plan in light of the continuing reduction of sugar cultivation on the Big Island. The eventual elimination of bulk sugar storage facilities at the harbor could free space up for other harbor-related uses.

With regard to the exist small boat harbors, improvements proposed at Kawaihae may result in the greater availability of boat slips. Honokohau small boat harbor is also proposed for expansion to accommodate approximately 450 new boat slips. The actual timetable for completion of these improvements is unknown.

6.1.2.2 Potential Impacts

The proposed project will contribute to the demand for building materials and consumer goods in the North Kona region. Because the Kawaihae deep draft harbor is the principal harbor serving West Hawaii, development of the proposed project will have an indirect impact upon harbor operations in the form of increased volumes of cargo arrivals. However, in light of the DOT's long-range plans for harbor improvements, it is anticipated that the increased activity generated by the proposed project will be easily accommodated at the harbor. Therefore, the projected impact is not considered to be significant.

The project could also impact recreational harbor facilities in West Hawaii in the form of increased demand for boat slips and charter services. Because demand for private slips has historically exceeded supply, the proposed project results in a negative impact because it may exacerbate the already existing demand. The extent of this potential impact cannot be easily quantified because there is no means available to determine how many potential occupants of the development will choose to purchase recreational boats and want to berth them at public small boat harbors. Nor is it possible at this point to determine whether existing and future demand for boat slips will be fully accommodated by the State's harbor expansion plans. Consequently, the matter cannot be resolved.

6.1.2.3 Proposed Mitigation

No specific measures to mitigate the potential impact of the project upon harbor facilities are warranted.

6.1.3 Airports

6.1.3.1 Existing Conditions

Passenger and cargo air service facilities for West Hawaii are located at Keahole Airport, about 8 miles south of the Petition Area. This State-owned facility had over 56,000 operations (includes arrivals and departures of air carriers, air taxis, general aviation, and military flights) in 1991. Nearly half of these operations were air carriers. In 1991, 134,000 overseas passengers deplaned at Keahole, along with 914,795 interisland passengers.

The Keahole runway was recently increased by 4,500 feet in length (for a total length of 11,000 feet) in order to accommodate intercontinental air service. The State is also planning to expand terminal facilities at the airport.

6.1.3.2 Potential Impacts

The proposed project represents a consequence of continuing visitor industry growth in West Hawaii. Because it is located within in an area identified by the State as a Resort Destination Node, the provision of state services such as expanded airport facilities to support projected growth is presently the subject of long-range planning activities by the Airports Division of the State DOT. Project related impacts at the Keahole Airport will likely take the form of increased passenger arrivals and departures (both intercontinental and interisland) and increased volumes of cargo arrivals and departures. Such increases will be easily accommodated by the State's airport facility expansion plans. Therefore, any impacts related to the project are not considered to be significant.

6.1.3.3 Proposed Mitigation

No mitigation measures are warranted.

6.1.4 Potable and Non-Potable Water

6.1.4.1 Existing Conditions

The Petition Area is not presently serviced by a potable water system.

6.1.4.2 Potential Impacts

At full build-out of the 1,030 unit project, demand for potable water will total approximately .82 mgd and demand for non-potable water for irrigation will total about 1.6 mgd. Table 6-2 provides a detailed explanation of these figures.

Table 6-2: Projected Water Demand

Proposed Land Use	Number of Units	Water Demand Per Unit (gpd)	Average Potable Water Demand (gpd)	Average Non-Potable Water Demand (gpd)
Low-Density Residential	530	600	382,800	49,194
Multi-Family Residential	500	600	349,800	58,125
Commercial Center	45,000 sf*		33,000	3,220
Recreation Area	6,749 sf		7,000	3,492
Ocean Club	14,134 sf		9,000	1,070
Golf Club House	57,802 sf		36,000	42,692
Golf Courses	2			1,245,000
Landscape Irrigation				211,583
TOTAL:			817,600	1,614,376

*leasable portion of 11 acre Commercial Center site.

To address this demand, a total of three new potable water wells and four non-potable wells will be required. With regard to the potable wells, two will be sufficient to address a maximum daily demand of 1.2 million gallons and the third is required by the County as a back-up well.

6.1.4.3 Proposed Mitigation

See discussion in section 4.6.3.

6.1.5 Wastewater Collection, Treatment, and Disposal
6.1.5.1 Existing Conditions

The Petition Area is not presently serviced by a wastewater collection and treatment system.

6.1.5.2 Potential Impacts

At build-out, the proposed project will generate a total of 544,500 gallons of wastewater per day, assuming 100 percent occupancy. Approximately 94 percent of this volume can be attributed to the proposed low-density and multi-family residential units. The remainder can be attributed to the proposed recreational uses.

6.1.5.3 Proposed Mitigation

Wastewater will collected and transmitted to a privately-funded and developed wastewater treatment plant, which will serve the proposed development as well as the adjacent Kaupulehu Resort and the Kona Village Resort. The secondary-level treatment facility will be located in a Resort Service Area that includes sufficient land to accommodate facility expansion to serve the cumulative Kaupulehu developments. Effluent from the treatment facility will be utilized to supplement non-potable irrigation water at the proposed project's 36-hole golf course.

6.1.6 Solid Waste Collection and Disposal
6.1.6.1 Existing Conditions

The Petition Area is not presently serviced by a solid waste collection and disposal system. Solid waste collected throughout the West Hawaii area is disposed of at the County's West Hawaii Sanitary Landfill at Puuanahulu.

6.1.6.2 Potential Impacts

At full build-out, the proposed project will have a daily de facto census of approximately 1,555 people, plus about 333 employees, as well as golfers, and temporary visitors. Utilizing the County's planning standard of 6 pounds per capita per day, it is projected that solid waste production by the project's population and facilities will be approximately 5.7 tons per day, or 2,067 tons per year. Based upon the County's projections for West Hawaii solid waste generation, in the year 2000 this volume would constitute just under 2.5 percent of the total annual volume of solid waste generated in West Hawaii, and about 1.3 percent of the total annual volume generated in West Hawaii in the year 2010 (West Hawaii Sanitary Landfill, Final EIS, July 1989). The project's impact upon the operation of the County landfill is believed to be insignificant.

6.1.6.3 Proposed Mitigation

Because the project is being constructed on a relatively barren lava field, very little green waste will be generated during the construction phase. During the operation phase, the mulching of yard trimmings and golf course green waste will help to reduce the volume of solid waste that must be sent to the County's landfill.

6.1.7 Electrical Power and Communications
6.1.7.1 Existing Conditions

The Keahole Generating Station is owned and operated by Hawaii Electric Light Company (HELCO) and is located just mauka of the Queen Kaahumanu Highway, about 8 miles south of the Petition Area. This facility has a current generating capacity of 30.25 megawatts (MW). According to a 1993 Revised Draft EIS submitted by HELCO to support its application for the expansion of the Keahole station by an additional 56 MW, "...the demand for electric service has increased significantly in the West Hawaii area in particular. HELCO's 1991 application to the Public Utilities Commission (PUC) reported that, between 1990 and 1994, more than half of HELCO's forecasted demand is expected to occur in West Hawaii" (HELCO, RDEIS, July 1993, p. 1-6).

The Kaupulehu ahupua'a is presently traversed by overhead 69 kv electrical transmission lines about 3,000 feet inland from the Queen Kaahumanu Highway at an elevation of about 425 feet above mean sea level. These lines generally parallel the alignment of the highway and link the Keahole Generating Station to the Waimea station, approximately 40 miles north east of Keahole.

Hawaiian Telephone Company provides telephone service to the North Kona area. Cable television service is provided in North Kona by a private company.

6.1.7.2 Potential Impacts

The total electrical demand for the proposed project at build-out is projected to be approximately 8,575 Kilowatts. This demand would constitute roughly 10 percent of the total future generating capacity of the Keahole Generating Station, if the current application for facility expansion is approved. Under present conditions, the project's demand would constitute approximately 30 percent of the Keahole Generating Station's existing capacity.

With regard to telephone service, the proposed project will require approximately 1,500 units.

6.1.7.3 Proposed Mitigation

According to the Office of State Planning's West Hawaii Regional Plan, "the impact of the proposed West Hawaii developments on the County's energy mix will be severe...To meet the increasing future demands of the region, Hawaii Electric Light Company, Inc., is planning to construct additional power plants, all to be fueled by petroleum and/or coal. The utility expects the need to generate an additional 200 megawatts of power generation capacity by the year 2007. (OSP, p. 63).

To assist in the reduction of electrical energy consumption, a number of conservation measures can be implemented at the proposed project. The energy-efficient design of homes and the strategic use of landscaping to shade homes will help to minimize the use of air conditioning units: a major consumer of electrical energy. The installation of low energy lamps and lighting fixtures, as well as room occupancy sensors will also be encouraged. The installation of solar water heaters will be recommended for homes.

All utility lines, including electrical, telephone, and cable television, will be buried.

6.2 Public Services
6.2.1 Police and Fire Protection
6.2.1.1 Existing Conditions

Police protection for the North Kona area is provided by approximately 60 police officers stationed at the County Satellite Police Station at Kealakehe, approximately 10 miles south of the Petition Area.

Fire protection services are provided by the County's Kailua Fire Station, located on Palani road just mauka of the Queen Kaahumanu Highway, approximately 15 miles south of the Petition Area. In 1993, the station had a staff of 33 and the following equipment: one ladder truck, one fire engine, one tanker, one rescue boat, and one ambulance unit.

6.2.1.2 Potential Impacts

Development of the 1,030 proposed residential units will probably require an expansion of emergency services in the West Hawaii area. As discussed in the previous chapter, the increased real property revenues generated by the proposed project will help to offset the County's expenses for general expansion of its emergency services to serve West Hawaii.

6.2.1.3 Proposed Mitigation

No specific mitigation measures are proposed.

6.2.2 Health Care
6.2.2.1 Existing Conditions

The State's Kona Hospital is located in Kealakekua, approximately 24 miles south of the Petition Area, and serves the entire western side of the Big Island. According to the County Planning Department, "It is a 75-bed acute care facility that provides a range of services including long-term care, skilled and interim nursing care, obstetrical, pediatrics, laboratory, cat scan, physio- and occupational therapy, chemotherapy, and a 24-hour emergency room" (R.M. Towill, 1992).

Construction of a new health care facility, the North Hawaii Community Hospital (NHCH), has recently begun in Waimea. The 75,000 square foot facility is planned to open in late 1995.

6.2.2.2 Potential Impacts

With a projected de facto population at build-out of approximately 1,555 persons, the proposed project will impact health care services in the West Hawaii area. However, considerable attention is being devoted to the issue of improved health care services by the State and the County. Therefore, it is believed that by the time the project is implemented, health care services will be sufficient to accommodate the increased demand.

6.2.2.3 Proposed Mitigation

No specific mitigation measures are warranted.

6.2.3 Schools
6.2.3.1 Existing Conditions

Public educational facilities in the region include Kahakai (grades k to 5), Kealakehe (k to 5 and 6 to 8), Konawaena at Kealakekua (7 to 12), and a new high school proposed at Kealakehe. Private schools in the area include University of Nations (with preschool), Creative Day Preschool, Kona Baptist Church, and Mokuaikaua church/Nursery. Additional private schools are located in Kamuela, Kapaau, Houaloa, and Honaunau. The State of Hawaii is also proposing a West Hawaii University campus be located somewhere between Kailua-Kona and Keahole.

6.2.3.2 Potential Impacts

Due to the occupancy characteristics of the proposed units, it is unlikely that project residents will have a significant impact upon the public and private schools of West Hawaii. It is more likely that project-generated employment will impact the school system. Approximately 333 employees will be required to fill jobs created by the proposed project: golf course club house and maintenance crews, commercial center retail staff, and common area maintenance crews.

The Petitioner projects that if all 333 employees are new arrivals to the area, they could generate approximately 67 elementary school students, 30 intermediate school students, and 27 high school students. However, at least a portion of the jobs will be filled by existing residents of the West Hawaii area, which would result in a reduced impact on the potential number of new students. Therefore, the project's potential impact upon West Hawaii schools is not considered to be significant.

6.2.3.3 Proposed Mitigation

No specific mitigation measures are warranted.

6.2.4 Parks and Recreation
6.2.4.1 Existing Conditions

The nearest existing park is the Kaloko-Honokohau National Historic Park which is operated by the National Park Service and is located adjacent to Honokohau Harbor, about 10 miles south of the Petition Area. The park boundaries include the 20-acre Aimakapa Fishpond, a brackish water pond and wetland providing habitat for endangered Hawaiian waterbirds, waterfowl, and shorebirds. The National Park Service improvement plans for the park include a parking area for up to 250 cars and buses, an orientation structure, and an administrative office building.

In its West Hawaii Regional Plan, the Office of State Planning includes recommendations for new state parks to be located at Kapalaoa-Kiholo and Maniniowali. The Kapalaoa-Kiholo area is situated makai of the Queen Kaahumanu Highway within the State-owned lands of Puuwaawaa, which abut the northeastern property boundary of the Kaupulehu ahupua'a and are adjacent to the Petition Area. The Maniniowali area is situated immediately south of the Kukio resort property, about two miles south of the Petition Area. The State Parks division of the Department of Land and Natural Resources indicates that these two areas will likely be retained as natural resource areas and there are no current plans for improvements. However, the division is presently preparing plans for the Makalawena-Mahaiula State Park which will be located along the coastline about mid-way between the Petition Area and Honokohau Harbor.

Existing State parks include the Hulihee Palace (operated by the Daughters of Hawaii) in Kailua, the Old Kona Airport State Recreation area (117 acres), and various facilities located at public school sites. The Old Kona Airport park includes a beach park, pavilion, sports fields, tennis facilities, a gym under construction, and a canoe storage project.

Existing County parks are generally situated in the Kailua-Kona area and include Hale Halawai (3.2 acres), Hillcrest Neighborhood Park (1.63 acres), the Kailua Community Park (the old Kona Airport area: 34.85 acres) within the State Recreation Area, Onea Bay (0.53 acre right-of-way), Kailua parking lot (0.3 acre landscaping), Kailua Pier (0.1 acre rest rooms), Palani Road (0.1 acre medial landscape), and other regional beach parks.

The County's Keahole to Kailua Development Plan recommends the development of a 1.5 acre Waterfront Park, regional sports complex (10 acres), a district park (10 acres), and a municipal golf course adjacent to the former Kealakehe landfill.

6.2.4.2 Potential Impacts

Given the character of the proposed project and the recreational amenities it includes, it is not anticipated that its residents will have a significant adverse impact upon public recreational facilities and parks in the West Hawaii area. With regard to public access to the project's coastal area, a large recreation area is proposed at the shoreline abutting the state property. The recreation area will include public parking and comfort station, and will provide public beach access to the historic coastal trail and shoreline.

6.2.4.3 Proposed Mitigation

No specific mitigation measures are warranted.

Chapter 7

Consistency with Land Use Policies, Plans, and Controls

CHAPTER 7 CONSISTENCY WITH LAND USE POLICIES, PLANS, AND CONTROLS

7.1 State Land Use Policies and Plans

7.1.1 Hawaii State Plan

The Hawaii State Plan as set forth in Chapter 226, *Hawaii Revised Statutes*, serves as a guide for future long-range development of the State. Specific goals, objectives, policies, and priority guidelines of the State Plan, which most directly relate to the proposed project, are presented and discussed below:

Part I. Overall Theme, Goals, Objectives and Policies

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 proposed project will contribute to the attainment of the "elements of choice and mobility" for Hawaii's people which are embodied in the three goals. The provision of up to 1,030 residential units, and the jobs created to construct and maintain them will contribute to the economy of the area and the social well being of the community. The low density character of the proposed project will create a complementary expansion of the Kaupulehu Resort.

SEC. 226-5 ***Objective and policies for population.*** *(a) 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. (b) To achieve the population objective, it shall be the policy of this State to:*

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

(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: Development of the proposed project is consistent with the state's population growth and distribution policies which identify West Hawaii as a major visitor destination area, as well as a dynamic resident growth center. The project will satisfy market demand for resort/residential units, which will in turn, benefit the economy of the region. The entire project will be constructed over a twenty year period and supportive infrastructure will be developed to accommodate the project phasing.

SEC. 226-6 *Objectives and policies for the economy-in general.* *(a) Planning for the State's economy in general shall be directed toward achievement of the following 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.*

(b) *To achieve the general economic objectives, it shall be the policy of this State to:*

(2) *Promote Hawaii as an attractive market for environmentally and socially sound investment activities that benefit Hawaii's people.*

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

(11) *Maintain acceptable working conditions and standards for Hawaii's workers.*

(12) *Provide equal employment opportunities for all segments of Hawaii's population through affirmative action and non-discrimination measures.*

(13) *Encourage businesses that have favorable financial multiplier effects within Hawaii's economy.*

Discussion: The proposed project will strengthen the visitor industry in West Hawaii by providing resort/residential opportunities for the Kaupulehu Resort destination node. The Concept Plan for the project will complement the development character of the neighboring Kaupulehu Resort. The transformation of Kailua-Kona area from an agricultural based economy to a visitor/service based economy will benefit the existing and future population by contributing to the diversification of employment opportunities. As discussed in the project's market report, development of the project will result in a multiplier effect of 2.0 for the West Hawaii economy: at build-out, the project will generate over 330 onsite jobs and over 700 offsite jobs.

SEC. 226-10 Objectives and policies for the economy - potential growth activities. *(a) Planning for the State's economy with regard to potential growth activities shall be directed towards achievement of the objective of development and expansion of potential growth activities that serve to increase and diversify Hawaii's economic base. (b) To achieve the potential growth activity objective, it shall be the policy of this State to:*

(6) *Provide public incentives and encourage private initiative to attract new industries that best support Hawaii's social, economic, physical, and environmental objectives.*

Discussion: The proposed project will contribute to the fulfillment of the State's vision for the West Hawaii visitor destination area, as set forth in the West Hawaii Regional Plan. Development of the Kaupulehu Resort destination node will generate new demand for business and services throughout region, thereby attracting new visitor-industry activities.

SEC. 226-11 Objectives and policies for the physical environment-land-based, shoreline, and marine resources. *(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:*

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

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

(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:

(1) *Exercise an overall conservation ethic in the use of Hawaii's natural resources.*

(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.*

(5) *Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.*

(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 to be developed on otherwise unusable lava flows. The shoreline and coastal region of the Petition Area will be preserved in its natural form. No development is proposed makai of the certified shoreline. A large public-oriented recreation area is proposed to facilitate public access to the coastal area. An existing historic trail along the shoreline will be preserved for public access. Public parking and comfort stations at the recreation area will enable the public to use the trail as a pedestrian route along the shoreline of the adjacent state property to Kiholo Bay and beyond, as envisioned by the State Parks Division of the Department of Land and Natural Resources. The proposed development will compliment the natural environment by maintaining a low-density character. The inclusion of a 36-hole golf course in the project will ensure the preservation of open space. An endangered plant identified on the subject property will be preserved through the creation of a special buffer area.

SEC. 226-12 Objective and policies for the physical environment--scenic, natural beauty, and historic resources. *(a) 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 multicultural/ historical resources. (b) To achieve the scenic, natural beauty, and historic resources objective, it shall be the policy of this State to:*

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

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

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

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

Discussion: A detailed Archaeological Inventory has been conducted for the entire property and 57 significant historic sites have been identified for preservation. The low-profile, low-density character of the proposed development is consistent with the policy to preserve views and vistas of the ocean and mountains. The shoreline trail discussed above will be preserved and restored.

SEC. 226-13 Objectives and policies for the physical environment--land, air, and water quality. *(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:*

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

(2) *Greater public awareness and appreciation of Hawaii's environmental resources.*

(b) *To achieve the land, air, and water quality objectives, it shall be the policy of this State to:*

(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.*

Discussion: Planning and design of the proposed project is supportive of Federal, State and County environmental regulations and controls. Conservation will be emphasized at the proposed project as a means of limiting demand for both potable and non-potable water. Potable water can be conserved in the proposed residential units by utilizing water conservation devices such as low-volume shower heads and by minimizing its use for irrigation purposes. The principal method for non-potable water conservation will be to utilize treated effluent from the wastewater treatment plant to supplement irrigation water intended for use on the 36-hole golf course. To mitigate the potential impact of surface water runoff and drainage, including storm drainage, on coastal resources, all components of the proposed development will be designed to retain surface drainage on-site. Direct discharge to the ocean will be minimized or avoided. This will be accomplished by grading development areas to direct surface runoff away from the ocean. No habitable structures are presently proposed in areas that may be subjected to potential storm water runup. With regard to tsunami hazards, a number of measures can be undertaken. First, all prospective homeowners within the general vicinity of the coastline will be provided with informative material at the time they purchase their home. Second, an evacuation plan will be prepared to identify the location of evacuation routes, evacuation procedures, and the location of emergency shelters. Third, a tsunami warning siren system will be installed within the proposed project as a means of informing area residents of an impending threat. The warning system will be linked to the statewide civil defense system and will be activated directly by the Hawaii County Civil Defense Agency. As is the case with tsunamis, due to the uncertainty of volcanic eruptions, the most practical mitigative measure is the provision of a early warning alert system that will warn area residents of an impending threat. Together with a comprehensive evacuation plan, a warning system will be implemented to ensure that loss of life does not occur. The evacuation plan will be submitted to the county for approval.

SEC. 226-14 Objective and policies for facility systems--in general. *(a) 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.*

(3) *Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.*

Discussion: The proposed project will be serviced by a privately-developed wastewater treatment plant and private access roads.

SEC. 226-15 Objectives and policies for facility systems - solid and liquid wastes. *(a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following 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.*

(b) *To achieve solid and liquid waste objectives, it shall be the policy of this State to:*

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

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

(3) *Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.*

Discussion: Wastewater will collected by a privately-developed wastewater collection system and transmitted to the wastewater treatment plant. The privately developed treatment facility will serve the Kaupulehu Resort, the Kona Village Resort, and the proposed project. With regard to solid waste, because the project is being constructed on a relatively barren lava field, very little green waste will be generated during the construction phase. During the operation phase, the mulching of yard trimmings and golf course green waste will help to reduce the volume of solid waste that must be sent to the County's landfill.

SEC. 226-16 Objective and policies for facility systems- water. *(a) 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.*

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

(3) *Reclaim and encourage the productive use of runoff water and waste water discharges.*

(6) *Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.*

Discussion: With regard to water supply, the proposed water wells will be limited to a daily pumpage of approximately 400 gallons per minute. These yields are based upon the calculated sustainable yield of the area's groundwater resources. Conservation will be emphasized at the proposed project as a means of limiting demand for both potable and non-potable water. Potable water can be conserved in the proposed residential units by utilizing water conservation devices such as low-volume shower heads and by minimizing its use for irrigation purposes. The principal method for non-potable water conservation will be to utilize treated effluent from the wastewater treatment plant to supplement irrigation water intended for use on the 36-hole golf course. The average volume of effluent projected to be available to supplement irrigation requirements is estimated to be 0.404 million gpd. In addition to the use of treated effluent for irrigation, salt-tolerant species of turf grass are being considered for use on the proposed golf courses. This will enable relatively high saline content brackish water to be utilized for irrigation.

SEC.226-18 Objectives and policies for facility systems - energy/ telecommunications. *(a) Planning for the State's facility systems with regard to energy/telecommunication shall be directed towards the achievement of the following objectives:*

(2) *Increased energy self-sufficiency.*

Discussion: To assist in the reduction of electrical energy consumption, a number of conservation measures can be implemented at the proposed project. The energy-efficient design of homes and the strategic use of landscaping to shade homes will help to minimize the use of air conditioning units: a major consumer of electrical energy. The installation of low energy lamps and lighting fixtures, as well as room occupancy sensors will also be encouraged. The installation of solar water heaters will be recommended for homes. All utility lines, including electrical, telephone, and cable television, will be buried.

SEC.226-19 Objectives and policies for socio-cultural advancement - housing. *(a) Planning for the State's socio-cultural advancement with regard to housing shall be directed towards achievement of the following 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.*

(b) *To achieve the housing objectives, it shall be the policy of this State to:*

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

(3) *Increase home ownership 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.*

(6) *Facilitate the use of available vacant, developable, and underutilized urban lands for housing.*

Discussion: The development of up to 1,030 residential units will provide new housing opportunities to satisfy demand for market-priced homes in West Hawaii. The low-density character of the project will be compatible with the Kaupulehu Resort and will strengthen it as a resort destination node and an economically beneficial use of the land.

SEC. 226-20 *Objectives and policies for socio-cultural advancement - health.*
(a) Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives:

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

(b) *To achieve the health objectives, it shall be the policy of this State:*

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

Discussion: The provision of a sanitary wastewater collection and treatment system will ensure environmentally healthful conditions.

SEC. 226-23 *Objective and policies for socio-cultural advancement - leisure.*
(a) 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. (b) To achieve the leisure objective, it shall be the policy of this State to:

(3) *Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved facility design and maintenance.*

(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.*

(5) *Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.*

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

Discussion: The provision of a recreational area at the project which will include public parking, comfort station, and shoreline access will enable the public to utilize the coastal region of state-owned property adjacent to Kaupulehu that is presently underutilized and largely inaccessible. In addition, the preservation of a coastal shoreline trail will provide opportunities for the enjoyment of recreational resources along the shoreline of the Petition Area.

Priority Guidelines:

The purpose of this part of the State Plan is to establish the 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 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 a 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:*

(A) *An industry that can take advantage of Hawaii's unique location and available physical and human resources.*

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

(C) *An industry that is willing to hire and train Hawaii's people to meet the industry's labor needs.*

(D) *An industry that would provide reasonable income and steady employment.*

Discussion: Development of the proposed project is consistent with the State's goal to focus visitor industry services at "destination nodes" in West Hawaii. At full build-out, the project will provide a combined total of more than a thousand onsite and offsite job opportunities, which will help to strengthen the economy of West Hawaii.

(e) Priority guidelines for water use and development:

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

(2) Encourage the improvement of irrigation technology and promote the use of non-potable water for agricultural and landscaping purposes.

Discussion: Potable water can be conserved in the proposed residential units by utilizing water conservation devices such as low-volume shower heads and by minimizing its use for irrigation purposes. Non-potable water will be utilized for irrigation of the proposed 36-hole golf course and for landscape irrigation wherever practicable.

(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.

(3) Provide incentives to encourage the use of energy conserving technology in residential, industrial, and other buildings.

Discussion: Solar-water heating and the use of low-energy electrical lights and energy-saving devices will be encouraged.

SEC. 226-104 Population growth and land resources priority guidelines.
(a) Priority guidelines to effect desired statewide growth and distribution. (b) Priority guidelines for regional growth distribution and land resource utilization:

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

(10) Identify critical environmental areas in Hawaii to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.

(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.

(13) Protect and enhance Hawaii's shoreline, open spaces, and scenic resources.

Discussion: The proposed project is designed to support the protection and preservation of the shoreline. No development is proposed makai of the certified shoreline and all infrastructure systems at the project will be designed to ensure that the offshore water quality is not compromised.

7.1.2 State Functional Plans

As set forth in Section 2 of the Hawaii State Plan, 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 state's twelve functional plans were examined to determine the relationship of the proposed project to each of their administrative areas of responsibility.

7.1.2.1 Agricultural Functional Plan (1985)

Because the Petition Area contains no agricultural lands, the objectives and policies of the State Agricultural Functional Plan area not applicable.

7.1.2.2 Conservation Functional Plan (1991)

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 proposed 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 utilization of barren lava fields for residential development (as opposed to agricultural lands) is a practical means of preserving critical and significant natural resources. By observing all County shoreline setbacks, the project will minimize impact on marine and coastal resources. Historical and archaeological resources identified as significant will be preserved.

7.1.2.3 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.

7.1.2.4 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.

7.1.2.5 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 will provide new employment opportunities in the construction trades and in golf course operation and management to the existing and future residents of the region which will have a direct impact upon improving the quality of life in the region. At full build-out, over a thousand new jobs will be generated by the project. The proposed project complies with the State Employment Functional Plan in providing alternative sources of employment to the region.

7.1.2.6 Energy Functional Plan (1991)

The Energy Functional Plan has three major strategies to achieve the objectives, policies and priority guidelines of the Hawaii State Plan. These involve reducing the state's dependency upon petroleum and other fossil fuels, developing an integrated approach for more effective energy development and management, and ensuring an adequate and timely supply of reserve petroleum in the event of disruption in petroleum supplies. The proposed project can assist in the implementation of the first strategy by ensuring that master planning promotes energy efficiency development techniques and energy conservation whenever possible.

7.1.2.7 Health Functional Plan (1989)

The State Health Functional Plan includes objectives and policies relating to environmental health. The proposed project intends to comply with all applicable Department of Health rules and regulations. 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 accommodate the sewage generated by the project will be master planned to ensure its timely development and thereby minimize environmental impacts.

7.1.2.8 Historic Preservation Functional Plan (1991)

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 this EIS document. Recommendations are included for the disposition of the sites, including preservation of those sites identified as significant for cultural, scientific or educational value. Implementation of the proposed project will include the preparation of an Historic Sites Mitigation Plan to ensure conformance with all applicable state, county and federal regulations concerning historic sites. The property owner is committed to full compliance with all adopted regulations and policies pertaining to Historic Preservation.

7.1.2.9 Housing Functional Plan (1989)

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

Policy: E(1) *Promote the design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, employment and other concerns of existing communities and surrounding areas.*

Discussion: The provision of recreational opportunities and commercial services within the proposed project will enhance the residential community and ensure that all needed services are provided.

7.1.2.10 Human Services Functional Plan (1989)

Objectives and polices of this Functional Plan are directed specifically to 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. The functional plan does not relate directly to the proposed project.

7.1.2.11 Recreation Functional Plan (1991)

Policy: II-A(1) *Plan and develop facilities and areas that feature the natural and historic/cultural resources of Hawaii. Develop interpretive programs for these areas.*

Policy: II-A(3) *Proceed with planning, acquisition, and development of trails.*

Policy: II-C(1) *Meet the demand for recreational opportunities in local communities.*

Policy: III-A(1) Require land use permit applications to fully address the impact of their projects on trails and public access.

Policy: III-C(1) Assure access to recreational areas in Forest Reserve lands.

Policy: III-D(1) Give priority to acquiring public access to selected shoreline and mauka recreation areas.

Policy: III-D(2) Provide adequate improvements at public accessways.

Discussion: The preservation and restoration of the coastal trail and the provision of public access to it fully supports the policies of the Recreation Functional Plan.

7.1.2.12 Tourism Functional Plan (1991)

The objectives and policies of the Tourism Functional Plan do not directly relate to the proposed development because they are mainly targeted to governmental agencies. However, Action II.A.7.c., which calls for the acquisition and expansion of beach parks in areas including the region between 'Anaeho'omalu Bay and Kaupulehu, is indirectly supported through the provision of the public recreation area at the proposed project and the restoration of the coastal trail. The promotion of greater public access to the State's coastal properties, and the provision of support services may assist the state in its own plans for coastal improvements in the area.

7.1.2.13 Transportation Functional Plan (1991)

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, specific mitigation measures have been proposed to improve traffic circulation in the region and provide greater access to the project site. These improvements will enhance the functional plan's intent to promote the timely development of infrastructure to serve new development and to improve the quality of life for residents of the area.

7.1.2.14 Water Resources Development Functional Plan (1985)

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. Implementation of water infrastructure will be done in cooperation with the appropriate State and County agencies.

7.1.3 State Land Use Law

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). The administrative rules of the Hawaii State Department of Land and Natural Resources, Title 13, Chapter 2, govern land use within the conservation district and provide for four categories, or subzones. The subject property contains 2 subzones; Resource, along the shoreline, and General on the remainder of the property.

The Petitioner is seeking reclassification of the Conservation designation for the subject area to Urban, consistent with the County General Plan designation of Urban Expansion and the State's policy promoting the development of Kaupulehu as a resort destination node. Figure 7-1 depicts the existing State Land Use District boundaries of the Kaupulehu property. Figure 7-2 presents the proposed Land Use District boundaries.

7.1.4 Coastal Zone Management Act (Chapter 205-A, HRS)

The proposed project does not involve Federal lands or agencies, and therefore, does not require a coastal zone management federal consistency review. The specific objectives and polices of the CZM act are implemented through Chapter 205A, Hawaii Revised Statutes, which establishes regulation of the Special Management Area (SMA). The project's compliance with SMA regulations is discussed below in section 7.2.5.

7.1.5 Hawaii Water Code

Chapter 174C, *Hawaii Revised Statutes*, The State Water Code, was adopted by the State Legislature in 1987 to "protect, control, and regulate the use of Hawaii's water resources for the benefit of its people." The Water Code is administered by the Commission on Water Resources Management, Department of Land and Natural Resources. The Code's policies include protection of water resources, maintenance of ecological balance and scenic quality, improvement of water quality, and establishment of comprehensive water planning statewide. A major element of the State Water Code is the development of the Hawaii Water Plan discussed below.

Discussion: Preparation of this environmental impact statement and the recommended mitigation measures contained herein represent the means for compliance with Water Code policies.

7.1.6 State Water Plan

As adopted by the Commission on Water Resource Management in July, 1990, the State Water Plan contains five elements; A Water Quality Plan prepared by the Department of Health, a Water Projects Plan prepared by the DLNR, a Water Resource Protection Plan prepared by the DLNR, and two County Water Use and Development Plans (Hawaii and Kauai). The overall purpose of the Water Plan is set forth in section 174 C-31(d):

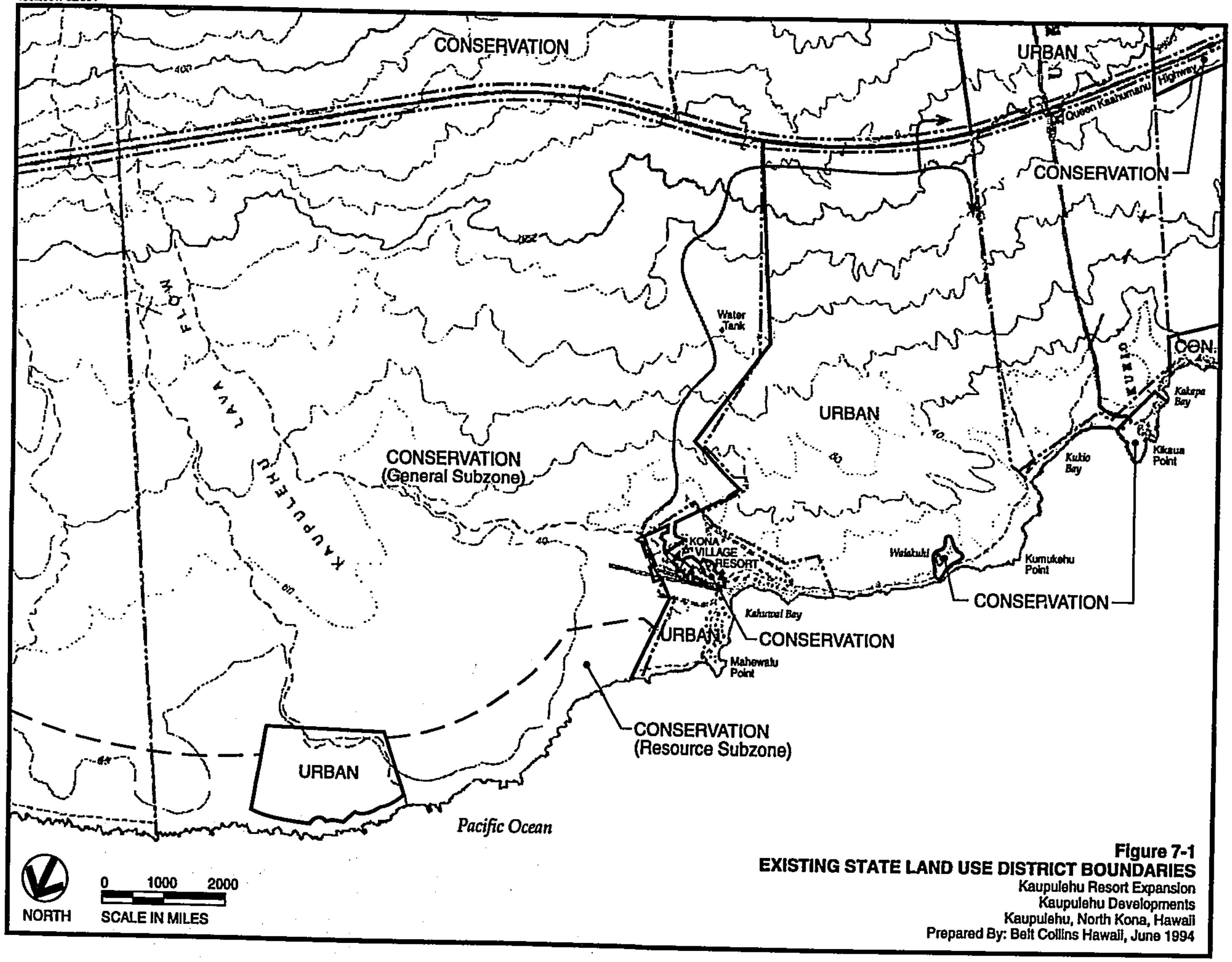


Figure 7-1
EXISTING STATE LAND USE DISTRICT BOUNDARIES
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

133.2001P02/007-1

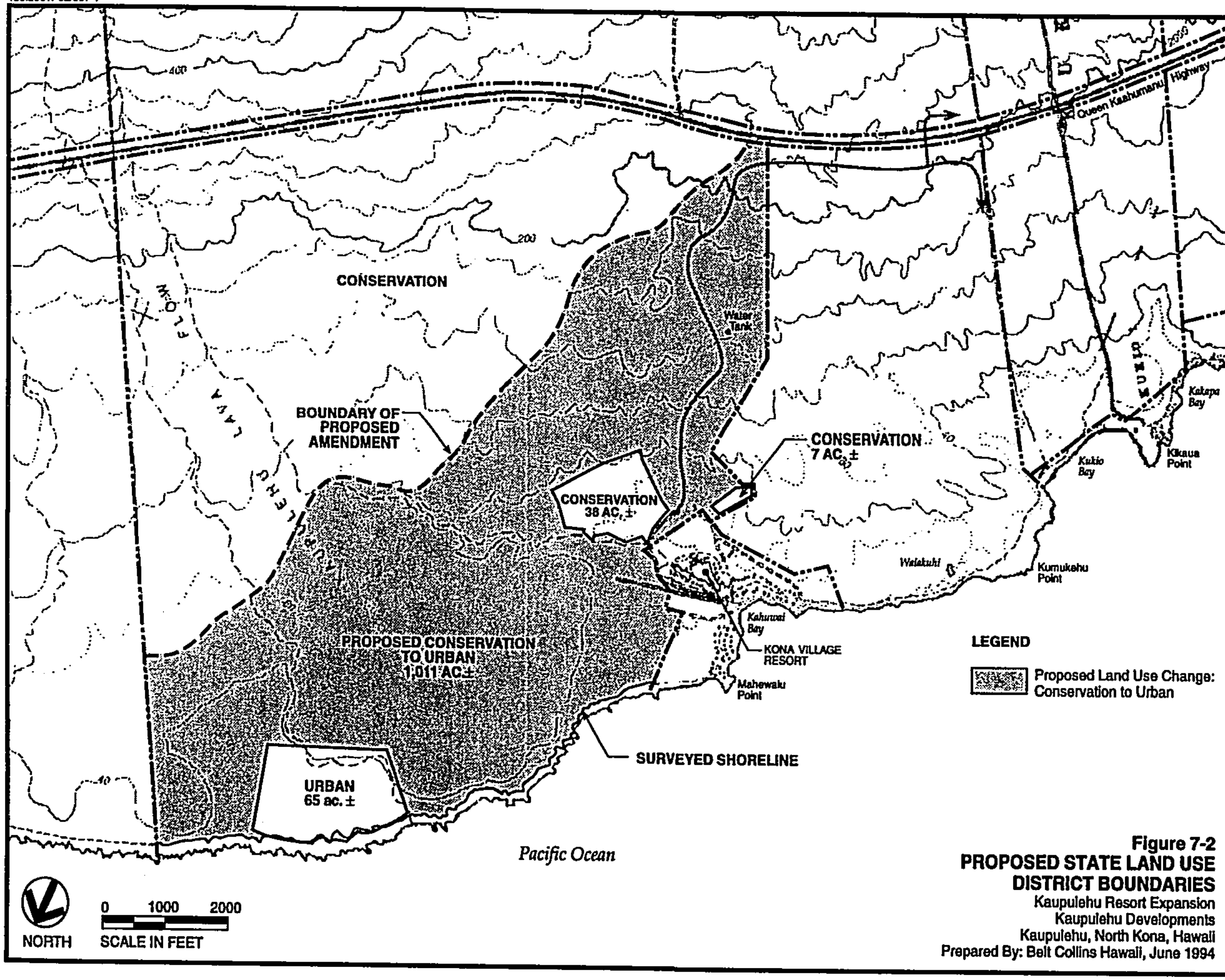


Figure 7-2
PROPOSED STATE LAND USE DISTRICT BOUNDARIES
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

(1) The attainment of maximum reasonable-beneficial use of water for such purposes as those referred to in subsection (a);

(2) The proper conservation and development of the waters of the State;

(3) The control of waters of the State for such public purposes as navigation, drainage, sanitation, and flood control;

(4) The attainment of adequate water quality as expressed in the state water protection and quality plan; and

(5) The implementation of the water resources policies expressed in section 174C-2.

This section, in turn, calls for "a program of comprehensive water resources planning" and "maximum beneficial use of the waters of the State" with adequate provision for the protection of "traditional and customary Hawaiian rights", fish and wildlife, and the maintenance of "proper ecological balance and scenic beauty". The proposed project will acquire potable water from existing and proposed wells within the Kaupulehu ahupua'a. The following objective and strategies are pertinent to the proposed action.

Objective: (2) Maximize the utility of the State's water resources for all uses of water by both mankind and nature.

Strategy: (2)(A) Maximize the efficient use of water and limit quantities of water use to the minimum required for efficient and economic utilization.

Strategy: (2)(B) Maximize the efficient use of water and limit the quality of water used to the minimum required for efficient and economic utilization.

Discussion: Development of potable and non-potable water resources at Kaupulehu and efforts to conserve its use are consistent with the intention of these strategies. The EIS includes a full and detailed discussion of how water resources will be conserved.

7.1.7 Department of Health Conditions Applicable to New Golf Course Development

The State Department of Health (DOH) requires that all new golf courses comply with its conditions for development. As of the writing of this EIS, version 4 of the department's conditions are in effect (dated January, 1992). Following is a summary of how the project will comply with these conditions.

7.1.7.1 Baseline Requirements

The DOH requires that a baseline of groundwater/vadose and/or, if appropriate, coastal water quality shall be established. The Petitioner has complied with this condition by initiating a monitoring program of coastal water conditions. The baseline report (dated November 1993) and monitoring studies conducted in 1993 and 1994 are included as appendices to this document.

7.1.7.2 Groundwater Monitoring

The DOH requires a groundwater monitoring plan and system to be submitted to the DOH for approval and specifies the components that it shall contain. The Petitioner will comply with this condition.

7.1.7.3 Mitigation of Groundwater Contamination

The DOH requires the project owner to take immediate action to mitigate any adverse effects caused by contamination of the groundwater detected during monitoring. The Petitioner shall comply with this condition as it pertains to the proposed project. If, however, groundwater contamination is detected by the proposed monitoring system but found not to be caused by actions occurring on the subject property, the Petitioner should not be considered responsible for mitigation.

7.1.7.4 Wastewater Disposal

The DOH requires that sewage disposal for the clubhouse and other facilities be connected to a public sewer system or approved private treatment system. The Petitioner will comply with this condition by connecting the golf course facilities to the private wastewater collection and treatment system proposed at the project. The condition also states that the use of wastewater for irrigation will be generally encouraged. The Petitioner intends to utilize treated effluent to supplement non-potable irrigation water on the golf course, as discussed in section 4.6.4 of this EIS.

7.1.7.5 Effluent Reuse

The DOH requires the development and implementation of an approved wastewater reuse plan and specifies provisions for compliance. The Petitioner will comply with this condition.

7.1.7.6 Underground Storage Tanks

The DOH specifies the requirements for the use of underground storage tanks and states that they will be generally discouraged. The Petitioner will make every effort to avoid having to utilize underground tanks. However, if their use becomes unavoidable, the Petitioner will adhere to the provisions of this condition.

7.1.7.7 Fertilizer and Pesticide Storage

The DOH specifies the manner in which pesticides and fertilizers shall be stored.

The Petitioner shall comply with this condition.

7.1.7.8 Best Management Practices

The DOH requires the establishment of a Best Management Practices for the use of fertilizers and biocides as well as for the golf course's irrigation schedule. The Petitioner will comply with this condition.

7.1.7.9 Noise Mitigation

The DOH requires that noise generated by golf course operations shall be minimized. The Petitioner shall comply with this condition.

7.1.7.10 Solid Waste Disposal

The DOH requires that solid waste disposal shall be managed so as to not create a nuisance. It also specifies that composting shall be used whenever possible and that it shall be confined to the golf course to minimize the necessity for offsite transport of raw or processed material. The Petitioner shall comply with this condition but may elect to utilize composting material at other locations within the subject property in addition to the golf course.

7.1.7.11 Fugitive Dust Control

The DOH requires that fugitive dust generated during construction shall be controlled in accordance with administrative rules of the department. It also requires that pesticides and other agricultural chemicals be applied in a manner that precludes offsite drift of spray material. The Petitioner shall comply with this condition.

7.1.7.12 Soil Runoff

The DOH requires the Petitioner to consult with the Soil Conservation Service to assure that best management practices are used to prevent soil runoff during construction. The DOH also requires a National Pollutant Discharge Elimination System (NPDES) stormwater permit application be submitted in accordance with Federal Clean Water Act requirements. The Petitioner shall comply with this condition.

7.1.8 Environmental Impact Statement Requirements

The preparation of this EIS was determined to be necessary by the State Land Use Commission in conjunction with the Applicant's Petition for an Urban District boundary amendment. This EIS has been prepared and submitted pursuant to the provisions of Chapter 343, Hawaii Revised Statutes (HRS) and rules promulgated thereunder.

7.2 West Hawaii Regional Plan

Published in November 1989 by the Office of State Planning, the West Hawaii Regional Plan presents the State's vision for the future development of the North Kona and South Kohala districts of Hawaii. With regard to planning for resort development, the plan's principal strategy is to cluster resorts in 'Resort Destination Nodes' in designated areas in West Hawaii, specifically including Kaupulehu. Figure 7-3 depicts the OSP's resort destination nodes. OSP's recommended actions include:

- the development of these nodes as "employment centers";
- the identification of other ancillary activities and services which support the destination node concept;
- the provision of economic incentives for private sector involvement in financing and development social and physical infrastructure systems;
- the utilization of the defined nodes as a basis for developing State positions on land use petitions before the Land Use Commission;
- the utilization of the defined nodes as a basis for the review of State Land Use District boundaries;
- the study of cumulative fiscal, social, and environmental impacts of resorts to determine the optimal size of the nodes;
- the encouragement of the County to maximize public benefits (infrastructure systems, day care, transportation, employment training, parks, etc.) for projects with nodes by utilizing zoning powers; and
- the reduction of dependency on a single industry by encouraging diversification of the economy.

The proposed project is fully supportive of the Resort Destination Node strategy and the above identified actions. The project will enhance the Kaupulehu node as an employment center by providing over a thousand new employment opportunities at full build-out. Ancillary services and activities will be made available through the provision of the 45,000 square foot (net) commercial center proposed in the project's concept plan. The development of privately funded roadway, wastewater collection and treatment, and drainage infrastructure will greatly reduce the need for public financial support in the area. The provision of new employment opportunities will assist in the continued diversification of the West Hawaii economy.

The proposed project is also supportive of the West Hawaii Regional Plan's identification of a proposed park along the shoreline of state lands adjacent to Kaupulehu.

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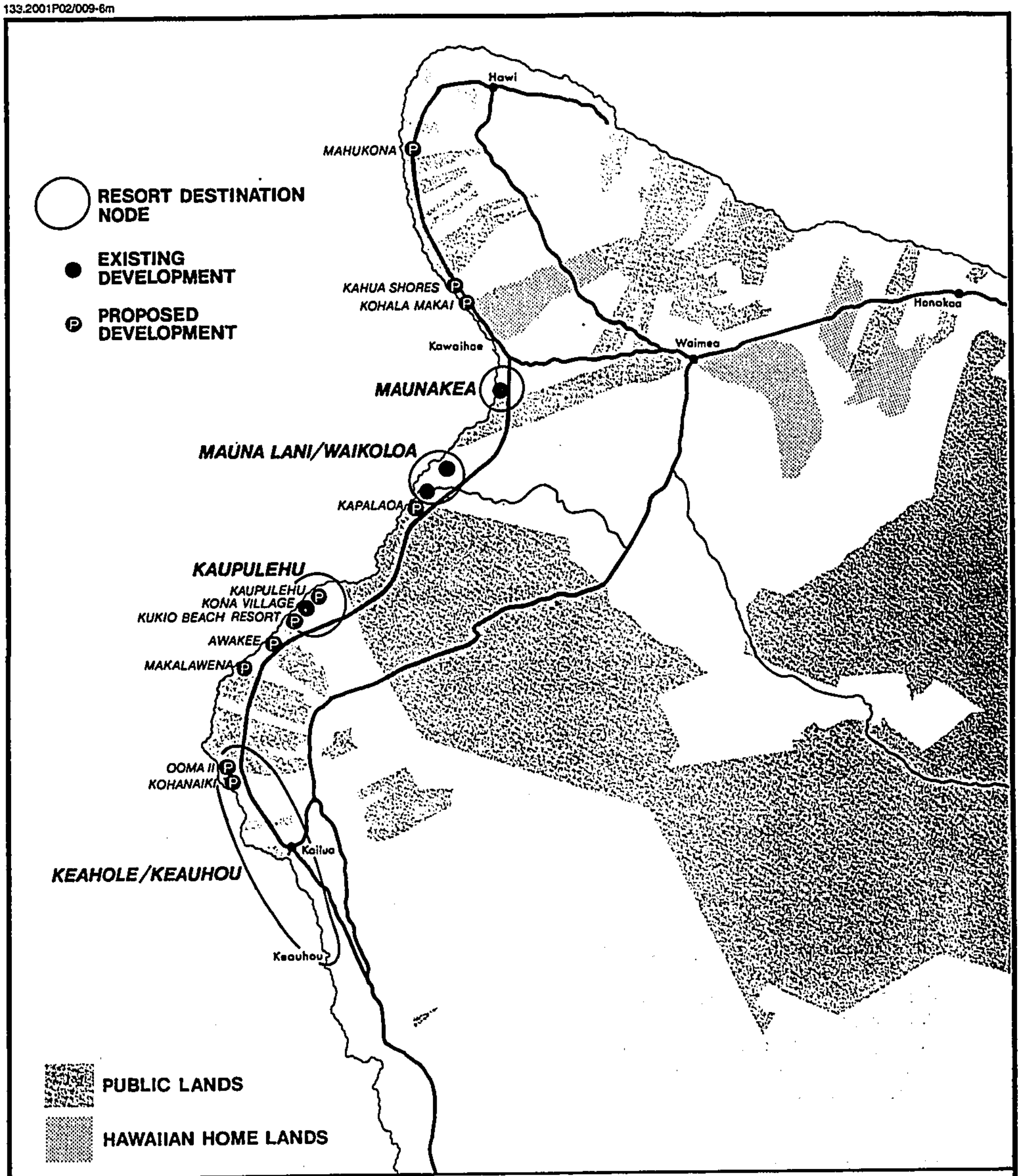


Source: Office of the Governor Office of State Planning, *West Hawaii Regional Plan*, November 1989

NORTH

0 4 8
SCALE IN MILES

Figure 7-3
WEST HAWAII REGIONAL PLAN
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

The project's provision of a large public recreation area adjacent to the state's property promotes greater public access to the shoreline in the area.

7.3 County Land Use Policies and Plans
7.3.1 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 LUPAG map designations for the project area are Urban Expansion and Open (see Figure 7-4). The development concept is consistent with the Urban Expansion designation which provides for residential uses. The Open designation corresponds to the shorefront of the property as well as that of the entire island. The Open designation reflects the policy of protecting recreational and other resources in the shoreline area and in other areas on the island. The project is consistent with the Open designation in light of its incorporation of open space and public access and recreational uses in the shoreline area. The proposed project is also consistent with the following policy elements of the General Plan.

7.3.1.1 Economic Element

Economic goals for the County of Hawaii include the need to "strive for diversity and stability in its economic system" and to "provide an economic environment which allows new, expanded, or improved economic opportunities that are compatible with the County's natural and social environment." Policies include an intent to "strive for an economic climate which provides its residents an opportunity for choice of occupation."

Discussion: Implementation of the proposed project will provide significant new employment opportunities in the region which will, in turn, help to further diversify the economy of West Hawaii.

7.3.1.2 Environmental Quality

A key attribute of the proposed project is its compliance with the County's policy to maintain the quality of the environment for residents and future residents.

Discussion: The transformation of barren lava areas to a residential community and golf course represents an efficient and environmentally appropriate use of otherwise unusable lands. Preservation of the property's coastal resources and the provision of public access to them will benefit existing and future residents of the region.

7.3.1.3 Flood Control and Drainage

The General Plan includes goals to conserve scenic and natural resources, prevent damage to manmade improvements, and to reduce surface water and sediment runoff. Policies include the intent that all development generated runoff be disposed of in a manner that is acceptable to the County's Department of Public Works. The private sector is seen as a partner to the government in maintaining and improving drainage systems and in building new drainage facilities.

Discussion: As discussed in this EIS, all infrastructure systems will be designed and constructed to comply with state and county policies and regulations to reduce surface water and sediment runoff.

7.3.1.4 Historic Sites

The General Plan includes a goal to "protect and enhance the sites, buildings and objects of historic and cultural importance to Hawaii" and a policy that the County require "both public and private developers of land to provide a historic survey prior to the clearing and development of land when there are indications that the land under consideration has historic significance."

Discussion: Significant archaeological sites will be preserved on the subject property as outlined in the Archaeological Inventory Survey conducted specifically for the proposed project.

7.3.1.5 Housing Element

General Plan goals for housing include a desire to have a diverse housing mix throughout the island, maintaining a housing supply that allows choice and a policy to accommodate the housing requirements of special need groups, including those residents living in rural areas.

Discussion: The Market Study prepared for the proposed project demonstrates market support for the residential units to be developed. The provision of new employment opportunities during construction and operational phases of the development will strengthen the economy of the area and will help to provide the financial means for residents to address their housing needs.

7.3.1.6 Natural Beauty

Goals concerning the scenic and natural beauty of Hawaii include the desire to preserve the quality of coastal scenic resources and to protect scenic vistas and view planes from becoming obstructed. The vast expanse of Kona's landscape is identified as the area's most striking feature.

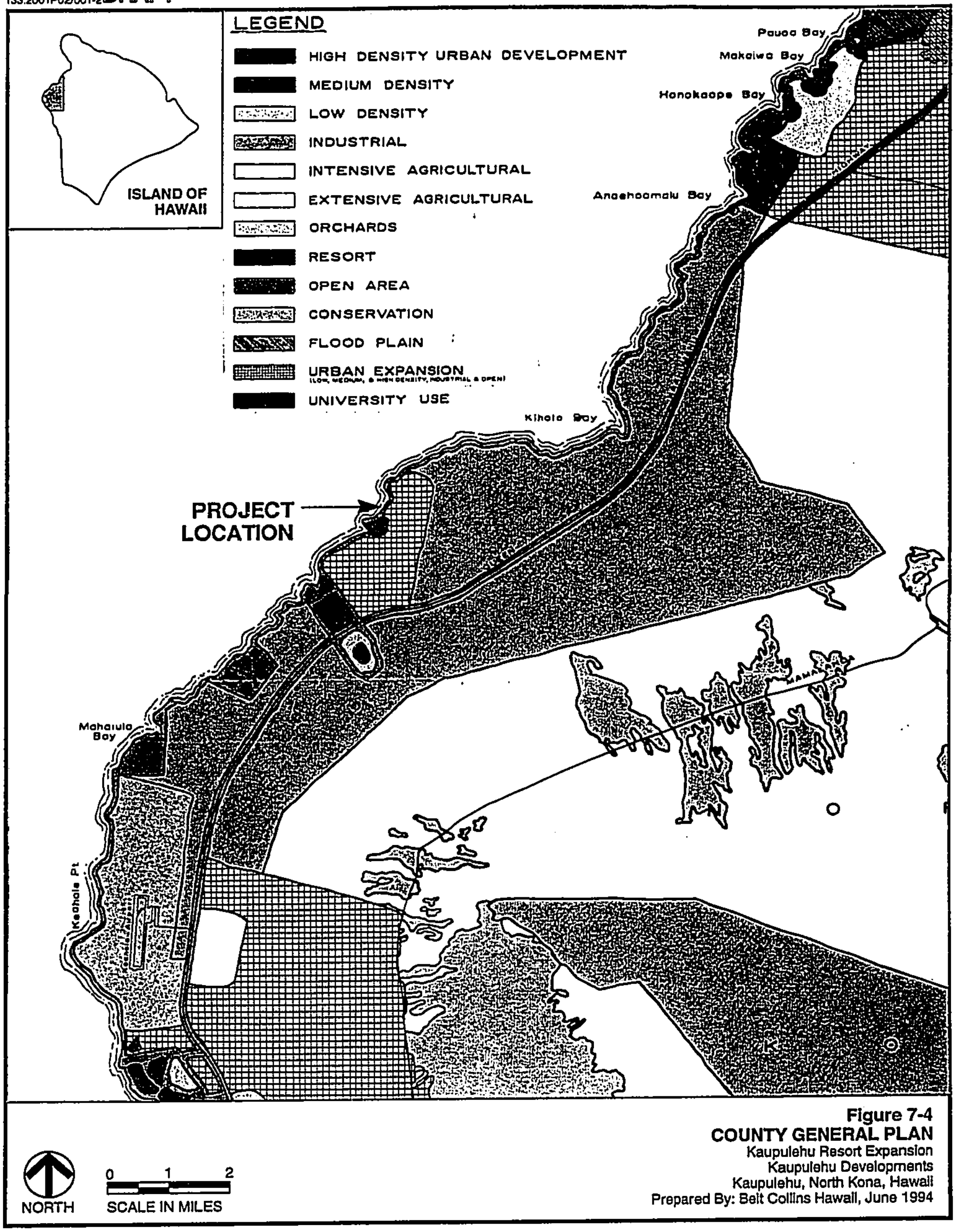


Figure 7-4
COUNTY GENERAL PLAN
Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

A primary goal of the General Plan is to "protect and conserve the natural resources of the County of Hawaii from undue exploitation, encroachment and damage". It is the County's policy that the shoreline be protected from the encroachment of manmade improvements and structures. It is also the County's policy to encourage the protection of unique habitats, wildlife species, and agricultural use of the land.

Discussion: As discussed in this EIS, the property's coastal resources will be preserved. No development is proposed makai of the certified shoreline.

7.3.1.7 Natural Resources and Shoreline

A primary goal of the General Plan is to "protect and conserve the natural resources of the County of Hawaii from undue exploitation, encroachment and damage". It is the County's policy that the shoreline be protected from the encroachment of manmade improvements and structures. It is also the County's policy to encourage the protection of unique habitats, wildlife species, and agricultural use of the land.

Discussion: Other than the restoration of the coastal trail, no development is proposed to encroach upon the coastal area makai of the certified shoreline.

7.3.1.8 Public Facilities

The General Plan identifies public facilities as schools, libraries, fire stations, police stations, detention and correction facilities, and refuse disposal areas. The County's overall goal is to improve public service through better facilities that are in keeping with the environmental and aesthetic concerns of the community.

Discussion: As a resort/residential area, the proposed project's impact upon public facilities will not be excessive. Due to relatively low full-time occupancy rates and the "second home" character of the project community, impacts upon social services such as schools and libraries will be minimal.

7.3.1.9 Public Utilities

The General Plan declares that public utilities, including water, telephone, electricity, gas, sewage treatment and disposal should complement adjacent land uses and be operated to avoid pollution or disturbance. The improvement of existing utility services is linked to demand for such services.

Discussion: The proposed project would acquire its electrical power from the Hawaii Electric Light Company (HELCO) system. It is anticipated that HELCO will have sufficient generating capacity to meet the electrical demands of the proposed project at the time of its implementation.

7.3.1.10 Recreation

As resident population on the Big Island continues to grow and the visitor industry continues to expand, demand for additional recreational resources is expected to increase. County polices include the intent to improve existing facilities, provide a broad range of recreational opportunities, and provide public access to the shoreline and shoreline resources.

Discussion: The proposed project includes the provision of a public recreation area and public beach access to meet the needs of the community.

7.3.1.11 Transportation

The General Plan includes policies to provide transportation facilities that promote the desired land use, improve transportation service, and plan for future needs.

Discussion: All roadways within the project area will be privately developed. The low-density development will not have a significant impact upon regional transportation circulation.

7.3.1.12 Land Use

The General Plan states a concern that areas identified for urban development should be adequately serviced by the appropriate infrastructure.

Discussion: The concept plan for the proposed development includes the privately-funded development of all basic infrastructure needed to service the proposed resort/residential community.

7.3.2 Northwest Hawaii Open Space and Community Development Plan (Draft)

The November 1992 public draft report of the County's Northwest Hawaii plan identifies the subject property for resort development. The proposed project will provide clarity and guidance to the plan, which presently states:

> "the only coastal property that does not yet have definite resort or State park plans is the "Conservation" zoned 2,000+ acre coastal parcel just north of the Kaupulehu Resort. This land is owned by Bishop Estate, and may eventually be proposed for resort development. The overall issue relative to these planned resorts is to ensure that they are developed according to the highest possible environmental and design standards to minimize adverse impacts on valuable coastal resources, and so that these resorts will further enhance the reputation of Hawaii's "gold coast"." (page 121)

As demonstrated in this EIS, the proposed project is fully supportive of the County's desire to minimize adverse impacts on coastal resources. The proposed preservation and restoration of the coastal trail is supportive of the plan's intention to preserve open space areas and coastal resources. Furthermore, the low-densities planned for the project will complement the open space character of the area.

7.3.3 Hawaii County Zoning

The subject property is presently zoned Open. If the requested Land Use boundary Petition is approved, the Petitioner will seek appropriate zoning classifications consistent with the existing General Plan designations for the property.

7.3.4 Special Management Area Regulations

The subject property is situated within the Special Management Area. As described below, the proposed development is consistent with the County of Hawaii Special Management Area (SMA) policies and guidelines.

7.3.4.1 Recreational Resources

Objective: Provide coastal recreational opportunities accessible to the public.

Discussion: The preservation and restoration of the coastal trail and the provision of a public-oriented recreation area fulfills this objective.

7.3.4.2 Historic Resources

Objective: Protect, preserve, and where desirable, restore those natural and man made historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Discussion: All significant archaeological resources identified in the project area are proposed for preservation.

7.3.4.3 Scenic and Open Space Resources

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

Discussion: The existing quality of the coastal scenic and open space resources of the area will be preserved by the project. The development of a low-density, golf course oriented community will not detract from the open space character of the region.

7.3.4.4 Coastal Ecosystems

Objective: Protect valuable coastal ecosystems from disruption and minimize adverse impacts on coastal ecosystems.

Discussion: As discussed in this EIS, the proposed project seeks to minimize any potential adverse impacts to coastal ecosystems. The potential adverse impact upon marine biota resulting from increased public access will be mitigated through the implementation of a shoreline management plan, prepared in conjunction with the SMA permit process.

7.3.4.5 Economic Uses

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

Discussion: Development of the subject property will assist the State in its implementation of the resort destination node strategy identified in the West Hawaii Regional Plan.

7.3.4.6 Coastal Hazards

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

Discussion: The proposed project has been designed to reduce potential hazards associated with coastal hazards, as discussed in Chapter 4 of this EIS.

7.3.4.7 Managing Development

Objective: Improve the development review process, communication and public participation in the management of coastal resources and hazards.

Discussion: Preparation of this EIS provides the public with the opportunity to participate in the review of development proposals adjacent to coastal resources.

7.3.4.8 Guidelines for Approval

As set forth in Section 9.7 of the Hawaii County Planning Commission's rules concerning decision making for SMA applications, the commission shall seek to minimize where reasonable:

A1. *Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough, or lagoon.*

Discussion: No dredging, filling, or alteration activities are proposed along the shoreline.

A2. *Any development which would reduce the size of any beach or other area usable for public recreation.*

Discussion: No development is proposed which would reduce the size of any beach or area usable for public recreation.

A3. *Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the Special Management Area and the mean high tide line where there is no beach.*

Discussion: The proposed project does not reduce or impose restrictions on public access to coastal resources. Through the provision of a recreation area and public access opportunities, it ensures that the public right to coastal access is preserved.

A4. *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 project will not substantially interfere with or detract from the line of sight from the Queen Kaahumanu Highway. The low density character of the project will not inhibit coastal views.

A5. *Any development which would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, estuarine sanctuaries, potential or existing agricultural uses of land.*

Discussion: The proposed project will not adversely affect water quality, as demonstrated in this EIS. No fisheries or wildlife habitats will be negatively impacted. No agricultural lands are impacted by the development.

No development shall be approved unless it is first found that:

B1. *The development will not have any significant adverse environmental or ecological effect, except as such adverse effect is minimized to the extent practicable and clearly outweighed by public health, safety, or compelling public interest. Such adverse effect shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial effect and the elimination of planning options.*

Discussion: With the exception of the potential impacts to coastal resources resulting from increased public access, the project does not generally result in any significant negative environmental impacts. With regard to public access, a shoreline management plan will be prepared and implemented to mitigate the impacts of increased public access upon specific marine biota that are popular with subsistence gatherers; limu, opihi, crab, and fish. Section 4.8.1.3 of this EIS discusses the cumulative impacts of increased public access to the project's shoreline.

B2. *The development is consistent with the objectives and policies as provided by Chapter 205A, HRS, and the Special Management Area guidelines as contained herein.*

Discussion: As demonstrated above, the proposed project is consistent with the objectives and policies of Chapter 205A.

B3. *The development is consistent with the County General Plan and zoning. Such a finding of consistency does not preclude concurrent processing when a general plan or zoning amendment may also be required.*

Discussion: The proposed development is consistent with the County General Plan's designations of Urban Expansion and Open for the subject property.

All developments shall be subject to reasonable terms and conditions as necessary in order to ensure that:

C1. *Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided to the extent consistent with sound conservation principles.*

Discussion: Public access to the coastline and to state-owned lands adjacent to the subject property will be provided and preserved. As discussed in section 4.8.1.4, a shoreline management plan will be prepared and implemented to mitigate the impacts of increased public access upon marine biota.

C2. *Adequate and properly located public recreation areas and wildlife preserves are reserved.*

Discussion: The project's concept plan includes the provision of a public recreation area.

C3. *Provisions are made for solid and liquid waste treatment, disposition, and management which will minimize adverse effects upon Special Management Area resources.*

Discussion: As discussed in Chapters 4 and 6 of this EIS, adequate provisions are included for solid and liquid waste treatment, disposition, and management to minimize adverse impacts on the Special Management Area's resources.

C4. *Alterations to existing land forms and vegetation, except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of an earthquake.*

Discussion: The grading necessary to construct the various components of the project will not cause significant adverse effects on coastal resources, scenic resources, or recreational amenities.

C5. *Adverse environmental or ecological impacts are minimized to the extent practicable.*

Discussion: As presented in section 4.8.1.4 of this EIS, a shoreline management plan will be prepared and implemented in conjunction with the SMA permit process to mitigate the potential adverse impact that increased public access to the project's coastal area may have upon marine biota.

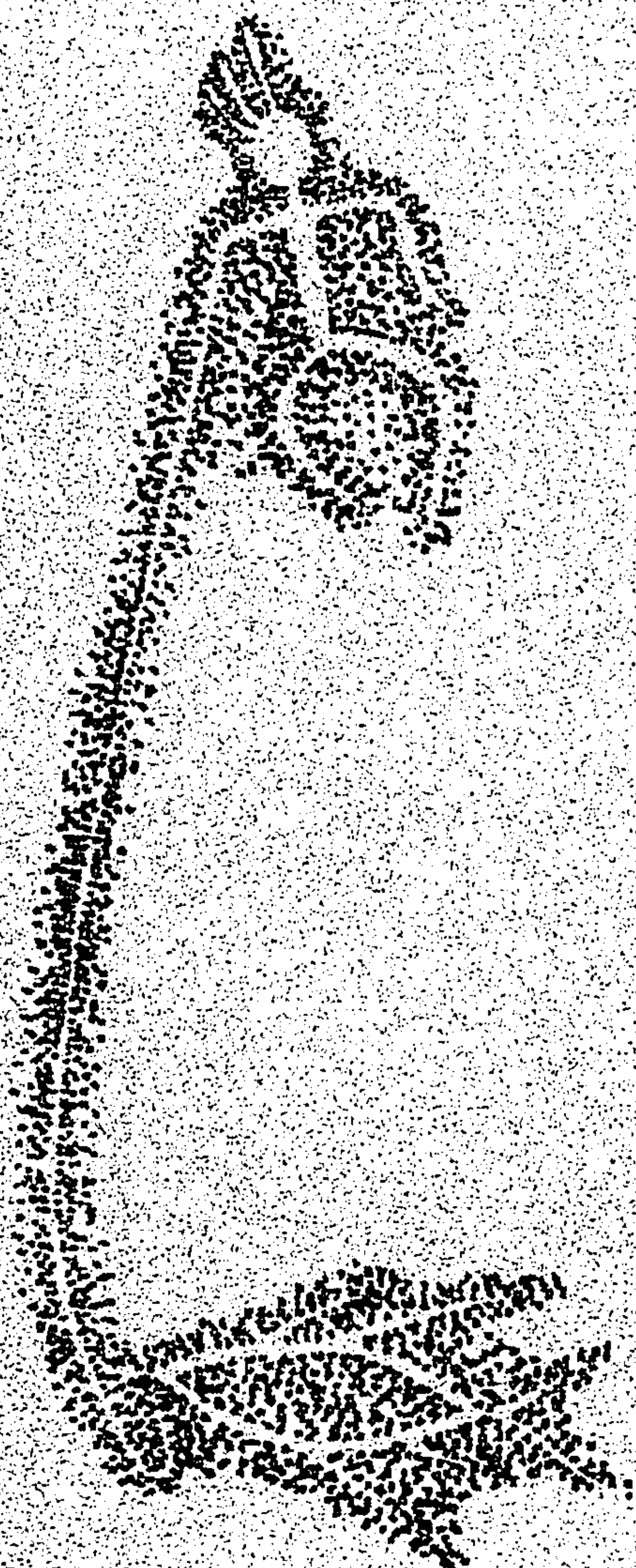
C6. *The proposed development is consistent with the goals, policies, and standards of the General Plan.*

Discussion: As discussed in section 7.3.1 above, the project is consistent with the goals, policies, and standards of the Hawaii County General Plan.

7.4 Summary of Major Permits

Following is a list of major approvals and permits required for implementation of the proposed project. Additional permits and approvals will be necessary but are too numerous to mention here.

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



Chapter 8

Other Topical Issues

CHAPTER 8 OTHER TOPICAL ISSUES

8.1 Relationship Between Short-Term Uses and Maintenance of Long-Term Productivity

No short-term exploitation of resources that will have negative long-term consequences have been identified in this EIS. The proposed project, developed over a twenty-year period, will be designed to last for decades. As such, it will not only be a resort/residential community, but a valuable component of the larger West Hawaii visitor destination area.

The principal long-term benefits of the project include the productive use of an otherwise unusable property and the provision of residential and employment opportunities. Increased economic opportunities for many segments of the West Hawaii region will be generated in the form of capital investment and economic multipliers. Thus, the potential long-term productivity of the property resulting from the proposed development is preferred over other short-term uses of the property which might otherwise occur.

8.2 Irreversible and Irretrievable Commitments of Resources

The proposed project will require the irreversible and irretrievable commitment of a number of resources including land, building materials, capital, manpower, and energy to construct, operate, and maintain the development. Utilization of the subject property will eliminate its potential for development to alternative uses. Goods and services consumed by future residents of the project, as well as employees and visitors, must also be considered. These include combustible fuels for transportation. The impacts of using these resources must be weighed against the projected positive socioeconomic benefits to be derived from the project.

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.

8.3 Offsetting Considerations of Governmental Policies

As discussed in Chapter 7, the project is consistent with the goals and policies of the Hawaii State Plan and Functional Plans, the West Hawaii Regional Plan, the Hawaii County General Plan, and the Special Management Area regulations as set forth in Chapter 205A, Hawaii Revised Statutes. Together, the unified vision of these plans is to provide government support and incentives for the expansion of the visitor industry in West Hawaii consistent with the guidelines set forth. Because the subject property is identified by the State as a "resort destination node" and by the County as an urban expansion area, the proposed project is mutually supportive of state and county plans.

The only significant offsetting consideration resulting from governmental policies pertains to the potential significant adverse impacts to marine biota resulting from State and County provisions calling for the preservation of shoreline public access. Based on the experience of other resorts along the West Hawaii coastline, increased public access usually results in depletion of specific marine biota that are popular among subsistence gatherers: limu, opihi, crab, and fish. Undeveloped coastal areas with limited access are often characterized by a relative abundance of marine biotic resources. However, when these areas become more accessible to the general public, marine resources are often depleted by subsistence food gatherers and fishermen who previously could not access the area. Because species such as opihi are relatively slow to mature, their depletion resulting from increased public access becomes immediately evident to the gatherers who formerly enjoyed the benefits of the area's geographic seclusion. Thus, the balance between public access for the greater community and the traditional subsistence gathering practices of a specific group within that community is upset.

In an attempt to restore balance among various user groups, the Petitioner will prepare a shoreline management plan in conjunction with the Special Management Area permit process. Provisions within the management plan pertaining to the issue of resource depletion will be coordinated with affected parties.

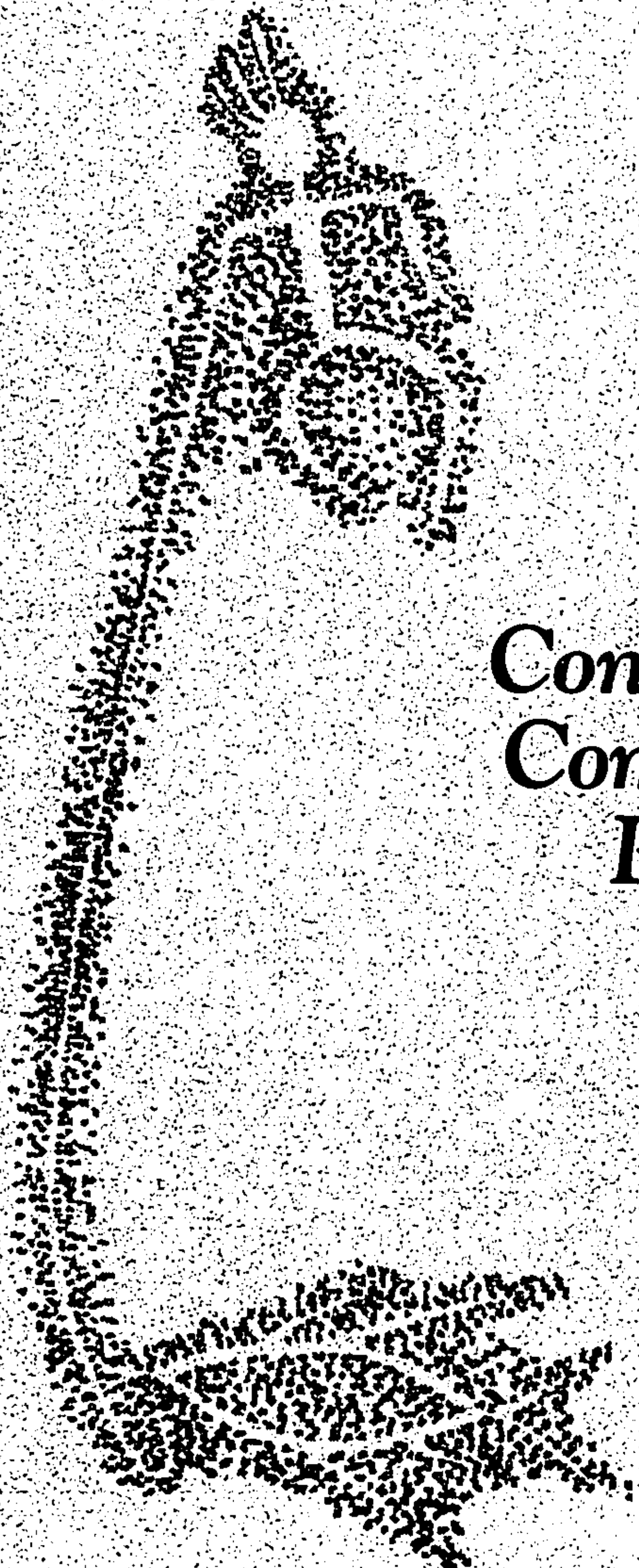
8.4 Unresolved Issues

As discussed in section 6.1.1.3, the Queen Kaahumanu Highway is planned for widening to four lanes by the State DOT. At the writing of this EIS, the actual date of implementation of this project is unknown. In a similar vein, the timing of other government capital improvement projects in West Hawaii may impact the proposed project. However, the extent to which this may occur is presently unknown.

As discussed in section 6.1.2.3, the proposed project could have a negative impact upon the availability of boat slips at public small boat harbors in West Hawaii because it may contribute to the already existing demand for the limited supply of slips. This issue cannot be resolved by the applicant. The future provision of public boat slips to satisfy demand is ultimately a capital improvement issue that must be addressed by the State Legislature.

The provision of affordable housing is also unresolved. Based upon current information, a 60% State affordable housing policy exists, and if applied to the proposed project, the Petitioner will work with the Housing Finance Development Corporation (HFDC) to develop the program for implementation. The County of Hawaii is presently re-evaluating its affordable housing policy.

Under current conditions and in light of substantial housing supply, it is difficult to project the construction timing and amount of units which will be necessary to meet demand. The Petitioner anticipates that the satisfaction of an affordable housing requirement within existing and growing communities will be pursued. These subjects will be discussed with the HFDC and the County with the objective of reaching a consensus on the appropriate manner of satisfying affordable housing requirements, which the Petitioner intends to develop.



Chapter 9

Consulted Parties and Comments on the EIS Preparation Notice

CHAPTER 9 CONSULTED PARTIES AND COMMENTS ON THE EIS PREPARATION NOTICE

9.1 Consulted Parties

A Notice of Availability of the Environmental Assessment and EIS Preparation Notice for the Kaupulehu Resort Expansion project was published in the OEQC Bulletin by the Office of Environmental Quality Control on January 23, 1994. In addition, representatives of the applicant have personally met with a wide variety of public agencies, community organizations, elected officials, and private individuals to inform them of the proposed project. The agencies, organizations, and individuals consulted about the project are listed below. Those who commented on the Enviromental Assessment in writing and/or requested status as a Consulted Party are identified by an asterisk (*). Copies of the correspondence with them are reproduced in this chapter.

Federal Agencies

  Fish and Wildlife Service, U.S. Department of the Interior
- * Department of the Army
- * National Marine Fisheries Service
- * Geological Survey

State Agencies

- * Department of Business, Economic Development and Tourism
- * Department of Health
- * Department of Land and Natural Resources
- * Department of Transportation
- * Department of Budget and Finance (Housing Finance & Development Corp.)
-   Office of Environmental Quality Control
- * Office of State Planning
-   Environmental Center, University of Hawaii at Manoa
-   State Housing Finance & Development Corporation
-   Water Resources Research Center, University of Hawaii at Manoa
-   Sea Grant Program, University of Hawaii at Manoa
-   Pacific Basin Development Council

County Agencies

-   Office of the Mayor
-   Department of Public Works
-   Department of Housing & Community Development
- * Department of Public Works
-   Planning Department
- * Department of Water Supply

* Police Department
* Civil Defense Agency
* Fire Department
* Department of Research & Development

Organizations

* Hawaii Leeward Planning Conference
* PBR Hawaii
* Na Ala Hele

Private Individuals and Landowners

* CJ Villa

Stephen K. Yamashiro
Mayor

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Victor V. Vierra
Chief of Police
Francis C. DeMorales
Deputy Chief of Police

County of Hawaii
POLICE DEPARTMENT
349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-2702

January 31, 1994

9-3

Ms. Anne L. Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

RE: KAUPULEHU PHASE 2 EXPANSION PROJECT
ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE

We foresee an increase in the demands for police services and request applicant ensure adequate traffic control planning.

Thank you for the opportunity to provide input.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

TH:sk

cc: Kona Police

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

June 14, 1994
133.2001/94P-319

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

Dear Chief Vierra:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of January 31, 1994 regarding the above project. As requested in your letter, the project will include design and operational measures to ensure that adequate traffic control is provided. The project will link up to the existing Kona Village Resort access road to gain access to Queen Kaahumanu Highway. No new highway connection is anticipated to be required.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

Stephen K. Yamashiro
Mayor

County of Hawaii
CIVIL DEFENSE AGENCY
920 Ululani Street • Hilo, Hawaii 96720
(808) 935-0031 • Fax (808) 935-6460

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Harry Kim
Administrator

Bruce D. Butts
Assistant Administrator

doc0291P

January 28, 1994

Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Blvd., First Floor
Honolulu, HI 96813-5406

9-4

KAUPULEHU PHASE 2 EXPANSION PROJECT

Following are comments relating to the project:

The paragraph relating to natural hazards needs to be clarified.

1. In listing the hazards, it fails to include tropical cyclones which must be considered a potential hazard for the area.

2. The statement on seismic activity in regards to magnitude is seriously questioned. Seismic data for this island indicates that it is and should be an issue of significant concern in the planning of the project. Building codes are passed for the island and not for districts.

Request that this agency be a consulting party in this project as requirements of an emergency plan and warning system are factors which need to be pursued.

Harry Kim
HARRY KIM, ADMINISTRATOR

dy

BCA
BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

June 14, 1994
133.2001/94P-320

Mr. Harry Kim, Administrator
County of Hawaii Civil Defense Agency
920 Ululani Street
Hilo, Hawaii 96720

Dear Mr. Kim:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of January 28, 1994 regarding the above project. We agree with your comment that hurricanes and earthquakes are both potential natural hazards which should be addressed. The Draft Environmental Impact Statement (EIS) for the project will include discussion of potential hurricane and earthquake hazards.

Should you have any further comments, please do not hesitate to contact me at 521-5361. We will provide you, as a consulted party, a copy of the Draft EIS for review and comment.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes
Anne L. Mapes

ALM:lws
cc: A. Kinzler

HAWAII LEEWARD PLANNING CONFERENCE

RECEIVED

January 27, 1994

Ms. Anne L. Mapes
Belt Collins Hawaii
680 Ala Moana Blvd.,
Honolulu HI 96813

Dear Anne,

We have reviewed the Environmental Assessment for Kaupulehu Phase 2 Expansion Project and have no comments on the assessment. We would however like to be a consulted party and review the Draft EIS when it is prepared.

Sincerely,

H. Peter L'Orange
President

HPL/km

OFFICE: POTTERY TERRACE, ORCHID BLDG. 9228, KAILUA-KONA • PHONE 329-2204 • FAX 329-7108

BCA
BELT COLLINS
& ASSOCIATES
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Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

June 14, 1994
133.2001/94P-321

Mr. H. Peter L'Orange
Hawaii Leeward Planning Conference
P.O.Box 635
Kailua-Kona, Hawaii 96745-0635

Dear Mr. L'Orange:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of January 27, 1994 regarding the above project. We will provide you, as a consulted party, a copy of the Draft EIS for your review and comment.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

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

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February 2, 1994

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, HI 96813-5406

EIS PREPARATION NOTICE
APPLICANT - KAUPULEHU DEVELOPMENT
TAX MAP KEY 7-2-3:1 (POR.)

We have reviewed the subject EIS Notice for the proposed subdivision and resort development. The water system in the area is privately owned and operated.

Pursuant to Section 23-84 of the Hawaii County Code regulating subdivisions, the following minimum requirements must be complied with for subdivision approval:

1. Provide a water system designed to deliver water at adequate pressure and volume under peak-flow and fire-flow conditions in accordance with the Water System Standards, State of Hawaii, and the Rules and Regulations of the Department of Water Supply. The water system shall include, but not be limited to, the installation of the necessary distribution pipeline, fire hydrants, and service laterals.

2. Submit construction plans for our review and approval.

2. Pay a fee of four-tenths of one percent of the estimated cost for the construction of the water system, but not less than $25.00, to cover the costs for plan review, testing, and inspection.

Should you have any questions, please contact our Water Resources and Planning Section.

H. William Sewake
Manager

WA

copy - Office of State Planning

Water brings progress...

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

June 14, 1994
133.2001/94P-322

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

Dear Mr. Sewake:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 2, 1994 regarding the above project. The project will comply with the requirements of Section 23-84 of the Hawaii County Code as outlined in your letter.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

PBR HAWAII

LANDSCAPE ARCHITECTURE
PLANNING
ENVIRONMENTAL STUDIES

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'94 FEB -8 A 11:44

February 7, 1994

Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813

SUBJECT: KAUPULEHU PHASE 2 DEVELOPMENT

Dear Ms. Mapes:

I understand that an Environmental Impact Statement Preparation Notice has been completed and filed with OEQC for the subject property. Could you please forward to me a copy of the subject property's Draft Environmental Impact Statement when it has been completed? My address is 101 Aupuni Street, Suite 310, Hilo, Hawaii 96720.

I can be reached at 961-3333 if you need further information.

Sincerely,

Erine Franks

ERINE E. FRANKS
Office Manager
PBR HAWAII - Hilo Office

1042 FORT STREET MALL, SUITE 300 HONOLULU, HAWAII 96813 TELEPHONE: (808) 521-5631 FAX: (808) 523-1402
BRANCH OFFICE: HILO LAGOON CENTER 101 AUPUNI STREET, SUITE 310 HILO, HAWAII 96720 TELEPHONE: (808) 961-3333 FAX: (808) 961-4989

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
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June 14, 1994
133.2001/94P-323

Ms. Erine E. Franks, Office Manager
PBR Hawaii - Hilo Office
Hilo Lagoon Center, Suite 310
101 Aupuni Street
Hilo, Hawaii 96720

Dear Ms. Franks:

Kaupulehu Phase 2 Expansion
<u>Environmental Impact Statement Preparation Notice</u>

Thank you for your letter of February 7, 1994 regarding the above project. We will provide you with a copy of the project's Draft Environmental Impact Statement once it has been completed.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

Anne L. Mapes

ALM:lws
cc: A. Kinzler

NA ALA HELE
Hawaii Trail & Access System

RECEIVED
'94 FEB -9 P 12:02

February 8, 1994

Anne L. Mapes
Belt Collins Hawaii
680 Ala Moana Blvd., First Floor
Honolulu, HI 96813-5406

Dear Ms. Mapes:

SUBJECT: Kaupulehu Phase 2 Expansion Project
Environmental Impact Statement (EIS) Preparation Notice

The Ala Kahakai traverses the coastal area of the subject 1,000 acres proposed for rezoning from Conservation to Urban. This coastal trail is a candidate for incorporation in the National Historic Trails system.

Traditionally, Na Ala Hele has been put to task due to various developments on the coastal areas of the island. We strongly feel that a corridor (with buffer) which incorporates the trail alignment/network should be left in Conservation. This will provide protection to the trail system as well as other valuable coastal resources and archaeological sites.

The inherent interest of Na Ala Hele necessitates close scrutiny of coastal developments and we wish to be a consulted party during the EIS process.

Very truly yours,

RODNEY T. OSHIRO
Na Ala Hele - Hawaii

cc: State Land Use Commission
Kaupulehu Developments
Christine Meller, NAH Project Coordinator
Robert Okawa, NAH Advisory Council

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& ASSOCIATES
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June 14, 1994
133.2001/94P-324

Mr. Rodney T. Oshiro
Na Ala Hele - Hawaii
Division of Forestry & Wildlife
Department of Land and Natural Resources
P.O.Box 4849
Hilo, Hawaii 96720-0849

Dear Mr. Oshiro:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 8, 1994 regarding the above project. The applicant shares Na Ala Hele's commitment to the preservation of the Ala Kahakai, a portion of which traverses the subject property.

On behalf of the Petitioner and the other project consultants, we appreciated the opportunity to initiate a dialogue with Na Ala Hele during our presentation to the Big Island Council in mid-May. As we stated then, the proposed project will include the maintenance and enhancement of safe public shoreline access. We believe that the public pedestrian corridor is an integral part of the development plan, and as such, should be in the lands that are the subject of land use change from Conservation to Urban. Inclusion of the corridor within the proposed Urban area will facilitate its long term upkeep and periodic maintenance, as well as that of certain archaeological sites within the corridor.

Concerning your request for consulted party status, we will provide you with a copy of the Draft Environmental Impact Statement once it has been completed. Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

Stephen K. Yamashiro
Mayor

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

RECEIVED
'94 FEB 10 P 2:21

Nelson M. Tsuji
Fire Chief

Edward Bumatay
Deputy Fire Chief

February 9, 1994

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, HI 96813-5406

9-9

Dear Ms. Mapes:

Subject: Kaupulehu Phase 2 Expansion Project
Environmental Impact Statement (EIS) Preparation Notice

The Hawaii County Fire Department's requirements as stated in the Fire Code are:

"Fire Apparatus Access Roads

"Sec. 207. (a) General. Fire apparatus access roads shall be provided and maintained in accordance with the provisions of this section.

"(b) Where Required. Fire apparatus access roads shall be required for every building hereafter constructed when any portion of an exterior wall of the first story is located more than 150 feet from fire department vehicle access as measured by an unobstructed route around the exterior of the building.

"EXCEPTIONS: 1. When buildings are completely protected with an approved automatic fire sprinkler system, the provisions of this section may be modified.

"2. When access roadways cannot be installed due to topography, waterways, nonnegotiable grades or other similar conditions, the chief may require additional fire protection as specified in Section 10.301 (b).

"3. When there are not more than two Group R, Division 3 or Group M Occupancies, the requirements of this section may be modified, provided, in the opinion of the chief, fire-fighting or rescue operations would not be impaired.

"More than one fire apparatus road may be required when it is determined by the chief that access by a single road may be impaired by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access.

"For high-piled combustible storage, see Section 81.109.

"(c) Width. The unobstructed width of a fire apparatus access road shall be not less than 20 feet.

"(d) Vertical Clearance. Fire apparatus access roads shall have an unobstructed vertical clearance of not less than 13 feet 6 inches.

"EXCEPTION: Upon approval vertical clearance may be reduced, provided such reduction does not impair access by fire apparatus and approved signs are installed and maintained indicating the established vertical clearance.

"(e) Permissible Modifications. Vertical clearances or widths required by this section may be increased when, in the opinion of the chief, vertical clearances or widths are not adequate to provide fire apparatus access.

"(f) Surface. Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be provided with a surface so as to provide all-weather driving capabilities." (20 tons)

"(g) Turning Radius. The turning radius of a fire apparatus access road shall be as approved by the chief." (45 feet)

"(h) Turnarounds. All dead-end fire apparatus access roads in excess of 150 feet in length shall be provided with approved provisions for the turning around of fire apparatus.

"(i) Bridges. When a bridge is required to be used as access under this section, it shall be constructed and maintained in accordance with the applicable sections of the Building Code and using designed live loading sufficient to carry the imposed loads of fire apparatus.

"(j) Grade. The gradient for a fire apparatus access road shall not exceed the maximum approved by the chief." (15%)

"(k) Obstruction. The required width of any fire apparatus access road shall not be obstructed in any manner, including parking of vehicles. Minimum required widths and clearances established under this section shall be maintained at all times.

"(l) Signs. When required by the fire chief, approved signs or other approved notices shall be provided and maintained for fire apparatus access roads to identify such roads and prohibit the obstruction thereof or both."

"INSTALLATION AND MAINTENANCE OF FIRE-PROTECTION, LIFE-SAFETY SYSTEMS AND APPLIANCES

"Installation

"Sec. 10.301. (c) Water Supply. An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are hereafter constructed, in accordance with the respective county water requirements. There shall be provided, when required by the chief, on-site fire hydrants and mains capable of supplying the required fire flow.

"Water supply may consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed system capable of supplying the required fire flow.

"The location, number and type of fire hydrants connected to a water supply capable of delivering the required fire flow shall be protected as set forth by the respective county water requirements. All hydrants shall be accessible to the fire department apparatus by roadways meeting the requirements of Section 10.207.

"(d) Fire Hydrant Markers. When required by the chief, hydrant locations shall be identified by the installation of reflective markers.

"(e) Timing of Installation. When fire protection facilities are to be installed by the developer, such facilities including all surface access roads shall be installed and made serviceable prior to and during the time of construction. When alternate methods of protection, as approved by the chief, are provided, the above may be modified or waived."

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

Sincerely,

NELSON M. TSUJI
Fire Chief

NMT/mo

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BELT COLLINS
& ASSOCIATES
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June 14, 1994
133.2001/94P-325

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

Dear Chief Tsuji:

Kaupulehu Phase 2 Expansion
<u>Environmental Impact Statement Preparation Notice</u>

Thank you for your letter of February 9, 1994 regarding the above project. The applicant will comply with the requirements of the Hawaii County Fire Code as outlined in your letter.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

RECEIVED
'94 FEB 10 P 2:29

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:

February 3, 1994 94-007/epo

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

Subject: Environmental Impact Statement Preparation Notice
Kaupulehu Phase 2 Expansion Project
North Kona, Hawaii
TMK: 7-2-03: por. 1

Thank you for allowing us to review and comment on the subject document. As this is a very preliminary document, we do not have any comments to offer at this time, other than requesting that the applicant/developer address the Department of Health's "Twelve Conditions Applicable to All New Golf Course Development" (attached) in the Draft Environmental Impact Statement (DEIS). We would also like to review a copy of the DEIS.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

STATE OF HAWAII
DEPARTMENT OF HEALTH

January, 1992 (Version 4)

TWELVE (12) CONDITIONS APPLICABLE TO ALL NEW GOLF COURSE DEVELOPMENT

The following conditions are recommended for all new golf course development in Hawaii to assure that environmental quality is preserved and enhanced as it relates to human health and the protection of sensitive ecosystems. Additional conditions may be imposed based on site-specific considerations.

1. Baseline groundwater/vadose zone and/or, if appropriate, coastal water quality shall be established. Once the sampling plan has been determined and approved by the State Department of Health, the owner/developer shall establish the baseline groundwater/vadose zone water quality, and, if appropriate, nearshore water quality, and report the findings to the State Department of Health. Analyses shall be done by a laboratory approved by the Department of Health.

2. The owner/developer and all subsequent owners shall establish a groundwater monitoring plan and system which shall be presented to the State Department of Health for its approval. The groundwater monitoring plan and system shall minimally describe the following components:

   a. A monitoring system tailored to fit site conditions and circumstances. The system shall include, and not be limited to, the use of monitoring wells, lysimeters, and vadose zone monitoring technologies. If monitoring wells are used, the monitoring wells shall generally extend 10 to 15 feet below the water table.

   b. A routine groundwater monitoring schedule of at least once every six (6) months, or more frequently, if required by the State Department of Health in the event that the monitoring data indicates a need for more frequent monitoring.

   c. A list of compounds which shall be tested for as agreed to by the State Department of Health. This list shall include, but not be limited to the following: total dissolved solids; chlorides; PH; nitrogen; phosphorus; and other compounds associated with fertilizers, biocides, or effluent irrigation.

3. If the data from the monitoring system indicate increased levels of a contaminate that poses, or may pose, a threat to public health and the environment, the State Department of Health shall require the owner to take immediate action to stop the source of contamination. Subsequently, the owner shall mitigate any adverse effects caused by the contamination.

4. Owner/developer shall provide sewage disposal for the clubhouse and other facilities by connecting to the public sewer system or by means of a treatment individual wastewater system approved by the Department of Health in conformance with Administrative Rules, Title 11, Chapter 62, Wastewater Treatment Systems. The use of wastewater for irrigation will be generally encouraged, with appropriate controls (see Condition 5).

5. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer, and all subsequent owners, shall develop and adhere to a Wastewater Reuse Plan which shall incorporate the provisions of the Department of Health's Guidelines for the Use of Reclaimed Water which includes:

   a. An Irrigation Plan encompassing buffer distances, pipe and appurtenance placement, and labeling.

   b. An Engineering Report encompassing treatment options and treatment levels.

   c. Hydro-geologic and hydrologic surveys to determine application rates, sizing and storage needs.

   d. A monitoring plan.

   e. A management plan.

   f. Public and employee education plans.

6. Underground storage tanks (USTs) used to store petroleum products for fueling golf carts, maintenance vehicles, and emergency power generators that pose potential risk to groundwater shall be discouraged. Use of electric golf carts and above-ground storage tanks for emergency power generators shall be encouraged.

   Should the owner/developer/operator plan to install USTs that contain petroleum or other regulated substances, the owner/developer/operator must comply with the federal UST technical and financial responsibility requirements setforth in Title 40 of the Code of Federal Regulations Part 280. These federal rules require, among other things, owners and operators of USTs to meet specific requirements in release detection and response, and subsequent corrective action. Also, the owner/developer/operator must comply with all State UST rules and regulations pursuant to the Hawaii Revised Statutes, Chapter 342-L, Underground Storage Tanks.

7. Buildings designed to house the fertilizer and biocides shall be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure for cleanup.

8. A golf course maintenance plan and program will be established based on "Best Management Practices (BMP)" in regards to utilization of fertilizers and biocides as well as the irrigation schedule. BMP's will be reviewed by the State Department of Health prior to implementation.

9. Every effort shall be made to minimize the amount of noise from golf course maintenance activities. Essential maintenance activities (e.g., mowing of greens and fairways) shall be conducted at times that do not disturb nearby residents.

10. Solid waste shall be managed in a manner that does not create a nuisance. Whenever possible, composting of green wastes for subsequent use as a soil conditioner or mulching material is encouraged. The composting and reuse should be confined to the golf course property to eliminate the necessity for offsite transport of the raw or processed material. In addition, during construction, the developer should utilize locally-produced compost and soil amendments whenever available.

11. Fugitive dust shall be controlled during construction in accordance with Hawaii Administrative Rules, Title 11, Chapter 60, Air Pollution Control. Pesticides and other agricultural chemicals should be applied in a manner that precludes the offsite drift of spray material. The State Department of Agriculture should be consulted in this regard.

12. To avoid soil runoff during construction, the developer should consult with the U.S. Department of Agriculture, Soil Conservation Service to assure that best management practices are utilized. If the total project area is five (5) acres or more and the development activities include clearing, grading, and excavation, a National Pollutant Discharge Elimination System (NPDES) stormwater permit application shall be submitted to the Department of Health in accordance with the Federal Clean Water Act requirements.

If there are any questions regarding the twelve (12) conditions mentioned here, please contact the Environmental Planning Office at 586-4337. We appreciate your cooperation in preserving and protecting environmental quality in Hawaii.

BCA
BELT COLLINS
& ASSOCIATES
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June 14, 1994
133.2001/94P-326

John C. Lewin, M.D.
Director of Health
State of Hawaii
Department of Health
P.O.Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

Kaupulehu Phase 2 Expansion
<u>Environmental Impact Statement Preparation Notice</u>

Thank you for your letter of February 3, 1994 regarding the above project. The Department of Health's "Twelve Conditions Applicable to All New Golf Course Development" will be addressed in the Draft Environmental Impact Statement (EIS). We would be pleased to provide you with a copy of the Draft EIS for your review once it has been completed.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes
Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR

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

RECEIVED
'94 FEB 24 P 3

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
KANANI HOLT
GLENN M. OKIMOTO
JOYCE T. OMINE
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.5755

February 9, 1994

Ms. Anne L. Mapes
Belt Collins Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

Subject: Environmental Impact Statement Preparation Notice
Kaupulehu Phase 2 Expansion Project
TMK: 7-2-03: por. 1

This project should be coordinated with other neighboring developments to minimize accesses onto Queen Kaahumanu Highway. Internal roadway connections and other related roadway infrastructure should also be coordinated.

We wish to reserve further comments until we have reviewed the draft environmental statement and the Traffic Impact Analysis Report (TIAR). The TIAR should address the entire development, including Phase 1, and any future phases, as well as proposed developments in the vicinity.

Please include our department as a consulted party during the EIS process.

We appreciate the opportunity to provide comments.

Sincerely,

Glenn M Okimoto

f. Rex D. Johnson
Director of Transportation

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& ASSOCIATES
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June 14, 1994
133.2001/94P-327

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

Dear Mr. Johnson:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 9, 1994 regarding the above project. Internal roadway connections and other roadway infrastructure will be coordinated with neighboring developments as requested in your letter. The proposed project will not need a separate access onto Queen Kaahumanu Highway because it will utilize the existing Kaupulehu Resort entry road and Kona Village Resort Access road per an agreement with the adjoining projects.

We would be pleased to provide you with a copy of the Draft EIS for your review, as well as the Traffic Impact Analysis Report, once they have both been completed.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

Anne L. Mapes

ALM:lws
cc: A. Kinzler

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

REPLY TO ATTENTION OF

February 11, 1994

RECEIVED
1994 FEB 14 P 2:58
BELT COLLINS HAWAII

Planning Division

Mr. Harold S. Masumoto, Director
Office of State Planning
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Mr. Masumoto:

Thank you for the opportunity to review and comment on the Residential, Golf Course, and Commercial Center for Kaupulehu, Hawaii (TMK 7-2-3: 1). The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. The proposed project does not involve work in waters of the U.S.; therefore, a DA permit is not required. However, if subsequent plans include work in coastal waters, the applicant will need to contact our Operations Division at 438-9258 and refer to file NP94-041.

b. The flood information provided on page 7 is correct.

Sincerely,

ORIGINAL SIGNED
Thomas M. Ushijima, P.E.
Acting Director
of Engineering

Copy Furnished:

Ms. Anne L. Mapes
Belt Collins and Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

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& ASSOCIATES
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June 14, 1994
133.2001/94P-328

Mr. Thomas M. Ushijima, P.E.
Acting Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Ushijima:

Kaupulehu Phase 2 Expansion
<u>Environmental Impact Statement Preparation Notice</u>

We have received a copy of your February 11, 1994 letter to the Office of State Planning regarding the above project. Thank you for your comments. Please be advised that no work in the ocean is contemplated at this time.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes
Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR

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

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

RECEIVED
'94 FEB 18 P 1:59

IN REPLY REFER TO:
94:PPE/716

February 15, 1994

Ms. Anne L. Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

Re: EIS Preparation Notice for Kaupulehu Phase 2 Expansion Project

We have reviewed the subject notice and wish to be a consulted party during the EIS process.

Thank you for your consideration.

Sincerely,

JOSEPH K. CONANT
Executive Director

HFDC

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& ASSOCIATES
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June 14, 1994
133.2001/94P-329

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

Dear Mr. Conant:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 15, 1994 regarding the above project. We would be pleased to provide you with a copy of the Draft EIS for your review once it has been completed.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

Stephen K. Yamashiro
Mayor

Diane S. Quitiquit
Director

County of Hawaii
DEPARTMENT OF RESEARCH AND DEVELOPMENT
25 Aupuni Street, Room 219 • Hilo, Hawaii 96720-4252 • (808) 961-8366 • Fax (808) 935-1205
KONA: (808) 329-5226 • Fax (808) 326-5663

RECEIVED
FEB 18 P 1:59

February 16, 1994

Ms. Anne L. Mapes
Belt Collins and Associates
680 Ala Moana Boulevard
Honolulu, HI 96813-5406

Dear Ms. Mapes:

Re: Kaupulehu Phase 2 Expansion Project
Environmental Impact Statement (EIS) Preparation Notice

We are in receipt of the EIS Preparation Notice for the referenced project. Our comments are as follows:

1. Under section 3.1.12, Natural Hazards and Constraints", the following is stated; "However, the magnitude of such tremors is not great, and such seismic activity is not considered to be a significant concern." Hawaii County building code requires designs to meet seismic Zone 3 conditions. Zone 4 is the highest level and applies to specific high risk regions of California. In view of this, it is felt that seismic activity is indeed a concern, as is hurricane risk which is not mentioned in the EIS Preparation Notice.

2. The proposed development will have a significant impact on the utility system in terms of electricity demand. The EIS should address this impact and could explore the use of energy conservation and efficiency measures in an effort to minimize operating costs to the residents of Kaupulehu as well as to reduce the impacts on the community in general and the environment.

Sincerely,

Raymond Carr, Economic Development Specialist

xc: Diane Quitiquit, Director

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BELT COLLINS
& ASSOCIATES
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June 14, 1994
133.2001/94P-330

Mr. Raymond Carr
County of Hawaii
Department of Research and Development
25 Aupuni Street, Room 219
Hilo, Hawaii 96720-4252

Dear Mr. Carr:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 16, 1994 regarding the above project. We agree with your comments concerning seismic activity and hurricane risk and will include a discussion of these natural hazards in the Draft EIS. In addition, a full discussion of the project's electrical energy impacts and recommendations to reduce electrical energy consumption will be provided in the DEIS.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE K. SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

RECEIVED
FEB 25 A 11:36

February 18, 1994

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard
First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Draft Environmental Assessment and Environmental Impact Statement Preparation Notice for Kaupulehu Phase 2 Development.

The comments were provided by the Land Use Commission. Questions regarding these comments may be directed to Esther Ueda, LUC Executive Officer, at 587-3826.

Thank you for the opportunity to comment.

Sincerely,

Mufi Hannemann

Enclosure

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

ESTHER UEDA
EXECUTIVE OFFICER

RECEIVED
FEB 25 A 11:37

February 1, 1994

SUBJECT: Director's Referral No. 94-029-R
Draft Environmental Assessment (EA) and Environmental Impact Statement (EIS) Preparation Notice for Kaupulehu Phase 2 Development

We have reviewed the subject EA transmitted as Director's Referral No. 94-029-R and wish to note that the document was submitted with LUC Docket No. A93-701/Kaupulehu Developments on December 13, 1993.

On January 13, 1994, the Land Use Commission determined that an EIS was required pursuant to Chapter 343, Hawaii Revised Statutes.

We have no other comments to offer at this time.

EU:KM:th

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
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June 14, 1994
133.2001/94P-331

Mr. Mufi Hannemann, Director
State of Hawaii
Department of Business and Economic Development
P.O.Box 2359
Honolulu, Hawaii 96804

Dear Mr. Hannemann:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 18, 1994 regarding the above project. We appreciate your forwarding the comments of the State Land Use Commission for our consideration. Pursuant to the Commission's direction, we have begun preparing a Draft Environmental Impact Statement for the project.

Should you have any comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

Anne L. Mapes

ALM:lws
cc: A. Kinzler

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213
TEL (310) 980-4000; FAX (310) 980-4018

RECEIVED
FEB 25 A 11:35

February 23, 1994 F/SW033:ETN

Ms. Anne L. Mapes
Belt Collins Hawaii
680 Ala Moana Blvd.
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

Thank you for your letter regarding the Environmental Impact Statement (EIS) Preparation Notice for the Kaupulehu Phase 2 Expansion Project on the island of Hawaii. I note that a baseline marine survey is underway for the project site that will include both water quality and marine life. I recommend that if not part of the study, benthic and intertidal algal resources be included as part of the studies, and the adjacent nearshore waters be surveyed for the presence of threatened green turtles (*Cholonia mydas*). The opportunity to provide comments at this stage of the EIS process is appreciated.

Sincerely,

Eugene T. Nitta

Eugene T. Nitta
Protected Species Program
Coordinator

cc: F/SW03 - Lecky

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

June 14, 1994
133.2001/94P-332

Mr. Eugene T. Nitta
National Marine Fisheries Service, Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

Dear Mr. Nitta:

Kaupulehu Phase 2 Expansion
<u>Environmental Impact Statement Preparation Notice</u>

Thank you for your letter of February 23, 1994 regarding the above project. A survey of benthic and intertidal algal resources has been included in the baseline marine assessment for marine biota, as well as the identification of any endangered or protected species, including green sea turtles (*Chelonia mydas*).

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

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

RECEIVED '94 FEB 28 A 10:55

REF:OCEA:KCK

File No.: 94-463
DOC. NO.: 4175

FEB 25 1994

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

Subject: Environmental Impact Statement Preparation Notice (EISPN): Kaupulehu Phase 2 Expansion Project, North Kona, Hawaii; TMK: 7-2-03: por. 1

We have reviewed the EISPN information for the subject project transmitted by your memorandum dated January 24, 1994 and have the following comments:

Division of Aquatic Resources

The Division of Aquatic Resources (DAR) suggests the forthcoming EIS discuss in detail potential short-term impacts related to construction and long-term effects that may impact adversely aquatic resources.

The EIS should project impacts, propose specific means for averting or minimizing adverse effects, and suggest possible mitigation or compensation for unavoidable damage to natural resource values.

Any proposed shoreline improvements or beach modifications should be adequately described in the DEIS and the Department should have the opportunity to review all proposed activities within the Department's jurisdiction.

Division of Land Management

The Division of Land Management (DLM) comments that they believe there should be a 500 foot setback (minimum) from certified shorelines to be developed which would be maintained by the owner for public uses (i.e. bath house, picnic facilities, trails). In addition, DLM believes the applicant should permit a minimum of 50% public play on the golf course at current municipal rates. DLM has no objections to the proposed reclassification subject to the foregoing conditions.

Office of Conservation and Environmental Affairs

The Office of Conservation and Environmental Affairs (OCEA) comments that the project area is currently located within the General "G" and Resource "R" subzones of the Conservation District.

Portions of this area were the subject of Conservation District Use Permit (CDUP) HA-2463. Approved by the Board of Land and Natural Resources on July 19, 1991, this CDUP authorized the construction of a by-pass road for access from the Queen Kaahumanu Highway to the Kona Village Resort. OCEA notes that HA-2463 was subject to seventeen (17) conditions (enclosed).

According to OCEA records, the Grant of Easements and Agreements with the County of Hawaii and its requisite CDUP condition language (pursuant to Condition No. 13), has not yet been executed.

We will forward any Historic Preservation Division and Commission on Water Resource Management comments as they become available.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

Keith Ahue
KEITH W. AHUE

cc: Hawaii County Planning Dept.

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
KEITH W. AHUE
MANABU TAGOMORI
Dan T. Kochi

REF:OCEA:SKK

SEP 25 1991

FILE NO.: HA-2463
DOC. NO.: 1711E

Kaupulehu Developments and
Kona Village Associates
c/o Gray, Hong, Bills and Associates
119 Merchant Street, Suite 607
Honolulu, Hawaii 96813

Attn: David Bills

Gentlemen:

Subject: Conservation District Use Application for an Access Easement at Kaupulehu, North Kona, Hawaii

We are pleased to inform you that your Conservation District Use Application to construct a roadway at Kaupulehu, North Kona, THK: 7-2-3: 01, was approved on July 19, 1991 subject to the following conditions:

1. An archaeological data recovery survey shall be conducted by a qualified archaeologist. Findings of the data recovery shall be submitted in report format to the Historic Preservation Division for review and approval prior to construction or any land alteration activity.

2. The applicant shall comply with all applicable statutes, ordinances, rules and regulations of the Federal, State and County governments, and applicable parts of Section 13-2-21, Administrative Rules, as amended;

3. The applicant, its successors and assigns, shall indemnify and hold the State of Hawaii harmless from and against any loss, liability, claim or demand for property damage, personal injury and death arising out of any act or omission of the applicant, its successors, assigns, officers, employees, contractors and agents under this permit or relating to or connected with the granting of this permit;

4. The applicant shall comply with all applicable Department of Health Administrative Rules;

5. Before proceeding with any work authorized by the Board, the applicant shall submit four (4) copies of the construction plans and specifications to the Chairperson or his authorized representative for approval for consistency with the conditions of the permit and the consistency with the conditions of the permit and the declarations set forth in the permit application. Three (3) of the copies will be returned to the applicant. Plan approval by the Chairperson does not infer approval required of other agencies. Compliance with Condition 2 remains the responsibility of the applicant;

6. Any work or construction to be done on the land shall be initiated within one (1) year of the approval of such use, and all work and construction must be completed within three (3) years of the approval of such use;

7. If, subsequent to the issuance of this permit, any information and data provided by the Applicant prove to be false, incomplete, or inaccurate, this permit may be modified, suspended, or revoked and the Department may, in addition, institute appropriate legal proceedings.

8. This permit does not convey any vested right or exclusive privilege.

9. Continuous public access to the beach will be provided by the Applicant both during and after construction.

10. A clearly visible sign will be posted on the Kona Village Resort gatehouse at the beginning of the roadway indicating the right of public access.

11. Thirteen additional unmarked parking stalls will be made available to accommodate public use of the shoreline.

12. Carts will be provided at the public parking areas to assist transport of beach accessories to the shoreline.

13. The conditions noted above in paragraphs 9 through 12 will be incorporated into the Grant of Easements and Agreements being negotiated with the County of Hawaii.

14. If any information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Department may, in addition, institute appropriate legal proceedings;

15. That all representation relative to mitigation set forth in the accepted Environmental Assessment/Environmental Impact Statement for this proposed use are hereby incorporated as conditions of this approval;

16. That failure to comply with any of these conditions shall render this Conservation District Land Use application null and void;

17. Other terms and conditions as prescribed by the Chairperson; and

Please acknowledge receipt of this permit, with the above noted conditions, in the space provided below. Please sign two copies. Retain one and return the other.

Should you have any questions on any of these conditions, please feel free to contact our Office of Conservation and Environmental Affairs staff at 548-7837.

Very truly yours,

WILLIAM W. PATY

Receipt Acknowledged

KAUPULEHU DEVELOPMENTS

By Barnwell Hawaiian
Properties, Inc.
A General Partner

By ______________
Its President

Date: 1/13/92

Receipt Acknowledged

KONA VILLAGE ASSOCIATES

By TT Keaau, Inc.
Its Managing Partner

By ______________
Its Vice President

Date: December 11, 1991

cc: Board Member

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
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June 14, 1994
133.2001/94P-333

Mr. Keith W. Ahue, Chairperson
Board of Land and Natural Resources
State of Hawaii
P.O.Box 621
Honolulu, Hawaii 96809

Dear Mr. Ahue:

Kaupulehu Phase 2 Expansion
<u>Environmental Impact Statement Preparation Notice</u>

Thank you for your letter of February 25, 1994 regarding the above project. Following are responses to the comments of each division presented in your letter.

<u>Division of Aquatic Resources</u>: The Draft Environmental Impact Statement (EIS) for the proposed project will address potential impacts, both short- and long-term, upon the area's aquatic resources. If adverse impacts are identified, the Draft EIS will recommend specific mitigation measures. The document will also include a discussion of specific means for averting or minimizing potential adverse effects. No shoreline improvements or modifications are contemplated at this time for the project.

<u>Division of Land Management</u>: The applicant is committed to the provision of public pedestrian shoreline access and has initiated a dialogue with Na Ala Hele on how best to plan for safe access. We have also met with State Parks Division staff to discuss coordination of public amenities, such as restrooms, with those planned by the State in the vicinity of the Ala Kahakai.

The applicant is considering various aspects of public shoreline access; however, specific details will not be available until a public access and shoreline management plan is prepared when the project advances beyond its current conceptual stage. Due to the topographic character of the project site and the requirements of a viable recreational/residential project oriented toward the ocean, a 500-foot minimum setback along the entire shoreline is not considered a practical alternative. A well-integrated project plan can include appropriate public shoreline access and amenities without such a limiting constraint.

In a similar vein, while the applicant is committed to the provision of public play at the proposed golf courses, it is premature to commit to a specific ratio of public play or a specific cost per round.

<u>Office of Conservation and Environmental Affairs</u>: With regard to the comment concerning the prior approved CDUP (HA-2463), that permit pertains to an access

easement to Kona Village Resort, a portion of which crosses the subject property. The physical improvements have been built, including the roadway and public parking stalls, and a public access sign has been posted. As you point out, the Grant of Easements and Agreements has not yet been executed. We understand, however, that all parties concerned are working diligently to finalize agreements so that the document can be executed.

Should you have any comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

Anne L. Mapes

ALM:lws
cc: A. Kinzler

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

FEB 25 A 11:38

February 16, 1994

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Blvd., First Floor
Honolulu, Hawaii 96813

Dear Ms. Mapes:

Subject: Kaupulehu Phase 2 Expansion Project, Environmental Impact Statement Preparation Notice (EISPN), Oahu, Hawaii

The staff of the U.S. Geological Survey, Water Resources Division, Honolulu District, has reviewed the subject EISPN and we have no comments to offer at this time.

Thank you for allowing us to review this EISPN.

We are returning the EISPN to your office for your future use.

Sincerely,

William Meyer
District Chief

Enclosure

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
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June 14, 1994
133.2001/94P-334

Mr. William Meyer, District Chief
Water Resources Division, Geological Survey
United States Department of the Interior
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 16, 1994 regarding the above project. We appreciate your taking the time to review the document. Should you have any comments in the future, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
830 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

DAYTON M. NAKANELUA
DIRECTOR

ALFRED C. LARDIZABAL
DEPUTY DIRECTOR

RECEIVED
1994 MAR -3 A 11:11

February 28, 1994

Ms. Anne L. Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard
First Floor
Honolulu, Hawaii 96813

Dear Ms. Mapes:

This is in response to your letter of January 24, 1994, regarding the Kaupulehu Phase 2 Development Environmental Impact Statement Preparation Notice.

We have reviewed the document and foresee no adverse effects by construction of the project. With Hawaii County's economy still staggering, the project will provide residents with some much needed employment opportunities.

Thank you for the opportunity to review the EISPN. If you need more information or have any questions, please call Frederick Pang, Chief, Research and Statistics Office at 586-8999.

Sincerely,

Dayton M. Nakanelua
Director

BCA
BELT COLLINS & ASSOCIATES
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June 14, 1994
133.2001/94P-336

Mr. Dayton M. Nakanelua, Director
Department of Labor and Industrial Relations
State of Hawaii
830 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Nakanelua:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of February 28, 1994 regarding the above project. Should you desire any additional information about the project, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

OFFICE OF STATE PLANNING
Office of the Governor

RECEIVED
'94 MAR -3 A 11:09

Ref. No. C-526

March 1, 1994

Belt Collins and Associates
680 Ala Moana Boulevard
First Floor
Honolulu, Hawaii 96813-5406

Subject: Kaupulehu Phase 2 Expansion Project Environmental Impact Statement Preparation Notice

We have reviewed the EIS Preparation Notice for the Kaupulehu Phase 2 Expansion Project and have the following comments.

Water quality, in particular coastal water quality, is a significant issue. A Coastal Zone Management policy is to: "Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate state water quality standards".

Given the relatively large nature of the project and its proximity to the coastline, the potential for significant quantities of contaminated runoff exists. The increase in impermeable surfaces such as roadway infrastructure may generate runoff contaminated with associated petroleum products. In addition, the proposed 36-hole golf course may generate runoff contaminated with pesticides and fertilizers. Measures to reduce these potential nonpoint sources of pollution should be considered, such as settling basins and water quality monitoring.

Land use concerns are also a significant issue and should be considered in the preparation of the environmental impact statement. The impact to natural resources such as land-based flora and fauna, as well as ocean ecosystems, should be addressed. The proposed project requires the reclassification of 1,000 acres of land from the Conservation to the Urban District. The location of approximately 750 single family residences and 600 multi-family units, 36-hole golf course with clubhouse, and a supporting commercial center adjacent to the Kona Village Resort may have an impact on the character of this visitor destination area. The projected need for the residential development, as well as the economic feasibility of the project, should also be addressed. Given the large scale of the development, the infrastructure required to support it will probably be a significant issue and should be thoroughly discussed in the EIS. Finally, a discussion of how this project will integrate into the West Hawaii Regional Plan is appropriate.

We appreciate the opportunity to review the document.

Sincerely,

Harold S. Masumoto
Director

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
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June 14, 1994
133.2001/94P-337

Mr. Harold S. Masumoto, Director
Office of State Planning
State of Hawaii
P.O.Box 3540
Honolulu, Hawaii 96811-3540

Dear Mr. Masumoto:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of March 1, 1994 regarding the above project. The matters you raised in your letter concerning impacts on water quality, impacts on land and ocean resources, impacts on the existing Kona Village Resort, economic feasibility, infrastructure requirements, and the integration of the project into the West Hawaii Regional Plan will all be discussed in the draft environmental impact statement.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR OF HAWAII

RECEIVED
14 A 9 27

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

March 8, 1994

LOG NO: 10753
DOC NO: 9403RC13

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813

Dear Ms. Mapes:

SUBJECT: **Kaupulehu Phase 2 Expansion Project -- EIS Prep Notice
Kaupulehu, North Kona, Hawaii
TMK: 7-2-03: portion 1**

We assume that our department has already responded. We will look forward to reviewing the Phase II inventory-level survey findings noted on page 10. Our Hawai'i Island Archaeologist is now Patrick McCoy. He can be reached at 587-0007.

Sincerely yours,

DON HIBBARD, Administrator
State Historic Preservation Division

RC:amk

c: OCEA (Id 4075)

BCA
BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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June 14, 1994
133.2001/94P-338

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

Dear Mr. Ahue:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of March 8, 1994 regarding the above project. To date, we have received two other letters from the Department of Land and Natural Resources providing comments on the above project. We will be forwarding to you a copy of the Phase 2 inventory level survey findings as soon as the report becomes available.

Should you have any additional comments concerning the project, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR OF HAWAII

RECEIVED

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

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

REF:OCEA:KCK

File No.: 94-463
DOC. NO.: 4235

MAR 15 1994

Ms. Anne L. Mapes
Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Ms. Mapes:

Subject: Environmental Impact Statement Preparation Notice (EISPN): Kaupulehu Phase 2 Expansion Project, North Kona, Hawaii; TMK: 7-2-03: por. 1

The following are our additional comments on the subject project which supplement those forwarded by our previous letter dated February 25, 1994:

Commission on Water Resource Management

The Commission on Water Resource Management's (CWRM) staff comments that the applicant should be advised that if the expansion of existing water systems includes new well development, a well construction permit pursuant to Section 13-168-12, Hawaii Administrative Rules will be required. On the other hand, if the applicant proposes to install larger pumps on existing wells, pump installation permits will be required.

We will forward any Historic Preservation Division comments as they become available.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

KEITH W. AHUE

cc: Hawaii County Planning Dept.

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
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June 14, 1994
133.2001/94P-335

Mr. Keith W. Ahue, Chairperson
Board of Land and Natural Resources
State of Hawaii
P.O.Box 621
Honolulu, Hawaii 96809

Dear Mr. Ahue:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of March 15, 1994 regarding the above project. We acknowledge the comments presented in your letter from the Commission on Water Resource Management. The impact of the project's demand on potable and non-potable water resources will be fully evaluated in the Draft Environmental Impact Statement. All necessary permits will be obtained prior to any well development or pump installations.

Should you have any comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

Stephen K. Yamashiro
Mayor

County of Hawaii
DEPARTMENT OF PUBLIC WORKS

25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

RECEIVED
MAR -9 A10:02

March 28, 1994

Anne L Mapes
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

SUBJECT: EIS Preparation Notice
Applicant: Kaupulehu Development
Location: Kaupulehu, North Kona, HI
TMK: 7-2-3:1

We have reviewed the subject application and our comments are as follows:

BUILDING

1. Buildings shall conform to all requirements of code and statutes pertaining to building construction.

DRAINAGE

2. All development generated runoff shall be disposed of on site and shall not be directed toward any adjacent properties.
3. Applicant shall be informed that if drywells are included in the subject improvements, Chapter 23, Underground Injection Control (UIC) Administrative Rules, Dept. of Health, prohibit any person from operating, constructing or modifying an injection well (drywell) unless authorized by a permit issued by the Director of Health, State of Hawaii.
4. A drainage study should be prepared and a drainage system should be installed meeting with the approval of DPW.

5. All grading and grubbing activities shall comply with Chapter 10 of the Hawaii County Code.
6. FEMA map 478C shows this parcel to lie within the VE and AE coastal flood zones. Flood zone boundaries should be plotted on development plans; all construction activities should be outside of these flood zones.

SOLID WASTE

7. A solid waste management plan should be developed. The plan should address, as a minimum, the following:
   a. Analysis of anticipated solid waste volume and composition.
   b. Proposed disposal and/or transportation methods to be employed for various components of the waste stream.
   c. Impacts to existing/proposed County solid waste facilities, including financial impacts, and appropriate mitigating measures.
   d. A waste reduction component which analyzes techniques to be employed to achieve a reduction goal of 25% by 1995 and 50% by 2000.
8. Based upon the current draft status of the Integrated Solid Waste Management Plan, we would recommend that the applicant be required to abide by the plan as ultimately approved by the County Council. This may or may not require the construction of an additional solid waste transfer station.

Galen Kuba, Acting Division Chief
Engineering Division

TWP:sls

cc: Engineering - Hilo
Engineering - Kona
Planning - Kona

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
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June 14, 1994
133.2001/94P-339

Mr. Galen Kuba
Acting Division Chief
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720-7198

Dear Mr. Kuba:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of March 28, 1994 regarding the above project. As requested in your letter, the project will conform to all building, drainage, and solid waste disposal requirements. Flood zone boundaries will be identified in the draft environmental impact statement.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

ALM:lws
cc: A. Kinzler

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

ESTHER UEDA
EXECUTIVE OFFICER

RECEIVED
'94 APR -5 A 11:10

April 4, 1994

CJ Villa
75-6100 Alii Drive, C36
Kailua-Kona, Hawaii 96740

Dear Sir/Madam:

Subject: LUC Docket No. A93-701/Kaupulehu Developments

We have received your letter dated March 25, 1994, requesting to be a consulted party for the draft Environmental Impact Statement (DEIS) for the subject docket.

By copy of this letter, we are forwarding a copy of your request to Ms. Anne Mapes of Belt Collins and Associates, the consultant responsible for the preparation of the DEIS.

Should you have any questions, please feel free to call me or Kathy Murakami of my staff at 587-3822.

Sincerely,

ESTHER UEDA
Executive Officer

EU:KM:th

cc: ✓Ms. Anne Mapes,
Belt Collins and Associates

CJ VILLA
75-6100 Alii Drive, C36
Kailua-Kona, HI 96740

RECEIVED
'94 APR -5 A 11:52

March 25, 1994

Esther Ueda
Executive Director
State of Hawaii Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, HI 96813

Dear Ms. Ueda:

I would like to be a consulted party for the Draft EIS for Kaupulehu Phase 2 Development, in the North Kona district of Hawaii, TMK 7-2-03: por. 1.

Thank you in advance for your cooperation.

Sincerely,

CJ Villa

LAND USE COMMISSION
STATE OF HAWAII
MAR 28 1 54 PM '94

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

June 14, 1994
133.2001/94P-340

CJ Villa
75-6100 Alii Drive, C36
Kailua-Kona, Hawaii 96740

Dear Sir/Madam:

Kaupulehu Phase 2 Expansion
Environmental Impact Statement Preparation Notice

Thank you for your letter of March 25, 1994 regarding the above project. As requested in your letter, we will include you as a consulted party and provide you with a copy of the Draft Environmental Impact Statement upon its completion.

Should you have any further comments, please do not hesitate to contact me at 521-5361.

Very truly yours,
BELT COLLINS HAWAII

Anne L. Mapes

Anne L. Mapes

ALM:lws
cc: A. Kinzler

Chapter 10

Organizations and Individuals Involved in the Preparation of the EIS

CHAPTER 10 ORGANIZATIONS AND INDIVIDUALS INVOLVED IN THE PREPARATION OF THE EIS

10.1 ORGANIZATIONS AND INDIVIDUALS WHO ASSISTED IN THE PREPARATION OF THIS EIS

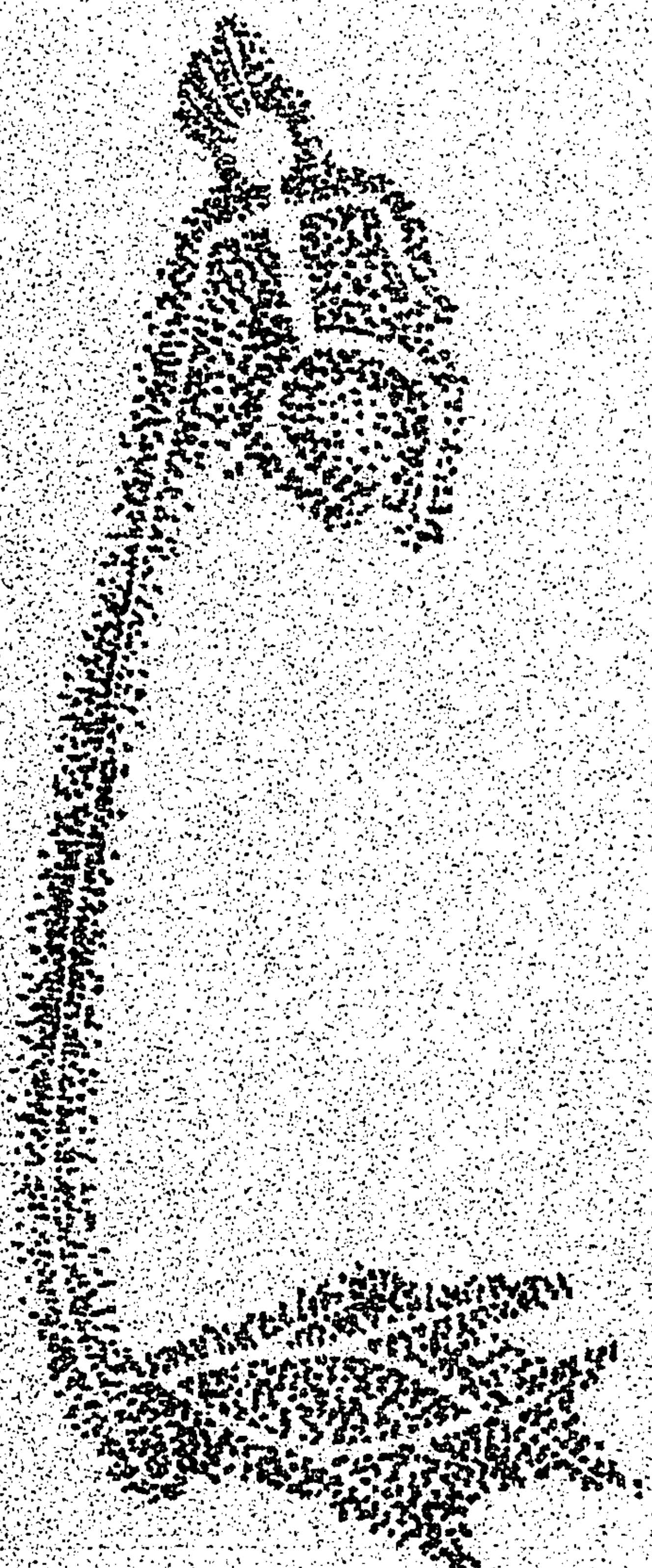
This Environmental Impact Statement was prepared for Kaupulehu Developments by Belt Collins Hawaii with input provided by consultants. The following Belt Collins personnel and consultants were involved:

Belt Collins Hawaii

James Bell	- Principal-in-Charge
Anne Mapes	- Project Manager and EIS Contributing Writer
Lee Sichter	- Planner and EIS Author
Richard Van Horn	- Planner
Trina Onuma	- Civil Engineer
Ed Kuniyoshi	- Planner
Karon Aoki	- Graphics Designer

Consultants

Archaeological Impacts	- Paul H. Rosendahl, Inc.
Air Quality Impacts	- Jim Morrow & Associates
Economic Impact Analysis	- The Hallstrom Group, Inc.
Fauna Impacts	- Phillip L. Bruner
Flora Impacts	- Char & Associates
Market Analysis	- The Hallstrom Group, Inc.
Marine Impacts	- Marine Research Consultants
Noise Impacts	- Y. Ebisu & Associates
Pesticide/Fertilizer Impacts	- Murdoch and Green
Traffic Impacts	- The Traffic Management Consultant, Inc.



Chapter 11

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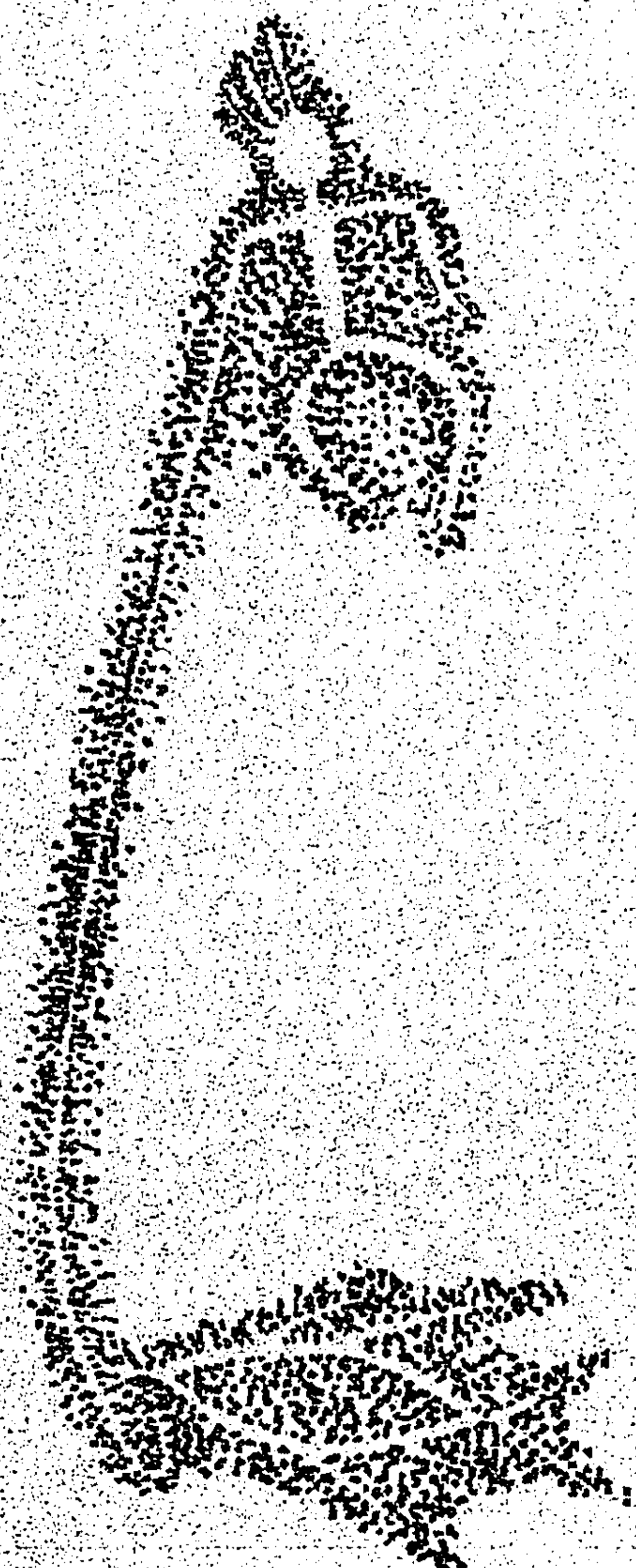
Chapter 12



Comments on the Draft EIS

CHAPTER 12 COMMENTS ON THE DRAFT EIS

A Notice of Availability of the Draft EIS for the Kaupulehu Resort Expansion project was published in the OEQC Bulletin by the Office of Environmental Quality Control on July 8, 1994. The deadline for comments was August 22, 1994. The agencies, organizations, and individuals who commented on the Enviromental Assessment in writing and/or requested status as a Consulted Party are identified by an asterisk (*) and their letters, together with responses, are presented in Chapter 9. The 21 parties who commented on the Draft EIS are identified with a plus-sign (+) and their letters, together with responses, are reproduced in this chapter.

Federal Agencies

*+ Department of the Army
* National Marine Fisheries Service
*+ Geological Survey, Water Resources Division
+ Department of the Navy
+ Department of Agriculture, Soil Conservation Service

State Agencies

*+ Department of Business, Economic Development and Tourism
* Department of Health
*+ Department of Land and Natural Resources
* Department of Transportation
*+ Department of Budget and Finance (Housing Finance & Development Corp.)
+ Office of Environmental Quality Control
* Office of State Planning
+ Environmental Center, University of Hawaii at Manoa
+ Department of Accounting and General Services, Public Works Division
+ State Land Use Commission
+ Department of Labor and Industrial Relations

County Agencies

* Department of Public Works
+ Planning Department
*+ Department of Water Supply
*+ Police Department
* Civil Defense Agency
*+ Fire Department
* Department of Research & Development

Organizations

- * Hawaii Leeward Planning Conference
- * PBR Hawaii
- * Na Ala Hele
- \+ Kona Hawaiian Civic Club
- \+ West Hawaii Sierra Club, Conservation Committee

Private Individuals and Landowners

- * CJ Villa
- \+ J. Curtis Tyler, III (note: Mr. Tyler submitted a letter dated 4/22/94 and a revised letter dated 8/22/94. He advised the EIS author by phone on 8/22 that the date of the 4/22 was in error and that his 8/22 letter was intended to correct the error. Therefore, only the 8/22 letter is reproduced here.)
- \+ McCorriston Miho Miller Mukai
- \+ John P. Powell (note: Mr. Powell submitted a letter on 8/15/94 and a revised letter on 8/18/94, requesting that the 8/15 letter be replaced. Thus, a total of 23 letters were received (including two letters each from Mr. Tyler and Mr. Powell, but only 21 are reproduced here.)

Stephen K. Yamashiro
Mayor

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'94 JUL 15 A 11:14

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

Nelson M. Tsuji
Fire Chief

July 11, 1994

Ms. Esther Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda:

Subject: Draft Environmental Impact Statement
Kaupulehu Resort Expansion
North Kona, Hawaii
TMK: 7-2-03: portion 1

We would like to amend our orginal comments regarding the above-referenced project as follows:

The Fire Department's requirements as stated in the Fire Code are:

"Fire Apparatus Access Roads

"Sec. 10.207. (a) General. Fire apparatus access roads shall be provided and maintained in accordance with the provisions of this section.

"(b) Where Required. Fire apparatus access roads shall be required for every building hereafter constructed when any portion of an exterior wall of the first story is located more than 150 feet from fire department vehicle access as measured by an unobstructed route around the exterior of the building.

"EXCEPTIONS: 1. When buildings are completely protected with an approved automatic fire sprinkler system, the provisions of this section may be modified.

"2. When access roadways cannot be installed due to topography, waterways, nonnegotiable grades or other similar conditions, the chief may require additional fire protection as specified in Section 10.301 (b).

"3. When there are not more than two Group R, Division 3 or Group M Occupancies, the requirements of this section may be modified, provided, in the opinion of the chief, fire-fighting or rescue operations would not be impaired.

"More than one fire apparatus road may be required when it is determined by the chief that access by a single road may be impaired by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access.

"For high-piled combustible storage, see Section 81.109.

"(c) Width. The unobstructed width of a fire apparatus access road shall be not less than 20 feet.

"(d) Vertical Clearance. Fire apparatus access roads shall have an unobstructed vertical clearance of not less than 13 feet 6 inches.

"EXCEPTION: Upon approval vertical clearance may be reduced, provided such reduction does not impair access by fire apparatus and approved signs are installed and maintained indicating the established vertical clearance.

"(e) Permissible Modifications. Vertical clearances or widths required by this section may be increased when, in the opinion of the chief, vertical clearances or widths are not adequate to provide fire apparatus access.

"(f) Surface. Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be provided with a surface so as to provide all-weather driving capabilities." (20 tons)

"(g) Turning Radius. The turning radius of a fire apparatus access road shall be as approved by the chief." (45 feet)

"(h) Turnarounds. All dead-end fire apparatus access roads in excess of 150 feet in length shall be provided with approved provisions for the turning around of fire apparatus.

"(i) Bridges. When a bridge is required to be used as access under this section, it shall be constructed and maintained in accordance with the applicable sections of the Building Code and using designed live loading sufficient to carry the imposed loads of fire apparatus.

"(j) Grade. The gradient for a fire apparatus access road shall not exceed the maximum approved by the chief." (15%)

"(k) Obstruction. The required width of any fire apparatus access road shall not be obstructed in any manner, including parking of vehicles. Minimum required widths and clearances established under this section shall be maintained at all times.

"(l) Signs. When required by the fire chief, approved signs or other approved notices shall be provided and maintained for fire apparatus access roads to identify such roads and prohibit the obstruction thereof or both."

"INSTALLATION AND MAINTENANCE OF FIRE-PROTECTION, LIFE-SAFETY SYSTEMS AND APPLIANCES

"Installation

"Sec. 10.301. (a) Type Required. The chief shall designate the type and number of fire appliances to be installed and maintained in and upon all buildings and premises in the jurisdiction other than private dwellings. This shall be done according to the relative severity of probable fire, including the rapidity with which it may spread. Such appliances shall be of a type suitable for the probable class of fire associated with such building or premises and shall have approval of the chief.

"(b) Special Hazards. In occupancies of an especially hazardous nature or where special hazards exist in addition to the normal hazard of the occupancy, or where access for fire apparatus is unduly difficult, additional safeguards may be required consisting of additional fire appliance units, more than one type of appliance, or special systems suitable for the protection of the hazard involved. Such devices or appliances may consist of automatic fire alarm systems, automatic sprinkler or water spray systems, standpipe and hose, fixed or portable fire extinguishers, suitable asbestos

blankets, breathing apparatus, manual or automatic covers, carbon dioxide, foam, halogenated and dry chemical or other special fire-extinguishing systems. Where such systems are installed, they shall be in accordance with the applicable Uniform Fire Code Standards or standards of the National Fire Protection Association when Uniform Fire Code Standards do not apply.

"(c) Water Supply. An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are hereafter constructed, in accordance with the respective county water requirements. There shall be provided, when required by the chief, on-site fire hydrants and mains capable of supplying the required fire flow.

"Water supply may consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed system capable of supplying the required fire flow.

"The location, number and type of fire hydrants connected to a water supply capable of delivering the required fire flow shall be protected as set forth by the respective county water requirements. All hydrants shall be accessible to the fire department apparatus by roadways meeting the requirements of Section 10.207.

"(d) Fire Hydrant Markers. When required by the chief, hydrant locations shall be identified by the installation of reflective markers.

"(e) Timing of Installation. When fire protection facilities are to be installed by the developer, such facilities including all surface access roads shall be installed and made serviceable prior to and during the time of construction. When alternate methods of protection, as approved by the chief, are provided, the above may be modified or waived."

Thank you for giving us the opportunity to review this document.

Sincerely,

NELSON M. TSUJI, Fire Chief

NMT/mo
cc: Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
✓Ms. Anne Mapes, Belt Collins Hawaii

BELT COLLINS
H A W A I I

August 25, 1994
94P-454/133.2001

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

Dear Chief Tsuji:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 11, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. We appreciate the time you and your staff spent in reviewing the DEIS. Your additional comments have been noted and the Fire Department's requirements as stated in the Fire Code will be adhered to as various portions of the project are developed.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

RECEIVED

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

July 12, 1994

Ms. Esther Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

DRAFT ENVIRONMENTAL IMPACT STATEMENT
APPLICANT - KAUPULEHU DEVELOPMENTS
TAX MAP KEY 7-2-03:01 (PORTION)

We have reviewed the subject Draft Environmental Impact Statement. Please refer to the attached copy of a letter dated February 2, 1994, to Ms. Anne L. Mapes, of Belt Collins & Associates, for our comments and requirements.

H. William Sewake
Manager

WA

Enc.

copy - Ms. Anne L. Mapes, Belt Collins & Associates
Mr. Alexander C. Kinzler, Kaupulehu Developments
Office of Environmental Quality Control (w/EIS enc.)

... Water brings progress...

BELT COLLINS
HAWAII

August 25, 1994
94P-453/133.2001

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

Dear Mr. Sewake:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 12, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

680 ALA MOANA BOULEVARD, FIRST FLOOR, HONOLULU, HAWAII 96813-5406 U.S.A., TEL: 808 521-5361 FAX: 808 538-7819
ENGINEERING • PLANNING • LANDSCAPE ARCHITECTURE • ENVIRONMENTAL CONSULTING

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

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REPLY TO ATTENTION OF

July 14, 1994

Planning Division

Ms. Esther Ueda, Executive Director
State of Hawaii
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for the Kaupulehu Resort Expansion, Kona, Hawaii (TMK 7-2-3: 1). We do not have any additional comments to offer beyond those offered in our previous letter dated February 11, 1994.

Sincerely,

Ray H. Jyo, P.E.
Director of Engineering

Copies Furnished:

Mr. Alexander C. Kinzler
Kaupulehu Developments
1100 Alakea Street, Suite 2900
Honolulu, Hawaii 96813

✓Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard., Suite 100
Honolulu, Hawaii 96813

BELT COLLINS
H A W A I I

August 25, 1994
94P-453/133.2001

Mr. Ray H. Jyo, P.E.
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Jyo:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 14, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

680 ALA MOANA BOULEVARD, FIRST FLOOR, HONOLULU, HAWAII 96813-5406 U.S.A. · TEL 808 521-5361 · FAX 808 538-7819
ENGINEERING · PLANNING · LANDSCAPE ARCHITECTURE · ENVIRONMENTAL CONSULTING

JOHN WAIHEE
GOVERNOR

RECEIVED
'94 JUL 19 P 1:07

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813

BRUCE S. ANDERSON, Ph.D.
INTERIM DIRECTOR

July 15, 1994

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: EIS for Kaupulehu Resort Expansion

We have reviewed the subject document and have no comments at this time. We have reviewed and approved the distribution list for the document as submitted.

If you have any questions, please call Ms. Betty Wood at 586-4185.

Sincerely,

for BRUCE S. ANDERSON, Ph.D.
Interim Director

BSA/BW:kk

c: Ms. Anne L. Mapes, Belt Collins Hawaii
Mr. Alexander Kinzler, Kaupulehu Developments

BELT COLLINS
H A W A I I

August 25, 1994
94P-453/133.2001

Bruce S. Anderson, Ph.D.
Interim Director
Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Dr. Anderson:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 15, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO
11010
Ser N42/7345

18 JUL 1994

Ms. Esther Ueda
Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda:

SUBJ: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE KAUPULEHU RESORT EXPANSION

Thank you for the opportunity to review the Draft Environmental Impact Statement (DEIS) for the Kaupulehu Resort Expansion.

The Navy has no comments to offer at this time and appreciates the opportunity to participate in your review process.

The Navy's point of contact is Mr. Stanford Yuen at 474-0439.

Sincerely,

STANFORD B. C. YUEN, P.E.
Facilities Engineer
By direction of
the Commander

Copy to:
Mr. Alexander C. Kinzler
Kaupulehu Developments
1100 Alakea Street, Suite 2900
Honolulu, HI 96813

Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Blvd., Suite 100
Honolulu, HI 96813

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'94 JUL 20 P 12:39

BELT COLLINS
H A W A I I

August 25, 1994
94P-453/133.2001

Mr. Stanford B.C. Yuen, P.E.
Facilities Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Yuen:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 18, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

Stephen K. Yamashiro
Mayor

DECEIVED
'94 JUL 26 A 11:58

County of Hawaii
POLICE DEPARTMENT
349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-2702

Victor V. Vierra
Chief of Police

Francis C. DeMorales
Deputy Chief of Police

July 19, 1994

LAND USE COMMISSION
STATE OF HAWAII
JUL 22 11 57 AM '94

Ms. Esther Ueda
Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: KAUPULEHU RESORT EXPANSION
NORTH KOHALA, HAWAII
TMK: 7-2-03: PORTION 1

The above application has been reviewed and we foresee no adverse effect should it be granted.

Thank you for the opportunity to provide input.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

JV:sk

SANDWICH ISLANDS

BELT COLLINS
HAWAII

August 25, 1994
94P-455/133.2001

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

Dear Chief Vierra:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 19, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. We appreciate the time you and your staff spent in reviewing the DEIS and have noted your comment of no foreseen adverse effect due to the project.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
RICK EGGED
Deputy Director
JEANNE K. SCHULTZ
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

RECEIVED
JUL 21 A 9:20

July 21, 1994

Ms. Esther Ueda
Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Esther ~~Ms. Ueda~~:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Draft Environmental Impact Statement for the Kaupulehu Resort Expansion, North Kona.

The comments were provided by our Energy Division. Questions regarding these comments may be directed to Maurice Kaya, Division Administrator, at 587-3800.

Thank you for the opportunity to comment.

Sincerely,

Mufi

Mufi Hannemann

Enclosure

cc: Mr. Alexander C. Kinzler
Ms. Anne Mapes

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

July 13, 1994

SUBJECT: Kaupulehu Resort Expansion, North Kona
Draft Environmental Impact Statement (DEIS)

The Energy Division has the following comments on the subject:

We note that the DEIS considers the requirements of the Energy Functional Plan (1991) and states that the proposed project can assist in reducing the State's dependence on fossil fuels by promoting "energy efficiency development techniques and energy conservation wherever possible."

We recommend that the project be designed to reflect a "Hawaiian sense of place" which can be accomplished through innovative master planning, architectural design and natural ventilation.

We would like to call your attention to the Model Energy Code which may be used as a guide for energy efficiency. If you do not already have a copy of the Energy Code, please call the Energy Division at 587-3800 and we will forward one to you.

BELT COLLINS
H A W A I I

August 25, 1994
94P-456/133.2001

Ms. Jeanne Schultz, Director
Dept. of Business, Economic Development & Tourism
State of Hawaii
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Ms. Schultz:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

We have received Mr. Mufi Hannemann's July 21, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Thank you for transmitting comments from your Energy Division. The recommendations for promoting energy efficiency and energy conservation within the project and for a design to reflect a "Hawaiian sense of place" will be taken into consideration during future planning and design as the project moves along in the permitting and development process.

We appreciate the time you and your staff spent in reviewing the DEIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

680 ALA MOANA BOULEVARD, FIRST FLOOR, HONOLULU, HAWAII 96813-5406 U.S.A., TEL: 808 521-5361 FAX: 808 538-7819
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(P)1667.4

JUL 25 1994

State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Attention: Ms. Esther Ueda

Gentlemen:

Subject: Kaupulehu Resort Expansion
North Kona, Hawaii
Draft EIS

Thank you for the opportunity to review the subject document. The proposed project will not impact any of our facilities. Therefore, we have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

Gordon Matsuoka

GORDON MATSUOKA
State Public Works Engineer

RY:jy
cc: Kaupulehu Developments
Belt Collins Hawaii
OEQC

BELT COLLINS
HAWAII

August 25, 1994
94P-453/133.2001

Mr. Gordon Matsuoka
State Public Works Engineer
Public Works Division
Dept. of Accounting and General Services
State of Hawaii
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Matsuoka:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 25, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
830 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

DAYTON M. NAKANELUA
DIRECTOR
ALFRED C. LARDIZABAL
DEPUTY DIRECTOR

July 27, 1994

LAND USE COMMISSION
STATE OF HAWAII
AUG 1 9 25 AM '94

Ms. Esther Ueda
Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

We have reviewed the Draft Environmental Impact Statement for the Kaupulehu Resort Expansion and have no additional comments.

Thank you for allowing us to review and comment this DEIS.

Sincerely,

Dayton M. Nakanelua
Director

RECEIVED
AUG -3 A 10:27

BELT COLLINS
HAWAII

August 25, 1994
94P-453/133.2001

Mr. Dayton M. Nakanelua, Director
Dept. of Labor and Industrial Relations
State of Hawaii
830 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Nakanelua:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 27, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

680 ALA MOANA BOULEVARD, FIRST FLOOR, HONOLULU, HAWAII 96813-5406 U.S.A., TEL: 808 521-5361 FAX: 808 538-7819
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BEN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

ESTHER UEDA
EXECUTIVE OFFICER

July 29, 1994

Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813

Dear Ms. Mapes:

Subject: LUC Docket No. A93-701/Kaupulehu Developments; Kaupulehu Resort Expansion Draft Environmental Impact Statement (DEIS)

We have reviewed the subject DEIS submitted on July 1, 1994, and have the following comments to offer:

1. Pursuant to Sections 15-15-50(c)(3) and 15-15-50(d)(3), HAR, a metes and bounds description and map of the property, prepared by a registered professional surveyor, should be submitted as part of the petition for reclassification. The metes and bounds description and map should be submitted prior to the submission of the final EIS. It is our understanding that a draft metes and bounds description and map of the property will be submitted for our review prior to the submission of the finalized version.

2. According to the DEIS, the provision of affordable housing was identified as an unresolved issue. We believe that the provision of affordable housing is an important issue and should be addressed as part of the petition for reclassification.

We have no further comments to offer at this time.

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

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:KM:th

CC: Alexander C. Kinzler
OEQC
R. Ben Tsukazaki, Esq.

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1994 AUG -1 P 1:39

BELT COLLINS
HAWAII

August 25, 1994
94P-457/133.2001

Ms. Esther Ueda
Executive Officer
Land Use Commission
State of Hawaii
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your July 29, 1994 comments concerning the above document. As requested, a metes and bounds description and map of the property will be submitted to you under separate cover before the submission of the Final EIS. The affordable housing issue will be addressed further as part of the petition for reclassification.

We appreciate the time you and your staff spent in reviewing the DEIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

680 ALA MOANA BOULEVARD, FIRST FLOOR, HONOLULU, HAWAII 96813-5406 U.S.A. TEL: 808 521-5361 FAX 808 538-7819
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United States Department of the Interior

U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

IN REPLY REFER TO

August 1, 1994

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'94 AUG -3 A10:28

Ms. Esther Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Subject: Draft Environmental Impact Statement (DEIS) for Kaupulehu Resort Expansion, North Kona, Hawaii, 7-2-03: portion 1

The staff of the U.S. Geological Survey, Water Resources Division, Honolulu, Hawaii, has reviewed the subject DEIS and we have no comments to offer at this time.

Thank you for allowing us to review this DEIS.

We are returning the DEIS to your office for your future use.

Sincerely,

William Meyer
William Meyer
District Chief

Enclosure

cc: Mr. Alexander C. Kinzler
Kaupulehu Developments
1100 Alakea Street, Suite 2900
Honolulu, Hawaii 96813

Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, Suite 100
Honolulu, Hawaii 96813

State of Hawaii
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

SANDWICH ISLANDS

BELT COLLINS
H A W A I I

August 25, 1994
94P-453/133.2001

Mr. William Meyer, District Chief
U.S. Geological Survey, Water Resources Division
U.S. Department of the Interior
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your August 1, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document. Although you did not have any comments, we appreciate the time you and your staff spent in reviewing the EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes
Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

United States Department of Agriculture | Soil Conservation Service | P. O. Box 50004 Honolulu, HI 96850-0001

August 10, 1994

LAND USE COMMISSION
STATE OF HAWAII
AUG 12 12 05 PM '94

Ms. Esther Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Subject: DRAFT ENVIRONMENTAL IMPACT STATEMENT
Kaupulehu Resort Expansion
North Kona, Island of Hawaii

We have completed review of the Draft Environmental Impact Statement (DEIS) for the Kaupulehu Expansion. We have no major concerns with the DEIS. The soils are basically A'a and pahoehoe, and the land in the project area are sea level to approximately 200'. Flood hazard is slight, erosion is not likely and mitigating measures for anticipated run off has been addressed.

No anchialine ponds exist within the petition area. However as the golf course is developed, erosion control measures should be implemented and maintained implemented in areas near the coastal area to preclude any runoff from entering the nearshore marine environment. The golf course development plan should incorporate the temporary best management measures into the permanent golf course features as practicable.

Thank you for the opportunity to provide comment. Should you have any questions, please do not hesitate to call Mr. Michael C. Tulang at (808) 541-2606 or Ms. Sandy Higa at (808) 322-2484.

Sincerely yours,

ACTING
KENNETH M. KANESHIRO
State Conservationist

cc: Ms. Sandy Higa, District Conservationist, Kealakekua Field Office

"To lead the way in helping our customers conserve, sustain, and enhance Hawaii's natural resources through efficient service of the highest quality."

BELT COLLINS
HAWAII

August 26, 1994
94P-469/133.2001

Mr. Kenneth M. Kaneshiro
State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
P.O. Box 50004
Honolulu, Hawaii 96850-0001

Dear Mr. Kaneshiro:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

We are responding to your August 10, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, concerning the above document.

Thank you for your suggestions regarding the need for erosion control measures. Such measures and others will be implemented as part of golf course and residential development.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
94:PPE/4391

August 11, 1994

TO: Ms. Esther Ueda, Executive Director
State Land Use Commission
c/o Office of Environmental Quality Control

FROM: Joseph K. Conant
Executive Director

SUBJECT: Site Selection Study and Draft Environmental Impact Statement for the Kaupulehu Resort Expansion

We reviewed the petition and offer the following comments.

Policies A(3) and (B) of the State Housing Functional Plan seek to ensure that (1) housing and (2) projects which impact housing provide a fair/adequate amount of affordable homeownership or rental housing opportunities. It appears that this project includes only market and luxury units. The petitioner correctly points out the need for housing units in West Hawaii but fails to acknowledge that the need is in affordable housing.

Based on this assessment, we suggest that the petitioner provide detailed information on how it will meet its affordable housing requirements.

Thank you for the opportunity to comment.

c: Alexander C. Kinzler, Kaupulehu Developments
Anne Mapes, Belt Collins Hawaii

HFDC

BELT COLLINS
HAWAII

August 26, 1994
94P-466/133.2001

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

Dear Mr. Conant:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

We are responding to your August 10, 1994 memo to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, commenting on the above document.

Affordable housing has been described in the DEIS as an unresolved issue, pending further discussion with the appropriate government agencies, the outcome of governmental re-evaluation of affordable housing policies, and the application of such policies to the proposed project. It is expected that affordable housing will be addressed through conditions of approval, typically at the County level. Although the project may not directly create any significant demand for affordable housing, the petitioner intends to satisfy applicable affordable housing requirements. The petitioner has in the past agreed to satisfy affordable housing requirements for Kaupulehu Resort development and expects to work with the same government agencies in fulfilling the requirements for Kaupulehu Resort expansion.

We will be contacting HFDC directly to discuss affordable housing issues. Thank you for your comments.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

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[illegible] 19 A 9:32

John P. Powell
73-1071 Makamaka St.
Kailua-Kona, Hawaii 96740

August 18, 1994

Anne Mapes
Belt Collins Hawaii
680 Ala Moana Blvd.
First Floor
Honolulu, Hawaii 96813-5406

Re: Kaupulehu Resort Expansion Draft Environmental Impact Statement (DEIS), June 1994

Dear Ms. Mapes:

I am a Kona resident and an occasional recreational user of the property which is proposed for reclassification. I am opposed to the proposed reclassification, which will result in a destruction of the pristine character of not only the area to be bulldozed and turned into golf courses and luxury housing, but the adjoining portion of Ka Lae Mano as well. Environmental impacts are understated, mitigation measures are vague, and the market survey, because it fails to address the specific market for which the development would seek to fill, i.e. luxury leasehold property, is wholly inadequate. My specific comments follow.

1. The market analysis, for both the luxury residences and golf courses, concedes that the development does not yet have a market but predicts that a market for the development will exist in twenty (20) years. Of course it is anybody's guess whether or not such a market will exist in 20 years but even if that were so, why is reclassification necessary now? Why not wait until the project is economically viable? A more serious objection to the market analysis is that it fails to address the specific market involved, i.e. <u>leasehold</u> luxury property. The market analysis is also misleading in suggesting that these houses would be attractive to local residents, other than extremely wealthy ones, when the construction costs are estimated at $300,000.00 for the single family residences and $165,000.00 for the condominium units. When the land value is added to this, it is clear that these will be vacation homes for the rich, rather than viable residences for local community members.

2. As the DEIS concedes, "the vast expanse of Kona's landscape is identified as the area's most striking feature."

(7.3.1.6) The view plane between Kaupulehu and Puuanahulu is, at present, a beautiful untouched expanse of ocean, lava, and mountains. Although the DEIS repeatedly refers to the land as "barren" or "unusable" lava, this expanse of rock and mountain is what Kona has to offer. The world abounds with golf courses, but the expanse of scenery between Kaupulehu and Puuanahulu is unique. Although the DEIS repeatedly claims that the natural resources will be protected, the only commitment contained therein is that no development is proposed makai of the certified shoreline. This is an essentially meaningless concession since no development would be permitted makai of the certified shoreline. Moreover, although the DEIS speaks of preserving the shoreline trail, the numerous references to the fifty (50) single family dwellings situated at the oceanfront raises serious questions as to what the actual preservation of the coastal trail will consist of, since no specific buffer zone or mitigation measures are set forth. The resident's club, set to provide water-oriented recreational activities also raises a question as to whether the shoreline will be preserved and in what state.

The development will destroy not only the open character of the Kaupulehu ahupua'a but, by providing increased access (and the proximity of the development) to the remainder of the Ka Lae Mano area, will destroy the open character and natural resources of that area as well. The project will destroy the ambiance of Kona Village, famed worldwide as a pioneer of low-impact, environmentally sensitive tourism. The statement in 7.3.4.3 that coastal scenic and open spaces resources will not be harmed by the imposition of luxury homes and 36 holes of golf course is ludicrous. The unspoiled nature of a very large portion of coastline will be lost, sacrificed for luxury homes and golf course which <u>may</u> have a market 20 years from how.

What is more, this is not forest land that can be replanted. Once the land has been bulldozed, the unspoiled nature of the land will be irretrievably lost.

3. The DEIS dismisses, but does not discuss in detail, the nearshore effects of golf course irrigation and fertilization.

The DEIS should, but does not specifically address in detail the results of the water chemistry analysis and the effects of long term use of chemicals over the entire project. Special attention should be given on the impact of the additives on the future/present use of the waters fronting this development. What are long-term effects?

Even though the area is primarily lava, lava lands have a high rate of percolation. The DEIS shows that the specific location of the subsurface water flow have not been identified, so that the potential for runoff to the ocean remains a possibility. Since it is unclear what the shoreline setback will be, it may be that fertilizer, pesticides, and effluent will be used within 40 feet of the shoreline.

4. What assurances, if any, are there that sufficient sustainable, potable groundwater will be found in this area of relatively low rainfall. The DEIS should address the current status of additional fresh water sources, along with the water limitations to occur in the area's foreseeable future.

What water source will be used to mix with the effluent? Brackish or potable? If brackish, what will be the source?

Has the availability of water for the proposed development as well as the impacts on water commitments for the "significant increase in resident/local population" and the "significant demand for housing in Kona" that are likely to occur as a result of developing the proposed project been addressed?

5. Critical issues are not really discussed. The issues of socio-economic impacts-resource depletion and affordable housing are committed to only in the vaguest terms.

6. The archaeological sites are assessed individually but no assessment or evaluation of the project area as a whole are made, nor is the potential significance of the Ka Lae Mano area which the project will bisect.

Other issues include:

7. What regional traffic mitigation measures are required as a cumulative result of this project and other projects that have been approved in the region and projects that seek approval?

8. I am concerned about the on-site sewage treatment, the effluent from which will be used for irrigation. Is it the intent to eventually hook-up to a regional sewage treatment facility. In addition, is desalination of brackish water being considered? What is the brackish water source, where will it be located, where is the location of the desalination plant? What will occur if the sewage treatment plant must be shut down for any period? Is there any scenario under which untreated sewage would be pumped at or near the ocean?

9. No conceptual detailed public access plan, including locations of shoreline access, trails, roads, parking areas is included, making the full impact of the project hard to evaluate.

Public access to, and reasonable amounts of free public parking (unrestricted) near the shoreline for fishermen and other recreational users--What is the specific plan?

In conclusion, the DEIS understates the environmental impact of the proposed project, fails to provide specifics of mitigation in several crucial areas, and fails to show the project would be economically viable.

Very truly yours,

John P. Powell

John P. Powell

BELT COLLINS
H A W A I I

August 25, 1994
94P-460/133.2001

Mr. John P. Powell
73-1071 Makamaka Street
Kailua-Kona, Hawaii 96740

Dear Mr. Powell:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

I am responding to your August 18, 1994 comments on the above document. Your concerns are addressed in the order of their discussion in your letter.

1. **Market Analysis**

The following response was prepared in consultation with The Hallstrom Group, author of the market study as well as the economic impact assessment and public cost benefit analysis for the EIS.

The market study concludes that there will be sufficient demand for the finished Kaupulehu Resort expansion inventory starting four to six years from now, not 20 years from now, as you state. The sales period is projected to last some 18 years. The Hallstrom Group conjectures that the proposed lots could be sold if they were to be made available today. Given the typically lengthy design refinement and government permit approval process, basic planning efforts must be undertaken now to ensure a consistent product stream within the Kaupulehu Resort community. Timing of the proposed project also takes into consideration the present and projected level of competition and the short-term status of the market.

There is widespread acknowledgement of concerns regarding the marketability and legal status of leasehold residential development, and the petitioner, along with the landowner, is pursuing means of restructuring the land tenure. It was agreed that The Hallstrom Group would assume in its market study that an accommodation would be reached, allowing the project inventory to be competitive in the fee simple dominated West Hawaii residential/resort market.

The market study does not contend the subject lots will be desirable or affordable to all local residents. On page 61 of the market study, The Hallstrom Group reiterates that "the master plan envisions a moderate- to high-quality, low-density residential community having a recreational lifestyle theme and limited-resort ambience appealing

to both local residents and second home purchasers." (Appendix I) These markets constitute a much broader market than the "extremely wealthy" you identify.

2. **Scenic and Natural Resources at the Project Site**

The Hawaii County General Plan states: "The Kona districts have long attracted people because of their natural beauty. Although man-made structures are in some places dominant, the vast expanse of the Kona landscape is still the area's most striking feature." (page 35) As you see on page 7-25 of the DEIS, where a portion of the General Plan Land Use Pattern Allocation Guide (LUPAG) Map is reproduced, most of the North Kona area is designated Conservation or Extensive Agriculture. On the same map, the project site is designated Urban Expansion. Moreover, the Office of State Planning's West Hawaii Regional Plan map on page 7-22 of the DEIS shows the Kaupulehu area as a resort destination node, with the project site designated for proposed development.

Development of the project site will not significantly alter the overall expansive nature of the North Kona district, given the low acreage of the Kaupulehu Resort Expansion area compared to the remaining hundreds of thousands of acres of land designated for open and agricultural uses. The low density nature of a golf/residential community makes the proposed project more compatible with the surrounding areas than the more urbanized Kailua-Kona south of the petition area. Expansive views of mountain and ocean will not be obstructed from public places, particularly from the major thoroughfare of Queen Kaahumanu Highway.

We have discussed the preservation, maintenance and enhancement of the shoreline trail with the State Parks Division of the State Department of Land and Natural Resources (page 2-7), Na Ala Hele, the Kona Hawaiian Civic Club, and other interested groups and individuals. The petitioner is committed to the preservation of public access along the shoreline and will continue its dialog with these groups as the project moves forward from its current conceptual stage, to better define the character of public shoreline access.

Typically, a detailed public shoreline access plan for a specific project is reviewed and approved by the County of Hawaii at the appropriate level of government permitting and project development, not at this stage of State Land Use District reclassification. The portion of Kaupulehu Resort which is under construction, located south of the expansion area, has an approved public shoreline access plan and it is expected that the details of the plan for the expansion area will be similar to and compatible with the approved plan, which includes provisions for comfort stations, showers, parking, and night-time recreational use such as fishing.

Since the plan for Kaupulehu Resort expansion is still in its conceptual form, it has not been determined how the 50 single-family dwellings will be sited along the approximately one and a half mile of shoreline. They will be set back at least 40 feet from the shoreline, and more where additional buffer would be appropriate. The residents' club will also be set back at least 40 feet from the shoreline and will not interfere with public shoreline access.

Your concern for the preservation of the shoreline trail is well taken, although it would seem to contradict your following statement that the open character of the Kaupulehu ahupua'a will be adversely affected in part by providing increased access to the Ka Lae Mano area.

As to your comments on the potential effects on the adjacent Kona Village Resort, please refer to pages 5-18 and 19 of the DEIS for a discussion of impacts on Kona Village and mitigation measures, including one which was taken prior to the publication of the DEIS: the revision of the Kaupulehu Resort expansion master plan to include open space uses around the perimeter of Kona Village Resort.

Finally, the community is not inherently best served by the full preservation of all "unspoiled" shoreline area. Some stretches are inaccessible without the access provided through development; others are young, virtually raw wastelands providing limited recreational or biological opportunities. Yet others have the potential to become economic resources enhancing the employment, capital and financial stability of the community.

3. <u>Nearshore Effects of Golf Course Irrigation and Fertilization</u>

Contrary to your statement, potential effects of golf course irrigation and fertilization are specifically addressed in the DEIS in the following studies: "Assessment of the Potential Impact of Fertilizers and Pesticides to be Used on the Proposed Kaupulehu Resort Expansion Golf Course," by Charles L. Murdoch, Ph.D., and Richard E. Green, Ph.D. (Appendix A), and "Baseline Marine Assessment, Kaupulehu Resort Lot 4: Marine Biota," by Marine Research Consultants (Appendix B). The study conclusions are summarized in Sections 4.6.2, 4.6.3, and 4.8.13 of the DEIS. In addition, water chemistry analysis was reported in two baseline studies included in Appendix B which were performed to reflect both summer and winter offshore conditions. These surveys will serve as a baseline against which to compare any future changes in water chemistry conditions.

Based on the results of the above analysis and the experience of existing golf courses such as the Mauna Kea Golf Course which has been operating for over 23 years, adverse impact to the offshore environment from runoff or groundwater extrusion is expected to be non-significant. Natural conditions in the area, including a dry climate, low runoff, and extensive dilution in unrestricted water circulation in the offshore zone, make buildup of nutrients unlikely. Further, much of the nutrient load from chemical applications will be taken up by vegetation on the golf course. Because the proposed project will be situated in a dry area, Murdoch and Green conclude that the need for

pesticide use will be low and those chemicals that are likely to be used will be applied in such small quantities that groundwater (which reaches the ocean) will not be threatened.

Mitigation measures, such as continued offshore water quality monitoring and strict adherence to a golf course maintenance and operation plan, will lessen the potential impact to nearshore waters. At present, no plans exist for improvements within the 40-foot setback which would require application of fertilizer, pesticides or effluent. Should any future improvements be proposed, the applicant will be required to seek a Shoreline Setback Variance from Hawaii County, a procedure which involves further analysis of environmental impacts.

4. <u>Groundwater Resources</u>

Wells which would provide potable water for human consumption and brackish water for the project irrigation would be located inland of Queen Kaahumanu Highway. All would be in the Kiholo aquifer system (No. 80902), a classification of the State Commission on Water Resources Management (George A. L. Yuen & Associates, 1992). This aquifer system encompasses 146 square miles, spanning 12.4 miles of the coastline from Kawikohale Point to Anaehoomalu Bay. The sustainable yield of the aquifer system is estimated by the Water Commission to be 18 MGD (million gallons per day). Of the numerous wells which have been developed in this aquifer system, only four are currently being used and the total pumpage is quite modest, on the order of 0.45 MGD.

In addition to the proposed Kaupulehu Resort expansion project, a number of other projects have been planned for the area which also would draw water from this aquifer sector, including Kaupulehu, Kukio, and Puu Ana Hulu area projects among others. At full buildout of all of the projects many years from now, it is conceivable that the total draft of groundwater could be in the range of 10 to 12 MGD, which would amount to only up to two-thirds of the aquifer sector's sustainable yield.

Population increase at the project site would be supported by water sources as described above. Resident population increase, due to worker in-migration needed to supplement existing resident worker pools, would add to the consumption of water in established communities with their own water sources from which to draw. It should be noted, however, that given the current Big Island economic situation, it is expected that many jobs will be filled by persons who will be laid off due to businesses shutting down. These persons' water consumption is already accounted for.

5. <u>Socioeconomic Impacts, Resource Depletion, and Affordable Housing</u>

Socioeconomic impacts and impacts to coastal area resources are addressed in Chapter 5 of the DEIS. As stated in the DEIS, various individuals who might be impacted by the project have been contacted; their concerns are summarized in Section 5.5.3. In addition, government entities such as the DLNR State Parks Division, Hawaiian groups, community groups, business organizations, and other interested groups and organizations have been consulted. As the project progresses, the petitioner will continue to consult with these individuals and groups, and their input will be sought at the appropriate stages of project permitting and development.

Affordable housing has been described as an unresolved issue, pending further discussion with the appropriate government agencies, the outcome of governmental re-evaluation of affordable housing policies, and the application of such policies to the proposed project. It is expected that affordable housing will be addressed through conditions of approval, typically at the County level. Although the project may not directly create any significant demand for affordable housing, the petitioner intends to satisfy applicable affordable housing requirements. The petitioner has in the past agreed to satisfy affordable housing requirements for Kaupulehu Resort development and expects to work with the same government agencies in fulfilling the requirements for Kaupulehu Resort expansion.

6. <u>Evaluation of Project Site in Relation to Archaeological Resources</u>

An archaeological survey was performed and the subsequent report prepared by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in accordance with the requirements of the State Historic Preservation Division of DLNR. (See Appendix H.) Individual sites were assessed as part of the requirements.

Extensive archaeological work has been performed in the Kaupulehu area in general and the results reported in other studies. As stated on page 10 of Appendix H, "A full discussion of previous archaeological studies within Ka'upulehu *ahupua'a* and coastal areas of North Kona and South Kohala districts has been presented in Walker and Rosendahl (1990). This information has also been presented in Head, Goodfellow, and Rosendahl (1992) et al. and much of the text will not be repeated here." As the project progresses and plans are refined, we anticipate the preparation of an archaeological mitigation and preservation plan which will include interpretive material, putting the individual sites into a regional context.

7. <u>Regional Traffic Impact Mitigation Measures</u>

Please refer to Appendix D of the DEIS: "Traffic Impact Analysis Report for the Proposed Kaupulehu Resort Expansion," prepared by The Traffic Management Consultant. Traffic resulting from anticipated development in the project region is taken into account in the traffic analysis both with and without the proposed Kaupulehu Resort expansion project. Mitigation measures to accommodate Year 2015 highway deficiencies, again both with and without the project, are outlined on page 15 of Appendix D. Other regional impacts are being addressed as part of a State DOT study of Queen Kaahumanu Highway.

8. <u>On-site Sewage Treatment</u>

Sewage will be treated at the resort in a private sewage treatment plant. It is anticipated that the sewage treatment facility for Kaupulehu Resort will be expanded as needed to accommodate sewage from Kaupulehu expansion. There are no plans to hook up to a regional sewage treatment facility. As with any other sewage treatment facility, the one for Kaupulehu Resort will be approved and regulated by government agencies. Before it is constructed, the facility will be required to have an emergency contingency plan to address plant shutdown, among other items.

Given current technology and the cost of desalinization, there are no plans to desalinate brackish water, nor is there a need to do so. It has been shown through other projects that brackish water and sewage effluent can be successfully mixed for irrigation without undue adverse effect. Brackish water wells have been drilled mauka of the project, near Queen Kaahumanu Highway for the Kaupulehu Resort project. As needed, additional wells will be drilled to accommodate resort expansion either in the same area or mauka of Queen Kaahumanu Highway.

9. <u>Conceptual Detailed Public Access Plan</u>

Figure 2-1 of the DEIS has been revised to show the general location of public access facilities near the shoreline. Also, please refer to my response 2 above.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

J. CURTIS TYLER, III
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RECEIVED
'94 AUG 25 A 10:51

August 22, 1994

Anne L. Mapes
BELT COLLINS & ASSOCIATES
680 ALA MOANA Boulevard, Suite 100
Honolulu, Hawaii 96813

Re: Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS) dated June 1994
Petition for Amendment of Land Use Classification: Conservation to Urban district (1010 acres)

Dear Ms. Mapes:

Thank you for the opportunity to review the subject DEIS. I offer the following comments:

1. It is my understanding that, when this project was originally proposed, plans called for an ocean recreation area for residents and their guests. Given the public nature of the ocean and shoreline and the recent community opposition to a proposed marina north of the subject area, I believe that a clear and written explanation of present and future plans regarding this aspect of the project must be included in the final EIS. The plans for the 70-acre recreation area should be more specific as well.

2. Given the proximity of the project to state lands to the north, and the need to develop multiple source wells for potable water, information which will address the future impact such wells will have on any groundwater resources under the state lands and other adjacent properties should be provided.

3. In consideration of seasonal ocean conditions in the area, and the stated desire and need to maintain adequate and perpetual public access to the shoreline, it would seem prudent to establish a larger shoreline buffer area from the outset. There is precedent for this in the Maniniowali-Kuki'o area where a 1000-foot buffer and a building setback of 400 feet have already been established. Consideration should be given for incorporating similar provisions as a condition of the reclassification.

4. As noted, provision for affordable housing has not been resolved. This should be more adequately addressed in the final EIS.

5. The DEIS notes that there are significant archeological resources on the project, including many burials. The sensitivity needed in dealing with these cannot be overemphasized. Dialogue with knowledgeable community persons and other experts, including lineal descendants, must occur at all levels in the planning and implementation phases of this project.

6. As noted throughout the DEIS, this development could have significant negative impacts on the aquatic ecosystem and the offshore Class AA water quality. The extent and nature of these impacts and mitigation of them should be more clearly described in the final EIS.

At this time, I have no further comments. However, on behalf of myself and my family, I would like to reserve the right to comment again at a later date, should the need arise.

I appreciate the detail that you and your associates have provided to date in the DEIS for this project. I look forward to receiving a copy of the final EIS upon its completion.

Thank you for your consideration and this opportunity to offer these initial thoughts.

Sincerely,

J. Curtis Tyler, III

cc: Via Facsimile 1-808-538-7819
Robert K. Lindsey, Kamehameha Schools/Bishop Estate
Alexander Kinzler, Kaupulehu Developments

BELT COLLINS
H A W A I I

August 25, 1994
94P-462/133.2001

Mr. J. Curtis Tyler, III
P. O. Box N
Kailua-Kona, Hawaii 96745-9012

Dear Mr. Tyler:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your August 22, 1994 letter commenting on the above document. I have addressed your comments in their order of appearance in your letter.

1. Please refer to Chapter 3 of the DEIS. The alternative which includes a marina was considered and rejected based on environmental and market concerns. The proposed project covered by the EIS does not include current or future construction of a marina.

   Plans for the 70-acre recreation area will include public shoreline access and amenities, as shown in Figure 2-1. As stated in the DEIS, facilities will include public parking, restrooms, showers and picnic areas near the shoreline. We do not have specific plans for the remainder of the recreation area at present since the project is still in its conceptual stage. We feel that it is appropriate for the project team to work with community groups to define what types of amenities are desired. For example, we are already working with groups such as the Kona Hawaiian Civic Club on suggestions that would benefit the public. In addition to recreational amenities, facilities being considered and evaluated include those with an educational or cultural element. Also, since some amenities in the 70-acre recreation area will also serve future project residents, it is premature to finalize specific plans at present.

2. Wells which would provide potable water for human consumption and brackish water for the project irrigation would be located inland of Queen Kaahumanu Highway. All would be in the Kiholo aquifer system (No. 80902), a classification of the State Commission on Water Resources Management (George A. L. Yuen & Associates, 1992). This aquifer system encompasses 146 square miles, spanning 12.4 miles of the coastline from Kawikohale Point to Anaehoomalu Bay. The sustainable yield of the aquifer system is estimated by the Water Commission to be 18 MGD (million gallons per day). Of the numerous wells which have been developed in this aquifer system, only four are currently being used and the total pumpage is quite modest, on the order of 0.45 MGD.

   In addition to the proposed Kaupulehu Resort expansion project, a number of other projects have been planned for the area which also would draw water from this aquifer sector, including Kaupulehu, Kukio, and Puu Ana Hulu area projects among others. At full buildout of all of the projects many years from now, it is conceivable that the total draft of groundwater could be in the range of 10 to 12 MGD, which would amount to only up to two-thirds of the aquifer sector's sustainable yield.

3. The petitioner is committed to integrating appropriate setbacks into the overall project, but cannot commit to a 1,000-foot shoreline setback along the entire shoreline, which, if implemented, would render the project economically unviable. The proposed Kaupulehu Resort expansion project site differs from those of the projects you mention. At the Kukio site, shoreline ponds need to be protected and Manini'owali is a State park project. Nevertheless, the petitioner will continue to consult with organizations such as the Kona Hawaiian Civic Club and Na Ala Hele to determine varying setbacks appropriate to the concept plan as well as access and safety issues.

4. As you mention, the affordable housing issue has been described as an unresolved issue in the DEIS. This is pending further discussions with the appropriate government agencies, the outcome of governmental re-evaluation of affordable housing policies, and the application of such policies to the proposed project. Although the project may not directly create any significant demand for affordable housing, the petitioner intends to satisfy affordable housing requirements based on applicable state and county policies. The petitioner has in the past agreed to satisfy affordable housing requirements for Kaupulehu Resort development and expects to work with the same government agencies in fulfilling the requirements for Kaupulehu Resort expansion.

5. We agree with your statement and have already entered into a dialogue with knowledgeable community residents, including lineal descendants of the area, and we fully intend to continue the dialogue with them and others.

6. For a discussion of potential impacts to the aquatic ecosystem and offshore waters, as well as mitigation measures, please refer to Section 4.8 of the DEIS, as well to Appendix B.

As requested, we will send you a copy of the Final EIS when it is published. We would be pleased to receive further comments should you have any after reviewing the Final EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

Kona Hawaiian Civic Club
P.O. Box 4008
Kailua-Kona, HI 96745

Rec'd 4:07p
8-22-94

August 22, 1994

Anne Mapes
Belt Collins Hawaii
680 Ala Moana Blvd., Ste. 100
Honolulu, HI 96813

Re: Ka'upulehu Project, Phase II

Dear Ms. Mapes:

On behalf of the Kona Hawaiian Civic Club, I thank you for taking the time to meet with me on Sunday, August 7. We appreciate your input on the proposed development at Ka'upulehu. We believe that it is imperative to include the local community and Hawaiian organizations during the early stages of the project's development so that critical issues are addressed.

There are several concerns we have regarding this project that we would like you to communicate to the developer:

1. It is our understanding that there are approximately at least 100 sets of human remains that need to be properly cared for. It is critical that the lineal descendants, together with the landowner, Kamehameha Schools/Bishop Estate (KSBE), be involved with you in creating a burial treatment plan to present to the Hawai'i Island Burial Council. This matter should be handled immediately as the iwi of our kupuna should be treated with the utmost care and sensitivity.

2. There is an additional concern for the protection of petroglyph and other cultural / historical sites within the development area. These links to our Hawaiian history are valuable and every effort should be made to keep them intact for future Hawaiian generations. We suggest that you incorporate these sites into your development as a means of enhancing the experience of your residents and other visitors to the area.

3. There is concern about the size and location of the area proposed for public use. One idea that was brought up would be to have a cultural site available to the public utilizing the petroglyphs and the unique cultural ambiance of Ka'upulehu. However, upon talking to some of the kupuna from that area, it was made known to us that Ka'upulehu was special to the people of that area as a sustenance area. More research needs to be done to investigate and possibly use that knowledge to ensure adequate public access.

4. Should the developer utilize the 70 acres that will be put aside for the public, how will they protect the natural resources of the area from being decimated? This area is known to the local community for the abundance of seafood, limu, etc... We do not want the area to be "desecrated" by public access. Why not work with the DLNR, who have responsibility for the shoreline, in deputizing local representatives who know the area? The developer would then take responsibility financially for their portion of the shoreline.

5. We are concerned that public access will compromise the carrying capacity of the shoreline, and we suggest that a 1000-foot setback, similar to the "buffer zone" in place at Manini'owali/Kukio II, from the shoreline. This will protect the integrity of the natural and cultural resources of this shoreline, as well as assuring optimum user safety given what we know of the topography and seasonal swell conditions.

6. How will the developer incorporate our local community in their long-range plans? Will there is job training for on-site positions? We understand that the only possibility for employment would possible be with the golf course proposed. Are there any other possibilities where the local community will have opportunities to learn and use job skills at this development?

7. What is your proposed market for this proposed residential area? Anyone who can pay the fee? Are you going to promote affordable housing, and if so, what is "affordable"?

8. Where are you going to get the water that will be needed for these structures? Will wells be dug? If so, what impact will they have on water resources of the adjacent ceded lands (Pu'uwa'awa'a)?

9. How will this development benefit the local community now and in the future? This is a simple, yet complex question. The area concerned is a large undeveloped area that will be forever lost when construction begins. One cannot put a monetary value on "memories" of what was once here, and had been here since before Western contact.

10. What steps will be taken, besides the developers word, to guarantee that the shoreline and marine resources will be protected from future plans for marina development?

11. How will the Ala Kahakai trail be preserved? Who will have access to it?

We feel, in these beginning and early stages, that concerns need to be addressed by the developer who should be working very closely with KSBE and with the community. We would like follow up correspondence from you regarding our concerns, as well as addressing these concerns in the final environmental impact statement.

Again, it was our pleasure to have the opportunity to discuss this important project, the Ka'upulehu Development Phase II Project.

Very truly yours,

Leimana DaMate

Leimana DaMate, President
Kona Hawaiian Civic Club

BELT COLLINS
H A W A I I

August 25, 1994
94P-459/133.2001

Ms. Leimana DaMate, President
Kona Hawaiian Civic Club
P.O. Box 4098
Kailua-Kona, Hawaii 96745

Dear Ms. DaMate:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your August 22, 1994 comments. We appreciate the time the Kona Civic Group has taken to review the Kaupulehu Resort expansion project and DEIS. Project team members look forward to working with you to discuss your concerns as the project progresses. Your comments are addressed in their order of appearance in your letter.

1. We agree that the lineal descendants and the landowner should be involved in creating a burial treatment plan for future presentation to the Hawaii Island Burial Council. Kamehameha Schools/Bishop Estate (KSBE) has been contacted and its representatives as well as lineal descendants of the area have visited the project site. We will seek their guidance and that of others as the project progresses, not only as pertains to burials, but also in regard to other significant archaeological resources on-site.

2. The petitioner shares your concern for the protection of significant cultural/historical sites within the development area. The concept plan has been revised taking into account the location of these sites. The applicant intends to follow PHRI's recommendations for the preservation of significant sites, as approved by the State Historic Preservation Office of the State Department of Land and Natural Resources.

3. We appreciate your suggestion and the cultural function of the area will be studied further, including additional research of the area as a sustenance area. The first stages of information gathering has already begun toward that end.

4. The 70-acre area at the north end of the project site is planned for public access amenities in the immediate shoreline area (see Figure 2-1), as well as other recreational and related uses open area residents and visitors. These latter uses could very well include cultural amenities as you suggest above. We plan to

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consult with DLNR in preparing a shoreline resource management plan, as well as with the County of Hawaii in later stages of permitting.

5. The petitioner is committed to integrating appropriate setbacks into the overall project, but cannot commit to a 1,000-foot shoreline setback along the entire shoreline, which, if implemented, would render the project economically unviable. The proposed Kaupulehu Resort expansion project site differs from those of the projects you mention. At the Kukio site, shoreline ponds need to be protected and Manini'owali is a State park project. Nevertheless, the petitioner intends to work with your organization and other interested groups to determine varying setbacks appropriate to the concept plan as well as access and safety issues.

6. As you know, the Kaupulehu Resort expansion project does not include a hotel component and therefore has fewer opportunities for operational period employment than one that includes a hotel, although at full buildout, over 300 permanent on-site jobs are projected, as well as 770 off-site jobs (including indirect employment). It is premature to determine what type of training will be provided for employment generated by the project. However, it is expected that job applicants will be drawn primarily from the local community.

7. The proposed market for the residential lots and multifamily units is defined on page 61 of the Hallstrom Group market study: "The master plan envisions a moderate- to high-quality, low-density residential community having a recreational lifestyle theme and limited-resort ambience appealing to both local residents and second home purchasers." (Appendix I)

   The term "affordable" housing is defined by government. As to the promotion of affordable housing, it has been described as an unresolved issue in the DEIS, pending further discussions with the appropriate government agencies, the outcome of governmental re-evaluation of affordable housing policies, and the application of such policies to the proposed project. Although the project may not directly create any significant demand for affordable housing, the petitioner intends to satisfy applicable affordable housing requirements based on State and County policies. The petitioner has in the past agreed to satisfy affordable housing requirements for Kaupulehu Resort development and expects to work with the same government agencies in fulfilling the requirements for Kaupulehu Resort expansion.

8. Please refer to Section 4.6 of the EIS for a description of groundwater resources and Section 6.1.4 for projections of potable and non-potable water use. Provision of water for the proposed project should not affect water resources of adjacent lands. Water for the Kaupulehu Resort expansion project would be drawn from the Kiholo aquifer system, a classification of the State Commission on Water

Resources Management. The sustainable yield of this aquifer system is estimated by the Water Commission to be 18 MGD (millions of gallons per day). Even at buildout, all West Hawaii projects which would draw from this aquifer sector would use only up to two-thirds of the sustainable yield.

9. As part of project development, amenities, such as those described in the EIS and in Item 4 above, will be provided for public use. There will be opportunities for the community to work with the petitioner and government in the management of important resources and significant archaeological sites. As a result of the proposed project, additional employment will be created (see 6 above) and affordable housing will be provided either directly or indirectly (see 7 above).

10. Private development plans are always the subject of government oversight and are required to conform with State and County policy. At this time, there are no plans for a marina. The alternative which includes a marina was considered and rejected based on environmental and market concerns. Should the present concept for the project change substantially, any future plans, with or without a marina, will require public review and government approvals.

11. A portion of the Ala Kahakai traverses the project property and public pedestrian shoreline access is currently unimpeded. Access along the entire shoreline of the project will be preserved. We have met and continue to be in contact with Na Ala Hele regarding public shoreline access.

We will be following up with your organization and other concerned community groups, as well as with KSBE, to seek further input as the project progresses.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

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August 22, 1994
RE:0651

RECEIVED
'94 AUG 23 A 10 51

Ms. Esther Ueda
Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Draft Environmental Impact Statement
Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

The applicant, Kaupulehu Developments, requests the reclassification of 1,010 acres of Conservation land in the North Kona district to Urban zoning to implement it's proposed Kaupulehu Resort Expansion project. This project entails construction of 530 single-family and 500 multifamily residential units; a 36-hole golf course and clubhouse; an 11-acre commercial center; a 70-acre recreation area; a 3-acre residents club; archaeological preserves; and all necessary on-site infrastructure associated with these developments.

We have reviewed the Draft EIS with the assistance of Eileen O'Hora-Weir, Agriculture and Resource Economics; Cynthia Hunter, Botany; George Curtis, Hawaii Institute of Geophysics; and Malia Akutagawa of the Environmental Center.

The Draft EIS thoroughly covered all phases of the development that might have a significant short and/or long-term effect on the environment. Overall, proposed measures in minimizing adverse impacts were satisfactory; however, there were some mitigation measures that were inadequate or required more elaboration. Also, certain inferences made from studies conducted were, at times, false and misleading.

Inadequate Mitigation Measures to Potential Long-Term Adverse Impacts
(Section 1.8.2)

Increased consumption of electrical energy to serve new development.

Simply encouraging efficient lighting in the proposed residential units will not adequately off-set the increased electrical energy demand. Since this location is excellent for the implementation of photo voltaic systems, either a village system installation or individual residential systems should be required as a primary source with grid back-up. There even exists the potential for selling the excess to the utility.

Increases in public access to the shoreline and a potential loss of marine biota popular among subsistence food gatherers; limu, crab and opihi. - AND - Potential biological resource depletion resulting from increased fishing activities resulting from increased public access.

The mitigation measure proposed was a preparation of a shoreline management plan in conjunction with zoning and SMA permit processes (p. 5-20). How do local residents feel about this solution? Do they propose more effective solutions to preserve these oceanic and cultural resources? Will the shoreline management plan sufficiently address the concerns of subsistence gatherers and fishermen concerned about improved access causing an increase in fishing pressure? Will efforts be taken to enforce the plan? This issue, if not properly addressed, may involve *an irrevocable commitment to loss or destruction of [several] natural [and] cultural resources* [Section 11-200-12(b)(1), H.A.R.].

Another related issue was brought up by Na Ala Hele, Hawaii Trail & Access System in a letter addressed to the developer (p. 9-8). The letter recommended that a "corridor (with buffer) which incorporates the trail alignment/network should be left in Conservation" to protect "the trail system as well as other valuable coastal resources and archaeological sites." The response was that the referenced property would be recommended for Urban designation anyway, and that the developer would upkeep and maintain the area, as well as "archaeological sites within the corridor."

It is important to allow local residents a true voice in determining what happens to their community, instead of contributing to their frustrations and feelings of hopelessness.

Socio-Economic Impacts

Although the proposed action may best meet the needs of the developer, "No-Action" Alternative #1 may be the best alternative for the surrounding community. Every project should not be seen solely in terms of cost-benefit.

The statement that one of the reasons why the "No-Action" Alternative is not the best route because "natural and historic resources would not be enhanced and protected" may be disputed (p. 3-2). Opinions differ as to how an area should be protected. There are certain cultural practices that may not mirror the developer's perceptions of preservation. Again, it is important for the developer to genuinely work with members of the community in deciding effective means of preserving sites of cultural and archaeological significance.

The affordable housing issue was not discussed at length since new definitions of such are now under discussion by government agencies. This is a critical point and needs further elaboration.

Water Availability

It was noted that Sectors 1 and 2 comprising the coastal area and highway region, contain only brackish water due to the effects of salt water intrusion. Sector 3 located in the upper slopes of Hualalai contains potable water with a sustainable yield of 3.4 million gallons per day (MGD). Average potable water demand is estimated to be 836,243 gallons per day (GPD); average nonpotable demand is undetermined (p. 4-9 to 4-11).

Are there other users (e.g., local residents) which depend on the same water sources? If so, what is the projected combined use? Will there be a conflict in who has priority to the water? Will there be heavy withdrawals of coastal brackish water resources which will encourage further salt water intrusion into presently uncontaminated water sources?

Water Conservation

The use of low-volume shower heads, the use of brackish water instead of potable water for irrigation, and the planting of salt tolerant strains of turf grass on golf courses are excellent proposals to mitigate fresh water use. An additional tip would be to ask hotel guests if they would like to reuse towels and linens instead of changing every day to reduce wash loads. At several hotels on Maui, the guests have been more than willing to conserve water in this way.

Potential Marine Impacts (Section 4.8.1.2)

We note that reference is made in this section to the report by Murdoch and Green which was appended to the 1987 EIS prepared by Belt Collins for the South Kohala Resort. In our review of the South Kohala Resort EIS, we pointed out the omission of data on silicate concentrations measured in coastal waters, and we demonstrated that when analysed in covariance with silicate data, nitrate concentrations could be shown to be elevated in coastal waters adjacent to golf courses. We further noted that the sampling error due to lack of replicates and time series analyses rendered any conclusions drawn from that study speculative at best. Hence, we suggest that reference to the Murdoch and Green report as substantiation of the lack of detectability of golf course chemicals in coastal waters is inappropriate.

Baseline Marine Assessment (Appendix B)

The methodologies employed to produce a baseline assessment of the coral, non-cryptic macro-invertebrate, and fish communities offshore of the proposed development were appropriate for this area. Similar methods have been used in other studies. However, some important details of the methodologies were omitted from the marine assessment and should be added to the Final EIS. These include:

- *Care was taken* to randomly locate transects in order to avoid bias; random quadrat locations were photographed. Were these *random* in a statistical sense or, rather, haphazardly chosen?
- In the quadrat analyses, how were *units* of bottom cover estimated? (e.g., points, percent cover per grid, by eye, etc.)
- How, exactly were photo-quadrat results combined with *in situ* estimates of bottom type? Appendix A (individual quadrat results) was apparently omitted from the report.

The apparent absence of any quantifiable algal cover at all study sites is curious. Were calcareous algae (*common ... throughout the study area*) or *frondose* algal species then included in the *limestone* category of benthic abundance?

We strongly disagree with the consultant's inference that *the existence of locally high regions of sand cover [note: 7% was maximum measured] points to a low potential for impact* of sedimentation. This statement is unsubstantiated and suggests that the author believes that there is no difference in the effects of different sediment types, grain size, or sedimentation regimes on reef organisms. Regardless of the basis for this statement, we concur with the consultant that there is probably little threat to this reef area due to increased sedimentation as a result of activities of the planned development as described.

The consultant's statement that *there are currently no reports in the scientific literature of detrimental impacts to reef communities directly caused by increased nutrient loads* is flatly mistaken. A number of peer-reviewed and published articles clearly demonstrate that eutrophication causes lower fecundity, decreased recruitment, and slower growth of corals while increasing algal overgrowth. We will be happy to provide these articles to the consultant. In the meantime, sweeping conclusions that nutrients will cause *little or no effect* are clearly in error.

A final misuse of scientific data is the statement that *there have been no substantiated instances of even detection of golf course biocides in any marine biota in Hawaii.* This is a misleading sentence in that (1) very few studies have been conducted, (2) analytical tests are not available for most of the more recently developed biocides, (3) detection limits for many of the tests that are available may be too high to be biologically relevant, and (4) organisms (gametes, larvae or adults) that may have been negatively impacted by biocides (e.g., were killed, outcompeted or avoided affected areas) are probably not available for testing.

Summary

As stated earlier, the Draft EIS was, overall, a thorough assessment of project impacts on the environment. Some false inferences were made in reference to study results and methodologies. We suggest that the Final EIS contain correct interpretations of study results; adequately and sincerely address local community concerns; provide additional data on current use of groundwater resources in the Kaupulehu region; and propose more effective measures to off-set the projected increases in electrical energy demand.

Thank you for the opportunity to review this Draft EA.

Sincerely,

John T. Harrison
Environmental Coordinator

cc: OEQC
Kaupulehu Developments
Belt Collins Hawaii ✓
Roger Fujioka
George Curtis
Cynthia Hunter
Eileen O'Hora-Weir
Malia Akutagawa

BELT COLLINS
H A W A I I

August 26, 1994
94P-467/133.2001

Dr. John T. Harrison
Environmental Coordinator
Environmental Center
University of Hawaii at Manoa
2550 Campus Road, Crawford 317
Honolulu, Hawaii 96822

Dear Dr. Harrison:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

Thank you for your August 22, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, commenting on the above document. Your comments are addressed in their order of appearance in the letter.

Increased Consumption of Electrical Energy

We did not state that simply encouraging efficient lighting in the proposed residential units will adequately offset the increased electrical energy demand. Please note that on page 6-11 of the DEIS we list the installation of low energy lamps and lighting fixtures as one of a number of conservation measures which would assist in reducing electrical energy consumption.

Your suggestion of a private producer selling excess electrical energy source from a photo voltaic system is well taken and might also be directed to HELCO.

Potential Impacts Due to Increased Public Shoreline Access

This is an area of concern where the needs of the general public have to be balanced with those of existing users. We have met with staff of the State Parks Division, DLNR, and discussed the preservation and enhancement of public access along the shoreline of the project area, as well as the construction of amenities such as public parking, restrooms, and showers. These facilities would serve the general public using the Ala Kahakai and complement those facilities anticipated to be provided by the State in other areas along the West Hawaii shoreline. We have also met with community groups such as the Kona Hawaiian Civic Club and continue our dialogue with them on how to best preserve resources of the project shoreline area. We are aware of their concerns and their suggestions will be incorporated into an integrated shoreline management plan for the project. The availability of increased public shoreline access

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and better facilities is considered by some as a significant public benefit of project development.

You will note that the letter to which you refer was sent by Na Ala Hele staff. Our project team has since met with the Na Ala Hele Advisory Council (which is made up of local residents) to present the proposed project and to obtain suggestions for managing public shoreline access. We also continue to seek advice from other local residents and community groups.

Socioeconomic Impacts

The "no action" alternative you suggest does not meet the stated project objective (page 1-2 of the DEIS). There are costs and benefits to every project, direct or indirect, implicit or explicit, monetary or non-monetary. Projects on private property are unlike public projects in that they would not occur without being financially viable.

As stated above, we are working with various community groups and individuals to seek guidance on the preservation of resources, including significant cultural resources.

The affordable housing issue has been described as an unresolved issue in the DEIS. This is pending the outcome of further discussions with the appropriate government agencies, governmental re-evaluation of affordable housing policies, and the application of such policies to the proposed project. Although the project may not directly create any significant demand for affordable housing, the petitioner intends to satisfy affordable housing requirements based on applicable state and county policies. The petitioner has in the past agreed to satisfy affordable housing requirements for Kaupulehu Resort development and expects to work with the same government agencies in fulfilling the requirements for Kaupulehu Resort expansion.

Water Availability

Wells which would provide potable water for human consumption and brackish water for the project irrigation would be located inland of Queen Kaahumanu Highway. All would be in the Kiholo aquifer system (No. 80902), a classification of the State Commission on Water Resources Management (George A. L. Yuen & Associates, 1992). This aquifer system encompasses 146 square miles, spanning 12.4 miles of the coastline from Kawikohale Point to Anachoomalu Bay. The sustainable yield of the aquifer system is estimated by the Water Commission to be 18 MGD (million gallons per day). Of the numerous wells which have been developed in this aquifer system, only four are currently being used and the total pumpage is quite modest, on the order of 0.45 MGD.

In addition to the proposed Kaupulehu Resort expansion project, a number of other projects have been planned for the area which also would draw water from this aquifer sector, including Kaupulehu, Kukio, and Puu Anahulu projects. At full buildout of all of the projects many years from now, it is conceivable that the total draft of groundwater could be in the range of 10 to 12 MGD, which would amount to about half to two-thirds of the aquifer sector's sustainable yield.

Water Conservation

You accurately summarize the project elements in the first paragraph of your letter; no hotel is proposed. Your suggested "additional tip" for water conservation is directed toward hotel guests; hence, it is not applicable here. We intend to examine further water conservation measures as project planning progresses.

Potential Marine Impacts

The Murdoch and Green report you cite was only one of several references mentioned in the DEIS, both within the body of the text and in the appendices. This early 1987 assessment was cursory in its sampling and analysis, compared to studies performed today, but we believe the study was still valid.

Baseline Marine Assessment

The following response was prepared by Marine Research Consultants.

Paragraph 1: As to methodologies employed, all of the bulleted questions were addressed in the methods section of the report. Randomly chosen statistically (random numbers table) units of cover were percent cover from projecting photos on a grid and summing grid units; photo-quadrat results were combined by insuring that all species too small to be visible in photographs were included in analysis. This method has the advantage of both accurate assessment of area cover of components that comprise a large sample area with presence of components that comprise a very small sample area or are very rare. Other methods generally miss one or the other. Appendix A of the marine study (individual quadrat results) was inadvertently omitted from the DEIS; it will be included in the Final EIS.

Paragraph 2: Coralline algae are included in limestone cover since this is what they are composed of.

Paragraph 3: You agree that sediment is not a problem. However, we offer the following for clarification. While there is definitely a difference in effect from sediment type, it is apparent from numerous case studies and observations around the Hawaiian Islands that naturally occurring carbonate sands can be substantially more detrimental to corals than terrigenous muds or other "softer sediments" that enter the ocean from land. Perhaps the best illustration of this is on the south shore of Molokai, where coral cover is higher in areas where runoff is greatest, and lowest in areas off sandy beaches. In addition, by virtue of its generally smaller particle size, terrigenous sediments rarely remain in the nearshore area; resuspension by waves and currents in open coastal areas prevents deposition that can be detrimental to corals. On the other hand, naturally occurring coarse sand is heavy enough to remain on the reef through many episodes of wave action and can cause severe abrasion of living colonies, and cover areas that might otherwise be suitable for settlement. Thus, 7% sand cover is sufficient to ensure that the communities have experienced effects of natural sediment resuspension.

Paragraph 4: The mention of reports of detrimental impacts to reef communities by increased nutrient loads is with respect to open coastal area such as that fronting the project site. We would welcome seeing reprints of articles that describe nutrient enrichment caused damage to coral reefs in open coastal areas. It is highly likely that the studies you mention are in lagoons or enclosed bodies of water with clearly restricted circulation, and the negative impacts are from a combination of pollutants, rather than just excess nutrients. Also, the statement in the report is clear that it does not include the secondary effects of algal overgrowth. The statement was in reference to the direct effect of increased nutrients. Recent work done at the Waikiki Aquarium shows that corals can grow at a maximum growth rate with no apparent effect on reproduction in water with nutrient concentrations several times higher than found in Hawaiian waters, as long as there were grazers in the aquariums to feed on algae. In addition, reefs in high latitude areas near areas of upwelling grow very well in high nutrient water. Many of the coral reef scientists at the School of Ocean and Earth Science and Technology at the University of Hawaii readily agree that increased nutrients per se at the levels that might occur in a project of this type are not a negative factor to coral growth, and when factors are in operation (e.g., grazing) that eliminate the potential for competitive exclusion by algae, increased nutrient concentrations in nearshore water are orders of magnitude higher than oceanic water, with no negative impact to corals. The generalized belief stated that nutrients are bad for corals needs to be put in the proper context of the review of the present project.

Paragraph 5: Why is the statement misleading if few studies have been conducted or if analytical tests are not available? The statement is that there have been no substantiated instances, without qualification. Studies were conducted by State of Hawaii agencies to detect routinely used golf course chemicals in long-lived organisms (shrimp) which inhabit anchialine pools in the middle of golf courses that receive input of irrigation water that undoubtedly contains residues of biocides. In no instance was any golf course chemical detected. If there are no detectable pesticides in these organisms, it would be virtually impossible to expect any in marine organisms. To say that this is a misuse of scientific data has no basis, in the absence of any other refuting data.

We appreciate your statement as to the general thoroughness of our DEIS and trust that this letter addresses your remaining concerns. Your comment letter and this response will be included as part of the Final EIS.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

WEST HAWAII SIERRA CLUB *CONSERVATION COMMITTEE*

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RECEIVED
'94 AUG 23 A 10:49

August 22, 1994

Ms. Esther Ueda
Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

SUBJECT: Kaupulehu Resort Expansion Draft EIS

Dear Ms. Ueda:

As members of the West Hawaii Sierra Club Conservation Committee, we would like to make the following comments on the above-referenced DEIS:

This project should not be built.

It is an unconscionable abuse of conservation district lands, and will result in the loss of irretrievable resources.

Given the size of the Draft EIS, we must assume that the developer will still proceed despite our strong protests. Therefore, we would like to make you aware of the some of the more blatant deficiencies in your report.

1. THE WIND DATA PROVIDED DOES NOT CORRESPOND WITH THE SITE.

"Surface Winds", Appendix C, paragraph 4.2, is provided for the Old Kona Airport, which any resident of West Hawaii can tell you is a completely different wind climate than the project area. Therefore, any conclusions which are based on this data are completely invalid.

2. THE ENERGY DEMAND FOR THE PROJECT PRESUPPOSES THE USE OF POWER PROJECTS WHICH DO NOT EXIST.

"Electrical Power and Communications", 6.1.7 mentions that the project would require 30% of the Keahole Generating Station's existing capacity. In other words, ***the developer cannot build the Kaupulehu Resort Expansion without the creation of another power plant.*** As any resident of West Hawaii can tell you, the proposed Keahole expansion is hotly contested, and by no means a certainty. This project should not see the light of day until necessary generating resources are already in existence.

3. THE FACT THAT AN "OCEAN ACTIVITIES CLUB" IS PROPOSED FOR THE AREA EVINCES A MARKED LACK OF FAMILIARITY WITH THE COASTLINE.

"Recreational Facilities", 2.6.5 envisions a private "water-oriented recreational amenity". However, that section of the coastline is characterized by lava outcroppings and rugged surf. As most residents of West Hawaii could tell you, only the most hardy souls brave the waters there, and only on the most calm days. Indeed, paragraph 4.8.3.2 of the DEIS, in explaining the proposed project's impact on sea turtles, claims that there will be no impact on the turtles because human activity will be limited due to the "rocky character of the coastline and lack of swimming areas". We have difficulty imagining the feasibility of this "amenity", a difficulty we are certain the residents and guests will have as well.

4. THE PRESERVATION OF THE ALA KAHAKAI IS INCOMPATIBLE WITH THE OCEANFRONT HOUSING AND THE "OCEAN ACTIVITIES" CLUB

We feel this is so obvious as to require no further explanation.

If, despite these concerns, as well as those raised by State agencies, the developer is not dissuaded from proceeding with this project, we strongly suggest they implement the following changes to the project.

1. THE KAUPULEHU RESORT EXPANSION MUST IMPLEMENT AN ACTIVE, RATHER THAN A PASSIVE, ENERGY POLICY

The project area is perhaps one of the best locales on the face of the Earth for alternative energy generation. It is a very sunny, very windy area. Rather than just "recommending" the use of things like solar water heaters, the project's backers must accept their responsibility for managing energy consumption. The project must go further than merely recommending solutions, and ***actually incorporate*** the latest technology in alternative energy generation and conservation. To do less is to for them to abdicate their responsibility to future generations, and to shut their eyes to today's conditions.

2. THE DIVISION OF LAND MANAGEMENT'S REQUEST FOR A 500-FOOT SHORELINE SETBACK MUST BE FOLLOWED

In a letter from Keith Ahue of the DLNR dated February 25, 1994, the DLM recommend a 500 foot (minimum) setback from the certified shoreline. We could not agree more.

3. THE GOLF COURSES SHOULD BE DESIGNED TO ELIMINATE OR AT LEAST MITIGATE THE NEED FOR AND THE USE OF PESTICIDES, FUNGICIDES AND HERBICIDES

Appendix A, Table 1 lists 26 pesticides, fungicides and herbicides which will be used to ensure the grass is green on the golf courses. Modern thinking has evolved to the point where environmentally-sound golf courses are within the realm of possibility. Especially given the pristine condition of the nearshore waters, the Draft EIS should at a minimum consider any approach other than the recommended use of "approved" chemicals.

These are just some of the most imperative concerns we have about this project. We will be providing further recommendations if the Kaupulehu Resort Expansion proceeds.

Thank you for this opportunity to comment.

Sincerely,

WEST HAWAII SIERRA CLUB CONSERVATION COMMITTEE

C. V. Villa, *Chair*
John Powell, *Land Use*
April Maberry, *Energy*

cc: Alexander Kinzler, Kaupulehu Developments
Anne Mapes, Belt Collins Hawaii
Bruce Anderson, OEQC

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H A W A I I

August 26, 1994
94P-470/133.2001

Mr. C. V. Villa, Chair
West Hawaii Sierra Club Conservation Committee
75-127 Lunapule Road, Suite 16
Kailua-Kona, Hawaii 96740

Dear Mr. Villa:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

We are responding to your August 22, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, commenting on the above document. I have addressed your comments in their order of appearance in your letter.

Comments on the DEIS

1. Wind Data:

   Please refer to page 4-26 and the following pages of the DEIS. As stated, wind data was collected at the project site in May 1994 as part of the air quality impact analysis prepared specifically for this project.

2. Energy Demand:

   The proposed project is in its early conceptual stage and will require many government approvals and detailed public review before construction can begin, a process expected to take several years. Obviously, the project will not be built unless resources are available, including sufficient electrical power.

3. Ocean Activities Club:

   The club is meant to be a community facility for project residents with views on the ocean, described in the DEIS as a water-oriented recreational amenity. Amenities might include a swimming pool and dining facilities. Other such clubs operate successfully despite proximity to similar shoreline characteristics and conditions.

4. Preservation of Ala Kahakai Incompatible with Oceanfront Housing:

   The project team has met and continues to be in contact with various community groups and government agencies concerning public shoreline access. These

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include the Kona Hawaiian Civic Club, Na Ala Hele, and the State Parks Division of the State Department of Land and Natural Resources. You are probably aware of the successful integration of public shoreline access via the Ala Kahakai and nearby residential and golf course development at projects all along the West Hawaii coast.

Suggestions

1. Implement an Active Energy Policy:

   As previously stated, the project is in its initial conceptual stage. If all of the approvals necessary for development are obtained and the project moves forward, an energy efficiency plan for the development will undoubtedly be an integral part of the project.

2. Shoreline Setback:

   We anticipate that setbacks will vary along the project shoreline area according to terrain and adjacent uses and resources. A County of Hawaii approved public shoreline access plan is in place for the under construction portion of Kaupulehu Resort and it is expected that the public shoreline access plan for the expansion area will complement the existing plan.

3. We agree that "modern thinking has evolved to the point where environmentally-sound golf courses are within the realm of possibility." Please refer to Appendix A of the DEIS (Assessment of the Potential Impact of Fertilizers and Pesticides to be Used on the Proposed Kaupulehu Resort Expansion Golf Course) for specific mitigation measures, including the implementation of an Integrated Pest Management plan.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

McCORRISTON MIHO MILLER MUKAI

ATTORNEYS AT LAW

August 22, 1994

RECEIVED

23 A 10:54

Ms. Esther Ueda
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Re: Kaupulehu Resort Expansion
<u>Draft Environmental Impact Statement Comments</u>

Dear Ms. Ueda:

Kona Village Associates, the owner of Kona Village Resort, has assembled a team comprised of the owner's representative, the Kona Village Resort management staff, civil engineering consultants, socio-economic consultants, and legal counsel (the "Review Team") to review the Kaupulehu Resort Expansion Draft Environmental Impact Statement and to analyze the impact of the proposed Kaupulehu Resort expansion project (the "Project") on Kona Village Resort. On behalf of Kona Village Associates, we forwarding to you herewith the initial comments prepared by Coopers & Lybrand and Gray Hong Bills & Associates, Inc., Kona Village Resort's consultants with respect to the socio-economic and civil engineering issues, respectively, arising from the Project, for the purpose of responding to the Draft Environmental Impact Statement prepared by Belt Collins Hawaii in connection with the Project. The more comprehensive findings of the Review Team on these and other issues impacting Kona Village Resort will be submitted to the Land Use Commission for its consideration in connection with its proceedings regarding Kaupulehu Development's Petition for Land Use District Boundary Amendment, Docket No. A93-701.

Thank you for this opportunity to comment on the Kaupulehu Resort Expansion Draft Environmental Impact Statement. If you have any questions with respect to the comments set forth in the enclosed documents, please contact the undersigned at 529-7300.

Very truly yours,

McCORRISTON MIHO MILLER MUKAI

Sharon H. Nishi

Clifford J. Miller
Sharon H. Nishi

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August 18, 1994

DATE RECEIVED
8-19-94

Clifford Miller, Esq.
McCorriston Miho Miller & Mukai
Five Waterfront Plaza, 4th Floor
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Re: Kaupulehu Developments' Impact on Kona Village Resort

Dear Mr. Miller:

In accordance with your request, we have read the Environmental Impact Study prepared for Kaupulehu Developments (developer) by Belt Collins Hawaii, and we evaluated the physical impact of the Kaupulehu developments on the Kona Village Resort (KVR). In addition, we have had an opportunity to analyze KVR's operations and assess the potential market and financial impacts of the massive Kaupulehu Developments on the resort.

On the basis of our analysis of KVR and our understanding of the developer's plan for the area, we believe that the impact on KVR will be severe and greatly detrimental. The most significant impacts will include:

1) The loss of privacy and exclusivity;

2) The loss of revenues to the resort; and,

3) The loss of tax revenues to the State of Hawaii.

<u>LOSS OF EXCLUSIVITY</u>

Kona Village Resort is a very special place. The resort's remote location, Polynesian village design and unusual operating philosophy combine to create a truly unique guest experience. In its current environs, KVR provides an ambiance that is private, exclusive, remote, serene, rustic, natural, and most of all, genuinely Hawaiian. These qualities are the reason KVR was voted the "Best Tropical Resort in the World" in 1991 by *Conde Nast Traveler*. KVR has strived to maintain its special ambiance by steadfastly holding to its special traditions since opening in December 1964. These traditions include the following:

- Full American Plan - The KVR offers this all-inclusive plan by which a guest pays one rate for a room, all three meals and other recreational and guest services. This program is the only one of its kind in Hawaii.

- No television sets, telephones, or clocks. The concept of complete decompression for high-powered executives and others relies on the return to a simple life, without modern communications and other distractions in the guest unit. Guests are truly able to leave many of their worries behind them, return to nature and reconnect with the beautiful pristine surroundings.

- No air-conditioning. The hales at Kona Village are all naturally cooled by louvered windows, ceiling fans and a creative architectural design which sets the individual units up on stilts to allow cooling air circulation beneath.

- No vehicular traffic within the Village. The resort provides complimentary shuttle service to and from the airport, and fewer than half of all guests rent a car during their visit. The vast majority of KVR guests are happy to remain on property for the duration of their stay. Within the resort, guests walk between facilities on sandy pathways.

In addition, guests at Kona Village Resorts enjoy a nearly private beach area which, although it allows public access, receives few outsiders.

The Kaupulehu Development will effectively erode many of the traditions at KVR which make it a unique and special place, unlike any resort in the world.

The size, proximity and nature of the development will create huge security problems for KVR. With strictly guarded access and a remote location, KVR has been able to operate without locks on the doors of guest units. Guests simply use a coconut placed outside their door to indicate they do not want to be disturbed. This extraordinary tradition not only frees the guest from the hassles of carrying a key, but also gives the guest an uncommon feeling of security and freedom.

The loss of privacy will also change the type of guest who will visit KVR. Current guests come to KVR and pay very high rates specifically to enjoy the traditions discussed above. Unlike other resort guests, these guests do not come to Kona Village looking for shopping, golf or entertainment. Most come to KVR because they want peace, quiet and relaxation.

Unfortunately the traditions described above require the privacy and exclusivity that KVR provides, and the traditions are the reasons why guests at the Kona Village willingly pay over $600 per day for their all-inclusive stay.

A change in the resort's clientele will in turn require a change in the Full American Plan to a modified American Plan (M.A.P.) or the European Plan (E.P.) which only includes the room. Food revenues as well as overall resort profitability will be severely impacted by this change. Currently KVR boasts the highest food revenues per occupied room of any hotel in Hawaii. The loss of the all-inclusive feature will no doubt decrease food revenues. Losses have been noted at other similar resorts after conversion to a Modified American Plan (two meals included) or European Plan (no meals included). An example is the Hotel Hana Maui. Urbanization of the surrounding area will provide other dining choices for the "new" guests.

Another problem related to the proposed development is pollution. Due to the fact that the hales are not air-conditioned, but are instead cooled by natural air flowing through the louvered windows, KVR's units will be severely impacted by both noise and dust as a result of the construction activity. There will be a negative impact on guest satisfaction as well as significant additional housekeeping expenses.

LOSS OF REVENUES

While it is difficult to estimate the potential loss of revenues for KVR due to the impacts of the Kaupulehu development projects over the estimated 20 years of development, it is clear that Kona Village will have to make major changes in its operation to remain a viable economic entity. Revenues at KVR will be negatively impacted forever by the:

- Loss of privacy and unique ambiance;
- Urbanization and changes to the surrounding environment; and,
- Change from A.P. to M.A.P. or E.P.

These impacts will effectively eliminate the special characteristics that have differentiated the KVR from other Hawaii luxury properties. As a result, KVR will be more vulnerable to the weak hotel and tourism market of the Kohala Coast.

It should be clearly noted that revenue losses in the operations will ultimately result in losses in employment and diminished Transient Accommodations Tax (TAT) and General Excise Tax (GET) revenues to the State of Hawaii. Annually, the Kona Village Resort generates nearly $1 million in tax revenues for the State. The new residential project will not provide the TAT and GET on an ongoing basis. Real property taxes, on the other hand, will be realized by the County of Hawaii.

EXTENDED DEVELOPMENT PERIOD

One of the most important aspects of the Kaupulehu Development's project is the build-out schedule of 20 years. This will mean constant disruptive activity in terms of noise, dust, traffic and other irritants which will impact guests of the KVR. This development period will also be unpredictable because it is driven by demand for market-priced housing.

The research department at Locations, Inc. reports that there are currently 325 single family homes and 450 condominiums listed on the market; a substantial inventory considering the size of the market as well as the relatively low number of sales there recently. Based on current demand and the surplus of available housing units in Kona and on the Kohala Coast, it may require a much longer period to absorb the units described in the Environmental Impact Statement.

SUMMARY AND CONCLUSION

The greatest impact of the Kaupulehu development will be the loss of the Kona Village as we know it today. It has been one of the few resorts to honor the Hawaiian culture as well as provide a rewarding guest experience. The most telling indication of KVR's specialness is the fact that nearly 50 percent of its guests are repeat visitors to the resort. It's special sense of place and unique style of hospitality have always made it stand out in the over-developed and highly competitive luxury resort market. The nature and the size of the Kaupulehu development, however, will greatly diminish the qualities of the KVR which have made it such a treasure. Although the resort may be able to adapt its operations and preserve its own financial feasibility, one of the great places of Hawaii will be history. The hope is that as neighbors to this historic place, the developer will make every effort to mitigate the problems created by their massive project.

Very truly yours,

Ronald K. Watanabe

RKW/CC:bn

08/22/94 15:43 ☎808 531 8018 GRAY HONG BILLS 001

Hard copy to follow

To Sharon Nishi, Esq	From David Bills
Co./Dept. MMMM	Co. GHB
Phone # 529-7300	Phone # 521-0306
Fax # 524-8293	Fax # 531-8018

Gray • Hong • Bills & Associates, Inc.
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August 22, 1994

Ms. Esther Ueda, Executive Officer
Land Use Commission
Dept. of Bus., Economic Dev. & Tourism
State of Hawaii
Old Federal Building
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

SUBJECT: Kaupulehu Resort Expansion
Draft Environmental Impact Statement Comments
TMK: 7-2-03: por. 1

Dear Ms. Ueda:

Kona Village Resort has assembled a team to review the Kaupulehu Resort Expansion Draft Environmental Impact Statement. The team, includes the owner, the village management staff, their legal representation, their civil engineer, and a socio-economic expert. At the direction of Kona Village, our office has been asked to summarize the review team's comments. The comments are as follows:

> The development proposal shown by Kaupulehu Development for the subject expansion plan is of considerable concern to Kona Village. Primarily, it is the general consideration of the EIS review team that any Kaupulehu Expansion approaching that proposed will essentially result in the demise of the Kona Village Resort as it currently exists.
>
> Kona Village was originally developed as an isolated retreat by barging all building materials from Kailua-Kona to the village site. Over the years access has been improved to a long trail from Mamalahoa Highway and in more recent years, a long undeveloped roadway from Queen Kaahumanu Highway. However, since its existence, Kona Village has thrived as an isolated retreat utilizing the peaceful setting of the Pacific Ocean and the austere lava background as its main sources of aesthetic beauty.
>
> Kaupulehu Resort is already under construction to the south of Kona Village. During its Land Use reclassification proceedings, the Land Use Plan shown on Figure 3-1 (April 1986 concept plan) was the basis for project development. This Land Use Plan showed a relatively significant buffer between Kona Village and the Kaupulehu Resort. In addition, most of the hotel mass on the Kaupulehu Resort was going to be on the southern boundary of the property, away from Kona Village. Kona Village supported this development based on the 1986 Master Plan. However, revisions to this master plan after the Land Use Commission proceedings now have resort development within 100 feet of the

Ms. Esther Ueda, Executive Officer
Land Use Commission
Dept. of Bus., Economic Dev. & Tourism
August 22, 1994
Page 2

closest unit of Kona Village. In addition, the mass of hotel and major occupancy areas as on the northern side of the Kaupulehu Resort and in close proximity to the Village. Essentially, the EIS review team already considers the Kaupulehu Resort Development breaching the concept support provided during the previous land use reclassification.

Now the same development entity (Kaupulehu Development) is proposing development which will totally surround Kona Village Resort. This particular development scheme shows single-family residences within 500 feet of the Village's boundaries, with no assurances that further encroachment such as occurred on the Kaupulehu Resort property will occur. The only assurance that Kona Village Resort has is that the petroglyph area will not be encroached into.

The management of Kona Village Resort and owners are particularly concerned that if this development proposal is approved in any fashion approaching that shown on the concept plan, Kona Village Resort will not be able to survive in its existing fashion. The end result will be either the demise of Kona Village or a complete restructuring caused solely by the surrounding development.

In addition to the foregoing major concept concern, there are also civil engineering issues related to the concept plan which show joint use of the main roadway going to Kona Village. This road in its present configuration is an undulating road for low density travel solely to the village. The Kaupulehu concept plan shows joint use and as such the road will not be acceptable for higher levels of traffic. The roadway will need to be completely redesigned to eliminate many of the horizontal curves and vertical undulations to meet traffic criteria for this level of usage. However, this issue is somewhat secondary based on the fact that there is a major question whether the whole concept plan is acceptable.

Should you have any questions, please contact our office.

Very truly yours,
GRAY, HONG, BILLS & ASSOCIATES, INC.

David B. Bills

David B. Bills

DB:am
1882-2

BELT COLLINS
H A W A I I

August 25, 1994
94P-465/133.2001

Clifford J. Miller, Esquire
Sharon H. Nishi, Esquire
McCorriston Miho Miller Mukai
P.O. Box 2800
Honolulu, Hawaii 96803-2800

Dear Mr. Miller and Ms. Nishi:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

This is to respond to your letter dated August 22, 1994, to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, which enclosed certain comments on the Draft Environmental Impact Statement ("DEIS") for the proposed Kaupulehu Resort Expansion (Land Use Commission Docket No. A93-701).

Our responses will generally follow the order of comments raised in the respective letters of Mr. Watanabe and Mr. Bills. In matters upon which those letter overlap, we indicate a response to both authors.

Loss of Exclusivity

Potential adverse impacts upon the Kona Village Resort ("KVR") from adjoining resort development are recognized by the petitioner and discussed in the DEIS at sections 5.5.1 and 5.5.2. Such potential impacts were previously considered by KVR, the petitioner, and the Land Use Commission in the context of the reclassification of land in 1986. This land bounds KVR to the south. Mitigation measures to address potential impacts of all development on Kaupulehu makai lands were incorporated into an agreement between the petitioner and KVR which provided a part of the basis for the Commission's favorable action. The concept plan for the Kaupulehu Resort Expansion conforms to the mitigation measures which are contained in that agreement.

In the 1986 proceeding, it became evident that KVR is likely to undergo an evolutionary process because it will lack the remoteness and exclusivity which once promoted its ambience. In spite of the low-density, low-profile character of the neighboring hotel design, there will be a substantial increase in visitors and resident population in the immediate area due to use of resort facilities, including public shoreline access. The result will be a reduction in KVR's seclusion and privacy and, possibly as Mr. Watanabe and Mr. Bills point out, a change in KVR's clientele.

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The proposed Kaupulehu Resort Expansion similarly presents issues relating to loss of exclusivity. Additional mitigation measures will be explored with KVR as has been done in the past. For example, concerns relating to the need for greater security can be addressed at the stage of more detailed project design when the location of access gates can be determined.

The petitioner shares KVR's concerns regarding the potential impacts on KVR's ambience and will continue to identify measures which can be taken to avoid or mitigate such impacts.

Loss of Revenues

As Mr. Watanabe states, it is difficult to estimate the potential loss of revenues which may result from the under-construction projects and other development projects at Kaupulehu over the long term. If KVR makes the "major changes" which Mr. Watanabe deems necessary, it is possible that significant revenue losses can be avoided over the long term.

Regarding related losses in State tax revenues, it is again impossible to estimate the extent of any loss, given the uncertainties as to KVR's revenues. It is possible that the increased real property tax revenues from the proposed project will offset potential losses in transient accommodation tax and general excise tax revenues.

Extended Development Period

Contrary to Mr. Watanabe's observation, the projected buildout period is 18 years, not 20 years. As to his concerns of potential impacts on KVR from noise, dust, traffic, and "other irritants" over the buildout period (we envision that the most significant construction-related impacts would occur within the first few years following receipt of all necessary government approvals). We believe that these construction-related impacts can be satisfactorily mitigated in accordance with the existing agreement between the petitioner and KVR, existing government regulations, and in further coordination with KVR as to desired construction periods. The construction-related impacts will also be somewhat reduced by virtue of the relative distance of various portions of the proposed project from KVR. As presently envisioned in the concept plan, the closest residential development would be approximately 1,000 feet from the nearest hale in KVR. This aspect of the plan was revised after consultation with KVR for the very purpose of reducing construction-related and long-term impacts on KVR.

Mr. Watanabe cites information on existing housing supply as a basis to project a possibly longer absorption for sale of residential units. It is doubtful that Mr. Watanabe's information relates to the golf course/ocean frontage products that are proposed and which are identified as a subject of future demand in the market analysis which is appended to the DEIS as Appendix I.

1986 Concept Plan

Mr. Bills contends that the Kaupulehu Resort concept plan has been revised such that initial resort development is located much closer to KVR than as shown in the 1986 plan. Although the petitioner is not the developer of that portion of the project, the petitioner believes that the concept plan is substantially the same as that shown in 1986. In addition, as presented to the Land Use Commission in 1986, KVR and the petitioner reached agreement on the particular measures which would be taken to mitigate impacts upon KVR. Among these measures were setback or buffer areas of 100 feet and 200 feet, 300 feet, and 1,350 feet with respective restrictions as to height, density, and land uses. The petitioner has taken steps to ensure that the present development entity (Kaupulehu Land Company) is aware of such mitigation measures, and the petitioner is not aware of any non-compliance with those measures.

Mr. Bills also contends that the Kaupulehu Resort Expansion will totally surround KVR and that KVR will not be able to survive in its existing fashion. We believe that KVR's future will be affected more by evolving governmental planning, regional growth, changing visitor preferences, and the impending development of Kaupulehu Resort (and possibly Kukio Resort) than by the proposed Kaupulehu Resort Expansion.

It is important to note that subsequent to the 1986 Land Use Commission approval of the urban district for Kaupulehu Resort, two major governmental planning documents emerged which establish the Kaupulehu area (including KVR, the initial Kaupulehu Resort, and its proposed expansion area) as a resort destination community. The County of Hawaii's General Plan was comprehensively amended in 1989 and designated Kaupulehu, including the proposed expansion area, for urban expansion in addition and relation to the existing resort designation. Also in 1989, the Office of State Planning developed its West Hawaii Regional Plan which likewise designates Kaupulehu as a resort destination node. The concept plan for the Kaupulehu Resort Expansion is consistent with the policies and objectives underlying both State and County plans.

The petitioner has met with KVR representatives in developing the present concept plan with the understanding that potential impacts on KVR are and will continue to be of concern and merit further discussion. In addition to mitigation measures, the future focus can include measures which may create mutual benefits for petitioner and KVR and increase KVR's viability. The petitioner will establish all future assurances regarding such measures in legal documents.

Access Roadway

Mr. Bills has pointed out that roadway redesign would be necessary to accommodate higher levels of traffic to and from the project area. Such redesign will be considered at such time that detailed project design is undertaken. The concept of

KVR's controlled access over a portion of the road is presently under consideration by the petitioner.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

Stephen K. Yamashiro
Mayor

County of Hawaii
PLANNING DEPARTMENT
25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-9615

Virginia Goldstein
Director

Norman Olesen
Deputy Director

RECEIVED
'94 AUG 24 A 11:10

COPY

August 22, 1994

Ms. Esther Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, HI 96813

Dear Ms. Ueda:

Draft Environmental Impact Statement (DEIS)
Kaupulehu Resort Expansion
TMK: 7-2-03: Portion of 1, North Kona, Hawaii

Thank you for the opportunity to review the above-referenced Draft EIS for the proposed Kaupulehu Resort Expansion. We have the following comments:

1. Page 1-1, Overview, the DEIS states "This Environmental Impact Statement addresses the identified environmental impacts that will result from the development of a 1,120-acre area as a recreation/residential community."

   The DEIS should clarify the purpose of the EIS. Is the EIS to be a support document for only the State Land Use Boundary Amendment petition? Or will it be also a support document for the subsequent Change of Zone application, SMA Use Permit application, and/or other approvals? The level of detail discussions in the EIS depends on the purpose of the EIS. For example, the information required at the change of zone and SMA Use Permit process level may not be included in the EIS. Therefore, a supplement to the Final EIS may be required.

2. Pages 1-5, 4-22 and 4-23, Public Access. A conceptual public access plan should be discussed in the EIS rather than at the time of subsequent permit approvals.

3. Pages 1-9 and 8-2, Unresolved Issues. The proposed development is for a recreation/residential community which does not include a marina. Why is there discussion on negative impact on the availability of boat slips?

4. Pages 1-10 and 7-33. The Building and Grading Permits are issued by the County Public Works Department rather than the Planning Department.

5. Page 3-3, Figure 3-1 indicates 3 sites for archaeological preserves. However on Page 2-3, Figure 2-1 shows only 2 preserve sites. Please clarify the discrepancy.

6. Page 4-39, Archaeology. The three appendices (A, B and C) attached to the Phase II archaeological survey report should be included in the Final EIS.

7. Page 4-42. The detailed Archaeological Mitigation Plan should be included in the Final EIS.

8. The DEIS should include a discussion that a Conservation District Use Application for the proposed golf maintenance area and plant nursery is pending with the Board of Land and Natural Resources.

Should you have any questions, please feel free to contact Alice Kawaha or Rodney Nakano of this office at 961-8288.

Sincerely,

Virginia Goldstein

VIRGINIA GOLDSTEIN
Planning Director

AK:
LtrUeda.AGK

xc: Ms. Anne Mapes, Belt Collins Hawaii
Mr. Ben Tsukazaki
Mr. Alexander C. Kinzler
Mr. Brian J. J. Choy, OEQC

BELT COLLINS
H A W A I I

August 25, 1994
94P-461/133.2001

Ms. Virginia Goldstein, Director
County of Hawaii
Planning Department
25 Aupuni Street
Hilo, Hawaii 96720-4252

Dear Ms. Goldstein:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

I am responding to your August 22, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission. Your comments are addressed in their order of appearance in the letter.

1. The EIS is intended to be a support document for the current petition for State Land Use District reclassification. As such, it identifies the potential impacts and mitigation measures for a project that is still in the concept stage, although those associated with land uses and densities have been addressed. We recognize that the impacts of a more specific plan will need to be analyzed at some later stage of government approval, typically at the County permitting level. We also recognize that this additional analysis of environmental impacts might or might not be in the form of a Supplemental EIS.

2. Figure 2-1 has been revised for the Final EIS and now shows the location of shoreline public access amenities. These include public parking, restrooms, showers and picnic facilities. As stated above, the plan for Kaupulehu Resort expansion is still in its conceptual stage and it would be inappropriate to determine specifics at this time. Typically, a detailed public access plan is prepared and submitted for County of Hawaii review and approval during the County approval process. As you know, Kaupulehu Resort has an approved public access plan and we anticipate that the plan for Kaupulehu Resort expansion will be similar to and complement the approved plan, and contain the same level of detail. We have already entered into a dialogue with concerned community and public interest groups to explore community desires as to the elements of public shoreline access. These suggestions will be incorporated into the plan during the future County approval process.

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3. As stated on page 6-7 of the DEIS, "The project could also impact recreational harbor facilities in West Hawaii in the form of increased demand for boat slips and charter services. Because demand for private slips has historically exceeded supply, the proposed project results in a negative impact because it may exacerbate the already existing demand." In other words, some residents of the proposed Kaupulehu Resort expansion project can be expected to be boat owners or potential boat owners who require boat slips. They would be added to the existing waiting list for boat slips and therefore contribute to an increase in demand for these slips. Since no new marinas are proposed, unmet demand can be seen as a negative impact.

4. Thank you for pointing out that the building and grading permits are issued by the County Public Works Department. This will be so noted in the Final EIS.

5. Figure 3-1 originally appeared in the 1986 EIS for the initial Kaupulehu Resort development and is dated April 1986. The archaeological preserves shown are based on the best available information of that time: a 1985 archaeological reconnaissance performed by the Bernice Pauahi Bishop Museum and other prior studies. Since then, PHRI has conducted a more thorough archaeological inventory survey, and the ensuing report is reproduced as Appendix H of the current EIS. Based on the more recent findings, the preserve boundaries have been redefined. The report is currently being reviewed by the State Historic Preservation Office (SHPO), Department of Land and Natural Resources (DLNR).

6. As stated on page 4-39 of the DEIS, "It should be noted that three appendices (A, B, and C) attached to the Phase II report are not included in this document due to their size (299 pages total). However, the Phase II report appendices are also available for review upon request." The copy of the report submitted to SHPO, DLNR for review and approval included the appendices. To date, no DEIS reviewer has requested a copy of the appendices. However, in the spirit of making the appendices more available, copies of the report with appendices will be available for public review at the Hawaii County Planning Department, the Hilo Regional Library, the Kailua-Kona Library, Hamilton Library at the University of Hawaii-Manoa, and the State Historic Preservation Division of the DLNR. (We have noted this on page 4-39 of the Final EIS.) We would like to reiterate that the appendices are also available upon request.

7. We consulted with your staff to clarify what was meant by this comment. After discussion, we agreed that the detailed archaeological mitigation plan will be prepared and submitted at the appropriate time, which is at the time of County of Hawaii approval when the development plan has been more defined. The petitioner will implement the mitigation measures recommended by the consulting archaeologist, as approved by the State Historic Preservation Division.

8. The developer of Kaupulehu Resort has submitted a Conservation District Use Application (CDUA) to the DLNR for a permit to allow the development of a golf maintenance area and plant nursery on land that is part of the Kaupulehu Resort expansion area, the subject of this EIS. As you know, the construction of the Four Seasons Hotel and golf course at Kaupulehu Resort is ongoing and support facilities must be in place when the golf course and hotel open. Given the potentially lengthy process of State Land Use District boundary amendment and the needs of the project under construction, it was decided that it would be prudent to submit the request for Conservation District use. Should the State Land Use Boundary change be successful and County approvals obtainable within the necessary timeframes, the Conservation District Use Permit application will be withdrawn.

Thank you for your comments and we look forward to working with you and your staff on subsequent stages of this project.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

JOHN WAIHEE
GOVERNOR OF HAWAII

COPY

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

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

KEITH AHUE, CHAIRPERSON
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STATE PARKS
WATER AND LAND DEVELOPMENT

August 22, 1994

LOG NO: 12143
DOC NO: 9408PM11

Ms. Esther Ueda, Executive Director
State Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

**SUBJECT: Kaupulehu Resort Expansion Draft Environmental Impact Statement
Kaupulehu, North Kona, Island of Hawaii
TMK: 7-2-03: Por. 1**

Thank you for submitting the subject document for our review and comments.

An archaeological inventory survey of the Petition Area, conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) between 1991 and 1994, identified a large number of historic sites of various types which are described and evaluated in a 410 page report that was submitted to us on July 15, 1994. We have not yet completed our review of the draft report. We do believe, however, that the survey adequately covered the area and that all of the major archaeological sites were identified and recorded. Until we have completed our review we cannot advise your agency whether all sites have had their significance acceptably evaluated or whether the mitigation proposals are acceptable. We anticipate concluding our review within the next month. Until then, we would request that any decision on this boundary petition by deferred.

If you have any questions please contact Pat McCoy (587-0007).

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

PM:amk

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'94 AUG 24 A 11:10

c: Alexander C. Kinzler, Kaupulehu Developments
Anne Mapes, Belt Collins Hawaii
OCEA (File 950-010)

BELT COLLINS
H A W A I I

August 26, 1994
94P-468/133.2001

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

Dear Dr. Hibbard:

Kaupulehu Resort Expansion
Draft Environmental Impact Statement (DEIS)
Kaupulehu, North Kona, Hawaii

We are responding to your August 22, 1994 letter to Ms. Esther Ueda, Executive Officer of the State Land Use Commission, commenting on the above document.

I have been in contact with Mr. Pat McCoy of your staff and will work with him to address any questions or concerns that emerge during your division's review of the archaeological inventory survey report. We look forward to receiving the results of your completed review.

Sincerely,

BELT COLLINS HAWAII LTD.

Anne L. Mapes

Anne L. Mapes

cc: Ms. Esther Ueda, State Land Use Commission
State Office of Environmental Quality Control
Mr. Alexander C. Kinzler, Kaupulehu Developments
R. Ben Tsukazaki, Esq., Menezes, Tsukazaki, Yeh & Moore

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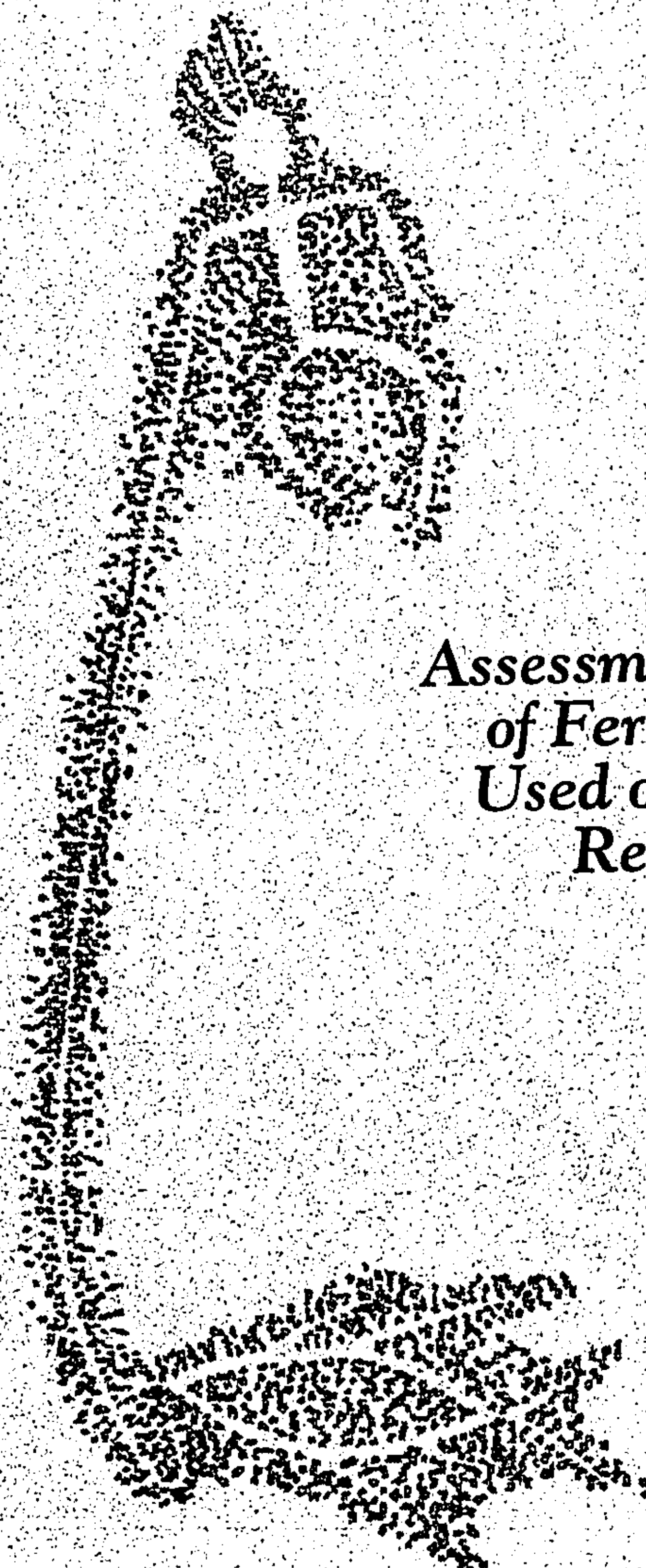

Appendix A

Assessment of the Potential Impact of Fertilizers and Pesticides to be Used on the Proposed Kaupulehu Resort Expansion Golf Course

ASSESSMENT OF THE POTENTIAL IMPACT
OF FERTILIZERS AND PESTICIDES TO BE USED ON THE
PROPOSED

KAUPULEHU RESORT EXPANSION GOLF COURSE

A REPORT TO

Belt Collins Hawaii Ltd.

June 1, 1994

PREPARED BY

Charles L. Murdoch, Ph. D

Richard E. Green, Ph. D

I. INTRODUCTION

This report address the potential environmental impact of fertilizer and pesticide application on the proposed 36-hole golf course associated with the Kaupulehu Resort Expansion. The focus is principally on the quality of groundwater and surface water in the vicinity of the project. The project site is located on the North Kona Coast at Kaupulehu, just northeast of the Kona Village Resort and adjacent to Kaupulehu Resort which is currently under construction. The total area of the Expansion is about 1000 acres, which will accommodate the golf course, residential lots and multifamily units, a supporting commercial center, archaeological preservation areas, and ocean club and recreational areas, including public park space and a large shoreline park (Belt Collins & Associates, 1993).

The fertilizers and pesticides likely to be used on a golf course in this area are considered in regard to potential for adverse effects on water quality. The environmental behavior and toxicity of pesticides are considered in the analysis, as are soil, topographic and climatic factors which may impact on fertilizer and pesticide movement. Principles of good management of water and chemicals are discussed, and recommendations are made on the basis of these principles and site specific factors.

II. APPROACH

Key elements of the analysis are (1) identification of a likely array of chemicals that may be used on the golf course, (2) calculation of the likely quantities of applied chemicals which may be used throughout the year, including nitrogen in applied treated sewage effluent, (3) compilation of soil, geologic and climatic information which will aid in the assessment of chemical movement, (4) estimation of water balance from rainfall, irrigation and evapotranspiration, (5) compilation of pesticide properties which may be of environmental significance, and (6) computation of the Attenuation Factor for pesticides likely to be used, using properties of the chemicals and dominant soil in the area, in order to estimate the likelihood of chemical movement to groundwater.

Background information about the proposed development was provided by Belt Collins & Associates. Soils information was obtained from the SCS-USDA soils publication for Hawaii island (Sato et al., 1973). The groundwater of the general area has been characterized by Mink and Lau (1993). Published rainfall and evaporation data in the area (Giambelluca et al., 1986; Ekern and Chang, 1985) provided an estimate of groundwater recharge from rainfall in the area. Anticipated use of pesticides in the development is based on an analysis of data from a recent study of pesticide use on golf courses in different regions of Hawaii (Brennan et al., 1992). Pesticide properties were obtained from Wauchope et al.(1992) and Hartley and Kid (1983).

We visited the site in January 1994.

III. ANALYSIS OF FACTORS IMPACTING ON CHEMICAL MOVEMENT

A. Site Factors

1. Topography, geology and soils

The topography can be characterized as slightly sloping in the mauka-makai direction (average slope about 3%). The project is situated on the western slope of Hualalai volcano. There have been two historical eruptions recorded along the northwest rift of Hualalai, the last being in 1800. The project site is located on pahoehoe and a'a lava flows from both historical eruptions.

There is essentially no soil in the area because of the youthful geologic materials and the extremely dry climate. The soils map (Sato et al., 1973, Sheet Number 42) delineates four areas: A'a lava flows (rLV), Pahoehoe lava flows (rLW), Rockland (rRO), and Beaches (BH). The study area boundary is shown on a soils map in Figure 1 (adapted from Belt Collins & Assoc., 1993).

2. Rainfall, evapotranspiration and potential recharge

The proposed project is located in one of the most arid areas of the state. Although there are no weather stations nearby, maps of estimated rainfall for the area (Giambelluca et al., 1986) show that mean annual rainfall is only approximately 14 inches per year. Approximately 60 percent of the annual average occurs in November through March. Heaviest rainfall is in January, which averages approximately 2.75 inches. The months April through October average less than one inch total rainfall, with less than 0.4 inch in July and August. Ekern and Chang (1985) estimated annual pan evaporation for the area to be approximately 90 inches. Water balance can therefore be estimated on an annual basis with an evaporation deficit of approximately 76 inches annually. Thus pan evaporation greatly exceeds rainfall in all months of the year. Estimated average monthly rainfall for the Kaupulehu area is shown in Figure 2. Estimated average annual rainfall, estimated annual pan evaporation and estimated annual evaporation deficit are shown in Figure 3. From these data it is apparent that there is little potential for groundwater recharge from rainfall.

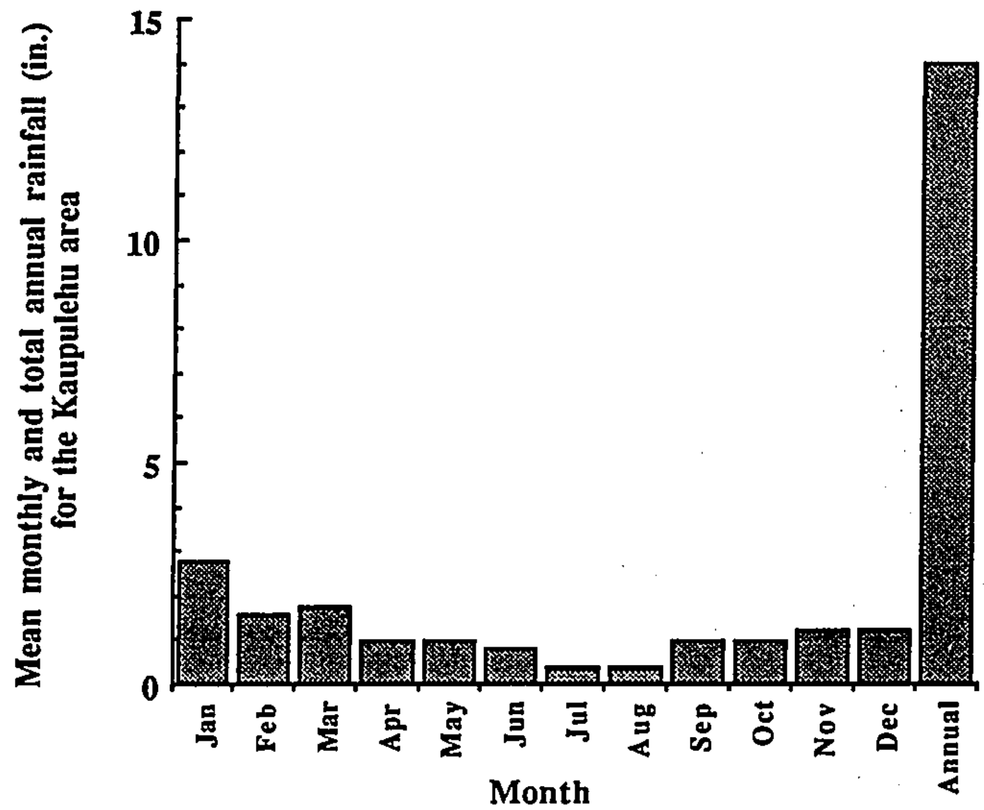

Figure 2. Mean monthly rainfall for the Kaupulehu area (Giambelluca et al., 1986).

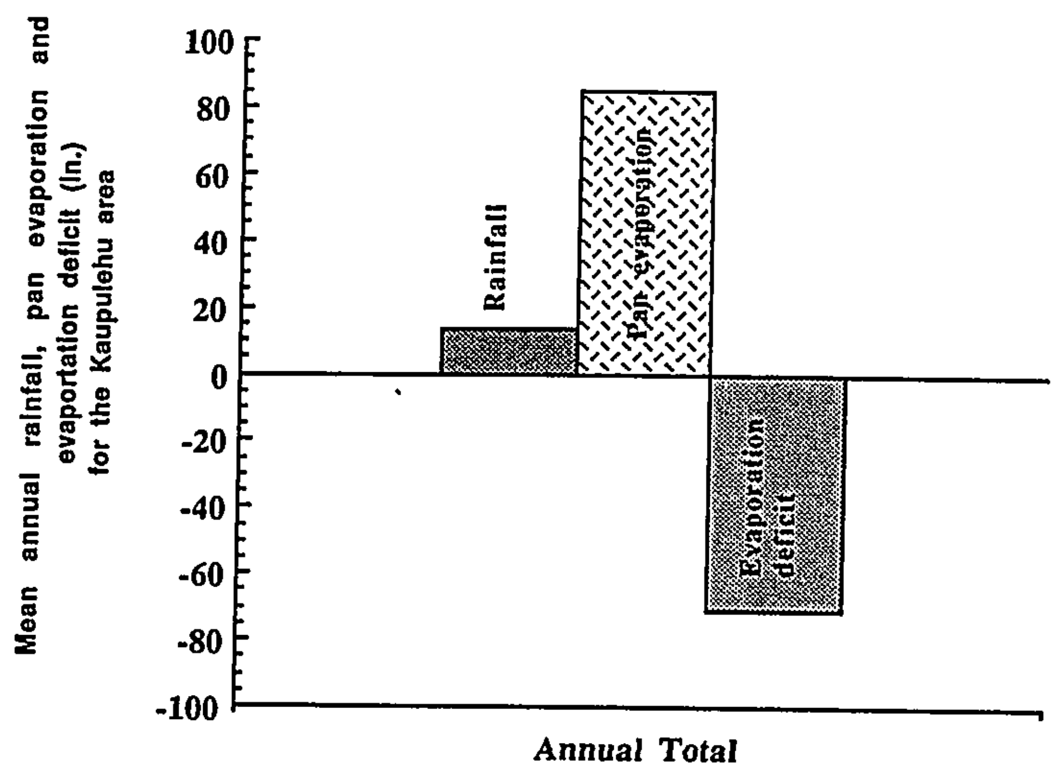

Figure 3. Average annual rainfall, pan evaporation, and evaporation deficit (rainfall minus pan evaporation) for the Kaupulehu area (inches). Data from Ekern and Chang (1985).

3. Groundwater and surface water

The groundwater aquifer has been classified by Mink and Lau (1993). The development site is included in Quadrangle H-6 of their map. The Aquifer Code for the entire area is 80902111. This Hualalai Aquifer Sector (09), includes the Kiholo Aquifer System (02), which includes three Aquifer Types (111, 213 and 212). The project considered here is within Aquifer Type 111, defined as basal, unconfined and flank (horizontally extensive lavas). The status code for this Aquifer Type is 11211, indicating that the aquifer is currently used for drinking water, has low salinity (250 - 1000 ug/L Cl^-), is irreplaceable and vulnerable to contamination. Mink and Lau indicate that up to 4 miles inland the groundwater is basal and mostly brackish. Brackish basal springs drain at the coast. Thus the classification of the aquifer as low salinity must refer to the more mauka portions of the aquifer. The aquifer type in which the development site is located extends from the coast to about 2 miles above Kaahumanu Highway or about 3.5 miles mauka from the coast. They also note that high-level water has recently been discovered farther inland. The high level aquifers are unconfined with some dike influence. We conclude that the project site is located over brackish basal water. The water source for irrigation will likely be high quality water from higher elevations.

There are no perennial streams passing through the project area, nor are there any surface fresh-water bodies.

The shoreline is rocky and exposed to the surf and wave action from the open ocean.

B. Management Factors

1. Fertilizers

Fertilizers are applied to golf courses to supply those essential nutrients which are used in large amounts and which are deficient in most soils. In typical soils, the elements which are normally applied in a turfgrass fertilization program are nitrogen (N), phosphorus (P), and potassium (K). Fertilizers are normally applied to only the greens, tees, fairways, and part of the roughs of a golf course. Typical areas in each of these types of turf for a 36-hole golf course are estimated in the discussion below.

The primary fertilizer elements of concern for contamination of ground and surface waters are nitrogen and phosphorus. Phosphorus is attached very tightly to soil clays and moves little if any from the site of application. Phosphorus, therefore, should not cause any problem with contamination of drainage water. Ammonium nitrogen (NH_4) likewise moves little in soils. Nitrogen applied in the ammonium form, however, is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. Because of high nitrogen use rates by turfgrasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall or excessive irrigation occurs soon after application of a soluble nitrogen source would there be loss of significant amounts of nitrogen by surface runoff or by leaching below the root zone. Thus nitrogen movement can be mitigated by applying a slow-release nitrogen fertilizer in which the nitrogen is in an insoluble form when applied (Brown, et al., 1977) or by applying small amounts of soluble N and irrigating carefully to minimize the amount of water leached through the rootzone (Snyder, et al., 1984).

Fertilizer use rates for the different golf course areas are shown in Table 1. Complete fertilizers (ones containing N, P, and K) are usually applied. Turfgrasses use much more N than other elements. Based on turfgrass clipping composition, it has been shown that the turfgrasses grown in Hawaii use about twice as much N as K and about 4 times as much N as P. Because nitrogen is applied in larger quantities and also because it is the only fertilizer element likely to cause contamination of ground or surface waters, only nitrogen application rates are given.

Table 1. Estimated fertilizer use for a typical 36-hole golf course in Hawaii.

Type of turf	Area (acres)	Fertilizer amount (lb. N/1000 sq. ft.)	Application frequency	Total annual application (tons N)
Greens	6.0	0.5	2 weeks	1.7
Tees	6.0	0.5	2 weeks	1.7
Fairways	100.0	1.0	4 weeks	26.1
Roughs	60.0	1.0	6 months	2.6
Total	172.0			32.1

Irrigation in excess of ET contributes recharge to groundwater, thus water management and the soil behavior of chemicals applied are important in limiting chemical movement. Nitrogen is the constituent in treated sewage effluent in Hawaii which is most likely to have a negative impact on ground water. Typical total N content of secondary sewage effluent in Hawaii is approximately 10 to 20 ppm. This amounts to approximately 80 to 160 pounds of N per million gallons of sewage effluent. Golf course superintendents should reduce total N fertilizer applications by the amount of N applied in sewage effluent irrigation. Table 2 below gives the amount of N supplied by sewage effluent containing 15 ppm total N. To illustrate the use of this table, if a superintendent is applying 2 inches of irrigation water per week and treated sewage effluent comprises 50% of the total irrigation water, then the total N supplied by sewage effluent would be 0.32 lb. N/1000 square feet/month. As the recommended N application rate is generally 1.0 to 1.5 lb. N/1000 sq. ft./month, only 0.68 to 1.18 lb. N/1000 sq. ft. would be required from fertilizer.

Table 2. Amount of total N supplied by different amounts of treated sewage effluent irrigation of turfgrasses.

Sewage effluent use (percent of total irrigation water)	Irrigation rate (inches per week) 0.5	1.0	1.5	2.0	2.5	3.0
	Amount of N supplied by sewage effluent (lb./1000 sq. ft./month)†					
5	0.01	0.02	0.02	0.03	0.04	0.05
10	0.02	0.03	0.05	0.06	0.08	0.10
25	0.04	0.08	0.12	0.16	0.20	0.24
50	0.08	0.16	0.24	0.32	0.40	0.48
75	0.12	0.24	0.36	0.48	0.60	0.72
100	0.16	0.32	0.48	0.64	0.80	0.96

† assuming total N content of sewage effluent of 15 ppm

2. Pesticides

There are a number of weed, insect and disease pests of turfgrasses in Hawaii which sometimes require application of chemical pesticides. Pesticides are normally applied only in response to outbreaks of pests. There are few instances in which pesticides other than herbicides are applied in a regularly scheduled, preventative program. A survey of pesticide use on golf courses in Hawaii was recently completed (Brennen et al., 1992). In the survey, 37 representative golf courses were visited and the golf course superintendent interviewed about pesticide use. Data from the 37 golf courses were then projected to give an estimate of total use of pesticides on all golf courses in the state. This survey showed that 6 herbicides, 5 fungicides, and 2 insecticides accounted for over 90% of the total use in their respective categories. Average use of these 13 pesticides are given in Table 3. There are several chemicals which may be substituted for certain ones in this suggested program. Properties of the chemicals listed in Table 3, as well as those of most chemicals used in turf in Hawaii, are given in Appendix Tables 1 and 2.

Table 3. Use characteristics of the 13 pesticides most commonly used on golf courses in Hawaii (from Brennen et al., 1992).

Pesticide	% of courses using	Areas treated*	% of area treated	Common use rate†	Application no./year	Lb. a.i. acre/year	Total ann. use(lb. a.i)¥
Herbicides							
MSMA	97	FTRG	55	2.0	2-6	11.67	834
Metribuzin	70	FR	48	0.5	1-3	0.95	59
Dicamba	54	FR	48	2.0	1-3	0.94	59
2,4-D	54	FR	48	0.5	1-3	0.78	49
MCPP	43	FR	48	0.5	1-3	0.73	46
Oryzalin	40	F	41	2.0	2-4	4.71	251
Fungicides							
Metalaxyl	84	G	3	1.0	3-6	2.95	12
Chlorothalonil	76	G	3	7.0	3-7	23.80	93
Mancozeb	71	G	3	8.5	3-7	31.26	122
Iprodione	38	G	3	5.0	1-3	4.82	19
Cupric hydroxide	34	G	3	15.0	2-4	19.37	76
Insecticides							
Chlorpyrifos	76	G, Sp	varies	1.0	1-3	3.02	varies
Carbaryl	37	G, Sp	varies	4.0	1-3	6.0	varies

*F=fairways, T=tees, F=roughs, G=greens, Sp=spot treatments only of areas other than greens.
† The most commonly used use rate in lb. active ingredient per acre.
¥ Assuming 130 acres of maintained turf.

In the survey of pesticide use on golf courses in Hawaii, the golf courses were grouped into three classes according to rainfall amounts. There were 16 golf courses in areas with less than 25 inches of rainfall annually, 13 golf courses with 26 to 50 inches, and 7 golf courses with more than 50 inches. Total pesticide use increased with increasing rainfall amounts. Golf courses in areas receiving less than 25 inches of rainfall annually used far less pesticide than the other two categories. Golf courses in areas receiving more than 50 inches of rainfall annually used much more fungicide than the other two categories. These results would be expected, as fungal diseases are known to be more prevalent in moist conditions. Data for pesticide use as influenced by rainfall amounts are shown in Table 4.

Table 4. Pesticide use on golf courses in Hawaii with different annual rainfall amounts (from Brennen et al., 1992).

Annual rainfall (in.)	Herbicides	Type of pesticide: Fungicides	Type of pesticide: Insecticides	Total pesticide
	Av. lb. a.i./year (± standard deviation)			
<25 (n=16)	951 ±777	153 ±167	54±78	1157 ±780
26-50 (n=13)	2060 ±1144	185 ±138	634±62	2308±1180
>50 (n=7)	1598 ±1200	1075 ±647	141 ±108	2814 ±1944

Since the Kaupulehu Resort Expansion is in an arid region, pesticide use on the golf course will likely be relatively low. Herbicides are the pesticides used in largest amounts on golf courses in Hawaii. Golf courses in areas with less than 25 inches rainfall average less than one-half the total herbicide use of golf courses in wetter areas. Fungicide use on golf courses with over 50 inches of rainfall use over 7 times as much fungicide than those receiving less than 25 inches per year. There is little difference in fungicide use between golf courses receiving less than 25 inches and those receiving 26 to 50 inches. Although insecticide use is relatively low on golf courses in Hawaii, courses with over 50 inches rainfall annually apply more than twice the amount of insecticide as those in areas receiving less than 50 inches.

Pesticide use in golf course management may be reduced by utilizing an Integrated Pest Management (IPM) approach to pest control. The IPM approach involves applying pesticides only when pest populations reach levels which are causing unacceptable damage. It includes monitoring for pest populations and determining the level of individual pests required to produce unacceptable damage. The amount of acceptable damage must be set by golf course management. It will vary from area to area, for example an acceptable level of damage in fairways might not be acceptable on greens. Likewise, an acceptable level of pest damage might be acceptable for daily play on a golf course, but would not be acceptable when important tournaments were scheduled. All known methods of pest control are utilized, including selection of turfgrass cultivars resistant to pests, cultural practices which decrease susceptibility to pests, applying the most effective pesticide and timing applications to improve pesticide efficiency, etc. Properly utilized, IPM reduces, but does not eliminate the use of pesticides. Many golf courses in Hawaii are practicing IPM to varying degrees at present. This is likely the reason for relatively low pesticide use reported in the survey of Brennen et al. (1992).

Short et al. (1982) reported that experimental turfgrass IPM programs in selected urban areas in Florida reduced pesticide application by approximately 90% without sacrificing visual appearance of the turfgrass. In an IPM scouting program in residential lawns in Maryland, it was suggested that using pest resistant ornamental plants could eliminate 40 to 80% of the pest problems (Hellman et al. 1982). McCarty et al. (1990) used an experimental IPM program on 7 golf courses in North Carolina from 1984 to 1987. Some of their findings were:

- Fungicide use was reduced by 30% by applying fungicides when weather conditions were favorable for disease development rather than on a calendar schedule.

- Recommended fertility levels and soil reaction that promoted vigorous turf reduced nitrogen application by 35% with no sacrifice in turf quality.

- Selective tree removal and recommended corrective soil drainage allowed better growth and pest resistance of turf.

- Planting shade tolerant cultivars in heavily shaded areas prevented soil erosion and weed encroachment.

3. Irrigation

Because the golf course is in a very arid area, irrigation will be required throughout the year. As there will likely be little natural recharge, over-irrigation would be the factor which could cause leaching of chemicals applied to the golf course. Proper irrigation scheduling therefore is very important in this, as in all other golf course sites.

Waste water from a sewage treatment plant on the development will be used to irrigate the golf course. The State of Hawaii, Department of Health, Wastewater branch (1993) has recently established guidelines for the treatment and use of reclaimed water. These guidelines are very specific and cover all phases of treatment and use of reclaimed water, including sewage effluent water. These guidelines will be followed in developing the sewage treatment plant and irrigation system for the Kaupulehu Resort Expansion. High quality water from off site will be used for potable water for the development. Once full development is reached, it is estimated that the sewage treatment plant will produce an average flow of 0.404 million gallons per day (mgd) with a maximum flow of 1.571 mgd and a peak flow of 1.996 mgd (data provided by Belt Collins Hawaii, 5/6/94). Warm season grasses will use water at approximately the same rate as pan evaporation if the soil moisture stress is small (Ekern, 1966). It has been demonstrated in several locations, however, that excellent quality bermudagrass turf can be maintained by using approximately 50% of pan evaporation (Handley and Black, 1984). From estimated pan evaporation data for the site (Ekern and Chang,1984) average daily pan evaporation is approximately 0.25 inches/day. Thus water requirements of bermudagrass turf for the estimated 172 acres of the 36 hole golf course which is irrigated will range from approximately 1.1 to 0.56 mgd. The higher figure is less than the estimated peak flow of the proposed sewage treatment plant, however other areas of the development such as common use areas, roadsides, etc. will be irrigated with sewage effluent also and will provide sufficient area to utilize the estimated peak flow when the development has reached the full proposed density. Until the sewage treatment plant is providing sufficient water to meet the needs of the turfgrass, however, either the high quality water from off site or brackish water from wells on site will be used to irrigate the golf course and mixed with sewage effluent water at various rates as development of the project continues. The sewage treatment process increases the salinity of the water used by approximately 300 ppm total soluble salts (0.47 mmhos/cm) (Jacobs, 1977). The salinity of the water used to irrigate the golf course will likely be changing as development proceeds. If brackish groundwater from on site is used in early development stages, a leaching fraction will be required to leach accumulated salts from the soil. The leaching fraction required to maintain a given salinity of the rootzone can be calculate by the formula, salinity of irrigation water / desired salinity of the rootzone.The salinity may be expressed in any units, but the units must be the same for irrigation water and rootzone.

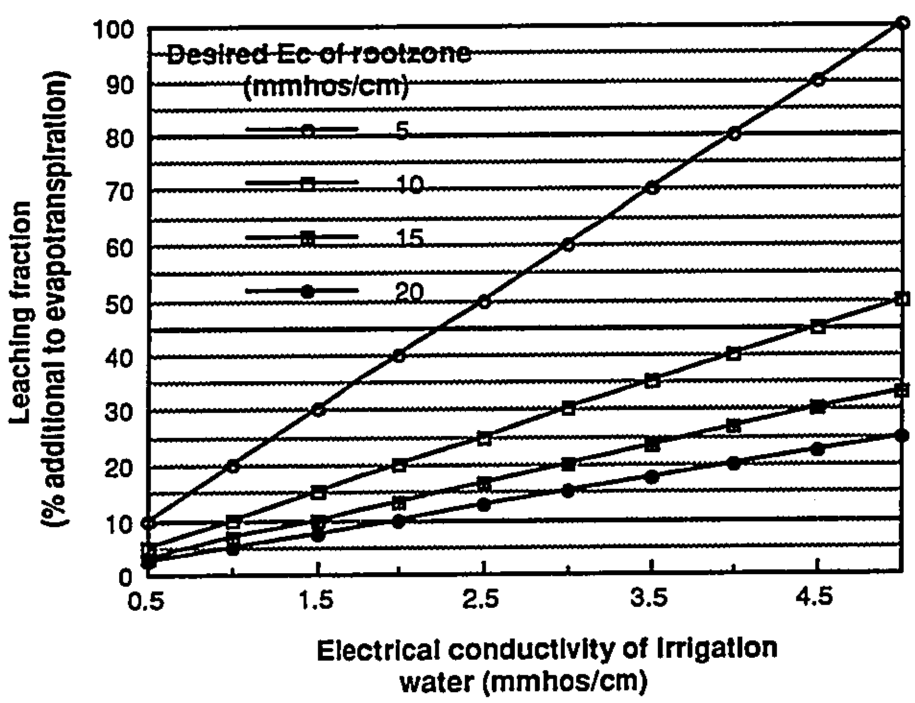

Figure 4. Leaching requirement to maintain various rootzone salinities when irrigating with waters of different salinities.

IV. POTENTIAL FOR CHEMICAL MOVEMENT TO GROUNDWATER AND SURFACE WATERS

A. Potential Impact on Surface Water Quality

The only surface water to be considered at this location is the coastal water near the shoreline. Important considerations in evaluating impact of chemical use are (1) the low runoff anticipated for the area most of the year, and (2) the extensive dilution of any runoff waters from the development by the turbulent shoreline water. In view of these considerations, there is no reason to expect any adverse impact of chemicals on the quality of shoreline water. This conclusion is substantiated by the sustained high water quality for the past 30 years in the relatively quiet water of the bay at Mauna Kea Beach Hotel, which receives some runoff and groundwater discharge from a large area, including both a golf course and the landscaped surroundings of the hotel. Dollar and Smith (1988) found increased nitrogen content of water in Keauhou Bay from over-irrigation with effluent during establishment of a new 9-hole golf course. The Keauhou golf course, however, is very near the shoreline and Keauhou bay is enclosed and protected from vigorous wave action, reducing the mixing of nitrate.

B. Potential Impact on Groundwater Quality

1. Nitrogen from fertilizer and treated sewage effluent irrigation

Monitoring results on the Mauna Kea Resort Golf Course, located a few miles from the Kaupulehu Resort Expansion area, have shown no apparent increase in nitrogen levels of well water or near-shore waters in Kaunaoa Bay. This bay receives groundwater flow from an aquifer which lies immediately below the fertilized golf course; thus it would be a likely place to find nitrogen enrichment from leached nitrate if such enrichment were occurring.

From the above it would appear that treated sewage effluent can be used to irrigate golf courses with no adverse environmental impact. Irrigation of golf courses with treated sewage effluent is considered a desirable method of waste water disposal by many (e.g.. Chang and Young, 1977). Because sewage effluent contains relatively high levels of total N, however, caution should be exercised in thinking of the golf course as a place to dispose of unlimited amounts of treated sewage effluent. The likelihood of nitrate leaching to groundwater and being transported to ponds and shoreline water is increased when an excessive amount of sewage effluent water is applied.

2. Pesticides

Given the array of pesticides that are most likely to be used on a golf course in Hawaii (Table 3) and the fact that most of the pesticide use in a dry area such as north Kona will consist primarily of herbicide application (Table 4), we can assume that many of the chemicals, especially the fungicides, listed in Table 3 will not be used in sufficient quantity to be a threat to groundwater. The pesticides in Table 3 which are most likely to move below the root zone are metribuzin, dicamba, 2,4-D, MCPP and metalaxyl. The relative mobility of these chemicals can be quantified by computation of the Attenuation Factor (AF) of each chemical for an appropriate set of conditions. Attenuation of chemical movement by the soil includes both retardation of movement due to sorption on soil organic matter and degradation in the soil by both biological and chemical pathways. The AF numerical index (Rao et al.,1985) has been evaluated (Khan and Liang, 1989; Loague et al., 1989) for use in an assessment methodology which the State of Hawaii will use in pesticide regulation. The AF index can have numerical values from AF = 0 (total attenuation) to AF = 1 (no attenuation). By definition, AF is the fraction of chemical remaining in the soil after a single application when the recharge is sufficient to carry the chemical to the bottom of a soil layer of a given depth (for example 30 cm). For soil and water recharge conditions of practical interest in

Hawaii, AF values for the five chemicals which are most likely to move beyond a depth of 30 cm are shown in Table 5. The soil properties are different for greens and tees (G/T) and fairways; appropriate values are indicated in the footnote of Table 5. The AF values for these relatively mobile chemicals suggest that of the chemicals applied on greens and tees, only metalaxyl will leach below the root zone in any significant quantity but a substantial fraction of the herbicides metribuzin (24%), dicamba (12%), and MCPP (16%) that might be applied to fairways could leach below 30 cm with a hypothetically high rate of water movement (0.25 cm/day). Physical factors that contribute to these computed high mobilities are the relatively shallow soil depth that is assumed (30 cm), the assumed low organic carbon content of the soil (0.5%), and the high amount of water moving below the root zone. These conditions represent a worst case for the site. The development of sod will increase organic carbon content and thus increase sorption of the chemicals and reduce leaching. Another mitigating factor is the expected low total amount of the designated herbicides which will be applied: 46 to 59 pounds/year for the entire golf course (Table 3). Thus, given the present non-potability of the groundwater and the low vulnerability of shoreline waters to contamination by transport of pesticides in groundwater, there is no reason for concern about pesticide contamination of either groundwater or shoreline water.

Table 5. Attenuation factors (AF)† for the most mobile pesticides used on golf courses in Hawaii.

Pesticide	Area (s) treated§	AF
Metribuzin	FR	0.24
Dicamba	FR	0.12
2,4-D	FR	0.02
MCPP	FR	0.16
Metalaxyl	G	0.099

†Based on the following conditions; soil organic carbon content=0.5% (fairways), 2.5% (greens and tees); soil bulk density=1.1g/cm^3 (fairways), 1.4 g/cm^3 (greens and tees); soil water content=30% by volume (fariways), 20% greens and tees; water recharge=0.25 cm/day; depth of penetration =30 cm.

§F=fairway, R=rough, G=greens

V. MITIGATION OF POSSIBLE NEGATIVE IMPACTS ON WATER QUALITY.

A. Irrigation

Irrigation practices may have a large influence on the movement of soluble nitrogen fertilizers in soils. If excessive irrigation water is applied soon after application of soluble nitrogen sources, the likelihood of runoff or leaching of nitrogen below the root zone is increased. Basing irrigation scheduling on water use rates and leaching requirements will result in large savings of water and also reduce the likelihood of chemicals being leached from the rootzone. Fertilizer applications should always be scheduled so that additional water (leaching fraction) is not applied soon after soluble nitrogen fertilizers are applied. Use of only slow-release N sources will ensure minimum N leaching.

B. Nitrogen Fertilizer Applications

Likelihood of nitrate leaching can be reduced by either using slow-release nitrogen fertilizers or applying light, frequent applications of a soluble nitrogen source. Golf courses have used slow-release nitrogen fertilizers for many years, primarily to reduce "foliar burn" from over-application of soluble nitrogen fertilizers. There is also the added benefit of more uniform growth and color response of turfgrasses to slow-release nitrogen sources over time. Fertilizer suppliers in Hawaii indicate that the use of slow-release nitrogen fertilizers on golf courses is increasing, likely as a result of concern about nitrate leaching or runoff. It is estimated that 30% to 40% of the nitrogen applied to golf courses in Hawaii at present is some form of slow-release N (Carolyn Ambrose, Brewer Environmental, personal communication).

The major obstacle to greater use of slow-release nitrogen sources is their relatively high cost in comparison to soluble nitrogen sources. Urea, which is the least expensive form of soluble nitrogen, costs less than $0.50 per pound of nitrogen. The least expensive form of slow-release N is sulfur coated urea (approximately $1.05/lb. N). IBDU and ureaformalehyde are frequently used in turfgrass fertilization programs. These are relatively expensive (over $1.50/lb. N) and therefore are used primarily on greens and tees. Natural organic nitrogen fertilizers are even more expensive (usually about $5.00/lb. N) and therefore can only be justified on small, intensively cultured areas such as greens.

Researchers in Florida have shown that light, frequent application of a soluble N source through the irrigation system was more effective in reducing nitrate leaching than use of slow-release N fertilizers on sandy soils overlying a shallow water table, but only if irrigation was carefully applied to only replace water used by turfgrasses (Snyder, et al., 1984). Light, frequent applications of granular soluble nitrogen sources would also be an effective method of reducing nitrate leaching, but would require more labor. The cost effectiveness of light, frequent applications of a soluble nitrogen source versus less frequent applications of higher rates of slow-release nitrogen fertilizers must be weighed by the superintendent of the golf course in deciding which method is best suited for the particular situation.

C. Pesticide movement

Although contamination of groundwater or shoreline water by pesticides is not expected to be a problem, as discussed in Section IV.B.2, it is prudent to use pesticides in such a way that any adverse effects on the environment are avoided. For example, when alternative herbicides are available to control a given weed species, the one which is least likely to leach beyond the root zone (i.e. the one having the lowest AF value) should be chosen. Also, an IPM system should be implemented to prevent unneeded applications of pesticides.

D. Responsibility of management

Reduction of negative environmental impact from chemicals applied to the golf course ultimately depends on the goals of management related to the degree of pest control desired, and the competence of maintenance personnel in proper selection of pesticides and their application. For this reason, a well qualified Golf Course Superintendent should be retained to supervise maintenance of the golf course.

VI. SUMMARY AND CONCLUSIONS

The proposed Kaupulehu Resort Expansion golf course is located along the coastline in North Kona, where the rainfall is about the lowest in the state (about 10 inches per year), the topography is characterized by slight slope (about 3%) toward the coast, and there is little or no soil due to youthful lava flows and the dry climate. Rough a'a and pahoehoe lavas cover the entire site. There are no perennial streams.

The only surface water subject to contamination at this site is the coastal water. The absence of significant runoff most of the year and dynamic mixing of turbulent shoreline water by wave action preclude any adverse effect of chemical use on the project if adequate care is taken in irrigation and in fertilizer and pesticide practices. Likewise, groundwater quality will not be adversely affected if recommended chemical application and irrigation practices are followed. Given the brackish nature of the groundwater at the site, the groundwater quality is of concern only as it impacts coastal water quality. The combined goals of water conservation and sustained coastal water quality will be well served by careful control of the amounts of irrigation and agricultural chemicals required.

Mitigation of adverse coastal water quality effects due to applied nutrients and pesticides can be accomplished by insuring an adequate depth of surface soil in any areas planted to turf, use of slow-release nitrogen fertilizers (or light applications of soluble ones), selection of pesticides which are effective against the pests but which are not likely to move from the site of application, and implementation of integrated pest management. Normal precautions in the use of pesticides registered for turf will also preclude negative impacts on wildlife (particularly birds) and air quality. The importance of good management requires the expertise of a well qualified Golf Course Superintendent.

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APPENDIX

Appendix Table 1. Pesticides labeled for use on golf courses in Hawaii and their mammalian toxicity*

Common name of Pesticide	Representative Trade names*	LD50(mg/kg)† Acute oral	LD50(mg/kg)† Acute dermal
Insecticides			
acephate	Orthene 75	866-945	>2,000
carbaryl	Sevin 80S	500-850	>7,000
trichlorfon	Dylox 80	560-630	>2,000
fluvalinate	Mavrik Aquaflow	261-282	>20,000
ethion	Ethion 8EC	208	-
chlorpyrifos	Dursban 50W	135-163	500-2,000
bendiocarb	Turcam	40-156	566-800
isofenphos	Oftanol 2E	28-38	>1,000
methomyl	Lannate	17-24	>5,000
Fungicides			
benomyl	Tersan 1991	>10,000	>10,000
chlorothalonil	Daconil 2787	>10,000	>10,000
mancozeb	Dithane M-45, Fore	>8,000	>10,000
anilazine	Dyrene	>5,000	>5,000
iprodione	Chipco 26019	3,500	>2,500
etridiazole	Terrazole 35 WP	1,100	
cupric hydroxide	Blue Shield	1,000	
metalaxyl	Subdue 2 E	669	>3,100
triadimefon	Bayleton 25	313-568	>1,000
Herbicides			
pronamide	Kerb	5,620-8,350	>3,160§
glyphosate	Roundup	5,600	>5,000§
simazine	Princep, Drexel Simazine	>5,000	>3,100
imazaquin	Image	>5,000	>2,000§
metribuzin	Sencor, DuPont Lexon	2,200	>20,000
dicamba	Banvel	1,707	>2,000§
MSMA	Drexel MSMA, Weed Hoe, Clean Crop MSMA, Dal-E-Rad 120	900	
2,4-D	DMA-6 Weed Killer, Weedar 64, Clean Crop Amine, Weedone 638	375	>1,600

* There are other pesticides registered by EPA for application to turf in other states.

** Trade names selected for this Table are representative of pesticides used in Hawaii. Failure to mention other proprietary names is for brevity only and does not imply a preference of the authors of this document for any commercial product identified by a specific common name.

†LD50 is the dose (milligrams of toxicant/kilogram of body weight) that kills 50% of the test animals. (LD50 values are from Agrochemical Handbook, 1987 ed., Royal Society of Chemistry, Info. Services, Nottingham, England).

§ The test animals were rabbits.

Appendix Table 2. Selected properties of pesticides used on turf in Hawaii related to environmental hazards.†

Pesticide common name	Representative Trade names§	Solubility in water (ppm)	Half-life in soil (days)	Soil Sorption Index (Koc)	Surface loss potential	Leaching loss potential	Toxicity to fish & wildlife
Insecticides							
acephate	Orthene Turf, Tree and Ornamental spray	650,000	3	100	small	small	-
carbaryl	Sevin 80S	40	7	229	medium	small	moderate
trichlorfon	Dylox 80	154,000	27	2	small	large	moderate
fluvalinate	Mavrik Aquaflow	0.005	50 E*	1,000,000 E*	large	small	-
chlorpyrifos	Dursban 50W	2	30	6070	large	small	high
bendiocarb	Turcam	40	7	-	-	-	-
isofenphos	Oftanol 2	24	-	-	-	-	-
methomyl	Lannate	57,900	8	28 E*	small	medium	-
Fungicides							
benomyl	Tersan 1991	2	100	2,100	large	small	low
chlorothalonil	Daconil 2787	0.6	20	1,380	large	small	low (birds) mod. (fish)
mancozeb	Dithane M-45	0.5	35	1,000 G**	large	small	low
anilazine	Dyrene 4	10 G†	1	3,000	small	small	low
iprodione	Chipco 26091	13	20 G**	500 E*	medium	small	low
etridiazole	Terrazole 35	50	20 G**	10,000 E*	large	small	-
cupric hydroxide	Blue Shield	-	-	-	-	-	-
metalaxyl	Subdue 2E	7,100	7	16	small	medium	low
triadimefon	Bayleton 25	260	21	273	medium	medium	low
Herbicides							
pronamide	Kerb 50W	15	30	990	large	small	low
glyphosate	Roundup	1,000,000	30	10,000 E*	large	small	low
simazine	Princep 80W, Drexel Simazine	3.5	75	138	medium	large	mod. (bird) low
imazaquin	Image 1.5 LC	160,000	60	20 E*	small	large	-
metribuzin	Lexon DF	1,220	30	41	medium	large	moderate
dicamba	Banvel	800,000	14	2	small	large	low

Continued on next page

Appendix Table 2 (Continued)

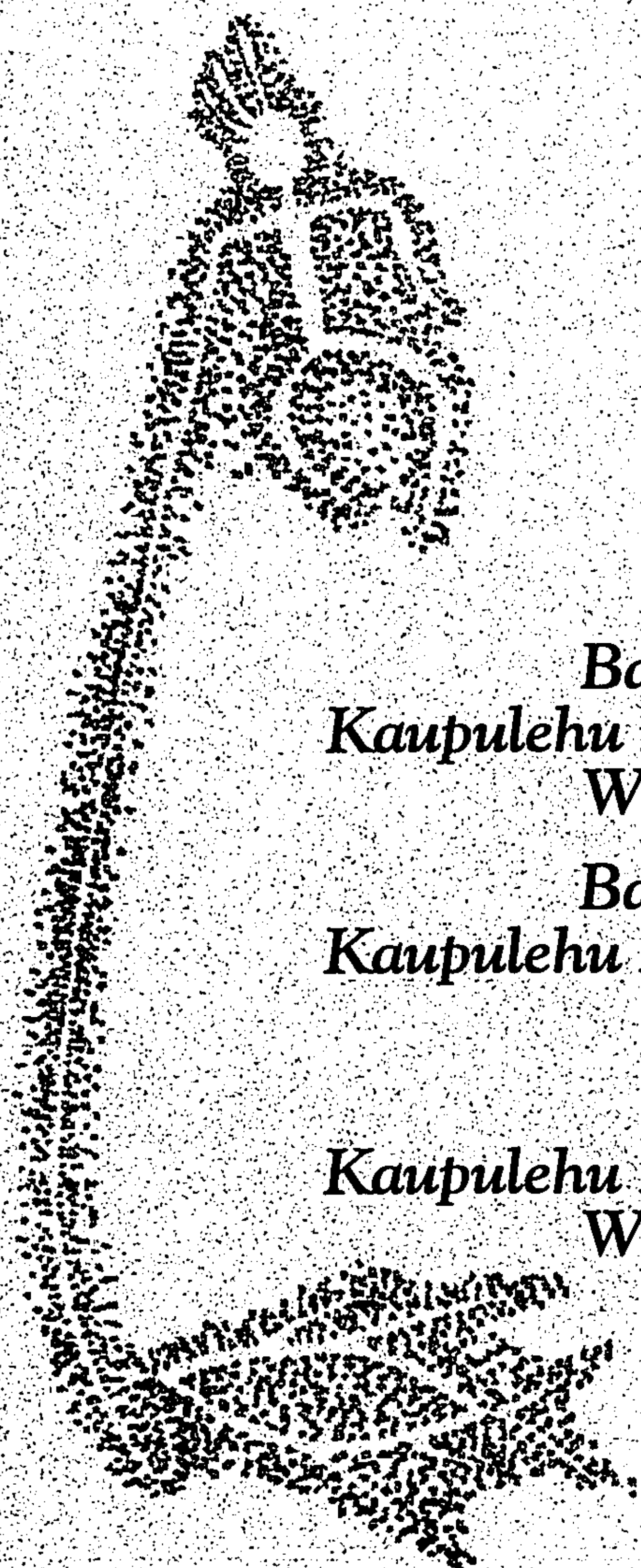
Pesticide common name	Trade name	Solubility in water (ppm)	Half-life in soil (days)	Soil Sorption Index (Koc)	Surface loss potential	Leaching loss potential	Toxicity to fish & wildlife
MSMA	Drexel MSMA, Weed Hoe, Clean Crop MSMA, Dal-E-Rad 120 Dal-E-Rad 120	1,000,000 E	100	10,000 E*	large	small	low
2,4-D (amine)	DMA-6 Weed Killer Weedar 64 Clean Crop Amine Weedone 638	300,000	10	109	medium	medium	high

† = References: Wauchope, R. D. 1988. USDA, ARS Interim Pesticide Properties Data Base, Version 1.0.; Agrochemical Handbook, 2nd. Ed. Royal Soc. Chem. Info. Serv., Nottingham England; Smith, G. J. 1987. Pesticide use and toxicity in relation to wildlife: organophosphates and carbamates. Res. Pub. #170. U. S. Dept. of Interior, Fish and Wildlife Service. 171p.

* E= Estimated value; probable error is 2X to 3X for Half-life, 3X to 5X for Solubility and Koc (Wauchop, 1988)

** G = Guess value; Probable error is 5X for Half-life, 1 to 2 orders of magnitude for solubility and Koc (Wauchop, 1988).

§ Trade names selected for this Table are representative of pesticides used in Hawaii. Failure to mention other proprietary names is for brevity only and does not imply a preference of the preparers of this document for any commercial product identified by a specific common name.



Appendix B

Baseline Marine Assessment, Kaupulehu Lot 4, North Kona, Hawaii, Water Chemistry Report I-93

Baseline Marine Assessment, Kaupulehu Lot 4, North Kona, Hawaii, Marine Biota, 1993

Marine Monitoring, Kaupulehu Lot 4, North Kona, Hawaii, Water Chemistry Report I-94

BASELINE MARINE ASSESSMENT, KAUPULEHU LOT 4, NORTH KONA, HAWAII

WATER CHEMISTRY

REPORT 1-93

MARINE RESEARCH CONSULTANTS

BASELINE MARINE ASSESSMENT, KAUPULEHU LOT 4, NORTH KONA, HAWAII

WATER CHEMISTRY

REPORT 1-93

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INTRODUCTION AND PURPOSE

Planning is underway for development of Lot 4 of the parcel owned by Kaupulehu Land Company (KLC), located in the North Kona District on the west coast of the Island of Hawaii. While the project plans have not yet been finalized, it is apparent that there will be resort development along the coastal region. While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned project. For this purpose, a baseline survey was conducted to evaluate the existing condition of the marine environment prior to any shoreline development. Presented below are methods and results of the baseline assessment of marine water chemistry offshore of the proposed Kaupulehu Lot 4 project site.

METHODS

Four locations fronting the Kaupulehu Lot 4 property were selected as sampling sites for the monitoring program. Site 1 lies at the northern end of the property; Sites 2 and 3 are approximately equally spaced between boundaries; Site 4 lies near the southern boundary at the juncture of the 1858 lava flow (see Figure 1). Water chemistry was evaluated along sampling transects at each site. Each transect was oriented perpendicular to the shoreline, and extends from the highest wash of waves across the intertidal and nearshore reef platform out to the open ocean, a distance of approximately 100 meters (m). Water samples were collected at six stations along each transect. Such sampling is intended to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone as this area is most likely to show the effects of shoreline modification. At each station a surface sample was collected within approximately 10 centimeters (cm) of the surface. With the exception of the stations located 0.1 and 2 m from the shoreline, a bottom sample was collected within 1 m of the sea floor.

Surface water samples were collected by opening triple-rinsed, 1-liter polyethylene bottles near the air-sea interface. Bottom samples were collected either by divers opening 1-liter bottles, or by using a 1.8-liter Niskin-type oceanographic sampling bottle. These bottles are lowered to the desired depth in an open position, where spring-loaded endcaps are triggered to close by a messenger released from the surface. Subsamples for nutrient analyses from both surface and deep samples were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to Honolulu.

Water quality constituents that were measured include the specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii, Department of Health (DOH) Water Quality Standards. These criteria include: total dissolved nitrogen (TDN), nitrate + nitrite nitrogen ($NO_3^- + NO_2^-$, hereafter referred to as NO_3^-), ammonium (NH_4^+), total dissolved phosphorus (TDP), chlorophyll a (Chl a), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) are also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NH_4^+, PO_4^{3-}, and $NO_3^- + NO_2^-$ are performed with a Technicon autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). Total dissolved nitrogen (TDN) and total dissolved phosphorus (TDP) were analyzed in a similar fashion following oxidative digestion. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated as the difference between TDN and dissolved inorganic N, and TDP and dissolved inorganic P, respectively. The level of detection for the dissolved nutrients is 0.2 μM for TDN and Si, 0.02 μM for TDP, NO_3^- and NH_4^+, and 0.01 μM for PO_4^{3-}.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with $HgCl_2$ to terminate biological activity. Fixed samples were kept refrigerated until turbidity ~~is~~ was measured on a Monitek Model 21 nephelometer, and reported in nephelometric turbidity units (NTU). Chl a was measured by filtering 300 ml of water through glass-fiber filters (GF/F); pigments on filters ~~was~~ were extracted in 90% acetone in the dark at -5° C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003°/oo.

In-situ field measurements included water temperature using a hand-held mercury thermometer with readability of 0.1° C., and pH using a millivolt field meter with a readability of 0.01 pH units. Continuous vertical profiles of salinity, temperature, depth and density were acquired using an Ocean Sensors Model 100 CTD.

Nutrient, turbidity and salinity analyses were conducted by Marine Analytical Specialists (Honolulu, HI), while Chl a analyses were conducted by OI Consultants, Inc. (Waimanalo, HI).

RESULTS OF WATER CHEMISTRY ANALYSIS

Environmental Conditions

The first monitoring survey was conducted on August 29, 1993. Environmental conditions were sunny with light tradewinds (approximately 10 kt). No rainfall occurred during the sampling, nor had considerable rainfall occurred during the weeks preceding the survey. Ocean conditions consisted of calm seas with virtually no swell; sampling was conducted during flood tide. Over the course of sampling, the tidal level rose from a low of approximately 0.3 feet to a tidal level of approximately 0.9 feet above mean low water.

Horizontal and Vertical Stratification

Tables 1 and 2 show the results of all water chemistry analyses for samples collected off Kaupulehu Lot 4 on August 29, 1993. Table 1 shows dissolved nutrient concentrations in micromolar (μM) units, while Table 2 shows concentrations in units of micrograms per liter (μg/L). The concentrations of eight dissolved nutrient constituents in surface and deep samples are plotted as functions of distance from the shoreline in Figure 2. Values of salinity, turbidity, Chl a and temperature as functions of distance from shore are shown in Figure 3.

At all four sites, the concentrations of several nutrients (Si, NO_3^-, PO_4^{3-}, TDP and TDN) were elevated in surface samples collected from the stations within 10 m of the shoreline (Table 1, Figure 2). Salinity exhibits the opposite trend of sharply decreased salinity within 10 m of the shoreline (Figure 3). Beyond 10 m, the concentrations of dissolved nutrients continue to decline and salinity continues to increase with increasing distance offshore but at a more gradual rate than in the nearshore area. During the August 1993 survey, the strongest gradients existed at Sites 2 and 4. At these sites, the change in salinity between the shoreline and offshore surface samples was 2.2‰ and 2.4‰, respectively. At Sites 1 and 3, the horizontal gradients of salinity were 1.5‰ and 1.1‰, respectively.

The peak values of Si, NO_3^-, PO_4^{3-}, TDN and TDP in combination with low salinity in the nearshore zone off of Kaupulehu Lot 4 indicates input of groundwater at the shoreline. Groundwater normally contains high concentrations of these nutrients and low salinity (see values for well water in Tables 1 and 2). It is also apparent in Figures 2 and 3 that the groundwater input is rapidly mixed to near background oceanic levels within 50 m of the shoreline; mixing of ocean water and groundwater by turbulent forces associated with waves, winds and currents effectively homogenizes the water column beyond approximately 50 m from the shoreline.

Dissolved nutrients not present in high concentrations in groundwater relative to ocean water (NH_4^+, DON and DOP) do not show the same distinctive patterns with respect to distance from the shoreline. Concentrations of NH_4^+ in surface samples within 10 m of the shoreline at Sites 1, 2 and 3 were variable; beyond 10 m there was little variation at each sampling site (Figure 1). At Site 4, the concentration of NH_4^+ increased to a maximum at a distance of 5 m from the shoreline and then decreased with further distance offshore. During the August 1993 survey, the concentrations of NH_4^+ within 50 m of the shoreline were highest at Site 4 compared to the other three sites. With the exception of DOP at Site 1, concentrations of DOP and DON remain relatively constant across all transects. At Site 1, DOP concentrations were distinctly higher in the samples collected 0.1 and 2 m from the shoreline.

Turbidity measurements were slightly higher in the samples collected within 10 m of the shoreline at Site 4 compared to the other sites (Figure 3). In general, turbidity showed no changes with distance from the shoreline during August 1993. Concentrations of Chl a were highest in samples collected at the shoreline from Sites 2 and 4. Beyond the shoreline, concentrations of Chl a showed no distinct patterns with distance offshore, and were equal in magnitude among the four sites (Figure 3).

Temperature measurements varied by only 0.6°C among the four sites during August 1993, with slightly lower temperatures at Site 1 (Figure 3). Temperature showed no horizontal gradient; the maximum variation in temperature along any one transect was 0.4°C (Table 1 and Figure 3).

Figures 2 and 3 also show patterns of water chemistry measurements from deep samples collected at stations beyond 2 m of the shoreline. As a result of lower density groundwater entering the ocean, a surface layer characterized by high nutrient concentrations and low salinity often forms in areas of relatively calm nearshore water in west Hawaii. This surface lens extends seaward until mixed to background oceanic levels by turbulent processes, primarily wave and wind action. Deep water samples collected offshore of the Kaupulehu Lot 4 project site during August 1993 had distinctly lower concentrations of Si, NO_3^-, PO_4^{3-}, TDP and TDN and higher salinity than surface samples. The vertical gradient was clearly evident out to a distance of 50 m from the shoreline at all the sites. There were no apparent vertical gradients in the other dissolved nutrients (NH_4^+, DON and DOP), turbidity, Chl a or temperature during the August 1993 survey.

Figures 4, 5 and 6 show continuous vertical profiles of salinity, temperature and sigma-t (density) recorded during the August 1993 survey. The profiles confirm the results from the discrete samplings. The presence of a distinct vertical gradient in salinity and density in the water column within 50 m of the shoreline is clearly evident (Figures 4 and 6). The gradients extended to a depth of approximately 1 m. Below 1 m the water column was homogeneous at all sites. There was, however, virtually no vertical stratification of temperature at any of the survey sites (Figure 5).

Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material inputs from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. It is possible to evaluate the extent of nutrient input from sources other than groundwater efflux by plotting the concentration of the dissolved material as a function of salinity (Officer 1979, Smith and Atkinson 1992, Dollar and Atkinson 1992). Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question. Figure 7 shows plots of concentrations of four constituents (Si, NO_3^-, NH_4^+, PO_4^{3-}) as functions of salinity for the samples collected offshore of the Kaupulehu Lot 4 project site in August 1993. Each graph also shows conservative mixing lines that are constructed by connecting the endmember concentrations of open ocean water and groundwater from a well that is used as a water source for the Kona Village Resort. The well is located upslope of the Kaupulehu Lot 4 property (see Table 1 for well water nutrient concentrations and salinity).

If the nutrient constituent in question displays purely conservative behavior (no input or removal resulting from any process other than physical mixing), data points should fall on, or near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer, and is not utilized rapidly within the nearshore environment by biological processes. Data points for Si from all four sites fall in a straight line on, or very near the conservative mixing line (Figure 7). The good linear relationship indicates that the mixing model provides a valid representation of the system under investigation.

The plots of NO_3^- versus salinity for the August 1993 survey show patterns similar to that for dissolved Si (Figure 7). Data points from all four sites fall very close to the conservative mixing line indicating that there appears to be no input of NO_3^- to the nearshore ocean environment from sources other than unaltered groundwater. Thus, there is no indication that human activities on land are causing any alteration to the concentrations of NO_3^- in groundwater.

The distribution of the other form of dissolved inorganic nitrogen, NH_4^+, shows no overall inverse relationship with respect to concentration and salinity for the present survey (Figure 7). Many of the highest concentrations are from samples with high salinity values. In addition, the conservative mixing line is essentially "flat" with similar concentrations in groundwater and open ocean water. These factors indicate that this material is not added to the ocean off the Kaupulehu Lot 4 site via input from land. As many of the measured NH_4^+ concentrations fall above the mixing line, it appears that there is a natural input of this form of nitrogen from biological processes within the nearshore area.

PO_4^{3-} is also a major component of fertilizer but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. Data points for PO_4^{3-} from Sites 1, 2 and 3 fall predominantly on or slightly above the mixing line (Figure 7). Data points from Site 4 fall predominantly below the mixing line. Such results indicate that there appears to be some factors responsible for different concentrations of PO_4^{3-} at Site 4 relative to other sites. Such factors may be related to differential uptake of PO_4^{3-} in the nearshore zone at Site 4, or different composition of groundwater entering the ocean at this site. Future surveys should provide clues as the reasons for the apparent differences in distribution of PO_4^{3-} data. While there is an apparent difference between sites, there does not appear to be substantial input of PO_4^{3-} to the nearshore area from sources other than naturally occurring groundwater.

Compliance with DOH Standards

DOH standards include specific criteria that are not to be exceeded during either 10% or 2% of the time. With only one sample collected to date from each sampling station, comparison of the 10% or 2% criteria for any sampling station is not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Tables 1 and 2 lists samples that exceed DOH water quality standards for open coastal waters under "wet" conditions. The criteria for wet conditions are applied to the Kaupulehu Lot 4 project area because this area probably receives at least 3 *million* gallons of groundwater input per mile per day. Comparing water chemistry results from the Kaupulehu Lot 4 samples to DOH criteria reveals that all surface samples within 100 m of the shoreline exceeded the 10% standards for NO_3^-. In addition, two surface samples of TDN exceeded the 10% standards. No measurements of NH_4^+, TDP, turbidity or Chl a exceeded the DOH 10% water quality criteria.

All of the samples with concentrations of NO_3^- and TDN that exceeded the DOH criteria were from stations near the shoreline where groundwater input was evident. As described in the sections above, NO_3^- is a natural component of groundwater. In areas that receive substantial input of groundwater there is typically a zone of mixing near the shoreline where NO_3^- concentrations may consistently exceed DOH criteria as long as salinity remains low. Thus it appears that natural processes can result in water quality that exceeds specified DOH limits.

SUMMARY

1. The first phase of water chemistry monitoring of the nearshore ocean offshore of the Kaupulehu Lot 4 project area was carried out on August 29, 1993. Forty water samples were collected along four transects running from the shoreline to

the open ocean. Sampling transects were spaced along the length of the development parcel. Samples were analyzed for chemical criteria specified by DOH water quality standards.

2. Groundwater mixing with ocean water in the nearshore area was apparent during the August 1993 survey at all transect sites, with Sites 2 and 4 showing the strongest gradients. Water chemistry constituents that are found in high concentration in groundwater (Si, NO_3^-, and PO_4^{3-}) were substantially elevated in samples collected within 50 m of the shoreline at all sites. Beyond approximately 50 m from the shoreline, mixing of groundwater and ocean water was sufficient to dilute all groundwater nutrients to near background oceanic concentrations.

3. A buoyant surface lens consisting of elevated groundwater nutrients and decreased salinity was apparent within the sampling regime out to a distance of 50 m from the shoreline.

4. Water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, DOP and DON) did not display any distinct trends. Other water chemistry parameters, turbidity, Chl a, and temperature also showed no distinct patterns. In general, the concentrations of these constituents showed no patterns with respect to distance from the shoreline or vertical gradients.

5. Scaling nutrient concentrations to salinity indicates that there is presently no external input of NO_3^- or PO_4^{3-} to the marine environment. Mixing analyses indicate that NH_4^+ is not being added to nearshore waters from activities on land.

6. Comparing measurements of water chemistry parameters to DOH standards reveals that NO_3^- exceeded specified criteria during August 1993. It is evident that natural inputs of groundwater can result in concentrations exceeding DOH limits since most of the concentrations above specific criteria occurred at stations located near the shoreline where substantial groundwater input occurs.

7. The next phase of the Kaupulehu 4 water chemistry monitoring will be carried out in October-December quarter of 1993.

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TABLE 1. Water chemistry measurements off Kaupulehu 4 lands collected August 29, 1993. Abbreviations as follows: S=surface; D=deep; DFS=distance from shore. Shaded values exceed DOH criteria for open coastal waters under "wet" conditions. Well data from freshwater well near the KL4 area collected in March 1991. For sampling site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (μM)	NO3 (μM)	NH4 (μM)	Si (μM)	DOP (μM)	DON (μM)	TDP (μM)	TDN (μM)	TURB (NTU)	SALINITY (o/oo)	CHL a (μg/L)	TEMP (deg.C)	pH
KL4-1	1S	0.1	0.36	6.41	0.13	48.46	0.66	7.92	1.02	14.46	0.11	32.981	0.16	27.1	8.17
	2S	2	0.27	5.85	0.04	41.91	0.78	6.43	1.05	12.32	0.11	33.215	0.12	26.9	8.17
	3S	5	0.17	2.89	0.05	21.01	0.29	6.48	0.46	9.42	0.12	33.897	0.10	27.0	8.18
	3D	5	0.09	0.70	0.07	7.00	0.27	6.15	0.36	6.92	0.14	34.353	0.17	27.0	8.17
	4S	10	0.33	6.57	0.13	49.13	0.23	6.53	0.56	13.23	0.10	33.026	0.14	26.9	8.17
	4D	10	0.07	0.43	0.18	4.38	0.30	7.50	0.37	8.11	0.16	34.456	0.07	27.3	8.18
	5S	50	0.12	1.84	0.07	13.27	0.31	6.59	0.43	8.50	0.09	34.160	0.11	27.3	8.18
	5D	50	0.10	0.23	0.15	2.75	0.28	6.95	0.38	7.33	0.11	34.521	0.10	27.3	8.19
	6S	100	0.07	0.20	0.08	3.30	0.24	6.56	0.31	6.84	0.11	34.485	0.12	27.2	8.19
	6D	100	0.07	0.14	0.14	2.48	0.28	6.52	0.35	6.80	0.09	34.503	0.10	27.2	8.19
KL4-2	1S	0.1	0.51	11.90	0.22	72.23	0.20	6.33	0.71	18.45	0.11	32.276	0.33	27.4	8.18
	2S	2	0.36	6.85	0.12	43.41	0.20	7.10	0.56	14.07	0.14	33.185	0.17	27.4	8.18
	3S	5	0.27	3.12	0.20	20.99	0.13	5.93	0.40	9.25	0.12	33.901	0.14	27.4	8.18
	3D	5	0.24	3.33	0.20	22.31	0.32	6.94	0.56	10.47	0.14	33.852	0.13	27.4	8.18
	4S	10	0.26	3.88	0.11	26.00	0.17	5.99	0.43	9.98	0.13	33.740	0.10	27.1	8.18
	4D	10	0.13	0.41	0.11	3.42	0.18	5.59	0.31	6.11	0.10	34.477	0.08	27.3	8.18
	5S	50	0.11	1.06	0.11	8.30	0.19	5.55	0.30	6.72	0.14	34.323	0.08	27.1	8.18
	5D	50	0.11	0.32	0.11	2.62	0.20	5.32	0.31	5.75	0.10	34.510	0.10	27.2	8.18
	6S	100	0.08	0.32	0.10	3.66	0.21	6.34	0.29	6.76	0.10	34.474	0.11	27.4	8.18
	6D	100	0.10	0.23	0.09	2.49	0.17	5.60	0.27	5.92	0.13	34.507	0.12	27.5	8.19
KL4-3	1S	0.1	0.29	6.30	0.19	40.31	0.19	6.06	0.48	12.55	0.12	33.266	0.11	27.3	8.19
	2S	2	0.25	6.09	0.22	38.55	0.21	7.15	0.46	13.46	0.11	33.328	0.14	27.3	8.19
	3S	5	0.15	3.07	0.23	21.71	0.21	6.90	0.36	10.20	0.11	33.882	0.15	27.3	8.19
	3D	5	0.14	2.69	0.27	19.46	0.21	6.29	0.35	9.25	0.13	33.952	0.11	27.3	8.18
	4S	10	0.14	1.69	0.27	12.91	0.20	7.91	0.34	9.87	0.10	34.177	0.08	27.3	8.18
	4D	10	0.09	0.43	0.20	4.30	0.18	6.02	0.27	6.65	0.10	34.456	0.11	27.4	8.19
	5S	50	0.09	1.03	0.20	8.60	0.21	7.84	0.30	9.07	0.09	34.327	0.13	27.2	8.18
	5D	50	0.15	0.19	0.17	2.23	0.13	6.67	0.28	7.03	0.08	34.519	0.10	27.3	8.19
	6S	100	0.08	0.69	0.24	5.36	0.21	6.88	0.29	7.81	0.13	34.407	0.12	27.4	8.18
	6D	100	0.07	0.19	0.19	2.77	0.19	5.85	0.26	6.23	0.10	34.511	0.10	27.4	8.19
KL4-4	1S	0.1	0.29	9.91	0.26	70.08	0.19	6.38	0.48	16.55	0.17	32.023	0.28	27.3	8.30
	2S	2	0.33	11.50	0.27	73.81	0.18	6.28	0.51	18.05	0.19	32.003	0.15	27.2	8.28
	3S	5	0.28	8.74	0.41	58.29	0.15	5.96	0.43	15.11	0.22	32.525	0.19	27.2	8.27
	3D	5	0.14	3.22	0.30	24.98	0.19	5.89	0.33	9.41	0.19	33.637	0.09	27.2	8.26
	4S	10	0.11	3.15	0.32	22.32	0.20	4.38	0.31	7.85	0.16	33.831	0.09	27.4	8.22
	4D	10	0.08	0.71	0.20	6.25	0.16	4.67	0.24	5.58	0.17	34.362	0.10	27.5	8.22
	5S	50	0.07	1.30	0.12	9.66	0.21	4.93	0.28	6.35	0.11	34.252	0.19	27.4	8.19
	5D	50	0.07	0.38	0.11	2.51	0.17	4.28	0.24	4.77	0.11	34.499	0.11	27.3	8.19
	6S	100	0.08	0.43	0.14	4.38	0.18	4.45	0.26	5.02	0.12	34.451	0.12	27.3	8.19
	6D	100	0.05	0.26	0.30	1.89	0.23	5.70	0.28	6.26	0.10	34.509	0.09	27.3	8.20
	WELL		5.26	140.40	0.21	1014	-	-	-	-	-	1.467	0.09	-	-
DOH WATER QUALITY STANDARDS															
NOT TO EXCEED 10%				1.00	0.61				1.29	17.86	1.25		0.90		
NOT TO EXCEED 2%				1.78	1.07				1.93	25.00	2.00		1.75		

TABLE 2. Water chemistry measurements (in µg/L) off Kaupulehu 4 lands collected August 29, 1993. Abbreviations as follows: S = surface; D = deep; DFS = distance from shore. Shaded values exceed DOH criteria for open coastal waters under "wet" conditions. Well data from freshwater well near the KL4 area collected in March 1991. For sampling site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	DOP (µg/L)	DON (µg/L)	TDP (µg/L)	TDN (µg/L)	TURB (NTU)	SALINITY (o/oo)	CHL a (µg/L)	TEMP (deg.C)	pH
KL4-1	1S	0.1	11.16	89.74	1.82	1361.7	20.46	110.88	31.62	202.4	0.11	32.981	0.16	27.1	8.17
	2S	2	8.37	81.90	0.56	1177.7	24.18	90.02	32.55	172.5	0.11	33.215	0.12	26.9	8.17
	3S	5	5.27	40.46	0.70	590.4	8.99	90.72	14.26	131.9	0.12	33.897	0.10	27.0	8.18
	3D	5	2.79	9.80	0.98	196.7	8.37	86.10	11.16	96.9	0.14	34.353	0.17	27.0	8.17
	4S	10	10.23	91.98	1.82	1380.6	7.13	91.42	17.36	185.2	0.10	33.026	0.14	26.9	8.17
	4D	10	2.17	6.02	2.52	123.1	9.30	105.00	11.47	113.5	0.16	34.456	0.07	27.3	8.18
	5S	50	3.72	25.76	0.98	372.9	9.61	92.26	13.33	119.0	0.09	34.160	0.11	27.3	8.18
	5D	50	3.10	3.22	2.10	77.3	8.68	97.30	11.78	102.6	0.11	34.521	0.10	27.3	8.19
	6S	100	2.17	2.80	1.12	92.7	7.44	91.84	9.61	95.8	0.11	34.485	0.12	27.2	8.19
	6D	100	2.17	1.96	1.96	69.7	8.68	91.28	10.85	95.2	0.09	34.503	0.10	27.2	8.19
KL4-2	1S	0.1	15.81	166.60	3.08	2029.7	6.20	88.62	22.01	258.3	0.11	32.276	0.33	27.4	8.18
	2S	2	11.16	95.90	1.68	1219.8	6.20	99.40	17.36	197.0	0.14	33.185	0.17	27.4	8.18
	3S	5	8.37	43.68	2.80	589.8	4.03	83.02	12.40	129.5	0.12	33.901	0.14	27.4	8.18
	3D	5	7.44	46.62	2.80	626.9	9.92	97.16	17.36	146.6	0.14	33.852	0.13	27.4	8.18
	4S	10	8.06	54.32	1.54	730.6	5.27	83.86	13.33	139.7	0.13	33.740	0.10	27.1	8.18
	4D	10	4.03	5.74	1.54	96.1	5.58	78.26	9.61	85.5	0.10	34.477	0.08	27.3	8.18
	5S	50	3.41	14.84	1.54	233.2	5.89	77.70	9.30	94.1	0.14	34.323	0.08	27.1	8.18
	5D	50	3.41	4.48	1.54	73.6	6.20	74.48	9.61	80.5	0.10	34.510	0.10	27.2	8.18
	6S	100	2.48	4.48	1.40	102.8	6.51	88.76	8.99	94.6	0.10	34.474	0.11	27.4	8.18
	6D	100	3.10	3.22	1.26	70.0	5.27	78.40	8.37	82.9	0.13	34.507	0.12	27.5	8.19
KL4-3	1S	0.1	8.99	88.20	2.66	1132.7	5.89	84.84	14.88	175.7	0.12	33.266	0.11	27.3	8.19
	2S	2	7.75	85.26	3.08	1083.3	6.51	100.10	14.26	188.4	0.11	33.328	0.14	27.3	8.19
	3S	5	4.65	42.98	3.22	610.1	6.51	96.60	11.16	142.8	0.11	33.882	0.15	27.3	8.19
	3D	5	4.34	37.66	3.78	546.8	6.51	88.06	10.85	129.5	0.13	33.952	0.11	27.3	8.18
	4S	10	4.34	23.66	3.78	362.8	6.20	110.74	10.54	138.2	0.10	34.177	0.08	27.3	8.18
	4D	10	2.79	6.02	2.80	120.8	5.58	84.28	8.37	93.1	0.10	34.456	0.11	27.4	8.19
	5S	50	2.79	14.42	2.80	241.7	6.51	109.76	9.30	127.0	0.09	34.327	0.13	27.2	8.18
	5D	50	4.65	2.66	2.38	62.7	4.03	93.38	8.68	98.4	0.08	34.519	0.10	27.3	8.19
	6S	100	2.48	9.66	3.36	150.6	6.51	96.32	8.99	109.3	0.13	34.407	0.12	27.4	8.18
	6D	100	2.17	2.66	2.66	77.8	5.89	81.90	8.06	87.2	0.10	34.511	0.10	27.4	8.19
KL4-4	1S	0.1	8.99	138.74	3.64	1969.2	5.89	89.32	14.88	231.7	0.17	32.023	0.28	27.3	8.30
	2S	2	10.23	161.07	3.78	2074.1	5.58	87.96	15.80	252.8	0.19	32.003	0.15	27.2	8.28
	3S	5	8.68	122.36	5.74	1637.9	4.65	83.44	13.33	211.5	0.22	32.525	0.19	27.2	8.27
	3D	5	4.34	45.08	4.20	701.9	5.89	82.46	10.23	131.7	0.19	33.637	0.09	27.2	8.26
	4S	10	3.41	44.10	4.48	627.2	6.20	61.32	9.61	109.9	0.16	33.831	0.09	27.4	8.22
	4D	10	2.48	9.94	2.80	175.6	4.96	65.38	7.44	78.1	0.17	34.362	0.10	27.5	8.22
	5S	50	2.17	18.20	1.68	271.4	6.51	69.02	8.68	88.9	0.11	34.252	0.19	27.4	8.19
	5D	50	2.17	5.32	1.54	70.5	5.27	59.92	7.44	66.8	0.11	34.499	0.11	27.3	8.19
	6S	100	2.48	6.02	1.96	123.1	5.58	62.30	8.06	70.3	0.12	34.451	0.12	27.3	8.19
	6D	100	1.55	3.64	4.20	53.1	7.13	79.80	8.68	87.6	0.10	34.509	0.09	27.3	8.20
WELL			163.06	1966	2.94	28493	-	-	-	-	-	1.467	0.09	-	-
DOH WATER QUALITY STANDARDS															
NOT TO EXCEED 10%				14.00	8.50				40.00	250.0	1.25		0.90		
NOT TO EXCEED 2%				25.00	15.00				60.00	350.0	2.00		1.75		

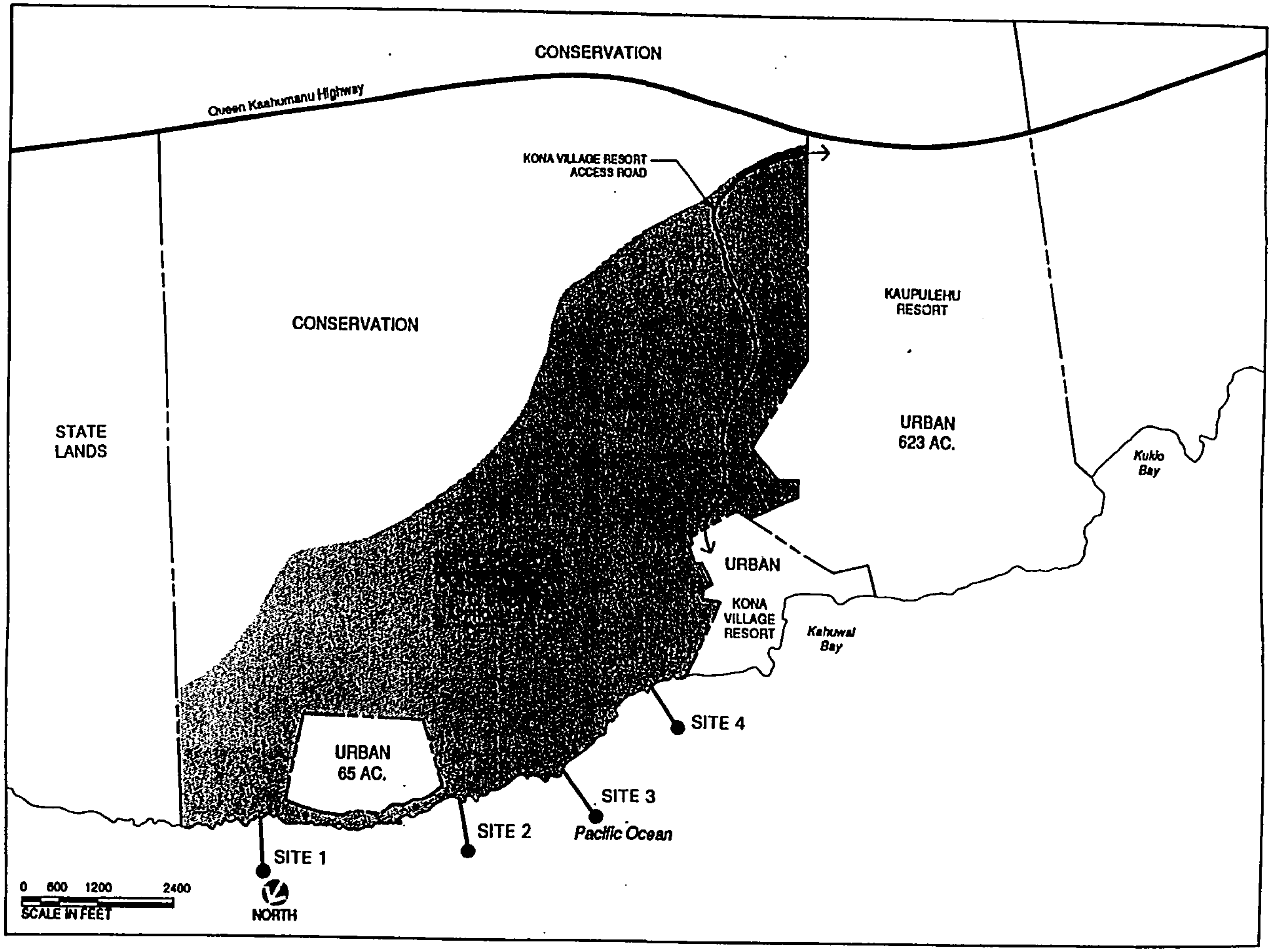

FIGURE 1. Map showing location of Kaupulehu Lot 4 property (shaded) and transect site locations for water chemistry baseline sampling.

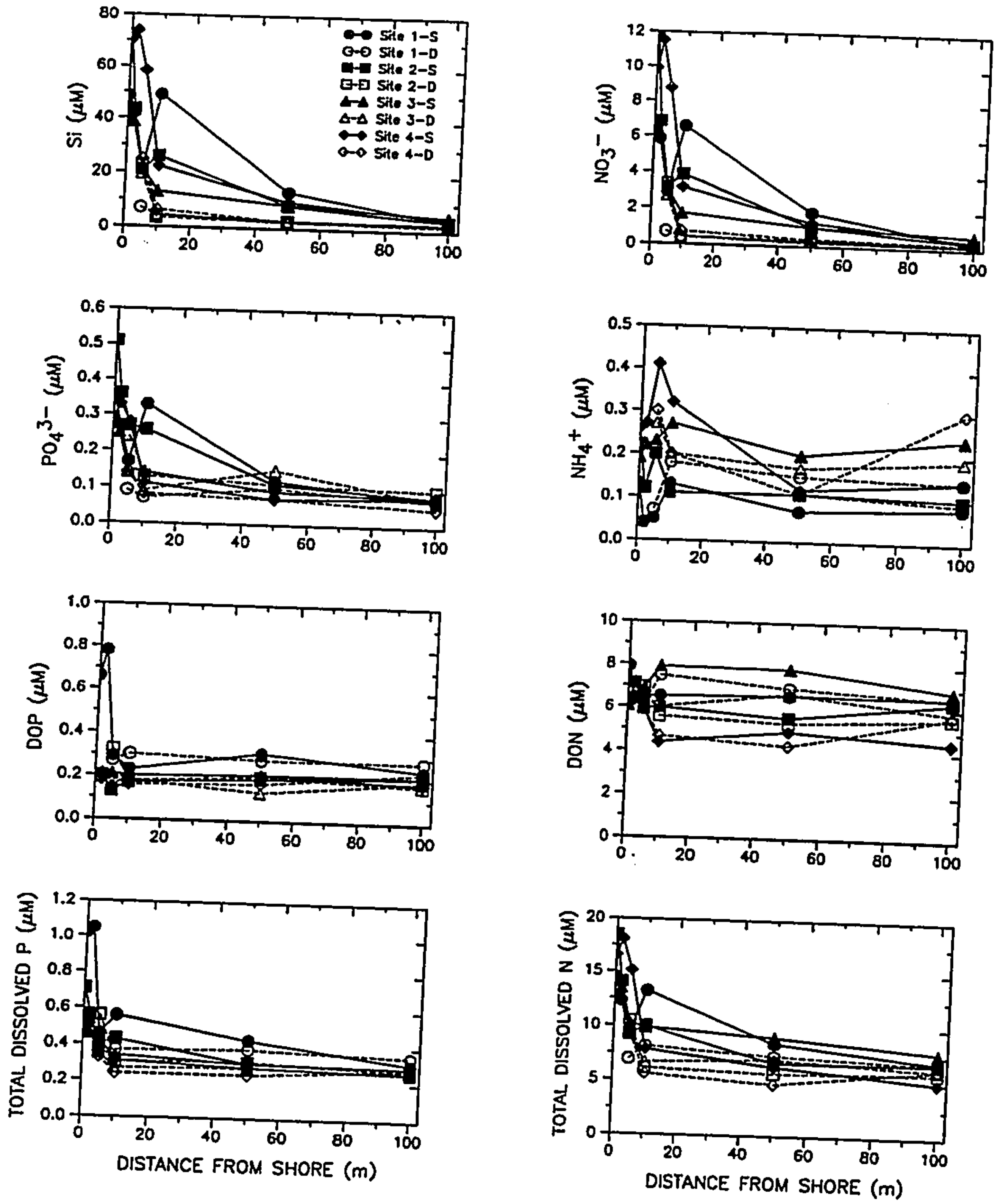

FIGURE 2. Plots of dissolved nutrient constituents collected from surface (S) and deep (D) samples off the Kaupulehu 4 project area in August 1993 as functions of distance from shore on sampling transects shown in Figure 1.

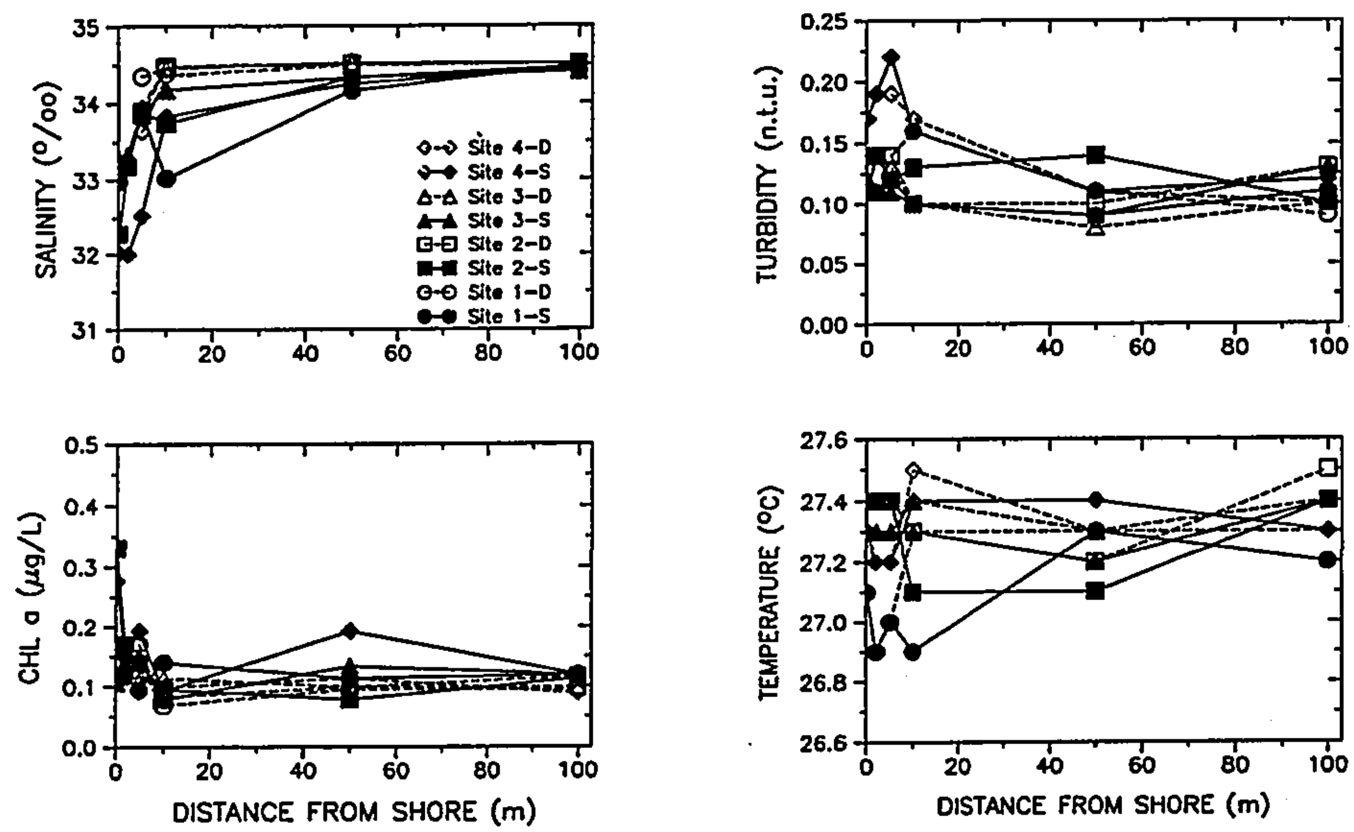

FIGURE 3. Plots of water chemistry constituents collected from surface (S) and deep (D) samples off the Kaupulehu 4 project area in August 1993 as functions of distance from shore on sampling transects shown in Figure 1.

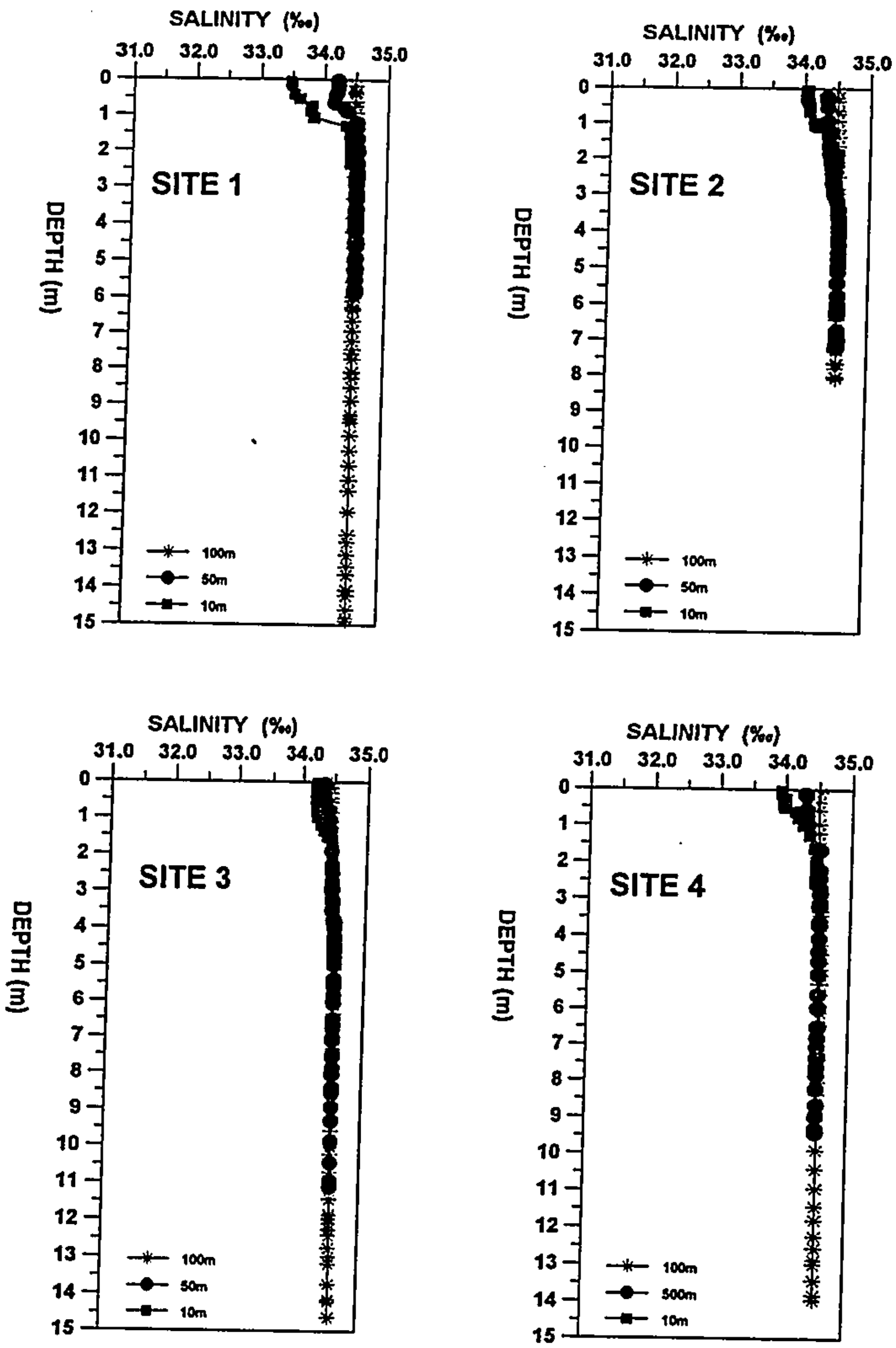

FIGURE 4. Continuous vertical profiles of salinity from sampling stations 10 to 100 m from shore at each of four sites offshore of the Kaupulehu 4 project area collected on August 29, 1993. For site locations, see Figure 1.

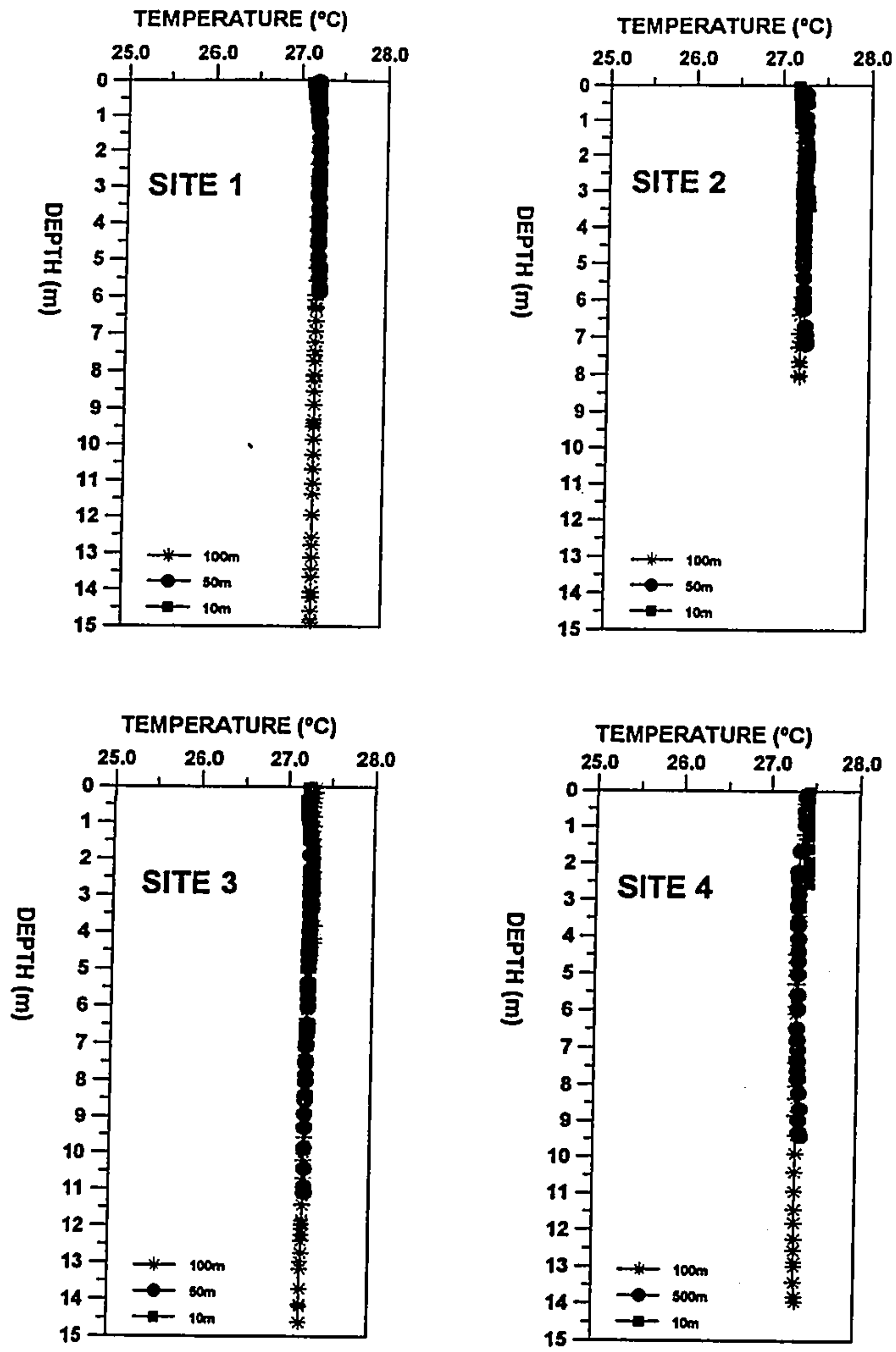

FIGURE 5. Continuous vertical profiles of temperature from sampling stations 10 to 100 m from shore at each of four sites offshore of the Kaupulehu 4 project area collected on August 29, 1993. For site locations, see Figure 1.

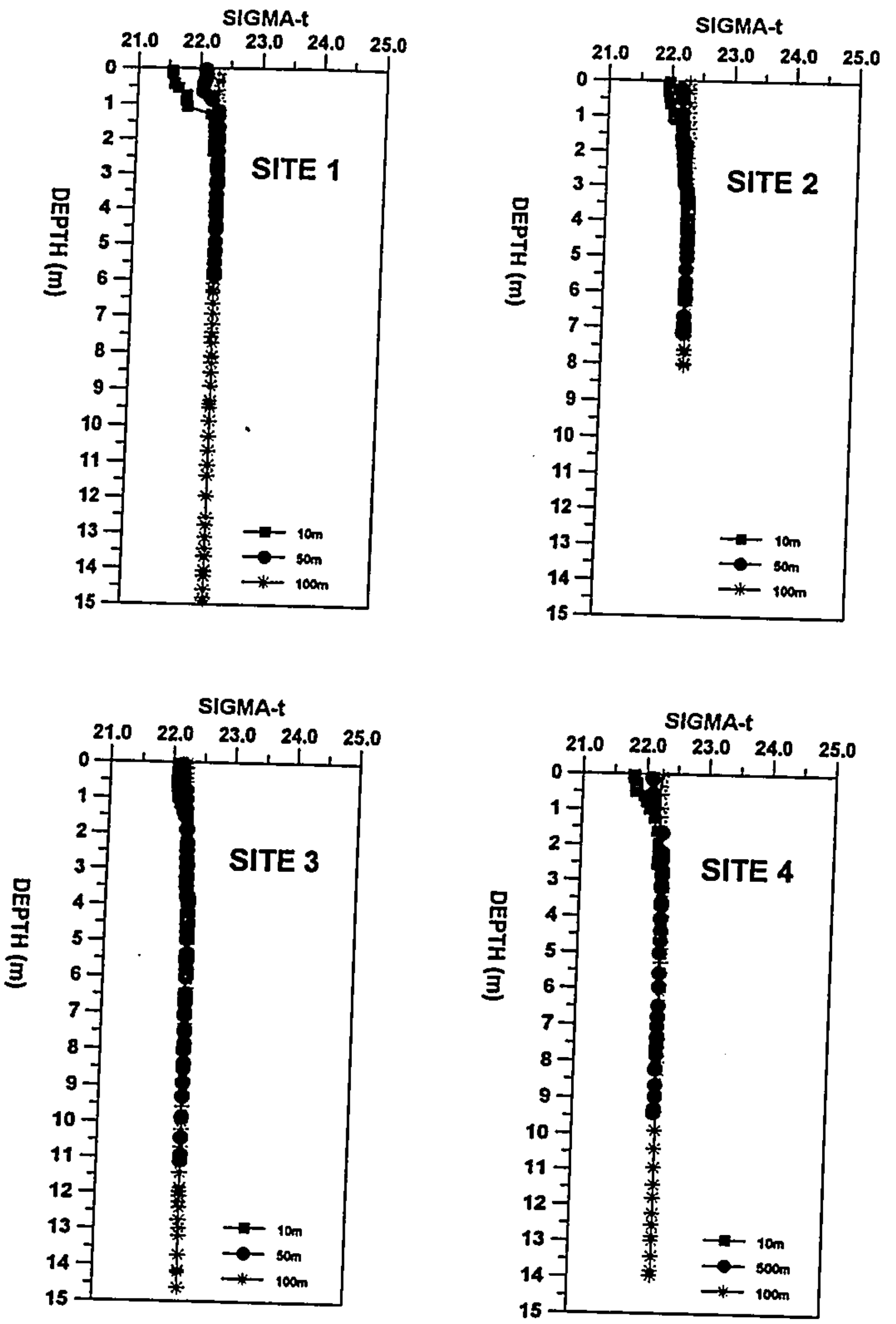

FIGURE 6. Continuous vertical profiles of sigma-t from sampling stations 10 to 100 m from shore at each of four sites offshore of the Kaupulehu 4 project area collected on August 29, 1993. For site locations, see Figure 1.

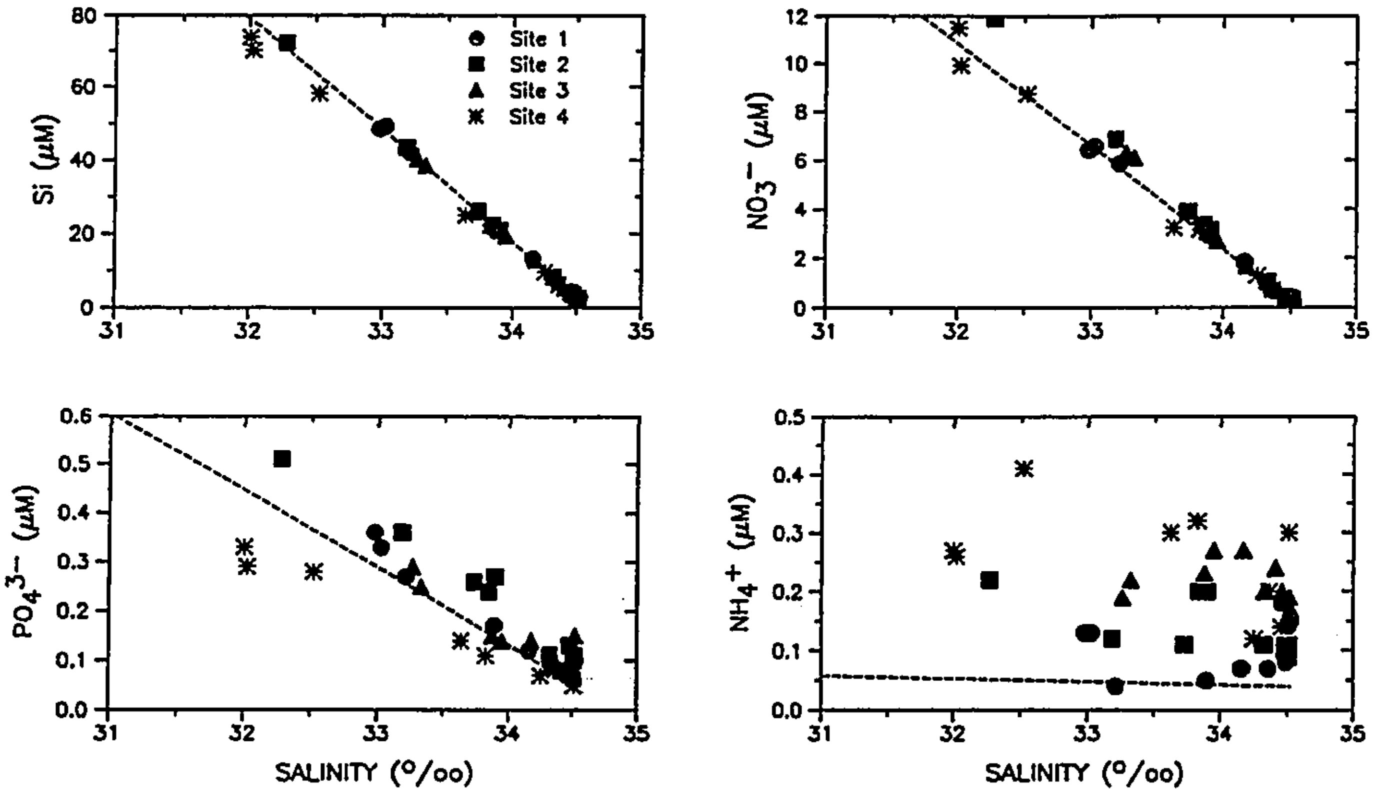

FIGURE 7. Plots of dissolved nutrients from water samples collected in August 1993 at four sites offshore of the Kaupulehu project area as functions of salinity. Solid line is the conservative mixing line constructed by connecting endpoint concentrations of open ocean water and well water.

BASELINE MARINE ASSESSMENT, KAUPULEHU LOT 4, NORTH KONA, HAWAII

MARINE BIOTA

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INTRODUCTION AND PURPOSE

Planning is underway for development of Lot 4 of the parcel owned by Kaupulehu Land Company (KLC), located in the North Kona District on the west coast of the Island of Hawaii. While the project plans have not yet been finalized, it is apparent that there will be resort development, including two golf courses along the coastal region. While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned project. The concern for preventing impacts to the nearshore marine environment is critical for the west coast of Hawaii owing to the nearly pristine nature of the coastal ocean, and the importance of the nearshore area as a recreational resource. For this purpose, a baseline survey was conducted to evaluate the existing condition of the marine environment prior to any shoreline development. Presented below are methods, results and conclusions of the baseline assessment of biotic communities offshore of the proposed Kaupulehu Lot 4 project site.

An important part of this investigation is to provide an evaluation of the degree of natural stresses (sedimentation, wave scour, freshwater input, etc.) that influence the nearshore marine environment in the area that could be potentially influenced by the proposed project. Typically, water quality and the composition of nearshore marine communities are intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed project may either be mitigated in large part, or amplified, by natural environmental factors. Therefore, evaluating the range of natural stress is a prerequisite for assessing the potential for additional change to the marine environment owing to shoreline modification.

Marine community structure can be defined as the abundance, diversity, and distribution of stony and soft corals, motile benthos such as echinoderms, and pelagic species such as reef fish. In the context of time-series surveys (the most appropriate method to determine environmental changes caused by changes in land use), the most useful biological assemblages for direct evaluation of environmental impacts to the offshore marine environment are benthic (bottom-dwelling) communities. Because benthos are generally long-lived, immobile, and can be significantly affected by exogenous input of sediments and other potential pollutants, these organisms must either tolerate the surrounding conditions within the limits of adaptability or die.

As members of the benthos, stony corals are of particular importance in nearshore Hawaiian environments. Corals compose a large portion of the reef biomass and their skeletal structures are vital in providing a complex of habitat space, shelter, and food for other species. Since corals serve in such a keystone function, coral community structure is considered the most "relevant" group in the use of reef community structure as a means of evaluating past and potential impacts associated with land development. For this reason, and because alterations in coral communities are easy to identify, observable change in coral population parameters is a practical and direct method for obtaining the information for determining the effects of stress in the marine environment. In addition, because they comprise a very visible component of the nearshore environment, detailed investigations of reef fish assemblages are presented.

METHODS

All fieldwork was carried out on September 18-19, 1993, and was conducted from a 18-foot boat using SCUBA gear. Biotic structure of benthic (bottom dwelling) communities inhabiting the reef environment was evaluated by establishing a descriptive and quantitative baseline between the shoreline and the 20 meter (m) (~60 foot) depth contour. Initial qualitative reconnaissance surveys were conducted that covered the area off the Kaupulehu Lot 4 property from the shoreline out to the limits of coral reef formation. These reconnaissance surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region of study.

Following the preliminary survey, four quantitative transect sites were selected offshore of the development area at the same sites where water quality was evaluated (see Figure 1). Station I was located at the northern property boundary, Stations II and III were located in the central area, and Station IV was located near the southern boundary of the property. At each station, three transect sites were selected, one in each of the dominant reef zones. Each transect was oriented parallel to depth contours so as to bisect a single reef zone. Care was taken to place transects in random locations that were not biased toward either peak or low coral cover. In total, twelve quantitative transects were conducted.

Quantitative benthic surveys were conducted by stretching a 50-m long surveying tape in a straight line over the reef surface. An quadrat frame with a

Nikonos camera mounted to photograph a fixed field with dimensions of 1 m by 0.66 m, was sequentially placed over 10 random marks on the transect tape so that the tape bisected the long axis of the frame. At each quadrat location a color photograph recorded the segment of reef area enclosed by the quadrat frame. In addition, a diver knowledgeable in the taxonomy of resident species visually estimated the percent cover and occurrence of organisms and substratum type within the quadrat frame. No attempt was made to disturb substrata to observe organisms, and no attempt was made to identify and enumerate cryptic species dwelling within the reef framework. Only macrofaunal species greater than approximately 2 centimeters were noted.

Following the period of fieldwork, quadrat photographs were projected onto a grid and units of bottom cover for each benthic faunal species and bottom type were recorded. Results of the photo-quadrats were combined with the in-situ cover estimates and community structure parameters (percent cover, species diversity) were calculated. The photo-quadrat transect method is a modification of the technique described in Kinzie and Snider (1978), and has been employed in numerous field studies of Hawaiian reef communities (e.g. Dollar 1979, Grigg and Maragos 1974), and has proven to be particularly useful for quantifying coverage of attached benthos such as corals and large epifauna (e.g., sea urchins, sea cucumbers). While this methodology is quantitative for the larger exposed fauna, many coral reef invertebrates are cryptic or nocturnal. Coupled with the generally small size of cryptic invertebrates, quantitative assessment of these groups requires methodologies that are beyond the scope of the present baseline assessment program.

Quantitative assessment of reef fish community structure was conducted in conjunction with the benthic surveys. As the transect tape was being laid along the bottom, all fish observed within a band approximately 2 meters wide along the transect path were identified by species name and enumerated. Care was taken to conduct the fish surveys so that the minimum disturbance was created by divers, ensuring the least possible dispersal of fish. Only readily visible individuals were included in the census. No attempt was made to seek out cryptic species or individuals sheltered within coral. This transect method is an adaptation of techniques described in Hobson (1974).

RESULTS AND DISCUSSION

Physical Structure

The main structural feature of the approximately 1.5 mile of shoreline of the Kaupulehu Lot 4 property is a basaltic ledge of pahoehoe lava. At the southern half of the property, the 1858 lava flow extends to the shoreline. Along the property frontage the shoreline is composed of a series of cusp-shaped embayments bounded by outcrops of lava that extend seaward. Along the northern half of the property, white sand beaches with scrub vegatation occur shoreward of the rocky shoreline. At the southern end of the property, a black sand beaches occurs between the edge of the lava flow and the rocky shoreline. The origin of the white calcareous grains appears to be primarily fragments of stony corals that have been broken and tossed ashore by periodic storm activity.

Because of the recent lava activity that is the constructional feature of the shoreline, there is virtually no intertidal area. The seaward edge of the lava shoreline is composed of either basaltic boulder fields, or vertical sea cliffs 5 to 10 feet in height. Beyond the shoreline, the structure of the offshore environment off of Kaupulehu Lot 4 generally conforms to the pattern that has been documented as characterizing much of the west coast of the Island of Hawaii (Dollar 1975, 1982, Dollar and Tribble 1993).

The zonation scheme consists of three predominant regions. Beginning at the shoreline and moving seaward, the shallowest zone beyond the shoreline is comprised of a seaward extension of the basaltic shoreline bench, along with scattered basaltic boulders that have entered the ocean after breaking off from the shoreline. *Pocillopora meandrina*, a sturdy hemispherical coral is the dominant colonizer of the nearshore area. This species is able to flourish in areas that are physically too harsh for most other species, particularly due to wave stress. The shallow (15') transects conducted off Kaupulehu Lot 4 all traversed the *Pocillopora meandrina*-boulder zone.

Seaward of the nearshore boulder zone, bottom structure is composed predominantly of a gently sloping reef bench composed of basalt, interspersed with lava extrusions and sand channels. In some areas, the bench is characterized by high relief in the form of undercut ledges and basaltic pinnacles. Fine-grained calcareous sediment also comprises a component of bottom cover. At Site 3, black sand covered much of the bottom seaward of the boulder zone. Water depth in this mid-reef zone ranges from about 20 to 50 feet. As wave stress in this region is substantially less than in the shallower areas, and suitable hard substrata abound, the area provides an ideal locale for colonization by attached benthos, particularly reef corals, and generally the widest assortment of species and growth forms are encountered in this region. The intermediate depth transects (30') at each survey station were located on the reef bench.

The seaward edge of the reef platform (at a depth of about 50 feet) is marked by an increase in slope to an angle of approximately 20-30 degrees. In the deep slope zone, substratum changes from the solid continuation of the island mass to an aggregate of generally unconsolidated sand and rubble. The predominant coral cover in the slope zone is typically interconnected mats of "finger coral" (*Porites compressa*), which grow laterally over unconsolidated substrata. In many areas of west Hawaii, the intensity of recent storm activity is apparent by the extent of rubble created from breakage of *P. compressa* branches (Dollar 1982, Dollar and Tribble 1993). At all of the Kaupulehu Lot 4 study sites, however, there was little evidence of rubble production of the deep reef slope, with the predominant cover consisting of living coral colonies. Such community composition indicates that the area has not been subjected to the force of destructive storm waves that have occurred in many areas of west Hawaii in at least the past decade (Dollar and Tribble 1993). Moving down the reef slope, coral settlement and growth cease at a depth of approximately 80 feet; beyond this depth the bottom consists mostly of sand, with occasional basaltic outcrops. The deep transects (60') at each survey station were located on the upper portions of the reef slope.

Biotic Community Structure

Coral Communities

Table 1 shows abundance estimates of invertebrates observed throughout the region of study. The predominant taxon of macrobenthos (bottom-dwellers) throughout the reef zones off the Kaupulehu Lot 4 property are Scleractinian (reef-building) corals. Results of quantitative line transects conducted within the three dominant reef zones provide a data base characterizing coral community structure. Table 2 shows the quantitative summary of coral community structure from the 1993 transects, while Appendix A is comprised of individual quadrat results.

In total, twelve species of "stony" corals, and two "soft corals" were observed throughout the region of study, while ten species of coral were encountered on transects. The number of coral species on a single transect ranged from two to eight. Species of coral that were observed in the region but did not occur on transects included *Porites brighami*, *Pocillopora eydouxi*, *Fungia scutaria*, and *Anthelia edmondsoni* (see Tables 1 and 2). The dominant species on all of the Kaupulehu Lot 4 transects was *Porites lobata*, which accounted for about 52% of total coral cover, and about 29% of all bottom cover. The second and third most abundant species, *Porites compressa* and *Pocillopora meandrina*, accounted for about 39% and 4% of coral cover, and 22% and 2%, of total bottom cover, respectively. Thus, these three species comprised about 95% of living coral cover, and 53% of all bottom cover. In total, living coral cover accounted for 66% of bottom cover.

Figure 2 shows histograms of coral cover, coral species diversity, and number of species on each transect in the shallow, mid-depth, and deep zones at each survey site. With respect to coral cover, it can be seen that at all sites, there is a progressive increase in cover with depth. Such a pattern is largely a reflection of the degree of wave stress that limits coral growth. The high percentage of living coral cover, and lack of abundant rubble fields at all of the deep transect stations is good evidence that the area has not been recently (within the last 10-20 years) subjected to damaging storm wave impact. On the shallow transects, coral cover is lower than in deeper water, presumably in response to the "normal" range of wave effects that limit settlement and growth of some species.

With respect to zonation of coral cover, the most abundant species on the shallow 15-foot transects were *P. lobata* and *P. meandrina*. Other species that were common in the shallow boulder covered areas were *Montipora verrucosa*, *M. patula* and *Pavona varians*. The 30-foot, mid-depth reef platform zone had the highest number of coral species at three of the four survey sites. In the mid-depth zone, dominant species were *Porites lobata* and *Porites compressa*. *Porites lobata* occurs in various growth forms including flat encrustations and large dome-shaped colonies, which are responsible for much of the true "reef" accumulation in the mid-depth zones. The abundance of suitable solid surfaces for coral settlement and growth, as well as the reduced wave stress compared to the shallower boulder zones provides a suitable setting for a variety of smaller encrusting coral species.

At the seaward edge of the reef bench, the slope of the bottom increases, and the substratum consists primarily of unconsolidated rubble and sand. Along much of the west Hawaii coastline, this region is generally covered by mats of *P. compressa*, which assumes a spreading growth form that extends laterally over areas of unconsolidated substratum in a manner that is not possible by other species. Owing to a fragile skeletal growth form, however, this species is especially susceptible to breakage by storm waves. On the deep reef transects off Kaupulehu Lot 4, *P. compressa* accounted for the largest percentage of bottom cover (19-53%) of any species at three of the four survey sites. At Site I, *Porites lobata* comprised the largest percentage of living coral (58%) on the deep reef slope.

At each survey site, the number of coral species is highest on the shallow and mid-depth transects, and lowest on the deep transects (Figure 2). Histograms of coral species diversity also exhibited a generally repeatable pattern between transects at each sites (Figure 2). Diversity was generally highest in the shallow or mid-depth zone and lowest in the deep slope zone. As seen in the histograms of coral cover (Figure 2), cover was lowest in the shallow zones where diversity is highest. Increased diversity in the shallow zones reflects the equitable distribution of coral cover between a relatively large number of component species. In the deep slope zone coral cover is highest, but domination of the community by two species results in lower equitability of distribution, hence reduced diversity. The observed pattern of diversity at Kaupulehu Lot 4 approximates the "typical" zonation pattern for West Hawaii (Dollar 1982).

Other Benthic Macroinvertebrates

The other dominant group of macroinvertebrates are the sea urchins (Class Echinoidea). Table 3 summarizes the occurrence of sea urchins at all of the survey stations. The most common urchin was *Echinometra matheai*, which occurred in all reef zones. *E. matheai* are small urchins that are generally found within interstitial spaces bored into basaltic and limestone substrata. *E. matheai* were most abundant at the mid-reef transects where the number of individuals ranged from 3 to 31. This species was least abundant on the reef slope transects where solid substrata was not common.

Tripneustes gratilla, and *Heterocentrotus mammillatus* were other species of urchins that occurred commonly on many transects. Both of these urchins occur as larger individuals (compared with *E. matheai*) that are generally found on the reef surface, rather than within interstitial spaces.

Sea cucumbers (Holothurians) observed during the survey consisted of three species, *Holothuria atra, H. nobilis,* and *Actinopyga obesa*. Individuals of these species were distributed sporadically across the mid-reef and deep reef zones (Table 1). The most common starfish (Asteroidea) observed on the reef surface were *Linckia spp.* Several crown-of-thorns starfish (*Acanthaster planci*) were observed feeding on colonies of *Pocillopora meandrina* and *Montipora verrucosa*. Numerous sponges were also observed on the reef surface, often under ledges and in interstitial spaces.

Frondose benthic algal zonation was not apparent at the study area off of Kaupulehu Lot 4. However, encrusting red calcareous algae (*Porolithon spp., Peysonellia rubra, Hydrolithon spp.*) were common on the boulders and exposed rocks throughout the study area. These algae were also abundant on bared limestone surfaces, and on the non-living parts of coral colonies. Frondose algae observed on the reef included *Valonia sp., Lyngbya majuscula, Halimeda spp., Sargassum spp.* and *Galauxura spp.* All of these plants occurred sporadically, and did not constitute a major component of the benthic biota. Also observed was an as yet unidentified benthic organism that may be chains of benthic diatoms. These organisms appear as stringy yellow-brown wisps that are delicately attached to the bottom. Only slight water motion is sufficient to dislodge the mats and scatter the wispy material in the water column. Mats of these organisms are often observed in west Hawaii growing in area of bared substratum in calm water.

The design of the reef survey was such that no cryptic organisms or species living within interstitial spaces of the reef surface were enumerated. Since this is the habitat of the majority of mollusks and crustacea, detailed species counts were not included in the transecting scheme. No dominant communities of these classes of biota were observed during the reef surveys at any of the study stations.

Reef Fish Community Structure

Reef fish community structure was largely determined by the topography and composition of the benthos. Transect results are presented in Table 4. On individual transects, the range of species diversity was 2.05 to 2.86, the range for number of species was 12 to 26, and the range in number of individuals was 116-192. A total of 1719 individuals representing 89 species was recorded during transect surveys. It can be seen in Table 4 that no significant pattern is evident with respect to distribution of fish species, number and diversity with respect to depth, or station location.

The reef fish community off Kaupulehu Lot 4 is typical of that found along most of the Kona Coast, as described by Hobson (1974), and Walsh (1984). Fish community structure can be divided into six general categories: juveniles, planktivorous damselfishes, herbivores, rubble-dwelling fish, swarming tetrodonts, and surge-zone fish.

Juvenile fish belonged mostly to the family Acanthuridae (surgeonfish), with representatives from the families Labridae (wrasses), Mullidae (goatfish) and Chaetodontidae (butterfly fish). Juveniles were most abundant on the deepest transects of the reef slope zone (60 feet) in areas dominated by finger coral (*P. compressa*), or basalt boulders. The complex habitat created by the spreading growth form of *P. compressa* provides shelter for small fish. The apparent absence of recent storm damage to the mats of finger coral in the deep slope zone off Kaupulehu Lot 4 appeared to provide a very favorable shelter zone for juvenile fish. However, even in areas where mats of finger coral are virtually destroyed by storm damage, fish communities continue to populate the rubble zones. It appears that fish abundance is not related directly to composition of intact living coral, but rather to the degree of shelter afforded by coralline structures, whether alive or dead.

Surgeonfish (*Acanthuridae*) were the most abundant family of fish. The most common species were the yellow tang (lau'i-pala, *Zebrasoma flavescens*) and the goldring surgeonfish (kole, *Ctenochaetus strigosus*). On the shallower reef terrace, adult whitebar surgeonfish (maikoiko, *Acanthurus leucopareius*), orangeband surgeonfish (na'ena'e, *A. olivaceus*), and parrotfish (uhu, *Scarus spp.*) were also common. Planktivorous damselfish, principally of the genus *Chromis* were abundant in all areas surveyed. In areas where coral rubble was abundant, common fish included potters angelfish (*Centropyge potteri*), and several species of wrasses, notably fourline wrasse (*Psuedochilinus tetrataenia*), eightline wrasse (*P. octotaenia*), and yellowtail wrasse (aki-lolo, *Coris gaimard*).

Surge zone fish were not quantitatively assessed because of the difficulty in working on the wave-swept basalt terraces that these fish inhabit. Visual observations, however, revealed that this biotope supported a large number of fish, principally herbivores such as rudderfish (nenue, *Kyphosus bigibbus*), surgeonfish (*Acanthurus spp.*), and unicornfish (mostly umaumalei, *Naso lituratus*). Saddle wrasse (hinalea lau-wili, *Thallassoma trilobatum*) and surge wrasse (hou, *T. purpureum*) were also abundant in the surge zone. Few juvenile fish were seen inhabiting the boulder zone environment. Black durgeon (humuhumu-ele'ele, *Melanichthys niger*) and pinktail durgeon (humuhumu-hi'u-kole, *M. vidula*) were also observed congregating in the water column over the reef platform.

Several species of "food fish" (taken by subsistence and/or recreational fishermen) were observed during the survey. Schools of several hundred individuals of goatfish (weke, *Mulloidichthys flavolineatus*), Hawaiian mackerel (opelu, *Decapterus macarellus*), and blue-lined snapper (taape, *Lutjanus kasmira*) were observed while diving. Numerous grand-eyed porgeys (mu, *Monotaxis grandoculis*) were also observed. Rocky ledges and large coral heads sheltered fair numbers of squirrelfish (u'u, *Myripristes berndti*). Other food fishes included parrotfish (uhu, *Scarus spp.*), goatfish (moana kea and malu, *Parupaneus cyclostomus* and *P. bifasciatus*), jacks (papio, *Caranx melamphygus*), and grouper (roi, *Cephalopholus argus*). None of these species were particularly abundant. Orange-eyed surgeonfish (kole, *Ctenochaetus strigosus*), while abundant, were generally not large enough to be considered suitable as "food fish".

Overall, fish community structure at Kaupulehu Lot 4 appeared fairly typical of the assemblages found in undisturbed Hawaiian reef environments. The presence of large schools of some food fish indicates that the area has probably been subjected to only moderate amounts of fishing pressure, by aquarium fish collectors and fishermen.

Endangered and Protected Species

Three species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly along the Kona Coast, and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from waters off the Kona Coast. Several green sea turtles were sighted on the surface and underwater during the baseline surveys off Kaupulehu Lot 4.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) are known to winter in the Hawaiian Islands from December to April. The present survey was conducted in September, when whales are not present in Hawaiian waters.

CONCLUSIONS

The ultimate purpose of baseline surveys is to estimate the potential for impact to environments from shoreline development. Implementation of the proposed plan for Kaupulehu Lot 4 would involve grading, vegetation removal, new construction and other changes to the existing environment on land. However, at present there are no plans for any alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment can only be considered from activities on land that may result in delivery of materials to the ocean through infiltration to groundwater, changes in surface runoff, and wind transport. Presented below are considerations of potential impacts from sedimentation, nutrient enrichment and biocides that may are considerations for the planned project.

Sedimentation

A potential mechanism for negative impact to nearshore marine systems is increased sedimentation from wind or runoff as a consequence of grading and changes in land use. With respect to alteration to the marine community offshore of the Kaupulehu Lot 4 property from increased sedimentation, the existence of locally high regions of sand cover points to a low potential for impact. Corals and other reef organisms are capable of removing sediment suspended by natural phenomena, up to threshold levels of deposition where cleaning mechanisms are overwhelmed and organisms become buried. Community structure is presently adapted to extremes in sediment stress from natural conditions. Organisms that do occur in the region are therefore capable of withstanding the stress associated with large natural sediment loads. In comparison to the frequent natural sediment resuspension within the study area, any additional input from land resulting from construction activity would probably not have the potential to accumulate to the point were organisms could be buried.

Several other scenarios around the Hawaiian Islands can also be drawn upon to estimate the potential for impact from sedimentation at Kaupulehu Lot 4. In particular, a study conducted at Princeville, Kauai (Grigg and Dollar, 1980) compared the reef environments off the completed phase of the resort with the environments off an area of pristine coastline. The hypothesis tested during this comparison was that increased sedimentation from exposure of soil during construction caused some modification of the coral reef environments offshore. Results of the survey showed that, if anything, the coral environments were better developed off of the existing Princeville development that was potentially subjected to increased runoff than off the unperturbed parcel. Even though the resort construction might have temporarily increased suspended sediment loads, this increase would have been insignificant in comparison to the natural sediment loads to which the reef communities are already pre-adapted. Therefore, the hypothesis was rejected that developmental alteration of land for Princeville construction, and by inference for similar developments such as the Kaupulehu Lot 4, could result in offshore impacts to the marine environment.

In addition, while it is generally accepted that sedimentation is a major source of impact on coral reefs throughout the world, several studies show that Hawaiian reefs may be significantly more resistant to heavy sediment loads than other reef areas. Results of surveys conducted at French Frigate Shoals (Dollar and Grigg, 1981) following the inadvertent grounding of a freighter and subsequent dumping of 2000 tons of a fine-grained mineral clay indicated that there was no damage to the reef corals and associated communities except where the organisms were actually buried by clay deposits for greater than a two-week period. Another study, conducted in Hilo Bay where natural sediment loads are very high and water is extremely turbid, reported that the dominant bottom cover consisted of nearly solid living coral--a condition rarely found under even the most "optimal" conditions (Dollar I985).

Runoff

As with sedimentation, it is not expected that runoff during construction would provide any negative stimulus to the marine environment. The climate of the South Kohala-North Kona districts is one of the driest in the Hawaiian Islands; therefore substantial rainfall causing sheet flow to the ocean during construction is rather unlikely. Even in the event of heavy rainfall, the porous nature of the lava and soil ground cover is such that sheet flow carrying suspended sediment toward the ocean is highly unlikely. Rather, most rainwater that would enter the ocean as runoff would do so following percolation through the surface rock layers to the water table, followed by groundwater extrusion at the shoreline.

Normal volumes of groundwater extrusion in the Kaupulehu area are probably range in the neighborhood of 3-6 million gallons per day (mgd) per mile. Results of water chemistry surveys conducted at the same sites as the biotic surveys have shown that a surface layer of low salinity, high nutrient groundwater occurs in the nearshore area (within 50 m of the shoreline) as a result of efflux of groundwater.

The increase to the volume of groundwater extrusion and resulting change in water chemistry owing to changes in shoreline characteristics is likely to be insignificant. For a development on the south Kohala coast at Waikoloa, it was estimated that the annual discharge of stormwater runoff is roughly equivalent to the amount of groundwater which enters the ocean each day (U. S. Army Corps of Engineers 1985). Therefore, the only major effect of rain during the period of grading might be to significantly decrease the amount and distribution of airborne dust--a circumstance that would have to be considered a beneficial side effect.

At this time no estimates exist of how drainage patterns might be changed as a result of the development plans. There appear to be no areas offshore of the Kaupulehu Lot 4 property where marine systems have been adversely affected by runoff to date. It is expected that this would remain the case. However, if analyses indicate that the proposed changes in land use and drainage patterns might result in substantial changes in water quality, additional field surveys will be conducted to determine the best location for the discharge of drainage and to assess the significance of expected water quality with respect to marine community structure.

<u>Golf Course Irrigation, Fertilization, and Pest Control</u>

The Kaupulehu Lot 4 development plans call for construction of golf courses that might be irrigated and fertilized with treated sewage effluent, as well as commercial fertilizer mixes. The potential for impacts to the aquatic ecosystems owing to possible increases in rates of nutrient loading must be considered. When subjected to substantial increases in nutrients, the response of some marine and freshwater systems is termed "eutrophication," and consists of increased growth of a portion of the community that is able to directly utilize the nutrients (phytoplankton), generally at the expense of normal community integrity. The overall result of this process is usually a degradation of environmental quality.

At the Kaupulehu Lot 4 site, it is anticipated that no such impacts will occur for several reasons. Most importantly, the unrestricted circulation of the offshore zone by tidal and wind-driven currents, meso-scale eddies, and wave action promotes rapid dilution and water exchange. Residence time of a parcel of water fronting the development is probably on the order of hours, so buildup of any nutrient is unlikely.

Another reason that the marine environment will probably show no effects as a result of golf course irrigation is that much of the nutrient load is taken up by the vegetation on the golf course. Chang and Young (l977) report that on a golf course on Oahu irrigated with treated sewage effluent 98% of the total nitrogen and 100% of the total phosphorus was taken up by the soil-plant surface layer. Chemical processes that account for the uptake include incorporation into plant biomass, cation exchange, fixation and adsorption on the soil, biological oxidation and denitrification. The important aspect of the study conducted on the Oahu golf course is that essentially none of the nutrient load reached the marine environment through groundwater runoff. While the underlying substrata on the Oahu course may differ from substrata at the Kaupulehu Lot 4 site, the soil mantle, where most of the chemical uptake and adsorption takes place should be similar at the two locations. Murdoch and Green (l987) also investigated the influence of golf course irrigation and pesticide application to nearshore marine waters. After 23 years of operation, material used to fertilize the golf course at the Westin Mauna Kea Resort could not be detected in the ocean.

Dollar and Atkinson (1992) modeled the input of golf course nutrients to the ocean downslope from two golf courses in West Hawaii over a four-year period. Results of the studies showed that at a location where fertilizer nutrients entered an embayment with restricted circulation relative to open coastal shorelines, nitrates increased by about 100% and phosphate increased by about 20% over natural input. However, because the nutrients were retained within a surface layer, there was no exposure to the benthos. Circulation within the embayment was also rapid enough to prevent phytoplankton blooms. These results indicated that even with long-term input of extremely high nutrient subsidies, there are situations where there are no negative effects to the receiving environment.

Another factor that accounts for the lack of potential for impact is the secondary level of sewage treatment commonly used by resort developments for irrigants and fertilizers. Studies done at several of the ocean discharges on Oahu (Dollar 1987) show that intentional discharges of greater volumes of secondary sewage into marine environments caused no detrimental effects whatsoever. In fact, the impacts that have been reported all can be considered beneficial since they result in increased fish populations, apparently in response to increased particulate food and shelter due to the outfall structure. Coral communities have also been documented to increase near the outfalls because diffuser structures provide settling sites that appear to be superior to natural sites.

A final consideration is the relatively high levels of nitrogen presently entering the marine environment through groundwater extrusion. Marine communities are therefore pre-adapted to high nitrogen loads. More importantly, the added nutrients are rapidly mixed during periods of intense water motion so virtually no buildup in nutrient concentration persists. In fact, there are currently no reports in the scientific literature of detrimental impacts to reef communities directly caused by increased nutrient loads. Based on these observations, it is probable that even if malfunctions in sewage plants cause temporary discharge directly into the ocean, there will be little or no effect to water quality or biotic communities.

Potential for negative alteration to marine ecosystems owing to pesticides and herbicides also seems to be nil. It has not been found necessary to utilize substantial quantities of pesticides on golf courses in Hawaii, and only very small applications of herbicides are periodically made to the greens (N. Bustamente, Mauna Lani Resort, personal communication). Such small quantities do not appear to be of a magnitude great enough to leach through the soil and lava, be carried to the ocean via groundwater extrusions, and then bioaccumulate to the point of producing a noticeable effect. To date, there have been no substantiated instances of even detection of golf course biocides in any marine biota in Hawaii.

Potential Effects to Protected Species

As mentioned in the Results, there are several protected marine species that may inhabit the offshore environment. Because there is no plan for any work in the nearshore region, there is no potential for blasting or excavation that might affect behavior of whales and other marine mammals. Short term changes in water quality resulting from construction would also not be of a magnitude to affect the behavior of sea turtles that might inhabit the reefs off of Kaupulehu Lot 4. Thriving turtle populations have been documented off many of the existing resort projects in West Hawaii. Increased access to the shoreline, once the development is constructed, might affect resident turtles because these animals often do not remain in areas frequented by humans. However, because the beaches on the development area are presently being used as recreation sites on a regular basis, any human-induced effects to turtle populations have probably already occurred. The potential for additional impact must be considered very slight, especially because there is abundant habitat space along the Kona coast.

The potential for impacts to marine communities as a result of development of the Kaupulehu Lot 4 project appear to be minimal. None of the developmental activities appear to have the potential to induce long-term changes in physio-chemical water quality parameters of a magnitude sufficient to cause changes in biological community structure. Marine environments are routinely subjected to stresses that can be much more destructive than the incremental changes that could result from any development activity. If some unexpected event related to development activities does occur, the resulting alterations to marine community structure would probably be reversible and recovery rapid once the stress factor is mitigated. Tolerance to such changes appears to already be part of the physiological range of the community.

It can be concluded that as long as reasonable steps are taken in construction practices, and operational procedures for the shoreline projects do not involve substantial changes in material delivery to the nearshore ocean, there should be no adverse impacts to the marine environment. However, regardless of how unlikely, there is always the potential for an unexpected event. It is recommended that the development plan includes a time-course monitoring program. If any development practices cause changes in physical-chemical parameters which lead to changes in environmental integrity, these effects could be quantified through time-series monitoring surveys. Such changes in water quality would be indicative of potential changes to marine community structure. Thus, any changes in water quality owing to shoreline development would trigger mitigative action, hopefully at a level below that capable of inducing change in biotic structure.

SUMMARY

1. Assessment of the benthic and reef fish community structure off the proposed Kaupulehu Lot 4 development was conducted on September 18-19, 1993. Twelve transects were evaluated at four stations located offshore of the property. Transects were located at three depths (15, 30 and 60 feet) representing the three major reef zones that typify much of the west Hawaii nearshore area.

2. Physical structure of the nearshore region consists predominantly of rocky basaltic shorelines that form the land-sea interface. The reef area is divided into three major zones; a shallow nearshore zone characterized by basaltic boulders and substantial water motion from breaking waves, a mid-reef zone which comprises

the major "reef-building area", and a deep reef slope. Substrata on the shallow and mid-reef consist predominantly of solid limestone and basalt, while substrata on the deep reef slope are predominantly sand and coral rubble.

3. In general, the coral communities off Kaupulehu Lot 4 are typical of the type that occurs throughout much of the west Hawaii coastline. Ten coral species were encountered on transects, and total coral cover was approximately 66% of bottom cover. The dominant coral species at all sites was *Porites lobata* which comprised 52% of total coral cover, and 29% of total bottom cover. The three dominant coral species accounted for 95% of coral cover in 1990, and 53% of total bottom cover.

4. Quantitative estimates indicate that coral cover ranges from about 18% to 81% on individual transects. At all four study sites, coral cover increased with depth. It appeared that coral cover was highest in the deep slope zone owing to lack of recent storm damage to mats of delicate finger coral. In the shallow boulder zones, coral cover was relatively low, probably as a result of limits to settlement of many species as a result of normal water motion associated with wave action.

5. The other dominant benthic macrofauna encountered on survey transects were sea urchins. The most abundant urchin is *Echinometra mathaei*, which occurred predominantly in the shallow and mid-reef zones.

6. Reef fish community structure was fairly typical of the assemblages found in undisturbed Hawaiian reef environments, and was characterized by six general categories: juveniles, plantivorous damselfishes, herbivores, rubble-dwellers, swarming tetrodonts, and surge-zone fishes. The presence of food fishes indicates that the area has been subjected to low to moderate amounts of fishing pressure, both by aquarium fish collectors and fishermen.

7. Based on the body of scientific information on existing projects, it does not appear that the planned development at Kaupulehu Lot 4 has the potential to cause adverse impacts to the marine environment. Stresses from natural forces that are presently the dominant factors in influencing community structure appear to be substantially greater than those that could result from shoreline development. The absence of plans to modify the shoreline or nearshore environment eliminates the potential for direct alteration of ecosystems. Secondary impacts associated with runoff of materials associated with the development do not appear to present the potential for changes based on similar, existing projects, provided that proper

management scenarios are employed. Continued monitoring during the course of development will allow determination of potential impacts to marine communities at levels where mitigative steps can be instituted prior to actual changes.

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TABLE 1. Marine invertebrate occurrence at transect stations in the vicinity of Kaupulehu Lot 4.
For station locations, see Figure 1.
Abundance code: "R" = rare (0 – 5 individuals or colonies sited on station)
"O" = occasional (5 – 20 individuals or colonies sited on station)
"C" = common (more than 20 individuals or colonies sited on station)

	TRANSECT											
	I 15'	I 30'	I 60'	II 15'	II 30'	II 60'	III 15'	III 30'	III 60'	IV 15'	IV 30'	IV 60'
SCLERACTINIA (Reef-Building Corals)												
Porites lobata	C	C	C	C	C	C	C	C	C	C	C	C
Porites compressa		C	C	O	C	C	O	C	C	O	C	C
Porites brighami		R		R	R						R	R
Pocillopora meandrina	C	C	R	C	C	C	C	C	C	C	C	C
Pocillopora eydouxi		R			O			R			R	
Montipora verrucosa	C	C	O	C	C	R	C	C	R	C	C	O
Montipora patula	C	C	O	C	C	R	O	C	R	O	O	O
Leptastrea purpurea	O	O		O	O		O	O		O	O	
Cyphastra ocellina		R		R	R	R	O	O		O	O	R
Pavona varians	O	O		R	R		R	R		R	R	
Pavona duerdeni		R			R			R			R	
Fungia scutaria		R										
ZOANTHINIARIA (Colonial "soft" corals)												
Palythoa tuberculosa	O	O	R	R	R	R	R	O	R	R	O	R
ALCYONACEA (Colonial "soft" corals)												
Anthelia edmondsoni	O	O	C	O	O	C	O	O	C	O	O	C
HOLOTHUROIDEA (Sea Cucumbers)												
Actinopyga obesa					O	R		R			R	
Holothuria atra	R	R	R	R	O	O	O	O	R	R	O	R
Holothuria nobilis		O	O		O	O	O	O	R	R	O	R
ECHINOIDEA (Sea Urchins)												
Diadema paucispinum		R										
Echinothrix diadema	R	C	R	R	C	R	O	C	R	O	O	R
Echinothrix calamaris		R	R		R							
Tripneustes gratilla	C	O	O	O	C	C	C	C	C	O	C	C
Echinometra mathaei	C	C	O	C	C	O	C	C	O	C	C	O
Echinometra oblonga	R	R		O			C	C		C	C	
Echinostrephus aciculatus	C	R	R	C	R		O	R		O	R	
Heterocentrotus mammillatus	C	C	O	C	C	O	C	C	O	C	C	O
ASTEROIDEA (Starfish)												
Linckia multifora		R			R							
Linckia diplax		R			R					R		
Acanthaster planci					R						R	
PORIFERA												
misc. sponges	C	C	C	C	C	C	C	C	C	C	C	C

TABLE 2. Coral species percent cover, non-coral substrata cover, and coral community statistics from transect surveys off Kaupulehu Lot 4 conducted in September 1993. For transect station locations, see Figure 1.

	TRANSECT											
	I	I	I	II	II	II	III	III	III	IV	IV	IV
CORAL SPECIES	15'	30'	60'	15'	30'	60'	15'	30'	60'	15'	30'	60'
Porites lobata	13.6	27.0	57.8	13.3	44.0	29.8	12.2	35.3	38.0	16.7	34.0	24.3
Porites compressa		33.2	19.2	2.3	19.2	47.3	0.3	12.9	42.3	1.2	28.5	53.3
Pocillopora meandrina	2.3	1.8		0.9	1.0	0.1	5.4	1.0	0.2	14.1	2.6	
Montipora patula	0.3	0.1	0.7	0.6	0.2		3.3	1.2		0.2	1.7	
Montipora verrucosa	0.7	0.9	1.2	0.7	0.5		2.7	0.5	0.2	1.2	0.2	
Pavona varians	0.3	0.2			0.5	0.2	0.9	1.7		2.1	1.2	
Leptastrea purpurea	0.4	0.5			0.1		0.1			0.5		
Pavona duerdeni		1.7										
Palythoa tuberculosa	0.1				0.3			0.1				
Cyphastrea ocellina										0.1		
TOTAL CORAL COVER	17.7	65.4	78.9	17.8	65.8	77.4	24.9	52.7	80.7	36.1	68.2	77.6
NUMBER OF SPECIES	7	8	4	5	8	4	7	7	4	8	6	2
CORAL COVER DIVERSITY	0.84	1.02	0.68	0.87	0.81	0.69	1.39	0.94	0.72	1.21	1.01	0.62
NON-CORAL SUBSTRATA												
Limestone	1.6	21.0	17.8	5.6	23.9	14.8	5.5	35.8	17.7	3.2	22.4	19.5
Sand		2.0	0.6		0.4	2.6	1.6	7.2	0.6			0.5
Basalt	80.7	11.7	2.7	76.6	4.8		65.9	3.7		60.7	9.4	2.4
Rubble					5.1	5.1	2.1	6.0				

TABLE 3. Sea urchin abundance on benthic transects off Kaupulehu Lot 4. For transect station locations, see Figure 1.

SEA URCHIN SPECIES	TRANSECT I 15'	I 30'	I 60'	II 15'	II 30'	II 60'	III 15'	III 30'	III 60'	IV 15'	IV 30'	IV 60'
Echinometra matheai	4	5		44	22	1	1	31	3	3	3	1
Echinostrephus aciculatus	2			2			1					
Heterocentrotus mammillatus		2			7	3		2	4			4
Tripneustes gratilla		1	1			7		1				3
Echinothrix diadema								1				
TOTAL URCHIN COUNT	6	8	1	46	29	11	2	35	7	3	3	8

TABLE 4. Reef fish abundance on transects off Kaupulehu Lot 4.

FAMILY Species	TRANSECT I 15'	I 30'	I 60'	II 15'	II 30'	II 60'	III 15'	III 30'	III 60'	IV 15'	IV 30'	IV 60'
CHANIDAE												
Chanos chanos								2				
KYPHOSIDAE												
Kyphosus bigibbus			12							4		4
CIRRHITIDAE												
Paracirrhites arcatus		3			3	2	3	2	1		1	
MULLIDAE												
Mulloides flavolineatus		2										
Parupeneus multifasciatus	7	6	8	3	4	5	6	7	3	7	5	7
P. bifasciatus	4											
P. cyclostomus						2	3					
SERRANIDAE												
Cephalopholis argus	1	1										
MALACANTHIDAE												
Malacanthus hoedtii			2									
LUTJANIDAE												
Lutjanus kasmira			4									
Aphareus furcatus	1											
CHAETODONTIDAE												
C. quadrimaculatus	2	2					2			2	2	2
C. ornatissimus		2	2									
C. multicinctus	6	2	6		8	4	6	4	6	2	4	2
Forcipiger flavissimus	3	3	2			2	3		3			
POMACANTHIDAE												
Centropyge potteri						3						

Table 4. continued.

FAMILY Species	TRANSECT I 15'	 I 30'	 I 60'	 II 15'	 II 30'	 II 60'	 III 15'	 III 30'	 III 60'	 IV 15'	 IV 30'	 IV 60'
POMACENTRIDAE												
Abudefduf abdominalis		4	13							12	8	12
A. sordidus	1											
Plectro. johnstonianus					3	1			1		1	
P. imparipennis	1											
Stegastes fasciolatus		3		3	3						2	
Chromis agilis			12			15		8	35		8	
C. hanui								2	3		3	
C. vanderbilti	24	12		12			8			12		12
C. ovalis												
LABRIDAE												
Cheilinus unifasciatus		4				2			2		3	
Pseudocheilinus octotaenia					1	2		1				
Bodianus bilunulatus			1									
Coris gaimard							3			1		1
C. venusta							1					
Anampses cuvier							2					
Thalassoma duperrey	17	4	7	21	10	8	16	8	6	12	6	12
T. ballieui									1			
Gomphosus varius	2				3		2	2	2	2	1	2
Labroides phthirophagus	1	1			1			1			2	
Stethojulis balteata	2			2		2	3	2			2	
Halichoeres ornatissimus	2	2		4		1				1	2	1
SCARIDAE												
Scarus sordidus	7	2	2		2	3		6			3	
S. perspicillatus		1									4	
S. psittacus			2			1					2	
S. rubroviolaceus			3									
juvenile Scarus	14			23						23		23
ACANTHURIDAE												
Zebrasoma flavescens	18	13	23	14	26	13	7	8	19	23	7	23
Acanthurus achilles		6	4		2			3		8		8
A. leucopareius		8										
A. olivaceus			2									
A. blochii		3									1	2
A. nigrofuscus	25	13		48	37		49	24		2	24	
Ctenochaetus strigosus	40	26	18	25	42	17		41	29	43	36	43
C. hawaiiensis		2							2			

Table 4. continued.

FAMILY Species	I 15'	I 30'	I 60'	II 15'	II 30'	II 60'	III 15'	III 30'	III 60'	IV 15'	IV 30'	IV 60'
						TRANSECT						
ACANTHURIDAE												
Naso lituratus	3	3	10	5	4	1	3			3	6	3
N. unicornis						30						
N. hexacanthus			8									
ZANCLIDAE												
Zanclus cornutus	2						2	2		1		1
BALISTIDAE												
Rhinecanthus rectangulus										1		1
Sufflamen bursa	3		4	2	4	2	3	3	4	2	4	2
Melichthys vidula					2							
M. niger	6	12			7				4	3	7	3
NUMBER SPECIES	24	26	21	12	18	20	18	19	16	20	25	20
NUMBER INDIVIDUALS	192	140	145	162	162	116	122	127	121	164	144	164
SPECIES DIVERSITY	2.5	2.8	2.7	2.0	2.2	2.4	2.2	2.2	2.1	2.3	2.6	2.3

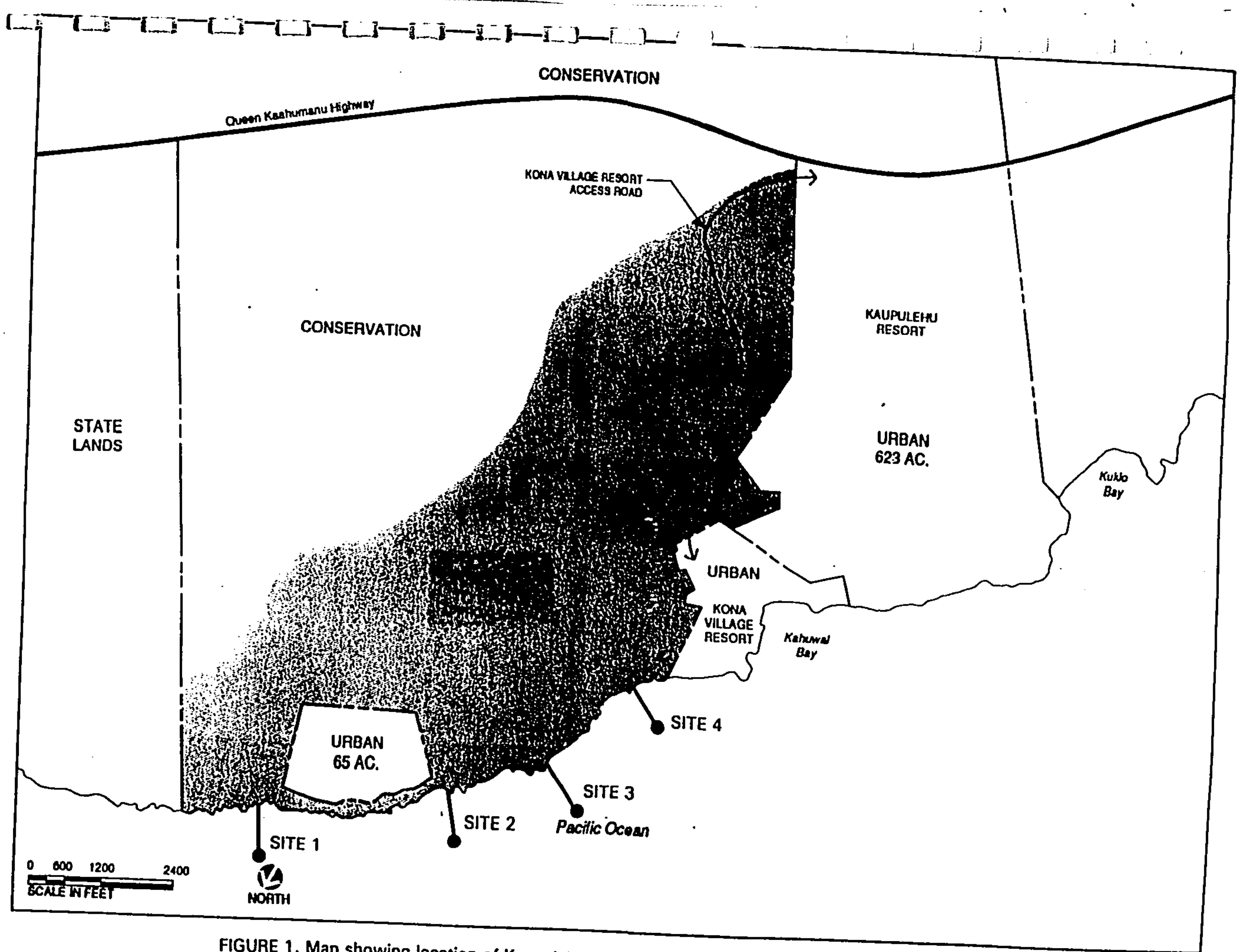

FIGURE 1. Map showing location of Kaupulehu Lot 4 property (shaded) and transect site locations for biotic baseline surveys.

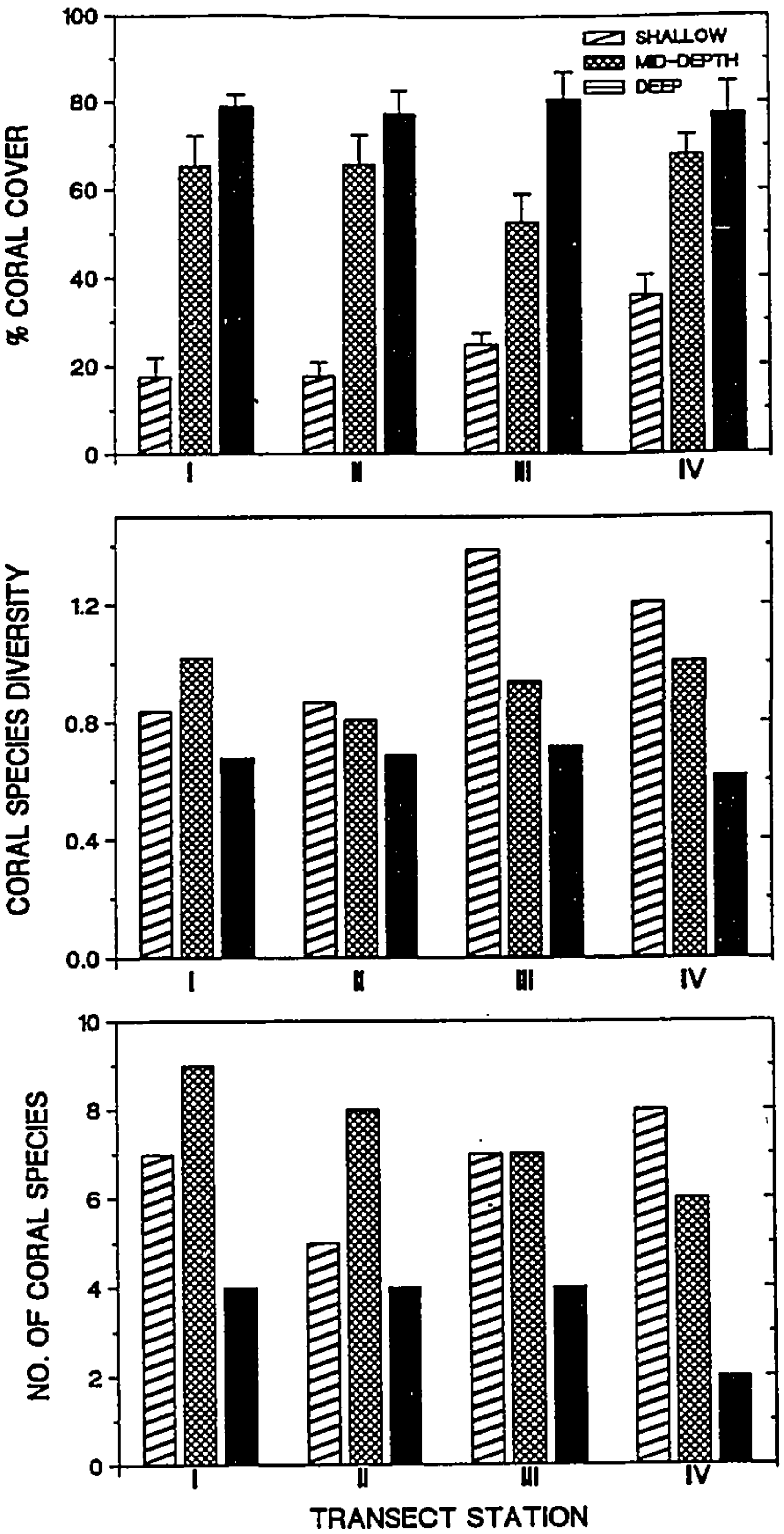

FIGURE 2. Histograms showing percent coral cover (top), coral species diversity (center), and number of coral species (bottom) on shallow, mid-depth, and deep transects at the four survey sites off of Kaupulehu Lot 4. Error bars represent standard error of coral cover. For transect site locations, see Figure 1.

APPENDIX A-1

REEF CORAL TRANSECT DATA SHEET

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	78.9 %
TRANSECT ID #:	1-60'	STD. DEV.	8.7
DATE:	9/19/93	SPECIES COUNT	4
		SPECIES DIVERSITY	0.677

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata	41	72	67	78	86	61	63	41	41	28	578.0
Porites compressa	38	6	20				12	38	46	32	192.0
Montipora verrucosa		3	1	1		3		2	2		12.0
Montipora patula					3	1				3	7.0
QUAD CORAL TOTAL	79	81	88	79	89	65	75	81	89	63	789.0
Basalt											0.0
Limestone	12	16	12	17	11	31	25	16	9	29	178.0
Sand	1					2				3	6.0
Rubble	8	3		4		2		3	2	5	27.0

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	65.4 %
TRANSECT ID #:	1-30'	STD. DEV.	21.4
DATE:	9/19/93	SPECIES COUNT	8
		SPECIES DIVERSITY	1.027

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata	21	2	26	14	46	2	3	41	84	31	270.0
Porites compressa	61	87	18	22	22	72	21	6	11	12	332.0
Pocillopora meandrina			3	6	4	2		3			18.0
Montipora verrucosa			2				3	3		1	9.0
Montipora patula									1		1.0
Pavona varians							2				2.0
Pavona doerdeni					8					9	17.0
Leptastrea purpurea	2				1			2			5.0
QUAD CORAL TOTAL	84	89	49	42	81	76	29	55	96	53	654.0
Basalt	4		24	21			58			10	117.0
Limestone	12	11	27	37	19	24	13	37	4	26	210.0
Sand								8		12	20.0
Rubble											0.0

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	17.7 %
TRANSECT ID #:	1-15'	STD. DEV.	13.3
DATE:	9/19/93	SPECIES COUNT	7
		SPECIES DIVERSITY	0.848

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata		21		4	32	36	24	6	10	3	136.0
Pocillopora meandrina	2	1	3	1	2	4	4	5	1		23.0
Montipora patula						3					3.0
Montipora verrucosa				2				3	2		7.0
Pavona varians		3									3.0
Leptastrea purpurea										4	4.0
Palythoa tuberculosa			1								1.0
QUAD CORAL TOTAL	2	25	4	7	34	43	28	14	13	7	177.0
Basalt	96	75	84	93	66	57	72	86	87	91	807.0
Limestone	2		12							2	16.0
Sand											0.0
Rubble											0.0

APPENDIX A-1 REEF CORAL TRANSECT DATA SHEET

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	77.4 %
TRANSECT ID #:	2-60'	STD. DEV.	16.8
DATE:	9/19/93	SPECIES COUNT	4
		SPECIES DIVERSITY	0.692

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	46	41	44	38	13	6	41	21	34	14	298.0
Porites compressa	42	38	13	41	74	75	56	68	43	23	473.0
Pocillopora meandrina				1							1.0
Pavona varians				2							2.0
QUAD CORAL TOTAL	88	79	57	82	87	81	97	89	77	37	774.0
Basalt											0.0
Limestone			38	15	8	15	3	11	23	35	148.0
Sand		12		3						11	26.0
Rubble	12	8	5		5	4				17	51.0

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	65.8 %
TRANSECT ID #:	2-30'	STD. DEV.	21.2
DATE:	9/19/93	SPECIES COUNT	8
		SPECIES DIVERSITY	0.818

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	34	41	73	23	42	33	73	68	31	22	440.0
Porites compressa	8	43	18	18	31	46	12	2	14		192.0
Pocillopora meandrina				2	1			5		2	10.0
Montipora verrucosa									2	3	5.0
Montipora patula				2							2.0
Pavona varians			1				2		2		5.0
Leptastrea purpurea									1		1.0
Palythoa tuberculosa								1	2		3.0
QUAD CORAL TOTAL	42	84	92	45	74	79	87	76	52	27	658.0
Basalt	3								22	23	48.0
Limestone	34	16	8	35	26	21	13	24	26	36	239.0
Sand				4							4.0
Rubble	21			16						14	51.0

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	17.8 %
TRANSECT ID #:	2-15'	STD. DEV.	9.9
DATE:	9/19/93	SPECIES COUNT	5
		SPECIES DIVERSITY	0.874

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	12	3	24	16	6	23	4	21	6	18	133.0
Porites compressa				14	8		1				23.0
Pocillopora meandrina	2		1	2		1		3			9.0
Montipora patula								2		4	6.0
Montipora verrucosa			2		3	2					7.0
QUAD CORAL TOTAL	14	3	27	32	17	26	5	26	6	22	178.0
Basalt	86	97	73	68	80	40	90	67	87	78	766.0
Limestone					3	34	5	7	7		56.0
Sand											0.0
Rubble											0.0

APPENDIX A-1

REEF CORAL TRANSECT DATA SHEET

TRANSECT SITE: KAUPULEHU LOT 4
TRANSECT ID #: 3-60'
DATE: 9/19/93

MEAN CORAL COVER 80.7 %
STD. DEV. 20.0
SPECIES COUNT 4
SPECIES DIVERSITY 0.722

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	38	31	73	41	26	51	65	8	43	4	380.0
Porites compressa	47	62	21	48	56	28	23	78	42	18	423.0
Pocillopora meandrina		1			1						2.0
Montipora verrucosa	2										2.0
QUAD CORAL TOTAL	87	94	94	89	83	79	88	86	85	22	807.0
Basalt											0.0
Limestone	13	6	6	11	7	21	12	14	15	72	177.0
Sand										6	6.0
Rubble											0.0

TRANSECT SITE: KAUPULEHU LOT 4
TRANSECT ID #: 3-30'
DATE: 9/19/93

MEAN CORAL COVER 52.7 %
STD. DEV. 20.1
SPECIES COUNT 7
SPECIES DIVERSITY 0.941

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	32	65	38	14	61	26	24	26	21	46	353.0
Porites compressa	3	6	3	61		2	8	4	4	38	129.0
Pocillopora meandrina							1	6	3		10.0
Montipora verrucosa			2						3		5.0
Montipora patula					12						12.0
Pavona varians	2			1	3	4	5	1	1		17.0
Palythoa tuberculosa	1										1.0
QUAD CORAL TOTAL	38	71	43	76	76	32	38	37	32	84	527.0
Basalt						21	16				37.0
Limestone	41	29	31	24	22	32	42	57	64	16	358.0
Sand	21		20		2	15	4	6	4		72.0
Rubble			6								6.0

TRANSECT SITE: KAUPULEHU LOT 4
TRANSECT ID #: 3-15'
DATE: 9/19/93

MEAN CORAL COVER 24.9 %
STD. DEV. 7.9
SPECIES COUNT 7
SPECIES DIVERSITY 1.385

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	21	6	4	8	14	3	15	14	16	21	122.0
Porites compressa			3								3.0
Pocillopora meandrina	6	4		14	13	2	2	4	8	1	54.0
Montipora patula	5	24							2	2	33.0
Montipora verrucosa		1	14				3	3	4	2	27.0
Pavona varians							2	5		2	9.0
Leptastrea purpurea							1				1.0
QUAD CORAL TOTAL	32	35	21	22	27	5	23	26	30	28	249.0
Basalt	55	65	79	62	70	70	77	67	63	51	659.0
Limestone	13				3	25		7	7		55.0
Sand				16							16.0
Rubble										21	21.0

APPENDIX A-1 REEF CORAL TRANSECT DATA SHEET

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	77.6 %
TRANSECT ID #:	4-60'	STD. DEV.	22.9
DATE:	9/19/93	SPECIES COUNT	2
		SPECIES DIVERSITY	0.621

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	14	20	5	1	40	62	48	2	48	3	243.0
Porites compressa	12	20	80	85	42	28	38	95	43	90	533.0
QUAD CORAL TOTAL	26	40	85	86	82	90	86	97	91	93	776.0
Basalt	24										24.0
Limestone	50	60	15	14	18	5	14	3	9	7	195.0
Sand						5					5.0
Rubble											0.0

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	68.2 %
TRANSECT ID #:	4-30'	STD. DEV.	14.1
DATE:	9/19/93	SPECIES COUNT	6
		SPECIES DIVERSITY	1.016

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	40	31	21	28	26	36	19	46	21	72	340.0
Porites compressa	45	14	38	31	42	46	28	12	18	11	285.0
Pocillopora meandrina			10		3	1	2		10		26.0
Montipora verrucosa		2									2.0
Montipora patula				17							17.0
Pavona varians		3	2		3				2	2	12.0
QUAD CORAL TOTAL	85	50	71	76	74	83	49	58	51	85	682.0
Basalt		24	1					24	45		94.0
Limestone	15	26	28	24	26	17	51	18	4	15	224.0
Sand											0.0
Rubble											0.0

TRANSECT SITE:	KAUPULEHU LOT 4	MEAN CORAL COVER	36.1 %
TRANSECT ID #:	4-15'	STD. DEV.	14.6
DATE:	9/19/93	SPECIES COUNT	8
		SPECIES DIVERSITY	1.219

SPECIES	QUADRAT 1	2	3	4	5	6	7	8	9	10	SPECIES TOTAL
Porites lobata	8	3	5	38	31	14	46	12	8	2	167.0
Porites compressa		12									12.0
Pocillopora meandrina	18	12	3	14	6	12	14	11	20	31	141.0
Montipora patula								1	1		2.0
Montipora verrucosa						1	2	8	1		12.0
Pavona varians	2	8	1	8	1				1		21.0
Leptastrea purpurea	1	1			1	2					5.0
Cyphastrea ocellina										1	1.0
QUAD CORAL TOTAL	29	36	9	60	39	29	62	32	31	34	361.0
Basalt	71	45	91	40	61	70	26	68	69	66	607.0
Limestone		19				1	12				32.0
Sand											0.0
Rubble											0.0

MARINE MONITORING, KAUPULEHU LOT 4, NORTH KONA, HAWAII

WATER CHEMISTRY

REPORT 1-94

MARINE RESEARCH CONSULTANTS

MARINE MONITORING, KAUPULEHU LOT 4, NORTH KONA, HAWAII

WATER CHEMISTRY

REPORT 1-94

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February 21, 1994

INTRODUCTION AND PURPOSE

Planning is underway for development of Lot 4 of the parcel owned by Kaupulehu Land Company (KLC), located in the North Kona District on the west coast of the Island of Hawaii. While the project plans have not yet been finalized, it is apparent that there will be resort development along the coastal region. While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned project. In order to evaluate the existing condition of the marine environment, as well as to assess the potential for impacts, a pre-construction baseline survey of the marine environment has been conducted. With respect to ocean water quality, two phases of sampling were included in the baseline; a summer sampling was conducted in August 1993, and a winter sampling was conducted in January 1994. The results of the August survey have been previously reported. Presented below are methods and results from the second increment of monitoring conducted in January 1994 offshore of the proposed Kaupulehu Lot 4 project site.

METHODS

Four locations fronting the Kaupulehu Lot 4 property were selected as sampling sites for the monitoring program. Site 1 lies at the northern end of the property; Sites 2 and 3 are approximately equally spaced between boundaries; Site 4 lies near the southern boundary at the juncture of the 1858 lava flow (see Figure 1). Water chemistry was evaluated along sampling transects at each site. Each transect was oriented perpendicular to the shoreline, and extended from the highest wash of waves across the intertidal and nearshore reef platform out to the open ocean, a distance of approximately 100 meters (m). Water samples were collected at six stations along each transect. Such sampling was intended to span the greatest range of salinity with respect to freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone as this area is most likely to show the effects of shoreline modification. At each station a surface sample was collected within approximately 10 centimeters (cm) of the surface. With the exception of the stations located 0.1 and 2 m from the shoreline, a bottom sample was collected within 1 m of the sea floor.

Surface water samples were collected by opening triple-rinsed, 1-liter polyethylene bottles near the air-sea interface. Bottom samples were collected either by divers opening 1-liter bottles, or by using a 1.8-liter Niskin-type oceanographic sampling bottle. These bottles were lowered to the desired depth in an open position, where spring-loaded endcaps were triggered to close by a messenger released from the surface. Subsamples for nutrient analyses from both surface and deep samples were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to Honolulu.

Water quality constituents that were measured included the specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii, Department of Health (DOH) Water Quality Standards. These criteria include: total dissolved nitrogen (TDN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium (NH_4^+), total dissolved phosphorus (TDP), chlorophyll a (Chl a), turbidity, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) are also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Analyses for NH_4^+, PO_4^{3-}, and NO_3^- + NO_2^- were performed with a Technicon autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). Total dissolved nitrogen (TDN) and total dissolved phosphorus (TDP) were analyzed in a similar fashion following oxidative digestion. Dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated as the difference between TDN and dissolved inorganic N, and TDP and dissolved inorganic P, respectively. The level of detection for the dissolved nutrients is 0.2 μM for TDN and Si, 0.02 μM for TDP, NO_3^- and NH_4^+, and 0.01 μM for PO_4^{3-}.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with $HgCl_2$ to terminate biological activity. Fixed samples were kept refrigerated until turbidity was measured on a Monitek Model 21 nephelometer, and reported in nephelometric turbidity units (NTU). Chl a was measured by filtering 300 ml of water through sub-micron glass-fiber filters (GF/F); pigments on filters were extracted in 90% acetone in the dark at -5° C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003°/oo.

In-situ field measurements included water temperature using a hand-held mercury thermometer with readability of 0.1° C. Continuous vertical profiles of salinity, temperature, depth and density were acquired using an Ocean Sensors Model 100 CTD.

Nutrient, turbidity and salinity analyses were conducted by Marine Analytical Specialists (Honolulu, HI), while Chl a analyses were conducted by OI Consultants, Inc. (Waimanalo, HI). Both laboratories possess the required approval ratings for the analyses.

RESULTS OF WATER CHEMISTRY ANALYSIS

Environmental Conditions

The winter pre-construction baseline monitoring survey was conducted on January 16, 1994. Environmental conditions were sunny with light tradewinds (approximately 10 kt). Moderate rainfall occurred during the night previous to sampling, and was the first instance of any rainfall to the area in over five months. Ocean conditions consisted of a large NW swell (5-6 ft); sampling was conducted during ebb tide. Over the course of sampling, the tidal level fell from 1.5 feet to approximately 1.1 feet above mean low water. Northwest swells that occurred during the sampling are typical for the winter months.

Horizontal and Vertical Stratification

Tables 1 and 2 show the results of all water chemistry analyses for samples collected off Kaupulehu Lot 4 on January 16, 1994. Table 1 shows dissolved nutrient concentrations in micromolar (μM) units, while Table 2 shows concentrations in units of micrograms per liter (μg/L). The concentrations of eight dissolved nutrient constituents in surface and deep samples are plotted as functions of distance from the shoreline in Figure 2. Values of salinity, turbidity, Chl a and temperature as functions of distance from shore are shown in Figure 3.

At Site 3, the concentrations of several nutrients (Si, NO_3^-, PO_4^{3-}, TDP and TDN) were elevated in surface samples collected from the stations within 10 m of the shoreline (Table 1, Figure 2). Salinity exhibits the opposite trend with sharply decreased values within 10 m of the shoreline (Figure 3). Beyond 10 m, the concentrations of dissolved nutrients continued to decline and salinity continued to increase with increasing distance offshore, but at a more gradual rate than in the nearshore area. During the January 1994 survey, no gradients in Si, NO_3^-, PO_4^{3-}, were observed at Sites 1, 2 or 4.

The peak values of Si, NO_3^-, PO_4^{3-}, TDN and TDP in combination with low salinity in the nearshore zone off Site 3 suggest input of groundwater at the shoreline. Groundwater normally contains high concentrations of these nutrients and low salinity (see values for well water in Tables 1 and 2). It is also apparent in Figures 2 and 3 that groundwater entering the ocean near the shoreline is rapidly mixed to near background oceanic levels within 50 m of the shoreline. Mixing of ocean water and groundwater by turbulent forces associated with waves, winds and currents effectively homogenizes the water column beyond approximately 50 m from the shoreline.

Dissolved nutrients not present in high concentrations in groundwater relative to ocean water (NH_4^+, DON and DOP) do not show the same distinctive patterns with respect to distance from the shoreline. Concentrations of NH_4^+ fluctuated within 10 m of the shoreline at all sites, but the overall variation among all the stations at any one site was no greater than 0.18 μM (Tables 1 and 2, Figure 1). Concentrations of DOP and DON remained relatively constant across all transects and was of the same magnitude at all four sites.

Turbidity measurements were slightly higher in the samples collected from Site 3 compared to the other three sites (Figure 3). In general, turbidity showed no changes with distance from the shoreline during January 1994. Concentrations of Chl a were highest in samples collected at the shoreline from Sites 1 and 3. Beyond the shoreline, concentrations of Chl a showed no distinct patterns with distance offshore, and were equal in magnitude among the four sites (Figure 3).

Temperature measurements varied by only 0.4°C among the four sites during January 1994, and showed no horizontal gradient (Figure 3).

Figures 2 and 3 also show patterns of water chemistry measurements from deep samples collected at stations beyond 2 m of the shoreline. As a result of lower density groundwater entering the ocean, a surface layer characterized by high nutrient concentrations and low salinity often forms in areas of relatively calm nearshore water in west Hawaii. This surface lens extends seaward until mixed to background oceanic levels by turbulent processes, primarily wave and wind action. Deep water samples collected offshore of Site 3 during January 1994 had slightly lower concentrations of Si and NO_3^-, and higher salinity than surface samples. The vertical gradient was evident out to a distance beyond 50 m from the shoreline at this site. There were no apparent vertical gradients in the other dissolved nutrients (PO_4^{3-}, TDN, and TDP) at Site 3. Sites 1, 2 and 4 showed no vertical gradients in any of the dissolved nutrients, turbidity, Chl a or temperature during the January 1994 survey.

Figures 4, 5 and 6 show continuous vertical profiles of salinity, temperature and sigma-t (density) recorded during the January 1994 survey. The consistent vertical profiles confirm the lack of any distinct vertical gradients in the water column during this survey.

Temporal Comparison of Monitoring Results

Figures 7-14 show surface water concentrations of various chemical constituents as functions of distance from the shoreline for both of the monitoring surveys conducted to date

(August 1993 and January 1994). The concentrations of Si, NO_3^-, and PO_4^{3-} at nearly all stations across each transect and at all four sites were higher during August 1993 as compared to January 1994 (Figures 7, 9, 11 and 13). Similarly, salinity was lower during August 1993 compared to the results of January 1994 (Figures 8, 10, 12 and 14). With respect to groundwater efflux near the shoreline at Site 3, horizontal gradients in groundwater nutrients and salinity tended to be steeper during August, while January results showed more gradual changes with distance offshore. Horizontal gradients in groundwater nutrients and salinity at Sites 1, 2 and 4 were evident only during the August 1993 survey.

With a few exceptions, dissolved nutrients generally not associated with groundwater efflux (NH_4^+, DOP, and DON) showed no distinct differences between the two surveys at any of the sites (Figures 7, 9, 11 and 13). At Site 1, the concentrations of DOP and DON were higher during August 1993 compared to January 1994 (Figure 7). At Site 3, concentrations of DON were also highest during August 1993 while the concentrations of DOP showed no differences between the two survey dates (Figure 11). At all four sites, turbidity and Chl a were lower during August 1993 compared to the results from January 1994 (Figures 8, 10, 12 and 14). A seasonal variation in temperature was evident with lower temperatures during January compared to August (Figures 8, 10, 12 and 14). At all four sites, temperatures were approximately 3°C lower during January than August.

Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material inputs from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. It is possible to evaluate the extent of nutrient input from sources other than groundwater efflux by plotting the concentration of the dissolved material as a function of salinity (Officer 1979, Smith and Atkinson 1992, Dollar and Atkinson 1992). Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question. Figure 15 shows plots of concentrations of four constituents (Si, NO_3^-, NH_4^+, PO_4^{3-}) as functions of salinity for the samples collected offshore of the Kaupulehu Lot 4 project site in January 1994, while Figure 16 shows similar plots for both the August 1993 and January 1994 data. Each graph also shows conservative mixing lines that were constructed by connecting the endmember concentrations of open ocean water and groundwater from a well that is used as a water source for the Kona Village Resort. The well is located upslope of the Kaupulehu Lot 4 property (see Table 1 for well water nutrient concentrations and salinity).

If the nutrient constituent in question displays purely conservative behavior (no input or removal resulting from any process other than physical mixing), data points should fall on, or near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer, and is not utilized rapidly within the nearshore environment by biological processes. Data points for Si from all four sites in January fall in a straight line on, or very near the conservative mixing line (Figure 15). When both summer and winter data are plotted, it can be seen that each array of data points falls on the respective mixing line in a linear distribution (Figure 16). The good linear relationship indicates that the mixing model provides a valid representation of the system under investigation.

The plots of NO_3^- versus salinity for both the August 1993 and January 1994 surveys show patterns similar to that for dissolved Si (Figures 15 and 16). Data points from all four sites fall very close to the conservative mixing lines for each survey indicating that there appears to be no input of NO_3^- to the nearshore ocean environment from sources other than unaltered groundwater. Thus, there is no indication that human activities on land are causing any alteration to the concentrations of NO_3^- in groundwater.

The distribution of the other form of dissolved inorganic nitrogen, NH_4^+, shows no overall inverse relationship with respect to concentration and salinity for the either the August or January surveys (Figures 15 and 16). Many of the highest concentrations are from samples with high salinity values. In addition, the conservative mixing line is essentially "flat" with similar concentrations in groundwater and open ocean water. These factors indicate that this material is not added to the ocean off the Kaupulehu Lot 4 site via input from land. As most of the measured NH_4^+ concentrations fall above the mixing line, it appears that there is a natural input of this form of nitrogen from biological processes within the nearshore area.

PO_4^{3-} is also a major component of fertilizer but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. During the January 1994 survey, data points for PO_4^{3-} from Sites 1 and 4 fall close to the mixing line, while data points for Sites 2 and 3 are substantially above the mixing line (Figure 15). Such results indicate that there appears to be some factors responsible for different concentrations of PO_4^{3-} at Sites 2 and 3 relative to Sites 1 and 4. Future surveys should provide clues as the reasons for the apparent differences in distribution of PO_4^{3-} data. Examination of the plots of PO_4^{3-} in August 1993 reveals a more linear relationship with respect to salinity. Thus, even though the data points from the January survey deviate from the conservative mixing line, the concentrations are below many of the data points from the August survey, when data points were close to the conservative mixing lines.

Compliance with DOH Standards

DOH standards include specific criteria that are not to be exceeded during either 10% or 2% of the time, or as the geometric mean of the sampling set. With only two samples collected to date from each sampling station, comparison of the 10% or 2% criteria or the geometric mean criteria for any sampling station are not statistically meaningful. However, comparing sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

Tables 1 and 2 lists samples that exceed DOH water quality standards for open coastal waters under "wet" conditions. The criteria for wet conditions are applied to the Kaupulehu Lot 4 project area because this area probably receives at least 3 million gallons of groundwater input per mile per day. During the January 1994 monitoring survey, only one sample from the Kaupulehu Lot 4 samples exceeded the DOH 10% criteria. This sample was from surface water at the shoreline of Site 3, where groundwater input was detected. As described in the sections above, NO_3^- is a natural component of groundwater. In areas that receive substantial input of groundwater there is typically a zone of mixing near the shoreline where NO_3^- concentrations may consistently exceed DOH criteria as long as salinity remains low. Thus it appears that natural processes can result in water quality that exceeds specified DOH limits.

SUMMARY

1. The winter phase of water chemistry monitoring of the nearshore ocean offshore of the Kaupulehu Lot 4 project area was carried out on January 16, 1994. Forty water samples were collected along four transects running from the shoreline to the open ocean. Sampling transects were spaced along the length of the development parcel. Samples were analyzed for chemical criteria specified by DOH water quality standards.

2. Groundwater mixing with ocean water in the nearshore area was apparent during the January 1994 survey only at Site 3. Water chemistry constituents that are found in high concentration in groundwater (Si, NO_3^-, and PO_4^{3-}) were substantially elevated in samples collected within 50 m of the shoreline at this site. Beyond approximately 50 m from the shoreline, mixing of groundwater and ocean water was sufficient to dilute all groundwater nutrients to near background oceanic concentrations.

3. A buoyant surface lens consisting of elevated groundwater nutrients and decreased salinity was apparent within the sampling regime out to a distance of 50 m from the shoreline at Site 3. No such lens was evident at the other sampling sites.

4. Water chemistry constituents that do not occur in high concentrations in groundwater (NH_4^+, DOP and DON) did not display any distinct trends. Other water chemistry parameters, turbidity, Chl a, and temperature also showed no distinct patterns. In general, the concentrations of these constituents showed no patterns with respect to distance from the shoreline or vertical gradients.

5. Comparing patterns of marine water chemistry constituents between the summer (August) and winter (January) samplings indicates substantially more mixing of the entire water column during the winter. Calm conditions (mainly from lack of long-period swells and breaking surf) that occurred during the summer resulted in substantially greater horizontal and vertical gradients of chemical materials that enter the ocean at the shoreline through groundwater efflux.

6. Scaling nutrient concentrations to salinity indicates that there is presently no external input of NO_3^- or PO_4^{3-} to the marine environment. Mixing analyses indicate that NH_4^+ is not being added to nearshore waters from activities on land.

7. Comparing measurements of water chemistry parameters to DOH standards reveals that NO_3^- exceeded specified criteria during January 1994 in only one instance. It is evident that natural inputs of groundwater can result in concentrations exceeding DOH limits since most of the concentrations above specific criteria occur at stations located near the shoreline where substantial groundwater input occurs.

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TABLE 1. Water chemistry measurements off Kaupulehu 4 lands collected January 16, 1994. Abbreviations as follows: S=surface; D=deep; DFS=distance from shore. Shaded value exceeds DOH criteria for open coastal waters under "wet" conditions. Well data from freshwater well near the KL4 area collected in March 1991. For sampling site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (μM)	NO3 (μM)	NH4 (μM)	Si (μM)	DOP (μM)	DON (μM)	TDP (μM)	TDN (μM)	TURB (NTU)	SALINITY (o/oo)	CHL a (μg/L)	TEMP (deg.C)
KL4-1	1S	0.1	0.13	0.22	0.08	2.71	0.18	5.17	0.31	5.47	0.19	34.827	0.35	24.8
	2S	2	0.12	0.19	0.05	2.66	0.19	5.33	0.31	5.57	0.22	34.828	0.41	24.8
	3S	5	0.11	0.16	0.05	2.47	0.20	5.48	0.31	5.69	0.20	34.836	0.23	24.8
	3D	5	0.10	0.17	0.06	2.66	0.19	5.62	0.29	5.85	0.23	34.834	0.26	24.7
	4S	10	0.16	0.21	0.13	2.40	0.16	5.68	0.32	6.02	0.21	34.845	0.24	24.8
	4D	10	0.11	0.20	0.13	3.06	0.17	5.82	0.28	6.15	0.20	34.825	0.22	24.8
	5S	50	0.11	0.21	0.09	2.53	0.18	5.76	0.29	6.06	0.24	34.835	0.19	24.8
	5D	50	0.12	0.18	0.10	2.73	0.17	5.61	0.29	5.89	0.17	34.835	0.17	24.8
	6S	100	0.13	0.15	0.11	2.88	0.14	5.50	0.27	5.76	0.19	34.833	0.20	24.8
	6D	100	0.12	0.02	0.10	1.72	0.15	5.48	0.27	5.60	0.16	34.859	0.17	24.8
KL4-2	1S	0.1	0.16	0.28	0.12	3.38	0.16	5.47	0.32	5.87	0.21	34.820	0.20	24.9
	2S	2	0.14	0.30	0.09	4.03	0.18	5.63	0.32	6.02	0.27	34.812	0.22	24.8
	3S	5	0.12	0.20	0.10	6.27	0.18	5.87	0.30	6.17	0.22	34.835	0.20	24.9
	3D	5	0.12	0.22	0.13	3.06	0.17	5.85	0.29	6.20	0.26	34.839	0.20	24.9
	4S	10	0.14	0.21	0.15	2.83	0.16	5.76	0.30	6.12	0.22	34.844	0.19	24.9
	4D	10	0.15	0.17	0.13	2.80	0.14	5.71	0.29	6.01	0.17	34.847	0.19	24.9
	5S	50	0.19	0.20	0.19	3.15	0.14	5.58	0.33	5.97	0.20	34.860	0.18	24.9
	5D	50	0.17	0.18	0.21	2.74	0.15	5.49	0.32	5.88	0.20	34.865	0.18	24.9
	6S	100	0.17	0.10	0.14	2.82	0.16	5.49	0.33	5.73	0.18	34.867	0.19	24.8
	6D	100	0.25	0.18	0.22	3.90	0.17	5.19	0.42	5.59	0.20	34.835	0.22	24.9
KL4-3	1S	0.1	0.37	1.15	0.17	13.91	0.18	5.10	0.55	6.42	0.32	34.646	0.33	24.7
	2S	2	0.16	0.94	0.20	9.76	0.16	5.19	0.32	6.33	0.31	34.703	0.32	24.9
	3S	5	0.21	0.68	0.20	8.08	0.14	5.30	0.35	6.18	0.30	34.746	0.31	24.8
	3D	5	0.17	0.63	0.17	7.66	0.13	5.46	0.30	6.26	0.32	34.753	0.35	24.7
	4S	10	0.15	0.68	0.25	6.85	0.14	5.72	0.29	6.65	0.29	34.775	0.28	24.8
	4D	10	0.26	0.52	0.31	5.50	0.16	5.86	0.42	6.69	0.23	34.810	0.26	24.9
	5S	50	0.20	0.45	0.23	6.25	0.17	5.92	0.37	6.60	0.29	34.804	0.23	24.9
	5D	50	0.19	0.19	0.27	3.20	0.18	5.83	0.37	6.29	0.21	34.883	0.24	24.9
	6S	100	0.19	0.11	0.21	2.78	0.19	5.83	0.38	6.15	0.19	34.886	0.26	25.0
	6D	100	0.14	0.09	0.32	2.10	0.18	5.26	0.32	5.67	0.17	34.911	0.23	24.9
KL4-4	1S	0.1	0.11	0.22	0.15	3.65	0.17	5.61	0.28	5.98	0.22	34.842	0.24	24.8
	2S	2	0.16	0.26	0.23	4.11	0.14	5.69	0.30	6.18	0.23	34.836	0.26	24.9
	3S	5	0.13	0.17	0.26	3.14	0.12	5.82	0.25	6.25	0.26	34.868	0.29	24.9
	3D	5	0.12	0.14	0.22	3.19	0.13	5.91	0.25	6.27	0.25	34.864	0.27	24.8
	4S	10	0.11	0.22	0.20	3.33	0.15	5.86	0.26	6.28	0.22	34.867	0.25	24.9
	4D	10	0.09	0.20	0.18	3.46	0.17	5.81	0.26	6.19	0.24	34.872	0.24	24.9
	5S	50	0.09	0.34	0.30	4.17	0.17	5.62	0.26	6.26	0.27	34.850	0.25	24.9
	5D	50	0.11	0.15	0.18	3.24	0.16	5.66	0.27	5.99	0.20	34.883	0.24	25.0
	6S	100	0.08	0.09	0.26	2.51	0.15	5.50	0.23	5.85	0.18	34.894	0.30	25.1
	6D	100	0.08	0.07	0.13	2.54	0.13	5.58	0.21	5.78	0.20	34.896	0.29	24.9
	WELL		5.26	140.40	0.21	1014	-	-	-	-	-	1.467	0.09	-
DOH WATER QUALITY STANDARDS														
NOT TO EXCEED 10%				1.00	0.61				1.29	17.86	1.25		0.90	
NOT TO EXCEED 2%				1.78	1.07				1.93	25.00	2.00		1.75	

TABLE 2. Water chemistry measurements (in μg/L) off Kaupulehu 4 lands collected January 16, 1994. Abbreviations as follows: S = surface; D = deep; DFS = distance from shore. Shaded value exceeds DOH criteria for open coastal waters under "wet" conditions. Well data from freshwater well near the KL4 area collected in March 1991. For sampling site locations, see Figure 1.

SITE	NO.	DFS (m)	PO4 (μg/L)	NO3 (μg/L)	NH4 (μg/L)	Si (μg/L)	DOP (μg/L)	DON (μg/L)	TDP (μg/L)	TDN (μg/L)	TURB (NTU)	SALINITY (o/oo)	CHL a (μg/L)	TEMP (deg.C)
KL4-1	1S	0.1	4.03	3.08	1.12	76.2	5.58	72.38	9.61	76.6	0.19	34.827	0.35	24.8
	2S	2	3.72	2.66	0.70	74.7	5.89	74.62	9.61	78.0	0.22	34.828	0.41	24.8
	3S	5	3.41	2.24	0.70	69.4	6.20	76.72	9.61	79.7	0.20	34.836	0.23	24.8
	3D	5	3.10	2.38	0.84	74.7	5.89	78.68	8.99	81.9	0.23	34.834	0.26	24.7
	4S	10	4.96	2.94	1.82	67.4	4.96	79.52	9.92	84.3	0.21	34.845	0.24	24.8
	4D	10	3.41	2.80	1.82	86.0	5.27	81.48	8.68	86.1	0.20	34.825	0.22	24.8
	5S	50	3.41	2.94	1.26	71.1	5.58	80.64	8.99	84.8	0.24	34.835	0.19	24.8
	5D	50	3.72	2.52	1.40	76.7	5.27	78.54	8.99	82.5	0.17	34.835	0.17	24.8
	6S	100	4.03	2.10	1.54	80.9	4.34	77.00	8.37	80.6	0.19	34.833	0.20	24.8
	6D	100	3.72	0.28	1.40	48.3	4.65	76.72	8.37	78.4	0.16	34.859	0.17	24.8
KL4-2	1S	0.1	4.96	3.92	1.68	95.0	4.96	76.58	9.92	82.2	0.21	34.820	0.20	24.9
	2S	2	4.34	4.20	1.26	113.2	5.58	78.82	9.92	84.3	0.27	34.812	0.22	24.8
	3S	5	3.72	2.80	1.40	176.2	5.58	82.18	9.30	86.4	0.22	34.835	0.20	24.9
	3D	5	3.72	3.08	1.82	86.0	5.27	81.90	8.99	86.8	0.26	34.839	0.20	24.9
	4S	10	4.34	2.94	2.10	79.5	4.96	80.64	9.30	85.7	0.22	34.844	0.19	24.9
	4D	10	4.65	2.38	1.82	78.7	4.34	79.94	8.99	84.1	0.17	34.847	0.19	24.9
	5S	50	5.89	2.80	2.66	88.5	4.34	78.12	10.23	83.6	0.20	34.860	0.18	24.9
	5D	50	5.27	2.52	2.94	77.0	4.65	76.86	9.92	82.3	0.20	34.865	0.18	24.9
	6S	100	5.27	1.40	1.96	79.2	4.96	76.86	10.23	80.2	0.18	34.867	0.19	24.8
	6D	100	7.75	2.52	3.08	109.6	5.27	72.66	13.02	78.3	0.20	34.835	0.22	24.9
KL4-3	1S	0.1	11.47	16.10	2.38	390.9	5.58	71.40	17.05	89.9	0.32	34.646	0.33	24.7
	2S	2	4.96	13.16	2.80	274.3	4.96	72.66	9.92	88.6	0.31	34.703	0.32	24.9
	3S	5	6.51	9.52	2.80	227.0	4.34	74.20	10.85	86.5	0.30	34.746	0.31	24.8
	3D	5	5.27	8.82	2.38	215.2	4.03	76.44	9.30	87.6	0.32	34.753	0.35	24.7
	4S	10	4.65	9.52	3.50	192.5	4.34	80.08	8.99	93.1	0.29	34.775	0.28	24.8
	4D	10	8.06	7.28	4.34	154.6	4.96	82.04	13.02	93.7	0.23	34.810	0.26	24.9
	5S	50	6.20	6.30	3.22	175.6	5.27	82.88	11.47	92.4	0.29	34.804	0.23	24.9
	5D	50	5.89	2.66	3.78	89.9	5.58	81.62	11.47	88.1	0.21	34.883	0.24	24.9
	6S	100	5.89	1.54	2.94	78.1	5.89	81.62	11.78	86.1	0.19	34.886	0.26	25.0
	6D	100	4.34	1.26	4.48	59.0	5.58	73.64	9.92	79.4	0.17	34.911	0.23	24.9
KL4-4	1S	0.1	3.41	3.08	2.10	102.6	5.27	78.54	8.68	83.7	0.22	34.842	0.24	24.8
	2S	2	4.96	3.64	3.22	115.5	4.34	79.69	9.29	86.6	0.23	34.836	0.26	24.9
	3S	5	4.03	2.38	3.64	88.2	3.72	81.48	7.75	87.5	0.26	34.868	0.29	24.9
	3D	5	3.72	1.96	3.08	89.6	4.03	82.74	7.75	87.8	0.25	34.864	0.27	24.8
	4S	10	3.41	3.08	2.80	93.6	4.65	82.04	8.06	87.9	0.22	34.867	0.25	24.9
	4D	10	2.79	2.80	2.52	97.2	5.27	81.34	8.06	86.7	0.24	34.872	0.24	24.9
	5S	50	2.79	4.76	4.20	117.2	5.27	78.68	8.06	87.6	0.27	34.850	0.25	24.9
	5D	50	3.41	2.10	2.52	91.0	4.96	79.24	8.37	83.9	0.20	34.883	0.24	25.0
	6S	100	2.48	1.26	3.64	70.5	4.65	77.00	7.13	81.9	0.18	34.894	0.30	25.1
	6D	100	2.48	0.98	1.82	71.4	4.03	78.12	6.51	80.9	0.20	34.896	0.29	24.9
WELL			163.06	1966	2.94	28493	-	-	-	-	-	1.467	0.09	-
DOH WATER QUALITY STANDARDS														
NOT TO EXCEED 10%				14.00	8.50				40.00	250.0	1.25		0.90	
NOT TO EXCEED 2%				25.00	15.00				60.00	350.0	2.00		1.75	

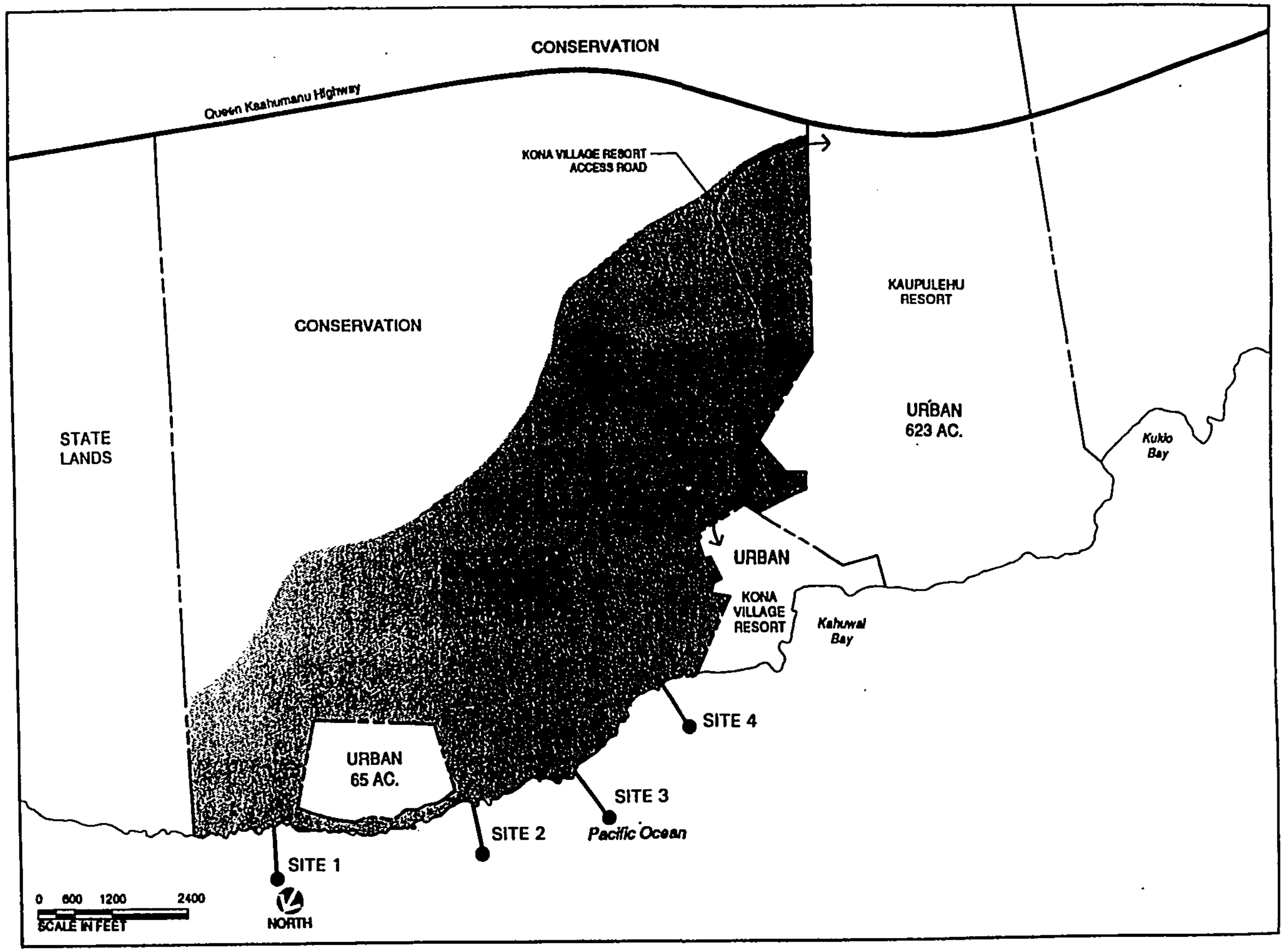


FIGURE 1. Map showing location of Kaupulehu Lot 4 property (shaded) and transect site locations for water chemistry baseline sampling.

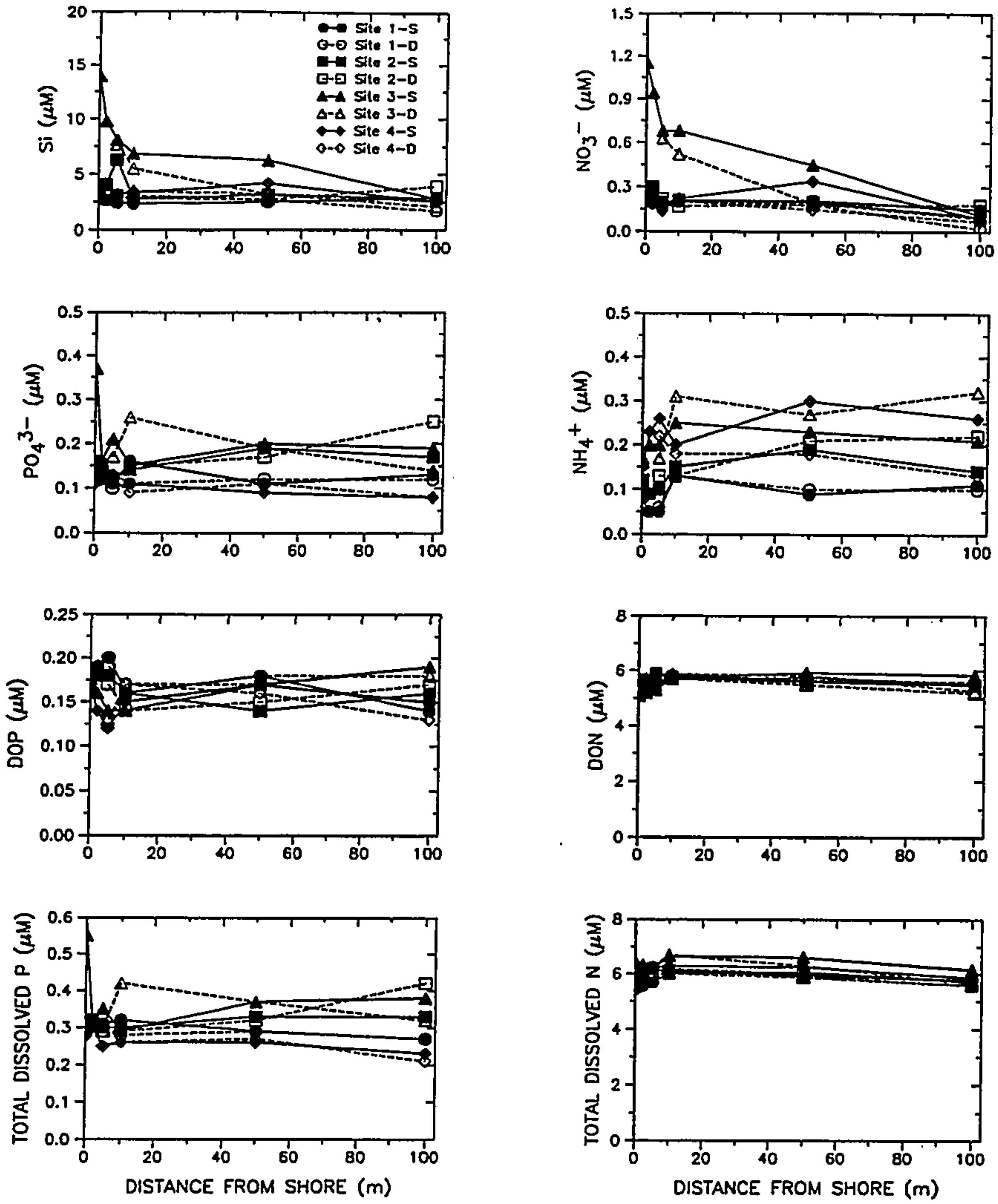


FIGURE 2. Plots of dissolved nutrient constituents collected from surface (S) and deep (D) samples off the Kaupulehu 4 project area in January 1994 as functions of distance from shore on sampling transects shown in Figure 1.

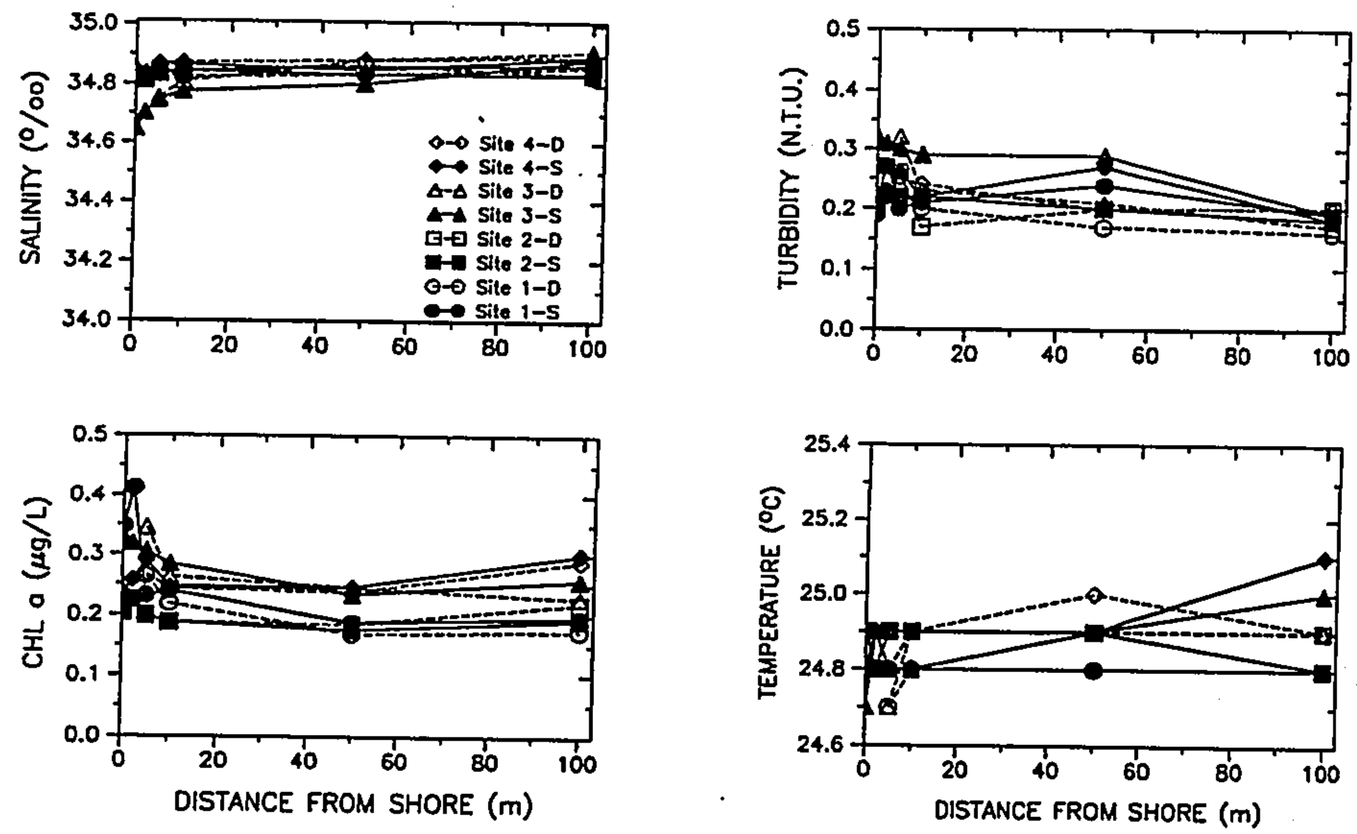


FIGURE 3. Plots of water chemistry constituents collected from surface (S) and deep (D) samples off the Kaupulehu 4 project area in January 1994 as functions of distance from shore on sampling transects shown in Figure 1.

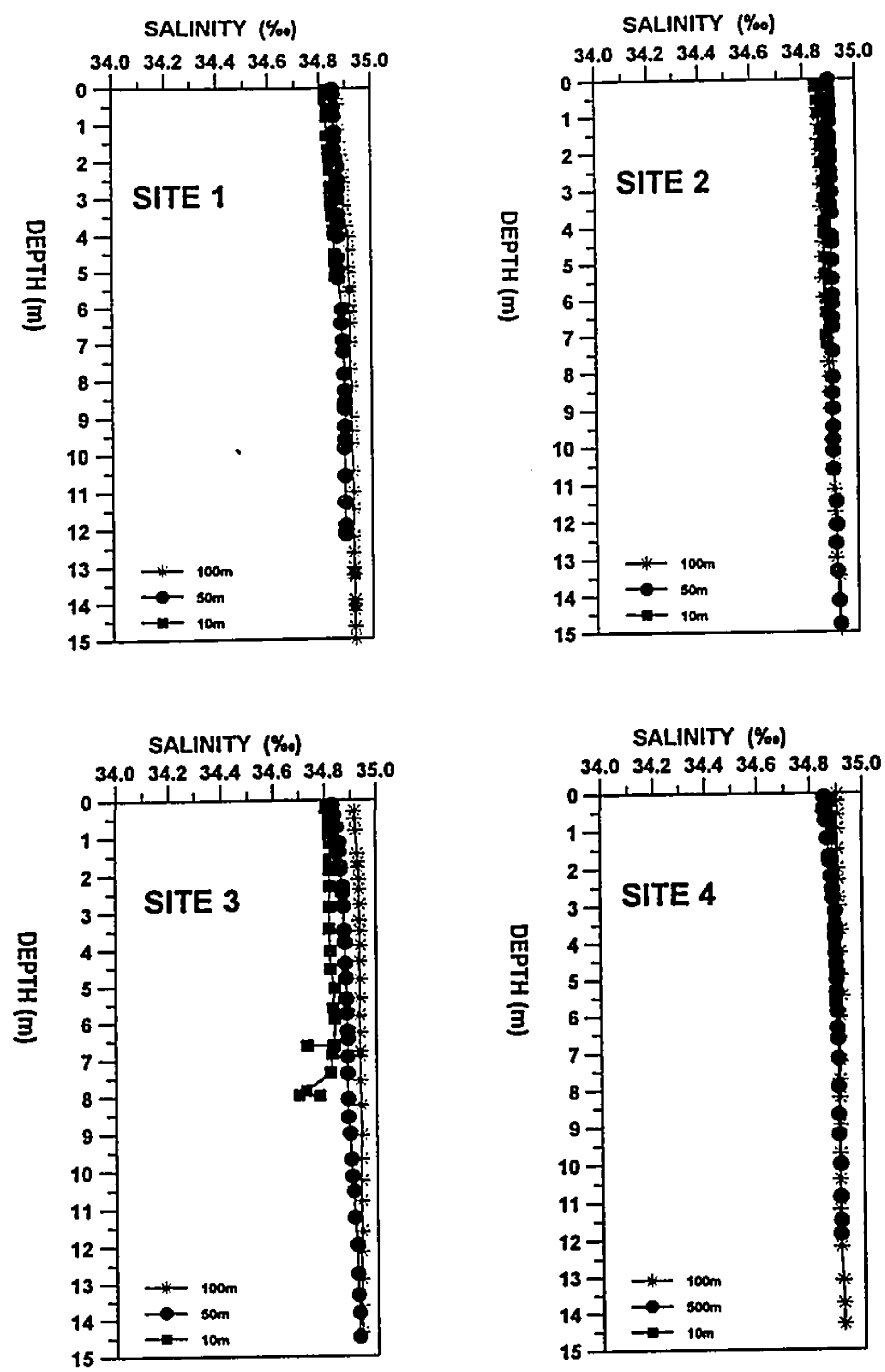


FIGURE 4. Continuous vertical profiles of salinity from sampling stations 10 to 100 m from shore at each of four sites offshore of the Kaupulehu 4 project area collected on January 16, 1994. For site locations, see Figure 1.

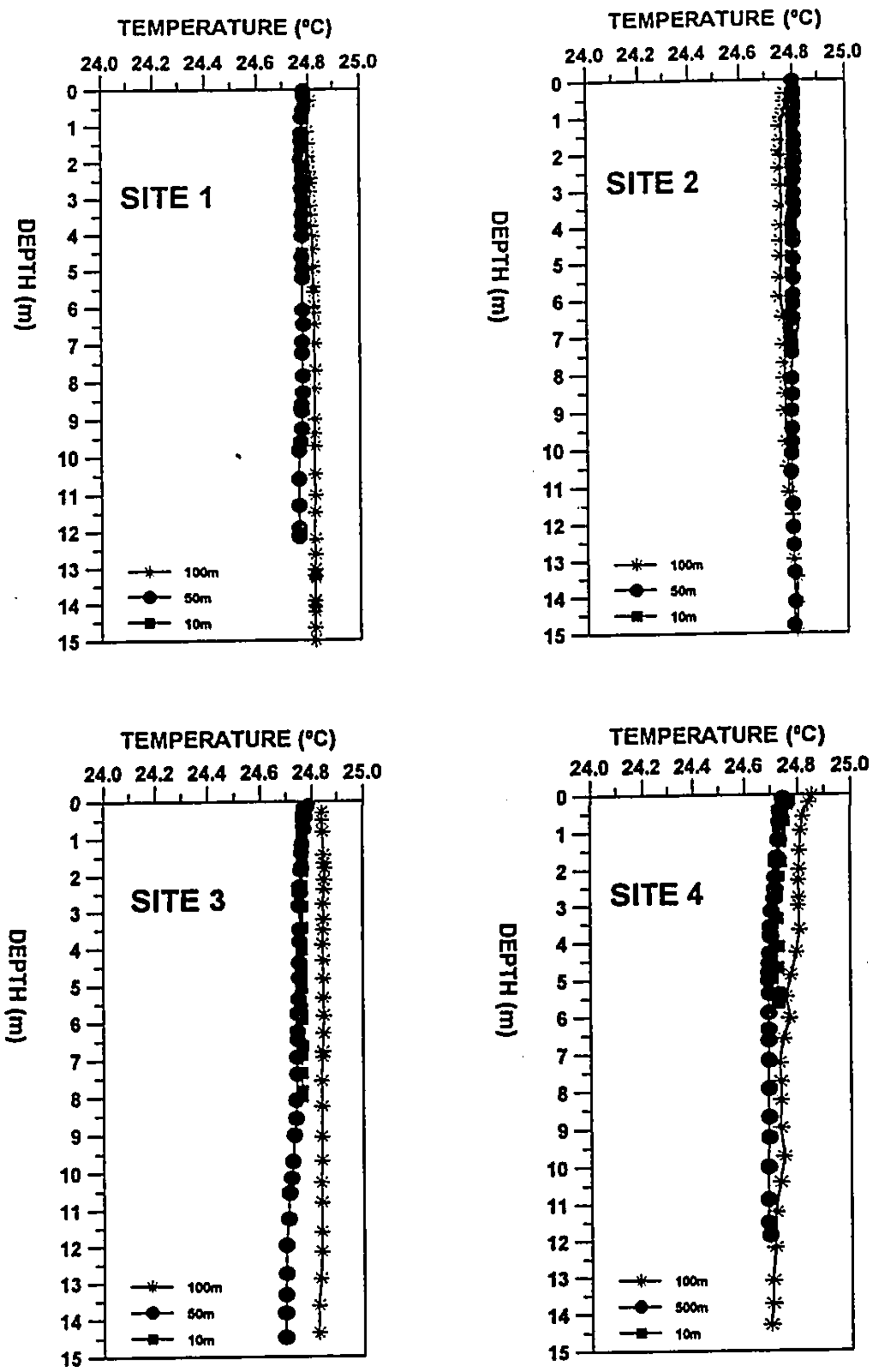


FIGURE 5. Continuous vertical profiles of temperature from sampling stations 10 to 100 m from shore at each of four sites offshore of the Kaupulehu 4 project area collected on January 16, 1994. For site locations, see Figure 1.

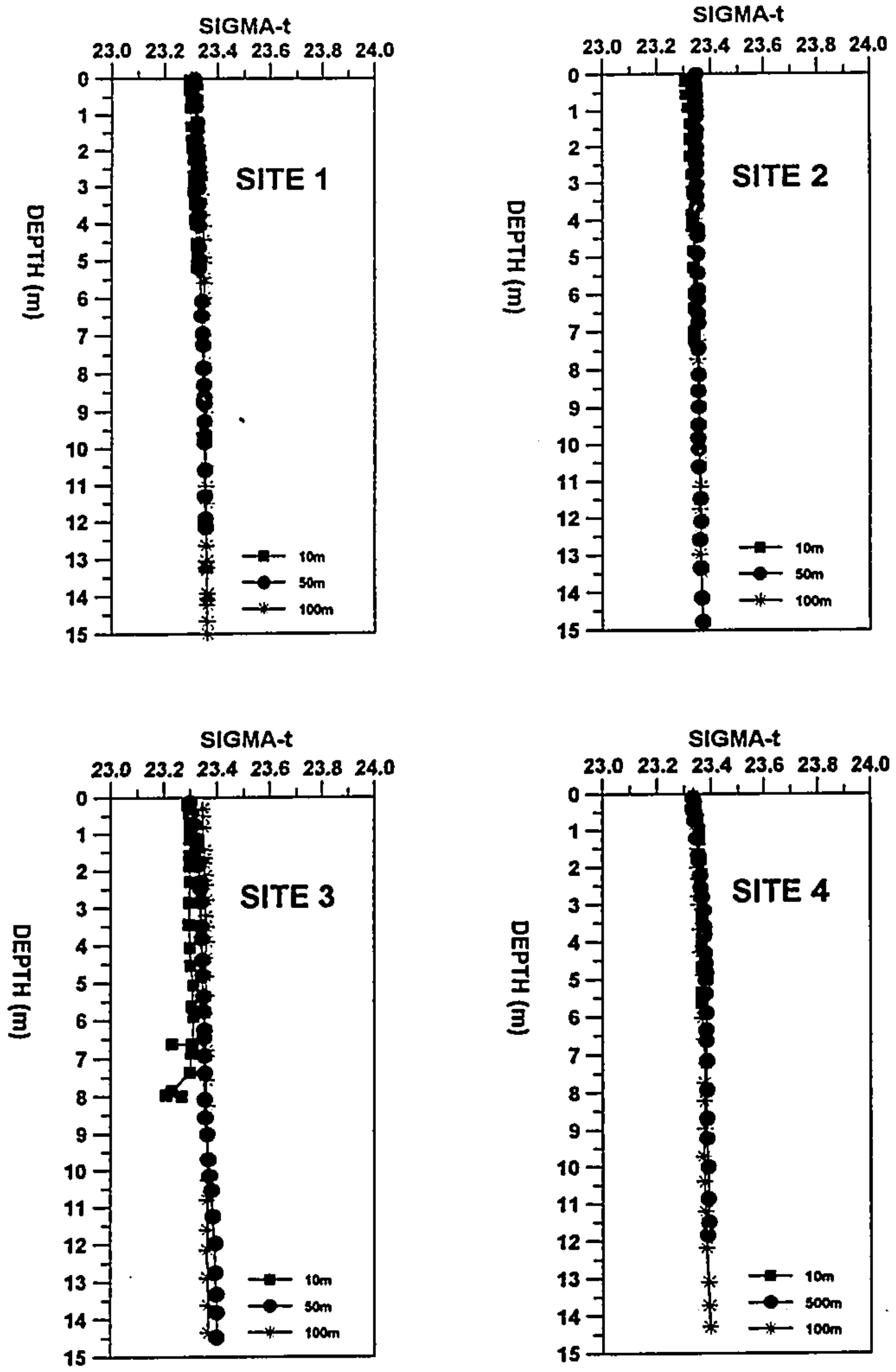


FIGURE 6. Continuous vertical profiles of sigma-t from sampling stations 10 to 100 m from shore at each of four sites offshore of the Kaupulehu 4 project area collected on January 16, 1994. For site locations, see Figure 1.

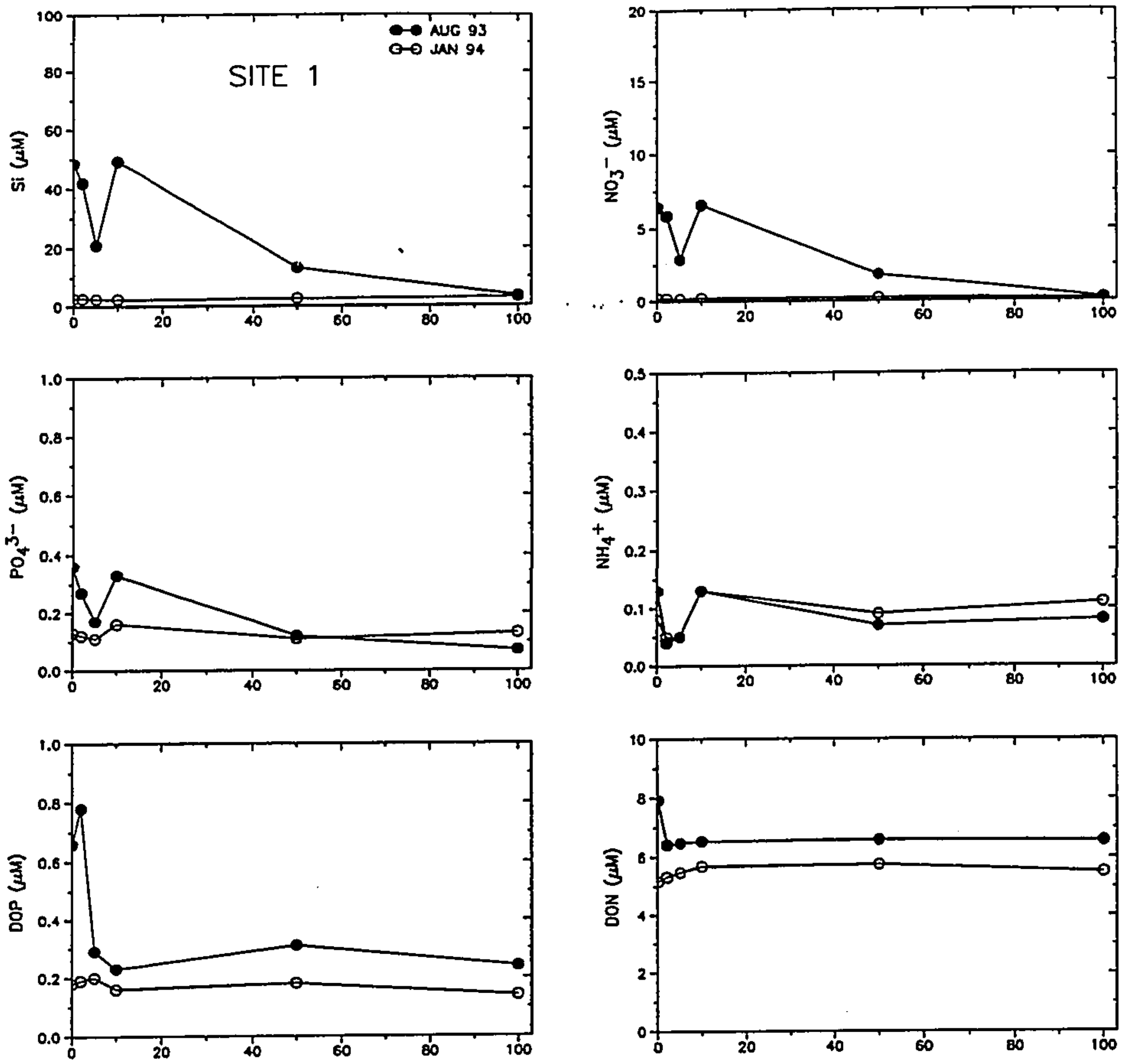


FIGURE 7. Plots of surface water dissolved nutrients as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 1 offshore of the Kaupulehu 4 project area. For location of Site 1, see Figure 1.

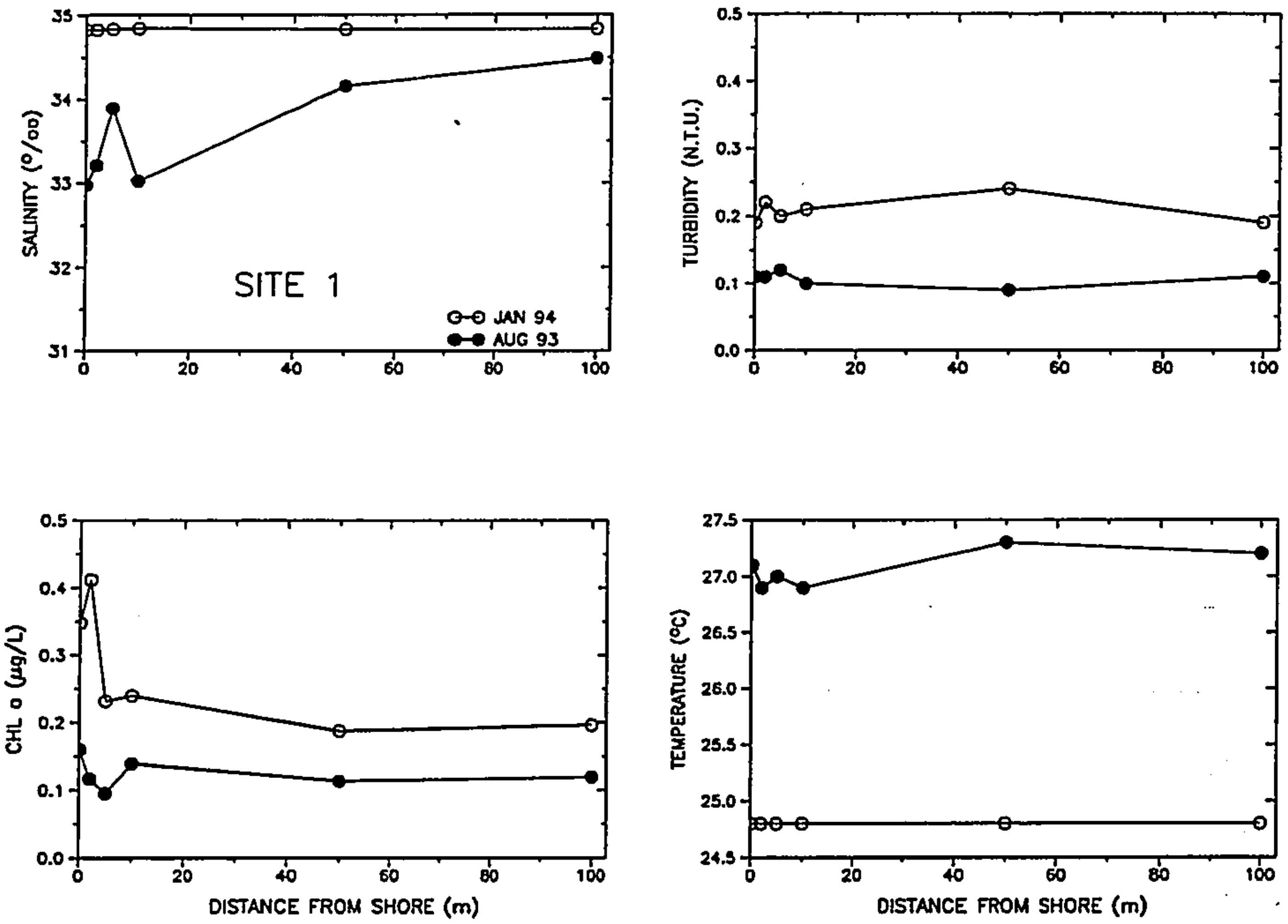


FIGURE 8. Plots of surface water chemistry constituents as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 1 offshore of the Kaupulehu 4 project area. For location of Site 1, see Figure 1.

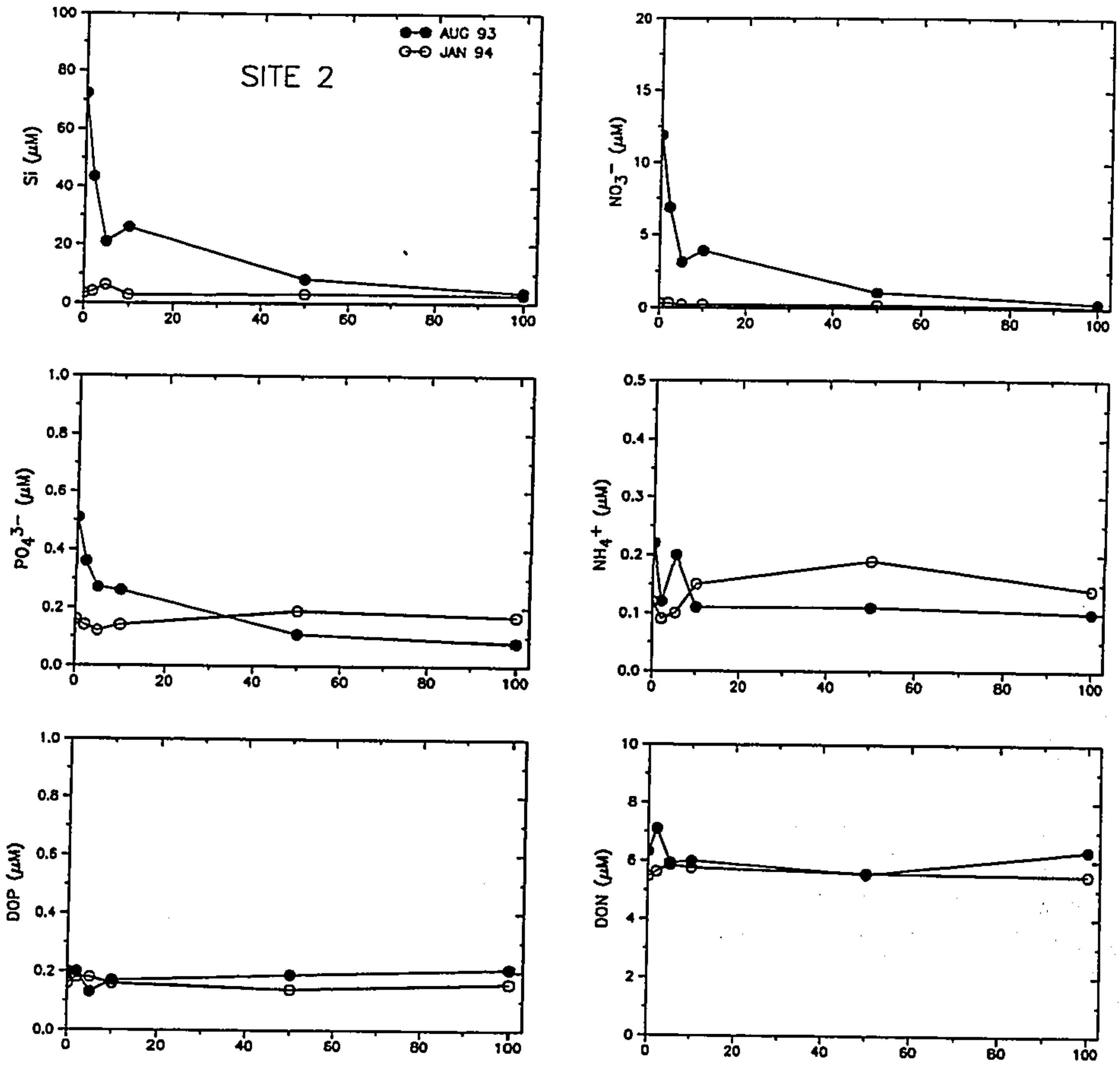


FIGURE 9. Plots of surface water dissolved nutrients as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 2 offshore of the Kaupulehu 4 project area. For location of Site 2, see Figure 1.

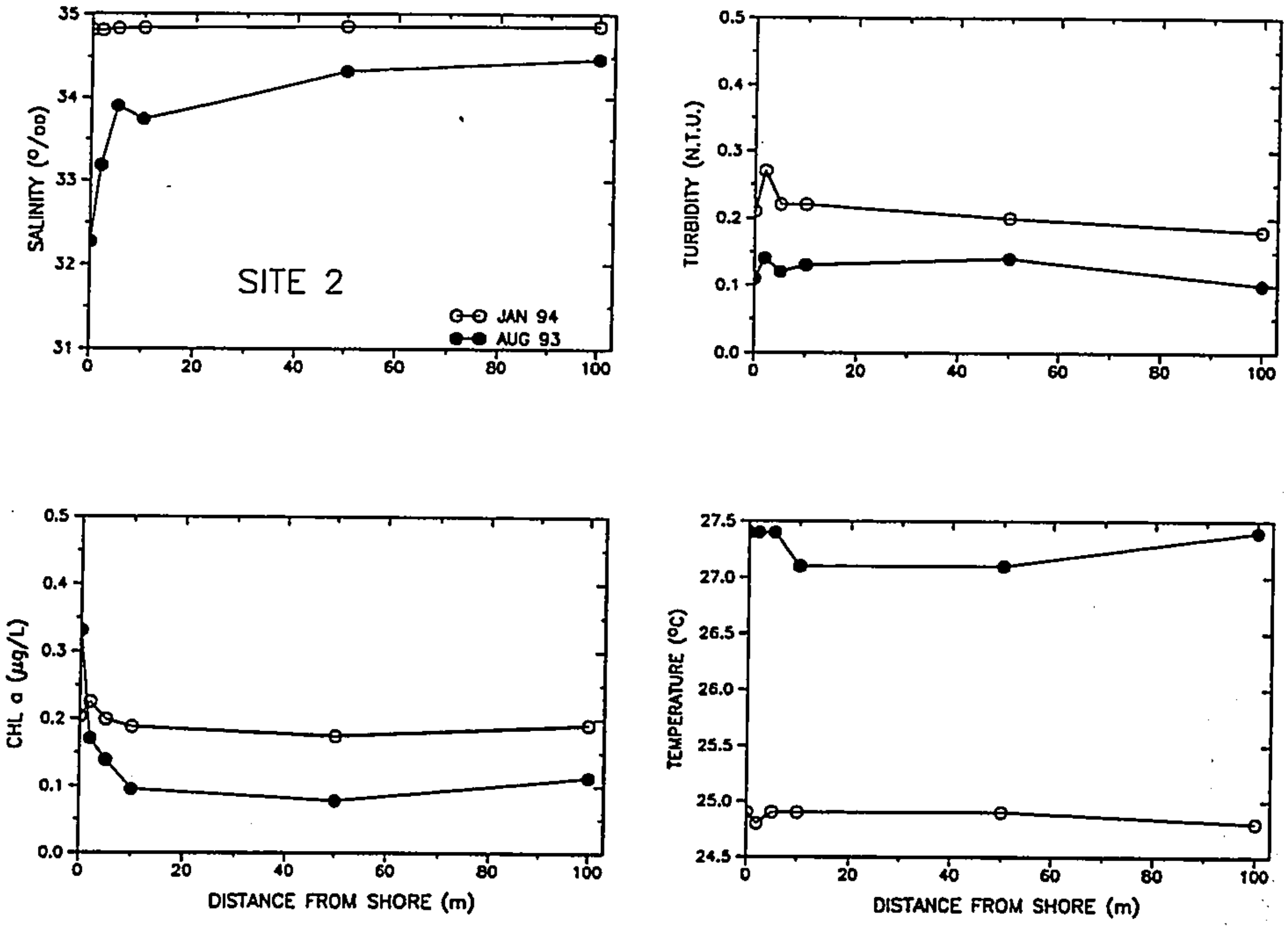


FIGURE 10. Plots of surface water chemistry constituents as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 2 offshore of the Kaupulehu 4 project area. For location of Site 2 see Figure 1.

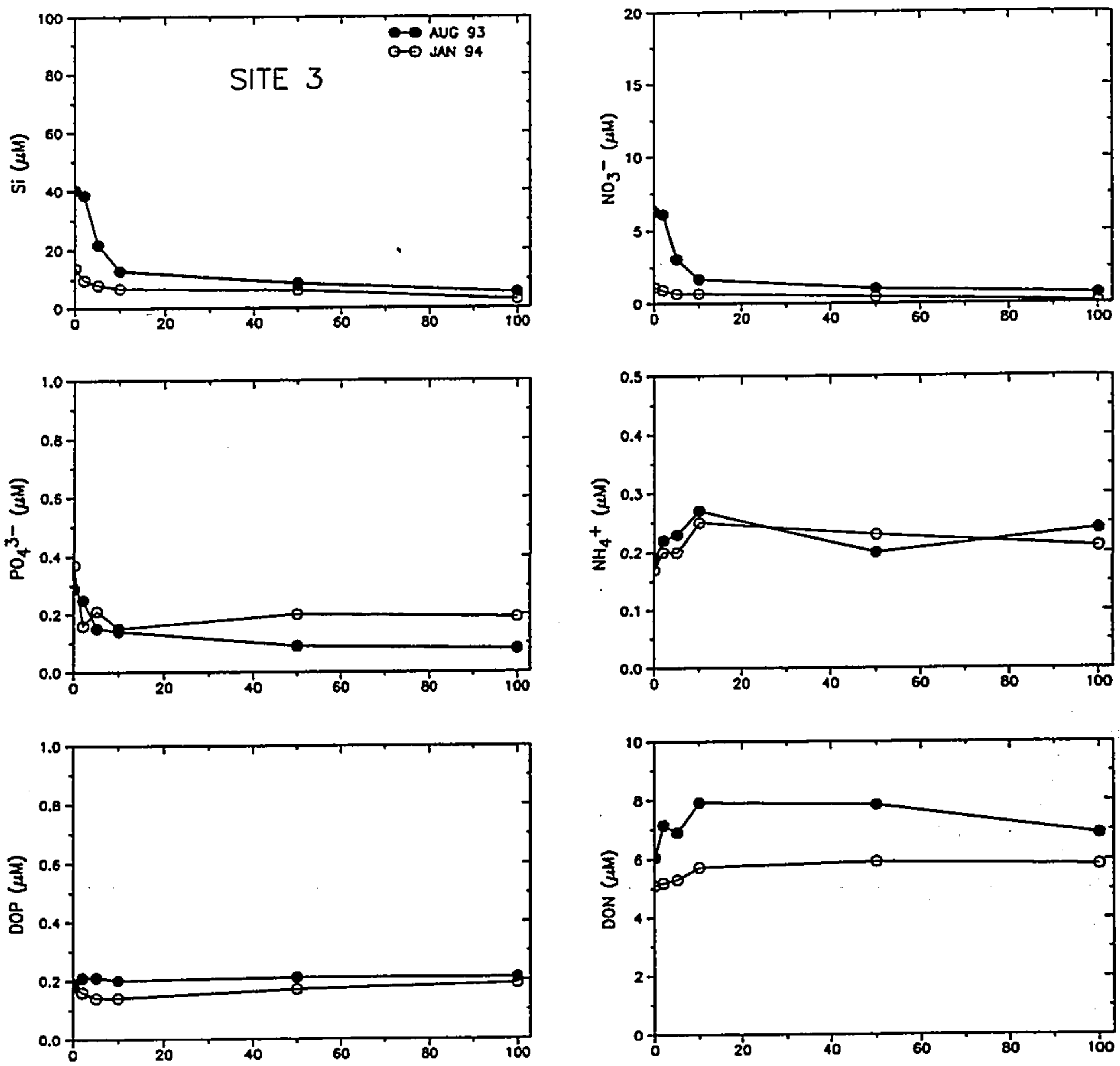


FIGURE 11. Plots of surface water dissolved nutrients as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 3 offshore of the Kaupulehu 4 project area. For location of Site 3, see Figure 1.

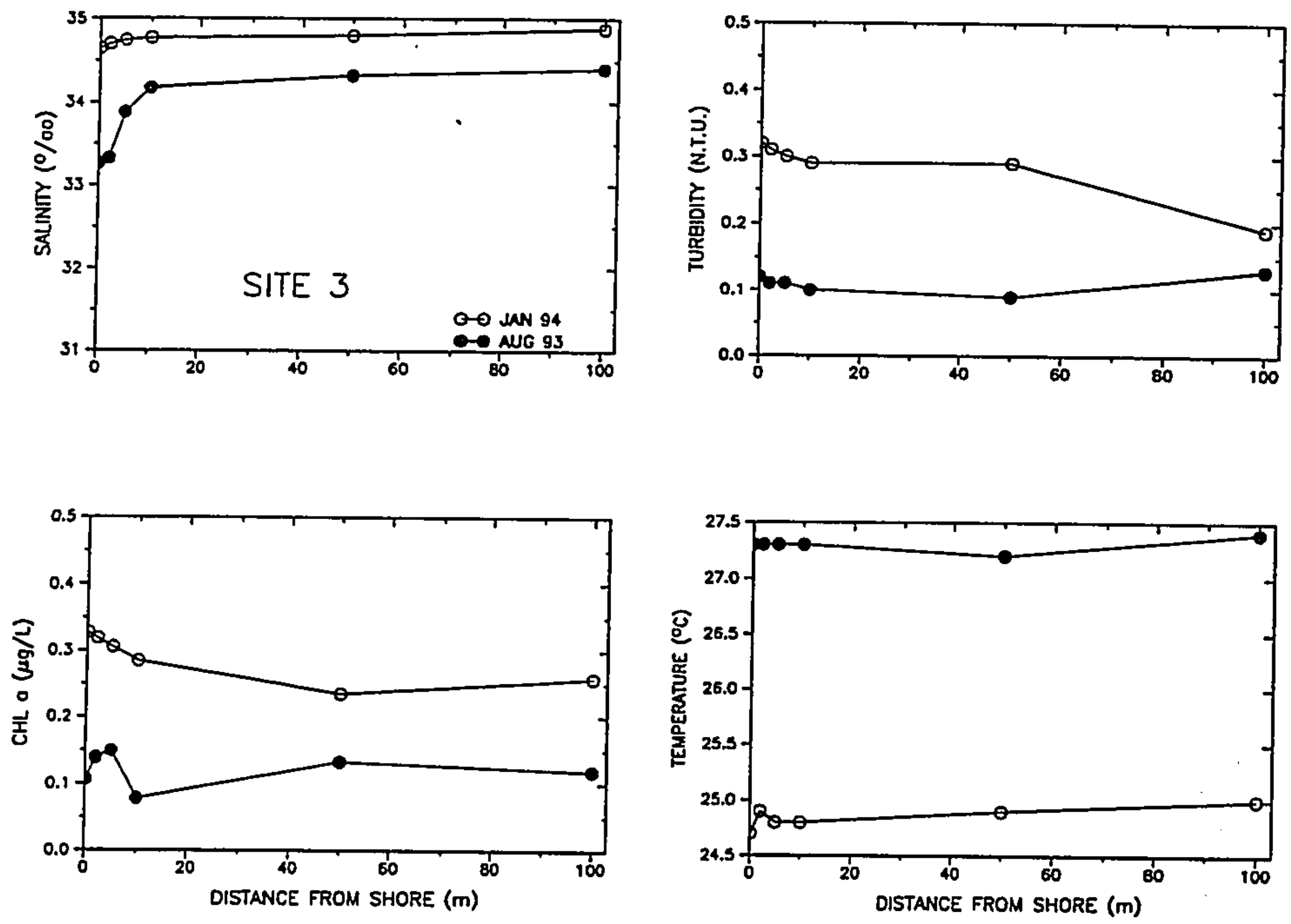


FIGURE 12. Plots of surface water chemistry constituents as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 3 offshore of the Kaupulehu 4 project area. For location of Site 3, see Figure 1.

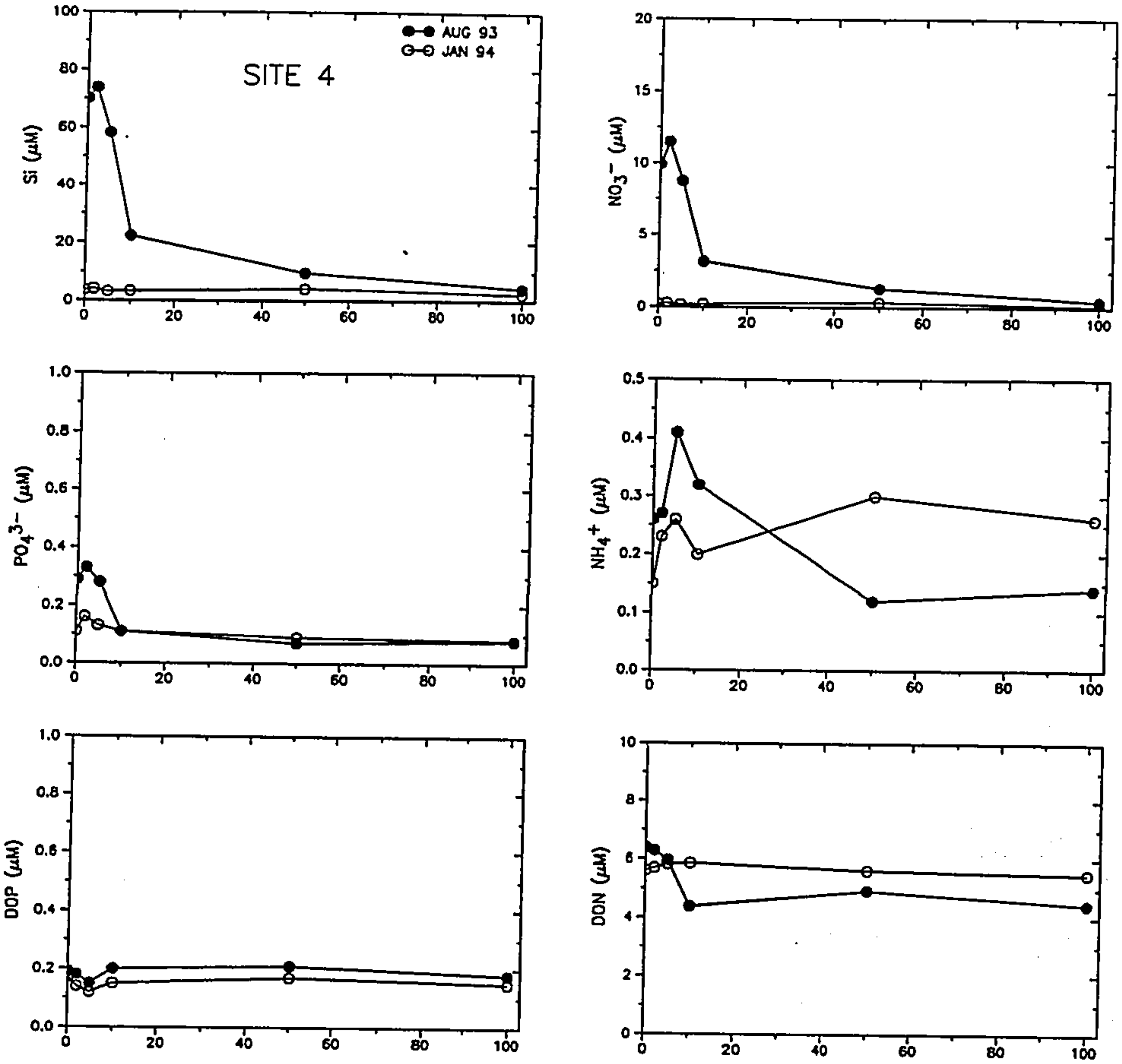


FIGURE 13. Plots of surface water dissolved nutrients as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 4 offshore of the Kaupulehu 4 project area. For location of Site 4, see Figure 1.

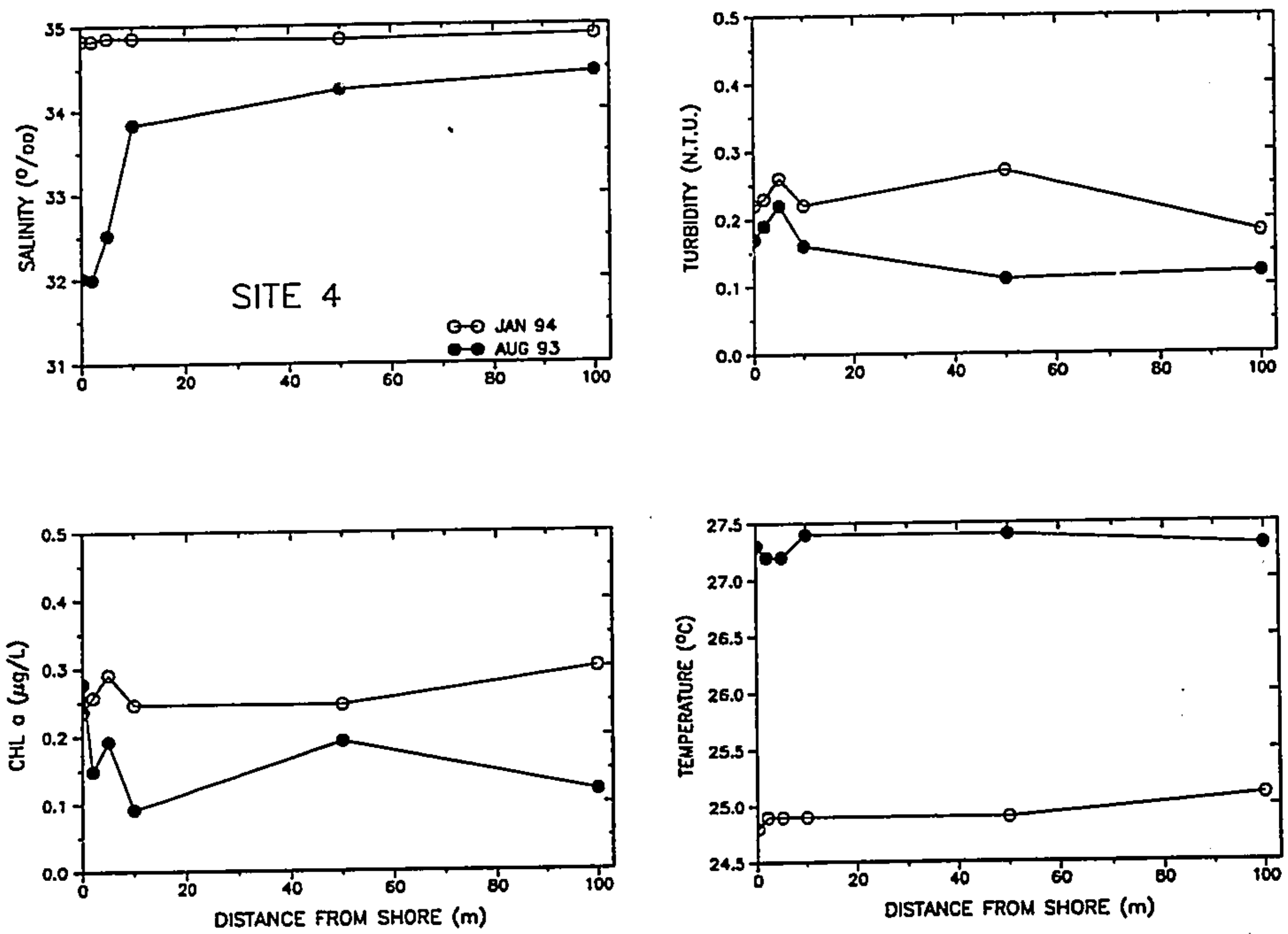


FIGURE 14. Plots of surface water chemistry constituents as functions of distance from the shoreline for the monitoring surveys conducted since August 1993 at Site 4 offshore of the Kaupulehu 4 project area. For location of Site 4, see Figure 1.

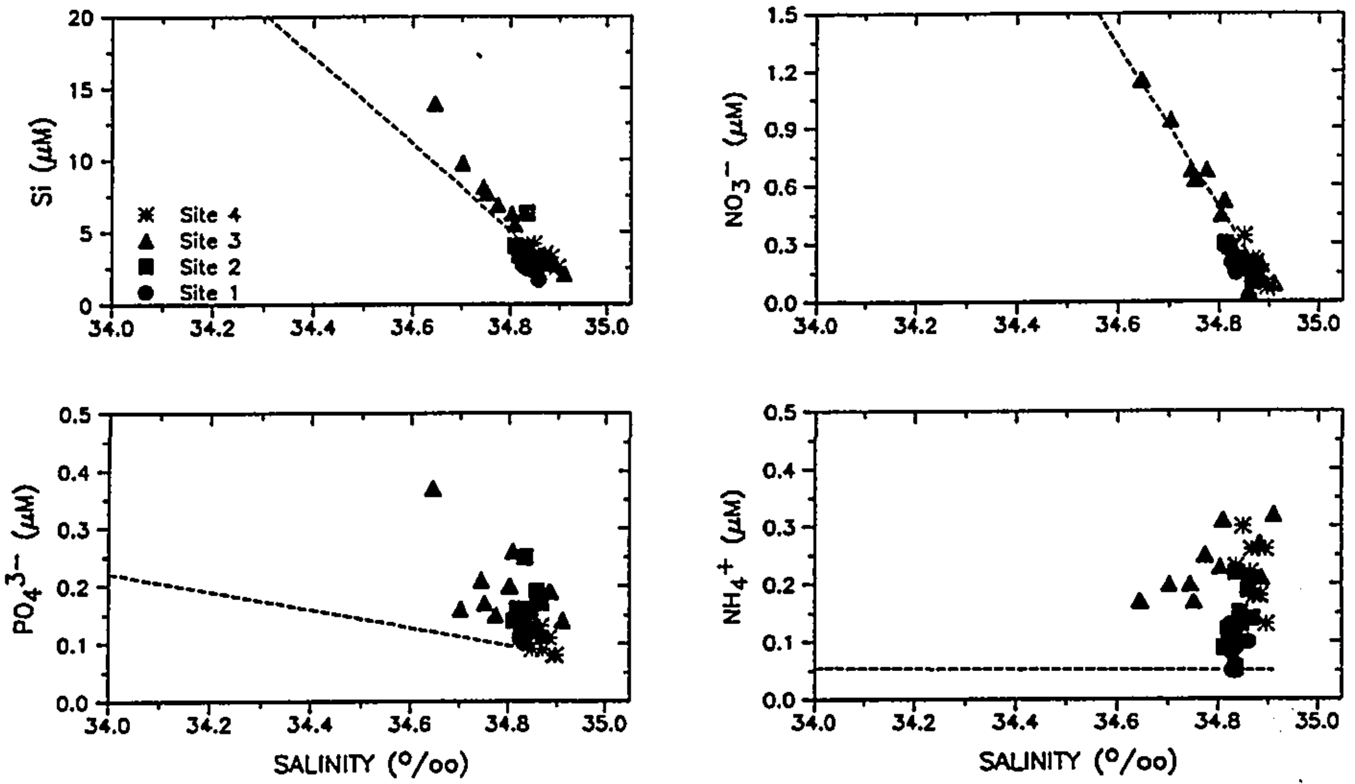


FIGURE 15. Plots of dissolved nutrients from water samples collected in January 1994 at four sites offshore of the Kaupulehu project area as functions of salinity. Solid line is the conservative mixing line constructed by connecting endpoint concentrations of open ocean water and well water.

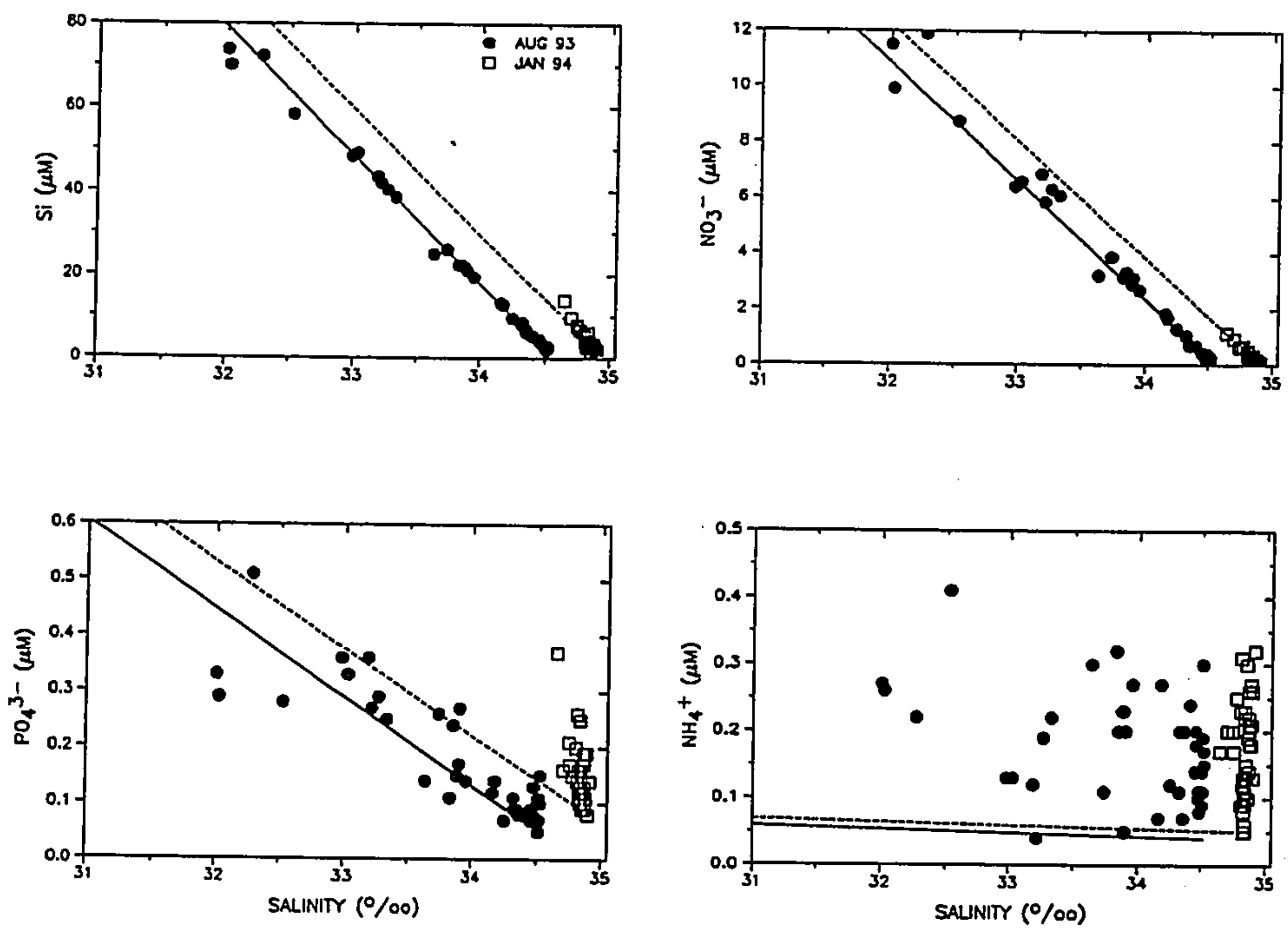
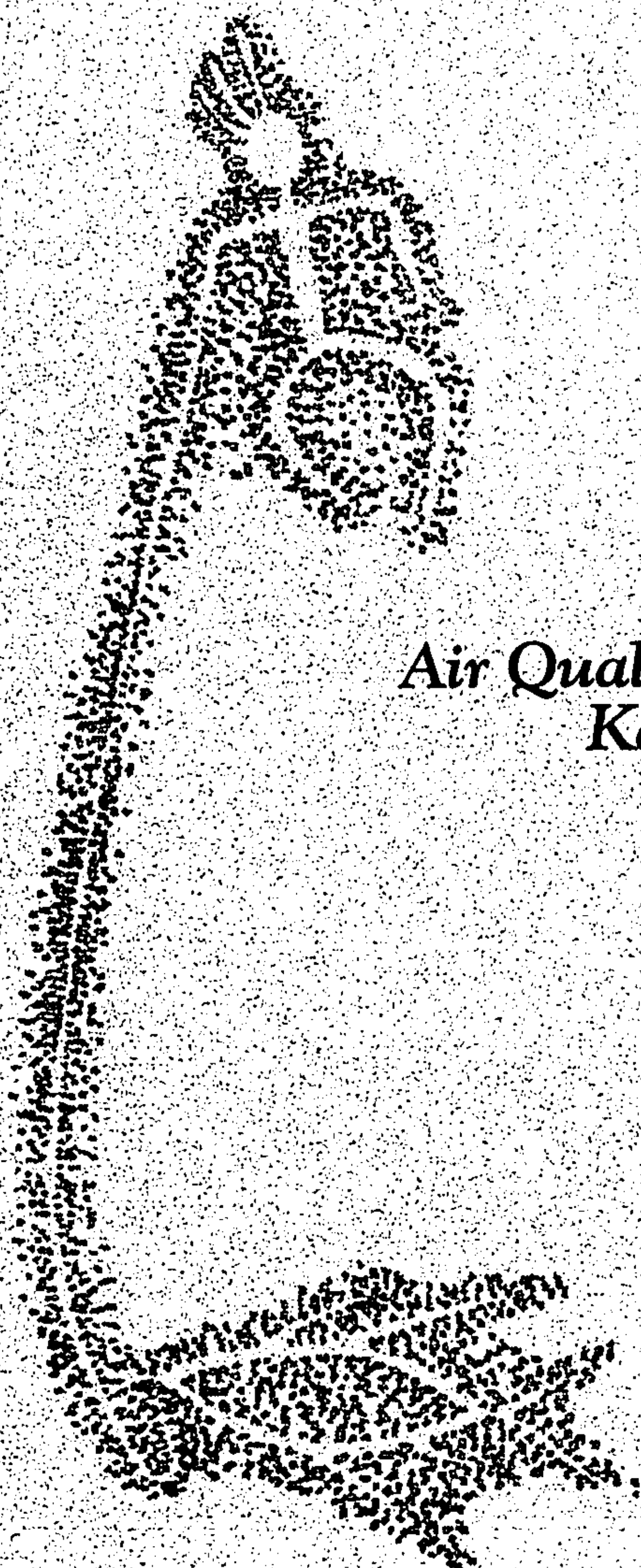


FIGURE 16. Plots of dissolved nutrients versus salinity for all water samples collected during summer (August 1993) and winter (January 1994) monitoring surveys offshore of the Kaupulehu Lot 4 project area. Straight lines are conservative mixing lines constructed by connecting endpoint concentrations of water from a well located upslope of the project area and ocean water collected in August (solid line) and January (dashed line).



Appendix C

Air Quality Impact Report (AQIR), Kaupulehu Resort Expansion

AIR QUALITY IMPACT REPORT
(AQIR)

KAUPULEHU RESORT EXPANSION

15 June 1994

PREPARED FOR:

Belt Collins Hawaii
Honolulu, Hawaii

PREPARED BY:

J. W. MORROW
Environmental Management Consultant
Honolulu, Hawaii

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1. INTRODUCTION

Kaupulehu Developments, a Hawaii general partnership, is proposing to expand its Kaupulehu Resort in North Kona on the island of Hawaii (Figure 1) with a second phase which will have a more residential focus than the original phase. The major elements of the Kaupulehu Resort Expansion include:

- two 18-hole golf courses
- 500 resort condominiums
- 530 single family residential dwellings
- 45,000 ft^2 of commercial space

The site is currently undeveloped and largely covered with a'a lava from the 1800 eruption of Hualalai (Figure 2).

The purpose of this report is to assess the impact of the proposed development on air quality on a local and regional basis. The overall project can be considered an "indirect source" of air pollution as defined in the federal Clean Air Act [1] since its primary association with air quality is due to its inherent generation of mobile source, i.e., motor vehicle, activity. Much of the focus of this analysis, therefore, is on the project's ability to generate traffic and the resultant impact on air quality. Air quality impact was evaluated for existing (1993) and future (2015) conditions.

A project such as this also has offsite impacts due to increased demand for electrical energy which must be met by the combustion of some type of fuel. This combustion process results in pollutant emissions to the air which have been addressed in the report.

Finally, during construction of the various buildings and facilities air pollutant emissions will be generated onsite and offsite due to vehicular movement, grading, concrete and asphalt batching, and general dust-generating construction activities. These impacts have also been addressed.

2. AIR QUALITY STANDARDS

A summary of State of Hawaii and national ambient air quality standards is presented in Table 1 [2, 3]. Note that Hawaii's standards are not divided into primary and secondary standards as are the federal standards.

FIGURE 1

PROJECT LOCATION

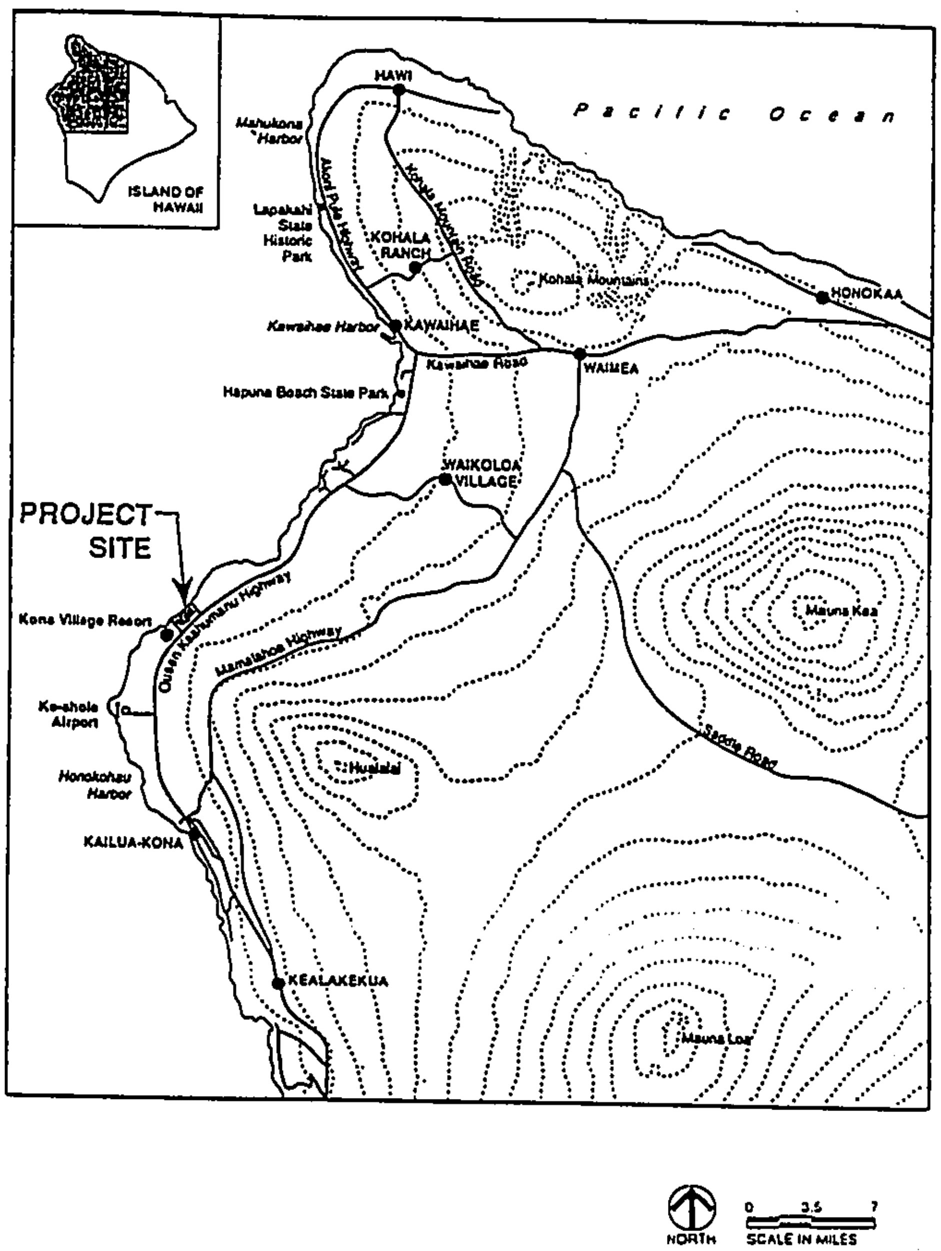
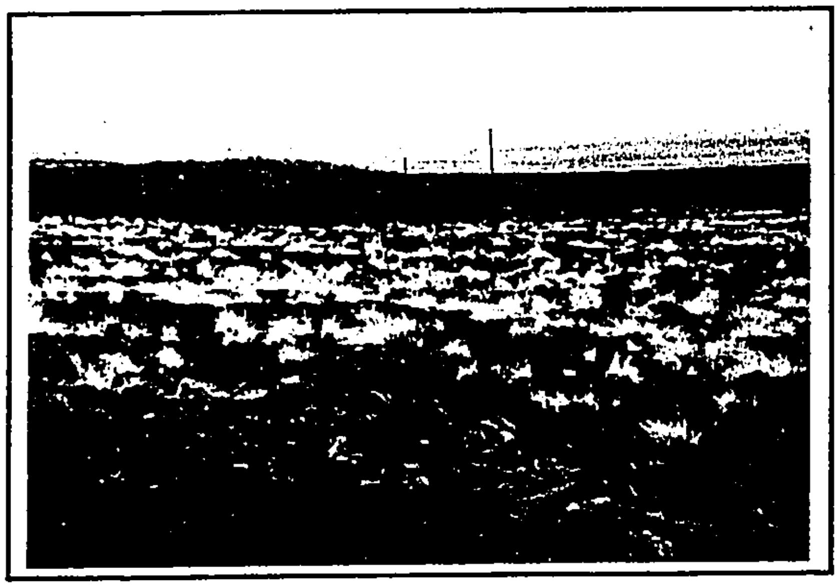


FIGURE 2

EXISTING SITE CONDITIONS
MAY 1994

Facing northwest across A'a lava from Queen Kaahumanu Highway



Facing West From Queen Kaahumanu Highway

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	SAMPLING PERIOD	NAAQS PRIMARY	NAAQS SECONDARY	STATE STANDARDS
PM_{10}	Annual	50	50	50
	24-hr	150	150	150
SO_2	Annual	80	---	80
	24-hr	365	---	365
	3-hr	---	1,300	1,300
NO_2	Annual	100	---	70
CO	8-hr	10	---	5
		40	---	10
O_3	1-hr	235	---	100
H_2S	1-hr	---	---	35
Pb	Calendar Quarter	1.5	---	1.5

KEY:
- TSP - total suspended particulate matter
- PM_{10} - particulate matter < 10 microns
- SO_2 - sulfur dioxide
- NO_2 - nitrogen dioxide
- CO - carbon monoxide
- O_3 - ozone
- Pb - lead

All concentrations in micrograms per cubic meter ($\mu g/m^3$) except CO which is in milligrams per cubic meter (mg/m^3).

Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [4].

Some of Hawaii's standards (CO, NO_2, and O_3) are clearly more stringent than their federal counterparts but, like their federal counterparts, may be exceeded once per year. It should also be noted that in November 1993, the Governor signed amendments to Chapter 59, Ambient Air Quality Standards [3], adopting the federal standard for particulate matter equal to or less than 10 microns in diameter (PM_{10}). Since measurement data in Hawaii indicate that PM_{10} comprises about 50% of total suspended particulate matter (TSP), the adoption of that federal standard with a numerical value equal to the original state TSP standard of 150 $\mu g/m^3$ represents a substantial relaxation of the standard (approximately doubling it).

In the case of the automotive pollutants [carbon monoxide (CO), oxides of nitrogen (NOx), and photochemical oxidants (Ox)], there are only primary standards. Until 1983, there was also a hydrocarbons standard which was based on the precursor role hydrocarbons play in the formation of photochemical oxidants rather than any unique toxicological effect they had at ambient levels. The hydrocarbons standard was formally eliminated in January, 1983 [5].

The U.S. Environmental Protection Agency (EPA) is mandated by Congress to periodically review and re-evaluate the federal standards in light of new research findings [1]. The last review resulted in the relaxation of the oxidant standard from 160 to 235 micrograms/cubic meter (ug/m^3) [6]. The carbon monoxide (CO), particulate matter, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) standards have been reviewed, but no new standards were proposed.

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [7]. There simply can be no visible emissions from fugitive dust sources.

3. EXISTING AIR QUALITY

3.1 General. The State Department of Health maintains a limited network of air monitoring stations around the state to gather data on the following regulated pollutants:

- particulate matter $\leq$ 10 microns (PM_{10})

- o total suspended particulate matter (TSP)
- o sulfur dioxide (SO_2)
- o carbon monoxide (CO)
- o ozone (O_3

In the case of PM_{10} and SO_2, measurements are made on a 24-hour basis to correspond with the averaging period specified in State and Federal standards. Samples are collected once every six days in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide and ozone, however, are measured on a continuous basis due to their short-term (1-hour) standards. Lead concentrations are determined from the TSP samples which are sent to an EPA laboratory for analysis. It should also be noted that the majority of these pollutants are monitored only in Honolulu.

3.2 Department of Health Monitoring. Since 1985 when the State Department of Health reduced its monitoring network on the Neighbor Islands, there has been no permanent air monitoring of regulated pollutants in Hilo or West Hawaii. However, due to public concern about volcanic air pollution, i.e., VOG, a special monitoring study was conducted during the 1985 - 1986 period in Kailua-Kona. The results of that study are presented in Table 2 and indicate very low levels of total suspended particulate matter (TSP) and sulfur dioxide (SO_2). Both State and Federal air quality standards appear to be met.

Unfortunately, and despite the growing population in Kona, the principal mobile source pollutants, carbon monoxide (CO), and nitrogen dioxide (NO_2) are not routinely monitored in West Hawaii.

3.3 Other Air Quality Data. Analysis of the airborne particulate matter during the 1983 eruption revealed some rather interesting results as unusually high concentrations of selenium, arsenic, indium, gold, and sulfur were found along with strikingly high concentrations of iridium [8]. A more recent 12-month study in West Hawaii has identified sulfates as the chief component of inhalable particles in the volcanic aerosol, comprising approximately 40%. Most metals were found at trace levels [9].

As suggested by the above references to VOG, the worst air pollution episodes experienced in Hawaii County are due to the infrequent and unpredictable volcanic eruptions. While volcanic emissions are somewhat variable and have not been fully characterized, it is well known that visibility is affected by the

TABLE 2

PM_{10} AND SO_2 MONITORING DATA
KAILUA-KONA, HAWAII
1985 - 1986

Mo/Yr	PM_{10}				SO_2			
	No.	Min	Max	Mean	No.	Min	Max	Mean
Sep 85	5	07	10	08	5	<5	<5	<5
Oct 85	5	07	20	14	5	<5	<5	<5
Nov 85	5	06	11	09	5	<5	<5	<5
Dec 85	5	06	18	12	5	<5	<5	<5
Jan 86	5	04	16	13	5	<5	<5	<5
Feb 86	5	06	26	15	5	<5	<5	<5
Mar 86	5	09	20	14	5	<5	<5	<5
Apr 86	4	10	15	13	4	<5	<5	<5
May 86	5	12	17	13	5	<5	<5	<5
Jun 86	5	12	20	15	5	<5	5	<5
Jul 86	5	13	25	18	5	<5	12	6
Aug 86	5	18	28	22	5	<5	<5	<5
ANNUAL	59	04	28	14	57	<5	12	<5

SOURCE: State of Hawaii
Department of Health

presence of fine particulates resulting directly from volcanic activity as well as secondarily from forest fires caused by lava flows.

3.4 Onsite Carbon Monoxide Sampling. In conjunction with this study, air sampling was conducted in May 1994, along Queen Kaahumanu Highway in the Kaupulehu area. The sampling site was within 10 meters of the road edge on the mauka(east) side. A continuous carbon monoxide (CO) instrument was set up and operated during the a.m. and p.m. peak traffic hours. An anemometer and vane were installed to record onsite surface winds during the air sampling. A simultaneous manual count of traffic was also performed. The variability of each of the parameters measured during the peak hours is clearly seen in Figures 3 and 4.

Onsite weather conditions during the afternoon of 25 May 1994 were strong northeasterly winds with a neutral atmosphere. Traffic counts were somewhat lower than the peak values reported in the latest traffic assessment [10]. CO concentrations were of the same order of magnitude as the computer-predicted concentrations discussed in Section 6 of this report, i.e., < 10 mg/m^3.

On the morning of 26 May 1994, winds were less than 5 mph and generally southerly in direction. Atmospheric stability was neutral throughout most of the time but gradually became slightly unstable as the sun rose. Traffic counts were again comparable to the traffic assessment [10], and the CO level was again low, i.e., less than 5 mg/m^3.

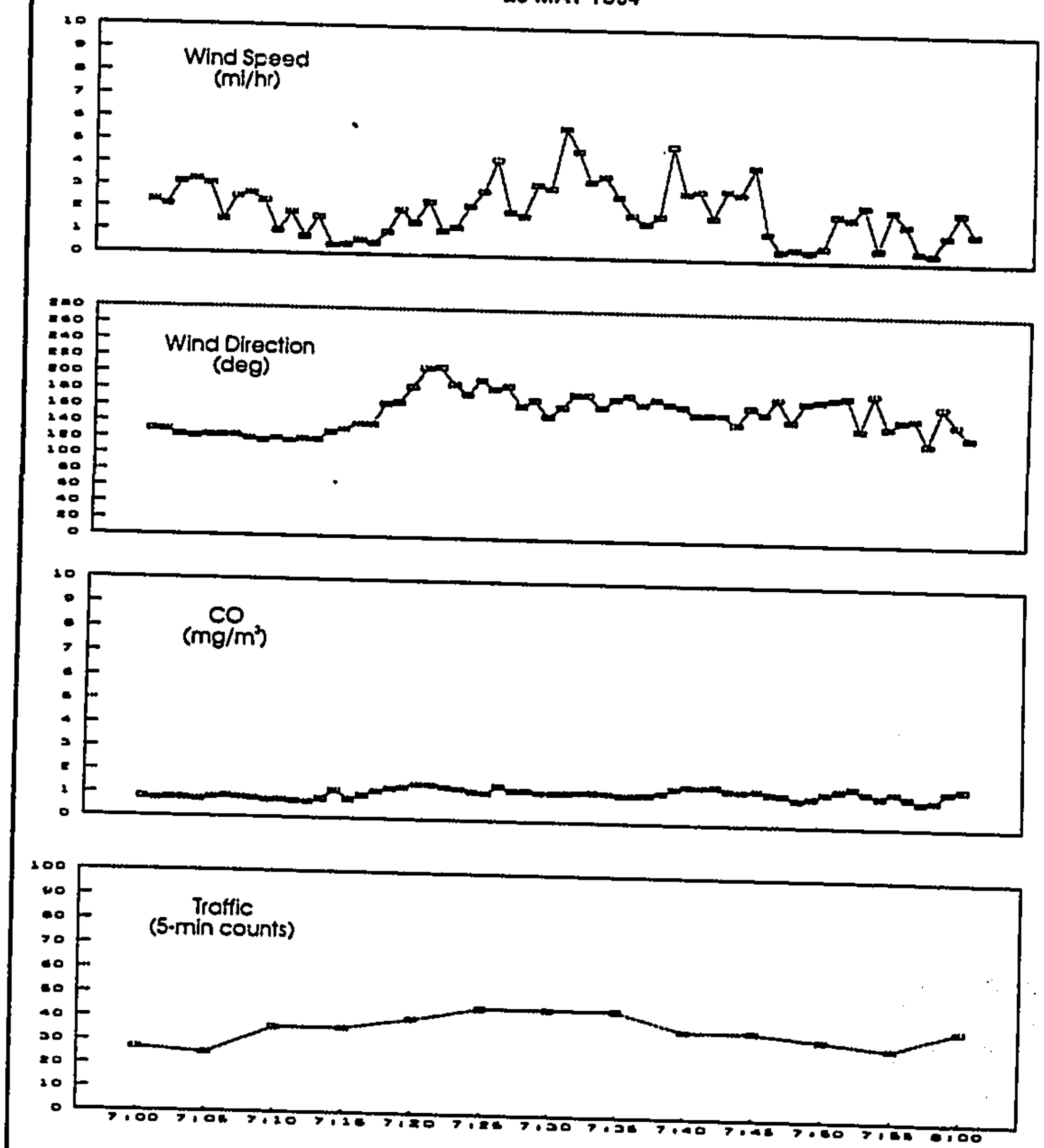
4. CLIMATE AND METEOROLOGY

4.1 Temperature and Rainfall. The project area is typical of Hawaii's climate with little seasonal or diurnal temperature variation. Monthly temperature averages vary by only about 6 degrees from the warmest months (July and August) to the coolest (January and February) [11]. Table 3 provides typical temperature data.

The 1991 precipitation data from nearby Keahole Point indicate a rather dry area with an annual rainfall less than 10 inches (Table 3). As in most of Hawaii, the winter months tend to be wet and summer months dry. With this temperature and rainfall profile, the area has a Thornwaite precipitation/evaporation (P/E) index of about 10.6 [12] indicating an arid climate. It should be noted, however, that, according to the National Weather Service, rainfall in 1991 was 12.04 inches below the long-term norm.

FIGURE 3

A.M. PEAK HOUR CONDITIONS
QUEEN KAAHUMANU HIGHWAY
26 MAY 1994



LOCAL TIME

FIGURE 4

P.M. PEAK HOUR CONDITIONS
QUEEN KAAHUMANU HIGHWAY
25 MAY 1994

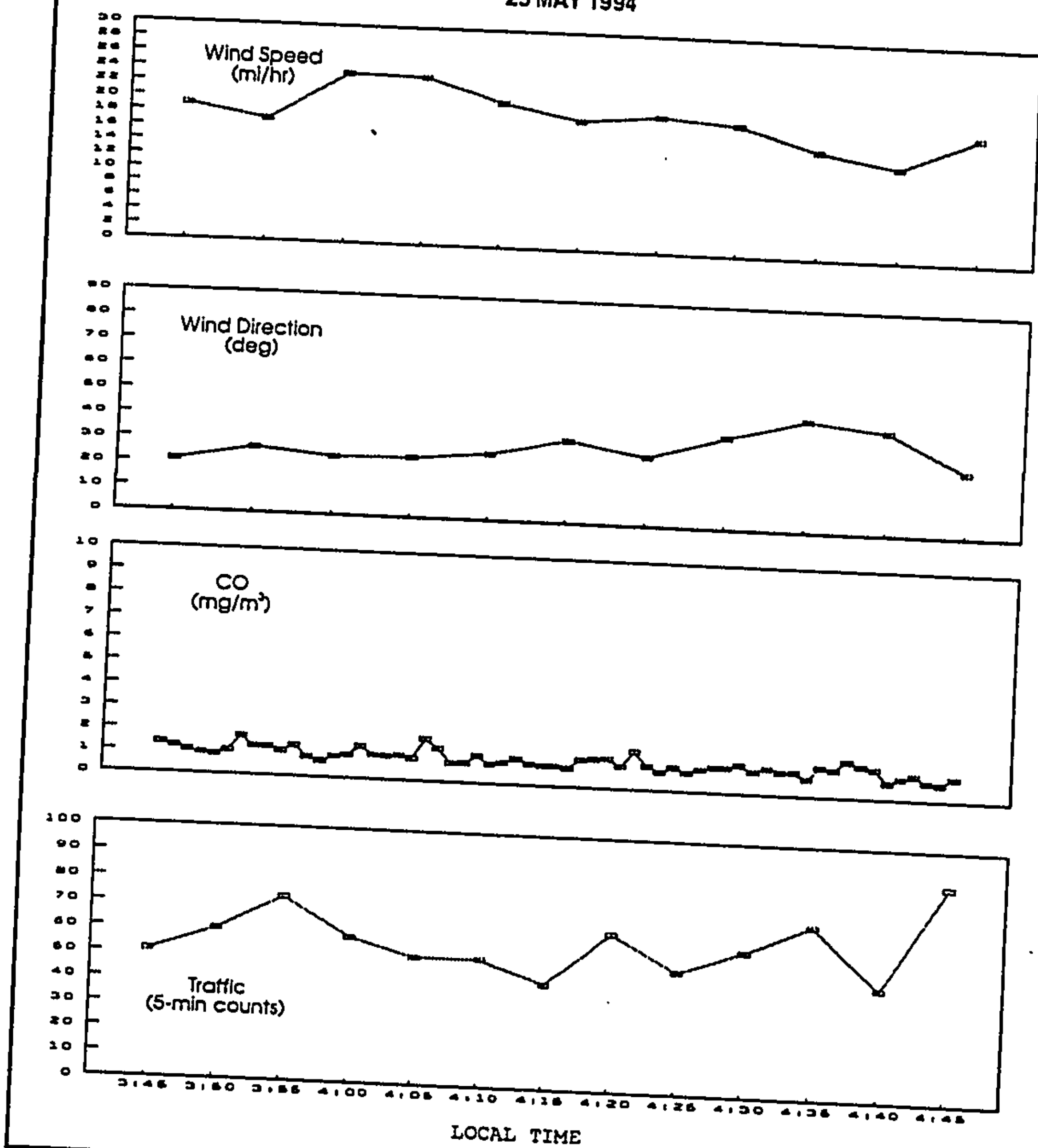


TABLE 3

TYPICAL TEMPERATURE AND RAINFALL DATA

Month	Temperature (° F)	Rainfall (inches)
January	73.1	2.60
February	72.9	0.09
March	73.8	1.38
April	76.7	0.00
May	77.0	0.40
June	78.3	0.40
July	78.3	1.83
August	79.1	0.20
September	77.7	0.83
October	77.3	0.23
November	75.4	0.14
December	73.8	1.03
ANNUAL	76.1	9.13

Notes:

1. Temperature data based on a 1974 summary of the National Oceanographic and Atmospheric Administration (NOAA) [11].
2. Rainfall data from Keahole Point, Hawaii (1991).

4.2 Surface Winds. One year (1973) of surface wind observations from the old Kona Airport located several miles south of Kaupulehu had been previously collected and reduced to produce various wind roses [13]. The annual wind rose (Figure 5) gives a clear indication of the dominance of onshore winds (SSW to WSW) whereas most other locations in Hawaii show a predominance of ENE trade winds. There also appears to be a seasonal variation with the winter months, typified by January, showing a greater diversity of wind direction (Figure 6) as compared to August where there is a greater frequency of the onshore SSW to WSW winds (Figure 7).

5. SHORT-TERM IMPACTS

5.1 Onsite Impacts. The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along Queen Kaahumanu Highway as well as in the vicinity of the project site itself. Because of the moderate level of existing traffic volumes, the additional construction vehicle traffic should not exceed road capacities although the presence of large trucks can reduce a roadway's capacity as well as lower average travel speeds. The site preparation and earth moving will create particulate emissions as will building and onsite road construction. Construction vehicles movement on unpaved on-site roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and a precipitation/evaporation (P/E) index of 50 [12,14].

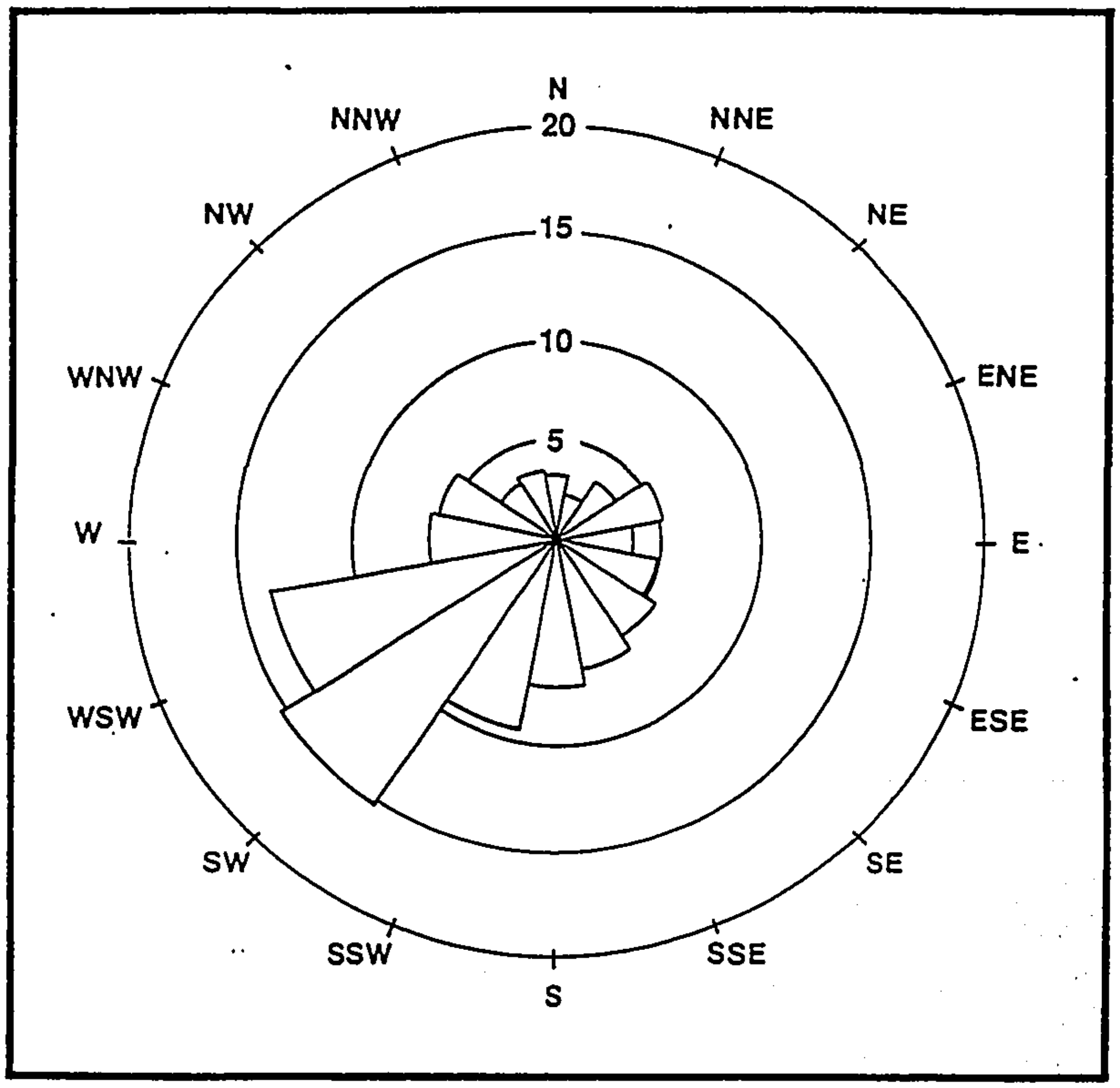
Since the site is currently lava covered with little or no exposed soil, soil will be brought to the site. Some of these soils are likely to have silt contents greater than the 30% cited above. In conjunction with the arid local climate (P/E Index 12), this suggests a potential for somewhat greater fugitive dust emissions.

5.2 Offsite Impacts. In addition to the onsite impacts attributable to construction activity, there will also be offsite impacts due to the operation of concrete and asphalt concrete batching plants needed for construction. It is too early, however, to identify the specific facilities that will be providing these materials and thus the discussion of air quality impacts is somewhat generic.

It was possible, however, to estimate ambient air impact using design and operating features of a typical concrete batching plant. This plant (Rex Transit Mix Batch Plant, Model LO GO 5)

FIGURE 5

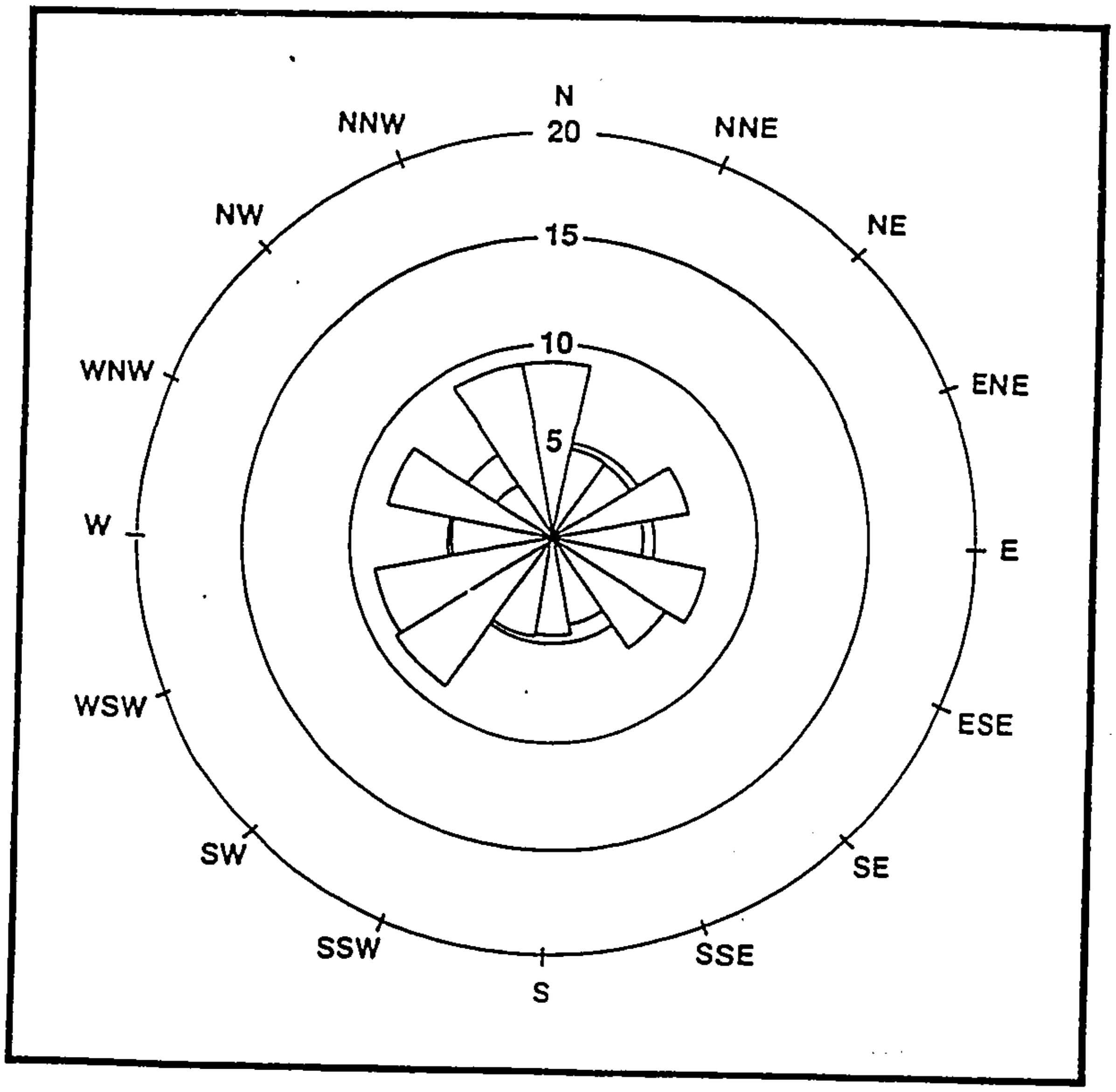
ANNUAL WIND ROSE
OLD KONA AIRPORT
1973



SOURCE: National Weather Service

FIGURE 6

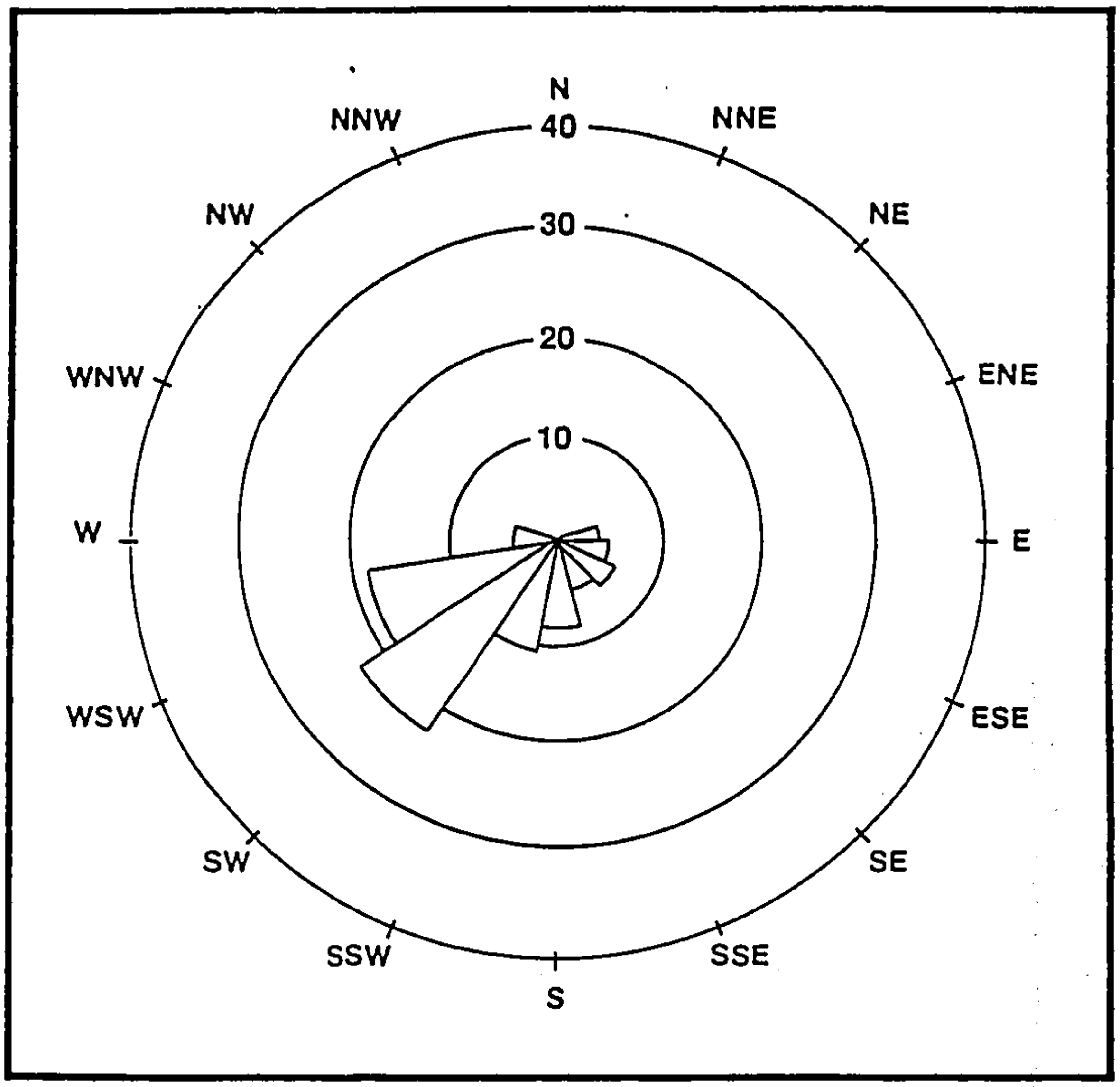
JANUARY WIND ROSE
OLD KONA AIRPORT
1973



SOURCE: National Weather Service

FIGURE 7

AUGUST WIND ROSE
OLD KONA AIRPORT
1973



SOURCE: National Weather Service

[15], is a portable unit capable of producing up to 100 cubic yards of concrete per hour. Assuming 8 hours/day operation and published EPA emission factors [14] for both direct plant emissions and fugitive dust emissions, estimates of worst case ambient impact were derived using the PTPLU screening model. Ninety percent control of particulate emissions from the plant itself and 60% control of fugitive dust emissions from the process were assumed. One-hour concentration estimates were adjusted to 8-hour averages using an EPA-recommended factor [16] and then to 24-hour averages based on a weighted averaging technique. The worst case concentration of total suspended particulates (TSP) was thus estimated to be 105 micrograms/cubic meter (ug/m^3) due to the plant operation.

Assuming that the plant would be located near the project site, existing data from the Kailua-Kona site were reviewed (Table 2). Adding the second highest TSP concentration from the 1985-86 data (26 ug/m_3) to the 105 ug/m^3 yields 131 ug/m3 which is below the state and federal 24-hour PM_{10} standard of 150 ug/m^3.

Design and operating data for a typical asphalt concrete batch plant (Astec Industries Model PDM-636-C) were also obtained and reviewed. This plant has a production capacity of 186 T/hour. The two primary emission sources associated with such a plant are the drum mix asphalt plant and a 600 kW diesel generator.

The modeling technique employed for the concrete batch plant was also applied to the asphalt plant. The estimated TSP and SO_2 concentrations were 60.9 and 21.6 ug/m^3, respectively, again well below state and federal standards.

6. MOBILE SOURCE IMPACTS

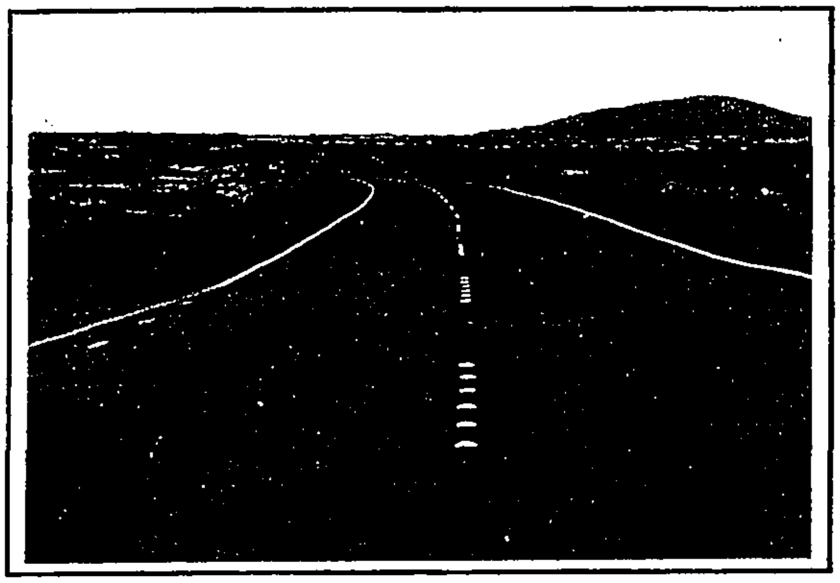
6.1 Mobile Source Activity. A traffic assessment was prepared for the proposed project and served as the basis for this mobile source impact analysis [10]. Existing peak-hour traffic volumes and projections for 2015 along Queen Kaahumanu Highway in the project vicinity were provided. It should be noted that highway improvements and mitigative measures assumed in the assessment were also assumed for the purposes of this air quality impact report. Current conditions at this intersection are depicted in Figure 8.

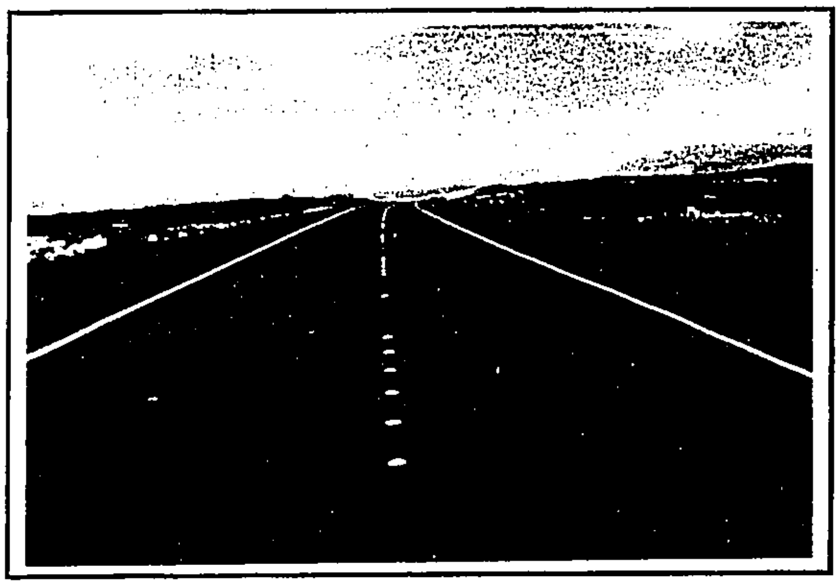
6.2 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 1994 and 2015 using the Mobile Source Emissions Model (MOBILE-5A) [17]. To localize the emission factors as much as possible, the September 1988 age distribution for registered vehicles in the City & County of Honolulu [18] was input in lieu of national statistics. That same

FIGURE 8

QUEEN KAAHUMANU HIGHWAY
IN THE VICINITY OF THE KAUPULEHU PROJECT
MAY 1994

Facing Southwest





Facing Northeast

age distribution was the basis for the distribution of vehicle miles travelled as well.

6.3 Modeling Methodology. Due to the present state-of-the-art in air quality modeling, analyses such as this generally focus on estimating concentrations of non-reactive pollutants. For projects involving mobile sources as the principal source, carbon monoxide is normally selected for modeling because it has a relatively long half-life in the atmosphere (ca. 1 month)[19], and it comprises the largest fraction of automotive emissions.

Using the available traffic data, modeling was performed for the intersection of Queen Kaahumanu Highway and the Kona Village access road for 1994 and 2015 (with and without the project).

Because of the generally rural nature of the area, a stable atmosphere (Category "F") was assumed in the morning and a neutral atmosphere (Category "D") [20] in the afternoon. A 1 meter per second (m/sec) wind speed was also assumed as worst case meteorological conditions.

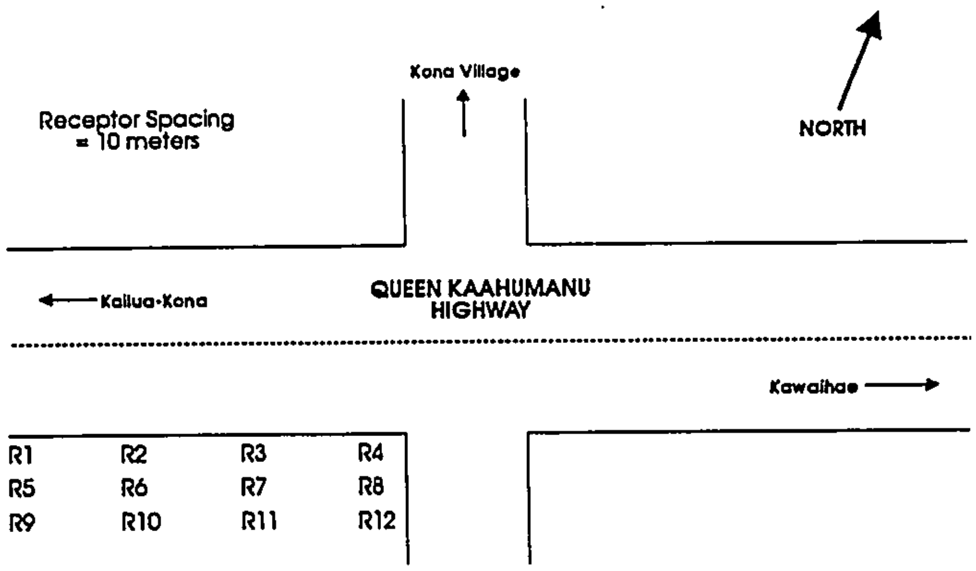
The EPA guideline model CAL3QHC [21,22] was employed to estimate near-intersection carbon monoxide concentrations. An array of receptor sites at distances of 10 meters from the road edge were input to the model. Because of the generally low level of upwind urban activity in the area, a background CO concentration of 0.1 milligram per cubic meter (mg/m^3) was assumed. The model uses an iterative process to identify the wind direction producing the maximum CO concentration at each receptor location.

6.4 Results: 1-Hour Concentrations. The results of this modeling are presented in Figures 9 and 10. Each figure depicts the concentrations in milligrams per cubic meter (mg/m^3) at 12 receptor locations on the southwest of the intersection which were identified by the model as the points of maximum concentration. The results indicate an increase over time in ambient CO levels close to the highway but demonstrate existing and future compliance with state and federal standards.

6.5 Results: 8-Hour Concentrations. Estimates of 8-hour concentrations can be derived by applying a "persistence" factor of 0.6 to the 1-hour concentrations. This "persistence" factor has been recommended in an EPA publication on indirect source analysis [23] and has been further corroborated by analysis of carbon monoxide monitoring data in Honolulu which yielded the same 8-hour-to- 1-hour ratio [24]. Applying this factor to the 1-hour results indicates compliance with federal and state 8-hour standards at all receptor locations.

FIGURE 9

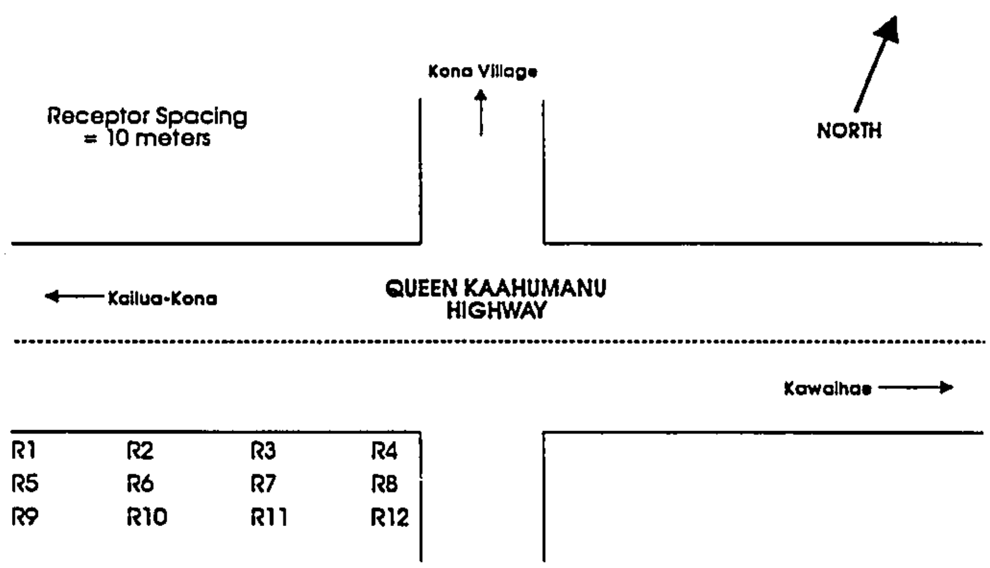
ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS
Queen Kaahumanu Highway
A.M. Peak Traffic Hour
1994 - 2015



Receptor	Concentration (mg/m^3) 1994	2015 w/o Proj	2015 w/Proj
R01	0.4	4.9	5.4
R02	0.4	4.7	5.2
R03	0.4	4.5	5.1
R04	0.4	4.3	4.8
R05	0.3	3.5	3.9
R06	0.3	3.3	3.9
R07	0.3	3.2	3.7
R08	0.3	3.3	4.3
R09	0.3	2.9	3.2
R10	0.3	2.8	3.2
R11	0.3	2.8	3.3
R12	0.3	2.9	4.2

FIGURE 10

ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS
Queen Kaahumanu Highway
P.M. Peak Traffic Hour
1994 - 2015



Receptor	1994	2015 w/o Proj	2015 w/Proj
	Concentration (mg/m^3)		
R01	0.4	3.1	3.6
R02	0.4	3.1	3.7
R03	0.4	3.3	3.6
R04	0.4	3.2	3.6
R05	0.3	2.3	2.6
R06	0.3	2.2	2.6
R07	0.3	2.3	2.7
R08	0.3	2.2	3.0
R09	0.2	1.8	2.1
R10	0.2	1.9	2.2
R11	0.2	1.8	2.4
R12	0.2	1.8	2.6

7. ELECTRICAL GENERATION IMPACT

The estimated annual electrical usage of 8.6 million kilowatt hours (kwhrs) will contribute to the demand on the local utility, Hawaii Electric Light Company (HELCO), and necessitate additional fuel combustion. Because of anticipated growth in the region, HELCO has already applied to the Public Utilities Commission (PUC) to expand its Keahole Station by 56 megawatts (MW) [25]. The facility currently consists of six 2.75 MW diesel generators and one 13.75 MW simple cycle combustion turbine. The estimated emissions resulting from fuel burned to provide the power needed by the Kaupulehu project are presented in Table 4.

TABLE 4

ESTIMATES OF ANNUAL EMISSIONS DUE TO ELECTRICAL GENERATION

Pollutant	Emissions (T/yr)	Percent of 1980 Emissions Inventory
Nitrogen oxides (NOx)	158	2.75
Carbon monoxide (CO)	41	0.06
Sulfur oxides (SOx)	18.9	0.42
Total hydrocarbons (THC)	4.1	0.06
Particulate matter (PM)	1.5	0.25

8. DISCUSSION AND CONCLUSIONS

8.1 Short-Term Impacts. Since as noted in Section 5, there is a potential for fugitive dust due to the dry climate and fine soils, it will be important for adequate dust control measures to be employed during the construction period. Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50% [14]. The soonest possible landscaping of completed areas will also help.

8.2 Mobile Source Impacts. As noted in Section 6, there will be an increase in traffic-related emissions attributable to the project, but both 1- and 8-hour carbon monoxide standards are predicted to be met during peak traffic hours even in close proximity to the highway.

8.3 <u>Electrical Generation</u>. The proposed project will increase electrical demand which in turn will cause more fuel to be burned and more pollutants to be emitted into West Hawaii's air. The estimated emissions represent relatively small increases over the latest available county emissions inventory. Until other nonpolluting means of generating electricity are developed or higher efficiency control technologies are applied, such increases in emissions are inevitable. Electrical demand, fuel consumption, and emissions can be reduced by energy conservations measures such as use of solar water heaters, heat pumps, proper design of buildings to reduce air conditioning needs, etc. For the present and future, the HELCO facility providing the power must demonstrate compliance with all applicable ambient air quality standards and control regulations in order to retain its operating permit.

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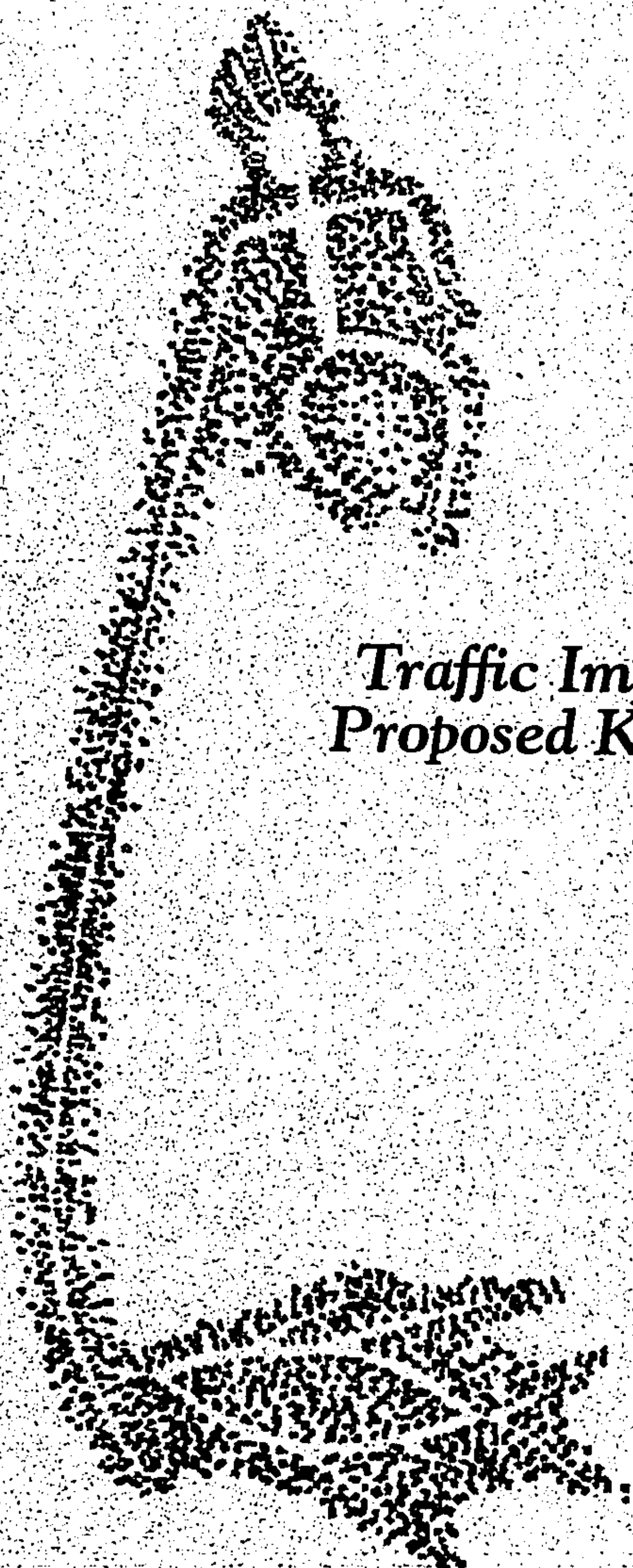

Appendix D

Traffic Impact Analysis Report for the Proposed Kaupulehu Resort Expansion

TRAFFIC IMPACT ANALYSIS REPORT FOR THE PROPOSED

KAUPULEHU RESORT EXPANSION

PREPARED FOR

BELT COLLINS HAWAII

PREPARED BY

TMC

THE TRAFFIC MANAGEMENT CONSULTANT

TRAFFIC IMPACT ANALYSIS REPORT FOR THE PROPOSED

KAUPULEHU RESORT EXPANSION

PREPARED FOR

BELT COLLINS HAWAII

June 27, 1994

PREPARED BY

TMC

THE TRAFFIC MANAGEMENT CONSULTANT

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FOR THE PROPOSED
KAUPULEHU RESORT EXPANSION

I. Introduction

A. Purpose of Study

The purpose of this study is to analyze the traffic impacts resulting from the proposed Kaupulehu Resort Expansion in North Kona, Hawaii. This report presents the findings and recommendations of the study.

B. Scope of Study

The scope of this study includes:

1. Description of the proposed project.
2. Evaluation of existing roadway and traffic conditions.
3. Analysis of future roadway and traffic conditions without the proposed project.
4. Development of trip generation characteristics for the proposed project.
5. The identification and analysis of traffic impacts resulting from the proposed project.
6. Recommendation of improvements that would mitigate the traffic impacts resulting from the development of the proposed project.

II. Project Description

A. Location

Kaupulehu Resort Expansion is located on the makai (west) side of Queen Kaahumanu Highway, approximately 7 miles north of the Keahole Airport in North Kona, Hawaii. The project location is shown in Figure 1. The 1,000+ acre site is identified as Tax Map Key 7-2-03: Portion of 1. The proposed project is located immediately to the north of Kaupulehu Resort and Kona Village Resort. The project vicinity is shown in Figure 2.

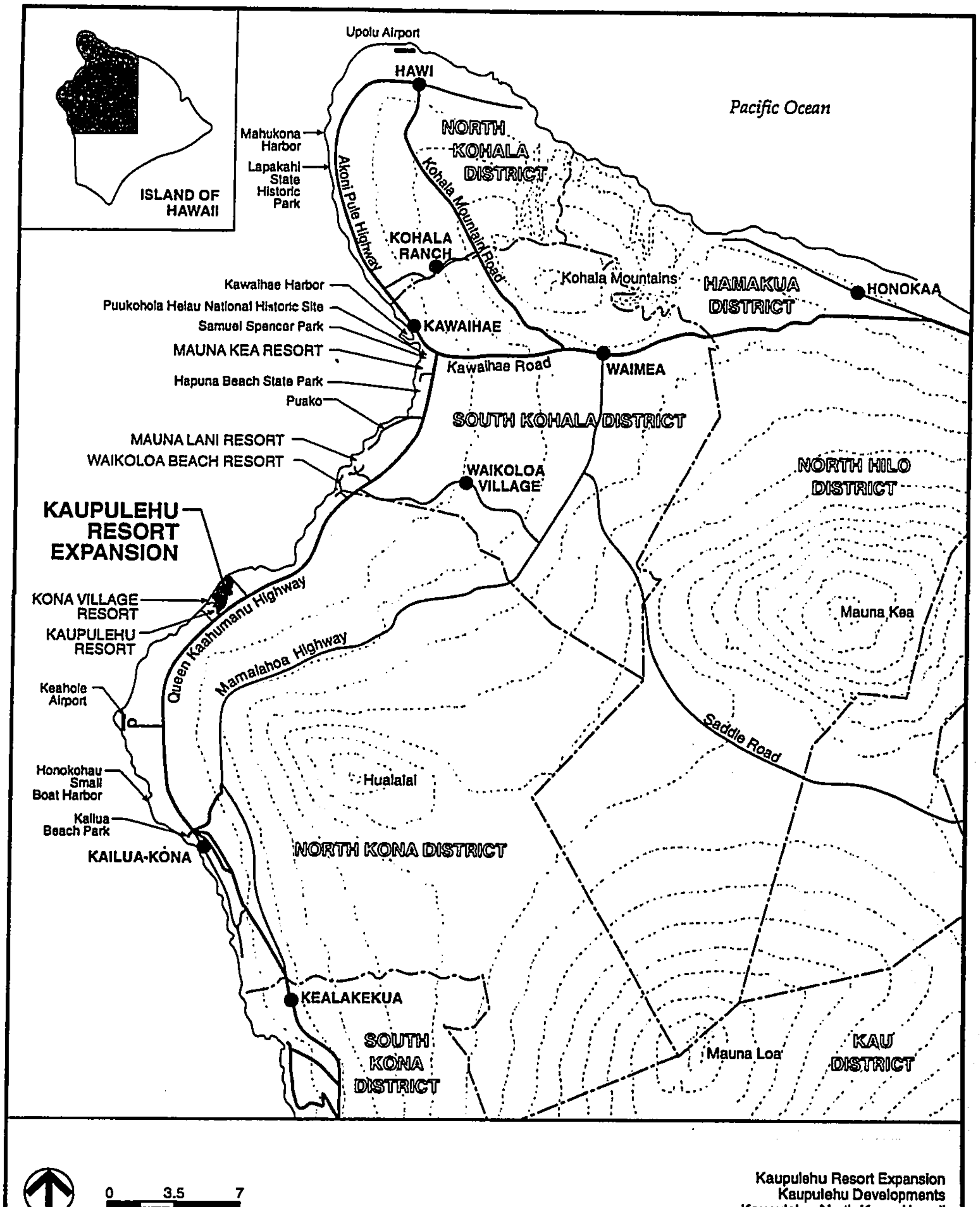


FIGURE 1 - LOCATION MAP

Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
Prepared By: Belt Collins Hawaii, June 1994

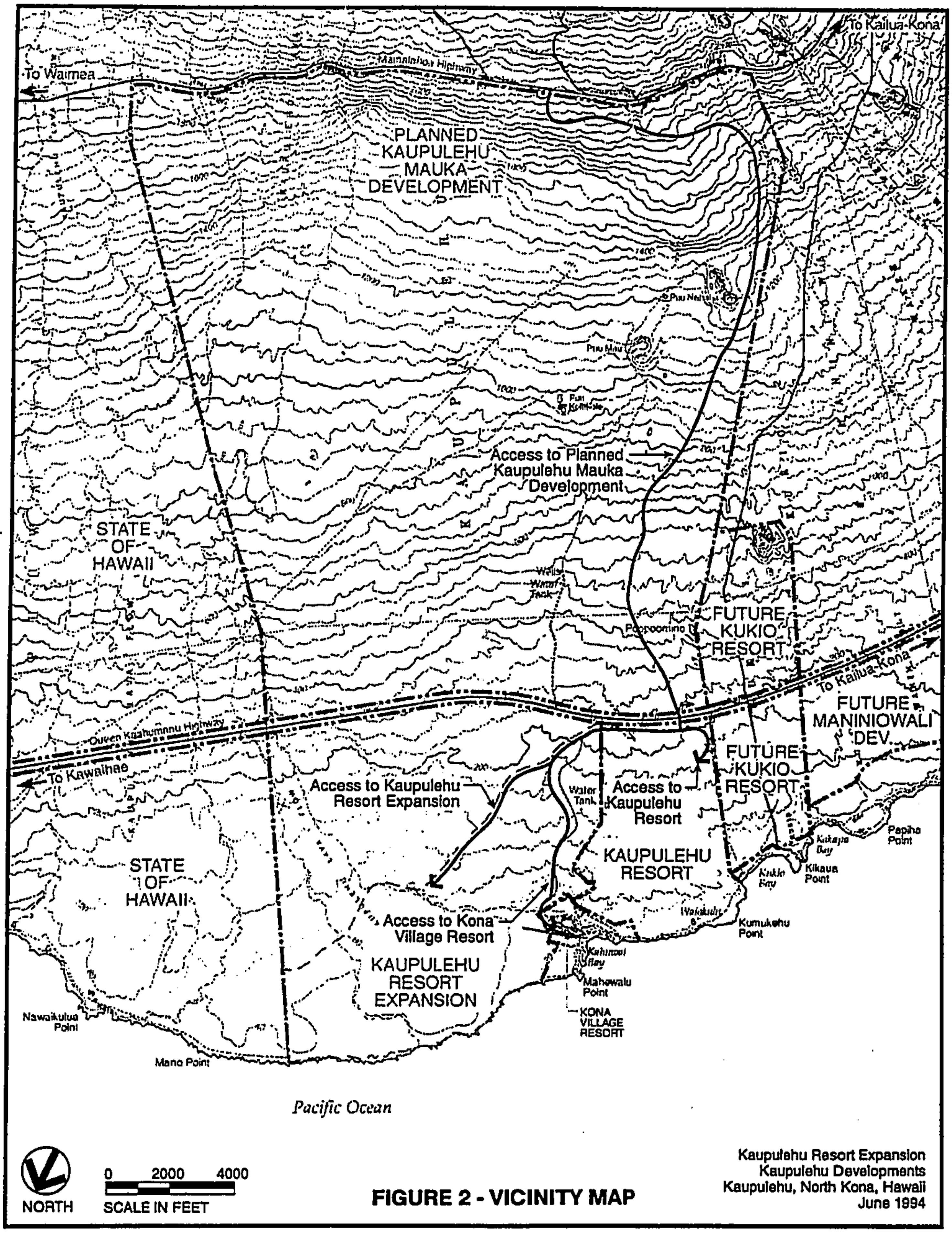


FIGURE 2 - VICINITY MAP

Kaupulehu Resort Expansion
Kaupulehu Developments
Kaupulehu, North Kona, Hawaii
June 1994

B. Site Characteristics

1. Proposed Land Use Intensity

The proposed Kaupulehu Resort Expansion project will be primarily a resort residential community with a 36-hole golf course and 45,000 square feet of gross leaseable commercial floor area. Kaupulehu Resort Expansion would contain a total of 1,030 dwelling units; consisting of 530 single family dwelling units and 500 multi-family dwelling units. About 75% of the single family dwelling units and 67% of multi-family units are projected to be purchased by part-time residents as "second homes" or recreational homes. The remaining units are assumed to be purchased by full-time residents. Table 1 shows a summary of the residential development plan.

Table 1. Residential Development Plan

Land Use		No. of Units
Single Family Dwellings	Full-Time residences	133
	Recreational Homes	397
Multi-Family Dwellings	Full-Time Residences	165
	Recreational Homes	335
Total Dwelling Units		1,030

For the purpose of this study, the project is analyzed at full build-out by the Year 2015. The site plan is shown in Figure 3.

2. Access

The project's internal road system would connect to the primary access road for Kaupulehu Resort, which intersects Queen Kaahumanu Highway at a single access point. For the purpose of this traffic impact analysis, site access is assumed to be provided by a signalized, at-grade intersection on Queen Kaahumanu Highway at or near the existing access to Kona Village Resort.

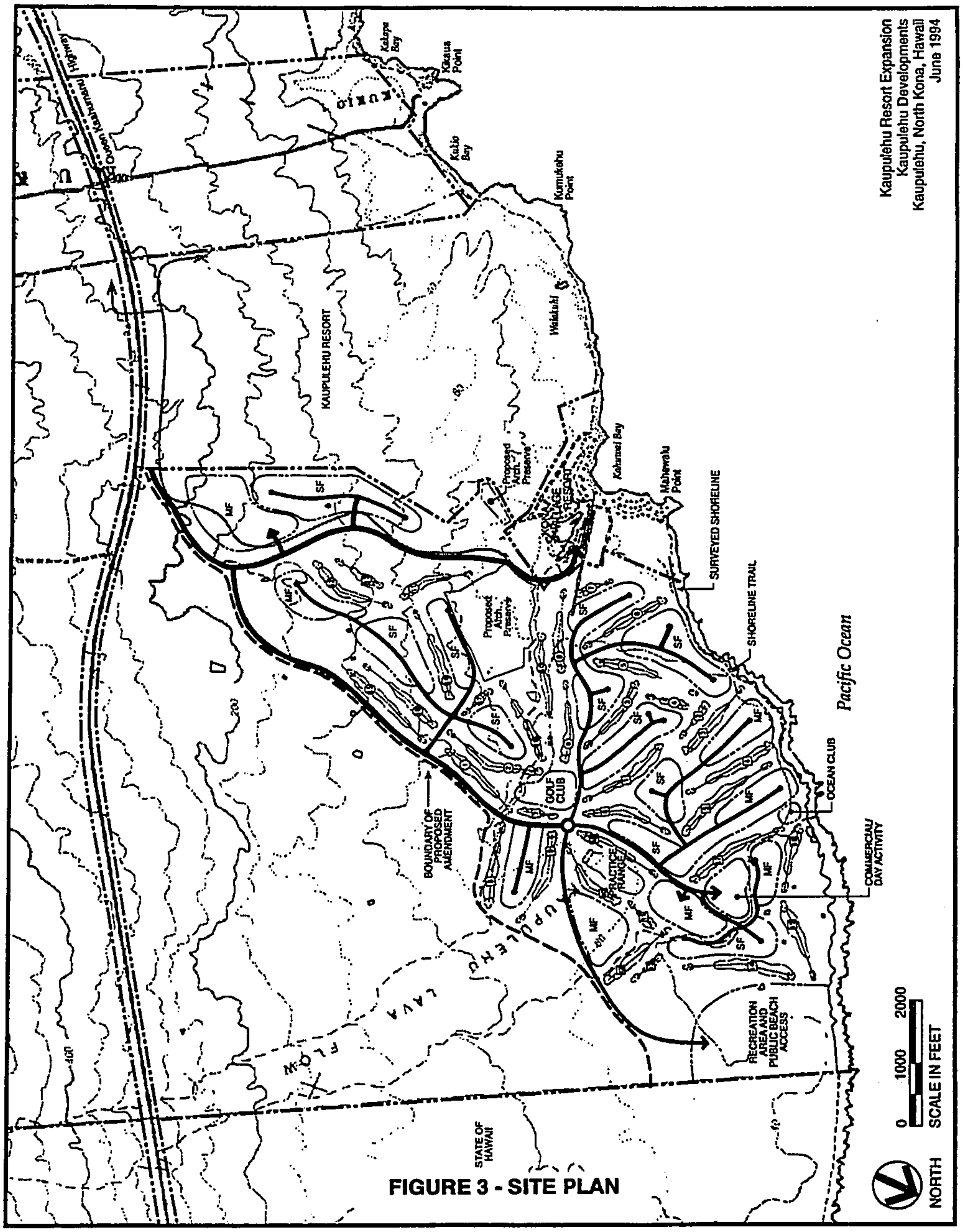


FIGURE 3 - SITE PLAN

III. Study Area Conditions

A. Area Of Influence

The study area is defined on Queen Kaahumanu Highway at the combined access road for Kaupulehu Resort, Kona Village Resort, and the proposed project. The State Department of Transportation's (DOT) long range plan for Queen Kaahumanu Highway is to develop a controlled-access, four-lane, divided highway. It includes approved interchanges at Keahole Airport Access Road and at Waikoloa, and a system of frontage roads to provide access to properties along the highway. It is assumed that primary access, under this long range plan, would be provided by a yet to be determined interchange located between Waikoloa and the airport. DOT is currently undertaking a plan for the Queen Kaahumanu Highway widening that would determine the location of additional interchanges and the functional aspects of the frontage road system. In a discussion regarding nearby Kaupulehu Resort, Kukio, and Maniniowali projects, DOT has indicated that an interchange would be located in the vicinity of the project, which would provide access to Queen Kaahumanu Highway. In any case, it is assumed that initial access to the project would be provided at a channelized at-grade intersection planned for Kaupulehu Resort. Ultimately, project access would be provided along the proposed frontage road system or at an interchange located at the project access.

B. Anticipated Future Development

West Hawaii is developing the potential for rapid growth, as several major projects are in various stages of development. Several resort/residential developments are located in the region. These include Kaupulehu Resort, Kaupulehu Mauka, Kukio, and Maniniowali. These projects are taken into account in developing the Year 2015 traffic forecast without the proposed project.

IV. Existing Traffic Conditions

A. Area Roadway System

Queen Kaahumanu Highway is the primary arterial highway in the region. Queen Kaahumanu Highway is a high quality, two-lane, two-way State highway between Kawaihae and Kailua. Mamalahoa Highway is a two-lane, two-way County highway located mauka of Queen Kaahumanu Highway. Existing mauka-makai connector roadways between the two highways are located about

13 miles to the north of the site at Waikoloa and about seven miles to the south at Keahole. The County of Hawaii has recently completed the extension Hina Lani Drive, connecting Mamalahoa Highway and Queen Kaahumanu Highway at the Kaloko Industrial Park. A future mauka-makai roadway is planned, by others, at the project access, which would connect Kaupulehu Resort and Kaupulehu Mauka. For the purpose of this analysis, it is assumed that this mauka-makai roadway would remain private, providing access to only the Kaupulehu projects.

B. Traffic Volumes and Conditions

1. General

a. Field Investigation

The field investigation, conducted in March, 1994, consisted of a site inspection and a manual traffic count between the hours of 6:30 AM and 8:30 PM and 3:00 PM and 5:00 PM. Additional traffic data were obtained from DOT and other studies conducted in the vicinity.

b. Capacity Analysis Methodology

The highway capacity analysis, performed in this study, is based upon procedures presented in the "Highway Capacity Manual" (HCM), Special Report 209, Transportation Research Board, 1985 as amended, and the "Highway Capacity Software", Federal Highways Administration.

Level of Service (LOS) is defined as "a qualitative measure describing operational conditions within a traffic stream". Several factors are included in determining LOS such as: speed, delay, vehicle density, freedom to maneuver, traffic interruptions, driver comfort, and safety. LOS "A", "B", and "C" are considered satisfactory levels of service. LOS "D" is generally considered a "desirable minimum" operating level of service. LOS "E" is an undesirable condition and LOS "F" is an unacceptable condition.

"Volume-to-capacity" (v/c) ratio is another measure indicating the relative traffic demand to the road's traffic carrying ability. A v/c ratio of 0.50 indicates that the traffic demand is utilizing 50% of the roadway's capacity.

The capacity analysis for signalized intersections, relating traffic volumes to intersection capacity, is presented in the HCM as the "planning analysis" method. Three categories are used to evaluate traffic operations: "under capacity", "near capacity", and "over capacity". Under capacity conditions indicate that critical traffic volumes would virtually always be below the intersection's capacity. Over capacity conditions indicate that the intersection capacity will be exceeded in most cases and the intersection would require geometric improvements. Near capacity conditions requires engineering judgment as to whether or not intersection improvements would be required, especially when critical traffic volumes approach over capacity conditions. The purpose of this analysis is to determine the adequacy of intersection geometrics, i.e., number of through and turning lanes required, under given traffic demands. The planning method is a broad measure of traffic operations at an intersection, where the details of the traffic signal design and operation, intersection geometrics, and vehicle type distribution of traffic are not available.

2. Existing Peak Hour Traffic Analysis

The AM peak hour of traffic in the vicinity of the project occurs between 7:00 AM and 8:00 AM. The PM peak hour of traffic occurs between 3:30 PM and 4:30 PM. Queen Kaahumanu Highway operates at satisfactory Levels of Service during the peak hours of weekday traffic. Figure 4 shows the existing peak hour traffic and results of the capacity analysis.

V. Projected Traffic

A. Site Traffic

1. Trip Generation Methodology

The trip generation methodology used in this study is based upon generally accepted techniques developed by the Institute of Transportation Engineers (ITE) and published in "Trip Generation", 5th Edition, 1991. The ITE trip rates for resort and residential uses are developed by correlating the vehicle trip generation data with various land use characteristics, such as vehicle trips per unit. The trip generation characteristics for Kaupulehu Resort Expansion are based upon the land use intensity described in Section II.

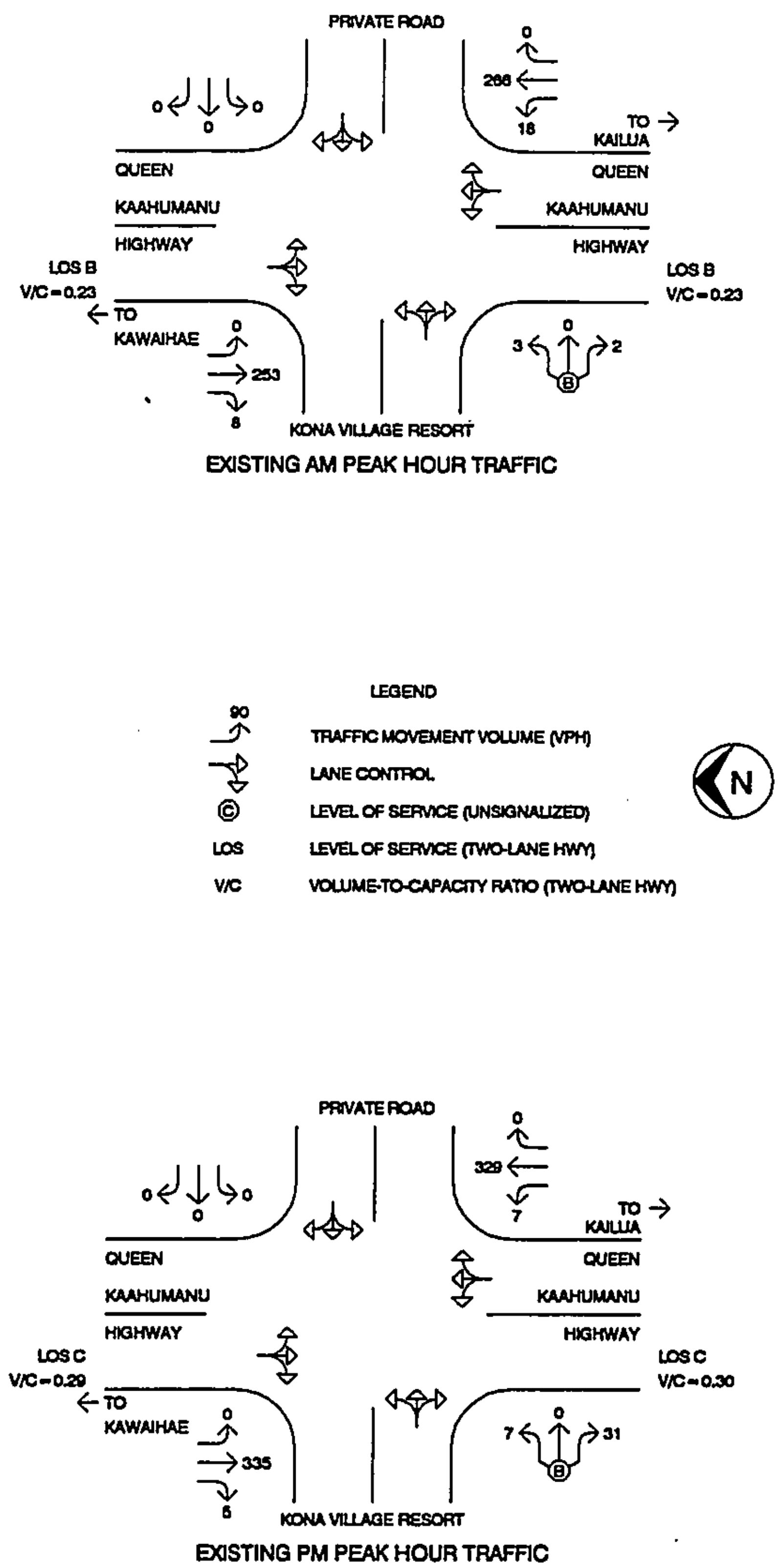


FIGURE 4 - EXISTING AM AND PM PEAK HOUR TRAFFIC

The total trips generated by a retail development can be defined as driveway traffic, i.e., traffic entering and exiting the project site. A portion of the trips generated by a commercial project can be considered "pass-by" trips, i.e., traffic already on the road stopping at a "secondary" destination. The remainder of the trips generated by the commercial project are considered to be "new" trips, i.e. trips with their primary destination being the proposed commercial development. Based upon the size of the gross floor area of the retail development, ITE estimates that 60% of the total PM peak hour trips, generated from a shopping center are passer-by trips. For the purpose of this traffic impact analysis, the pass-by trips are defined as "internal" trips, i.e., trips attracted from within the resort areas of Kaupulehu Resort, Kona Village, and the proposed project. These trips are not included in the traffic impact analysis, since they either never leave the site or are secondary trips and already accounted for under other land use activities. The new trips are defined as "external" trips, i.e., trips attracted from outside the resort area, and are included in the traffic impact analysis.

2. Trip Generation Characteristics

The proposed project is expected to generate a total of 571 vph during the AM peak hour of traffic, 326 vph entering the site and 245 vph exiting the site. During the PM peak hour of traffic, the Kaupulehu Resort Expansion is expected to generate a total of 705 vph, 374 vph entering the site and 331 vph exiting the site. Table 2 shows a summary of the trip generation characteristics.

Table 2. Trip Generation Summary							
Land Use	No. of Units	AM Peak Hour Traffic (vph)			PM Peak Hour Traffic (vph)		
		Enter	Exit	Total	Enter	Exit	Total
Single Family Residential (DU)	133	27	76	103	91	49	140
Multi-Family Residential (DU)	165	13	63	76	62	32	94
Recreational Homes (DU)	732	78	39	117	78	112	190
Golf Course (Holes)	36	144	29	173	64	59	123
Retail (1,000 GSF)	45	64	38	102	79	79	158
Totals Trips		**326**	**245**	**571**	**374**	**331**	**705**

B. External Traffic

1. General

The purpose of analysis of projected traffic condition without the proposed project is to establish the base line conditions from which to analyze the traffic impacts directly attributable to the proposed project. The Year 2015 is selected as the planning horizon, corresponding to full build-out of Kaupulehu Resort Expansion.

2. Through Traffic

DOT and the County of Hawaii has completed the "Island of Hawaii Long Range Highway Plan" (HLRHP) in 1991. This Highway Plan included a travel forecast for the Year 2010, based upon a land use forecast developed by the County of Hawaii. The 7.24% average annual growth in traffic for the region is adopted for the purpose of establishing future baseline traffic conditions from which to analyze the traffic impacts resulting from the proposed project. The traffic forecast used in this study is considered conservative (overestimated), since the HLRHP took the development of Kaupulehu Resort and Kukio into account.

State DOT is in the process of updating its transportation plan for the island of Hawaii. The updated plan is expected to be completed by the end of 1994. This long-range plan update would address the transportation needs for island of Hawaii through the Year 2020.

3. Future Off-Site Traffic In Study Area

The traffic impact analysis for Kaupulehu Resort and Kaupulehu Mauka is presented in "Traffic Impact Assessment Report for Kaupulehu", December 13, 1991, prepared by Pacific Planning & Engineering, Inc. (PP&E). In the PP&E report, Kaupulehu Resort Expansion is referred to as Kaupulehu North-Ocean: Phase III. The development plans for Kaupulehu Resort and Kaupulehu Mauka have since been revised. The current development plan for the Kaupulehu Resort consists of a 250-room hotel, a 36-hole golf course, 415 single family dwelling lots, and 585 multi-family dwelling units. Similar marketing assumptions are applied to the Kaupulehu Resort resort/residential dwelling units, i.e.; about 75% of the single family dwelling units and 67% of multi-family units are projected to be purchased by part-time residents, and the remaining units are assumed to be purchased by full time residents.

The trip generation analysis for the proposed Kukio project, presented in the PP&E report, also is adopted for use in this study.

The traffic impact analysis for the proposed Maniniowali Residential Community is presented in "Traffic Impact Analysis Report for the Proposed Maniniowali Residential Community", dated October 11, 1991. The trip generation analysis, developed in that study, is adopted for use in this analysis.

C. Peak Hour Traffic Analysis Without Project

1. General

The Year 2015 peak hour traffic analysis is performed, assuming the following improvements are constructed:

a. A new private mauka-makai roadway is constructed between Mamalahoa Highway and Queen Kaahumanu Highway opposite the Kaupulehu Access Road.

b. The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road is upgraded to a fully channelized intersection, providing exclusive left turn storage lanes and right turn deceleration lanes on Queen Kaahumanu Highway, in both the northbound and southbound directions. This intersection is analyzed under both unsignalized and signalized conditions.

c. Kaupulehu Access Road and the mauka-makai road provide separate right turn, through, left turn lanes.

2. Year 2015 Peak Hour Traffic Analysis Without Project

During the Year 2015 AM peak hour of traffic without project, the intersection of Queen Kaahumanu Highway and Kaupulehu Access Road is expected to operate at near capacity conditions under signalized conditions. Queen Kaahumanu Highway would operate at LOS "F", and at a v/c ratio of 1.02.

The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road would operate at over capacity conditions under signalized conditions, during the Year 2015 PM peak hour without project. Queen Kaahumanu Highway would operate at LOS "F", and at a v/c ratio of 1.10. Figure 5 shows the Year 2015 AM and PM peak hour traffic without project and results of the capacity analysis.

VI. Traffic Impact Analysis

A. General

The traffic impact analysis is performed, assuming that Queen Kaahumanu Highway is widened to a four-lane, divided highway to mitigate LOS "F" conditions expected during the Year 2015 PM peak hour without project.

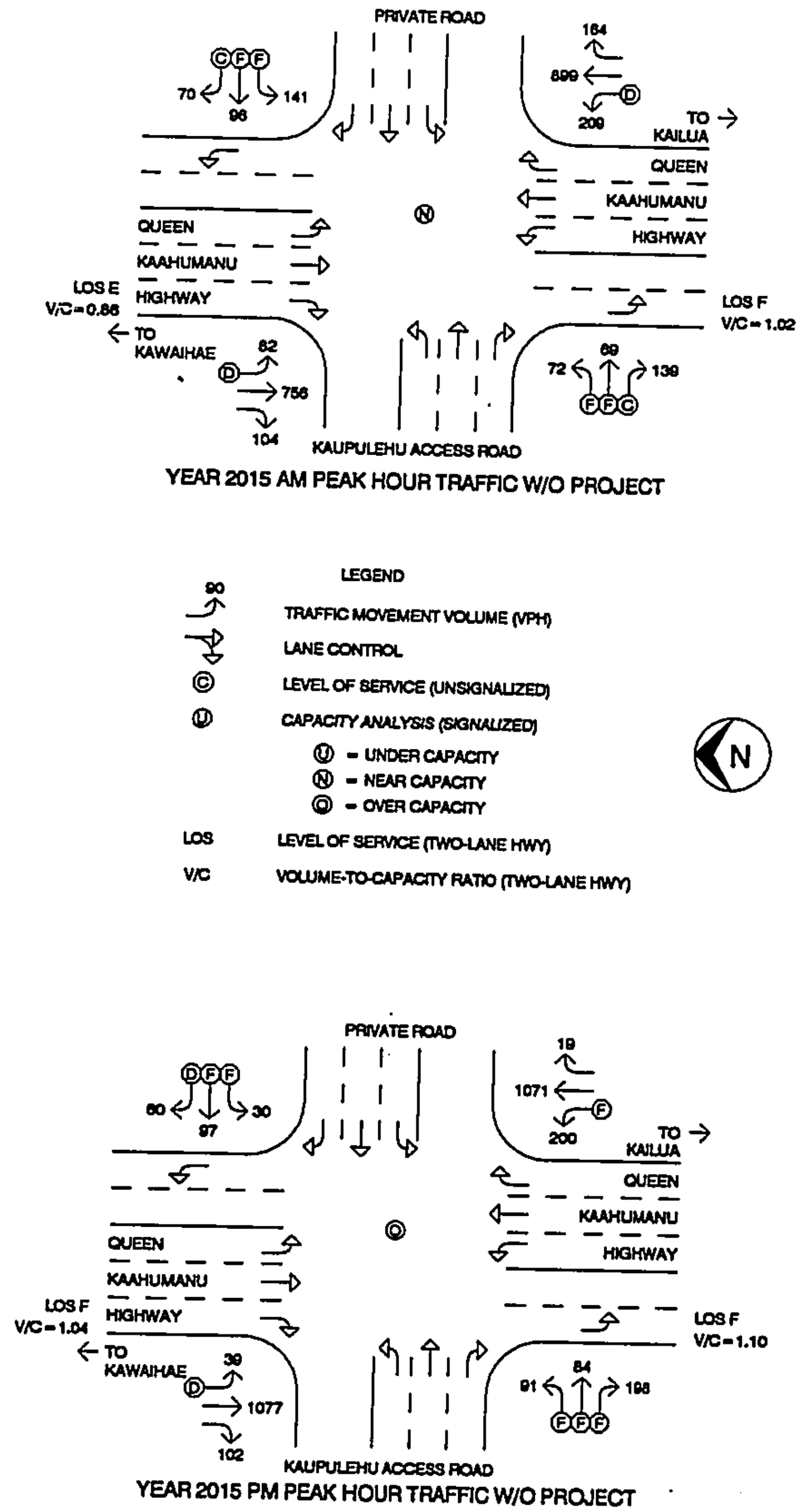


FIGURE 5 - AM AND PM PEAK HOUR TRAFFIC WITHOUT PROJECT

B. Peak Hour Traffic Analysis With Project

Figure 6 shows the AM and PM peak hour traffic with project. The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road is expected to operate at under capacity conditions during the AM peak hour with project. Northbound Queen Kaahumanu Highway would operate at LOS "B", and at a v/c ratio of 0.50.

During the PM peak hour of traffic with project, the intersection of Queen Kaahumanu Highway and Kaupulehu Access Road is expected to operate at near capacity conditions. Northbound Queen Kaahumanu Highway would operate at LOS "B", and at a v/c ratio of 0.42.

VII. Recommended Highway Improvements

A. Improvements Necessary to Accommodate the Year 2015 Highway Deficiencies Without Project

1. The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road should be upgraded to a fully channelized intersection, providing exclusive left turn storage lanes and right turn deceleration lanes on Queen Kaahumanu Highway, in both the northbound and southbound directions. Kaupulehu Resort is in the process of implementing this improvement.
2. Queen Kaahumanu Highway should be widened to provide a four-lane, divided highway, as proposed in the State DOT Long Range Highway Plan.
3. The intersection of Queen Kaahumanu Highway and Kaupulehu Access Road should be signalized, when warranted.
4. Kaupulehu Access Road and the mauka-makai road should provide separate right turn, through, left turn lanes.

B. Improvements Necessary to Mitigate Traffic Impacts With Project

The proposed improvements described in the previous section should accommodate the site traffic from the proposed project.

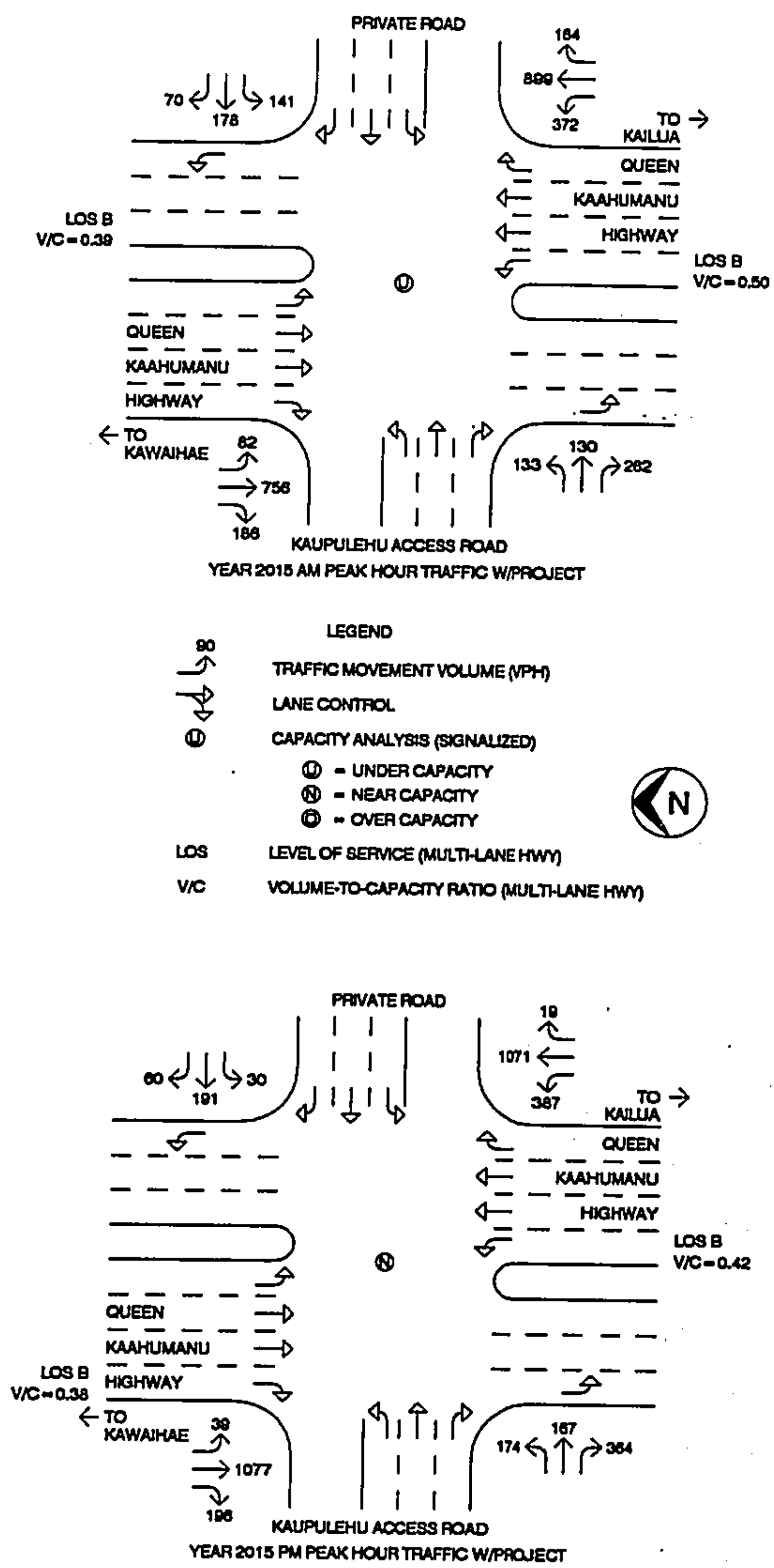
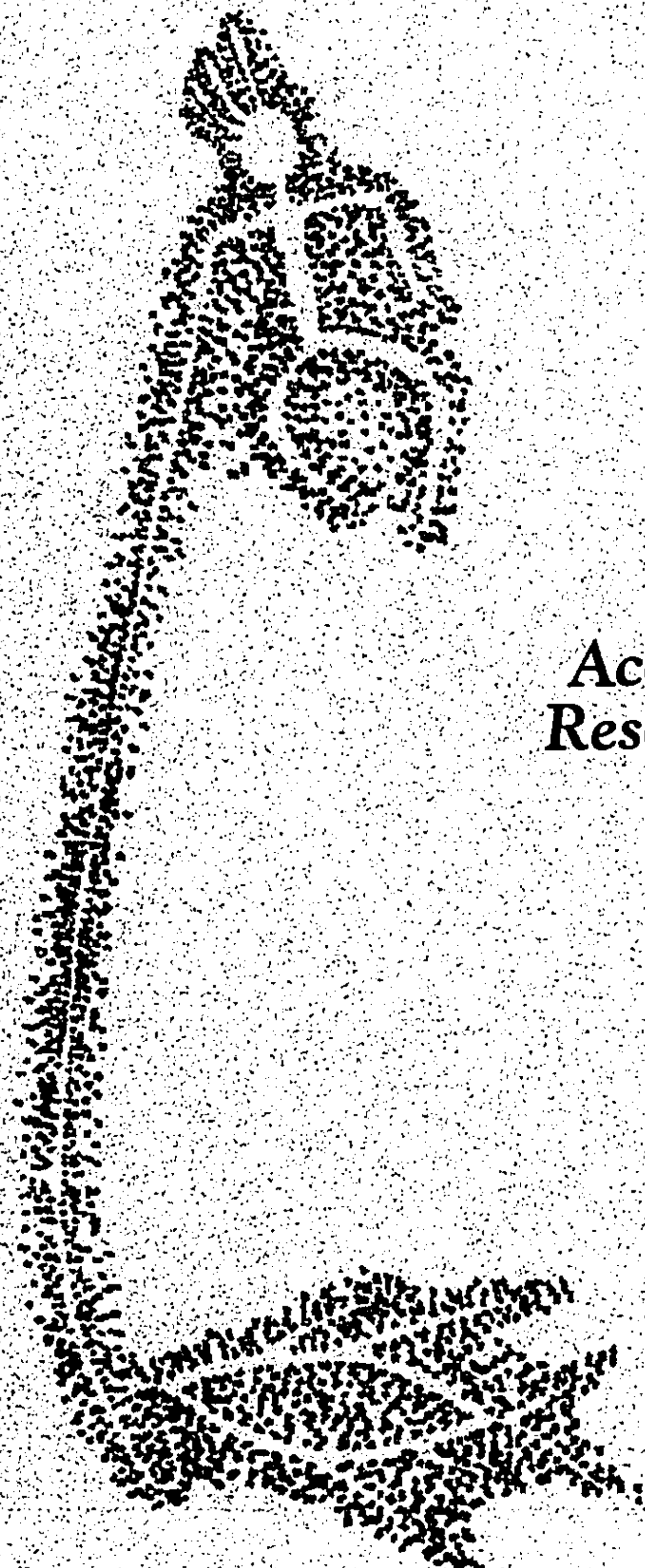


FIGURE 6 - AM AND PM PEAK HOUR TRAFFIC WITH PROJECT

VIII. Conclusions

With the implementation of the road improvements recommended in this study, the proposed Kaupulehu Resort Expansion should not have any significant impacts on traffic within the time frame of this study. An at-grade, traffic signalized, fully channelized intersection should accommodate the project access needs through the Year 2015.

It is anticipated that Queen Kaahumanu Highway would initially be widened to a four-lane, divided highway with at-grade signalized intersections at warranted locations. As traffic continues to increase, grade-separated interchange facilities and a frontage road system would be constructed, as warranted. An interchange is expected to be located at the access to Kaupulehu Resort, which would also provide access to nearby developments, such as Kukio and Maniniowali, via a frontage road system. The preliminary engineering study for Queen Kaahumanu Highway, conducted by State DOT, is expected to determine the access requirements for each of the proposed projects on Queen Kaahumanu Highway that would either provide direct access via an interchange or connect to the frontage road system leading to the nearest interchange. The study also should determine how the frontage road system would collect and distribute traffic to and from the interchanges.



Appendix E

Acoustic Study for Kaupulehu Resort Expansion, Kaupulehu, North Kona, Hawaii

ACOUSTIC STUDY FOR KAUPULEHU RESORT EXPANSION

KAUPULEHU, NORTH KONA, HAWAII

Prepared for:

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JUNE 1994

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CHAPTER I. SUMMARY

The objectives of this study were to describe the existing and future traffic noise environment in the vicinity of the proposed Kaupulehu Resort Expansion in North Kona on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined. Specific objectives were to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Potential noise impacts from the planned development and golf courses on the neighboring Kona Village Resort were also evaluated. Recommendations for minimizing these noise impacts were also to be provided as required. In addition, assessments of possible noise impacts from short term construction noise at the project site were included in the noise study objectives.

The future traffic noise levels along the primary access roadways to the proposed project site were calculated for the Year 2015 following build-out of the proposed development. Along Queen Ka'ahumanu Highway, traffic noise levels are expected to increase by approximately 5.8 to 6.2 dB above existing noise levels between CY 1994 and CY 2015. Due to its relatively low volume when compared to existing and non-project traffic along Queen Ka'ahumanu Highway, project traffic is predicted to cause an insignificant portion (0.3 to 0.6 dB) of the total increases in traffic noise along the highway. For this reason, traffic noise impacts are not expected to result from project generated traffic.

Adequate setback distances of future housing units from Queen Ka'ahumanu Highway and the internal roadways are planned for the project. For this reason, noise levels at the project's housing units should not exceed the 65 Ldn FHA/HUD noise standard, and are expected to be approximately 55 Ldn or less.

The proposed development would increase the existing background ambient noise levels in the environs of the project due to the proposed urbanization of presently vacant lands. This increase in existing background ambient noise levels may result from golf course maintenance activities, as well as from normal residential activities at the project's housing units. These increases in background ambient noise levels on the project site are unavoidable, and administrative controls will be required to minimize their impact on noise sensitive receptors.

A potential for complaints regarding audible sounds from the Kona Village Resort Luau Show does exist due to the planned location of new single family residences near the northeast boundary of the Kona Village Resort. The golf course should provide approximately 300 to 400 FT of buffer space, but amplified music and crowd noise from the luau may still be audible at the planned residences due to the low nighttime background ambient noise levels in the project area. As a minimum, adequate disclosure of the music or other sounds emanating from entertainment activities at the Kona Village Resort should be provided to prospective tenants of the project's dwelling units.

Temporary noise impacts may occur during the construction of the proposed project and are considered to be unavoidable. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. Therefore, construction activities are predicted to be audible at the adjoining Kona Village Resort, and the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. To minimize construction noise impacts, the use of quiet equipment and construction curfew periods, as required under the State Department of Health noise regulations on the island of Oahu, are recommended. The early phasing of the construction of landscaped buffers/berms between noise sensitive receptors and the job sites of later phases of construction is another possible noise mitigation measure. As a minimum, prospective clientele of both the existing Kona Village Resort and the future Kaupulehu Resort Expansion should be advised of any ongoing construction activities within audible distances.

CHAPTER II. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

A general consensus has developed for use of the Day-Night Sound Level (Ldn) in describing environmental noise in general, and for relating the acceptability of the noise environment for various land uses. The Day-Night Sound Level represents the 24-hour average sound level for a typical day, with nighttime noise levels (from 10:00 P.M. to 7:00 A.M.) increased by 10 decibels prior to computation of the 24-hour average.

The Ldn descriptor employs a process of averaging instantaneous A-Weighted sound levels as read on a standard Sound Level Meter, which are normally referred to as meter readings in dBA. A brief description of the acoustic terminology and symbols used are provided in **APPENDIX B**. The average noise level during a one hour period is called the hourly equivalent sound level, and is designated as Leq(h) or Leq. The maximum A-Weighted sound level occurring during an intermittent event (or single event) is referred to as the Lmax value. The mathematical product (or integral) of the instantaneous sound level times the duration of the event is known as the Sound Exposure Level, or Lse, and is analogous to the energy of the time varying sound levels associated with the intermittent noise event. Current noise standards and criteria which associate land use compatibility or adverse health and welfare effects with various levels of environmental noise are normally described in terms of Ldn rather than the single event (Lmax or Lse) noise descriptors. The reasons for this are based on the relatively good correlation between the cumulative Ldn descriptor and annoyance reactions of the exposed population. However, at very low levels of environmental noise (55 Ldn or less), other attitudinal variables and biases (besides noise) of the exposed population tend to influence annoyance reactions, and the correlation between annoyance reactions and Ldn levels deteriorates. This is particularly true for intermittent sounds associated with maintenance and recreational activities, which may occur at average levels below 55 Ldn, but when barely audible or intermittently loud, may be considered to be annoying to some individuals.

TABLE 1, extracted from **Reference 1**, categorizes the various Ldn levels of outdoor noise exposure with severity classifications. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in **FIGURE 1**, which was extracted from **Reference 2**. A general consensus among federal agencies has developed whereby residential housing development is considered acceptable in areas where exterior noise does not exceed 65 Ldn. This value of 65 Ldn is used as a federal regulatory threshold for determining the necessity for special noise abatement measures when applications for federal funding assistance are made.

Federal agencies (HUD and EPA) recognize 55 Ldn as a desirable goal for exterior noise in residential areas for protecting the public health and welfare with an adequate margin of safety (**References 3 and 4**). Although 55 Ldn is significantly quieter than 65 Ldn, the lower level has not been adopted for regulatory purposes by federal agencies due to economic and technical feasibility considerations.

The U.S. Federal Highway Administration (FHWA) uses the Leq or L10 descriptors rather than the Ldn noise descriptor in assessing highway noise impacts and traffic noise mitigation requirements (**Reference 5**). The L10 descriptor represents the noise level exceeded ten percent of the time during the peak traffic hour of interest. The Leq is normally evaluated during the peak traffic hour, and has been selected for use in this study. **TABLE 2**, which was extracted from **Reference 5**, presents the current FHWA Noise Abatement Criteria which are normally applied in evaluations of potential noise impacts on federally-sponsored roadway improvement projects. In general, the 67 Leq threshold for Activity Category B is applied at all residences in the vicinity of these roadway improvement projects. The FHWA 67 Leq threshold is ap-

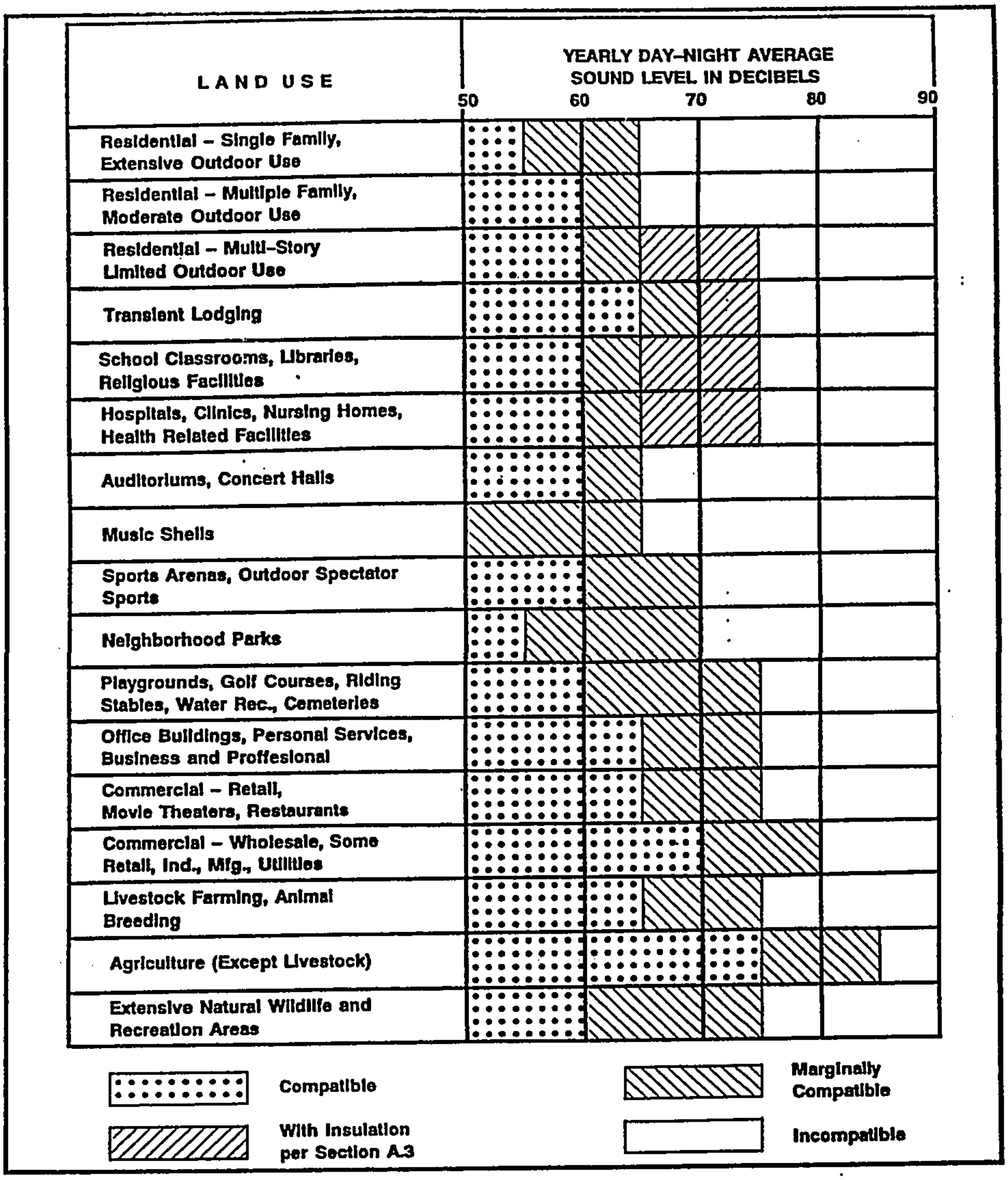
TABLE 1

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 S12.40–1990)

FIGURE 1

TABLE 2

FHWA NOISE ABATEMENT CRITERIA
[Hourly A–Weighted Sound Level––Decibels (dBA)]

ACTIVITY CATEGORY	LEQ (H)	DESCRIPTION OF ACTIVITY CATEGORY
A	57 (Exterior)	Lands on which serenity and quiet are of extra–ordinary significance and serve an important public need and where the preservation of those qualities is essential if the areas are to continue to serve their intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, activity sports areas, parks, residences, motels, hotels, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	------	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

proximately equivalent to 67 Ldn, and is less stringent than the FHA/HUD noise standard of 65 Ldn for residences. Where use of the 67 Leq threshold would result in a significant increase in background ambient noise levels at residences which are located in quiet communities, the FHWA 57 Leq criteria can be used as a more conservative noise abatement threshold.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 Ldn are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 Ldn.

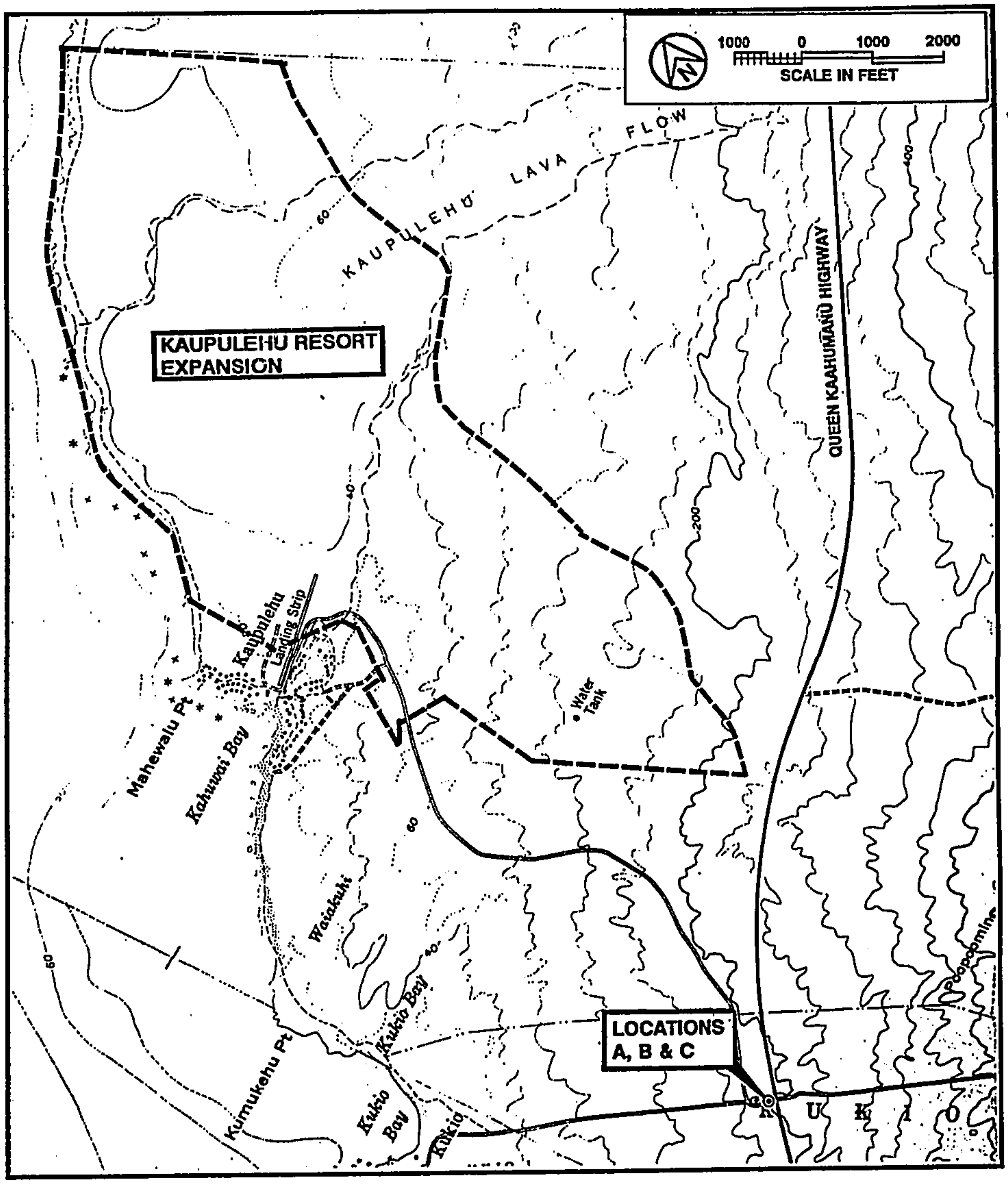
For the purposes of this study, the level of 55 Ldn was used to define the noise impact zones along the sides of a roadway, and to define the maximum acceptable level of background ambient noise. This lower level was considered appropriate due to the resort character of the project area and due to the relatively low ambient noise levels in the area. Also, at an exterior noise level of 55 Ldn, the noise attenuation characteristics of typical naturally ventilated dwellings produce acceptable noise levels within the dwellings (approximately 45 Ldn).

CHAPTER III. GENERAL STUDY METHODOLOGY

<u>Noise Measurements</u>. Existing background ambient and traffic noise levels were measured at three locations in the project environs to provide a basis for describing the existing traffic noise levels along Queen Ka'ahumanu Highway and for developing the project's traffic noise contributions along the access roadways to the project site. **FIGURE 2** depicts the project site and the noise measurement locations (A thru C). The background and traffic noise measurements were performed during the month of April 1994.

<u>Traffic Noise Predictions</u>. The traffic noise measurements were used to calibrate the traffic noise prediction model used in this study. The Federal Highway Administration (FHWA) Traffic Noise Prediction Model (**Reference 6**) was used as the primary method of calculating the existing and future traffic noise levels. 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 data and projections for the project (**Reference 7**) and Hawaii State Department of Transportation traffic counts along Queen Ka'ahumanu Highway north and south of the project (**References 8 and 9**), 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 all access roadways to the project site. These assumptions were based on computations of both the hourly Leq and the 24-hour Ldn of traffic noise on Queen Ka'ahumanu Highway north and south of the project.

At traffic noise measurement Locations A thru C, the measured traffic noise levels were compared with model predictions to insure that measured and calculated noise levels for the existing conditions were consistent and in general agreement. **TABLE 3** presents the results of the traffic noise measurements and their com-



LOCATIONS OF PROJECT AND NOISE MEASUREMENT SITES	FIGURE 2

TABLE 3

NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	---Hourly Traffic Volume--- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A. 50 FT from centerline of Q.K. Highway at entrance road to Kona Village Resort (4/21/94)	1215 TO 1307	55	584	14	27	62.3	62.5
B. 100 FT from centerline of Q.K. Highway at entrance road to Kona Village Resort (4/21/94)	1530 TO 1630	55	764	8	23	56.3	56.0
C. 200 FT from centerline of Q.K. Highway at entrance road to Kona Village Resort (4/21/94)	1425 TO 1525	55	652	10	28	49.1	49.0

parisons with the traffic noise model predictions. As indicated in **TABLE 3**, spot counts of existing traffic volumes were obtained during the measurement periods and were used to generate the equivalent sound level (Leq) predictions shown in the table. The agreement between measured and predicted traffic noise levels was considered to be good and sufficiently accurate to justify use of the highway noise model to develop the traffic noise contours.

Future traffic noise levels for CY 2015 conditions following project build-out were developed along Queen Ka'ahumanu Highway at the project access road. **Reference 7** was used to develop the Base Year (CY 1994) and future (CY 2015) traffic volumes along the access roadways to the project site. The PM peak hour was used as the period of highest hourly traffic volumes based on **References 7 thru 9**.

The future (CY 2015) traffic noise levels along the access roadways to the project site were calculated for conditions with and without the proposed development. The predicted future traffic noise levels were compared with the FHWA (see **TABLE 3**) and FHA/HUD (see **TABLE 1**) noise abatement criteria to determine specific locations where noise abatement measures might be necessary. Additionally, the locations of the 65, 60, and 55 Ldn traffic noise contours with and without the benefit of shielding from natural terrain or man-made sound barriers were calculated along the access roadways to the project site.

<u>Construction and Other On-Site Noise Evaluations</u>. Noise levels from construction activities on the project site were also described using available sound level data. Measures for minimizing risks of future adverse impacts from these and other on-site activities were also described.

CHAPTER IV. EXISTING NOISE ENVIRONMENT

Traffic Noise. The existing noise environment along Queen Ka'ahumanu Highway in the area of the proposed resort is controlled by vehicular traffic. Noise levels are in the "Minimal Exposure, Unconditionally Acceptable" category, with traffic noise below 55 Ldn at approximately 150 FT or greater setback distances from the highway's centerline.

The results of the April 1994 traffic noise measurements are summarized in **TABLE 3** and **FIGURES 3 thru 5**. In the histograms, Lmax and Lmin represent the maximum and minimum noise levels measured, respectively; L10 and L50 represent the levels exceed 10 and 50 percent of the time, respectively; and Leq represents the Equivalent (or average) Sound Level. Measured traffic noise levels were 3 to 5 dB lower than FHWA model source levels, which was consistent with previous (1984) traffic noise measurements in the North Kona area.

FIGURES 6 and 7 depict the existing Ldn vs. distance curves for Queen Ka'ahumanu Highway north and south of the proposed project at Kaupulehu. The traffic noise levels shown in the figures only apply when unobstructed line of sight conditions exist to the roadway. These conditions would generally occur at short (50 to 100 FT) distances to a roadway, within any flat, open space along the roadway, and at distant, but elevated locations above the roadway. The existing traffic noise levels shown in the figures should be reduced by 3 to 5 dB if partial shielding (line of sight obstruction) exists between the roadway and receptor location. If the receptor location is behind an obstruction (berm or hill), the noise levels in the tables and figures should be reduced by 5 to 10 dB.

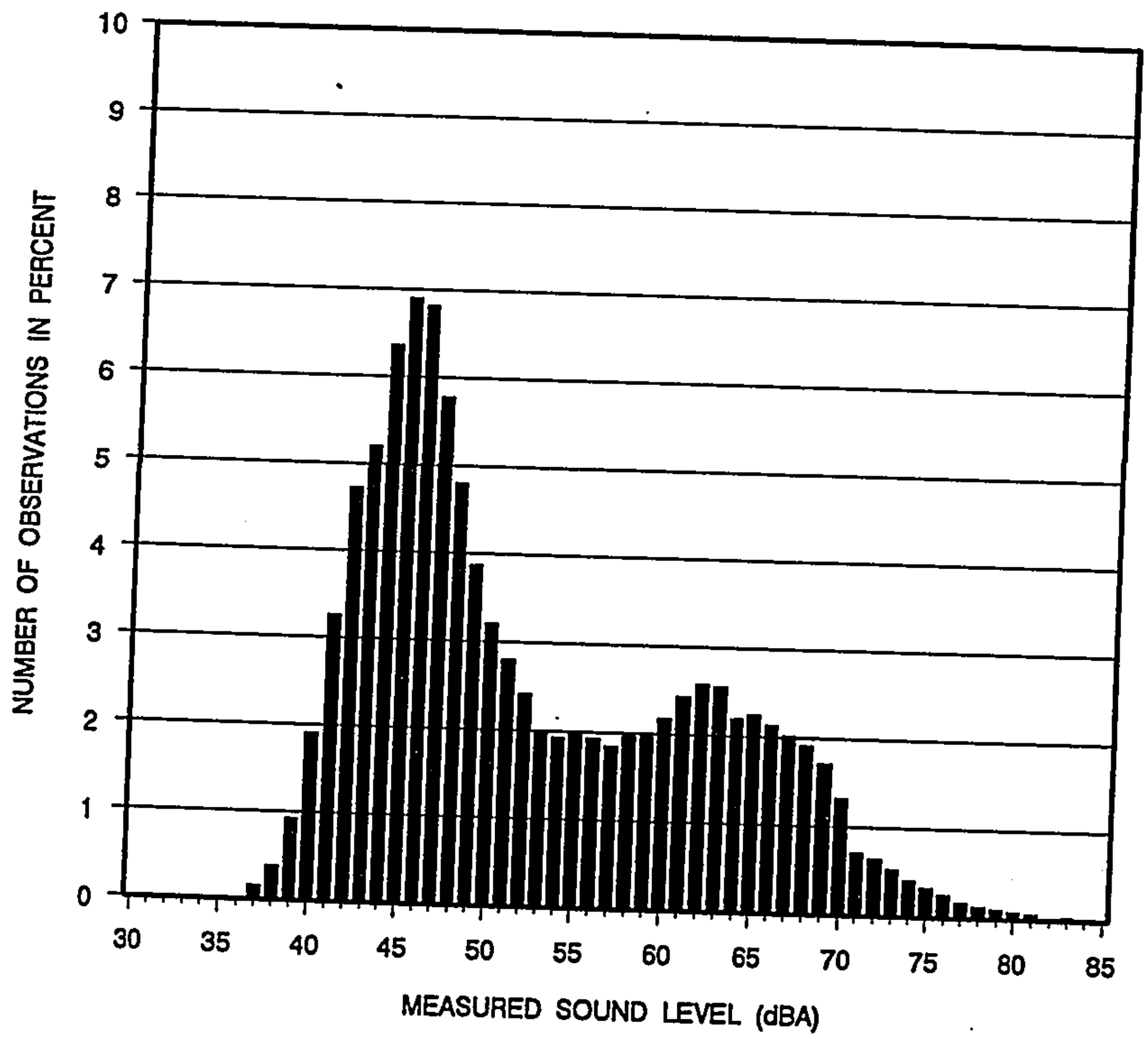
Other Background Noise. In areas removed from Queen Ka'ahumanu Highway, existing ambient noise levels are controlled by wind and foliage, surf, birds, and/or intermittent flyby events

FIGURE 3

HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "A"

DATE: APRIL 21, 1994
TIME: 1220–1307 HOURS

METER RESPONSE: FAST



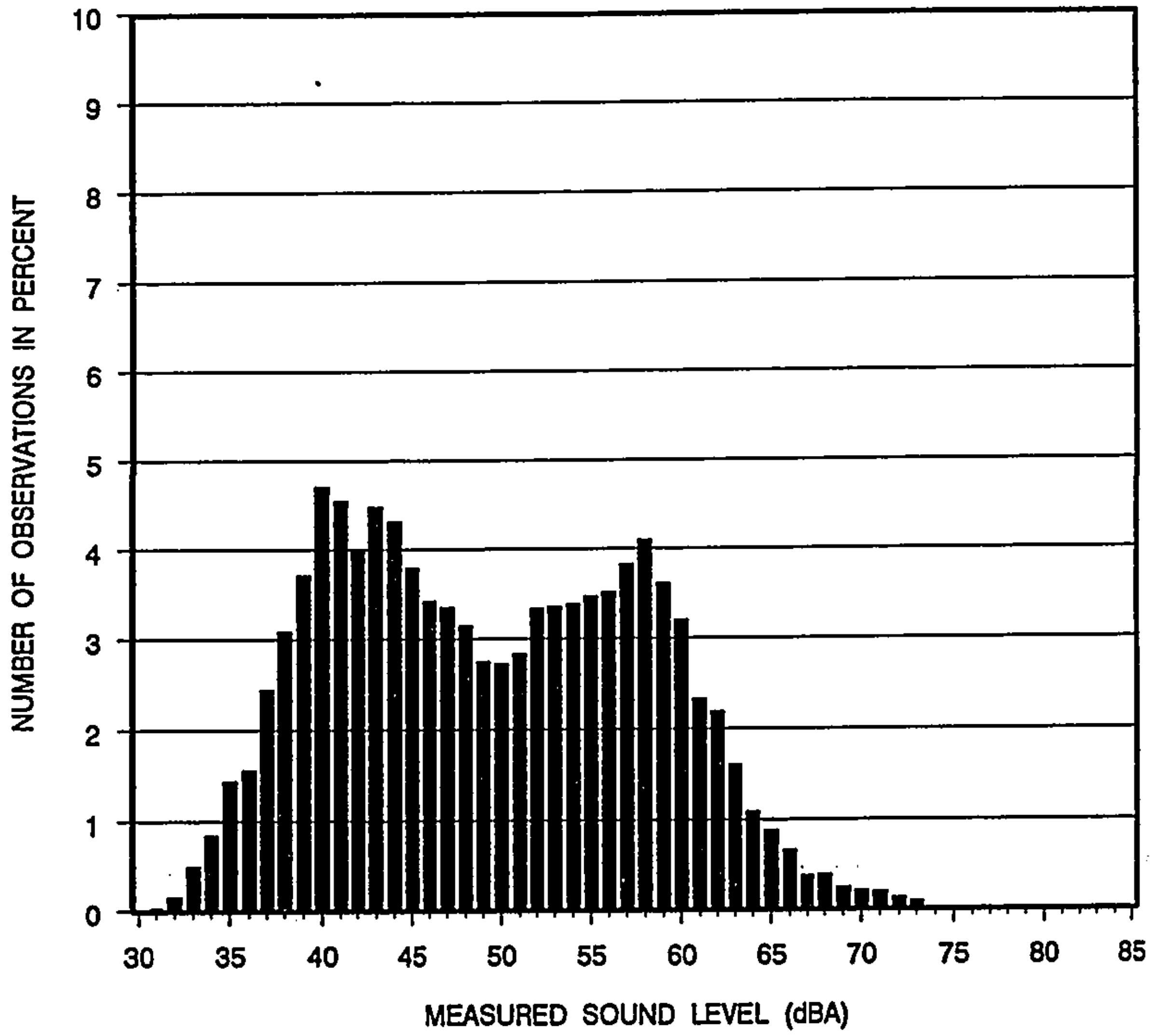
Lmax: 83.0 dBA
L10: 66.1 dBA
L50: 48.6 dBA
Leq: 62.3 dBA
Lmin: 35.6 dBA

FIGURE 4

HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "B"

DATE: APRIL 21, 1994
TIME: 1530–1630 HOURS

METER RESPONSE: FAST



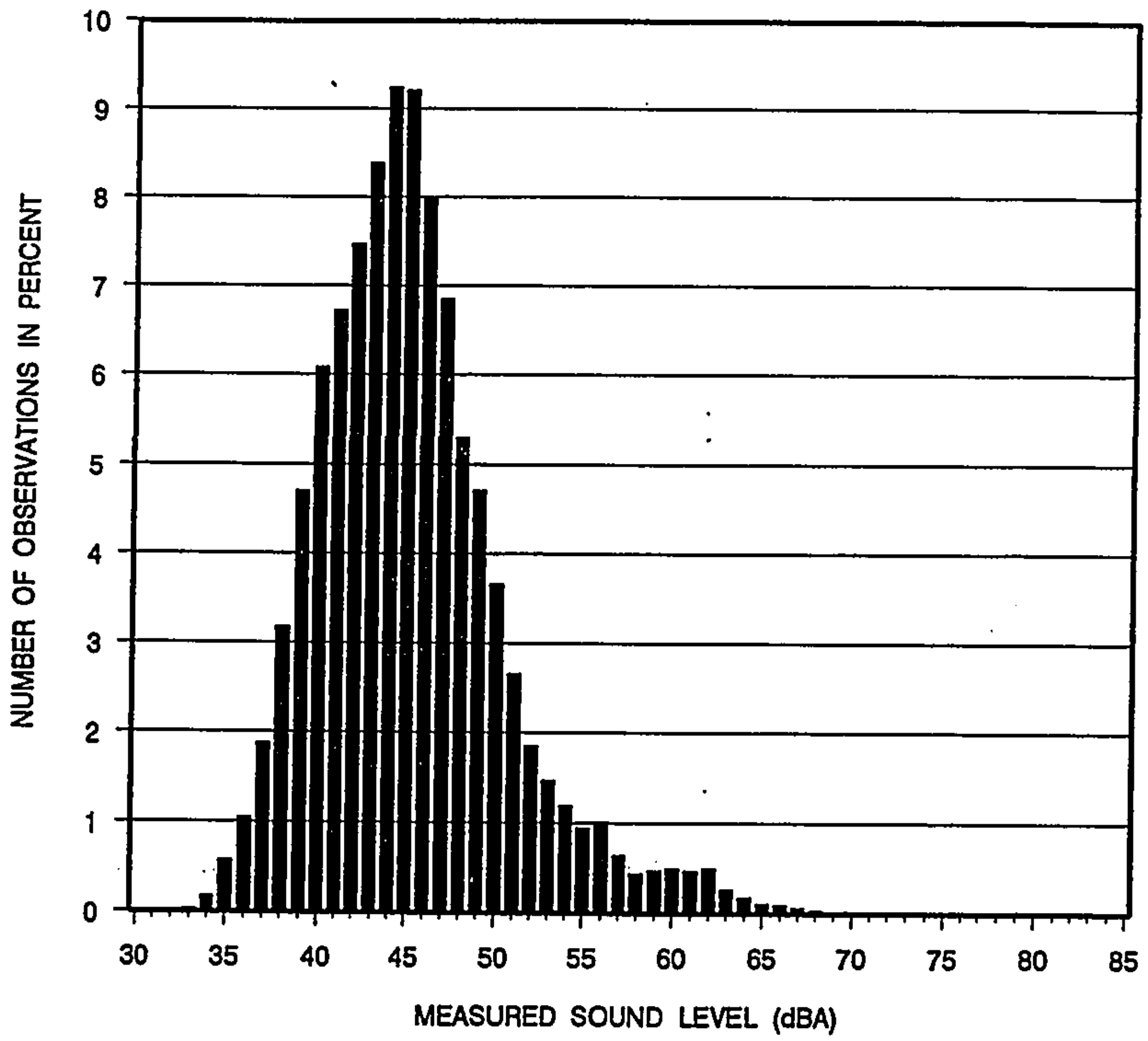
Lmax: 73.3 dBA
L10: 60.1 dBA
L50: 48.1 dBA
Leq: 56.3 dBA
Lmin: 31.2 dBA

FIGURE 5

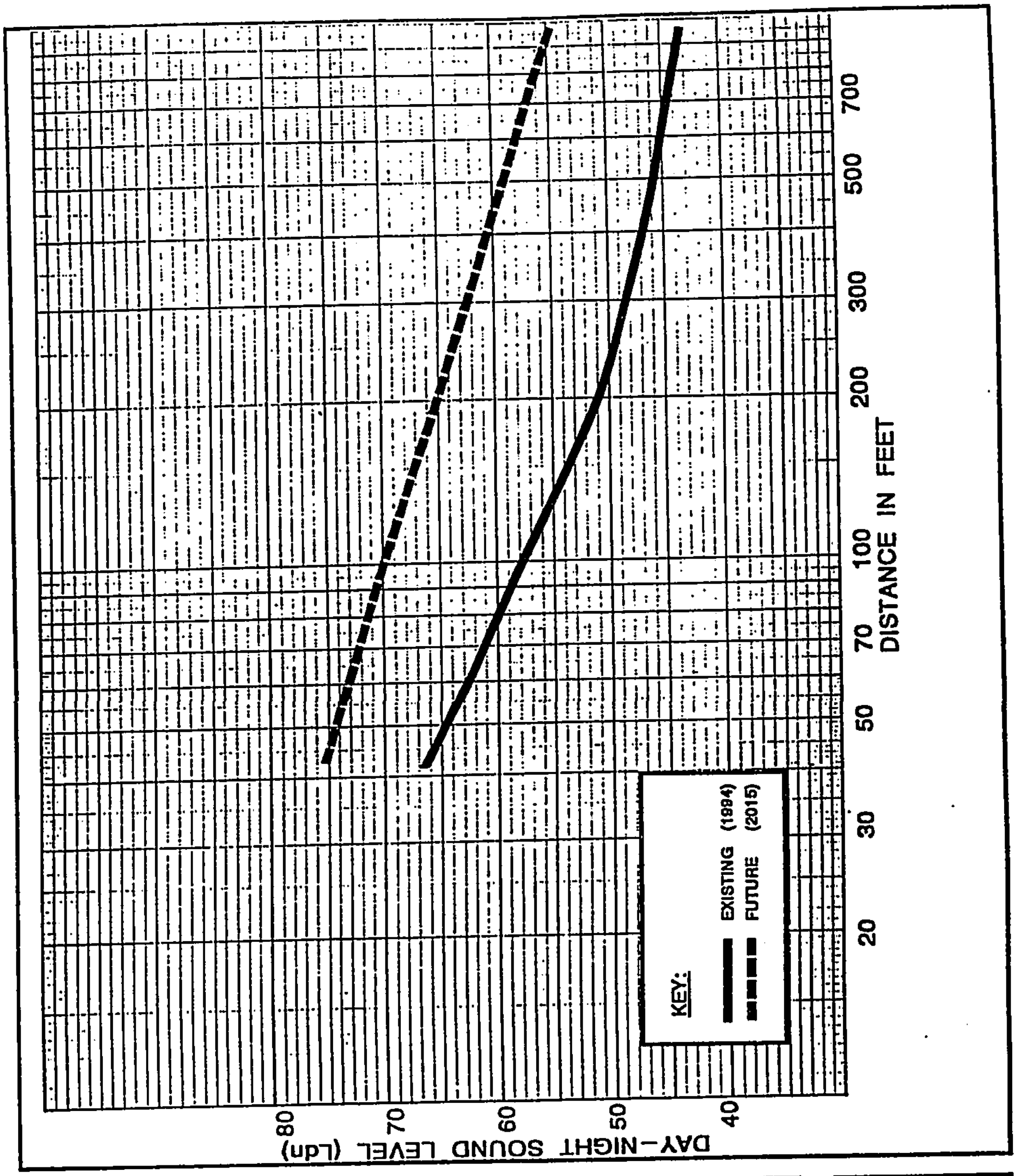
HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "C"

DATE: APRIL 21, 1994
TIME: 1425–1525 HOURS

METER RESPONSE: FAST

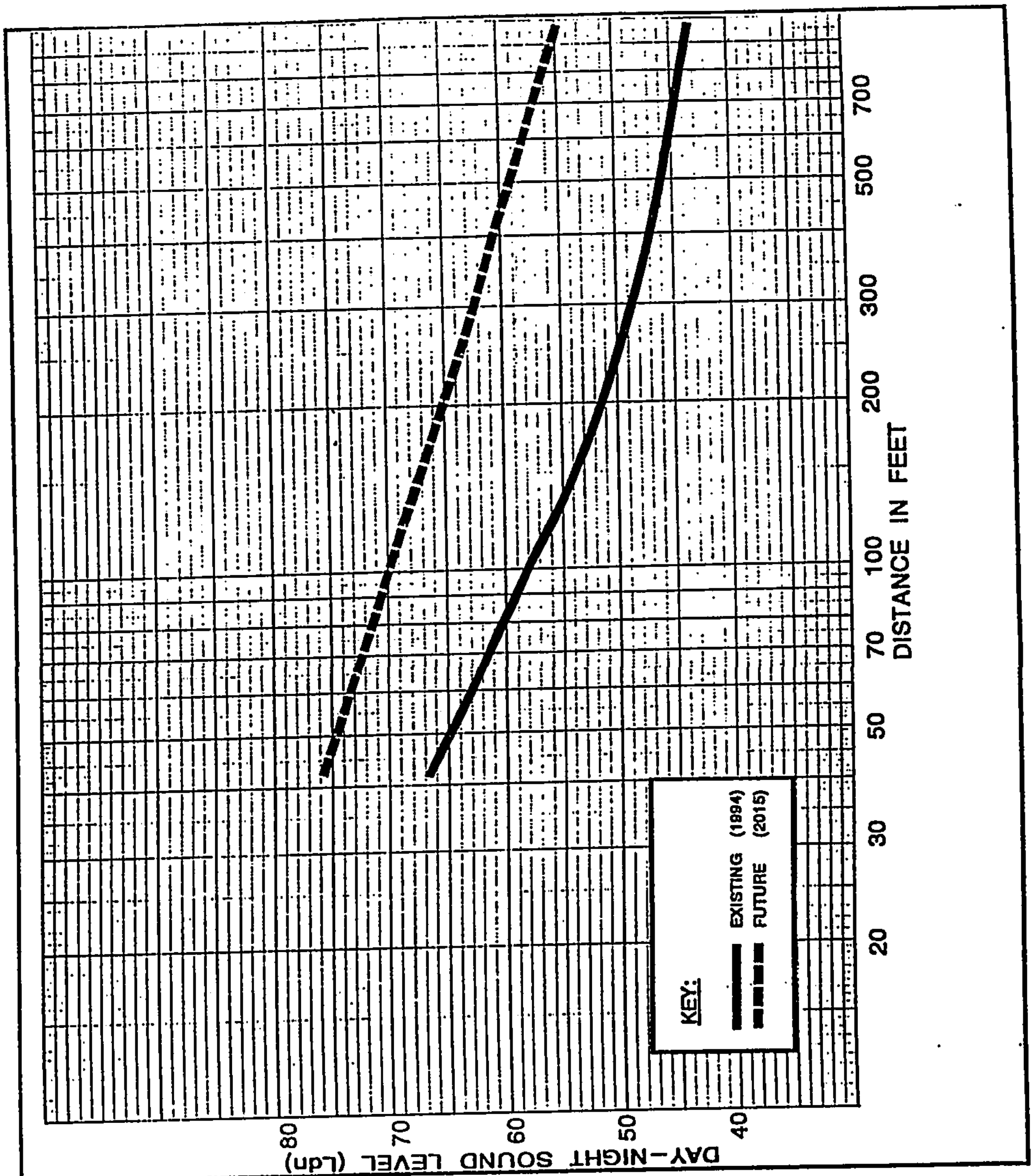


Lmax:	70.6 dBA
L10:	61.1 dBA
L50:	44.1 dBA
Leq:	49.1 dBA
Lmin:	32.7 dBA



EXISTING AND FUTURE TRAFFIC NOISE VS. DISTANCE FROM CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY (NORTH)

FIGURE 6



EXISTING AND FUTURE TRAFFIC NOISE VS. DISTANCE FROM CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY (SOUTH)

FIGURE 7

of helicopters and aircraft. At the adjacent Kona Village Resort, measured background ambient noise levels ranged from 44 to 50 dBA, and were controlled by wind, foliage, and birds. At 100 FT from the edge of the surf, measured ambient noise levels ranged from 50 to 65 dBA for 1 to 3 FT waves. Helicopter and light aircraft flyby events (no overflights observed) ranged from 55 to 70 dBA. Distant jet aircraft noise (probably from aircraft operating to or from Keahole Airport) ranged from 45 to 55 dBA. Estimated background ambient noise levels in the populated areas of the Kona Village Resort probably range from 50 to 55 Ldn. In the now vacant lands of the proposed Kaupulehu Resort Expansion, estimated background ambient noise levels are 40 to 50 Ldn in areas removed from surf and traffic noise, and from 55 to 65 Ldn within 100 FT of the surf. These levels are in the "Minimal Exposure, Unconditionally Acceptable" category (with the high surf noise levels excluded).

CHAPTER V. FUTURE ACOUSTICAL ENVIRONMENT

Along Access Roadways to Project Site. Worst case predictions of future traffic noise levels were made using the traffic volume predictions for CY 2015 following project build-out. **FIGURES 6 and 7**, present the future traffic noise level vs. distance curves which are predicted to be applicable by CY 2015. The shape of the traffic noise vs. distance curves are also expected to change due to the predicted change in roadway source characteristics from a series of intermittent traffic noise events to a nearly continuous level of traffic noise. This change is due to the increase in traffic volumes predicted by the year of ultimate development in 2015.

From **FIGURES 6 and 7**, the 55 Ldn traffic noise contour may extend as far as 950 FT from the centerline of Queen Ka'ahumanu Highway by CY 2015 for receptors with unobstructed lines-of-sight to the traffic lanes. For those receptors with obstructed (due to lava berms, etc.) lines-of-sight to the highway, the setback distances to the 55 Ldn contour are expected to range between 100 and 450 FT. By 2015, traffic noise levels within 210 FT of the centerline of Queen Ka'ahumanu Highway may be in the "Significant Exposure, Normally Unacceptable" category. Proposed single and multi-family units of the project are located beyond the 65 Ldn traffic noise contour, and should be in the "Acceptable" category. At the proposed minimum setback distance of approximately 900 FT from the highway centerline for these housing units, traffic noise levels should be below 60 Ldn, and may be below 55 Ldn if they are shielded from the highway by terrain features. The majority of the project's housing units will be located beyond the 55 Ldn contour, and they should be in the "Minimal Exposure, Unconditionally Acceptable" category.

Along the main entrance roads of the project, and beyond 172 FT from the centerlines of these roadways, future traffic noise levels are predicted to be in the "Minimal Exposure, Unconditionalally Acceptable" category. The proposed housing units of the project are located beyond 172 FT from the centerlines of the main entrance roads, and therefore, should be in this "Minimal Exposure" category.

TABLE 4 compares the increases the future traffic noise attributable to both project and non-project traffic between CY 1994 and 2015. From **TABLE 4**, traffic noise increases of approximately 5.6 Ldn are predicted to occur along the Queen Ka'ahumanu Highway as a result of non-project traffic by the Year 2015. This level of increase is considered to be significant, and will result in the enlargement of the 65 and 55 Ldn contour setback distances by a factor of approximately 2.6. Traffic noise increases attributable to project traffic should be insignificant along Queen Ka'ahumanu Highway at 0.3 to 0.6 Ldn. For this reason, traffic noise impacts resulting from project traffic should not occur along Queen Ka'ahumanu Highway.

<u>Other Background Noise</u>. With the development of the second phase of the Kaupulehu Resort, background ambient noise levels will naturally rise due to the introduction of foliage, housing occupants, visitors, employees, mechanical equipment, and transportation vehicles. However, in order to maintain the desired resort characteristics of the area, it is expected that background ambient noise levels will be controlled to levels in the 50 to 55 Ldn range by site planning and engineering controls. The addition of foliage to the primarily barren area is expected to increase the natural background ambient noise levels as a result of wind effects and the attraction of birds. Overall, minimum background ambient noise levels are predicted to rise from the 30 dB range to the 40 dB range, but it should be possible to limit total background ambient noise to levels of 50 to 55 Ldn.

TABLE 4

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2015)

STREET SECTION	NOISE LEVEL INCREASE (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Q. Kaahumanu Hwy. North of Project	5.5	0.3
Q. Kaahumanu Hwy. South of Project	5.6	0.6
Project Entrance Road @ Highway	18.8	3.1
Mauka–Makai Road @ Highway	55.9	2.2

CHAPTER VI. POTENTIAL NOISE IMPACTS AND RECOMMENDED NOISE MITIGATION MEASURES

Traffic Noise. Risks of adverse impacts from traffic noise within the project site are low and should not require extraordinary traffic noise mitigation measures. Use of adequate setback distances, control of future vehicle speeds to 25 miles per hour within the proposed housing areas, and control of vehicle speeds to 35 miles per hour along the main entrance and circulation roadways are recommended to keep future traffic noise at the lowest practical level.

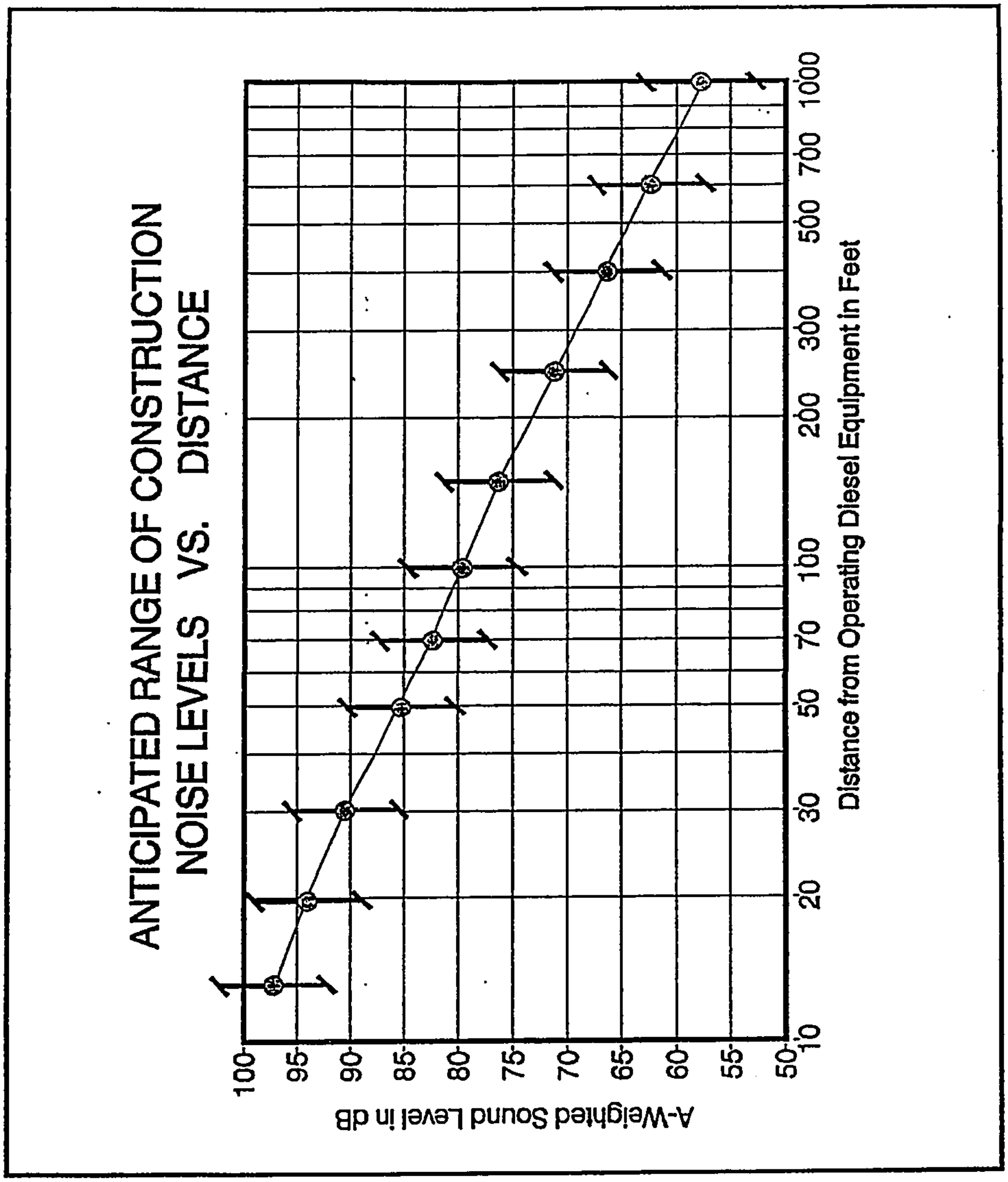
Based on this study, it was concluded that adverse impacts from project traffic noise are not likely along Queen Ka'ahumanu Highway due to the insignificant increases in traffic noise resulting from project traffic. However, to minimize future traffic noise levels at proposed housing units closest to the highway, the use of berms is recommended to provide additional noise attenuation between the highway and the housing units. In order to be effective, these berms must block the visual lines-of-sight between the windows of the proposed housing units and the highway lanes.

Intrusive Noise. The primary environmental consequence of the proposed project is the anticipated increase in background ambient noise levels at the adjacent Kona Village Resort. These increases are unavoidable due to the development of now vacant lands with housing units and new golf courses. Typical sound levels of gasoline engine powered grounds maintenance equipment exceed 70 dBA at 30 FT distance, and are high enough to be audible at the Kona Village Resort. Use of grounds maintenance equipment on the golf courses and within the proposed housing areas will occur, and adverse noise impacts from these equipment are possible.- Use of hearing protection devices for operators of these equipment are recommended, as well as scheduling of these grounds maintenance activities to avoid conflicts with nearby housing occupants and guests of the Kona Village Resort. Serious adverse noise impacts or conflicts are not expected as a result of the project since they have generally been avoidable at other similar developments.

A potential for complaints regarding audible sounds from the Kona Village Resort Luau Show does exist due to the planned location of new single family residences near the northeast boundary of the Kona Village Resort. The golf course should provide approximately 300 to 400 FT of buffer space, but amplified music and crowd noise from the luau show may still be audible at the planned residences due to the low nighttime background ambient noise levels in the project area. As a minimum, adequate disclosure of the music or other sounds emanating from entertainment activities at the Kona Village Resort should be provided to prospective tenants of the project's dwelling units.

Construction Noise. Short-term noise impacts associated with construction activities on the project site may occur. These impacts can occur as a result of the short distances (less than 100 FT) between residences and the anticipated construction work sites. The total duration of the construction period for the proposed project is not known, but noise exposure from construction activities at any one receptor location is not expected to be continuous during the total construction period.

Audible construction noise will probably be unavoidable during the project construction period. Noise levels of diesel powered construction equipment typically range from 80 to 90 dB at 50 FT distance. Typical levels of noise from construction activity (excluding pile driving activity) are shown in **FIGURE 8**. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in **FIGURE 8**, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. **FIGURES 9 thru**



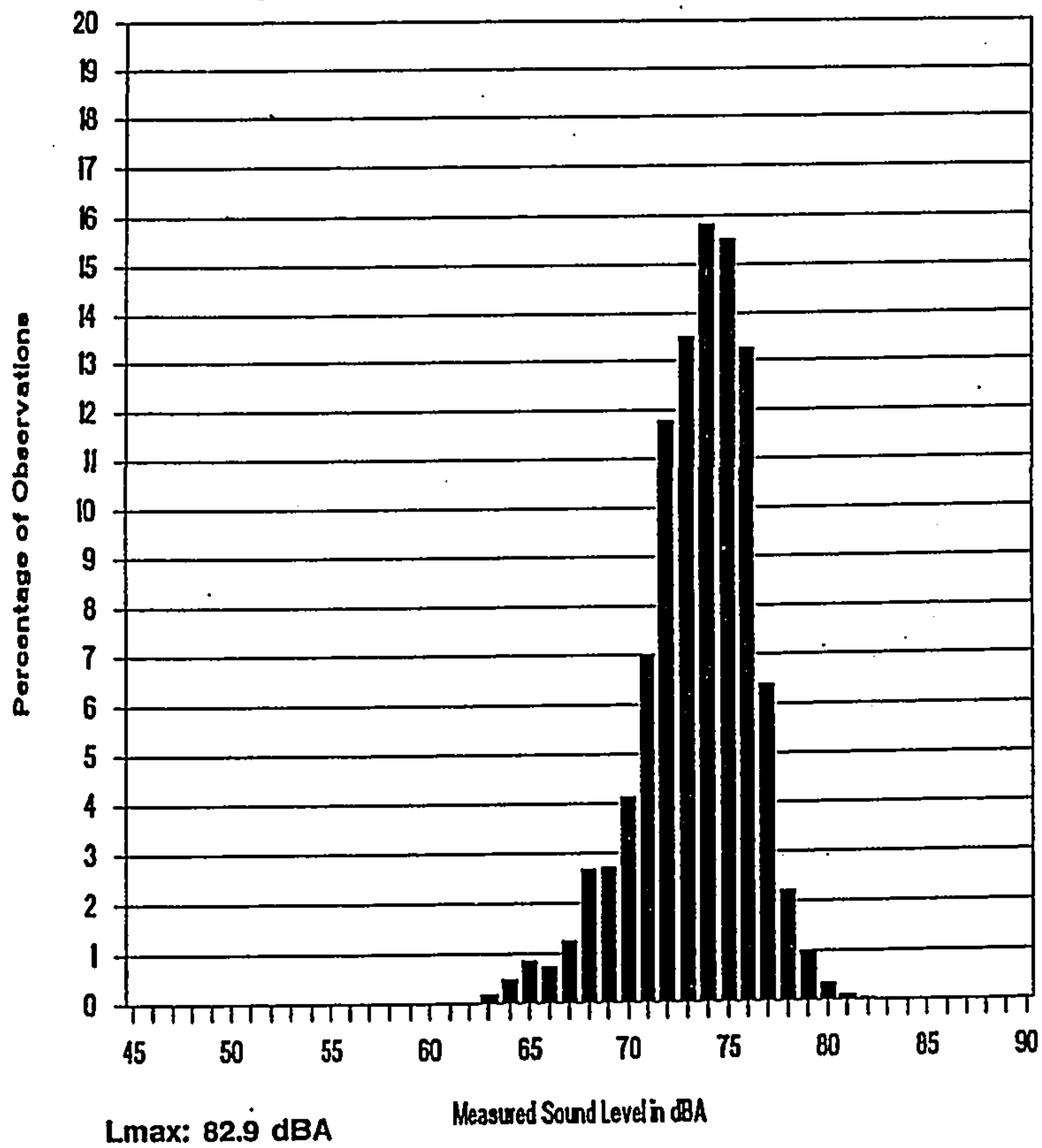
CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 8

FIGURE 9

TYPICAL NOISE LEVELS FROM GRADING WORK AT 100 FT DISTANCE

DATE: May 21, 1990 **METER RESPONSE:** Slow

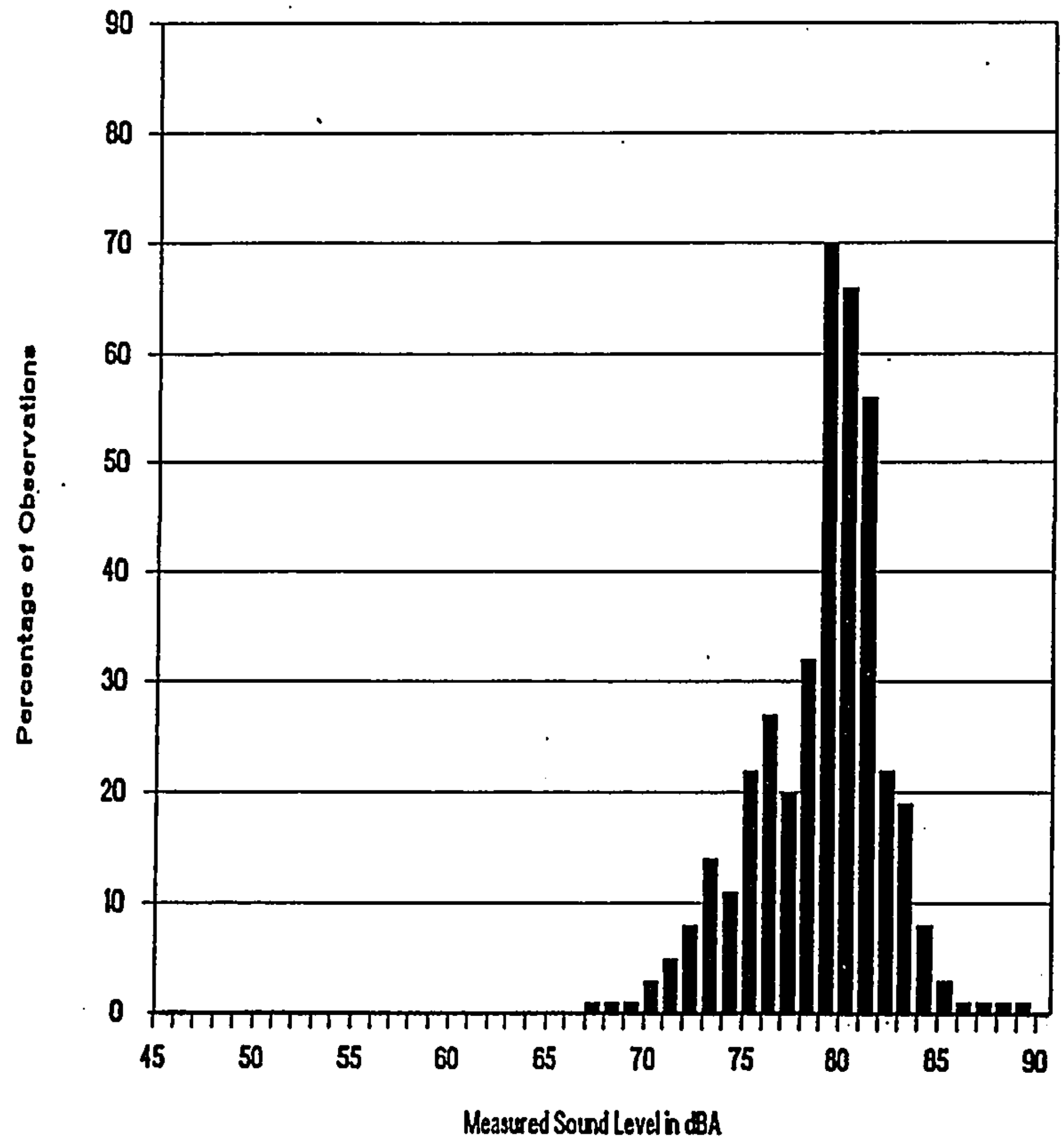


Lmax: 82.9 dBA
L10: 77.0 dBA
Leq: 74.7 dBA
Lmin: 63.0 dBA

FIGURE 10

TYPICAL NOISE LEVELS FROM TRENCHING WORK AT 100 FT DISTANCE

DATE: Mar. 2, 1988 METER RESPONSE: Slow



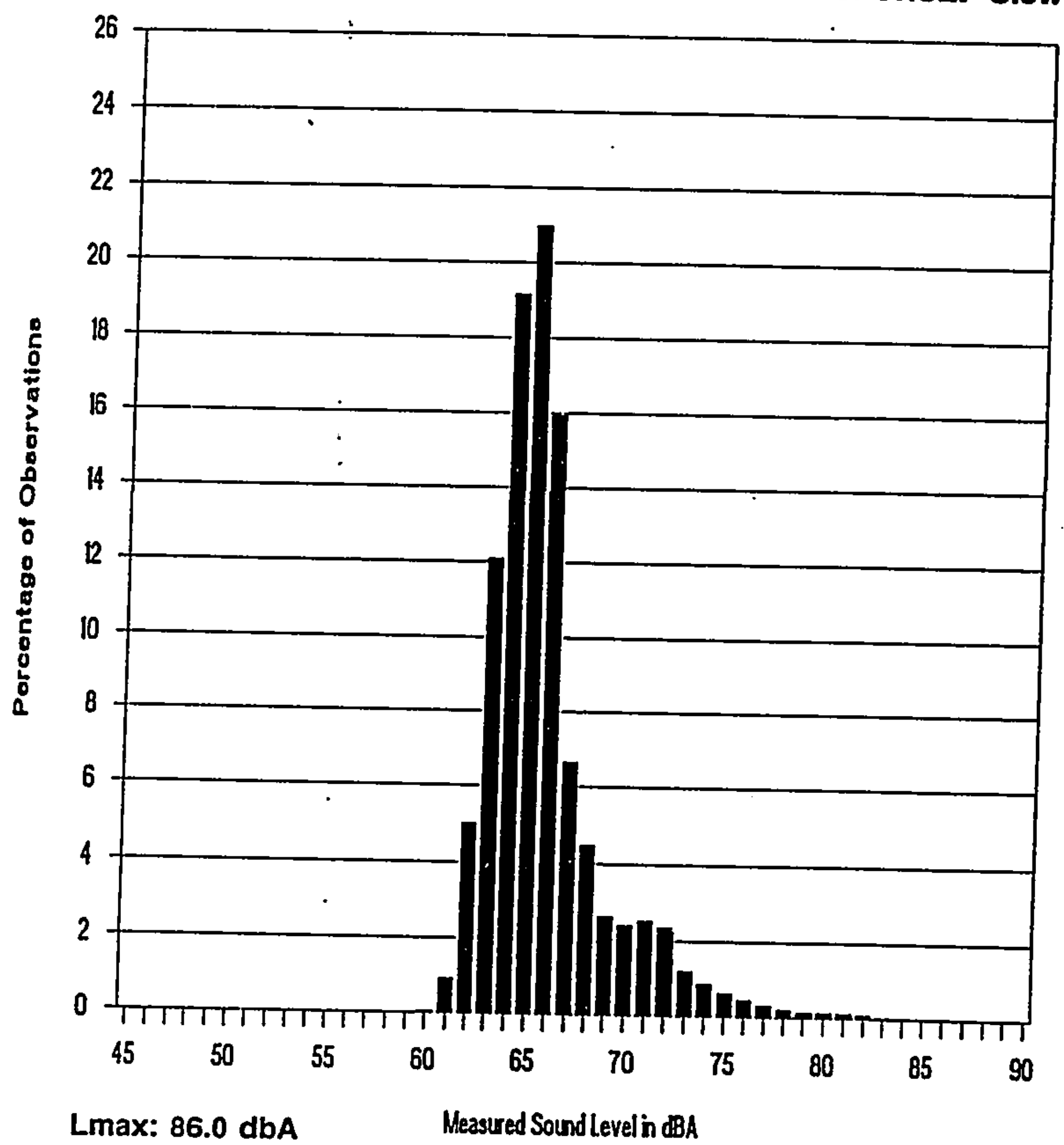
Lmax: 89.5 dBA
Leq: 79.1 dBA
Lmin: 65.3 dBA
L10: 82.0 dBA

FIGURE 11

TYPICAL NOISE LEVELS FROM BUILDING ERECTION WORK AT 100 FT DISTANCE

DATE: May 17, 1990

METER RESPONSE: Slow



Lmax: 86.0 dbA
L10: 70.0 dBA
Leq: 67.9 dBA
Lmin: 60.0 dBA

11 depict the typical noise levels during various phases of construction work at 100 FT distance. 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.

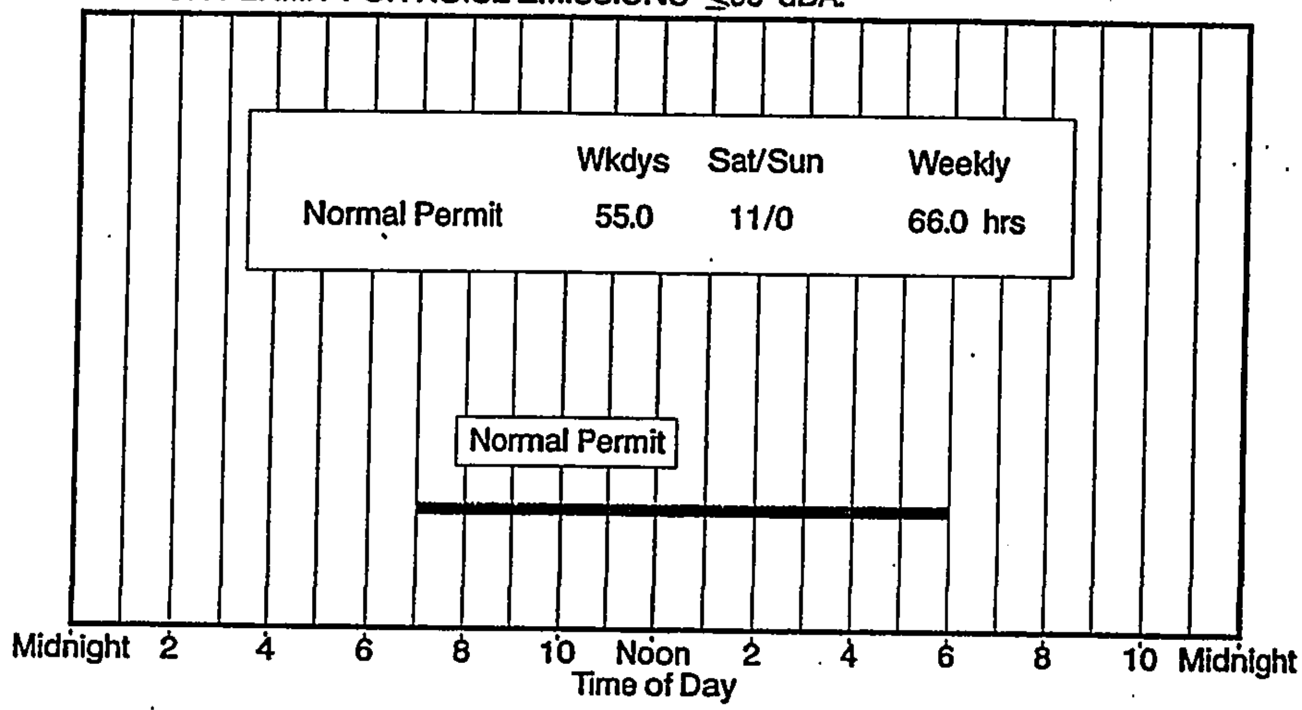
The noise sensitive property which is predicted to experience the highest noise levels during construction activities is the adjacent Kona Village Resort. Construction noise levels at the resort will be audible and may intermittently exceed 80 dB when site preparation work is being performed at close distances to the resort boundaries.

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 (rock breaking, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment and construction vehicles which comply with State Department of Health vehicular noise limits (Reference 10) should be required on the job site. The State Department of Health currently regulates noise from construction activities on Oahu under a permit system (Reference 11). Under current permit procedures (see TABLE 5), noisy construction activities which exceed 95 dB at the project boundary lines are restricted to hours between 9:00 AM and 5:30 PM, from Monday through Friday, and exclude certain holidays. The incorporation of State Department of Health construction noise limits and curfew times are recommended as another construction noise mitigation measure. The use of properly muffled construction equipment and vehicles, plus the siting of heavy truck staging areas and portable generators, pumps, or compressors away from noise sensitive receptors are also recommended. The early phasing of the construction of

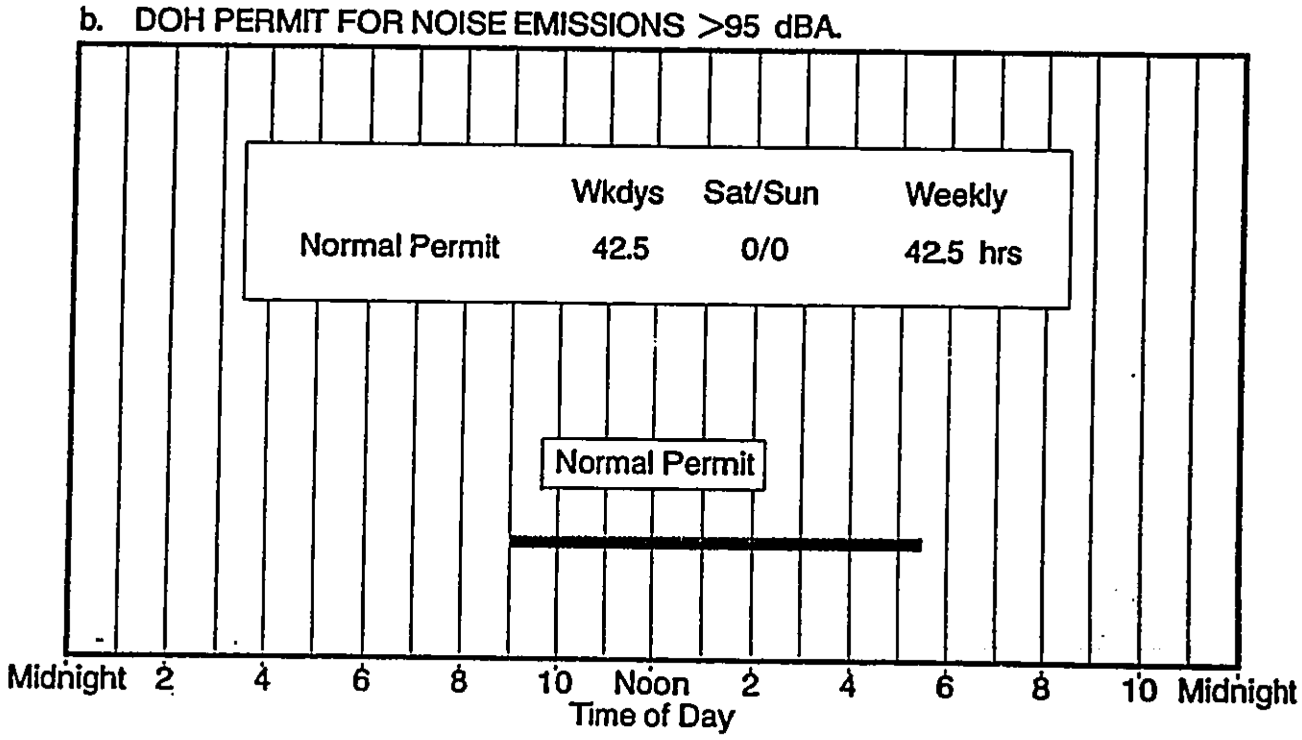
TABLE 5

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤95 dBA.



b. DOH PERMIT FOR NOISE EMISSIONS >95 dBA.



landscaped buffers/berms between noise sensitive receptors and the job sites of later phases of construction is another possible noise mitigation measure. As a minimum, prospective clientele of both the existing Kona Village Resort and the future Kaupulehu Resort Expansion should be advised of any ongoing construction activities within audible distances. The minimum audible distances to construction noise sources will be more accurately determinable during the early phases of the construction.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use;" ANSI S12.40-1990; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74-004; March 1974.

(5) Federal Highway Administration; "Procedures for Abatement of Highway Traffic Noise and Construction Noise;" 23 CFR Chapter I, Subchapter J, Part 772; July 8, 1982.

(6) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model"; FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(7) Traffic Assignments for Kaupulehu Phase II Development; Transmittal from The Traffic Management Consultant; May 20, 1994.

(8) 24-Hour Traffic Counts; Station #8-P, Queen Ka'ahumanu Highway at Keahole Airport Road; Hawaii State Department of Transportation; July 6, 1992.

(9) 24-Hour Traffic Counts; Station #8-H, Queen Ka'ahumanu Highway at Waikoloa Road; Hawaii State Department of Transportation; July 6, 1992.

(10) "Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu;" Hawaii State Department of Health; October 24, 1981.

(11) "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

<u>Descriptor Symbol Usage</u>

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.

<u>Descriptor Nomenclature</u>

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., deci).

<u>Noise Impact</u>

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" (PHL) shall be used consistent with CHABA Working Group 69 Report <u>Guidelines for Preparing Environmental Impact Statements (1977)</u>.

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

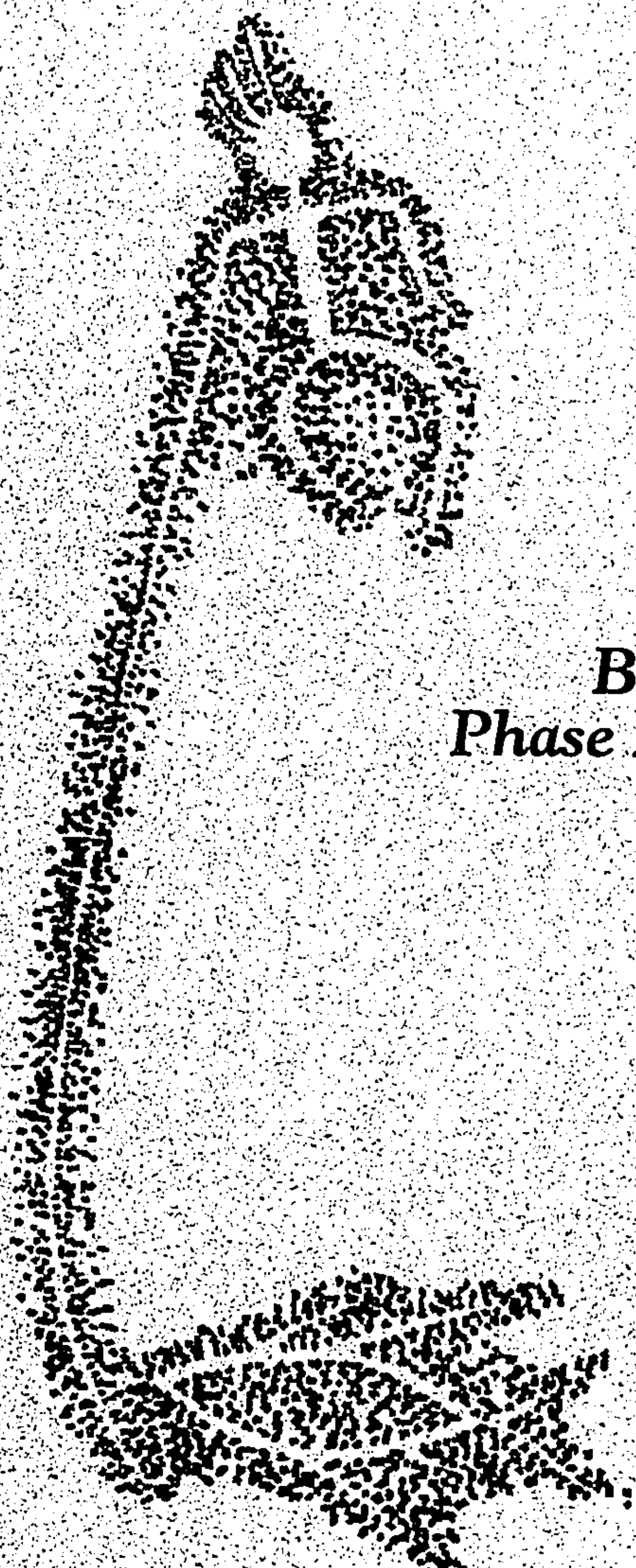
TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% 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_{Bd}	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

Botanical Survey, Kaupulehu Phase 2 Development, North Kona District, Island of Hawaii

BOTANICAL SURVEY
KA'UPULEHU PHASE 2 DEVELOPMENT
NORTH KONA DISTRICT, ISLAND OF HAWAI'I

by

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March 1994

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BOTANICAL SURVEY
KA'UPULEHU PHASE 2 DEVELOPMENT
NORTH KONA DISTRICT, ISLAND OF HAWAI'I

INTRODUCTION

The project site consists of approximately 1,000 acres of land located in North Kona. It is bounded by the Queen Ka'ahumanu Highway to the south, the Ka'upulehu Resort, Phase 1, to the west, the undeveloped Land of Pu'uwaawaa to the northeast, and the ocean and Kona Village Resort to the northwest. The subject property is proposed for reclassification to the State Urban District to accommodate some of the future development of the Ka'upulehu Resort. The developments proposed for the property include single and multi-family housing, a 36-hole golf course and clubhouse, a commercial center, archaeological preserve areas, etc.

The vegetation on the ±1,000-acre project site consists of an open scub on the areas with pahoehoe lava flows; its general physiognomy is of scattered patches of grasses, shrubs, and short-statured kiawe trees. The Ka'upulehu Flow of 1800, an 'a'a lava flow, covers roughly half of the project site; the flow is barren of vegetation except along its edges where it interfaces the geologically older and weathered pahoehoe flows. Along the shoreline, there is a narrow band of coastal strand vegetation composed primarily of kiawe trees on the rocky headlands and low mats of beach morning-glory or pohuehue on the coastal flats with course coralline sand.

Field studies to assess the botanical resources found on the ±1,000-acre project site were conducted on 24 and 25 February 1994. A team of three botanists was used. The primary objectives of the field studies were to: 1) provide a general description of the major vegetation types; 2) inventory the flora; 3) search for threatened and endangered species as well as rare and vulnerable plants; and 4) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other studies conducted in the general area. Topographic maps and a colored aerial photograph were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

Access was from the Kona Village Resort road. Along the ocean is a coastal trail. The trail is a narrow footpath where it crosses the Ka'upulehu Lava Flow, but widens into a jeep trail towards its northern end. The field studies focused primarily on the scrub vegetation on pahoehoe flows and the coastal strand. No transects were made across the 'a'a lava flow except where the coastal trail crosses over the flow.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, topography, exposure, drainage, etc. Plant identifications were made in the field; plants which could not be positively determined were collected for later identification in the herbaria (HAW, BISH), and for comparison with the most recent taxonomic literature.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. A survey taken at a different time of the year and under varying environmental conditions would no doubt yield slight variations in the species list, especially of the weedy, annual plants. Landscape plantings which are found along portions of the project site where it adjoins the Kona Village Resort are not included in the species list found at the end of this report.

DESCRIPTION OF THE VEGETATION

There have been a number of botanical surveys on the Ka'upulehu lands mauka of the Queen Ka'ahumanu Highway, and on the nearby Kuki'o property. The lower southern portion of the Phase 2 project site was originally included in the earlier botanical survey (Char 1985) for Phase 1 of the Ka'upulehu Resort. One plant of 'ohai (Sesbania tomentosa) was found during the 1985 survey; the plant was relocated during the present study. A more detailed discussion of the 'ohai can be found in the "Endangered Species" section of this report.

Scrub vegetation covers roughly about one-half of the Phase 2 project site where it occurs on pahoehoe lava flows (mapped as "rLW" on the soil maps) or on rockland (mapped as "rRO"). The Ka'upulehu Lava Flow ("rLV") which dominates much of the project site is barren except along its edges where there is sparse scrub vegetation. Along the coastline, there is a narrow band of coastal strand vegetation on areas with pahoehoe lava. Where the Ka'upulehu flow meets the sea, it is barren, jagged, tumbled heaps of 'a'a lava with small pockets of black sand beaches. The scrub vegetation and coastal strand vegetation are decribed in more detail below.

Coastal Strand Vegetation

This vegetation type occurs as a narrow belt along the shoreward portion of the project site. Where the Ka'upulehu Lava Flow meets the sea, the 'a'a flow is barren; there is only one small patch of beach morning-glory vine or pohuehue (Ipomoea pes-caprae) on the black sand beach closest to the Kona Village Resort side of the flow.

On the northern portion of the coast, the substrate is pahoehoe lava flows. Here, kiawe trees (Prosopis pallida) form a dense thicket, 18 to 25 ft. high. Beneath the trees there is no ground cover, although there is a thick layer of organic material from the decayed leaves. Stretching along the coast in some places, between the kiawe thickets and the wave-swept boulder beaches and rocky headlands, are flat areas with course coralline sand. These sandy flats are covered primarily with low, tangled mats of beach morning-glory. Also found in these areas are plants of pluchea (Pluchea symphytifolia), 'uhaloa (Waltheria indica), fountain grass (Pennisetum setaceum), 'aheahea (Chenopodium murale), nena or kipukai (Heliotropium curassavicum), and 'ilima (Sida fallax). A few trees of tree heliotrope (Tourneforthia argentea) also occur here.

No anchialine ponds or wetland areas were observed in this vegetation type, or on the Phase 2 project site.

Scrub Vegetation

This vegetation type consists of scattered patches of plants on pahoehoe lava flows of different ages. Fountain grass is the most abundant of the grasses, although in low-lying places or swales Natal redtop grass (Rhynchelytrum repens) may be locally common. Two native subshrubs, 'ilima and 'uhaloa, are abundant. Other shrubs found here occasionally include pluchea, noni (Morinda citrifolia), indigo (Indigofera suffruticosa), and nehe (Lipochaeta lavarum). A'ali'i shrubs (Dodonaea viscosa) are rare and occur on the mauka-most portion of the property. Scattered trees of kiawe are of short-stature, 6 to 12 ft. tall, and form about 3 to 5% cover. Smaller herbaceous material consists of plants such as Portulaca pilosa, coatbuttons (Tridax procumbens), hairy spurge (Chamaesyce hirta), Eragrostis tenella, and thread-stem carpetweed (Molluga cerviana). A small, annual, endemic grass, Panicum pellitum, is uncommon on the project site. Most of the vegetation on the ±1,000-acre project site shows browsing damage from feral donkeys and goats. Donkey droppings are a common sight on the property.

There is some slight variation in the scrub vegetation depending on the age of the flow and the amount of weathering. The older flows have a very thin layer of soil in shallow swales and support a denser cover of grasses and somewhat taller kiawe trees, 12 to 18 ft. high. Plant cover is about 30 to 40%. The 'ohai (Sesbania tomentosa) occurs on such an older flow. Most of the site, however, is covered by a younger pahoehoe flow which is somewhat "shelly", that is, the upper crust has broken into many fragments and is slightly oxidized; it crunches underfoot. Plant cover on this type of flow may vary from 5 to as much as 20%. 'Uhaloa tends to be abundant over these flows with 'ilima, indigo, and fountain grass occurring primarily in depressions. Kiawe cover is low, about 1 to 3%, and consists of shorter trees, 6 to 8 ft. tall. On the northeast portion of the property, the pahoe-hoe is geologically younger with a glassy, black surface. There is very little vegetation (about 5% cover) on this flow except in swales and other low spots.

As mentioned earlier, the Ka'upulehu Lava Flow is devoid of vegetation except along its margins where the massive 'a'a flow has crept over the older pahoehoe lavas. Along this interface area, the sparse vegetation usually consists of somewhat taller fountain grass and pluchea shrubs.

ENDANGERED SPECIES

One plant of 'ohai (Sesbania tomentosa) was found during the field studies; this is the same plant recorded in the earlier survey (Char 1985), then identified as Sesbania arborea. Since the most recent treatment of the Hawaiian flora by Wagner et al. (1990), all of the Hawaiian Sesbania have been synonymized with Sesbania tomentosa.

The 'ohai along with eleven other island-wide Hawaiian species is currently proposed for endangered species status by the U.S. Fish and Wildlife Service (1993). The proposal is expected to be finalized sometime soon. When this occurs, the 'ohai will become an officially listed endangered species and the Federal protection and recovery provisions provided by the Endangered Species Act of 1973, as amended, would be implemented. When listed, it would also implement State regulations protecting the plants as endangered species on all lands within the State (H.R.S. 195-D).

The 'ohai on the project site is found about 600 ft. north of the Kona Village Resort water tanks, at about 120 ft. elevation (Figure 1) on weathered pahoehoe lava with open scrub and scattered kiawe trees. In the 1985 survey, only a single plant was found; no seedlings or saplings were observed then. During this study, an intensive search was made of the Phase 2 site, especially in areas with similar aged pahoehoe flows, but no other 'ohai plants were found. Again, no seedlings or young plants were observed near the one plant, although it produces fruit readily. Mature fruits were collected for distribution later to the National Tropical Botanical Garden (NTBG).

The main branch appears to have fallen over since the plant was last observed in 1985, but in general the plant appears healthy and is flowering.

Two Category 2 candidate endangered species also are found on the project site. Category 2 plants are species for which there is some evidence of vulnerability, but for which there are not enough data to support listing proposals at this time (U.S. Fish and Wildlife Service 1990). The native caper or maiapilo (*Capparis sandwichiana*) can be found mauka of the Ka'upulehu landing strip. A few plants of *Fimbristylis hawaiiensis* can be found scattered throughout the scrub vegetation.

DISCUSSION AND RECOMMENDATIONS

The Ka'upulehu Lava Flow of 1800 (1801?), a massive 'a'a flow, dominates much of the project site. It is largely devoid of vegetation except along its margins where it adjoins the older pahoehoe flows. The geologically older and more weathered pahoehoe flows support an open scrub vegetation composed primarily of fountain grass, shrubs of 'ilima and 'uhaloa, and scattered trees of kiawe. Along the coastline, the Ka'upulehu flow is again barren of vegetation except for one, small patch of beach morning-glory. Where the substrate is pahoehoe lava, there is a dense thicket of kiawe trees. Sandy flat areas support tangled mats of beach morning-glory.

One plant of the 'ohai (*Sesbania tomentosa*), a proposed endangered species, occurs on the project site at about the 120 ft. elevation, just north of the Kona Village Resort water tanks. A few plants of maiapilo (*Capparis sandwichiana*) and *Fimbristylis hawaiiensis*, both Category 2 candidate endangered species, also are found on the project site. Besides the 'ohai, maiapilo, and *Fimbrsitylis*, no ther listed, proposed, or candidate threatened endangered species (U.S. Fish and Wildlife Service 1989, 1990, 1992, 1993) were found during the field studies.

Of a total of 44 species inventoried on the Phase 2 project site, 28 (64%) are introduced or alien species; 2 (4%) are originally of Polynesian introduction; and 14 (32%) are native. Of the natives 7 are endemic, that is, they are native only to the Hawaiian Islands, and 7 are indigenous, that is, they are native to the islands and also elsewhere.

Recommendations

The vast majority of the area planned for development contains either barren 'a'a lava or scrub vegetation. The scrub vegetation and the narrow belt of coastal strand vegetation do support a number of native components, but, in general, these are primarily wide-spread species and the proposed development is not expected to have a significant negative impact on these botanical resources.

Of primary concern, is the preservation of the 'ohai plant. It is recommended that a plant preserve area be established around the plant. There is already an archaeological preserve area planned near the 'ohai; this preserve may be enlarged to include the 'ohai. It is also recommended that a management/horticultural plan be prepared for increasing the number of 'ohai plants. These additional plants as well as the maiapilo can be used for land-scaping the archaeological preserve areas.

As the 'ohai is expected to be listed as an endangered species soon, it is recommended that the U.S. Fish and Wildlife Service and the State's Division of Forestry and Wildlife be contacted for advice at the planning stage.

PLANT SPECIES LIST -- Ka'upulehu Phase 2 Development

A checklist of all those terrestrial, vascular plant species inventoried on the project site during the field studies is presented below. The species are arranged alphabetically by families within each of three groups: Ferns, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns follow Lamoureux (1988); the flowering plants, Monocots and Dicots, are in accordance with Wagner et al. (1993).

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 Hawaiian islands, and also elsewhere throughout the Pacific
   P = Polynesian = plants originally of Polynesian introduction prior to Western contact (1778); not native
   X = introduced or alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact; not native
4. Presence (+) or absence (-) of a particular species within each of two vegetation types recognized on the project site (see text for discussion):
   c = Coastal Strand Vegetation
   s = Scrub Vegetation

Scientific name	Common name	Status	Vegetation type c	Vegetation type s
FERNS				
NEPHROLEPIDACEAE (Sword Fern Family)				
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X	-	+
FLOWERING PLANTS				
MONOCOTS				
ARECACEAE (Palm Family)				
Cocos nucifera L.	coconut, niu	P	+	-
CYPERACEAE (Sedge Family)				
Fimbristylis hawaiiensis Hillebr.		E	-	+
POACEAE (Grass Family)				
Aristida adscensionis L.	sixweeks threeawn	X	-	+
Cenchrus ciliaris L.	buffel grass	X	+	+
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	X	-	+
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili, piligrass	I	-	+
Panicum pellitum Trin.		E	-	+
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X	+	+
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	-	+
DICOTS				
AMARANTHACEAE (Amaranth Family)				
Amaranthus viridus L.	slender amaranth, pakai	X	-	+
APOCYNACEAE (Dogbane Family)				
Catharanthus roseus (L.) G. Don	periwinkle	X	-	+

Scientific name	Common name	Status	Vegetation type c	Vegetation type s
ASCLEPIADACEAE (Milkweed Family)				
Calotropis gigantea (L.) W.T. Aiton	crown flower, puaka-launa	X	-	+
Calotropis procera (Aiton) W.T. Aiton	small crown flower	X	-	+
ASTERACEAE (Sunflower Family)				
Emilia fosbergii Nicolson	pualele	X	+	+
Lipochaeta lavarum (Gaud.) DC.	nehe	E	-	+
Pluchea symphytifolia (Mill.) Gillis	pluchea, sour bush	X	+	+
Tridax procumbens L.	coat buttons	X	-	+
Vernonia cinerea var. parviflora (Reinw.) DC.	little ironweed	X	-	+
BORAGINACEAE (Heliotrope Family)				
Heliotropium curassavicum L.	kipukai, nena	I	+	-
Tourneforthia argentea L.f.	tree heliotrope	X	+	-
CACTACEAE (Cactus Family)				
Opuntia ficus-indica (L.) Mill.	panini	X	-	+
CAPPARACEAE (Caper Family)				
Capparis sandwichiana DC.	maiapilo, puapilo	E	+	+
CHENOPODIACEAE (Goosefoot Family)				
Chenopodium murale L.	nettle-leaved goose-foot, 'aheahea	X	+	-
COMBRETACEAE (Combretum Family)				
Terminalia catappa L.	tropical almond, false kamani	X	+	-
CONVOLVULACEAE (Morning-glory Family)				
Ipomoea indica (J. Burm.) Merr.	koali 'awania	I	-	+

Scientific name	Common name	Status	Vegetation type c	Vegetation type s
Ipomoea pes-caprae ssp. brasiliensis (L.) Ooststr.	beach morning-glory, pohuehue	I	+	-
Jacquemontia ovalifolia ssp. sandwicensis (Choisy) H. Hallier	pa'uoHi'iaka, kauao-Hi'iaka	E	+	-
EUPHORBIACEAE (Spurge Family)				
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	+	+
FABACEAE (Pea Family)				
Indigofera suffruticosa Mill.	indigo, 'iniko	X	-	+
Leucaena leucocephala (Lam.) de Wit	koa-haole, ekoa	X	-	+
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X	+	+
Sesbania tomentosa Hook. & Arnott	'ohai	E	-	+
LAMIACEAE (Mint Family)				
Hyptis pectinata (L.) Poit.	comb hyptis	X	-	+
MALVACEAE (Mallow Family)				
Sida fallax Walp.	'ilima	I	+	+
MOLLUGINACEAE (Carpetweed Family)				
Mollugo cerviana (L.) Ser.	threadstem carpetweed	X	+	+
PAPAVERACEAE (Poppy Family)				
Argemone glauca (Nutt. ex Prain) Pope	pua kala, kala	E	-	+
PASSIFLORACEAE (Passion Flower Family)				
Passiflora foetida L.	scarlet-fruited passion-flower, pohapoha	X	-	+

Scientific name	Common name	Status	Vegetation type c	s
PORTULACACEAE (Purslane Family)				
Portulaca oleracea L.	pigweed, common purslane	X	+	+
Portulaca pilosa L.		X	+	+
PROTEACEAE (Protea Family)				
Grevillea robusta A. Cunn. ex R. Br.	silk oak, 'oka kalika	X	-	+
RUBIACEAE (Coffee Family)				
Morinda citrifolia L.	noni	P	-	+
SAPINDACEAE (Soapberry Family)				
Dodonaea viscosa Jacq.	a'ali'i	I	-	+
STERCULIACEAE (Cacao Family)				
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?	+	+

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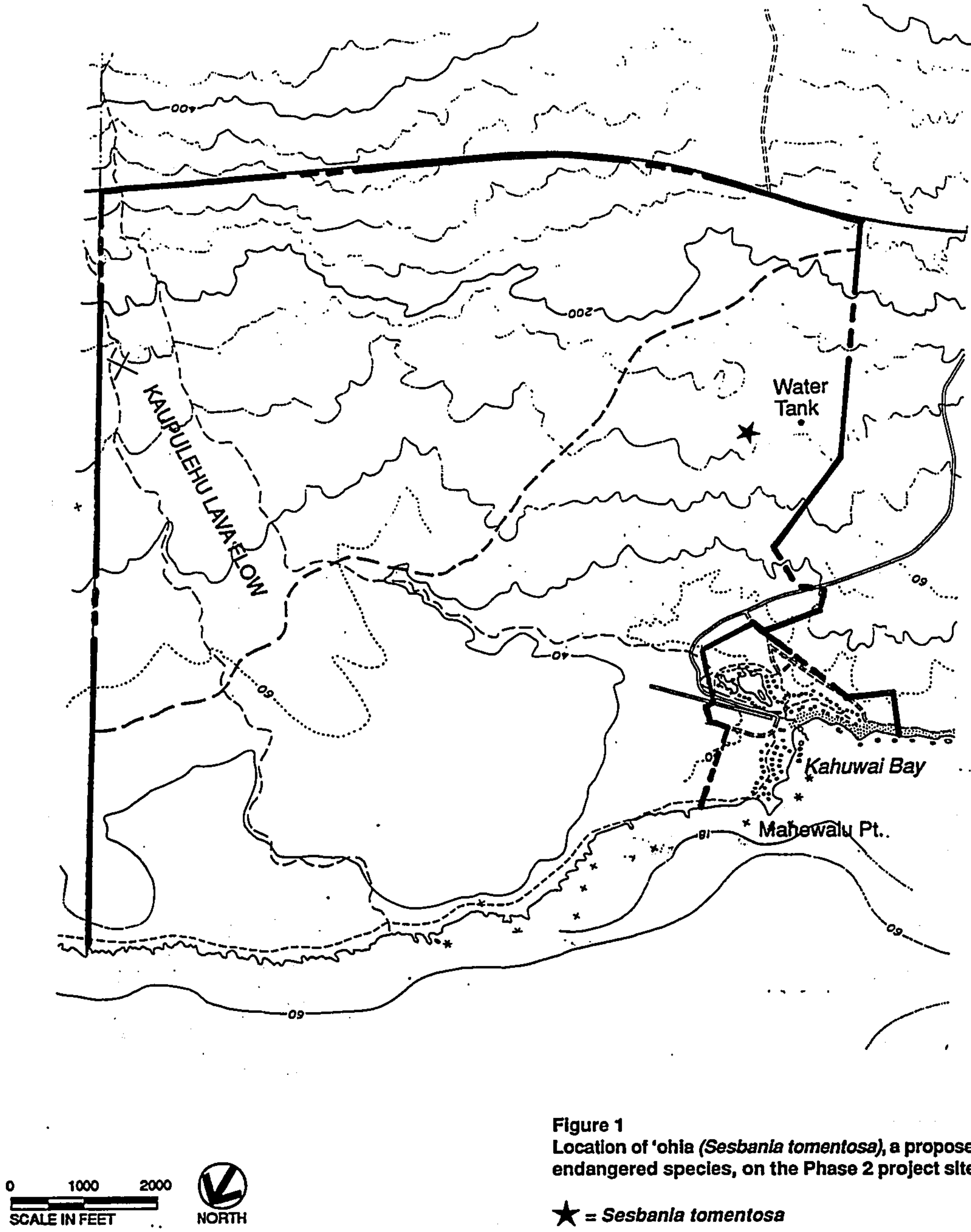
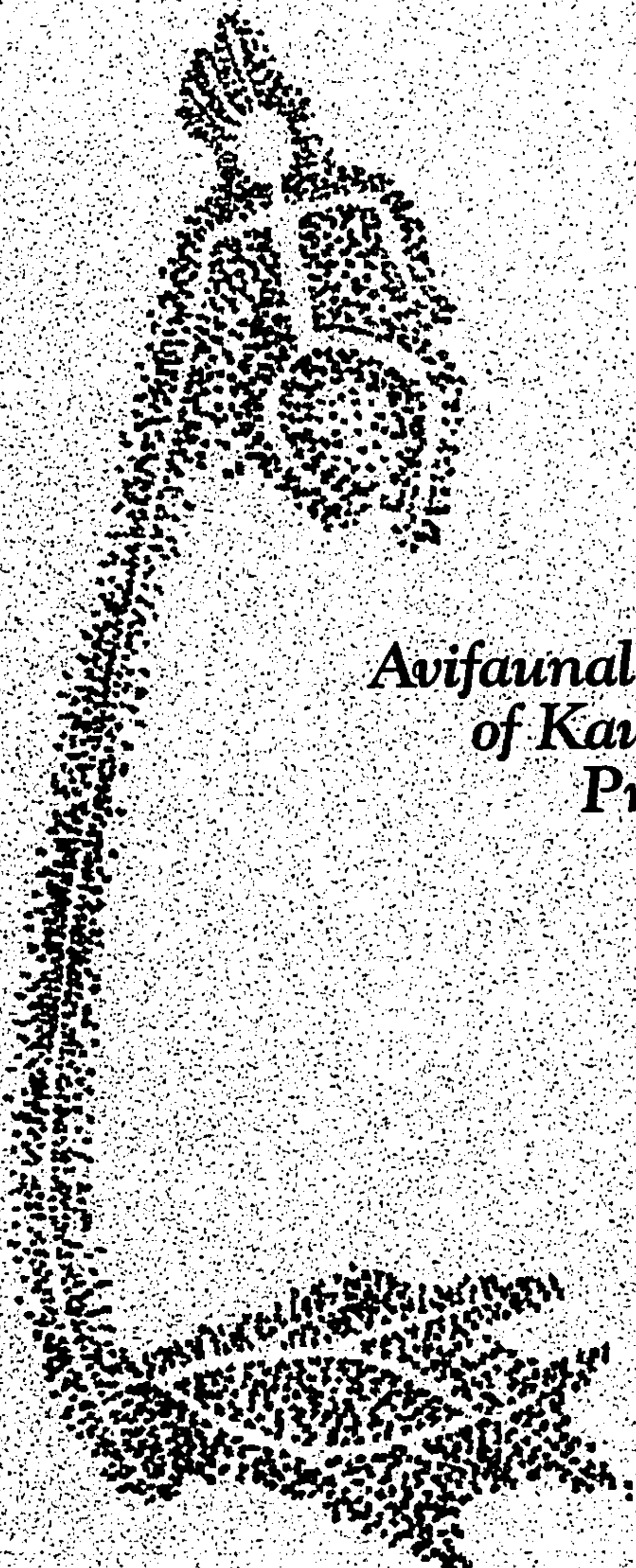


Figure 1
Location of 'ohia *(Sesbania tomentosa)*, a proposed endangered species, on the Phase 2 project site.

★ = ***Sesbania tomentosa***



Appendix G

Avifaunal and Feral Mammal Survey of Kaupulehu Phase 2 Expansion Project, North Kona, Hawaii

AVIFAUNAL AND FERAL MAMMAL SURVEY OF KAUPULEHU
PHASE 2 EXPANSION PROJECT, NORTH KONA, HAWAII

Prepared for

Belt Collins & Associates

by

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9 February 1994

INTRODUCTION

The purpose of this report is to summarize the findings of a two day (5-6 February 1994) bird and mammal field survey conducted on approximately 1000 acres of the Kaupulehu Phase 2 Expansion Project, North Kona, Hawaii (Fig. 1). Also included in the report are references to pertinent literature as well as unpublished faunal studies.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely be found there given the type of habitats available.

2- Provide some baseline data on the relative (estimated) abundance of each species.

3- Determine the presence or likely occurrence of any native birds or mammals, particularly any that are listed as "Endangered" or "Threatened".

4- Identify any sites or habitat that may be unique or of special importance to native wildlife.

GENERAL SITE DESCRIPTION

Figure One indicates the limits of the area surveyed for birds and mammals. Barren A'A lava flows cover much of the lower elevation portions of the site. The upper (mauka) sector contains scatterred brush, dry grasses and low growing native plants like Ilima. The nearby Kona Village resort is an oasis of large trees and ornamental plantings surrounding small brackish ponds. No wetland habitat was found on the Kaupulehu Phase 2 property.

Weather during the field survey was variable with both clear and cloudy conditions. Winds were from the N at 10-20 mph.

STUDY METHODS

The survey consisted of a walking tour of the property and nearby lands. Field observations were made with binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon/early evening. At various locations eight minute counts were made of all birds seen or heard (Fig. 1). Between these count (census) stations any special observations of birds were also noted. These data provide the basis for the relative (estimated) abundance figures given in this report (Table 1). Published and unpublished reports of birds known from similar habitat elsewhere were also consulted in order to assess what possible species might be expected in this region (Bruner 1989a, 1989b, 1989c, 1990, 1991, 1992; Pratt et al. 1987; Hawaii Audubon Society 1993; David 1989, 1990). 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 additional data on their abundance and distribution. Two evenings were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinereus semotus).

Scientific names used in this report follow those given in Hawaii's Birds (Hawaii Audubon Society 1993); Field guide to the birds of Hawaii and the tropical Pacific (Pratt et al. 1987) and Mammal species of the World (Honacki et al. 1982).

RESULTS AND DISCUSSION

Resident Endemic (Native) Birds:

No endemic birds were observed on the survey. The only species which potentially might occur in this area are: Short-eared Owl or Pueo (Asio flammeus sandwichensis) and the endangered Hawaiian Hawk or 'Io (Buteo solitarius). These two birds forage in open grasslands as well as forests and agricultural fields (Pratt et a. 1987: Hawaii Audubon Society 1993).

Migratory Indigenous (Native) Birds:

Four migratory species were recorded on the survey. Fifteen Pacific Golden Plover (Pluvialis fulva) were seen either flying over the property or foraging along the shoreline near Kona Village resort. Long term studies of this species have shown that they are both site-faithful (return each year to the same area) and territorial (actively defend their foraging space) (Johnson et al. 1981, 1989). Four Ruddy Turnstone (Arenaria interpres) were observed along the shore near the north end of the property. Ten Wandering Tattler (Heteroscelus incanus) and one Sanderling (Calidris alba) were also observed along the coast. These four species are the most frequent migrants to Hawaii. They are not endangered or threatened.

Resident Waterbirds and Seabirds:

No waterbirds or seabirds were found on this property. The absence of wetland and the abundance of predators restricts their occurrence.

Exotic (Introduced) Birds:

Thirteen species of exotic birds were recorded during the field survey (Table 1). The relative abundance data for these species were comparable to that gathered on nearby lands (Bruner 1989a, 1989b, 1989c, 1990, 1991, 1992). Other species which may also occur on or near the property include: Barn Owl (Tyto alba), Ring-necked

Pheasant (Phasianus colchicus), Black Francolin (Francolinus francolinus), Northern Mockingbird (Mimus polyglottus) and Lavender Waxbill (Estrilda caerulescens) (Pratt et al. 1987; Hawaii Audubon Society 1993; David 1989, 1990).

Feral Mammals:

Small Indian Mongoose (Herpestes auropunctatus) were observed. Skeletal remains and scats of feral goats (Capra hircus) were noted throughout the mauka sections of the property. Feral Donkeys (Equus asinus) were seen on both survey days. One herd contained over 20 animals. No rats, mice or cats were observed but likely do occur on or near the site. No trapping was conducted in order to assess the relative abundance of mammals.

Published records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinereus semotus) are relatively limited but the species does occur on the island of Hawaii (Tomich 1986; Kepler and Scott 1990). No bats were seen on the survey. An employee of Kona Village reported seeing a bat emerge from a lava tube near the petroglyph field just mauka of the village about one year ago. The natural history of the Hawaiian Hoary Bat and its ecological requirements are poorly known. They generally roost solitarily and forage for flying insects at dusk often over bays and ponds or forest clearings.

CONCLUSION

A brief field survey of a large area such as this one can provide only a limited perspective of the wildlife. The number of species and the relative abundance of each may vary throughout the year due to available resources and reproductive success. Birds which are migratory will quite obviously be found only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987; Moulton et al. 1990). Thus only long term studies can provide a comprehensive view of the bird and mammal populations in a particular area. Nevertheless, some general conclusions related to bird and mammal activity on this site are provided below:

1- The survey was conducted by walking the site and stopping periodically to conduct eight minute counts of all birds seen or heard. These data provided the numbers necessary to calculate the relative abundance estimates given in Table One.

2- No endemic species were recorded, however, Pueo and 'Io may at times forage at this location.

3- Four species of migratory shorebirds were observed on the property. All of these species are common migrants to the Pacific.

4- The numbers of exotic birds recorded were typical of this region of the island. No unexpected exotic species were found. A few species known from this region of the island were not recorded. Their absence from the survey may indicate their numbers are low at this location or may not at present exist on this site.

5- No wetlands were located on the property surveyed. No water-birds were found.

6- No unexpected observations of mammals were noted. Feral donkeys have long been common in this area. The endangered Hawaiian Hoary Bat was not recorded at this site but potentially could occur here. Kona Village personel have seen the bat on their property.

7- No particularly special or unique bird or mammal habitat was discovered on this property.

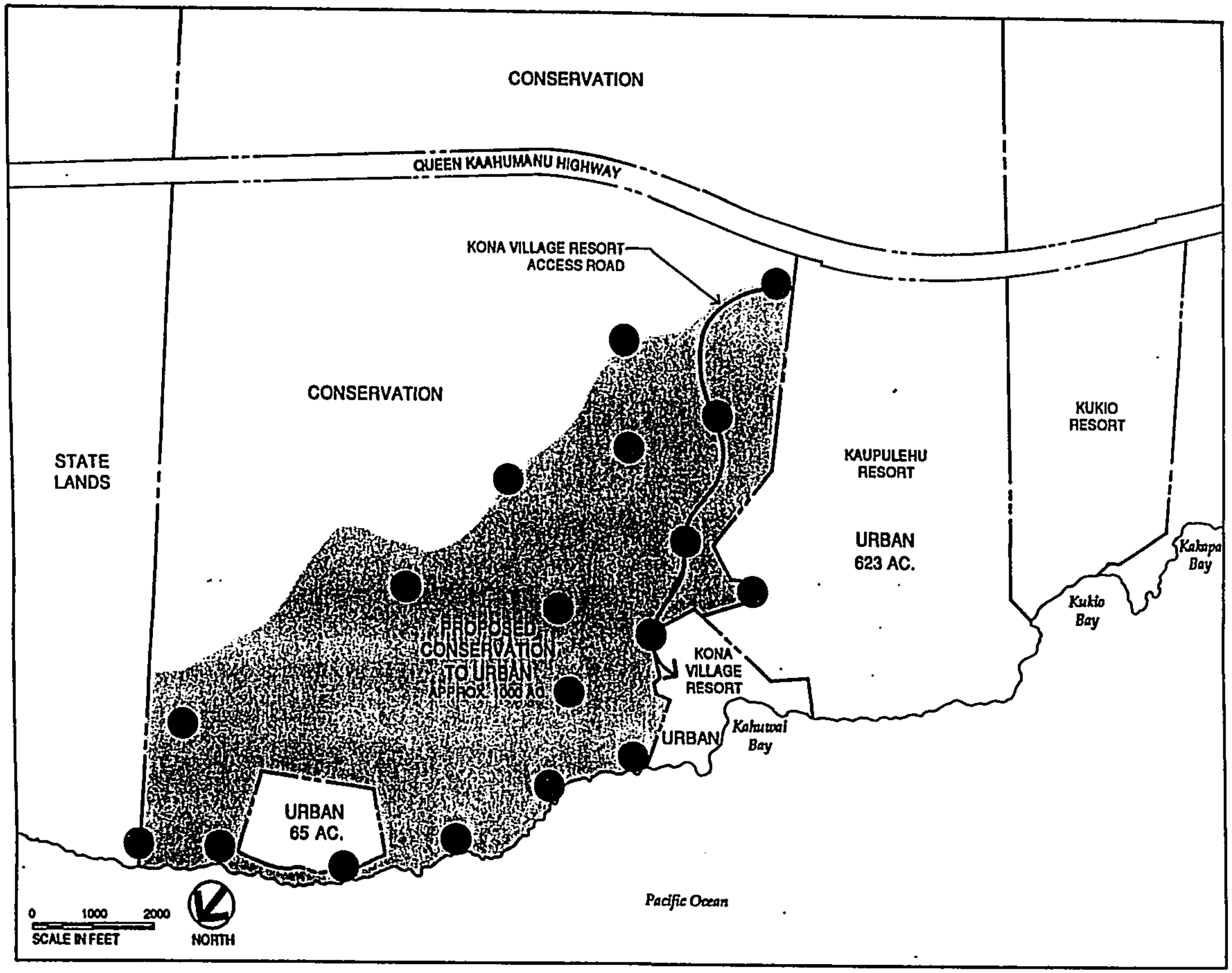

Fig. 1. Location of faunal (bird & mammal) survey with census stations shown as solid circles.

TABLE 1

Exotic (introduced) birds recorded at Kaupulehu Phase 2 Expansion Project, North Kona, Hawaii.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Gray Francolin	Francolinus pondicerianus	U = 4
Spotted Dove	Streptopelia chinensis	R = 3
Zebra Dove	Geopelia striata	C = 9
Common Myna	Acridotheres tristis	C = 8
Northern Cardinal	Cardinalis cardinalis	R = 4
Yellow-billed Cardinal	Paroaria capitata	C = 6
Japanese White-eye	Zosterops japonicus	C = 7
Yellow-fronted Canary	Serinus mozambicus	R = 8
Nutmeg Mannikin	Lonchura punctulata	A =12
Warbling Silverbill	Lonchura malabarica	C = 9
Saffron Finch	Sicalis flaveola	R = 2
House Finch	Carpodacus mexicanus	U = 4
House Sparrow	Passer domesticus	R = 3

* (see page 10 for key to symbols)

KEY TO TABLE 1

Relative abundance = Number of times observed during surveys or average number on eight minute counts in appropriate habitat.

A = abundant (ave. 10+)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

R = recorded (seen or heard at times other than on 8 min. counts or on one count only). Number which follows is the total number seen or heard over the duration of the survey.

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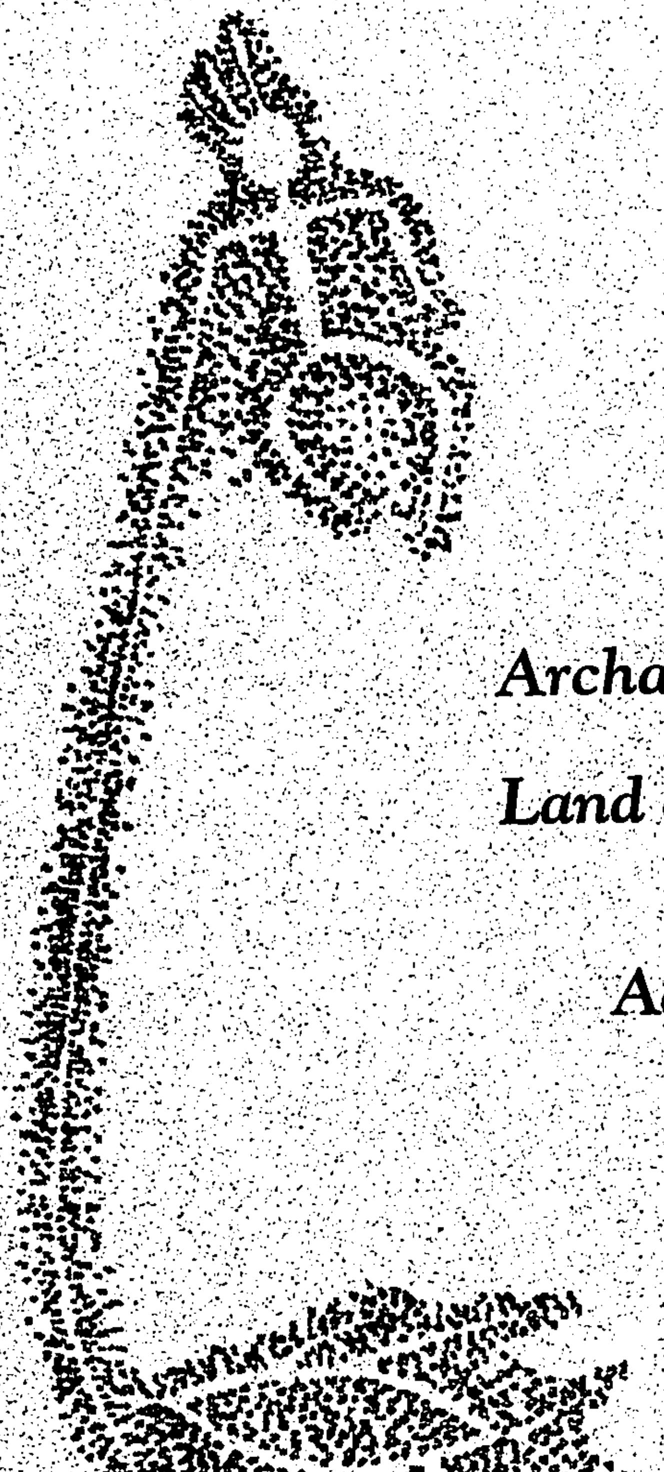

Appendix H

Archaeological Inventory Survey, Kaupulehu Makai - Lot 4, Land of Kaupulehu, North Kona District, Island of Hawaii

Addendum to Archaeological Inventory Survey (1994), Kaupulehu Makai - Lot 4

Report 1397-112593

Archaeological Inventory Survey Ka'ūpūlehu Makai - Lot 4

Land of Ka'ūpūlehu
North Kona District, Island of Hawai'i
(TMK:3-7-2-03:Por. 1)

BY

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and
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SUMMARY

Between July 21-October 29, 1993, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted the Phase II - Data Collection portion of a phased archaeological inventory survey of the approximately 889 ha (2,184 acre) Ka'ūpūlehu Makai - Lot 4 project area, located in the Land of Ka'ūpūlehu, North Kona District, Island of Hawai'i (TMK: 3-7-2-03:Por. 1). During Phase II of this inventory, 185 sites consisting of 633 discrete features were recorded. One hundred eighty-one of these sites were located during the preceding site identification Phase I, site identification (Smith and Rosendahl 1991); the remainder (4) were found in this phase. The sites comprise 90 complexes (multiple-feature sites) and 95 single feature sites. As well, two IF (Isolated Find) locations were noted and recorded. The sites consist of both single and multiple component sites, and their physical condition ranges from poor to good. Formal feature types noted include petroglyph, shaped wall, cairn, enclosure, mound, modified lava tube with utilization, pahoehoe excavation, lava tube with cultural material, modified outcrop, terrace, modified lava tube, trail, modified depression, and others. Probable functional interpretations are suggested for most features. Functional feature types present include temporary habitation, habitation, burial, marker, indeterminate, communication, quarry, transportation, agriculture, recreation, storage, ceremonial and others. Generally the features combined to form site complexes assigned to the broader functional categories of habitation (both temporary and longer-term), marker, indeterminate, communication, transportation, agriculture.

The data from the current project indicates the project area was occupied both historically and prehistorically, possibly as early as AD 1441 at Sites 19903, 19103, 19150, and 19151. Occupation at Site 19103 was most likely semi-permanent; other early sites are probably temporary.

Of the 185 sites recorded in the project area, 75 sites are assessed as no longer significant and require no further work. Fifty-two sites assessed as significant for information content only are recommended for further data collection. Thirty-nine sites assessed as significant for information content and as excellent examples of site types are recommended for further data collection followed by preservation with interpretive development of selected features. Eight sites are assessed as significant for information value and for cultural value; they are recommended for further data collection followed by for preservation "as is". Five additional sites are also assessed as significant for information content and for cultural value but are recommended for preservation "as is" only. Three sites are assessed as significant for information value, as excellent examples of site types, and for cultural value. They are recommended for further data collection and preservation "as is." Two sites are also assessed as significant for information, site type and cultural values, but are recommended for preservation with interpretive development (the recommendation is provisional for Site 19124, pending the results of discussions between local community members, the client, and planners). The final site is assessed as significant for information and cultural values, but is recommended for further data collection, only.

Contents

Contents (cont.)

Illustrations

Illustrations (cont.)

Tables

Tables (cont.)

INTRODUCTION

BACKGROUND

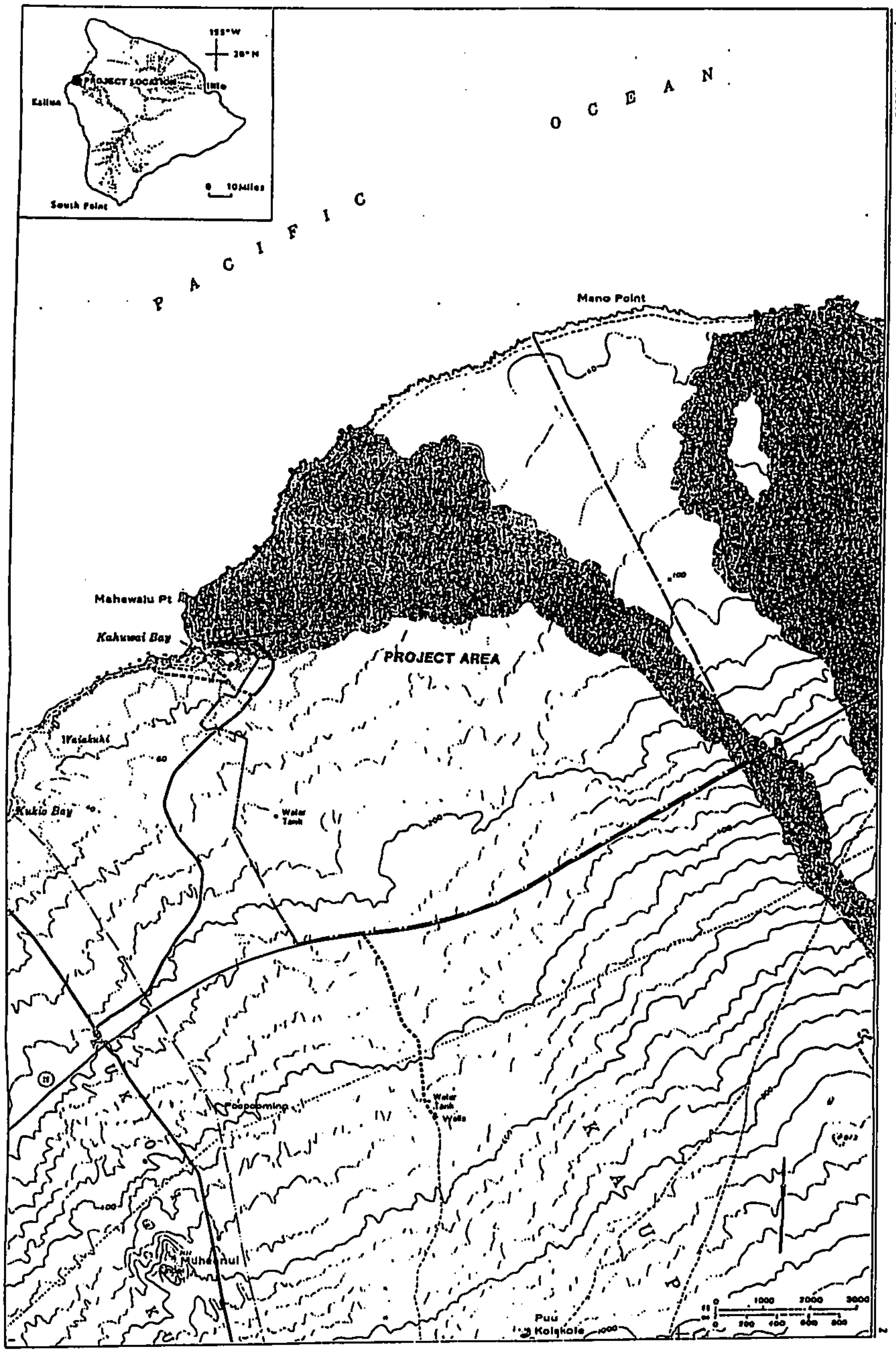
At the request of Ms. Anne Mapes of Belt Collins Hawaii, on behalf of their client, Kaupulehu Developments, personnel from Paul H. Rosendahl, Ph.D., Inc. (PHRI) recently completed a phased archaeological inventory survey of the approximately 889 ha (2,184 acre) Kaupulehu Makai - Lot 4 project area, located in the Land of Ka'ūpūlehu, North Kona District, Island of Hawai'i (TMK: 3-7-2-03:Por. 1) (Figure 1). The overall objective of the inventory survey was to provide sufficient information to satisfy all historic preservation regulatory review requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) Hawai'i County Planning Department (HCPD).

The results of the first phase of this project (site identification) were reported by Smith and Rosendahl (1992) and are summarized below under Previous Archaeological Work. The second phase work (Data Collection Field Work and Data Analysis) and conclusions for the project are presented in this report. The field work for the second phase was conducted July 21 - October 29, 1993 by a crew ranging in size from three to six, under the direction of Project Supervisors James Head, B.A. and Constance R. O'Hare, B.A.. Alan T. Walker, B.A., Projects Manager-Hawai'i, and Principal Archaeologist Dr. Paul H. Rosendahl provided overall guidance for the project. Crew members included Field Archaeologists Mikele Fager, B.A., Catherine Glidden, B.A., Warren Wulzen, B.A., along with Field Technicians Lauren Appelbaum, B.A., Leona Hamano, and Chris Kitchens. Completion of the field work required approximately 2,400 labor-hours.

SCOPE OF WORK

The basic purpose of an inventory survey is to identify and document all sites and features of potential archaeological significance present within a specified project area. An *inventory survey* is an initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted with the primary aim of determining the presence or absence of archaeological resources. A survey of this type indicates both the general nature and the variety of archaeological remains present, and the general distribution and density of such remains. It permits a general significance assessment of the archaeological resources, and assists in the formulation of recommendations and estimates for any subsequent *mitigation* work that might be necessary or appropriate. Such work could include further data collection involving limited excavations and detailed recording of sites and features. It might also involve subsequent data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The basic objectives of the present survey were fourfold: (a) to identify archaeological features and remains present within the project area; (b) to evaluate the potential general significance of all identified archaeological remains; (c) to determine the possible impacts of proposed development upon the identified remains; and (d) to define the general scope of any subsequent further data collection and/or other mitigation work that might be necessary or appropriate.



Report 1397-112593

Figure 1. Project Area Location

The following specific tasks were determined to constitute an adequate and appropriate scope of work for Phase II - Data Collection of the phased inventory survey:

1. Complete archaeological and historical documentary background 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. Relocate, flag, and assist professional surveyors in plotting the location of known burial features containing multiple burials and review a draft map;

3. Conduct an inventory-level recording of identified sites, including (a) sites identified during the previous Phase I field work, and (b) any newly identified sites found;

4. Conduct subsurface testing of selected sites and features identified within the project area (a) to determine the presence or absence of potentially significant buried cultural features, deposits, or burials, and (b) to obtain suitable samples for age determination analyses; and

5. Analyze the field and historical research data, and prepare appropriate reports summarizing (a) project background, (b) all identified sites, and (c) general significance assessments and recommended general treatments for all sites.

These tasks were determined based on a review of readily available background literature, familiarity with both the general project area and the current requirements of pertinent State and County review authorities, the results of the previously completed Phase I - Site Identification work, and discussions with Ms. Mapes.

The inventory survey was carried out in accordance with the current standards for inventory-level survey required by DLNR-SHPD. The significance of all archaeological remains identified within the project area was assessed in terms of (a) the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60), and (b) the Draft Rules Governing Procedures for Historic Preservation Review (DLNR Draft Rules 1989). DLNR-SHPD and HCPD both use these criteria to evaluate eligibility for both the Hawai'i State and National Register of Historic Places. A discussion of this assessment process is presented along with the assessments and recommendations at the end of this report.

PROJECT AREA DESCRIPTION

On the north, the project area is bounded by the boundary between Ka'ūpūlehu and Pu'uwa'awa'a Ahupua'a. The east (or *mauka*) boundary is formed by the present Queen Ka'ahamanu Highway, and on the south it is defined by an arbitrary line between this development and the Four Seasons development area. The western (or *makai*) boundary is formed by high water mark of the Pacific Ocean.

The project area encompasses elevations ranging from sea level (0.0 m) on the west, to roughly 107 m (350 ft) on the east. Average annual rainfall in this rain shadow area of Hualalai Mountain ranges from less than 0.51 m (20 in), near the coast, to c. 1.14 m (45 in) in the upper elevations (Armstrong 1983:63), with most of the cloud cover and moisture occurring as light, gentle rains in the afternoon (Carlquist 1980:74-75). Mean annual temperature for the project area is c. 24° C. (75° F.). The physiographic type found in the project area is Kiholo Lava Plain, which is defined as "coastline with little or no cliff along the shoreline" (Armstrong 1983:37).

In their 1990 Archaeological Resources Assessment of the Ka'ūpūlehu Resort Expansion Master Plan, Walker and Rosendahl note seven classifications of soil/terrain types present in their project area (Walker and Rosendahl 1990:4-6). Modified for the current project, this figure is included in this report as Figure 2. Descriptions of the soils and terrain types and their distribution were based on (a) Sato et al.(1973), (b) color infra-red aerial photos (1979 and 1989; 1"=1,600' approx. scale), and (c) field observations made during earlier archaeological work. Walker and Rosendahl (1990) noted that the distribution shown on the soil/terrain map was generalized and could be modified in the future. Of the seven soil/terrain types presented, four are within the current project area (Aa Lava Flows [includes historic aa flows], Pahoehoe Lava Flows, Rock Lands, and Beaches). These four types are shown on Figure 3 and are discussed in greater detail below:

1. **Aa Lava Flows** - This type comprises c. 1005 acres or 407 ha (48% of the project area). This soil/terrain type includes the Ka'ūpūlehu flow (AD 1800). According to Sato et al. "[t]his lava has practically no soil covering and is bare of vegetation, except for mosses, lichens, ferns, and few small *'ohi'a* trees...is rough and broken...[i]t is a mass of clinkery, hard, glassy, sharp pieces piled in tumbled heaps" (1973:34).

2. **Pahoehoe Lava Flows** - Pahoehoe lava flows comprise c. 1093 acres or 442 ha (51% of the project area). This soil/terrain type consists solely of prehistoric period flows. According to Sato et al., "[t]his lava has a billowy, glassy surface that is relatively smooth..[i]n some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Pahoehoe lava has no soil covering and is typically bare of vegetation except for mosses and lichens. In areas of higher rainfall, however, scattered *'ohi'a* trees, *'ohelo* berry, and *a'ali'i* have gained a foothold in cracks and crevices" (1973:34).

3. **Beaches** - This type comprises c. 48 acres or 19 ha (.02 % of the project area). This soil/terrain type is confined to the shoreline in the northwest portion of the project area; this shoreline is fronted by a low rocky coastline. According to Sato et al., beaches consist of "long, narrow, sloping areas of sand and gravel along the coastline of the island. The sand and gravel vary in color according to the material in which they formed. The yellowish or white sand formed in coral and sea shells, the black sand formed in lava rocks, and the green sand formed in olivine" (1973:14).

4. **Rock Lands** - Rock Lands comprise c. 45 acres or 18 ha (.02 % of the project area). This soil/terrain type is present in a small area inland of Kahuwai Bay and in areas immediately adjacent to the project area in Pu'uwa'awa'a and Kūki'o. According to Sato et al. it "consists of

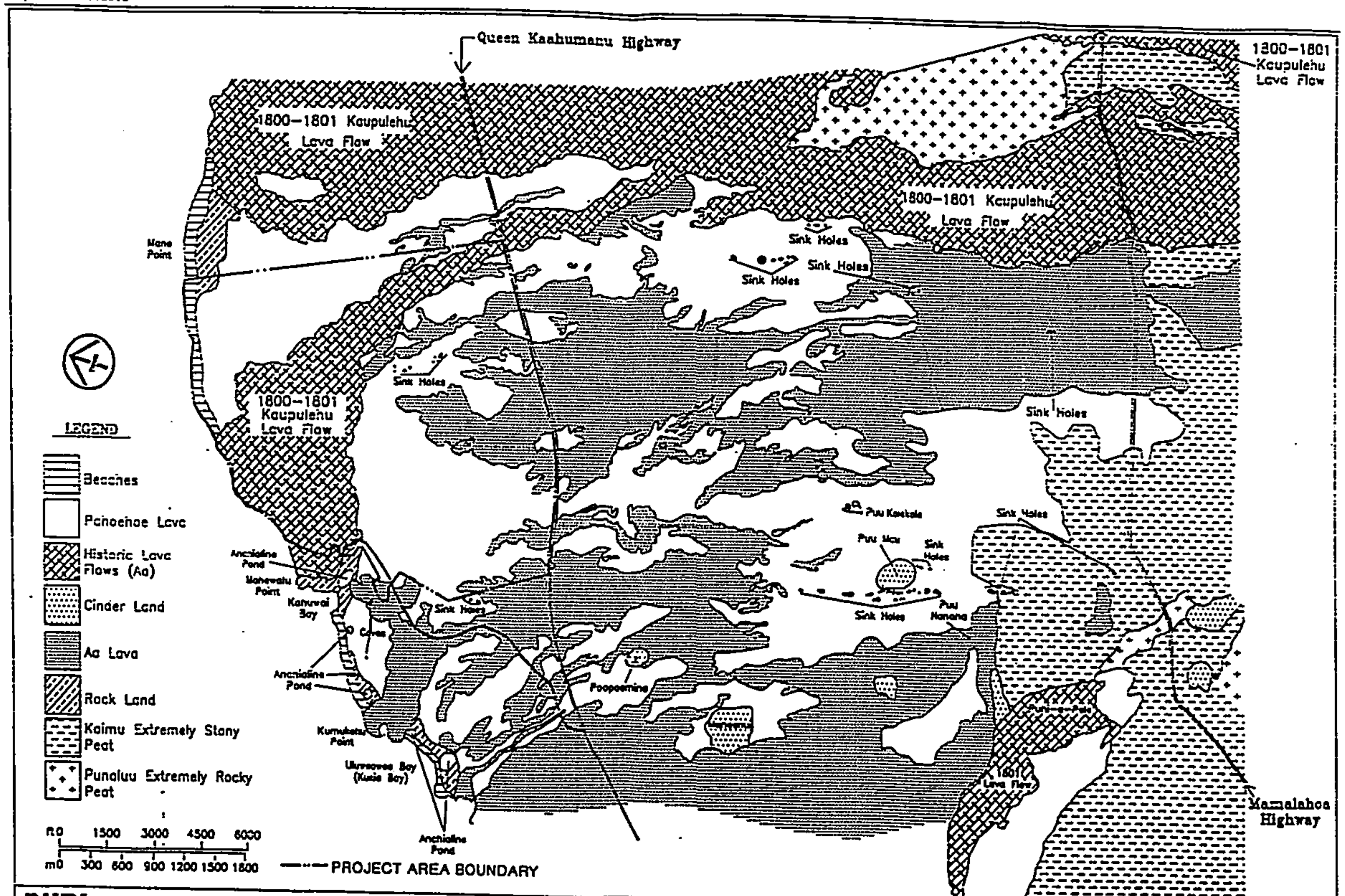


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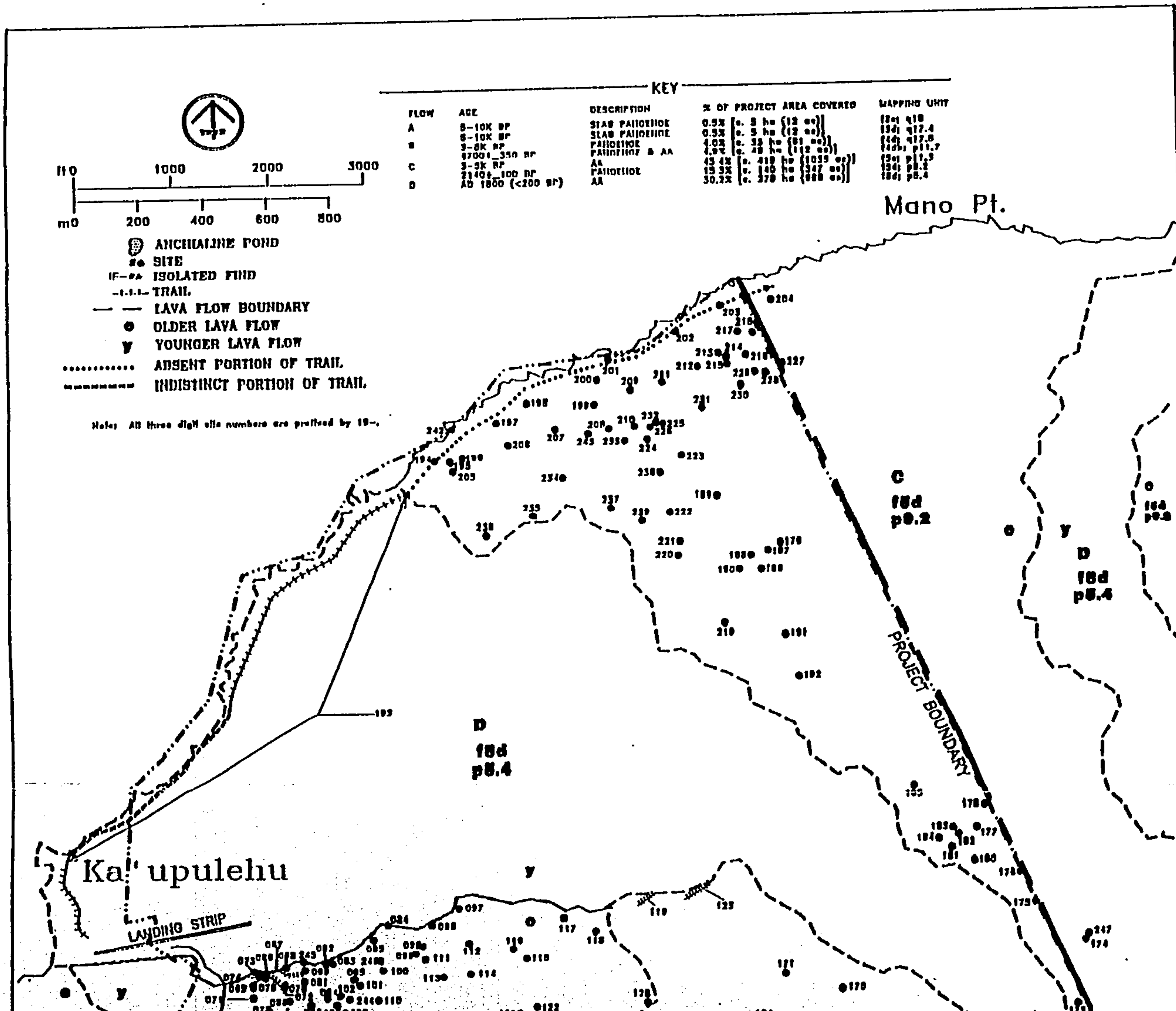
Figure 2.
DISTRIBUTION OF TERRAIN TYPES,
PROJECT AREA AND VICINITY


KEY
FLOW
AGE
DESCRIPTION
% OF PROJECT AREA COVERED
MAPPING UNIT
0 1000 2000 3000
m0 200 400 600 800
ANCHIALINE POND
SITE
ISOLATED FIND
TRAIL
LAVA FLOW BOUNDARY
OLDER LAVA FLOW
YOUNGER LAVA FLOW
ABSENT PORTION OF TRAIL
INDISTINCT PORTION OF TRAIL
Mano Pt.
PROJECT BOUNDARY
Ka'upulehu
LANDING STRIP

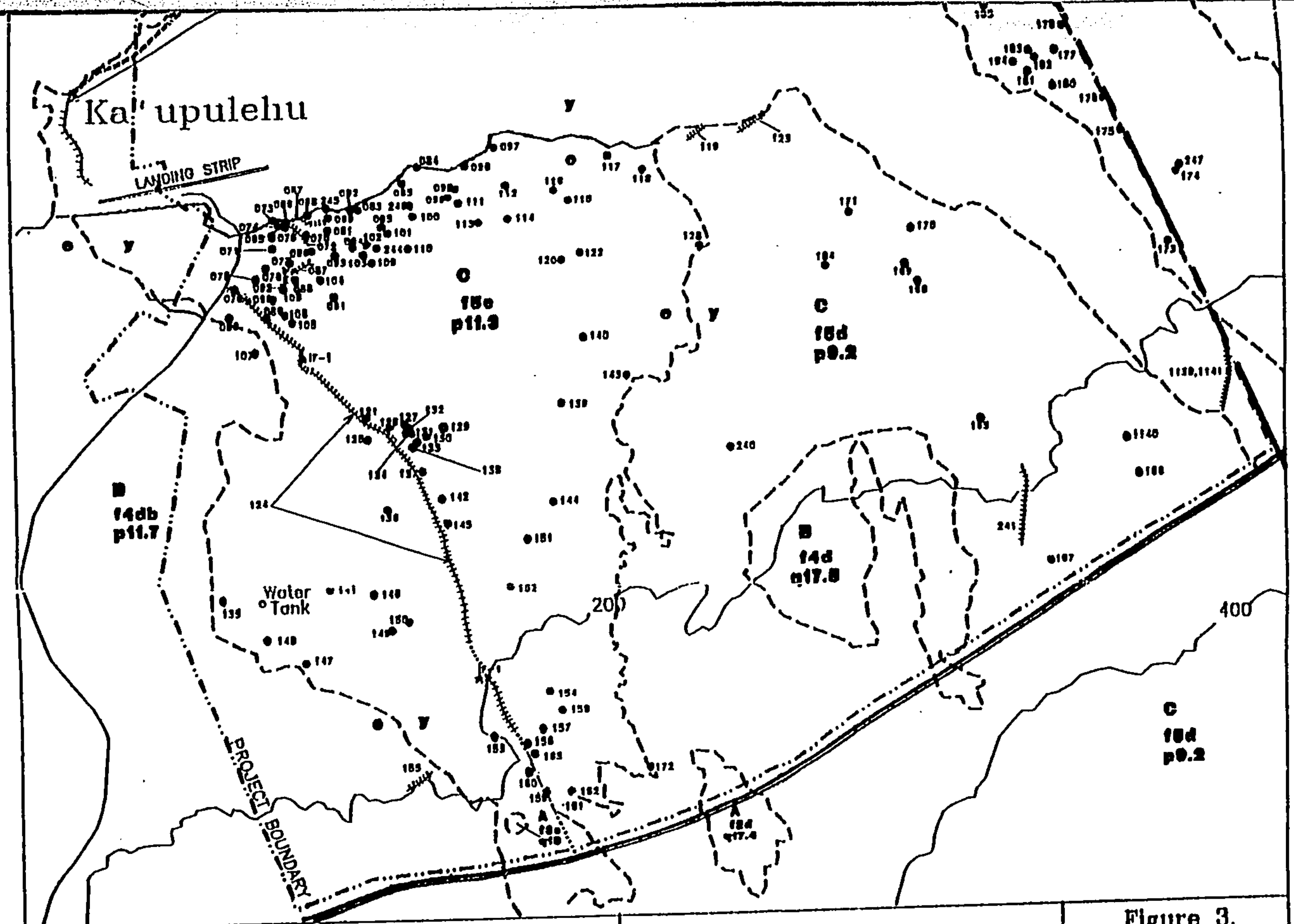


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Figure 3.

LAVA FLOWS BY TYPE AND AGE

> pahoehoe lava bedrock covered in places by a thin layer of soil material...Pahoehoe outcrops occupy 50 to 90 percent of the surface. The average depth of the soil material is between 6 and 8 inches [0.15-0.2 m]...[t]he vegetation is confined mainly to the soil-covered areas and the cracks in the lava" (1973:51).

Since the project area is located on the northwest slope of Mt. Hualalai, the volcanology of the region was also examined. The most recent mapping of Hualalai Volcano (Moore and Clague 1991) indicates two small flows (Figure 3) in the project area near Queen Ka'ahamanu Highway. The flows range in age from 5,000 to 10,000 years old (areas keyed on Figure 3 as f3c q18 and f3d q17.4). These slab pahoehoe flows encompass approximately 5.0 ha (12 acres)(Table 1). Two other flows (both pahoehoe and aa) are included in the group keyed as f4 (f4d q17.5 and f4db p11.7) and date between 3,000 5,000 years before present (BP). These areas cover 33 ha (81 acres) and 45 ha (112 acres), respectively. Most of the project area, 559 ha (1382 acres), is formed by f5c p11.3 (aa) and f5d p9.2 (pahoehoe) (1,500-3,000 years old) flows. These are overlain by the AD 1800 aa flows from Hualalai Volcano (f8d p5.4), which cover approximately 278 a (688 acres).

Table 1.
*Lava Flow Types by Age**

Flow	Age Group	Flow Description	Project Area Covered	Mapping Unit
A	5-10K BP†	Slab Pahoehoe Flows	c. 5 ha (12 acres) 0.5%	f3c q18, f3d q17.4
B	3-5K BP, 4700 ± 350 BP	Pahoehoe Flows Pahoehoe & Aa Flows	c. 33 ha (81 acres) 4.0% c. 45 ha (112 acres) 4.9%	f4d q17.5 f4db p11.7
C	3-5K BP, 2,140± 100 BP	Aa Flows Pahoehoe Flows	c. 419 ha (1,035 acres) 45.4% c. 140 ha (347 acres) 15.3%	f5c p11.3 f5d p9.2
D	AD 1800 , (<200 BP)	Aa Flows	c. 278 ha (688 acres) 30.2%	f8d p5.4

** After Moore and Clague 1991*
† Before Present (AD 1955)

Vegetation in the project area is somewhat diverse. Introduced fountain grass (*Pennisitum setaceum* [Forsk,] Cheiv.) is present in the lower and intermediate elevations. Also present in varying densities are exotic shrubs such as indigo (*Indigofera suffruticosa* [Mill.]) and *kiawe* (*Prosopis pallida* [Humb. and Bonpl. ex Willd.] HBK), with occasional examples of balloon plant (*Gomphocarpus physocarpus* E. Meyer), *pa-nini* (*Opuntia megantha* Salm-Dyck), lantana (*Lantana camara* L.), and Christmas-berry (*Schinus terebinthifolius* Reddi).

Several native species were observed and included: *'uhaloa* (*Waltheria americana* L.), *'ilima* (*Sida fallax* Walp.), *nehe* (*Lipochaeta integrifolia* Gray), *'a'ali'i* (*Dodonaea*), *pua-kala* (*Argemone glauca* [Nutt. ex Prain] Pope), *pua-pilo* (*Capparis sanwichiana* DC), *naupaka-kahakai* (*Scaevola sericea* Vahl; synonyms. *S. frutescens* (Mill.) Krause var. *sericea* (Forst. f.) Merr., *S. taccada* (Gaertn.) Roxb. var. *sericea* (Vahl) St. John, and *S. plumieri* (L.) Vahl var., and *'ihi* (*Oxalis corniculata* L.).

A vegetation map initially presented in Walker and Rosendahl (1990) has been modified to show the bounds of the present project area (Figure 4). This map shows (a) the relationship between vegetation and survey areas examined, (b) the relationship between vegetation and site distribution patterns, and (c) the locations and extents of relatively unweathered lava flows, which are nearly, or totally, barren of vegetation. The original map was prepared using (a) a botanical survey report prepared for Potomac Investment Associates by Camara (1989), (b) a black-and-white aerial photograph (R.M. Towill Corp. 1988, 1"=200' approx. scale) and a color infra-red photograph (1979 and 1989, 1"=1600' scale approx.), and (c) field observations made during previous surveys and the Phase II assessment. The vegetation map should be considered as generalized and subject to modification.

Of the nine major vegetation communities found by the Walker and Rosendahl (1990) study, five are represented in the current project area.

1. Barren Lava with Sparse Vegetation - This vegetation type is present at all elevations throughout the project area. The unnamed AD 1800 lava flow is included within this zone. The substrate of this vegetation type consists entirely of aa lava. The vegetation consists predominately of solitary specimens of *'ohi'a* (*Metrosideros collina* [Forst.] Gray subsp. *polymorpha* [Gaud.] Rock), *kiawe*, and *lama*;

2. Beach Strand - Located immediately seaward of *kiawe* thicket zone. This type consists of moderately thick *naupaka-kahakai*, *pohuehue* (*Ipomoea pes-caprae* [L.] Sweet), and Indian pluchea (*Pluchea indica* [L.] Less.).

3. Kiawe Thicket - Characterized by dominant overstory of *kiawe*, with variable understory of one or more of grasses, *'uhaloa*, and *'ilima*. This vegetation type is concentrated along coastal areas where subsurface fresh water is present (elevation range sea level-50 ft AMSL). In coastal areas, especially the area surrounding anchialine ponds, (none of which lie in the current project area), vegetation also includes stands of mangrove (*Rhizophora mangle* L.), *hau* (*Hibiscus tiliaceus* L.), *milo* (*Thespesia populnea* [L.] Sol.), Indian pluchea, and various reeds and sedges.

4. Sparse Grassland - This vegetation type is present at middle to lower elevations (200-950 ft AMSL) within the project area. The substrate of the type consists of both aa and pahoehoe lavas. Vegetation consists predominately of sparse grasses, *'uhaloa*, and *'ilima*. Solitary *pua-pilo* (*Capparis sandwichiana* DC.), indigo, *lama*, and *kiawe* may also be present;

5. Scrub/Grassland - At lower elevations, this type includes sparsely distributed grasses, *uhaloa*, *'ilima*, and scattered *kiawe*. At higher elevations, covering a large part of the land between c. 500-1,700 ft AMSL, the type also includes occasional solitary trees such as silver oak, *lama*, and *'ohi'a*;

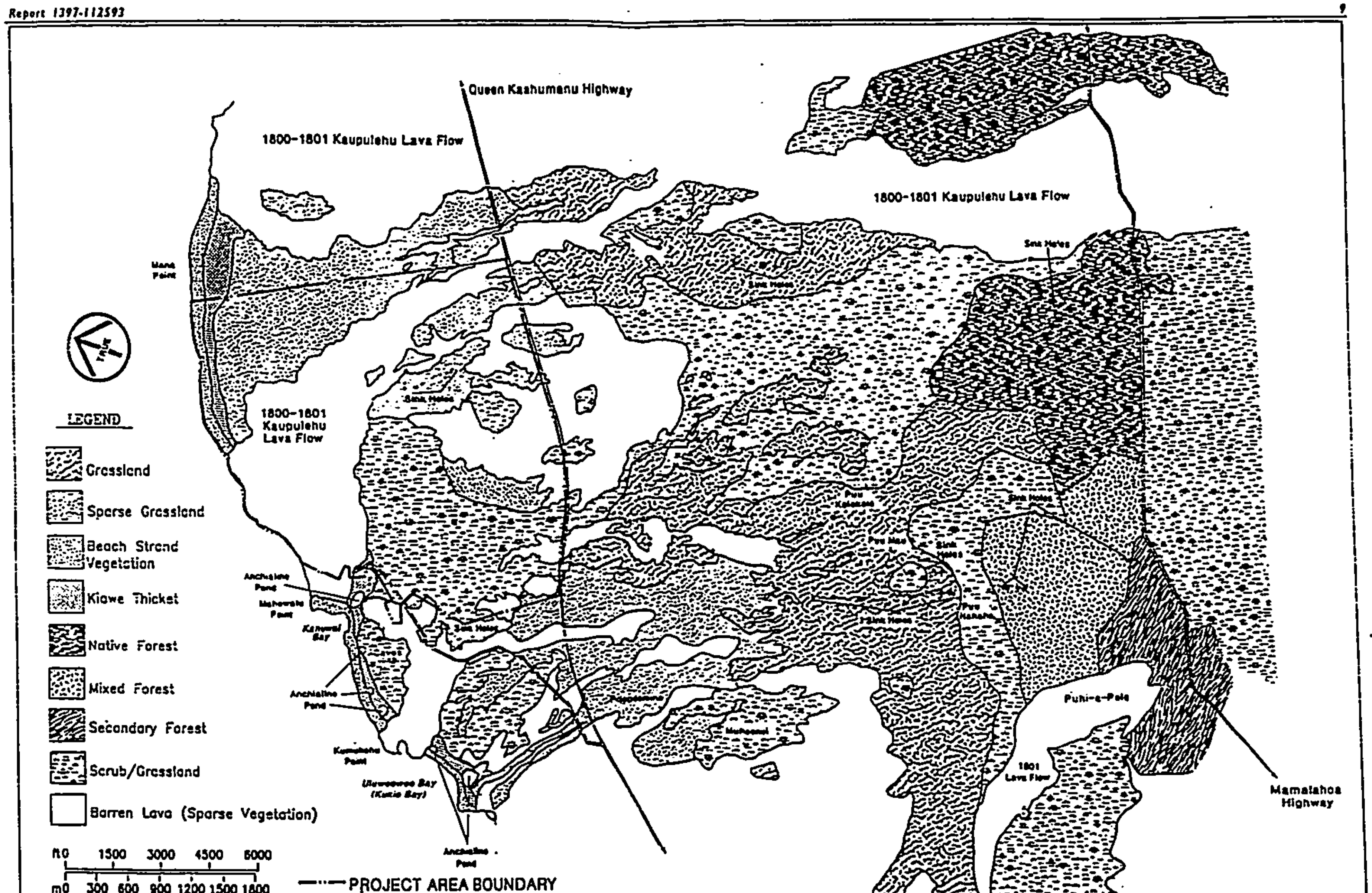

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Figure 4.
DISTRIBUTION OF VEGETATION TYPES, PROJECT AREA AND VICINITY

PREVIOUS ARCHAEOLOGICAL WORK

A full discussion of previous archaeological studies within Ka'ūpūlehu *ahupua'a* and coastal areas of North Kona and South Kohala districts has been presented in Walker and Rosendahl (1990). This information has also been presented in Head, Goodfellow, and Rosendahl (1992) et al. and much of the text will not be repeated here. Only those projects inside the current project boundaries will be discussed. Table 2 and Figure 5 present selected information concerning the archaeological projects in the area. Table 3 presents a more detailed look at projects that have occurred within the current project area.

In the most recent work conducted, PHRI recently conducted an aerial and pedestrian site identification survey of the current project area (Smith and P.H. Rosendahl 1992). This work was Phase I (identification only) of the current inventory survey, and identified 197 sites consisting of 518 component features. Formal feature types identified included C-shape, double C-shape, U-shape, double U-shape, L-shape, J-shape, T-shape, crescent, enclosure, terrace, platform, possible shrine, wall, cairn, trail, cave, overhang, petroglyph, *papamu*/, salt pan, modified outcrop, modified depression, pahoehoe excavations (with modification and or midden/cultural deposit), mound, alignment, and midden/cultural deposit.

The features were assigned the following functional types: habitation, possible habitation, burial, possible burial, transportation, marker, rock art, recreation, possible ceremonial, agriculture, possible agriculture, quarry, and indeterminate. In addition, c. 1,500 pahoehoe excavations (some with associated waterworn basalt hammerstones) were identified and tabulated by survey sweep. One site (a previously identified trail) was found in the center of the project area, on the AD 1800 lava flow, and another was found in a *kipuka* of the other major 'aa flow (Smith and P.H. Rosendahl 1992)

Earlier work within the current project boundaries began in 1930, when J.E. Reinecke recorded four sites there (Sites 122–125) while carrying out a survey of sites along the western coast of Hawaii Island for B.P. Bishop Museum, along the shoreline of Ka'ūpūlehu within the present project area (Reinecke n.d.). Reinecke inspected only the immediate shoreline area—no more than a few hundred feet inland—and his recording of sites was sketchy, making definite correlation of his specific features with features subsequently recorded in the area difficult. Reinecke's sites were later included in an inventory of Hawaii Island sites prepared by B.P. Bishop Museum for the HCPD (Emory 1970). That inventory was based entirely on records existing in Bishop Museum's Department of Anthropology and did not involve any field work.

In early 1963, L.J. Soehren of Bishop Museum conducted a reconnaissance survey of Ka'ūpūlehu and Makalawena for B.P. Bishop Estate (Soehren 1963). Soehren identified 26 sites, of which 16 (Sites 1-13, 21-23) are included within the present project area. Three petroglyph sites identified by Soehren (Sites 19, 22, and 23) are also described in Cox and Stasack (1970). Soehren did not make recommendations concerning further archaeological work. Soehren's sites were later included in an inventory of Hawai'i Island sites prepared in 1970 by B.P. Bishop Museum for the HCPD (Emory 1970). That inventory was based entirely on records existing in the museum's Department of Anthropology and did not involve any field work.

Between June-October 1970, the Parks Division of the State Department of Land and Natural Resources conducted a surface survey of the Kailua-Kawaihae road corridor for the

Table 2.
Previous Archaeological Work in Ka‘ūpūlehu and Surrounding Ahupua‘a

Year	Author(s)	Coverage	Zone	Ahupua‘a
1930	Reinecke	R	C	Various
1963	Soehren	R	C,M	Ka‘ūpūlehu-Makalawena
1970	Ranger	R	C	Kaloko-Kūki‘o 2nd
1971a	Barrera	R,E	M	‘Anaeho‘omalu
1971	Ching	R	M	Various
1973	Rosendahl, P.H.	MI,D	M	Various
1981	Cordy	I,E,D	C,M	Kūki‘o 1st-Kūki‘o 2nd
1981	Komori	R	C,M	Ka‘ūpūlehu
1985	Cordy	A	C,M	Kalaoa-‘O‘oma
1985	Carter	R	C,M	Ka‘ūpūlehu
1985	Walker & Rosendahl, P.H.	R	C,M	Kūki‘o 1st
1986	Rosendahl, M.L.K.	R	C	Ka‘ūpūlehu
1986a	Donham	R	C	Ka‘ūpūlehu
1986b	Donham	R	C	Makalawena
1986	Silva	H	C,M,U	Makalawena
1987	Springer	ET	C,M,U	‘Awake‘e
1986	Springer	ET	C,M,U	Makalawena
1987	Donham	R	C	‘Awake‘e
1987	Silva	H	C,M,U	‘Awake‘e
1988	Jensen	I,D,R	C,M	‘Anaeho‘omalu
1988	Rosendahl, P.H.	R	M	‘Awake‘e
1988	Walker & P.H. Rosendahl	I,E,D	C	Ka‘ūpūlehu
1989	Jensen & P.H. Rosendahl	MI	C,M	Ka‘ūpūlehu
1989	Springer	ET	C,M,U	Ka‘ūpūlehu
1989	Walker & P.H. Rosendahl	R	C	Pu‘uanahulu
1989	Rosendahl, M.L.K.	R	C,M	Ka‘ūpūlehu
1989a	Rosendahl, P.H.	R	M	Ka‘ūpūlehu
1989b	Rosendahl, P.H.	R	M	Ka‘ūpūlehu, Manini‘owali, Kūki‘o 1st
1990	Walker	A	C,M,U	Ka‘ūpūlehu
1990a	Rosendahl, P.H.	R	C,M	Ka‘ūpūlehu
1990b	Rosendahl, P.H.	R	C,M	Ka‘ūpūlehu
1991	Rosendahl, P.H.	R	M	Ka‘ūpūlehu
1991	Sullivan & Goodfellow	MI,D	C,M	Ka‘ūpūlehu
1992	Smith & P.H. Rosendahl	R	C,M	Ka‘ūpūlehu
1992	Head et al.	I,D	M,U	Ka‘ūpūlehu
1992	Goodfellow & Head	I,D	M,U	Ka‘ūpūlehu
1992	Goodfellow et al.	MI,D	M,U	Kūki‘o 1st

Key:

ET	*Ethnography*	*MP*	*Mitigation Plan*
I	*Intensive Survey*	*DR*	*Data Recovery*
R	*Reconnaissance Survey*	*C*	*Coastal Zone*
E	*Excavation*	*M*	*Midlands Zone*
D	*Dating*	*U*	*Upland Zone*
H	*Historical Documentary Research*	*MI*	*Mitigation*
LS	*Literature Search*	*A*	*Resources Assessment*

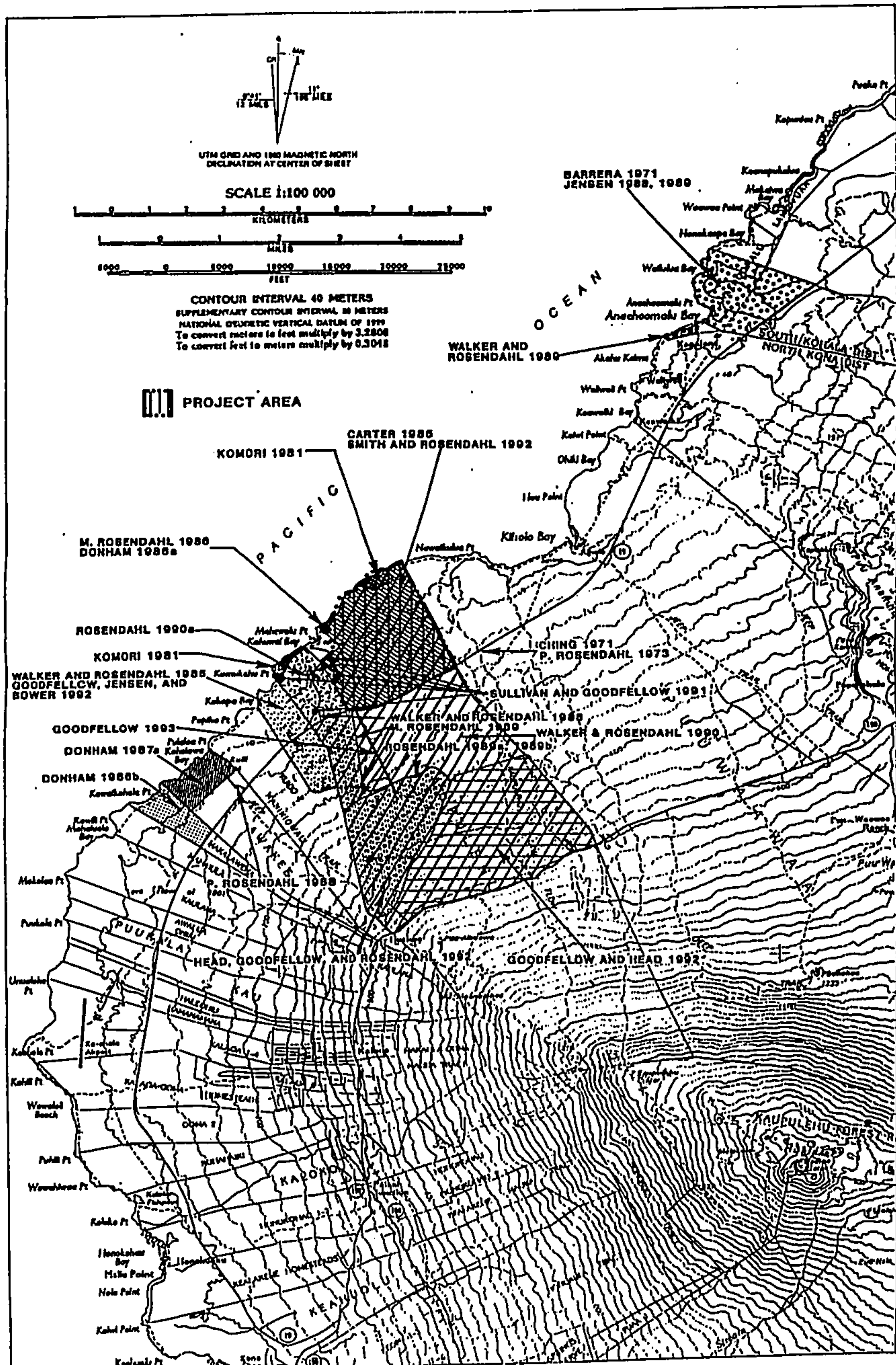

Figure 3. Previous Archaeological Coverage

Table 3.
Details of Previous Archaeological Work within Project Area

Year	Author(s)	Area	Objectives of Survey	Findings
1930	Reinecke	Shoreline (<5% of project area)	Coastal survey	Four sites, consisting of many features.
1963	Soehren	Mauka of 1800 flow, north shoreline (<10% of project area)	Reconnaissance survey of Ka'ūpūlehu and Makalawena	Twenty-two sites, including house sites, walls, caves, petroglyphs
1971	Ching	Queen Ka'ahumanu Alignment (<5% of project area)	Kailua-Kawaihae road corridor	SIHP Sites 1138, 1140, 1141.
1973	Rosendahl, P.H.	Queen Ka'ahumanu Alignment (<5% of project area)	Salvage excavation of Site 1140	Mostly abraders, and a one-piece fishhook
1981	Komori	North shoreline (<5% of project area)	Reconnaissance survey of two coastal parcels	Four sites, composed of lava blisters or shell midden.
1985	Carter	All of present project area, with an additional area to west (100% of project area)	Reconnaissance survey of makai portion of Ka'ūpūlehu	100+ sites, including burial caves, habitation, petroglyphs, trail, and cairns
1992	Smith & P.H. Rosendahl	Current project area (100% of project area)	Phase I - Site Identification	One hundred ninety-seven sites consisting of 518 component features

State Department of Transportation (Ching 1971). Ching identified approximately three sites in the project area (SIHP Sites 1138–1141). Of the three, Ching evaluated one site (Site 1140) as highly significant and recommended that the site be saved, because it was a good example of a site types and in excellent condition. Ching evaluated the remaining two as being of low significance and recommended, with reservations, that the sites be destroyed following archaeological salvage investigations (Ching 1971:5-7).

In August 1972, in response to Ching's (1971) investigation, the B.P. Bishop Museum Department of Anthropology conducted archaeological salvage excavations and detailed recording of selected sites within the Kailua-Kawaihae road corridor (P.H. Rosendahl 1973). SIHP Site 1140 in the Land of Ka'ūpūlehu was included in the salvage work. Upon completion of that project, no further archaeological work was recommended for this site. Based on ethnographic and ethnohistoric sources, coupled with results of the archaeological investigations, Rosendahl (1973) was able to present a model of aboriginal prehistoric Hawaiian settlement patterns for the portion of North Kona north of Kailua. Rosendahl's model defines four zones: (a) a coastal habitation zone associated principally with the exploitation of various marine resources; (b) a sloping, barren intermediate zone of recent volcanics, almost devoid of soil or vegetation, and associated mainly with temporary habitation and transportation between the coastal and inland zones; (c) an upland habitation zone associated with agricultural exploitation; (d) and an inland forest zone that was utilized but rarely inhabited.

Rosendahl's upland settlement model applies principally to the slopes of Mt. Hualalai, above Kailua; Rosendahl indicates that virtually nothing is known of the upland areas between the Lands of Mahaiula and Pu'uanahulu. Rosendahl's model was subsequently expanded upon by Hommon (1976). Hommon suggested that during the period of about AD 1400–1500, a shift in settlement patterns occurred, in the form of inland expansion and permanent settlement, through the development of permanent upland agriculture. Volcanic glass and radiocarbon age ranges from all sites investigated by Rosendahl indicate a time range of AD 1265–1855. Volcanic glass age ranges specifically from the Land of Ka'ūpūlehu yielded an overall date range of AD 1427–1763. No radiocarbon samples were submitted from the Land of Ka'ūpūlehu.

In April 1981, E. Komori of the Department of Anthropology, B.P. Bishop Museum, conducted a reconnaissance survey of two parcels of land in the coastal portion of Ka'ūpūlehu for Cambridge Pacific, Inc. Komori identified 19 sites, all of which are located seaward of the present project area. Based on the findings of his survey, Komori evaluated the sites as "not unique for the leeward coast of the Island of Hawai'i. Therefore, *in situ* preservation of the structures is not necessary" (Komori 1981:21). However, Komori recommended a program of salvage excavations (including mapping); he also recommended that any human burials found be given proper treatment prior to construction work.

In September of 1984, the Department of Anthropology, B.P. Bishop Museum, conducted a reconnaissance survey of the entire seaward portion of the Land of Ka'ūpūlehu (between Queen Kaahumanu Highway and the Pacific Ocean) for Barnwell Industries, Inc. (Carter 1985). The primary objectives of that survey were (a) to locate and record previously undocumented sites, (b) to relocate previously recorded sites, noting present condition, (c) to identify and locate areas with probable subsurface deposits, and (d) to recommend appropriate work for subsequent phases of archaeological investigations. Carter states in her report that objective "b", was only partially met, because of time constraints, and that previously identified Sites 1–5, 25, 26, 28, 29, 39, 41, 42, 43, and 202 were not field-checked. She also indicates that her survey did not cover coastal areas (which had been examined previously) and lava flow interiors (1985:1,4). Carter's survey located 195 sites, 47 previously identified and 148 newly identified (Carter states 151 new sites were found but she includes three sites [Sites 79, 80, and 91] previously recorded by Ching 1971 [Sites 1146–1152, 1144, and 1161]). Carter also states that the identified sites contained numerous component features, but she does not say exactly how many (Carter 1985:5). Based on the findings of her 1984 survey, Carter recommended a program of "extensive survey" (including test excavations), intensive mapping, and treatment of human remains for one general and eight specific study areas (Carter 1985:29-33). She concludes that "recommendations regarding the preservation of specific sites will be contingent upon the results of extensive (Phase I) survey" (Carter 1985:27).

SUMMARY OF HISTORICAL DOCUMENTARY RESEARCH

Legendary accounts indicate that the region was well populated by c. 1200, when the small protected bays and shoreline areas were settled. Initially, planting probably occurred in and around the coastal communities, and as the population grew and the political and religious systems became more formalized, the communities spread out. The coastal and upland plains in the low forested zone were planted with important staple and supplemental crops that were less water dependent than the *kalo wai* (wet taro), which was the staple of the *ko'olau* (windward) side of the island. *Pu'epu'e* (planting in built-up mounds), *mākālua* and *'umoki* (planting in dugout-mulched holes) are three methods of planting techniques which are recorded as having been extensively used in Kona.

Crops such as sweet potatoes, sugar cane, bananas, yams, breadfruit, gourds, and coconuts provided the "bread" of the Hawaiian diet. On the upper slopes were grown the endemic *olonā* (*Touchardia latifolia*) for cordage, and *'awa* (Piper methysticum) for ceremonial and domestic use, and from the upland forests various woods and resources were collected, which were used for spears, paddles, canoes, and tools, etc.

Fishing in this region was considered some of the best on Hawai'i, and it is likely that a great deal of energy went into harvesting of other ocean resources. Though farmers gathered some ocean resources, and fishermen grew some food plants, it is generally accepted that the fishermen primarily provided fish and other ocean resources to the planters who in turn supplied the fisherman with their agricultural products. This division of labor appears to be supported in some of the legendary accounts. Indeed, legendary descriptions of this region depict viable communities and describe the various resources on which they depended for their survival.

The 19th century was a time of great environmental change. Shortly after Western contact (c. AD 1800-1801), lava flows from Hualālai reclaimed much of the land used for settlements, agriculture, and fishponds. Subsequent ranching also resulted in significant modification of the landscape.

Following unification of the islands under the rule of Kamehameha I, large portions of land were given to *ali'i* who had supported the chief and remained loyal to his descendants. Associated with these loyal chiefs were the *maka'āinana*, or people of the land. Following the Māhele of 1848, the lands were further divided between Kamehameha's descendants; additionally, small parcels of land were also given to natives who had lived upon, and worked the land. During this period, the Hawaiian population was in decline, and by the mid 1800s use of the land by foreigners for upland ranching and cultivation of coffee and other crops was increasing, and other Western businesses were thriving as well. Ranching stripped the mountain slopes of increasing amounts of forest, and as the forest disappeared, water catchment became unreliable. Many of the famed water caves dried up, and the remaining *ki'owai* (fresh water sources) on the shore became more brackish. As the water resources dried up and Western land use practices replaced traditional methods, Hawaiian communities gradually disappeared.

By the late 1800s and through the early 1900s, immigrant populations were on the rise, and often the immigrants outnumbered the native Hawaiians. There is little documentation concerning events in Ka'ūpūlehu during this time, but generally, by the 1920s and 1930s many of the native tenants were gone, and there were few buildings. The 1946 tsunami forced the relocation of the remaining families, thus leaving coastal Ka'ūpūlehu without permanent inhabitants until its rediscovery by John Jackson who opened the Kona Village Resort in 1964.

SETTLEMENT PATTERNS

A basis for building a set of expectations for the current study area can be formulated using background information presented by Kelly (IN Carter 1985) along with the historical documentary research presented by Maly (above) and the findings of previous archaeological work in the project area and vicinity.

Chronological Framework

A general developmental sequence for the Kekaha area of West Hawai'i, the northern part of the district of North Kona and the southern part of South Kohala, was synthesized by Donham (1987b:142-145) on the basis of her work at 'O'oma II and for 'Awake'e (Donham 1987a) and based on previous research by Cordy (1981, 1986), Hommon (1976), and Kirch (1979, 1985). In this general developmental sequence, initial occupation of the northern end of North Kona occurred at 'Anaeho'omalu around AD 900. This initial occupation of the dry, leeward coast of Hawai'i Island is believed to have occurred in response to expanding agricultural activities along the windward coast of the Island. According to Kirch (1985), this windward expansion resulted in an increased demand for additional agricultural lands, eventually leading to the exploitation of areas less suited to agricultural, such as North Kona. The dating results from Ka'ūpūlehu appear to generally conform with the above model, with initial occupation of Site 10959 occurring at c. AD 1030 (Walker and Rosendahl 1988:66). Although the population of West Hawai'i remained low and fairly stable until around AD 1200, a significant increase in population density appears to have begun around AD 1200 and to have continued through AD 1600. Due to the generally arid, rocky environment and the lack of fresh water in the Kekaha area, the population increase between AD 1200–1600 was uneven, with the greatest increases occurring in the area of 'Anaeho'omalu and probably at Kiholo, Ka'ūpūlehu, and Kūki'o. No comparable dating information is currently available for coastal sites at Kiholo. Kūki'o dating information (Goodfellow et al. 1992:122-126) span a 725-year span extending from AD 1230 to the present (present = AD 1955). Five coastal sites provide an average probable age span of AD 1594-1839 (ibid.)

Cordy has suggested that as population increased in certain favorable areas, substantial uninhabited zones between the primary population centers remained (Cordy 1981:173). Within these zones, initial settlement was delayed until around AD 1400, as at Kohana-Iki and 'O'oma II (Cordy 1981:168). Between about AD 1400 and 1600, the population increased within these areas, in a manner comparable to population expansion in the areas that had initially been occupied along the coast (e.g., 'Anaeho'omalu and Kalahuipua'a). Again, information from Ka'ūpūlehu generally supports these existing models, suggesting an increase in the local population during the period c. AD 1500–1800. The place of Ka'ūpūlehu within this general sequence is presently unknown, however, due to a relative lack of analyzed dating material from the area.

P.H. Rosendahl (1973:60-61, 65-66) has postulated general patterns of aboriginal settlement for the North Kona area, based on ethnohistoric and ethnographic sources. Rosendahl divided the area of occupation into three principal environmental zones: a narrow and arid coastal zone, where activity centered on the use of marine resources; a sloping and rocky, barren midland zone, and an upland habitation-agricultural zone. He notes that the further *mauka* forest zone was used, but rarely inhabited. He described these occupational zones as follows:

> ***Coastal Occupation*** - Inhabitants lived in fishing hamlets along the shore, frequently near fishponds and small bays, and were principally engaged in marine exploitation (including in-shore and deep-water fishing, gathering shellfish, and production of salt. They also engaged in aquaculture, and in very limited agriculture in small beach areas and tiny pockets of sand and gravel on barren flows. This included cultivation of coconut, sweet potatoes, and possibly bananas, and these may have supplied travelers going by canoe between Kailua and Kawaihae.

Barren-Zone Occupation - Temporary shelter and the *mauka-makai* foot trails indicate the movement of people, and probably goods, between the coast and uplands. Midden from habitation sites, containing the remains of terrestrial and marine resources, evidence access to both upland and coastal zones. Artifacts and structural remains indicate recurrent use of temporary occupation features.

Upland Occupation - Rosendahl described this as a major occupation area, with scattered, small, hamlets (probably located above 2,000 ft elevation and receiving 25 inches of rainfall per year). Inhabitants practiced extensive dryland swidden agriculture. The principal crops were dryland taro and sweet potato, but breadfruit, bananas, paper mulberry, ti, gourds, *awa*, and sugarcane were also cultivated.

Cordy's (1985) findings in 'O'oma and Kalaoa Ahupua'a, also in Kekaha, but south of the current project area led him, like Rosendahl (1973), to divide the study area into environmental zones (coastal, barren, and upland). Cordy examined and described site locations and types within each land unit.

Coastal Zone - The Coastal Zone extends from the shoreline to 50 meters inland, with a maximum elevation of six meters. It is composed of low pahoehoe with some sand beaches. Features found there include trails, caves, enclosures, platforms, pools, cairns, C-shapes, and pavings. Cordy suggested that there are at least 22 permanent house sites located right along the shore. The permanent structures included platforms, enclosures, and pavings with relatively shallow fill.

Also located in the Coastal Zone are sites interpreted as temporary dwelling areas, with feature types such as caves and C-shaped shelters. These are located at the interface with the Barren Zone, or along the shore in areas not used for permanent housing. There are two very large structures interpreted as *heiau* in the Coastal Zone, in 'O'oma 1.

Barren Zone - Cordy's Barren Zone in 'O'oma and Kalaoa, is a band from the 20 foot contour to c. 0.8–1.4 kilometers inland, and is similar to Rosendahl's Barren Occupation Zone in terms of environment and features (trails). Sites in this zone appear to consist mostly of a few *mauka/makai* trails, the early-historic Mamalahoa Trail (which parallels the shore), a few C-shaped structures and caves near the trails, and cairns that may be associated with the trails. With some exceptions, the habitation sites appear to be temporary, containing only shallow deposits.

At the 200-400 ft (61-122 meters) level of Kalaoa 5 and 'O'oma 1 site density increases. Large numbers of cave shelters in tubes branching off of sinks and on the floors of the sinks are reported. These are marked by extensive features which may be indicative of recurrent, short-term usage. A number of surface cairns in the vicinity could mark trail locations with associated caves. A single historic walled permanent structure (with associated features) was found near the upper end of the Barren Zone (Rosendahl (1973:32).

Upland Zone - Cordy's Upland Zone, consists of rough *aa*-and-soil terrain from 426 ft to 3,379 ft (130-1,030 meters) in elevation, and up to six kilometers from shore. Only three archaeological studies had been conducted in this zone, but indications of upland agricultural features, platforms, mounds, and walls were noted. Cordy reported virtually continuous sites beginning at the c. 450 foot elevation and extending up to at least the 800 foot contour (and perhaps beyond). There were indications that this was the lower margin of an upland agricultural system, and site types included house enclosures, stone platforms, high-stacked *ahu* [cairns], stone walls, and numerous stone mounds suggesting that the local crop was largely sweet potato (Davis IN Cordy 1985). The details of this system remain largely unknown, but it included both permanent and temporary housing. Thus, for the most part, the archaeological data supports the ethnographic record in defining prehistoric settlement patterns for the larger area of North Kona.

Neither Rosendahl (1973) nor Cordy (1985) discuss the forest zone above the upland zone. Historic documents, however, provide glimpses of how it may have been used. Menzies [IN Kelly 1983:63] noted that it was occupied by a few families engaged in short-term tasks, and who lived in small, temporary villages. Activities in the forest zone included harvesting large timber, roughing logs into canoes, and catching birds for feathers.

A recently published report based on archaeological work conducted in Kaloko Ahupua'a in 1971 (Cordy, et al. 1991) indicates the presence of features characteristic of an agricultural field system extending to at least 1,070 m (3,500 ft) into the Upland-Forest zone. These agricultural features contained formal, walled fields, up to c. 700 m (2,300 ft) and scattered features including walls, terraces, and enclosures above that elevation. It was proposed that in the formal, walled area, the major walls run parallel to the coast, and thus, perpendicularly the direction of erosion. The authors state that such a large labor investment for erosion control may be indicative of the clearing of trees and thus the farming areas were once less densely forested than today (ibid.:442). Major elements of this field system (up to c. 700 m) include major walls, terraces, mounds, enclosures, cairns, platforms, and an upright. Above, the major north-south walls were lacking, but small terraces, small linear depressions, clearings, clusters of mounds, and small enclosures were found. The features suggest temporary shelter and small agricultural clearings (ibid.:445).

Implications for Present Project Area

Settlement patterns within the project area may be expected to follow the general patterns noted by Rosendahl (1973) and Cordy (1985). While no portion of the current project area lies within the upper zone, the presence of prehistoric settlements there has been amply demonstrated by previous research. Within the current project area, the midlands (or barren zone) is defined by the expanses of pahoehoe and aa lava, and extends from ten meters to 107 m in elevation. The term *midlands* is used in this report, but is equivalent to "*barrens*", as used by Rosendahl and Cordy. This name change will be discussed further in the Conclusion.

As indicated by work in surrounding *ahupua'a* and areal models, sites in Ka'ūpūlehu may date to as early as AD 900 for initial occupation, although Cordy (1981) has suggested that initial settlement may have not occurred until around AD 1400. Again, an increase in overall population is suggested c. AD 1500-1800. The coastal portion is expected to contain both permanent and temporary habitations, in varying densities. The permanent habitations may include platforms, enclosures, pavings, and/or terraces. Temporary habitation features may include caves and C-shaped shelters. A possibility are very large structures (such as *heiau*). Other expected activities include local resource exploitation features (related to activities such as fishing and gathering of inshore resources). The midlands (or barren zone) was expected to reflect temporary occupation, evidenced by *mauka-makai* trails and shelters such as C-shapes and short-term habitations in lava tubes. The habitation sites are expected to be temporary, with only shallow deposits. These trails are indicative of movement of resources between the seacoast residences and gathering areas and the residences and gardens in the uplands. The upland zone, although not a part of the current project area, is defined by dryland forests and grasslands extending from c. 400–600 m (1300–2000 ft) in elevation. Sites within the upland zone are expected to be dispersed residential features associated with agricultural features. These residential features, while probably not indicative of permanent habitation, should indicate long-term recurrent or seasonal habitation.

The Upland Forest zone of Ka'ūpūlehu has not been sampled, but it is probable that prior to disturbance, a similar utilization to that of Kaloko would have been present. Settlement patterns within the forest zone may be expected to have been formal, walled fields up to c. 700 m with scattered features including wall, terraces, and enclosures above. Features indicating temporary shelters for field workers would probably have been present.

FIELD METHODS AND PROCEDURES

During the first phase of the current the Ka'ūpūlehu Makai Lot 4 inventory survey, field methods consisted of a 100% coverage, low-level aerial survey (altitude of 30-50 ft [9-15 m]) of all portions of the project area, and variable coverage (partial to 100%), variable intensity ground survey.

The pedestrian, 100% survey of the project area was accomplished using a series of pedestrian transects which were oriented at 220/40° (approximately perpendicular to the major axis of the project area). Intervals between transects were 15-20 meters. To ensure complete coverage, the edges of the transects were flagged with red- or blue-striped flagging. As sites were identified they were marked with pink and blue flagging and a metal tag, and were assigned a PHRI temporary site number prefixed by "1141-" and beginning with "1141-1". All sites and features were plotted onto a 1"=400' scale color aerial photo, and were listed in a field notebook, along with a brief description of the feature.

The AD 1800 Ka'ūpūlehu flow and another major aa flow in the southeast portion of the project area were examined 100% by the aerial survey, but were sampled by way of a pedestrian survey. Areas were sampled using transects spaced at 20 meter intervals at a bearing of 220/40°. Six sample sweeps (each comprising three transects) were conducted over the AD 1800 Ka'ūpūlehu flow, and seven sweep (21 transects) were conducted over the other major flow.

The Phase I survey adequately identified all sites and demonstrated that with the exception of a single, isolated feature, the aa flows did not contain archaeological sites The recording of the archaeological resources to the inventory level progressed from the *mauka* (toward the mountains, or eastern) portion of the project area (near Queen Ka'ahumanu Highway) to the *makai* (seaward or western) portion, along the Pacific Ocean.

Phase I site locations were plotted on an R.M. Towill Corp. aerial photograph (Photograph No. KV-7, scale 1"=400', 1979) and on computer drafted maps prepared earlier for PHRI

Project 92-1141 (Smith and Rosendahl 1992:3). While workers were in the field, site locations were confirmed and slightly adjusted when necessary. Site relocation adjustments were aided by the Towill aerial and USGS quadrangle (Kiholo, Hawai'i-7.5'-1982).

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Because the Phase II data collection took place at known archaeological remains, no aerial survey was thought necessary, and no formal ground survey was during this phase, because most of cultural remains were believed located during site identification. Of the 185 sites recorded during the Phase II work, 181 had been located during the Phase I Site Location Phase. Interestingly, only a single, previously unknown archaeological site (Site 19240) was located in the sample transects across the recent aa flows. Sixteen Phase I sites (of the initial total of 197) were not recorded during Phase II, for the following reasons: after further examination, five locations were determined not to be archaeological sites; three sites were found to be outside of this project area (and had been previously recorded); and eight sites could not be relocated during this phase. These eight sites along with their Formal Site/Feature Type and Tentative Functional Interpretation are shown below in Table 4.

Table 4.
Phase I Sites Not Recorded during Phase II

PHRI No.	Formal Site/Feature Type	Tentative Functional Interpretation	Comments
1141-58	Complex (2)	Indeterminate	–
A	T-shape	Indeterminate	–
B	Linear wall	Indeterminate	–
1141-106	Petroglyph	Communication	Shielded man; associated with trail 19194
1141-132	Mound	Indeterminate	Very small mound
1141-136	Modified lava tube with utilization	Possible habitation	Some random piling and midden scatter present
1141-137	Depression	Possible habitation	Midden scatter in a natural depression abutted by a large outcrop on the back
1141-145	Salt pan	Habitation	–
1141-146	Salt pan	Habitation	–
1141-195	Enclosure	Indeterminate	Small, circular

Although these sites could not be relocated during Phase II work, they were apparently all either temporary habitation, or in the case of 1141-145 and 1141-146, possibly associated with nearby habitations. It is unlikely that any ceremonial or burial sites were not found.

Four additional sites were located and described during the Phase II Data Collection Phase. These sites were found during travels to previously identified Phase I sites.

All sites were described on standard PHRI site survey record forms and were photographed using 35 mm black-and-white film (PHRI Roll Nos. 4521-4524, 4527-4532, 4536-4537, 4540-4554, 4557, and 4579-4580). Detailed recording of sites included written descriptions, measurements, and plan maps. Each site, or the primary feature within the site complex, was marked with pink-and-blue flagging tape, and with an aluminum tag bearing the temporary site number, date, the letters "PHRI," and the PHRI project number (93-1397). This aluminum tag was usually tied to a small stone, which was then wrapped in pink or blue flagging tape (which also had the above information written on it). The stone was placed in a prominent part of the site. All newly identified sites were assigned one- or two-digit PHRI temporary field numbers prefixed with "1397-," beginning with "1397-1" (Table 5).

Although surface collection of several sites was recommended in the Phase I report, this was generally not done during Phase II. Diagnostic artifacts were collected, and an observation list of ecofact (shell) genera and non-diagnostic artifacts was completed during site recording. This information is presented in the Site Descriptions (Appendix A) by specific site. Limited testing took place in nine features at eight sites. Informal burial testing occurred in 16 features at ten sites that had been indicated as possible burial locations during the Phase I - Site Identification.

Testing of the sites followed standard PHRI testing procedures. Test unit size ranged from 0.50 by 0.50 m to 1.0 by 1.0 m. Initially, a pre-excavation photograph was taken of the unit and all surface features were drawn. Excavation then progressed by arbitrary 0.10 m levels until bedrock was reached. All removed material was passed through 1/8-inch screen and cultural material was collected. At the conclusion of excavation, the unit was profiled, photographed, and backfilled. Burial testing of possible burial features was more informal. Where possible, rocks were removed to look for burials; when this was not deemed feasible, a square unit (usually 1.0 by 0.50 m or 1.0 by 1.0 m) was laid out, surface was photographed and drawn, and the rocks were removed, usually in a single level. Excavation proceeded until bedrock (or human remains) were encountered. If human skeletal remains were encountered, excavation ceased and the pit was backfilled. If bedrock was found, the unit was photographed and backfilled. For tested units consisting only of stacked or piled rock resting on pahoehoe profiles were not drawn.

Site and Feature Descriptions

During field and summary work, efforts were made to maintain consistency in classification and recording of features and sites. To standardize observations, features were assigned and recorded as one of 20 formal types, grouped into five categories. This was done in order to reduce recorder prejudice, while maintaining consistency throughout the project. The criteria given below were used to determine the classification of formal types. This system is not definitive, but was used only to facilitate this inventory survey. Upon closer examination, it may be noted that not all formal types are unique and some overlap can occur. The classification system, therefore, is subject to change. The system is described below:

Table 5.
Correlation of Site Numbers

*SIHP	PHRI Temp No.	Prev.PHRI	Aerial Surv. No.	BPBM
19065	1397-1	1141-1		
19066	1397-2	1141-2		
19067	1397-3	1141-3		
19068	1397-4	1141-4		
19069	1397-5	1141-5		
19070	1397-6	1141-6		
19071	1397-7	1141-7		
19072	1397-8	1141-8		
19073	1397-9	1141-9		
19074	1397-10	1141-10		
19075	1397-11	1141-11		
19076	1397-12	1141-12		148
19077	1397-13	1141-13		145
19078	1397-14	1141-14	28	
19079	1397-15	1141-15	27	
19080	1397-16	1141-16		
19081	1397-17	1141-17		
19082	1397-18	1141-18		
19083	1397-19	1141-19		
19084	1397-20	1141-20	30	22
19085	1397-21	1141-21		
19086	1397-22	1141-22		
19087	1397-23	1141-23		
19088	1397-24	1141-24		
19089	1397-25	1141-25		
19090	1397-26	1141-26		
19091	1397-27	1141-27		147
19092	1397-28	1141-28		
19093	1397-29	1141-29		
19094	1397-30	1141-30		142
19095	1397-31	1141-31	36	137
19096	1397-32	1141-32	35	133
19097	1397-33	1141-33	34	
19098	1397-35	1141-35		
19099	1397-36	1141-36		132
19100	1397-37	1141-37		
19101	1397-38	1141-38		
19102	1397-39	1141-39		143
19103	1397-40	1141-40		
19104	1397-41	1141-41		153?
19105	1397-42	1141-42		153?
19106	1397-43	1141-43		
19107	1397-44	1141-44		153
19108	1397-45	1141-45		
19109	1397-46	1141-46		
19110	1397-47	1141-47		
19111	1397-48	1141-48		
19112	1397-49	1141-49	40	131
19113	1397-50	1141-50		138
19114	1397-51	1141-51		134
19115	1397-52	1141-52	41	130
19116	1397-53	1141-53		
19117	1397-54	1141-54		129
19118	1397-55	1141-55	42	73
19119	1397-56	1141-56	44	
19120	1397-57	1141-57		128
19121	1397-59	1141-59	53	124

* *State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five-digit numbers prefixed by 50-10-19 (50=State of Hawaii; 10=Island of Hawaii; 19=USGS 7.5' series quad map ["Kiholo, Hawaii"]).*

Table 5. (cont.)

*SIHP	PHRI Temp No.	Prev.PHRI	Aerial Surv. No.	BPBM
19122	1397-60	1141-60	46	
19123	1397-61	1141-61		74
19124	1397-62	1141-62	60	125/152
19125	1397-63	1141-63		123
19126	1397-64	1141-64	52	
19127	1397-65	1141-65		
19128	1397-66	1141-66	51	76
19129	1397-67	1141-67		122
19130	1397-68	1141-68	61	
19131	1397-69	1141-69		
19132	1397-70	1141-70		
19133	1397-71	1141-71	62	
19134	1397-72	1141-72		
19135	1397-73	1141-73		
19136	1397-74	1141-74		121
19137	1397-75	1141-75		119/120
19138	1397-76	1141-67	54	
19139	1397-77	1141-77		82
19140	1397-78	1141-78		81
19141	1397-79	1141-79		
19142	1397-80	1141-80		118
19143	1397-81	1141-81	64	75
19144	1397-82	1141-82	63	
19145	1397-83	1141-83		
19146	1397-84	1141-84	66	117
19147	1397-85	1141-85		
19148	1397-86	1141-86		102
19149	1397-89	1141-89		114
19150	1397-90	1141-90	67/68	109-113,115,118
19151	1397-91	1141-91	65	116
19152	1397-93	1141-93	70	
19153	1397-95	1141-95	72	
19154	1397-96	1141-96		
19155	1397-97	1141-97		90
19156	1397-98	1141-98		
19157	1397-99	1141-99	73	
19158	1397-100	1141-100	74	80
19159	1397-101	1141-101	78	79
19160	1397-102	1141-102		
19161	1397-103	1141-103		78
19162	1397-104	1141-104		204
19163	1397-105	1141-105		
19164	1397-107	1141-107	58	
19165	1397-109	1141-109		
1140	1397-110	1141-110		35/71
19166	1397-111	1141-111	77	
1138,1141*	1397-112	1141-112	80	36/200
19167	1397-113	1141-113	84	
19168	1397-114	1141-114		77
19169	1397-115	1141-115		
19170	1397-116	1141-116		
19171	1397-117	1141-117		72
19172	1397-118	1141-118		
19173	1397-119	1141-119		
19174	1397-120	1141-120		
19175	1397-121	1141-121		
19176	1397-122	1141-122	55	
19177	1397-123	1141-123		
19178	1397-124	1141-124		
19179	1397-125	1141-125		
19180	1397-126	1141-126		53
19181	1397-127	1141-127	48	54
19182	1397-128	1141-128		
19183	1397-129	1141-129		

* Assigned by Ching (1971)

Table 5. (cont.)

*SIHP	PHRI Temp No.	Prev.PHRI	Aerial Surv. No.	BPBM
19184	1397-130	1141-130		
19185	1397-131	1141-131		67
19186	1397-133	1141-133	33	
19187	1397-134	1141-134		68
19188	1397-135	1141-135		
19189	1397-138	1141-135	26	
19190	1397-139	1141-139	32	
19191	1397-140	1141-140		
19192	1397-141	1141-141	42	66
19193	1397-142	1141-142		
19194	1397-143	1141-143		
19195	1397-144	1141-144		
19196	1397-147	1141-147		
19197	1397-148	1141-148		
19198	1397-149	1141-149		
19199	1397-150	1141-150		
19200	1397-151	1141-151	5	8
19201	1397-152	1141-152	6	7
19202	1397-153	1141-153	7	5
19203	1397-154	1141-154		
19204	1397-155	1141-155		
19205	1397-156	1141-156		
19206	1397-157	1141-157		
19207	1397-158	1141-158		
19208	1397-159	1141-159		
19209	1397-160	1141-160		
19210	1397-161	1141-161		
19211	1397-162	1141-162	15	
19212	1397-164	1141-164		
19213	1397-165	1141-165		
19214	1397-166	1141-166	14	
19215	1397-167	1141-167		
19216	1397-168	1141-168	13	
19217	1397-169	1141-169	12	
19218	1397-170	1141-170		
19219	1397-171	1141-171		
19220	1397-172	1141-172		
19221	1397-173	1141-173		
19222	1397-174	1141-174		
19223	1397-175	1141-175		
19224	1397-176	1141-176		
19225	1397-177	1141-177		
19226	1397-178	1141-178		
19227	1397-179	1141-179		
19228	1397-180	1141-180		
19229	1397-181	1141-181		70
19230	1397-182	1141-182	19	
19231	1397-183	1141-183		
19232	1397-184	1141-184		
19233	1397-185	1141-185		
19234	1397-186	1141-186		
19235	1397-188	1141-188		
19236	1397-189	1141-189		
19237	1397-190	1141-190		
19238	1397-191	1141-191		
19239	1397-192	1141-192		
19240	1397-193	1141-193		
19241	1397-194	1141-194		
19242	1397-196	1141-196		
19243	1397-197	1141-197		
19244	1397-996	—		
19245	1397-997	—		
19246	1397-998	—		
19247	1397-999	—		

Platform - A quadrangular structure (rarely oval) with a large surface area (length should be greater than c. 4.00 m); length is usually the maximum dimension; the sides are usually composed of stacked rocks and may be faced; the surface is fairly level and even, and may be paved. It must be raised (elevated) on all sides.

Cairn - A quadrangular or oval structure of stacked stones with a very small surface area (length should be less than <3.00 m); height is usually the maximum dimension; sides may be faced; the feature may have vertical or sloping sides; may be conical or dome-shaped. May be solid or have a hollow interior.

Mound - A quadrangular, oval, linear or amorphous structure of piled material; maximum dimension can be length or height; the feature is conical or dome shaped in profile, with sloping sides; the sides are not faced; usually designated by process of elimination (construction is piled rather than stacked so it can't be a platform, cairn or wall or sides are not faced, so it can't be a faced mound); If material is used to fill a depression and then piled above the lip of the depression, the feature is a mound, *not* a modified depression.

Wall - A linear structure with stacked sides; usually longer than high; surface usually flat; sides usually vertical or slightly sloping; sides may be faced; may be core filled; may be free-standing or abut other features; may be semicircular (C-shaped); may consist of adjoining segments (e.g., L-shaped wall, *U-shaped* wall, T-*shaped*, *etc.* [e.g., shaped wall]); differentiated from a linear mound by the more formal construction (stacked sides rather than piled sides).

Terrace - A quadrangular, oval, linear, or amorphous structure with at least one side consisting of material piled or stacked more than one course high; also, at least one side must be flush with the ground surface or abut some natural or artificial feature (e.g., one side of a terrace may be built against the side of an elevated outcrop so that the surface of the terrace is flush with the top of the outcrop; or, the terrace is built on ground with a southwest slope, so that the northeast side is level with the ground, but the southwest side is built up to create a level surface for the terrace); may be higher than long or longer than high; sides may be piled, stacked or faced; surface may be level, convex, concave or irregular; may incorporate natural outcrops into the structure.

Alignment - A linear structure composed of just one course of three or more stones in a line; stones may be placed so ends overlap, or touch end to end, or are slightly apart.

Pavement - A quadrangular, oval, amorphous or linear structure composed of material placed one course deep over the ground surface to form a usually level and very regular surface; sometimes a component of another feature (e.g., a pavement inside an enclosure;) however, if the surface of a platform is paved with coral, this is considered part of the platform, not a separate feature.

Excavations - Man-made depressions in bedrock created by breaking stone away from pahoehoe outcrops or blister tops, or created by removing loose aa from aa flows; the material excavated may be missing, or piled inside or around the excavated area (therefore, it is part of the feature).

Cleared Areas - Areas cleared of all rock, or cleared of all larger material, so a level smooth area is left; usually only considered as a discrete feature when it is isolated from other features. For instance, if the central area of a cave has been cleared of roof fall, this area would not be a feature separate from the cave itself; the same would apply to the interior of an enclosure that has been cleared of all scattered rock; this would not usually be considered a separate feature.

Pecked Stone - Any non-patterned pecked surface on large boulders or non-portable stone (e.g., bedrock, rocky shorelines or cave walls); pecked areas may also consist of shallow or deep basins.

Petroglyph - Any patterned pecked or etched surface of boulders or non-portable stone; the patterns can consist of human figures, stylistic designs or rows of holes

Enclosure - A quadrangular, triangular or oval structure that encloses at least 75% of an interior space, in other words, if *less* than 75% of the structure's interior is *not* enclosed, it should be classified as a wall for example; the structure could consist of walls, linear mounds or alignments that enclose an area; the enclosure can also incorporate man-made features as part of the enclosure (e.g., three sides are composed of an U-shaped wall and the fourth side is composed of the side of a platform), or incorporate natural features (both ends of a semicircular wall abut the side of an outcrop, resulting in a semicircular enclosed area).

Modified Outcrop - An amorphous feature usually chosen after eliminating other feature types (e.g., not piled enough to be a mound, rocks are scattered rather than aligned, etc.); usually consists of a scatter of rocks on top of bedrock or a bedrock outcrop; the rocks sometimes form rough rings; the surface is usually irregular and bedrock is often exposed in the center of the feature; if the outcrop itself is excavated, then the feature is an excavation, *not* a modified outcrop.

Modified Depression - Any type of modification to a natural depression (*not* a man-made excavation—then the feature would simply be called an excavation); the depression may be filled, have modifications inside the depression or around the lip of the depression; the depression may consist of a crevice, a collapsed blister or lava tube, or just a low area; may contain discrete features (e.g., a wall around the lip, a cairn in the bottom, a pavement covering the bottom, etc.).

Lava Tube with Cultural Material - The simple presence of cultural material may represent utilization, even of there is no modification to the tube itself. Features that represent separate activities should be given separate designations. General habitation deposits (i.e., midden) will not be designated as separate features.

Modified Lava Tube - Include tubes with structural modifications to the tube itself (e.g., stacking rocks to constrict the entrance or clearing the floor of roof fall); this category may also include tubes containing discrete structures (e.g., internal walls, platforms or cairns), which should be given separate feature designations; modified lava tubes may be separated into caves (depth greater than width at opening) or overhangs (width of opening greater than depth).

Modified Lava Tube with Utilization - Includes tubes exhibiting modifications to tube itself, and may also include internal structures. Utilization within the tube is indicated by the presence of ecofacts, artifacts, or burials.

Trail - Any feature for which the function is transportation. Trails can include of an alignment of pahoehoe slabs or waterworn cobbles (steppingstone trail); a scatter or linear pavement of pebbles, coral, or other material; a raised wall with perimeter boulders (kerbstone trail); an area cleared of larger rocks to form a level path; a linear path of crushed aa; an alignment of cairns or branch-coral fragments that mark a trail over smooth pahoehoe.

Midden - A nondiscrete or discrete deposit of ecofactual material (including ash, charcoal, faunal remains, manuports). It is only given a separate designation if considered a discrete activity area within the feature.

Other - Features constructed to elevate or hold an object above the ground or cave floor (lamp or torch holders; stands which contain or form a rest for gourd water catchments). This category may also include game pieces for *papamū*, and hearths.

As with formal feature types, functional interpretations have been standardized for this project. It should be again be noted that these definitions are used *only* in this project. Descriptions of each functional type are given below:

Ceremonial - Features are given a ceremonial function if they are considered to have been used in religious ceremonies or observations; evidence of ceremonial use usually includes one or more of the following:

1. Presence of portable artifacts or modifications traditionally considered ceremonial (e.g., a platform paved with waterworn coral, a platform or terrace with a large square hole in the center, upright waterworn boulders embedded into the feature surface, large branch coral fragments inside a cave, etc.). These may be on the surface or below the surface.

2. A feature that took a great deal of time and effort to construct (e.g., an extremely large, well-built platform).

3. No dense concentrations of food remains; artifacts may or may not be present.

Burial - Single features are given a burial function if a burial is present or there is evidence that a burial was once present (e.g., a bundle burial in a cave marked by *lau hala* mat remains, an empty and obviously disturbed crypt in a cave or platform with scatter, etc.)

Habitation - Features are given a habitation function if they are considered to have been used as an actual living space or are special activity areas associated with a habitation complex; evidence of habitation usually includes one or more of the following:

1. A feature with a large, level surface that was probably used as the floor of a structure (e.g., platforms, large terraces, pavements, cleared areas, enclosures with level interiors, the bottom of natural depressions, cave floors, etc.)

2. A feature that took much time and effort to construct (e.g., platforms with paved surfaces, large terraces with stacked and faced sides, enclosures with interior pavements, caves with many modified entrances, etc. Many of these features may also have attributes that mark them as *ceremonial* in function. Determination may depend on the presence or absence of artifacts, manuports, etc.)

3. A feature associated with other possible habitation features (e.g., several clustered features inside an enclosure, a pavement adjacent to a terrace, a cluster of features with cairns at the extreme northern and southern ends, etc.).

4. A feature with internal features (e.g., platforms with cupboards, caves with hearths)

5. A feature with a concentration of surface or subsurface artifacts and ecofacts

Agricultural - A feature is assigned an agricultural function if it is thought to have been used in growing crops or if it was part of a field system; this would include walls and linear mounds used as field boundaries, and mounds composed of rocks cleared from the interior of the fields (clearing mounds). An agricultural function is sometimes assigned because of the presence of certain characteristics, and sometimes due to the absence of certain characteristics; these attributes are:

1. A feature that does not have a level, even surface (an informal platform with many small basin-shaped depressions that were probably used as planting pits [not as postholes for idols], a terrace with a sloping surface, etc.)

2. A feature that did not take (in itself) extensive time and effort to construct (e.g., a terrace with sloping sides of loosely piled stones, low mounds of piled stone, modified outcrops consisting of only a small scatter of stone on top of an outcrop, a cleared area, an aa excavation)

3. Little artifactual or ecofactual material is present

4. Pollen samples that reveal certain Polynesian crops were grown in the features; layers of dispersed charcoal that may be evidence of clearing of agricultural fields by fire

5. Association of features with clusters of other possible agricultural features (e.g., cleared areas surrounded by mounds, walls and alignments in a grid system that suggests field boundaries)

Boundary - A feature is assigned a boundary function if it appears to delineate a *line*. This function is usually restricted to linear mounds, walls and alignments, but It can also be used for an alignment of features (e.g., an alignment of cairns). There is usually little cultural material in these features.

Marker - A feature is assigned a marker function if its function was to mark the location of a site, the perimeter of a site, the end of a trail, a petroglyph or panel, etc. At Ka'ūpūlehu, where vast expanses are present, these markers can be seen from a distance. There is usually little cultural material present at these features, but they may be topped by some white coral or beach conglomerate fragments, which would have made the feature easy to spot at a distance or at night. This functional designation is usually used for mounds and cairns, and rarely is used to designate *ahu* which mark *ahupua'a* boundaries.

Transportation - Features are given a transportation function if they are trails; trails may also serve to mark boundaries (see trails, under feature types);

Recreation - Features used for recreation purposes only, such as *papamū* boards (a type of petroglyph), *holua* slides or modifications to ponds or streams to create bathing areas.

Quarry - Features such as aa and pahoehoe excavations are marked by areas of removed or broken pahoehoe or aa lava. These may have a quarry function (sources of stone for building or other purposes).

Other - Features constructed to enclose a very small space (cupboards, walled overhangs, modified depressions) may have a storage function; pecked areas on scoria rock may have been tool manufacturing areas; shallow pecked basins on the shoreline may have been basins for grinding bait (bait cups) or may have functioned as salt pans.

During the Phase II testing of the sites, possible diagnostic artifacts and potential radiocarbon samples were collected. These materials and the test results will be discussed in the following sections.

FINDINGS

SURFACE FINDINGS

During the Phase II Data Collection phase of the current inventory survey, 185 sites, consisting of 633 discrete features, were recorded (Figure 6, at end). One hundred eighty-one of these sites were located during the preceding site identification phase (Smith and Rosendahl 1991); the remainder (n=4) were found during the current phase. The sites comprise 90 complexes (multiple-feature sites) and 95 single feature sites (Table B-1, Summary of Identified Sites and Features). In addition, two Isolated Find (IF) locations were noted and recorded. Isolated Finds are locations defined as single artifacts which are spatially separated from nearby archaeological sites. The archaeological sites consist of both single and multiple component sites, and their physical condition ranges from poor to good. Formal feature types noted include petroglyph, shaped wall, cairn, enclosure, mound, modified lava tube with utilization, pahoehoe excavation, lava tube with cultural material, modified outcrop, terrace, modified lava tube, trail, modified depression, and others (Table 6). Construction methods for these formal feature types generally consisted of rough piling or stacking of unshaped pahoehoe blocks. In some cases, however, especially in those sites indicative of longer-term habitation, substantially more effort was expended in construction. This more substantial construction may include bifaced walls and stone fill, as indicated by Cordy (1981:66). As Cordy's model (ibid.) suggests, there are small, special-purpose structures (for work and storage) associated with these habitation structures. Probable functional interpretations are suggested for most project area sites. Most common functional feature types present include temporary habitation (57), indeterminate (21), and marker (21). These are followed by, communication (18), transportation (12), and habitation (10). Other less common types (<than 15 examples) consist of agriculture, transportation, recreation, burial, storage, ceremonial and others (Table 7). Generally the features combined to form site complexes that were assigned to the broader functional categories of habitation (both temporary and longer-term), marker, indeterminate, communication, transportation, and agriculture.

Functional Analysis

Sites with temporary or longer-term habitation functions number 57 and comprise 30.8% of all sites. Sites and features were defined as temporary versus permanent habitation based on criteria defined by Cordy (1981:66). Cordy includes the following criteria: shape (consists of platforms, pavings, low enclosures), size (permanent is larger, with areas greater than 16 m^2), construction (permanent housing exhibits substantial construction; short-term habitation features are often poorly made); presence of internal stratified features, such as firepits; presence of special purpose structures (small, special purpose structures for work and storage are associated with permanent housing, not with short-term camps); and lastly, location (permanent housing tends to cluster mostly on the coast either along the shore, or at the mouths and sides of valley floors; short-term camps are found along trails, among the agricultural fields, or on the coast). For purposes of this discussion, sites with a habitation function were broken into two categories—temporary habitation or habitation (with the latter indicating longer-term or "permanent habitation." Those features which appear to be short-term *within* long-term habitations have been assigned the term ancillary habitation. These sites may have served as single-use or resource-specific processing structures within the Hawaiian household (*kauhale*).

Table 6.
Frequencies of Formal Feature Types

Formal Type	Number	%	SIHP
Petroglyph	123	19.4	19065(B-2),19069-2,19073(C), 19078(I,J),19081(G,H),19082(A-11,B-3,C,D),19083,19084(H-3,I,K,L-5,M-2,N), 19086(J-2),19088,19091(E), 19093 (F),19094(A-3,B-2), 19101(I), 19102,19115(A), 19127, 19131, 19132-2,19133(A-2) 19134,19137(A), 19143(B-3), 19145,19150(G-3,K), 19152(A-4), 19153(A-5),19156, 19159(C-2, D,E-2,F-2),19160,19163, 19179(A), 19194(J),19200(B), 19201(F), 19206(H-7,N,P,Q,S), 19207(A-D),19211(B-3), 19234(B,C), 19243,19245
Shaped wall	91	14.4	1140(B),19068, 19071(A-C,E-H,N,X), 19076(D), 19077 (A,C,E-I), 19078(B,E,G), 19081 (B,E), 19084(A,E,G), 19086 (C,D,F,G), 19090(A,G-I),19091 (D), 19093(B,D), 19099(I), 19101 (C,E,F), 19103(A-2,E), 19106 (B), 19108, 19109(A), 19126,19136, 19143(C),19146(C), 19150 (A,B), 19157 (B),19170,19178,19185(A), 19192(B,E), 19194(C-E), 19197(C), 19198 (B,C), 19199(A), 19200(A), 19201 (A,C,E) 19202(C-2,F,G,J,N-2), 19203 (D,E), 19206(G,O), 19210(F,Q), 19212 (A),19217(B), 19226 (B), 19237(A), 19246(A-2,B)
Cairn	91	14.4	19065(A),19070,19071(J,Q-W), 19076(F),19077(D-2),19079, 19084(D),19090(B,F), 19091 (A,F,H-L,N,O), 19095(01-10),19097(A,B), 19100(A,B), 19103(F),19104(B), 19105, 19107, 19115(B-2),19116, 19122(A,B), 19123(B),19130(C), 19133(B-6),19138,19140(2), 19143(D),19144,19146(B),19153(B),19158(B,C),19166, 19169,19174,19176,19177(B,C), 19181(C),19183,19190(A), 19192(D),19199(B-2,D), 19206(L,R-2),19209(A,B), 19210(B,S),19211(A), 19215(A),19223(A),19225, 19230(B)
Enclosure	76	12.0	19071(I),19073(A,B),19075,19076(B-3,C,E),19077(B-3), 19078(A,F),19084(B),*19085, 19086(A,E),19090(C-E), 19091(C,G)*, 19093(A), 19095(05A), 19096(A), 19101(H), 19106(A), 19109(B-2),19114,19117(A-C),19135,19137(B),19146(F,G), 19158(F),19180(A),19181(A),19189(A,B),19194(B,F), 19195(A,B),19196,19197(B), 19201(D-2), 19202(B,E-2,I-2,K,L-2,M), 19203(A-2,B-2,C,F-2),19204,19205,19206(A,C-2,K), 19231(A),19233(C),19246(A)
Mound	46	7.2	19078(H-3),19081(D-2), 19086(B),19111,19130(A,B), 19137 (C,D),19141,19147, 19150(F), 19152(B,C), 19153 (C,D), 19159(A), 19167(A), 19177 (A,D,E), 19179(B), 19180(C), 19184,19186, 19188, 19191(C), 19192(A,C), 19197(D), 19201 (B),19202(A,B), 19209(E), 19210(A,G), 19212(B), 19216 (A-C), 19218, 19223(B), 19227(B),19230(A)
Mod. lava tube w/util.	37	5.8	1140(A),19081(A),19084(C,F), 19086(I),19093(E),19098, 19101(A), 19103(B,C),19121(E), 19128(A,B), 19129,19146(E), 19150(M),19151(A-C),19158(A), 19162(A),19165,19187, 19206(D,M), 19210(C,D), 19220(A), 19221(A),19226(A), 19229,19233 (D,E),19234(A), 19235,19236, 19237(D)
Pahoehoe excav.	28	4.4	19096(B),19120,19181(D),19208(B-G),19209(C,D,F-H), 19210(K,M,N),19215(B), 19216(D), 19227(A),19231(B,C), 19237(B),19240(A-E)
Lava tube w/ cultural material	26	4.1	1140(C),19080,19084(G),19086(H),19089,19110,19118, 19121(A),19137(E),19139,19142, 19143(A),19148(A),19149, 19150(H), 19154,19157(A),19164, 19168(A), 19208(A),19213(A), 19220(B), 19221(B),19233(B), 19239,19247
Modified outcrop	20	3.2	19066,19077(J),19078(C), 19090(J), 19091(M),19146(D), 19167(B), 19168 (B),19171(A), 19172(A), 19175,19177 (F), 19181(B), 19182, 19199(C),·19210 (H,J,R), 19217(A),19228(A)

Table 6. (cont.)

Formal Type	Number	%	SIHP
Mod. depression	15	2.4	19071(K,P),19076(A,G), 19093(C), 19101(D), 19103(D), 19150(I), 19190(B,C), 19206(B,J),19210(O), 19228(B), 19244
Terrace	15	2.4	19071(L,M),19081(F),19091(B),19101(B,G),19148(B),19150(C,D), 9158(D,E),19162(C),19198(A), 19206-2
Modified lava tube	14	2.2	19121(B,C),19162(D),19185(B), 19189(C), 19210(L,P), 19213(B), 19214, 19222,19224,19233(A), 19237(C),19238
Trail	14	2.2	1131,19067,19072,19077(K), 19087,19092,19093(G),19119, 19155,19161,19123(A),19124, 19193,19241
Alignment	11	1.7	19091(P),19104(A),19106(D),19112,19125, 19162(B),19171(B),19191(B), 19197(A),19206(F),19232
Wall	10	1.6	19095(11)19103(G),19106(C), 19113,19121(D),19172(B), 19180(B), 19191(A),19198(D), 19202(H)
Platform	5	0.8	19071(D),19150(E),19159(B), 19194(H),19210(I)
Depression	4	0.6	19071(B),19078(D-2),19219
Midden	2	0.3	19150(N),19173
Pecked stone	2	0.3	19194(G),19242
Lava tube w/cultural material-petroglyph	1	0.2	19084(J)
Modified lava tube w/cultural material	1	0.2	19081(C)
Other (hearth)	1	0.2	19194(A)
Other (papamu game pieces)	1	0.2	19074
TOTAL	634	100.3	

Table 7.
Frequencies of Functional Site Types

Functional Type	Number	%
Temporary habitation	55	29.7
Indeterminate	21	11.3
Marker	21	11.3
Communication	18	9.7
Transportation	12	6.5
Habitation	12	6.4
Temporary habitation-burial	7	3.8
Communication-marker	5	2.7
Temporary habitation-quarry	5	2.7
Burial	4	2.2
Habitation-burial	4	2.2
Agriculture	3	1.6
Quarry	3	1.6
Quarry-marker	3	1.6
Recreation	2	1.1
Storage	2	1.1
Agriculture-quarry	1	0.5
Marker-agriculture	1	0.5
Possible ceremonial	1	0.5
Possible ceremonial-marker	1	0.5
Possible temporary habitation	1	0.5
Quarry-indeterminate	1	0.5
Temporary habitation-indeterminate	1	0.5
Temporary habitation-recreation	1	0.5
Total	185	99.6

Habitation - Sites which appear to have served as permanent (or longer-term) habitations comprise 6.4 % (n=12) of all sites and, as Cordy suggests, tend to cluster along the coast. These permanent structures often co-occur with interim habitations that appear to have served as ancillary habitation features. These are defined as temporary, or short-term-habitation related features found within a residential complex. These habitation features may have served as cooking areas, storage space, work areas, religious shrines, men's houses, eating or sleeping areas within the residential complexes—activities *ancillary* to habitation (Weisler and Kirch 1985). When these structures are found outside of the residential complex, they may have been used as temporary habitations by people exploiting coastal and near-shore resources. Ancillary structures in the project area include a full range of formal feature types, including C-shapes and similarly shaped walls, enclosures, modified depressions, and terraces.

Another area of other, possible permanent (or longer-term, recurrent) structures is located somewhat inland, near the brackish ponds *mauka* of Kahuwai Bay. These two brackish water ponds are located just outside of the current project area. They do not *presently* appear to meet the locational criteria of habitation as defined by Cordy (1985) since they are located well back from the coast.

Twelve residential complexes were identified in the project area. One habitation feature at each of these complexes was designated as the probable primary habitation feature. Table 8 presents information on these residential complexes. Figure 6 illustrates the locations of these sites within the project area. These sites are grouped in the functional category of Habitation, but most also evidence use for other activities. As can be seen in Table 8, a number of these sites provisionally resemble residential complexes, but a more definite evaluation cannot be made until further data collection (in the form of test excavations) is undertaken. The residential complexes are summarized in terms of size, feature density and probable age (Table 8). Size criteria for the table is based upon the following: small are those complexes smaller than 2,000 sq m; medium complexes are those from 2,000 to 5,000 sq m; large complexes are greater than 5,000 sq m. Two sites are considered large (Sites 19071 and 19203), with one having medium feature density, the other is low. Two complexes are medium-sized and have a moderate to high feature density. The remainder (eight sites) are all small, seven of the eight have high feature density. Site 19201 is moderately dense.

Site 19203 (Figure 7), is located along the coast between the arms of the AD 1800 Ka'ūpūlehu aa flow. It is a residential complex which includes six features (Feature A, B, C, and F are enclosures, Features D and E are U-shaped walls). All features, with the exception of Feature F, appear to indicate longer-term or permanent habitation. Feature F was determined to be a probable temporary habitation feature or possibly a ceremonial structure. This latter determination was made on the presence of a pair of small upright waterworn boulders which were partially buried.

There are 12 additional cases where it appeared habitation occurred in association with additional activities. These sites were assigned a dual, or multiple, function. These evaluations were given on the basis of other attributes as, for example, where the structural types and associated midden and artifacts suggested not only habitation but perhaps burial, quarrying, or agriculture, concurrently.

Temporary habitation - These sites comprise 30.8 % (n=57) of the project area total. Locations appear to be scattered throughout the project area from the seacoast to the upper elevations. These sites include both caves and surface features. As expected, a number tended to lie close to Site 19124, the *mauka-makai* trail that extends from Queen Ka'ahamanu Highway to Kahuwai Bay. Within the project area, a variety of feature types appear to have been used for temporary habitation, including lava tube caves, enclosures, platforms, modified outcrops, terraces, and shaped walls (such as C-shapes, U-shapes, T-shapes, J-shapes). At most temporary habitation sites the assemblage of surface artifacts or ecofacts was limited; this, however, may be a function of what is preserved in the archaeological record, or it may reflect discard/disposal patterns.

Site 19121 (Figure 8) typifies the prehistoric temporary habitation complexes in the project area. It is located very near to Site 19124 and consists of Features A, B, C, D, and E (lava tube with cultural material, two modified lava tubes, wall, and a modified lava tube with utilization). All features probably served a temporary habitation function.

Marker - Twenty-one probable marker sites (11.3% of total) were encountered in the project area. One example is at Site 19070 (Figure 9a), a small cairn (0.66 m^2 by 0.40 m high). The feature consists of a rough, round cairn in the middle of a bare pahoehoe area. The marker is constructed of 4–5 courses of slab-like pahoehoe and aa-like, irregular cobbles and very small boulders. The feature is thought to have functioned as a possible marker for the trail site 19072.

Table 8.
Summary of Residential Complexes

Site No.	Site Size	Feature Density	Probable Age	Primary Habitation Feature Size and Form (Designation)	No. of Anc. Hab. Feats.	No. of Agri. Feats.	No. of Burials	No. of Other Feats.	Total No. of Feats.
19071*	LG	MOD	PRE	Small C-shaped wall (Fea. E)	13	1	0†	9	24
19078	SM	HI	PRE?-EH	Large enclosure (Fea. A)	5	3‡	0	6	13
19081	SM	HI	PRE	Large L-shaped wall (Fea. E)	4	0	1	4	9
19084	MED	HI	PRE-EH	Large enclosure (Fea. B)	5	0	c. 15	15	21
19086*	SM	HI	PRE-EH	Small C-shaped wall (Fea. C)	6	0	1	4	11
19091	SM	HI	PRE	Small enclosure (Fea. C)	3	0	0†	12	16
19101*	SM	HI	PRE	Medium terrace (Fea. B)	6	0	2	2	9
19103*	SM	HI	PRE	Small C-shaped wall (2) (Fea. A)‡	4	0	0	2	7
19194	SM	HI	PRE	Large enclosure (Fea. B)	7	0	0	1	9
19201	SM	MOD	PRE	Small J-shaped wall (Fea. A)	3	0	0	2	6
19202	MED	MOD	PRE	Small J-shaped wall (Fea. G)	13	0	0	5	19
19203	LG	LO	PRE-EH	Small Enclosure (2) (Fea. A)	5	0	0	0	6
Total					74	4	19	62	150

Site Size:
SM = Small complex (less than 2,000 sq m);
MED = Medium-sized complex (2,000 to 5,000 sq m);
LG = Large complex (greater than 5,000 sq m)

Feature Density:
LO = Low (greater than 600 sq m per feature);
MOD = Moderate (200 to 600 sq m per feature);
HI = High (less than 200 sq m per feature)

Probable Age:
PRE = Prehistoric;
PRE? = Possible prehistoric component;
EH = Early historic

** Tentative assignments, as permanent residential complexes pending further work*
† Potential burial not tested, because the site is in recommended preserve area
‡ Recorded as single feature (Fea. H)

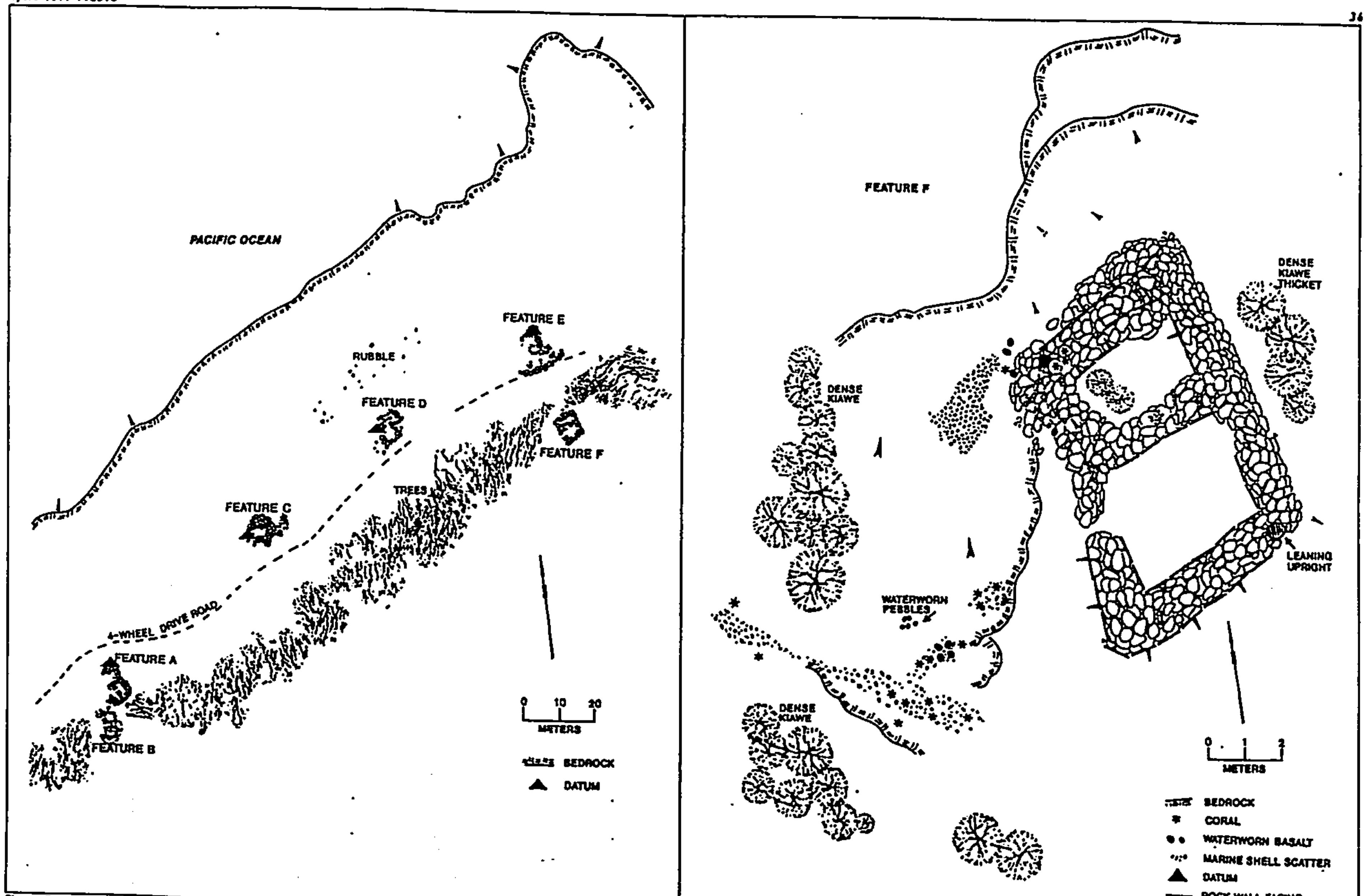


Figure 7. Site 19203, Residential Complex

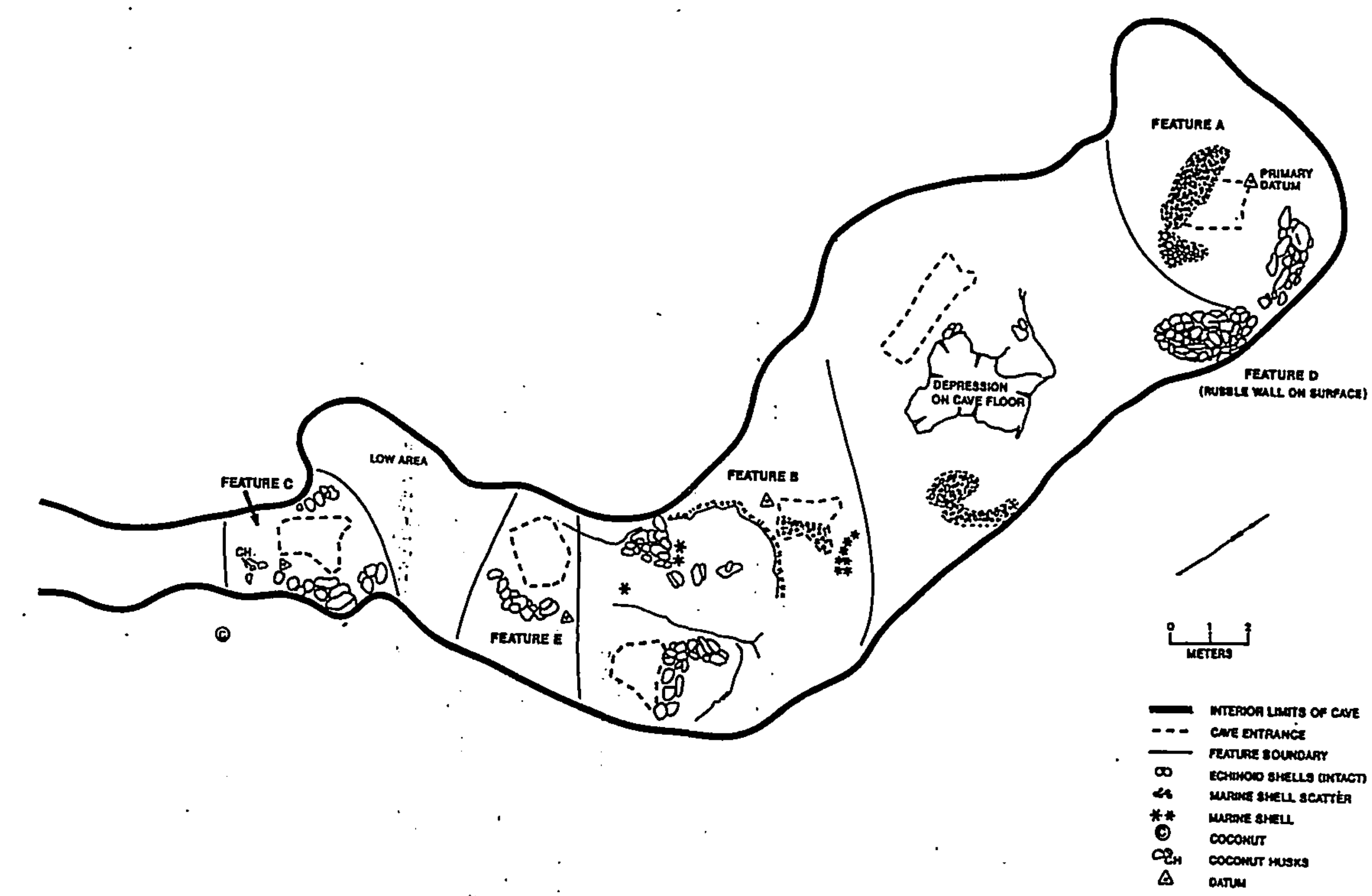


Figure 8. Site 19121, Temporary Habitation

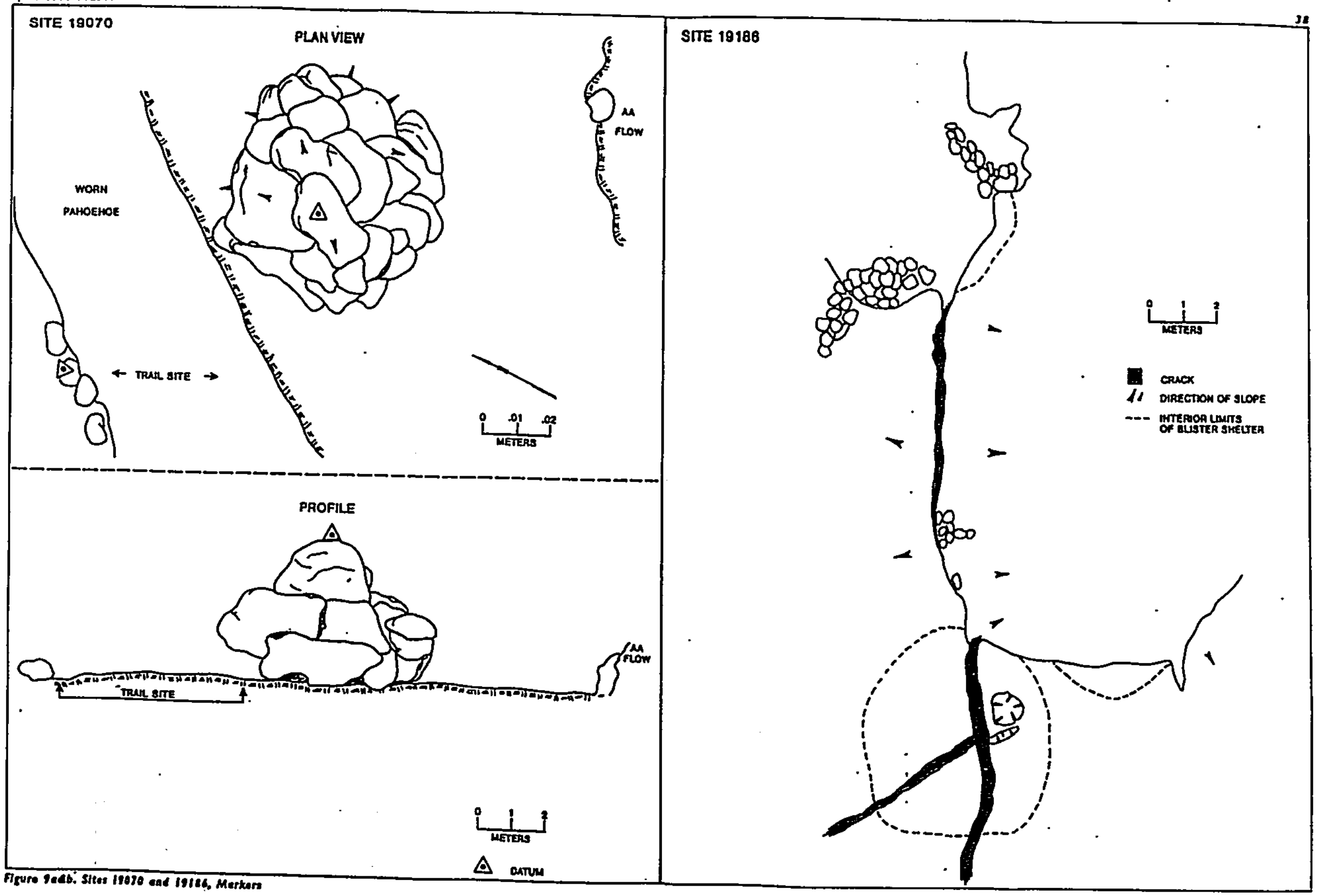


Figure 9a&b. Sites 19070 and 19186, Markers

An additional example is Site 19186 (Figure 9b), a small, low mound on top of a northeast-trending (c. 50°) line of blisters. This mound is oval to quadrangular in plan view, but appears partially collapsed, especially on the east and southeast sides. It is roughly piled to three rocks high, and the building material ranges from small cobbles to medium boulders. The mound lies on the east side of a long crack that traverses the apex of the blister. Just below the mound (and crack) is a c. 5.0 m^2 cleaned floor area. This area may have served as a temporary habitation. Another similar area (marked by an overhang) could have served a similar purpose. Also found within the immediate area are pahoehoe excavations, at one of which, the mined pahoehoe has been placed and piled in a rough semi-circle around the mined area. No portable remains were found at the site.

Communication - There were eighteen sites (9.7%) that were assigned a function of communication. These sites generally consist of petroglyphs such as shield figures, sails, and amorphous figures. Site 19094 (Figure 10) is a series of five trapezoidal anthropomorphic figures located in an area of smooth pahoehoe terrain approximately five meters *makai* of an upthrust area. Three petroglyphs are located at Feature A and an additional two were found at Feature B. All figures were formed by pecking into black pahoehoe causing crushing of the line areas. Additional areas of pecking were also noticed in the vicinity. A small amount of *Cypraeidae* was noted nearby, indicating that some habitation possibly took place.

Discussing petroglyphs, Kirch (1985:271) wrote:

> Hawaiian petroglyphs motifs include human figures, animals, and objects, either singly or sometimes in associated groups or panels. Anthropomorphic figures are most common and range from simple rectilinear stick figures to triangular-bodied figures to forms that display musculature. Some human figures hold or manipulate objects (clubs, paddles, fishhooks, headdresses, etc.), and others are associated in action...Among the artifacts seen in petroglyph groups, the typical crab-claw sail of Hawaiian canoes is not infrequent.

Simple geometric motifs, especially circles and concentric circles, are also common. All of the above motifs were observed in the current project area.

Transportation - Twelve sites (6.5% of total) that appear to have functioned for transportation were located in the project area. These range from steppingstone trails across aa lava flows, to a *mauka-makai* trail from the upper project area to Kahuwai, to a large coastal trail, crossing both aa and pahoehoe flows. All trails within the project area appear to be Type A trails (Apple 1965:65), which are marked with cairns and often have petroglyphs and steppingstones (both waterworn basalt and flat slabs of pahoehoe) in association.

For this discussion, two trails were chosen as examples of the transportation site type. The first is Site 19124 (Figure 6, at end). Site 19124 is a probable prehistoric *mauka-makai* trail used to access the coastal and upland resources at Ka'ūpūlehu, including the large, brackish ponds near Kahuwai Bay. Note that the trail as it presently exists is indistinct or absent in portions (Figure 6). This trail may be an ancient trail which passed through Ka-pipa, on the route from Ka'ūpūlehu to Mauna Kolohana (Maly-pers. comm.). At least fifteen archaeological sites (including temporary habitation and communication sites) were located within ten meters of this trail as it passes from the Queen Ka'ahumanu Highway to the northwestern edge of the project area, near Kona Village. One associated feature of particular interest is Fea. C, Site 19137. This large (5.2 m by 3.2 m by 0.95 m high) stacked, sided mound (with a central depression) may have served as an *'ipuka* or *puka pā* (a gate separating one *'ili*, or land unit, from another) (ibid.).

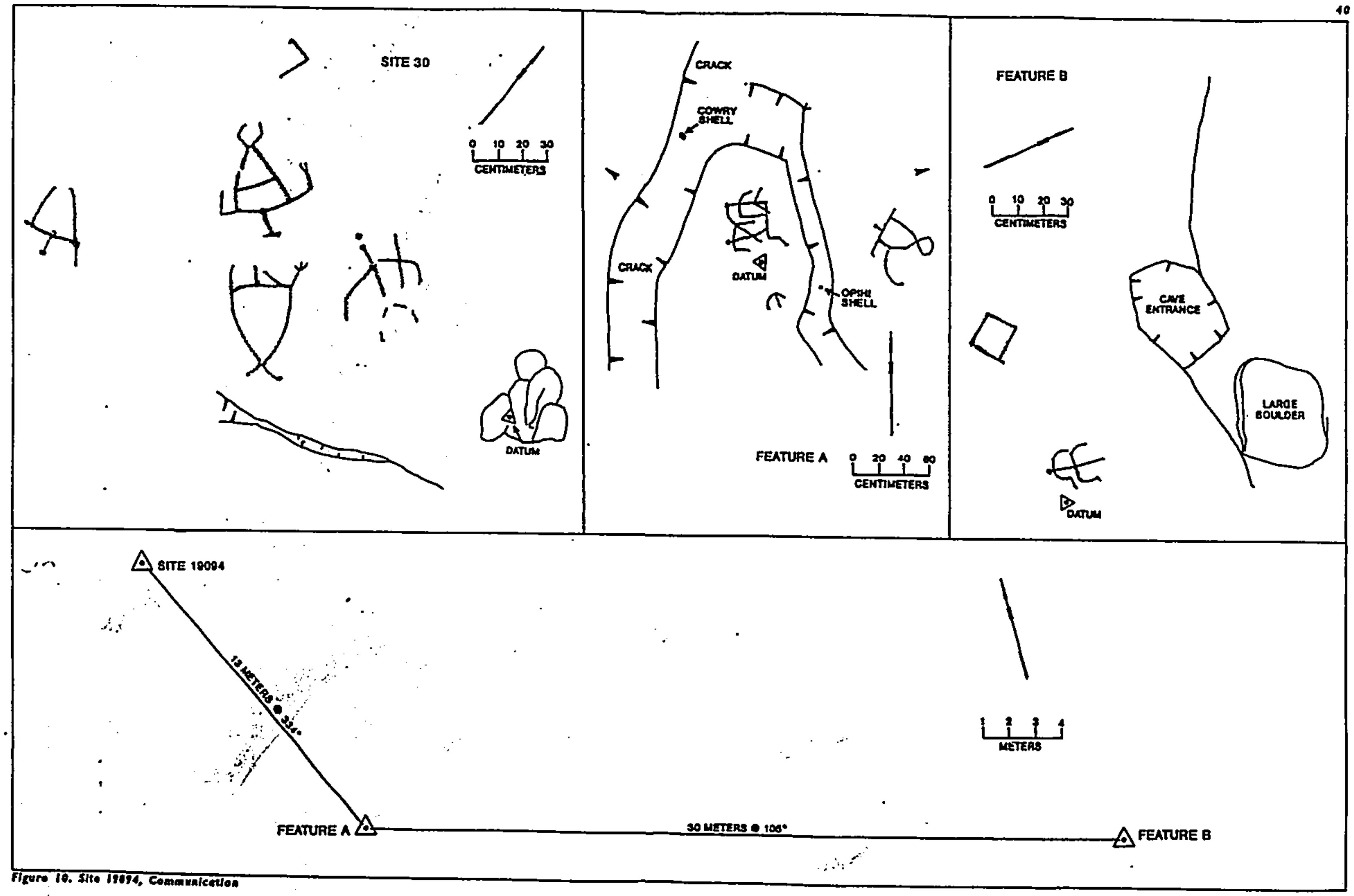


Figure 10. Site 19094, Communication

Site 19124, does not appear to have been up-graded from a Type A to a Type AB trail (Apple 1965:65) to accommodate horses, while other trails in the area were (such as SIHP Site 1319, which passes from Hu'ehu'e Ranch, in upland Ka'ūpūlehu to Kiholo Bay). It also does not appear to have been as heavily used as Site No. 1193, another *mauka-makai* trail in Kūki'o 1st. There may be two possible explanations for the lack of modification or heavy use. First, it could have been unnecessary to have two nearby trails running from the seacoast (1193 from Uluweuweu [Kūki'o] Bay and 19124 from Kahuwai Bay) to the uplands, or perhaps the Site 19124 trail has been used only intermittently in the past 200 years since the upper reaches had been buried under the 1800 aa flow. There is evidence that the trail continued to be used in historic times (as evidenced by historic petroglyphs), but this was probably secondary usage, because it appears that the upper portions were buried. In the early 1800s, therefore, travel between the coast and the uplands was mostly restricted to the Kūki'o-Hu'ehu'e trail (Site 1193).

Another trail is Site 19193, a large coastal trail (*Alaloa*) in the project area (Figure 11). Discussing a similar trail, Apple (ibid.:10) writes..."the beach trail, Type "A" in most places, can be followed from the air as one continuous trail through both districts" (e.g., South Kohala-North Kona). For purposes of recording during the current project, the coastal trail (through the project area) was broken into six sections or segments. These segments were based on incursions of the AD 1800 aa lava flows, and each trail segment was recorded and photographed. Some sections of the trail were indistinct or were not present at all because they passed over either pahoehoe or sand, both of which do no retain evidence of use as well as aa (see Figure 3).

Burial - Four sites (2.2%) were determined to have functioned solely as burial sites. These range from scattered human remains; to a mostly complete single burial; to a multiple burial at Site 19149, a lava tube with cultural material (in this case, human skeletal remains), found in the midlands (Figure 12). At this single feature site, the cave is entered through a vertical shaft. The tube then extends east and west, with the burials found in three distinct areas. Two burials with copious amounts of wood artifacts are nearby; the artifacts include carry poles, a possible canoe plank, and other unidentified wood. Another chamber runs south, then southeast, where it enters a chamber measuring 18 m². The remains of at least 15 individuals were found in this chamber.

Features containing burials (or scattered human remains) were found at an additional 12 sites, making a total of sixteen sites containing human remains. The remainder of these are contained under combinations of functions (e.g., habitation-burial). Human remains encountered in the project area are summarized in Table 9.

Figure 11a. Site 19193, Transportation (Neg. No. 4543-16)

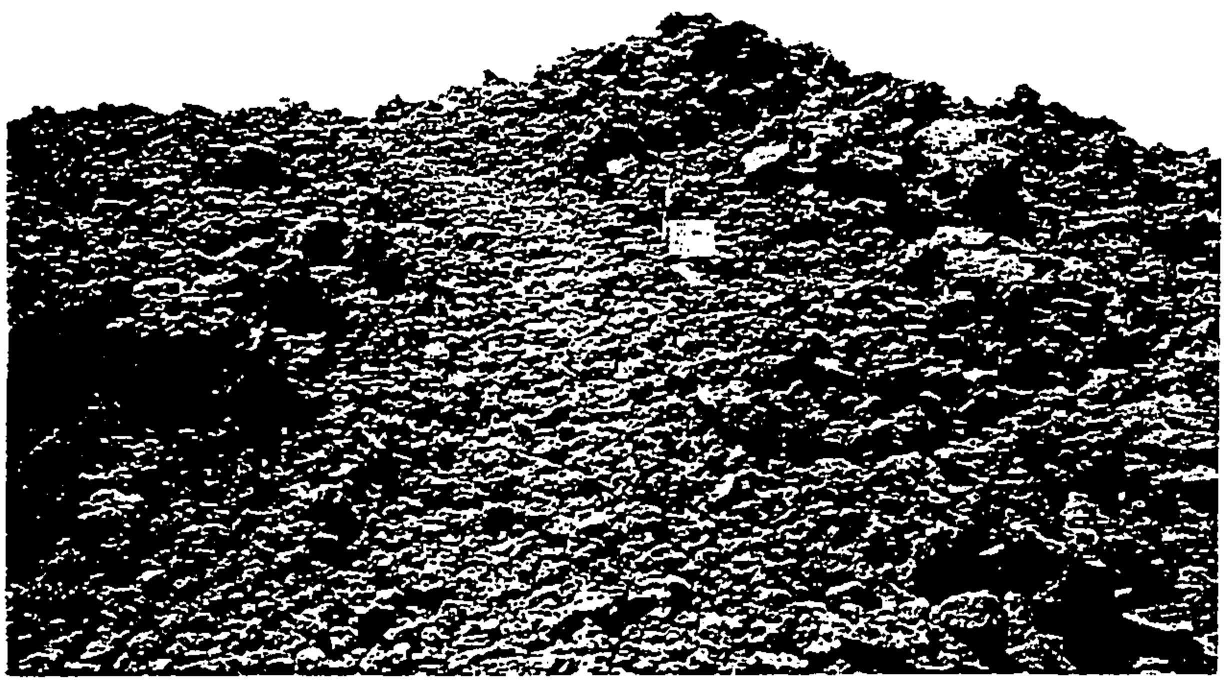


Figure 11b. Site 19193, Transportation (Neg. No. 4543-23)

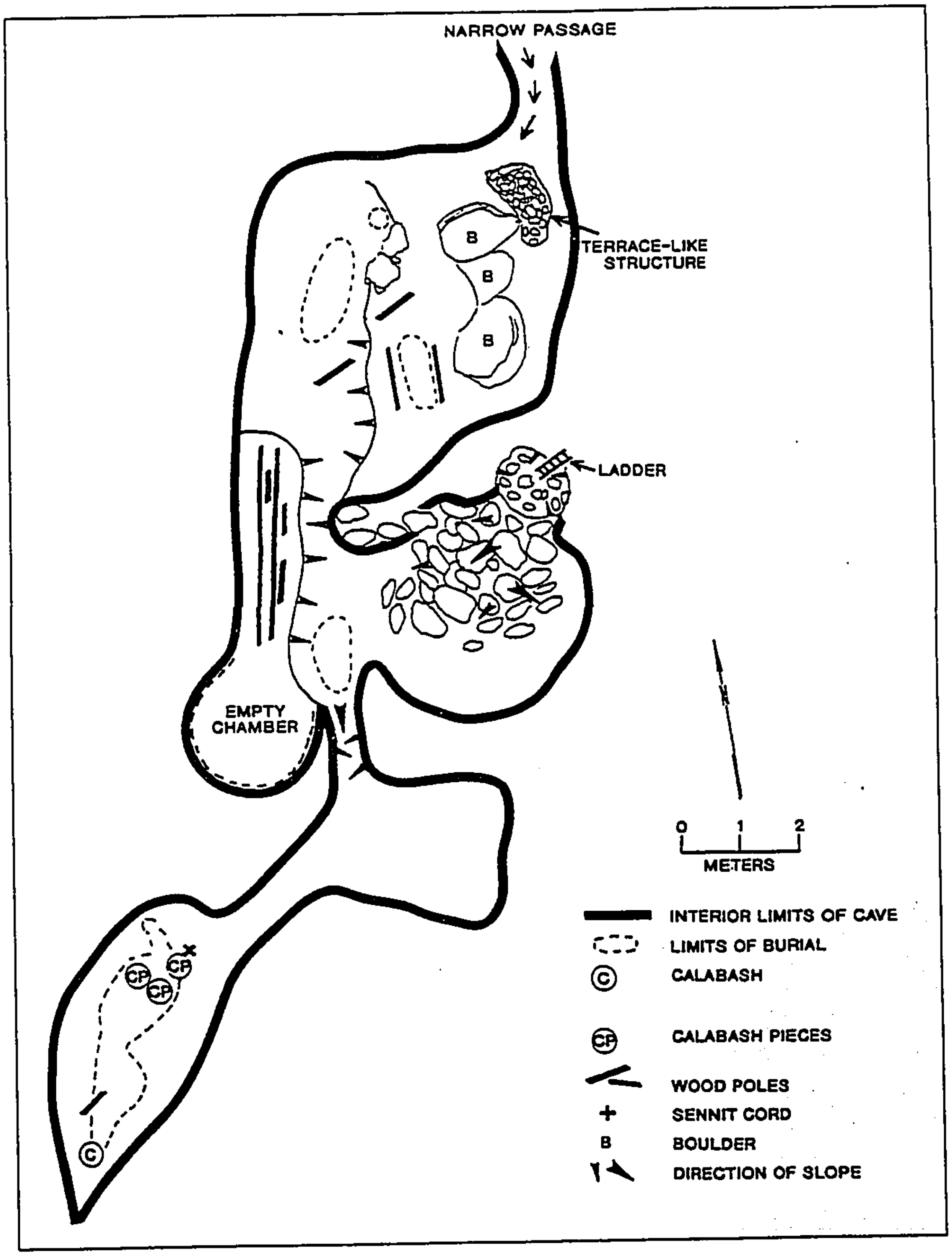


Figure 12. Site 19149, Burial Cave

Table 9.
Summary of Burial Features

Site (Fea.)	Feature Form	Size (m²)	Height (m)	Type of Site	Environmental Zone	Comments
19081 (C)	Modified lava tube w/ utilization	17.5	0.85	Residential complex	Midlands	Human Skeletal Remains (HSR) One right calcaneus with foot phalanges.
19084 (F)	Modified lava tube w/ utilization	2,730	0.70-5.0	Residential complex	Midlands	Mass (immovable). Remains of at least fifteen individuals found with copious wood, ecofacts, and other prehistoric, historic, and modern artifacts-portable remains.
19086 (I)	Modified lava tube w/ utilization	124.1	0.75	Residential complex	Midlands	Human bone scatter including intact cranium, long bone, ribs and innominates.
19101 (C)	U-shaped wall (with cave)	U-shape 27 Cave 35	1.15	Residential complex	Midlands	(Presumed) single infant burial in trunk, such as example at 19084 (F).
19101 (G)	Terrace	26.6	0.12	Residential complex	Midlands	Scattered non-articulated human remains (partial femur, ribs, et al. in blocked lava tube).
19129	Modified lava tube w/ utilization	190	1.10	Temporary habitation-burial (single-feature site)	Midlands	HSR; single partial human cranium w/ mandible.
19139	Lava tube w/ cultural material	45	0.95	Burial	Midlands	Human skeletal remains present in two chambers. Wood present ; no ecofacts.
19143 (A)	Lava tube w/ cultural material	330	1.5	Temporary habitation complex	Midlands	Mass, (immovable); approximately 10 human burials (both pre- and early historic).
19149 (B)	Lava tube w/ cultural material	17.1	2.3	Burial (single-feature)	Midlands	Mass, (immovable); at least 19 human burials with carrying poles and other unidentified wood.
19151 (B)	Modified lava tube w/ utilization	15.6	0.75	Temporary habitation complex	Midlands	Scattered human remains and possible hearth.
19158 (A)	Modified lava tube w/ utilization	840	1.87	Temporary habitation complex	Midlands	Mass (immovable); Twenty+ individuals in at least three areas of a long tube which ends in large chamber.
19164	Lava tube w/ cultural material	180 (sinkhol area)	1.00	Burial (single-feature)	Midlands	Single, mostly complete burial; remains are in small overhang (2.0 x 2.0 x0.90 high) in sink. Cranium, vertebrae, phalanges, clavicle, pelvis present.
1140 (C)	Lava tube w/ cultural material	12 (burial chamber only)	0.70	Temporary habitation complex	Upper Midlands	Single, partial human burial with skull, poss. humerus, pelvis frag., phalanges, and mandible.
19208 (A)	Lava tube w/ cultural material	1,025	1.10	Temporary habitation-quarry complex	Lower.Midland	HSR; two bundle burials, human bone scatter, and a possible third burial. All possibly prehistoric.
19224	Modified lava tube	342	0.61	Burial (single-feature)	Lower.Midland	HSR; possible prehistoric female skull (partial), ulna shaft, bone dust.
19234 (A)	Modified lava tube w/ utilization	98	0.60	Temporary habitation complex	Lower.Midland	Mass (immovable); possible 20+ burials in cave, two have wooden coffins, one w/ partial canoe. Others have cloth material associated. Possibly both prehistoric and historic are present.

Agricultural - Three sites (1.6% of total) were tentatively given an agricultural function. One example of this site type was Site 19246 (Figure 13), located near the south side of the large AD 1800 aa flow, on rolling and undulating pahoehoe. The site consists of two features. Feature A is a small (2.0 m N-S by 1.8 m by 0.45 m high) enclosure; Feature B is a C-shaped wall (with uprights). Feature A is constructed of subangular and slab-like pahoehoe stacked one to two courses high. The interior of the feature is somewhat depressed, and c. 0.10 m of silty brown loam is present. At Feature B, the northern portion of the rough C-shaped wall is built of small slab-like pahoehoe boulders sitting upright on their edges. Both the east and west walls are constructed of medium-sized cobbles, and together with the northern wall, form a small, sheltered area in the interior. There is c. 0.05 m of deep brown, loamy silt in this area.

The presence of soil, and the sheltered aspect of both features, may indicate the use of these structures for agriculture. Both features have windbreak walls that probably retained both soil and moisture.

Quarry - Possible evidence of quarrying (specifically pahoehoe excavations) were found at hundreds of locations throughout the project area. This site type is created by the removal (and often displacement) of the pahoehoe surface. Areas overlying small blisters or tubes may have been broken, often with a medium waterworn boulder, and the broken material was removed. Such excavations yielded material such as scoriaceous lava, volcanic glass, or other suitable toolstone. In some coastal areas, these excavations are associated with abrader depressions (Jensen 1991); but no abrader depressions were identified in the current project area. Some of the excavations in the current project area may have had secondary functions, such as water catchment, or served as agricultural planting areas.

An example of a site that includes quarry features is Site 19208 (Figure 14). The tentative functional interpretation of Site 19208 is temporary habitation-burial-quarry, but quarry features (pahoehoe excavations) comprise over 85% of all features at the site. Feature A, a lava tube with cultural material was apparently first used as a temporary habitation (perhaps while the quarrying was taking place) and then as a burial cave. Pahoehoe excavations at this site are quite large, consisting of several excavated depressions. Most of the features have blocks of excavated material roughly piled around their outside limits. The features appear to be prehistoric.

Carter (1985:17) counted over 2,100 of these clearings, or holes, in her survey area. In the current project area, which includes the northern half of Carter's area, there are probably as many.

Moore and Bevacqua (1972:17) developed a detailed classification system for the pahoehoe excavations at Waikoloa. They report that Barrera (1971a:60) and Austin (1971:241) also found similar holes in Waikoloa. Moore and Bevacqua examined several hundred holes in pahoehoe and postulated a range of activities to explain their existence.

1. The holes may be natural.

2. The holes may be culturally derived and functioned as:
    a. Burial locations
    b Agricultural locations
    c. Storage areas
    d Shelter locations

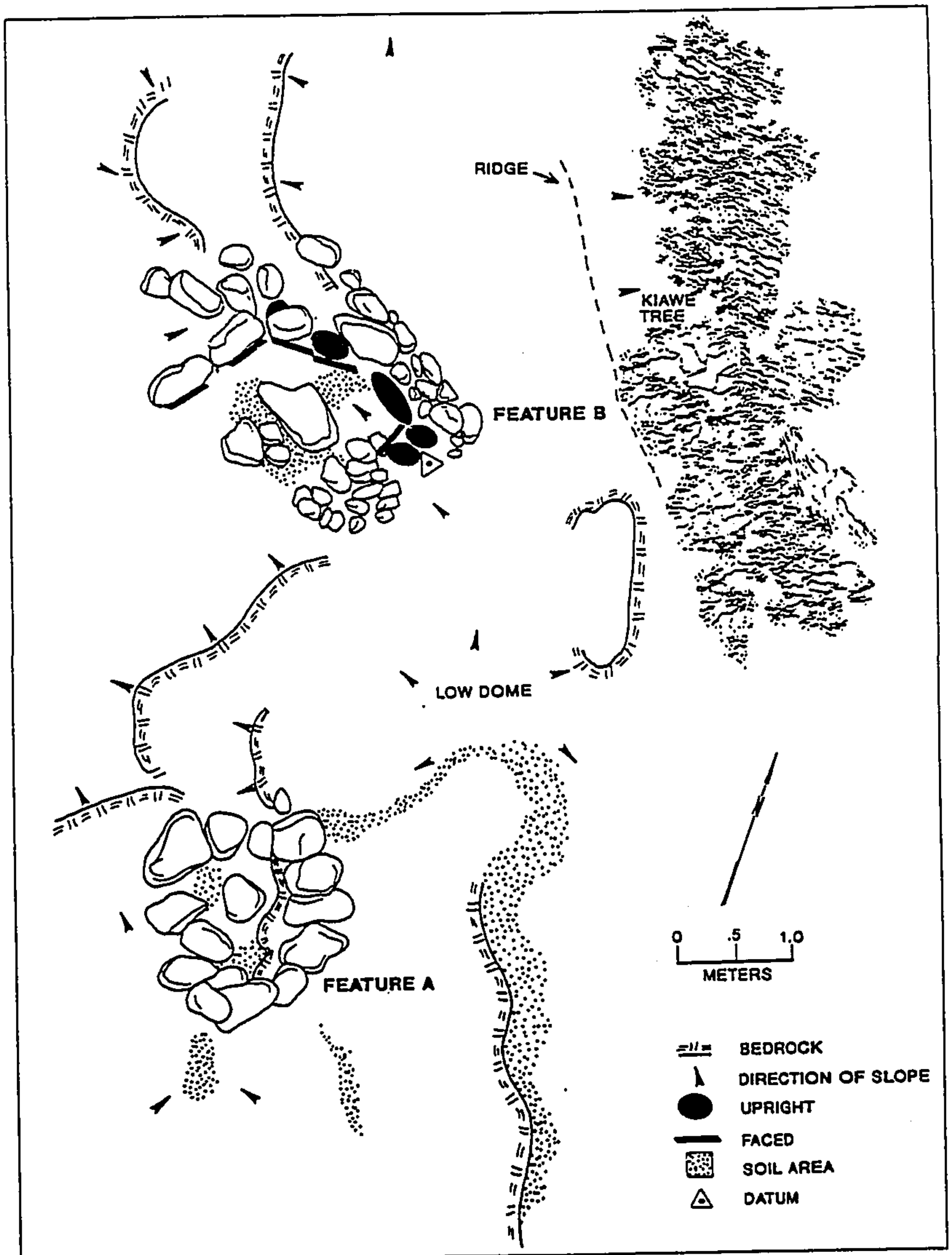


Figure 13. Site 19246, Agriculture

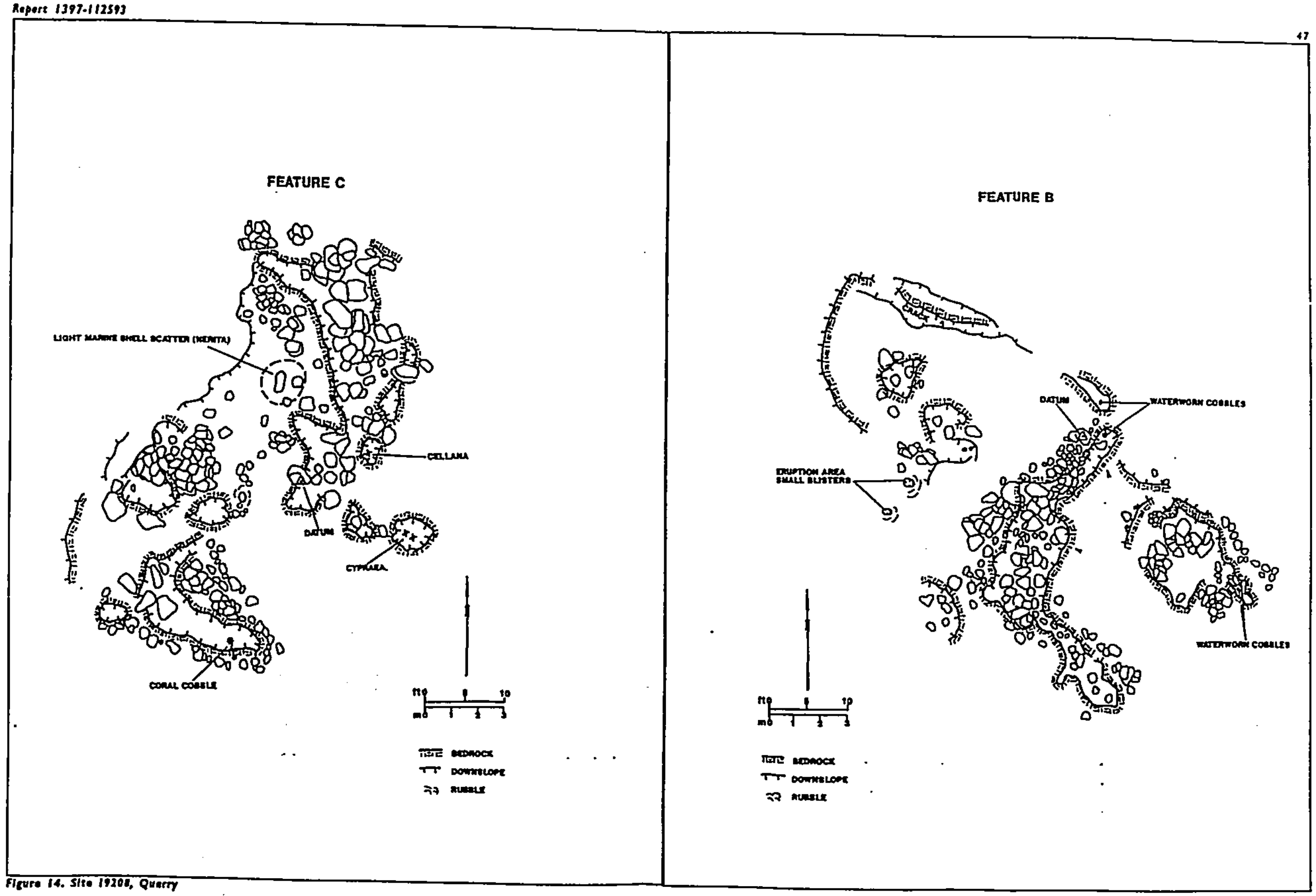


Figure 14. Site 19208, Quarry

e. Abrader procurement
f. Construction stone procurement

According to geologists cited by Barrera (1971a) and Moore and Bevacqua (1972), these features are not natural, and the lack of bones in the features precluded the burial hypothesis.However, the primary author and Dr. A.Z. Ziegler have discussed the idea that a number of these excavations may have been caused by the pooling of subsurface flammable gases in bubble areas of pahoehoe. These gases could ignite, ripping open the surface and scattering the pieces. This scenario may explain some of the excavations in the project area (the ones located far from any habitations) but would not account for all since many have been consciously modified.

The agricultural function received little support from Moore and Bevacqua, but Carter (1985:21) presents historical documentation that states, "Sweet potatoes grown in the semidisintigrated lava were fertilized by heaping rubbish around the vines, which also facilitated the holding of moisture in arid areas. However, sweet potatoes grown in this fashion are said to be tasteless" (Handy and Handy (1972:129).

Maly's historical research has indicated that *'umoki* (planting in dugout-mulched holes) was extensively used in Kona. He also consulted Handy and Handy (1972:106-109) in his discussion of dry-land planting methods. Some of the planting methods used were mulched holes (for dry taro; called *mākālua*), earthen or stone mulched mounds (called *pu'epu'e*), and planting in *kukui* groves, where trees were felled and used to construct growing troughs (*pā kukui*).

Moore and Bevacqua feel that a storage function is unlikely, given the dearth of cultural material found in them and their random distribution (away from habitation areas) (ibid. 17).

The authors also discount hypothesis that pahoehoe excavations were used for shelter. They state that only about three percent of those found would have been large enough to use. This, along with the sharp and jagged interiors, would also have precluded their use as shelter.

Moore and Bevacqua present argue persuasively for the use of pahoehoe excavations as quarries for abrader material and construction stone. In the project area, abrader grinding surfaces are rarely found in conjunction with pahoehoe excavations, so this use of the features (at least in this project area) appears unlikely. It seems likely that many of the pahoehoe excavations were used initially to obtain construction stone, followed by use for agriculture.

Recreation - Two sites (1.1% of all sites) were given a recreation function. Both of these sites were *papamū* used in the play of the Hawaiian board game *konane*. These features were fairly common in the project area, although many are combined with habitation complexes. Sites 19074 and 19102 (Figure 15) were chosen to illustrate this functional site type. Site 19074 is made up not of the board itself, but the game pieces used to play *konane*. This site is located in the extreme northwest portion of the project area, immediately *mauka* of the AD 1800 lava flow. The site consists of a number of small *'ili 'ili* stones (basalt) and small coral. Site 19102 is a *papamū* used to play the game. Construction consists of about 110 holes pecked 0.02–0.04 m into pahoehoe bedrock. There was also a possible cupboard c. 1.00 m north of the board, in which possible game pieces were located. This latter site is located approximately 30 m northeast of Site 19103, a habitation complex.

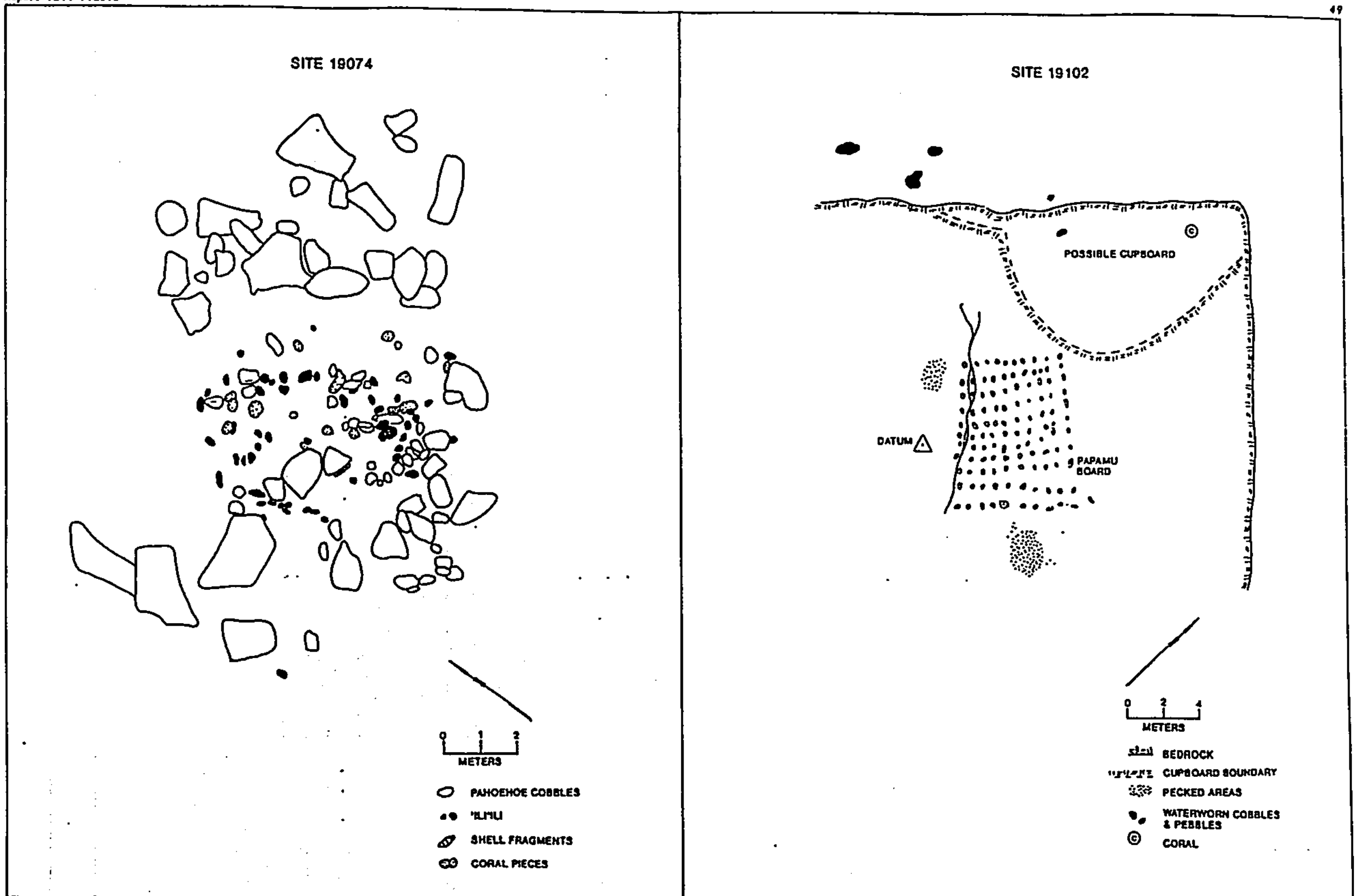


Figure 15. Sites 19074 and 19102, Recreation

Storage - Two sites (1.1% of all sites) were assigned a storage function. Both of these sites are C-shaped walls located in the midlands. Site 19126 is a compartmentalized, C-shaped wall that is approximately 2.9 m by 2.0 m and includes a cupboard and a secondary hollow cache. It is constructed of relatively thin pahoehoe slabs and oriented at c. 30°. A single ground, waterworn, basalt cobble was located at the northeast limits of the structure. Site 19170 is also a wall, located in the middle elevations of the project area. Here, the feature is constructed of piled slab-subangular pahoehoe clinkers and is approximately 2.9 m by 1.7 m. The inside portion of the structure is roughly 0.80 m by 0.70 m and the feature is 0.60 m high. The feature was given a tentative functional assignment based on size (too small for temporary habitation), location (too barren for agriculture), and construction (too formally constructed to be a collapsed cairn or modified outcrop).

Multiple - The remainder of the sites (32 or 17.3%) in the project area were assigned a dual function. These evaluations were given on the basis of other evidence, as for example, where structural types and associated midden and artifacts suggested not only habitation but perhaps burial, quarrying, or agriculture, concurrently with habitation. The twelve residential complexes are multiple function sites. A good example of this is Site 19084 (Figure 16). This site is a complex of approximately 21 features, many of which indicate that long-term habitation has occurred. These habitation features include C-shaped wall, enclosure, two modified lava tubes with utilization, L-shaped wall, and lava tube with cultural material. Also found with this site are several petroglyphs (indicating both communication and recreation functions), a marker, and a large cave containing multiple burials. The site is located on a prehistoric pahoehoe flow almost immediately south of the southern edge of the AD 1800 aa flow. Other multiple-function sites include temporary habitation sites with quarry, markers with agricultural, and marker with burial.

Indeterminate function - At twenty-one sites (11.4% of total), a definite function could not be established. One example is Site 19217, near the northernmost limits of the project area (Figure 17). This is an area of undulating pahoehoe flows marked by lava tubes and blisters. The site is located among these blisters, approximately 175 m *mauka* of the shore. This two-feature complex includes Feature A, a modified outcrop and Feature B, a T-shaped wall. Both features are constructed of locally obtained pahoehoe. Feature A utilizes ropy pahoehoe; Feature B is constructed of large pahoehoe blocks that are placed in a T-shaped alignment. Feature A was called a modified outcrop when all other possibilities were eliminated. It consists of a low wall on the northeast, two parallel alignments, approximately 8.0 m long, which run perpendicular to the first wall, and a partial paving between these alignments. These stones or partial paving are denser on the northwest, and become more spotty to the east. Sparse *Cypraeidae* was noted in the interior, indicating potential temporary habitation.

Feature B at Site 19217 is a T-shaped wall which uses local pahoehoe blocks ranging in size from 0.08–0.53 m diameter. They are generally placed only one course high and one course wide, although there is a grouping of smaller stones in the southwest corner. Ecofacts in the area included *Cellana*; also present was waterworn basalt, and coral. Possible temporary habitation is also indicated here.

ISOLATED FIND

Two isolated find (portable remains) locations were noted during the inventory. Both locations were well away from present site locations, but in conjunction with the Site 19142 trail. IF-1 is a partial coconut shell (*Cocos nucifera* L.) that may have served as a drinking cup; IF-2 was located in a more *mauka* portion of the trail and consisted of a large, flat, waterworn basalt cobble. The obverse side appears slightly hollowed for possible use as a salt pan.

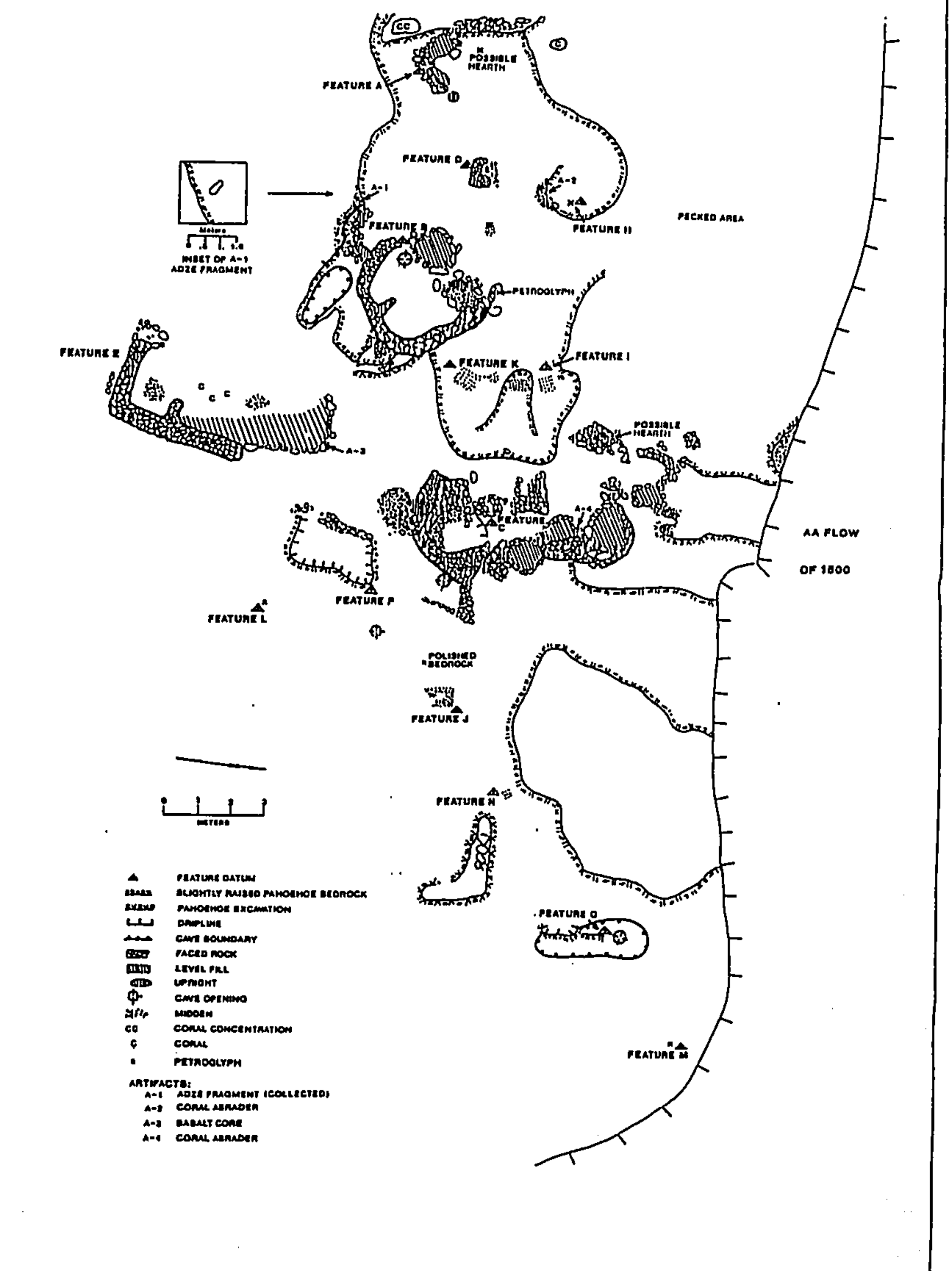


Figure 16. Site 19084, Multiple Function

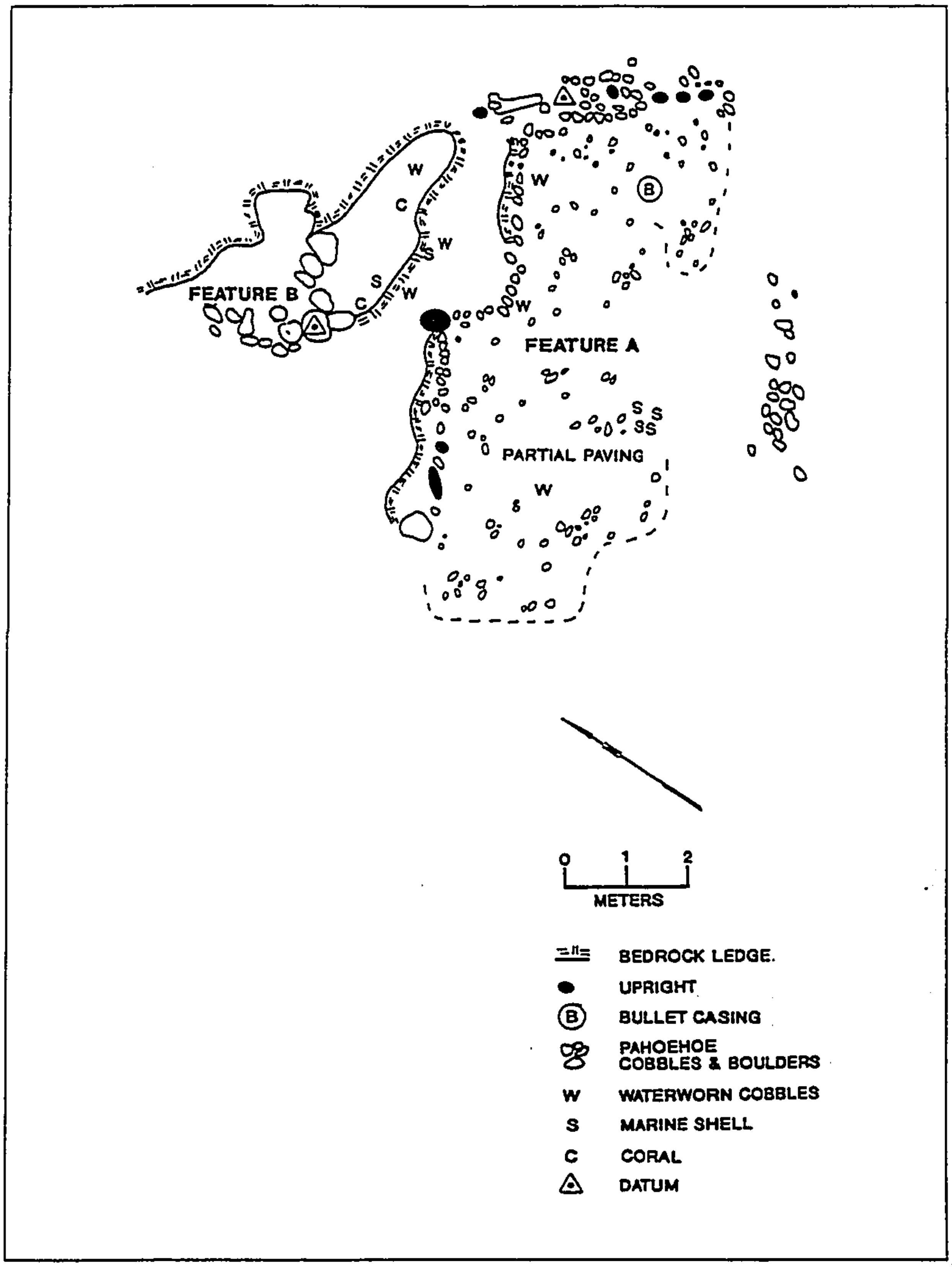


Figure 17. Site 19217, Indeterminate Function

SUBSURFACE FINDINGS

The subsurface testing for this project consisted of ten test units at eight sites. Of the excavated units, six were profiled and the results are presented below. A total of 8.3 m² were excavated. Twelve features were probed at eight sites and four features were examined at two sites.

Site 19101, Feature C, TU-1

Site 19101 is a probable prehistoric complex of at least nine features—one modified lava tube with utilization (Feature A), two terraces (Feature B and G), two U-shaped walls (Features C and E), a modified depression (Feature D), an enclosure (Feature F), and a petroglyph (Feature I).

Test Unit 1 (1.0 by 1.0 m) was placed on top of a small flat area of Feature C, which appeared to be constructed over a small blister cave. Layer I was the architectural layer, which consisted of medium pahoehoe cobbles. Layer II was delineated at the "capstone" layer which was immediately over the open blister cave. After removal of the layer, a probable trunk burial was found in the blister cave below. No radiocarbon samples were obtained from the unit and no profiles were recorded.

Site 19101, Feature E, Burial Probe

It had been suggested during the Phase I Site Location that the U-shaped wall of Feature E obscured a cave opening. It was also thought should the cave be present, it might contain a human burial. Probing the pavement revealed it was placed on pahoehoe bedrock.

Site 19101, Feature G, TU-2

Test Unit 2 (1.00 m by 0.50 m) was placed in the paved area of the Feature G terrace, at the same site (Figure 18). The general soil matrix description is of pahoehoe cobbles in a 0.05 by 0.18 by 0.17 m size range. This unit was excavated in order to test for a possible burial. Smooth paving was removed to a depth of 0.19 m below surface, where bedrock was encountered. A blocked lava tube was discovered. Upon clearing the rubble, scattered non-articulated human skeletal remains were encountered. These elements appear to consist of the distal end of a femur, two rib bones, a metatarsal, cervical vertebrae, and other unidentifiable elements. Bone was initially encountered at c. 0.20 m below the surface of the tube and continued until the end of the probe at around 0.50 mbs. It should be noted that the area underneath the rest of Feature G may also contain additional human remains.

Site 19103, Feature C, TU-1

Site 19103 is a prehistoric site complex of seven features—two C-shaped walls (Feature A), a single C-shaped wall (Feature E), two modified lava tubes with utilization (Feature B and C), modified depression (Feature D), a cairn (Feature F) and a wall (Feature G).

Test Unit 1, a 0.50 by 0.50 m excavation, was placed in the interior of Feature C (Figure 18). Much of the cave has been disturbed, so the location of the test unit was chosen for its lack of disturbance. The surface of the unit was a very silty, dark reddish gray soil with numerous small rootlets and small pahoehoe cobbles. Layer I was designated a cultural layer because

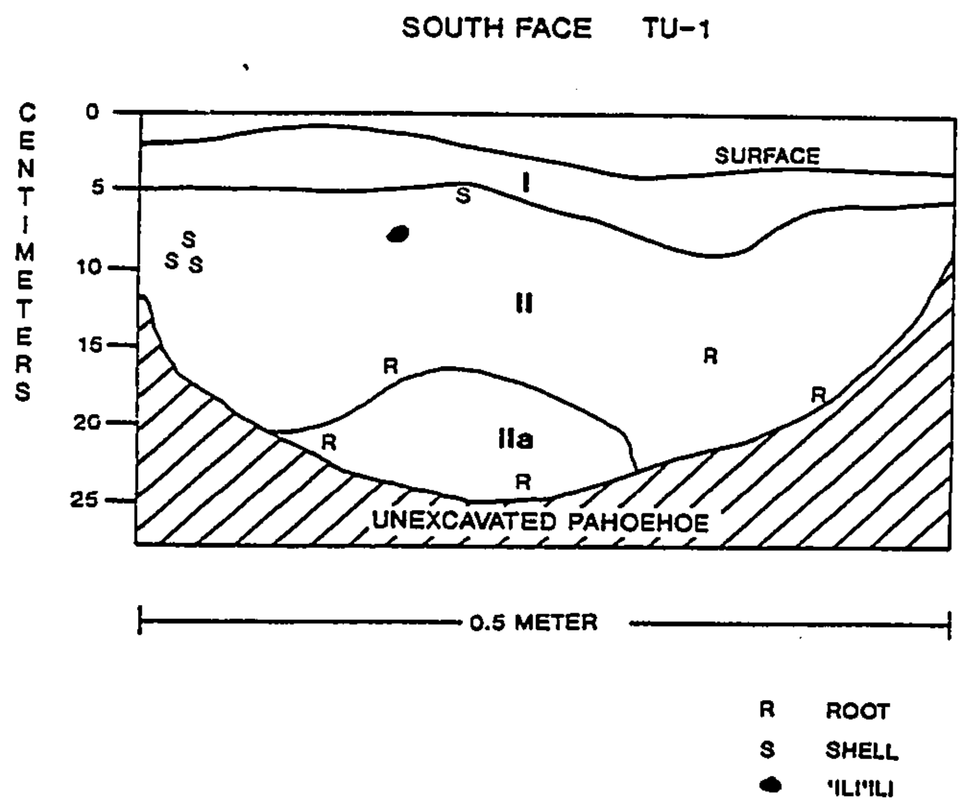


Figure 18. Site 19103, Feature C, TU-1

shell midden was present. Layer II consisted of silty clay with roots. Animal bone and charcoal were collected from this layer and it is thought to be cultural as well since shell midden was again present. Layer III is silty clay, contains shell midden, mammal bone, and charcoal. Five radiocarbon samples were obtained from this test unit; one was submitted for radiocarbon age determination and returned a date of AD 1445–1706 (68% probability). The unit was terminated at 0.25 mbd, at bedrock. TU-1 displayed the following stratigraphy:

SITE 19103, FEATURE C
TU-1, SOUTH FACE

Layer	*Description*
I	4.5-9 cmbd; ranges from 1.5-5.5 cm in thickness; very dark grayish brown (10YR 3/2 moist), dark reddish gray (5YR 4/2 dry); silt; structureless; loose, nonsticky, nonplastic consistence; common roots; no pores; abrupt, wavy boundary; cultural layer;
IIa	4.5-23 cmbd; ranges from 4.5 to 15 cm in thickness; reddish gray (5YR 2/2 moist); clayey silt; dark brown (7.5YR 3/2 dry); weak, very fine, subangular blocky structure; loose, friable, slightly sticky consistence; many roots, many pores; clear, wavy structure; cultural layer;
IIb	16-25 cmbd; ranges from 1-8.5 cm in thickness; dark yellowish brown (10YR 3/4 moist), brown (10YR 5/3 dry); clayey silt; weak, very fine structure; loose, very friable, slightly sticky consistence; many roots, few pores; cultural layer; terminated at bedrock.

Site 19103, Feature D, Burial Probe

Smith and Rosendahl (1992:13) listed this feature as a possible burial. A burial probe was made in the filled area of this modified depression. A small, informal excavation was placed in front of a possible cave opening in the northeast quadrant of the feature. Results of this probe were negative: c. 0.40 m below the top of the stones, pahoehoe bedrock was reached and no cave or burial was located.

Site 19146, Feature D, Feature Examination

The Phase I - Site Location (Smith and Rosendahl 1992:16) listed Feature D as a modified outcrop consisting of filled cracks in a pahoehoe outcrop forming a level area and possibly blocking lava tube-possible burial. The area around and including Feature D was closely examined, but no tube was found and no human remains were present.

Site 19150, Feature F, Burial Probe

This mound, in close association with trail Site 19124, was informally probed to examine for a possible burial. Rocks were removed from the west side of the mound, creating a small tunnel approximately 0.70 long, by 0.65 wide, by 0.82 m deep. The hole was dug to the bedrock below. No evidence of human remains was revealed. Two pieces of shell were found at the bottom, as well as a single piece of burnt wood. The burnt wood was collected.

Site 19195, Feature B, TU-1

This site is a temporary habitation complex consisting of two features, Feature A and Feature B, both enclosures. Test Unit 1, a 0.50 by 0.50 m excavation was placed in the sandy interior of Feature B (Figure 19). The surface, designated as an A Horizon, consisted of a very loose organic horizon with abundant organic material and dark brown silt. Layer I (0.30-0.40 mbd) appeared to be a cultural layer in which abundant shell and volcanic glass was noted. A charcoal stain was encountered at 0.04 mbs throughout the unit. This was designated as Layer II. Layer II (0.37-0.42 mbd) also contained abundant shell, although less than Layer I. Some charcoal was noted in the west wall of the unit, but because the soil was quite wet, the charcoal was difficult to collect and identify. Layer III (0.37-0.46 mbd) was a matrix similar to the two layers above; a small amount of shell was present. There were abundant small cobbles throughout, and the layer was terminated at bedrock. TU-1 displayed the following stratigraphy:

SITE 19195, FEATURE B
TU-1, WEST FACE

Layer	*Description*
A Horiz.	0–1 cmbs; dark brown (7.5YR 3/2 moist); silt; weak, very fine, single grain structure; very friable, non-plastic consistence; few roots; few pores; abrupt boundary; non-cultural layer;
I	1–6 cmbs; 3.5 to 6 cm in thickness; very dark grayish brown (2.5Y 3/2 moist); silty sand; weak, very fine, single grain structure; very friable, non-sticky, non-plastic consistence; few roots; few pores; abrupt boundary; cultural layer;
II	4–9.5 cmbs; 2 to 4 cm in thickness; black (7.5YR 2/0 moist); silty sand; weak, very fine single grain structure; very friable, slightly sticky, non-plastic consistence; common roots; common pores; abrupt boundary; cultural layer;
III	6.5–11.5 cmbs; 1.5–3.5 cm in thickness; dark grayish brown (2.5Y 2/0 moist); silty sand; weak, very fine single grain structure; very friable, non-sticky, non-plastic consistence; very few roots; very few pores; abrupt boundary; cultural layer; terminated at bedrock.

Site 19197, Feature D, TU-1

This site is a prehistoric complex consisting of four features: an alignment (Feature A), an enclosure (Feature B), an L-shaped wall (Feature C), and a faced mound (Feature D).

Test Unit 1 was 1.0 by 2.0 m and was placed in Feature D, a faced mound, on the side of the ocean (Figure 20). This testing was done in response to a possible burial determination by Smith and Rosendahl (1992:23). Layer I consisted of the architectural layer, and was cultural. Material was subangular pahoehoe cobbles and boulders. After the removal of the rock layer, Layer II was begun at 1.43 mbd. The matrix of Layer II consisted of storm deposited, dark brown, coarse sand. This deposit was thought to be non-cultural since storm deposited plastic and other historic and modern materials (and a lack of prehistoric cultural remains) were noted.

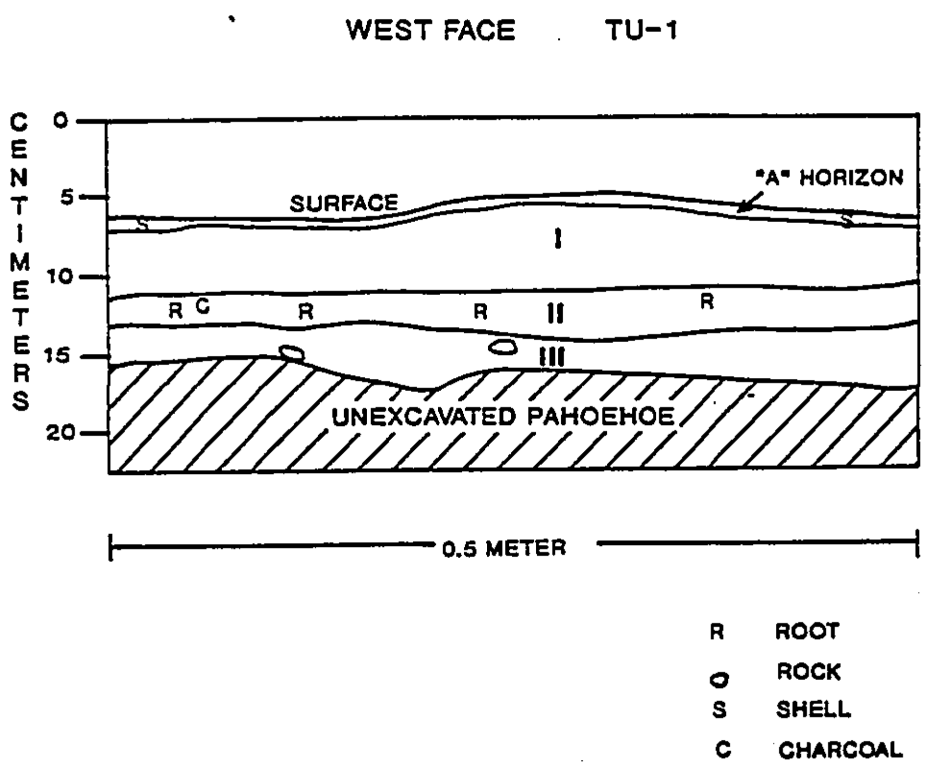


Figure 19. Site 19195, Feature B, TU-1

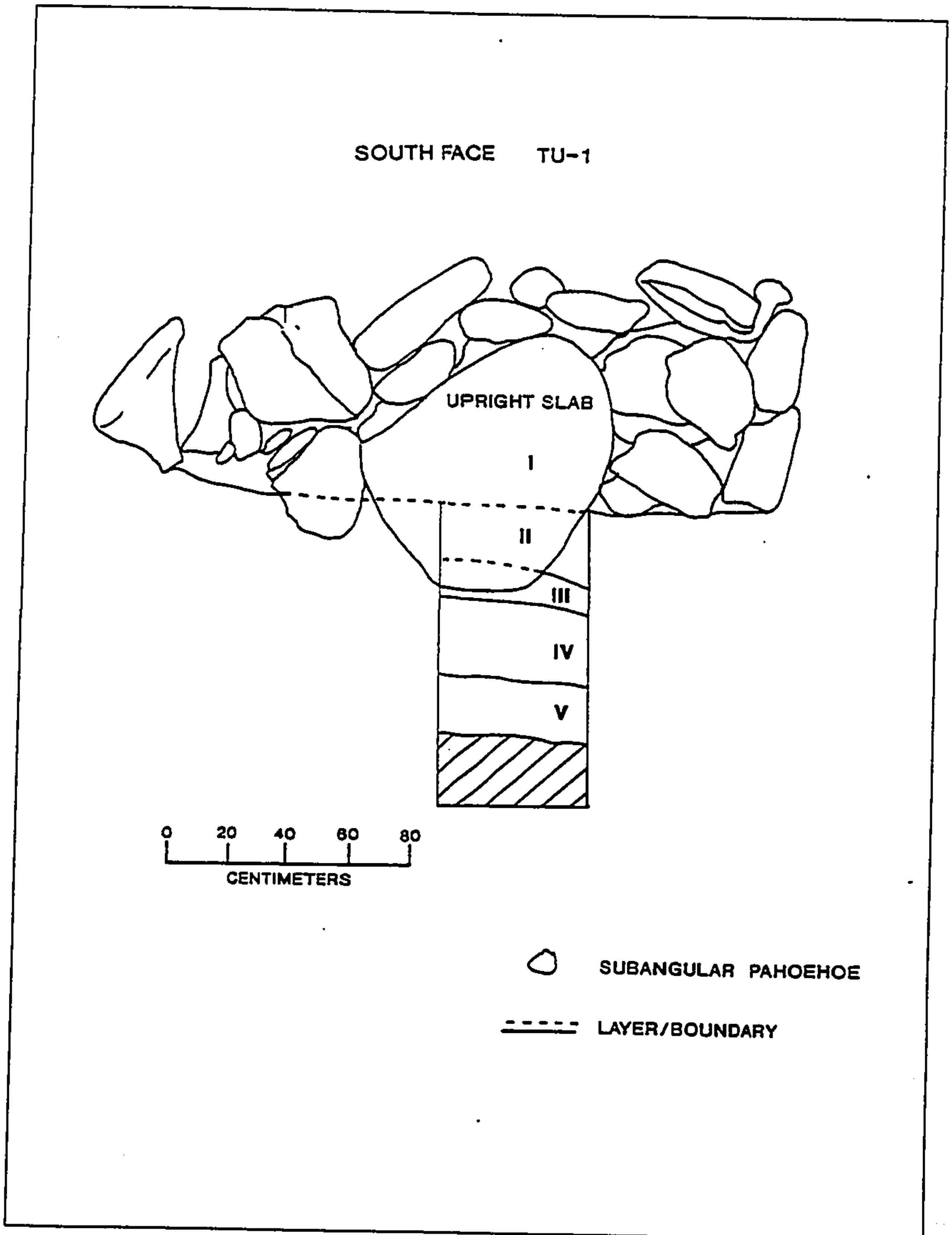


Figure 20. Site 19197, Feature D, TU-1

Layer III (1.59-1.89 mbd) also consisted of a dark brown coarse sand with mottles of fine-grain white sand. The fine sand appeared to have a small amount of charcoal dispersed throughout. This charcoal returned a radiocarbon age determination of AD 1660-1818 (52% probability). The layer was determined to be cultural, because an octopus lure was found *in situ*. Layer IV, a gravelly sand with fine white inclusions, was found between 1.69-1.99 mbd. The lower portions of the layer disclosed few artifacts, but the upper portions revealed large amounts of marine ecofacts and four volcanic glass pieces. Layer V was a darker (moister) more compact sand layer. This appeared to be a non-cultural layer, because of a lack of cultural materials, and the matrix appeared to be beach sand with more pristine (non-fragmented) shell material. Excavation was terminated at 2.21 mbd. TU-1 displayed the following stratigraphy:

SITE 19197, FEATURE D
TU-1, SOUTH FACE

Layer	*Description*
I	0–143 cmbd; 39 to 141 cm in thickness; vesicular basalt boulders and cobbles; cultural layer;
II	125–163 cmbd; 125 to 163 cm in thickness; black (10YR 2/1 moist), dark gray (10YR 4/1 moist), and dark grayish brown (10YR 4/2 dry); sand; weak, very fine single grain structure; loose, non-sticky, non-plastic consistence; no roots; many, very fine, interstitial pores; clear boundary; non-cultural layer;
III	156–176 cmbd, 156 to 169 cm in thickness; light brownish gray (10YR 6/2 moist), sand; weak, very fine single grain structure; loose, non-sticky, non-plastic consistence; no roots; many, very fine, interstitial pores; diffuse boundary; cultural layer;
IV	169–199 cmbd, 26 to 28 cm in thickness; very pale brown (10YR 7/3 moist), white (10YR 8/1 dry); sand; weak, very fine single grain structure; loose, non-sticky, non-plastic consistence; no roots; many, very fine, interstitial pores; diffuse boundary; cultural layer;
V	195–221 cmbd, 18 to 20 cm in thickness; dark yellowish brown (10YR 4/4 moist), yellowish brown (10YR 5/4 dry); sand; weak, very fine single grain structure; loose, non-sticky, non-plastic consistence; no roots; many, very fine, interstitial pores; diffuse boundary; non-cultural layer.

Site 19202, Feature J, Burial Probe

Site 19202 is a prehistoric habitation complex consisting of 15 features: two faced mounds (Feature A and B), a U-shaped wall (Feature C, F, J, and N), an enclosure (Feature D, E, I, K, L, and M), a J-shaped wall (Feature G), and a wall (Feature H).

Site 19202, Feature J was listed as a possible burial or habitation feature by Smith and Rosendahl (1992:24). The feature was probed in two areas by the removal of a few rocks to look for a possible burial. Both tests were informal and were taken to approximate ground level below the feature; no human skeletal material or buried tubes were located.

Site 19203, Feature A, TU-1

Site 19203 is a probable prehistoric habitation complex consisting of nine features: three double-enclosures (Features A, B, and F), a single-enclosure (Feature C), U-shaped wall (Feature D and E).

Two test units were excavated in Feature A, which appeared to be the primary habitation feature of the site complex. Test Unit 1 was a 0.50 by 0.50 m excavation placed in the extreme northwest interior corner of Feature A (Figure 21). Layer I was a sandy layer that contained shell midden, volcanic glass, and charcoal. This charcoal was not dated at this time. This arbitrary layer was terminated when bedrock was encountered at 0.15 mbd. TU-1 displayed the following stratigraphy:

SITE 19203, FEATURE A
TU-1, EAST FACE

Layer	*Description*
I	1–15 cmbd; 10 to 13 cm in thickness; dark grayish brown (10YR 4/2 moist), dark gray (10YR 4/1 dry); sand; structureless; loose, non-sticky, non-plastic consistence; no roots; no pores; abrupt, smooth boundary; cultural layer; terminated on bedrock;
Lens	2.5–10 cmbd; 3 to 5 cm in thickness; very dark gray (10YR 3/1 moist); sand; structureless; loose, non-sticky, non-plastic consistence; no roots; no pores; abrupt, smooth boundary; cultural layer.

Test Unit 2 was a 0.50 by 0.50 m unit also placed in the interior of Feature A, beneath a flat vertical stone and in front of an apparent cupboard in the south wall (Figure 22). Layer Ia (0-0.10 mbs) was an arbitrary level which passed through a cultural layer containing shell midden and bone awls. Layer Ib (0.10-0.20 mbs) was also sandy and contained artifacts, charcoal, and lithics. A radiocarbon age sample was dated to AD 1660–1818 (52% probability). Both Layers Ia and Ib are the same, but for a difference in moisture between the upper (Ia) and the lower (Ib). Layer Ic was relatively undisturbed sand also containing shell midden and volcanic glass, and contained more of an ashy appearance than the upper layers. The excavation was terminated when rocks were encountered at the bottom. This layer of rocks extended out of the unit, but appeared different than the surrounding pahoehoe bedrock. It appeared that there may be greater depth of deposit beside/beneath the south wall of Feature A. TU-2 displayed the following stratigraphy:

SITE 19203, FEATURE A
TU-2, SOUTH FACE

Layer	*Description*
Ia	3–6 cmbs; 2 to 6 cm in thickness; gray/light gray (10YR 6/1 dry), dark gray (10YR 4/1 moist); very fine sand; structureless; loose, non-sticky, non-plastic consistence; few roots; common pores; cultural layer;
Ib	4-37 cmbs, 28 to 33 cm in thickness; very dark gray (10YR 3/1 moist and dry); very fine sand; structureless; loose, non-sticky, non-plastic consis-

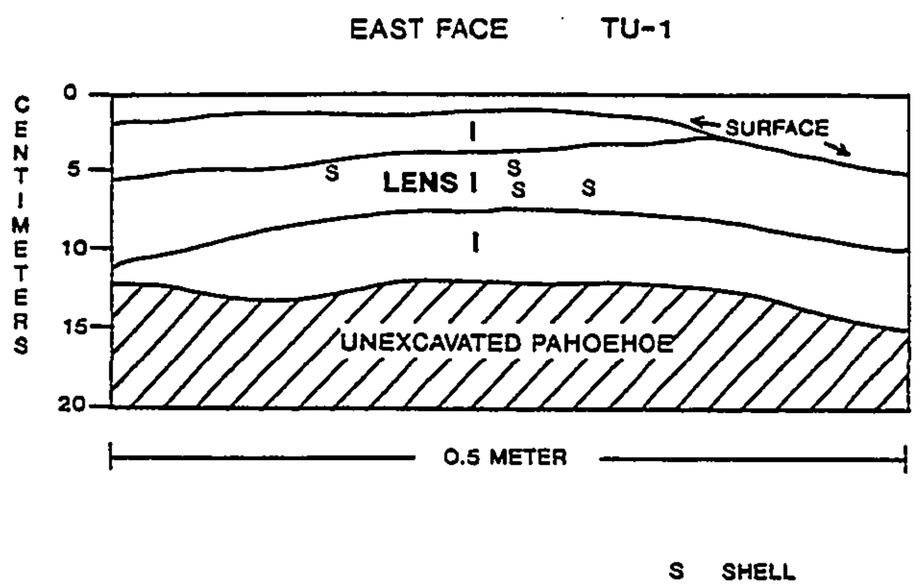


Figure 21. Site 19203, Feature A, TU-1

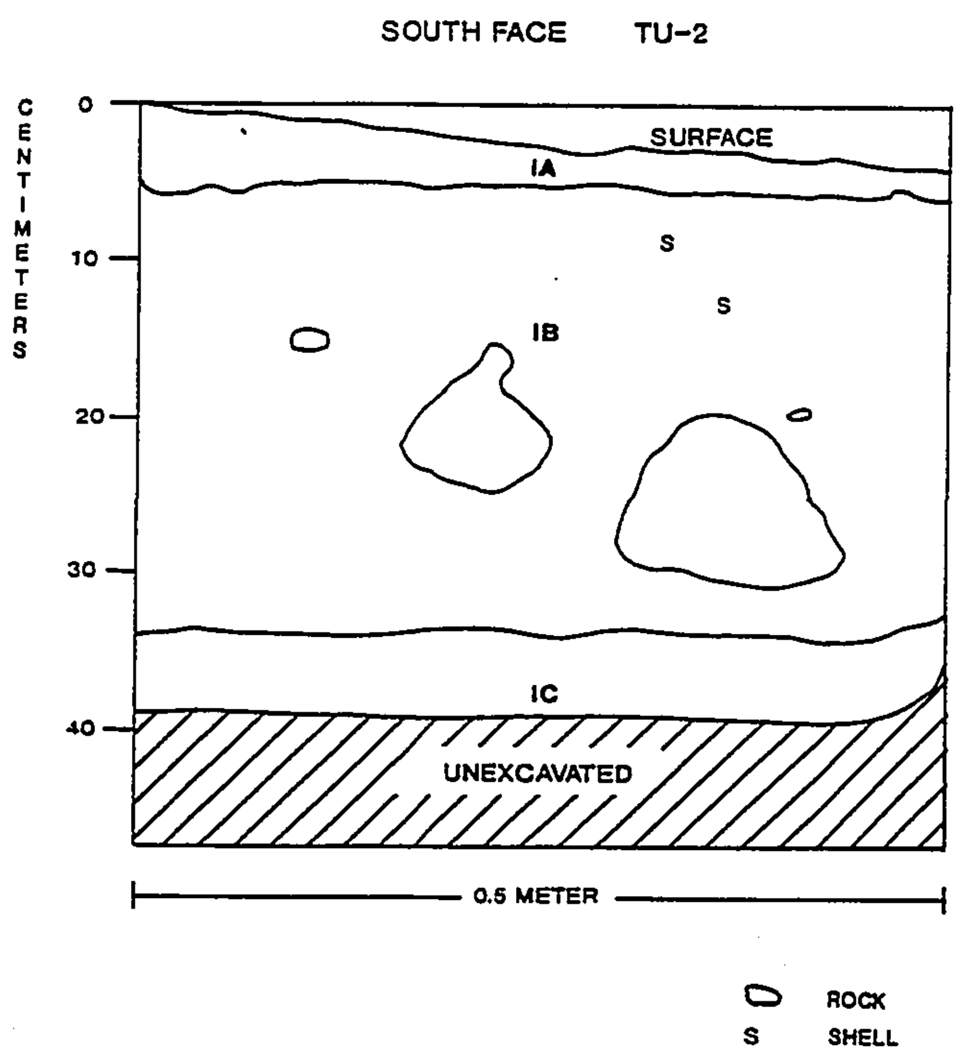


Figure 22. Site 19203, Feature A, TU-2

tence; few roots; common pores; gradual, wavy boundary; cultural layer;

Ic 37-49 cmbs, 9 to 11 cm in thickness; black (7.5YR 2/0 moist), very dark gray (10YR 3/1 dry); very fine sand; weak, very fine, single grain structure; loose, very friable, slightly sticky, non-plastic consistence; very few roots, few pores; cultural layer.

Site 19206, Feature K, TU-1

Site 19206 is a temporary habitation complex consisting of 28 features–three enclosures (Feature A, C, and K), five petroglyphs (Feature H, I, N, P, and Q), two cairns (Feature L and R), a depression with overhang (Feature B), two modified lava tubes with utilization (Feature D and M), two terraces (Feature E), a U-shaped alignment (Feature F), two C-shaped walls (Feature G and O), and a modified depression (Feature J).

Test Unit 1 (1.0 by 0.70 m) was placed in Feature K, an enclosure. This unit was placed because a possible burial was thought to exist at Feature K. Layer I was determined to be the architectural layer and consisted of pahoehoe cobbles placed by hand. Three *opihi* shells were noted just below the surface of the feature and appeared to have fallen in from above. A narrow crack in the rock was encountered, at which point, Layer II was begun. This very thin layer (0.01 m deep) consisted of a thin layer of sand over pahoehoe bedrock. No human skeletal materials were observed during excavation, and no profile was drawn.

Site 19210, Features M and R, TU-1 and TU-2

Site 19210 is a prehistoric complex of 18 features: two mounds (Feature A and G), two cairns (Feature B and S), two modified lava tubes with utilization (Feature C and D) an L-shaped wall (Feature F), three modified outcrops (Feature H, J, and R), a platform (Feature I), three pahoehoe excavations (Feature K, M, and N), two modified lava tubes (Feature L and P), a modified depression (Feature O), and a C-shaped wall (Feature Q).

Two test units were placed in features of the site. Test Unit 1 was placed in Feature M, a pahoehoe excavation thought to be a possible burial (Smith and Rosendahl 1992:27). Only Layer I was removed; the layer consisted of pahoehoe boulders and cobbles with reddish-brown soil at the base. The unit was terminated when bedrock was encountered at c. 0.68 mbs. No human skeletal remains were encountered during the excavation. Test Unit 2 was placed in Feature R, again because of the assessment by Smith and Rosendahl that the feature was a possible burial (ibid.). This modified outcrop was taken apart to a depth of 1.65 mbs. No burial was identified, and no profile was drawn.

Site 19210, Feature I, Feature Examination

Smith and Rosendahl (ibid.) also list Feature I, a platform which "may block a tube or contain a burial". This feature was closely examined during recording, and a number of rocks were removed and replaced. No burial was found.

Site 19210, Feature L, Feature Examination

This feature is listed by Smith and Rosendahl (1992) as a possible burial. Again, a close examination during recording failed to disclose any indications of deposition or a blocked tube that might contain a human burial.

Site 19214, Burial Probe

The Phase I work (Smith and Rosendahl 1992:27) indicated that a possible burial may be found in this cave. The modified lava tube was an indication that while temporary habitation had taken place, a thorough examination failed to disclose the area where "piling continues along the length of the outcrop blocking a tube-possible burial". No blocked tube was found even though a few rocks were removed (and then replaced) in several locations. No human skeletal remains could be found.

Site 19222, Burial Probe

This modified outcrop blocking a small lava tube was thought to be a possible burial by Smith and Rosendahl (ibid.:28). Again, a few rocks were removed to check out the tube. It was found the cave was much too small to be of use, and no human skeletal material was located.

Site 19226, Feature A, Burial Probe

Smith and Rosendahl (ibid.:29) stated that in the south chamber of Feature A cave, piling blocked a tube entrance that may have been a possible burial. The south chamber was probed in order to determine the possibility of a blocked tube. A linear mound in a crack appeared to be blocking a chamber to the southwest of the entrance. The linear mound to the southwest was found to be covering some shell scattered on the floor. The mound was completely removed from the blocked entrance, but no burial was found. The mound was reconstructed to its original state.

Site 19227, Feature A, Burial Probe

Feature A of this site was also listed as a possible burial by the Smith and Rosendahl (ibid.) A close examination and some limited rock removal in the pahoehoe excavation there failed to disclose a blocked tube or possible burial. No human skeletal material was found.

Site 19228, Feature A, Burial Probe

Smith and Rosendahl (ibid.) list this feature as containing a piled crevice possibly containing a burial. The area surrounding Feature A was examined, and a number of rocks were removed. No human skeletal material was located.

Site 19234, Feature A, Burial Probe

Feature A of Site 19234 is a modified lava tube with utilization. It was listed by Smith and Rosendahl (ibid.) as having an "...opening totally blocked by phh. excavated boulders" and a possible burial. The blockage was removed during the recording work at the site, and approximately 20+ burials were found inside. Most are in the southwest portion of the cave, and several appear to be associated with wooden coffins and cloth. Further information is contained in Appendix A, Site Descriptions.

Site 19237, Feature C and D, Burial Probe

Both of these features at Site 19237 are listed by Smith and Rosendahl (ibid.) as possible burials. During the current work, Feature C was probed by closely examining the feature and removing of just a small number of stones. It was determined that rather than being a possible blockage of a tube entrance, the *puka* was simply roof spall on the upper edge of a lava blister. No human skeletal material was located in Feature C. Feature D was listed as having piling at the entrance. Some rocks were removed to reveal bedrock just below. The north chamber was also cleared. It was revealed that the chamber travels down and splits to the right and left. The left chamber continues northeast c. 12 m, with pahoehoe near the end. The right chamber appears blocked by boulders, but goes east or southeast. It extends back about eight meters. No burials or human skeletal material was found.

DATA ANALYSES

by Susan T. Goodfellow, Ph.D. and Wanda Pua-Kaipo

AGE DETERMINATIONS

Objectives and Methods

The purpose of age determination analysis is to provide initial chronological data to aid in assessing the relative significance of sites in a project area. As part of the data recovery investigations, seven samples were selected from discrete cultural deposits within Sites 1140, 19093, 19103, 19150, 19151, 19197, and 19203 for age determination using radiocarbon analysis. Samples were selected based on the amount and nature of datable material present, stratigraphic context, and association with portable remains. The samples were submitted for radiocarbon analysis to Beta Analytic Inc. of Coral Gables, Florida.

Using standard procedures, the samples were pretreated with an acid, alkali, acid series of soakings to remove carbonates and humic acids. After pretreatment, the samples were combusted to form carbon dioxide gas, combined with lithium to separate the carbon, and hydrolized for conversion to liquid form. The liquid was then catalyzed to form benzene and placed in a liquid scintillation counter to determine the amounts of carbon-13 and carbon-12. The isotope values obtained during the counting process were then used to calculate the carbon-13/ carbon-12 ratio for the sample, with the final result being determined relative to international standards in order to reduce errors produced by carbon isotope fractionation. Processing of the samples proceeded normally.

Results

The results of the radiocarbon age determination are summarized in Table 10. The age for each sample is reported as a range corresponding to the calendric age +/- two standard deviations. Ages were calibrated using the formulas (Method B) provided in Stuiver and Reimer (1993), which correct for variations in marine and atmospheric carbon over time.

As shown in Table 10, sample RC-1518 yielded a definitive calendric range while the remaining samples produced multiple calendric ranges. Multiple ranges are caused by "flat" regions in the calibration curve, which correspond to periods when atmospheric carbon decreased at a rate greater than 1.2 ppm/ 10 years, resulting in more than one possible fit of a sample to the calibration curve. While multiple ranges are more difficult to interpret archaeologically, detailed examination of the statistical curves, combined with evidence from feature stratigraphy, generally provides a means of selecting one range as more probable than the others. Based on these criteria, the most likely calendric ranges for the samples are as follows:

RC-1519 AD 1796-1946 (57% probability)
RC-1514 AD 1445-1706 (68% probability)
RC-1517 AD 1441-1701 (75% probability)
RC-1520 AD 1443-1680 (87% probability)
RC-1516 AD 1652-1893 (78% probability)
RC-1515 AD 1652-1893 (78% probability)

Table 10.
Summary of Radiocarbon Age Determinations

PHRI Lab. No. RC-	Lab. No. BETA-	Provenience	C-14 Age Yrs. BP (one sigma)	C-13/ C-12 Ratio	C-13 Adjusted C-14 Age Yrs. BP	*Calendric Range Yrs. BP
SITE 1140						
1519	67844	Feature A, Surface, ID No. 13	90 ± 60	-22.9	120 ± 60	1672-1781 1796-1946 1953-1955#
SITE 19093						
1518	67843	Feature B, Surface, ID. No. 14	140 ± 50	-13.0	340 ± 50	1458-1651
SITE 19103						
1514	67839	Feature C, TU-1, Layer II Level 2, 20-30 cmbd, ID. No. 2	300 ± 90	-26.4	280 ± 90	1445-1706 1714-1820 1838-1872 1915-1955#
SITE 19150						
1517	67842	Feature F, ID. No. 29	320 ± 80	-26.8	290 ± 80	1441-1701 1719-1818 1918-1955#
SITE 19151						
1520	67845	Feature B, Surface, ID. No. 15	340 ± 70	-26.9	310 ± 70	1443-1680 1754-1804 1937-1955#
SITE 19197						
1516	67841	Feature D, TU-1, Layer III, 1.56-1.89 cmbd, ID. No. 26	180 ± 60	-24.7	180 ± 60	1652-1893 1905-1955#
SITE 19203						
1515	67840	Feature A, TU-2, Layer I, Level 2, 10-20 cmbs, ID.5	200 ± 60	-26.2	180 ± 60	1652-1893 1905-1955#

** Calibrated according to Stuiver and Pearson (1986). Range at two sigmas.*
 # Denotes influence of bomb C-14

The results of the age determination analysis span a 509-year period extending from AD 1441 to the present (present = AD 1950). Within this period, the results from specific samples can be grouped into three clusters. The first cluster consists of samples RC-1518 from Feature B of Site 19093; RC-1514 from Feature C of Site 19103; RC-1517 from Feature F of Site 19150; and RC-1520 from Feature B of Site 19151; all of which yielded prehistoric calendric ranges (AD 1441-1706).

Sample RC-1518 derives from a C-shape interpreted as a temporary habitation, but was not associated with other portable remains. Sample RC-1514 derives from a modified lava tube interpreted as an ancillary habitation, and is associated with two basalt flakes, a coral abrader, an echinoid abrader, and 354.13 grams of ecofactual remains (both vertebrate and invertebrate taxa). Sample RC-1517 derives from a mound with an indeterminate function, and like sample RC-1518, was not associated with any portable remains. Finally, sample RC-1520 derives from a modified lava tube interpreted as a temporary habitation, and is associated with two volcanic glass flakes.

The second cluster consists of samples RC-1516 from Feature D of Site 19197 and from RC-1515 from Feature A of Site 19203; both of which yielded calendric ranges spanning the late prehistoric and historic periods. Sample RC-1516 derives from a faced mound interpreted as a temporary habitation, and is associated with an octopus lure, a basalt flake, two volcanic glass cores, 19 volcanic glass flakes, and 522.68 grams of ecofactual remains (both invertebrate and vertebrate taxa). Sample RC-1515 derives from an enclosure interpreted as a long-term habitation, and is associated with a shell scraper, a basalt flake, a volcanic glass core, eight volcanic glass flakes, an echinoid abrader and 49.76 grams of ecofactual remains (both invertebrate and vertebrate taxa). Both samples are interpreted as late prehistoric in age, based on the absence of historic period artifacts and the 52% probability (at 1 sigma) that their actual calendric ranges fall between AD 1660-1818.

The third cluster consists of sample RC-1519 from Feature A of Site 1140, which yielded a historic calendric range. The sample derives from a modified lava tube interpreted as a temporary habitation and was not associated with other portable remains. The interpreted age ranges for samples in all three clusters are consistent with known stratigraphic relationships, and do not appear to be affected by contamination.

Based on the results of the age determination analysis, initial occupation of the project area occurred during the prehistoric period, beginning potentially as early as AD 1441, at Sites 19093, 19103, 19150 and 19151. All four of these sites are interpreted as temporary or ancillary habitations, a fact supported by the relative scarcity of associated artifacts and ecofactual remains. The overlap in the calendric ranges for the four sites suggests that they may have been utilized contemporaneously, probably in association with exploitation of marine resources. Sites 19197 and 19203 were occupied during the late prehistoric period, and appear, based on their interpretation as temporary or long-term habitations, to have been utilized for a range of activities similar to that at the four earlier sites. Again, overlap in their age ranges suggests that Sites 19197 and 19203 were utilized contemporaneously. Evidence for historic period occupation of the project area consists of a historic calendric range for Feature A of Site 1140 and four historic artifacts. The radiocarbon sample from Site 1140 was collected from the surface of Feature A and was not associated with other portable remains. This suggests that the feature was utilized as a temporary shelter rather than as a habitation. The four historic artifacts are generally fragmentary and non-diagnostic, and appear to have been deposited as a result of recreation and/or dumping during historic/modern times.

PORTABLE ARTIFACTS

A total of 169 artifacts were recovered from the project area, 165 of which are classified as indigenous artifacts (Table B-2). The remaining four artifacts are non-indigenous and will be discussed in a later section. Indigenous artifacts are those fabricated using traditional Hawaiian manufacturing techniques and local raw materials, and they range in type from tools and fishing gear to various decorative or religious items. The inventory of indigenous artifacts from the current project area is fairly narrow in content, and consists of domestic items, fishing gear, flaked stone, personal adornments, tools, and several artifacts of uncertain function. A detailed tabulation of artifacts by archaeological site, feature, and unit is presented in Table B-2. The results of the artifactual analysis are discussed below.

Domestic Items

Six artifacts classified as indigenous domestic items were encountered in the project area during the current investigation. The assemblage includes items manufactured from bone, shell and coconut; these are described by type below.

Pick - One bird bone pick (Cat. 1) was recovered from Site 19103, Feature C. It is informal in manufacture, with the distal end modified to a point by cutting and/or abrasion; this suggesting opportunistic use of the bone rather than an attempt to produce a finished tool. The specimen measures 40 mm long, 4.5 mm wide and 4.0 mm in diameter. Generally referred to as *kui*, picks of mammal, bird, and fish bone are among the most common of domestic implements found at habitation sites. Some of these may have been used to split *hala* (Pandanus) leaves into thin strips for mat-making, while others were interpreted as picks for extracting shellfish meat (Kirch 1985:189-193).

Cup - A coconut shell cup, or *'apu*, (Cat. 67) was recovered from a shelf c. 95 cm above the floor of a lava tube (Site 19221, Feature B). The cup is cracked, very weathered and measures 65 mm high and 113 mm in diameter. The term *'apu* generally refers to the Hawaiian form of the English work cup; but has been used to describe gourd and coconut cups used by native Hawaiians before the introduction of crockery cups. Such cups were utilized for water collection; gourds were used more frequently but were not as durable as coconut shells which held water longer. The coconut cup recovered from Site 19221 may have been set up for water catchment where a steady drip was known to occur (pers comm. Kepa Maly.)

Scraper - Four shell scrapers, or *wa'u*, were recovered from the project area. One was collected from Feature C of Site 19103 (Cat. 3), two were from deposits at Feature D of Site 19197 (Cat. 60 and 62), and the other from Feature A of Site 19203 (Cat. 57). Three scrapers are complete, moderately abraded *'opihi* (Cellana sp.) shells and range in diameter from 62 to 73 mm. The remaining scraper is also manufactured from *'opihi* (Cellana sp.), but was modified, to the point where none of the natural edges are left. It measures 54 mm long, 32 mm wide and 11 mm high. Shell scrapers were used for removing the skin from cooked taro in the preparation of *poi*, for scraping the skin from breadfruit, and probably for other culinary operations. *'Opihi* shell was the shell most commonly used for scrapers because they had a naturally sharp edge that required little modification prior to use.

Fishing Gear

Six specimens of indigenous fishing gear (Cat. Nos. 26, 36, 40, 48, 51 and 52) were recovered from the project area during the current investigation. They are described by function below.

Fishhooks - Hawaiian fishhooks, or *makau*, exhibit a wide range of sizes and shapes adapted for catching various kinds of fish by different methods of fishing. Fishhook classifications, such as "Coding Systems for Hawaiian Fishhooks" devised by Y.H. Sinoto (IN Kirch 1979:231-233), are therefore based on shape and function. The two specimens encountered in the project area (Cat. Nos. 48 and 52) are one-piece fishhooks manufactured from bone. One-piece hooks were fashioned as either jabbing or rotating hooks depending on the fisherman's intended catch strategy (Johannes 1981:113). Jabbing hooks are those in which the point is straight or slightly incurved, so that if extended, the point would not intersect the shank. Rotating hooks are hooks in which the point is incurved so that its extension would intersect the shank in the lower two-thirds of the shank. They rotate when pulled.

Cat. 48 is a fragment of a one-piece hook recovered from Feature D of Site 19197. There is not enough of the piece to determine whether it derives from a jabbing or rotating hook. It contains an inner shank barb with a HT4b-type head and measures roughly 23 mm in shank length. Cat. No. 52 is a rotating hook recovered from Feature I of Site 19086. It has an incurved point (it is missing c. 1 mm at the very tip) that is unbarbed and a u-shaped bend. It measures 16.5 mm in shank length, 10 mm in point length and 10 mm wide.

Both specimens were manufactured from mammal bone, although the actual taxa could not be identified. Human bones were frequently used for fishhook manufacture. According to Buck, Hawaiians believed that fishhooks made from the bones of people without hair on their bodies, who were termed *'olohe*, were more attractive to fish than hooks from the bones of normal people. Thus the *'olohe* risked being prematurely dispatched to supply the luck-bringing material.

Cat. 51 is a large pearl shell fishhook recovered from Feature I of Site 19086. It is a nearly complete one-piece hook, but does not include enough of the point to determine whether it is a jabbing or rotating hook. It measures 28 mm in shank length and has a v-shaped bend. The head type closely resembles that of Type HT1d.

Shell hooks were usually made of pearl shell (*uhi*) in small and medium sizes. The small hooks were termed *makau paweo* and were used for catching *'opelu*. Perfect specimens of larger-size hooks are scarce, because the points break off so easily.

Fishhook Tabs - Fishhook tabs are preforms for fishhooks, and are categorized according to their manufacturing stage, following terminology outlined by Sinoto (1975). Roughed out tabs represent the first stage, in which bone or shell material is cut to the appropriate size of the intended fishhook. Shaped tabs are the second stage; and are distinguished from roughed-out tabs by the refinement of their edges and initial shaping of the shank and bend portions of the fishhook. Hook blanks are the last stage before actual finishing, which involves the removal of material to form the inner edges of the hook, between the point and the shank.

The fishhook tab recovered from Feature A of Site 19203 is a hook blank manufactured from mammal bone. The hook blank is roughly triangular, and measures 22 mm long. It has visible signs of filing and/or abrasion and shows evidence of intention to perforate the area that would have been the inside of the bend.

Octopus lures - Two *leho he'e*, or complete cowrie shell lures, were collected from the surface of Feature A of Site 19104 (Cat. No. 36) and from the cultural deposit associated with Feature D of Site 19197 (Cat. No. 40). Both have been perforated on opposing sides of the dorsal surface just above the natural indentation of the lip and have had a hemispherical notch removed from one ventral lip; presumably to aid in attaching the lure to the toggle assembly. Both appear to be manufactured from *Cypraea maculifera*, although the lure collected on the surface was extremely weathered. Cat. No. 36 measures 70 by 41 by 33 mm and Cat. No. 40 67 by 47 by 32 mm.

Cowrie lures are composed of five parts: a wooden stem, a stone sinker, a cowrie shell, a hook, and a hackle (or tail) of *ti* leaves. Sinkers could be manufactured from any kind of stone, but cowries were selected with great care. According to Kamakau, "a well formed cowrie had the power of attracting squid just as a beautiful woman arouses desire in a man." Some lures were named after ancestors or relatives, and many are famous in song and story. Kamakau says that some were so attractive that if they were merely shown over the side of the canoe, "squids came climbing in." The hook is a curved point made from dog or human bone. The form of the point and the two lashings are so similar to the bonito hook technique that there is little doubt that the lure hook was copied from the bonito hook (Buck 1964:359-363).

According to Buck (1957:359), the process of fishing by shaking (*lu*) the toggle assembly up and down was termed *lu he'e*. The cowrie lure assemblage was made primarily to catch squid in water 80-120 fathoms deep, but was also used by aristocrats to catch squid for sport in more shallow waters.

Flaked Lithics

A total of 133 flaked lithic artifacts was recovered from Sites 19365 and 19376. Eight were manufactured from aphanitic basalt, one was manufactured from chert, while 124 were manufactured from volcanic glass.

All flaked stone material was evaluated with respect to flake/core type. Following established procedures for evaluating flaked stone material (Phagan 1980), diagnostic (primary) flakes are defined as those flakes having a complete or partial striking platform and a bulb of percussion. Non-diagnostic (secondary) flakes are broken flakes or fragments that lack the platform and/or bulb. Shatter represents the debris associated with flaked stone tool manufacture, and may include partial flakes, or flake-like chips. Cores tend toward multifaceted polyhedral shapes dominated by one or more platforms, and typically show little evidence of subsequent use as tools. Primary cores exhibit only flake scars, while secondary cores are actually flakes with a bulb from which other flakes have been removed. Based on these criteria, the 133 specimens can be categorized as follows: six primary and 17 secondary cores, 21 diagnostic flakes, and 89 pieces of shatter.

Cores - All cores are manufactured from volcanic glass. The primary cores range from 11.0 to 17.0 mm long, 10.0 to 17.0 mm wide and 6.0 to 9.0 mm thick; and are generally polyhedral in shape. The secondary cores range from 6.0 to 35.0 mm long, 5.0 to 24.0 mm wide and 3.0 to 6.0 mm thick. Cortex was noted on the body of one primary core and the platform of another. It was also noted on the platform of one secondary core and the body and platform of six other secondary cores, suggesting that these specimens were less used than the other cores prior to discard.

Flakes - Twenty of the diagnostic flakes and 80 pieces of shatter were manufactured from volcanic glass, while one diagnostic flake was manufactured from chert and eight pieces of shatter were from basalt. While the volcanic glass flakes are primarily trachytic in appearance (85%), the remaining flakes are manufactured from poor quality volcanic glass. Nearby Pu'uwa'awa'a and Pu'uanahulu were often used sources for volcanic glass and could have been the source of volcanic glass flakes and cores recovered during the present survey.

The diagnostic flakes range from 7.0 to 28.3 mm long and 4.0 to 23.7 mm wide, while shatter ranges from 8.0 to 28.6 mm long and 4.0 to 25.7 mm wide. Flakes and shatter manufactured from aphanitic basalt are generally larger than those manufactured from volcanic glass, because of the relative flaking properties of the materials.

Uses for flaked lithic artifacts have been suggested both by Barrera (1971b) and Kirch (1973), who observed:

> The possible functions...are many and varied. Basaltic glass holds a fine sharp edge and the tools make excellent cutting and scraping implements.

They may have been used in food preparation, for cutting and scraping plant materials, or for delicate woodworking...[t]hese artifacts are extremely common, being found in virtually every type of [Hawaiian] site. The suggestion, then, is that the ubiquitous basaltic glass flakes functioned as a prehistoric "pocketknife," to use a modern analogy... (1973:185-6).

Personal Adornment

One perforated *Nerita picea* (Cat. No. 56), interpreted as a personal adornment, was recovered from Feature C of Site 19103. Two perforations were noted, one on the dorsal surface c. 5.0 mm from the shell aperture and one on the ventral surface between the aperture and whorl (where they are commonly pierced for stringing.) Cat. No. 56 measures 10.0 by 8.0 by 8.0 mm. *Nerita* shells were commonly used in shell *lei*. As Buck (1957) notes:

> *Nerita* shell necklaces (*lei pipipi*) ... were popular because of their numerous shades of color and varied markings. In this shell a hole was made through the large whorl behind the shell aperture. ...the convex surface of the whorl was filed down thin and the hole punched through. Thus many of the holes are irregular in shape and show no signs of drilling. The cord or ribbon is threaded through the hole and the shell aperture to form a long single chain. In some necklaces the shells are turned alternately on the cord so that the apertures of each pair face each other. The shell commonly used was *Nerita polita* (*kupe'e*); but *N. picea* and *N. neglecta*, both called *pipipi* were used occasionally...(1957:543).

Tools

Seventeen artifacts recovered from the project area were identified as tools. They include an adze blank, two adze fragments and fourteen abraders, and are described by type and function below.

Abraders - Coral abraders are evaluated according to their overall shape in plan view, following the classification system and nomenclature set forth by Suggs (1961) to describe coral abraders found at Nuku Hiva in the Marquesas Islands, French Polynesia. In this system, abraders are either informal or formal, with informal meaning that the shape of the raw material is dominant and formal indicating that the characteristics of the raw material have been extensively modified by use. Cross-sections are generally taken perpendicular to the tip and butt of the abrader, while abrasion faces indicate preferential abrasion on given surfaces.

Of the 14 abraders from the project area, five were manufactured from coral (Cat. Nos. 4, 8, 47, 54 and 64) and derive from deposits at Feature C of Site 19103, Feature D of Site 19197, and from the floor of Feature A of Site 19221. The remaining nine abraders (Cat. Nos. 9, 11, 18, 19, 23, 38, 55, 59 and 63) were fashioned from echinoid spine (*Heterocentrotus mamillatus*) and were recovered from Feature C of Site 19103, Feature B of Site 19195, Feature D of Site 19197 and Feature A of Site 19203.

All of the coral abraders are partial, with 75% or more of artifact represented, and formal in description. They range in size from 16 to 47 mm long, 6.5 to 30.0 mm wide, and 5.0 to 12.0 mm thick. The smallest abraders (Cat. No. 8 and 54) are long-triangular in plan view, lenticular-oval in cross section, and have five abraded facets. Cat. No. 8 was recovered in two pieces and subsequently mended. The larger abraders (Cat. No. 47 and 64) are irregular in plan view with right triangular and lenticular/plani-lateral cross-sections, respectively. Each exhibits six abraded surfaces. The remaining coral abrader (Cat. No. 4) is plano-convex/lateral in plan view, irregular in cross-section and exhibits five facets.

The echinoid abraders include three complete specimens and six fragments. The partial specimens and fragments range from 15 to 63 mm long, and from 5.0 to 9.0 mm wide. The number of abraded faces on the echinoid abraders varies from one to three, with the most common type of face being a bevel extending from the midsection to the distal end. The fragments represent portions of the distal end or midsection. All of the echinoid abraders are informal in shape, but vary great deal in the degree of abrasion represented.

Coral abraders apparently served multiple purposes prehistorically, ranging from "rubbers" used to finish canoes and wooden bowls (Buck 1957), to saws or files used in the manufacture of bone and shell fishhooks (Emory, Bonk, and Sinoto 1968; Suggs 1961). The variety of shapes, edges, and worn surfaces represented by the abraders in the assemblage suggests that the abraders served as multipurpose tools. Use of a particular surface over a period of time might generate a sawing or filing edge, which in turn would wear down during use to a new shape that could serve a new purpose. Echinoid abraders, in contrast, are small and fairly soft, and were probably used for finishing and more specialized tasks.

Adze Blank - Adzes are described according to a system developed by PHRI, based on work done by Craib (1971), which records attributes such as cross-sectional shape, shape in plan-view, poll shape, cutting edge morphology, number and placement of ground surfaces, bevel type and angle, nature of side surfaces, and presence or absence of tangs. Terminology follows Buck, Emory, Skinner, and Stokes (1930), except that "face" and "base" are substituted for front and back.

The adze blank encountered in the project area derives from the surface of Feature P of Site 19071. This complete specimen was manufactured from aphanitic basalt and measures 84 mm long, 37 mm wide and 32 mm thick. It exhibits waterworn cortex on one side and has not yet been ground

The stone adze (*ko'i*) was probably the single most important prehistoric Hawaiian tool. *Ko'i* were used for a variety of tasks (including woodworking butchering), and ranged in size from miniature blades, only a few centimeters long, up to a length of 55 cm, the largest known specimen (illustrated in Brigham 1902:pl. LVII). Adzes were manufactured by flaking and polishing dense andesite and basalt, obtained from a number of quarries throughout the Islands.

Late prehistoric Hawaiian adzes are highly standardized and are distinguishable from other Polynesian adzes by their distinctive attributes. Usually, Hawaiian adzes are generally rectangular or quandrangular in cross section, displaying a reduction of the butt, termed a tang, which facilitated lashing of the stone blade to a wooden handle; some of the smaller, thinner adzes lack the tang (Kirch 1985:184-189).

Innovative work by McCoy (1976, 1977) and Cleghorn (1982) at the massive adze quarry atop Mauna Kea has led to an understanding of the sequence of adze manufacture and production. Cleghorn summarizes the major steps in adze manufacture:

> It appears the basic strategy was to maintain the length of the adze early in the reduction sequence. The primary reduction of the length was done when the bevel was created. Bevels were usually created by the removal of three

> to five flakes...primarily in a direction parallel to the long axis of the adze, using the future cutting edge as the platform. Often, some flakes were also detached perpendicular to the long axis...Preforms were made with parallel sides, with edge widths roughly equaling both midsection and butt widths. Thickness measures almost the same as these three widths. There seems to be little variability in these proportions, and this parallel-sided adze with a relatively equal width-to-thickness ratio appears to be the dominant form at the quarry (Cleghorn 1982:216-7).

From his analyses, Cleghorn was able to draw certain inferences concerning the organization of labor at the Mauna Kea quarry:

> Preform manufacture generally followed a set sequence of manufacturing steps...where the basic cross section was formed first, then the bevel was created, and finally the tang was formed. The bevel may have been created early so as to reduce the risk of end shock. These results point to one fact, that there was a tremendous amount of standardization at the Quarry. This high degree of standardization (adze form, size proportions and procedure) supports the contention that the adze makers were craft specialists.
>
> This study has also provided details on the dynamics of behavior at the Quarry. It appears that expert craftsmen worked where there was abundant raw material, while apprentices foraged for suitable raw material on the outwash plain, where they practiced their skills (Cleghorn 1982:343).

The quarry atop Mauna Kea is the largest single quarry site in the islands and could be the source for the adze recovered during the present survey. Mauna Kea adze stone is probably the densest, and has the best edge-holding qualities, of any stone quarried in Hawai'i. Twenty-three other quarries of various sizes have been identified on all islands.

Adze Fragments - Two aphanitic basalt adze fragments comprise the remainder of the tool category. Cat. No. 32 measures 45 mm long, 15 mm wide, 10 mm thick and derives from the surface of Feature P of Site 19071. It is a corner piece with three modified surfaces but does not exhibit the high degree of polish associated with completed adzes. Cat. No. 33 is a fragment recovered from the surface of Site 19142 and measures 23 mm long, 17 mm wide, 7.0 mm thick. It has two highly polished surfaces that come together as part of the cutting edge of an adze blade.

Uncertain Function

Two artifacts of uncertain function were recovered from the project area. The assemblage comprises items manufactured from sandstone and bone. In general, artifacts classified as uncertain function are specimens that have been modified by cutting or drilling, but which were discarded before completion. In some cases, however, fragmentary artifacts, or artifacts in such poor condition that they are unidentifiable, are included in this category.

Modified Bone - One modified mammal bone (Cat. No. 2) was classified under uncertain function. The specimen measures 42 mm long, 11 mm wide, 2.0 mm thick and derives from Feature C of Site 19103. The artifact displays evidence of cutting and filing on both sides of the long axis.

Modified Sandstone - One donut-shaped sandstone cobble (Cat. No. 37) was also classified as uncertain function. It measures c. 68 mm in diameter and 32 mm high and was recovered from the surface of Feature A of Site 19217. The perforation diameter measures 40 mm on one side and tapers toward a diameter of 15 mm on the other side.

Non-Indigenous Artifacts

Four artifacts of recent historic manufacture were recovered from the project area. Three of the artifacts were recovered from Site 19203. They include a nail fragment from Feature A, and an iron spike fragment and one amber bottle base fragment from Feature D. The remaining artifact is a clear non-diagnostic glass fragment from Feature D of Site 19197. These artifacts indicate historic period or recent activity at these sites, but provide little information concerning place or date of manufacture, or function.

Discussion

Analysis of the artifact assemblage encountered during the current investigation suggests that prehistoric activities in the project area were focused primarily on subsistence. Manufacture and use of fishing gear is indicated by the presence of bone and pearl shell hooks, a hook blank, octopus lures, and small abrader/files; although these types of artifacts were encountered in limited numbers. Stone tool manufacture and use is indicated by the chert, basalt and volcanic glass material, and may have been accompanied by food processing and craft production activities that relied on the use of flaked stone tools. Domestic activity is also indicated by the scrapers, pick, and coconut cup. Woodworking, such as canoe manufacture or wooden tool production, is suggested by the coral abraders present in the project area assemblage.

The non-indigenous assemblage is also very narrow in content, and was most likely deposited in the project area through recent recreation or dumping activities rather than occupation. Based on their condition, the artifacts are interpreted as recent.

Comparison of the project area assemblage with assemblages encountered elsewhere in West Hawaii indicates that a general similarity in the range, but not abundance of artifacts. Assemblages from Anaehoomalu (Jensen 1990), Makalewena (Donham 1986b), Ooma II (Donham 1987b), Awake'e (Donham 1987a), and Kalahuipuaa (Kirch 1979) have fairly high proportions of fishing gear and artifacts manufactured from marine materials (such as shell, and sea urchin spines), as well as moderate amounts of materials manufactured from bird or mammal bone. The relative abundance and variety of artifacts in the current assemblage is greater than that noted for Awake'e (where wave action has destroyed many of the potential prehistoric sites), but is less than that encountered in the other areas, although this is in part a result of the small sample of sites excavated as part of the current project. That the sites in the current project area are likely to contain a greater wealth of material is indicated by the recovery of larger, more complex artifact assemblages from sites excavated elsewhere in Kaupulehu. Such assemblages provide evidence that occupation of coastal Kaupulehu was associated with a range of habitation, agricultural and ceremonial activities; and extended throughout the prehistoric and early historic periods.

ECOFACTUAL REMAINS

Objectives and Methods

Ecofactual remains are archaeologically significant on a number of levels, because the variety and content of food remains contained within a given cultural deposit provide useful information concerning prehistoric diet and resource utilization patterns. The analysis of ecofactual remains for inventory survey projects thus has two primary objectives:

1. To determine the variety and distribution of ecofactual remains present in each cultural deposit encountered within the project area; and

2. To provide an indication of dietary and resource exploitation patterns for each site, and for the project area as a whole.

All ecofactual remains recovered from the project area undergo detailed analysis in the laboratory. Detailed analysis involves splitting the sample into two size classes by passing it through 1/4-in and 1/8-in mesh screens. One hundred percent of the material retained in the 1/4-in screen is completely sorted to the lowest taxonomic level possible, while the material retained in the 1/8-in screen is inspected both for artifactual material and for taxa not encountered in the larger portion of the sample. Each category of identified invertebrate material is then bagged and individually weighed. Relative percentages of invertebrate types are calculated for each provenience, as well as for the site as a whole. Marine shell identifications are verified and augmented using Kay (1979). The vertebrate faunal remains derived from investigations by PHRI are submitted to Dr. Alan Ziegler of Kaneohe, Oahu for identification.

The sampling design outlined above is adapted from Kirch (1979), based on a series of experiments measuring the relative distribution of molluscan and bone material retained on each screen. Kirch concluded that screening increased the speed of the sorting without decreasing either the accuracy or statistical validity of the overall analysis. The taxonomic distribution and weight of material retained on the 1/4-in screen should thus be considered as representative of the variety and relative percentages of each taxon present in the entire sample.

Results

Weight Data - Ecofactual remains were encountered in the deposits at Sites 19103, 19195, 19197, 19203, and 19220. The results of the analysis are presented in Table B-3. Total weights for each taxon (in grams) are tabulated by unit, with subtotals indicating the combined weight per site or feature for each larger material class (e.g., gastropods). The total weight of each taxon within the assemblage is provided in the final column of each table, while the final line of grand total represents the combined weight of all the ecofactual materials derived from the analyzed deposits.

By weight, 81.62% of the 3,508.55 grams of ecofactual remains recovered from the project area is contributed by marine gastropods, 6.98% by bivalves, 6.83% by other invertebrates, 1.48% by Osteichthyes, 0.02% by Aves, 0.51% by Mammalia, and 2.54% by vegetal remains. Forty-four species representing 39+ families were identified including 15 gastropod (marine), six bivalve, 12 Osteichthyes, two Aves and two Mammalia families (Table B-3, Summary of Ecofactual Remains). Members of the Families Cypraeidae and Patellidae were the most common invertebrate taxa identified, while members of the family Scaridae were the most commonly identified vertebrate taxon. Vegetal remains comprised primarily *Cocos nucifera* and unidentified wood fragments, along with small amounts of charcoal and *Lagenaria siceraria*, or bottle gourd (*ipu* or *hue*).

The ecofactual assemblages associated with individual sites and features are generally similar in content and relative distribution to the total assemblage discussed above. The remains recovered from Feature C of Site 19103 represent 54.3% (by weight) of the total assemblage, and comprise 86.5% marine gastropods, 11.4% bivalves, 1.5% other invertebrates, 0.53% Osteichthyes, 0.04% Aves and 0.02% Mammalia. Cypraiedae and Neritidae dominate the invertebrate taxa recovered from this feature, while unidentified fish dominate the vertebrate taxa. Ecofactual material from Feature D of Site 19197 contributes the second greatest percentage by weight (30.9%), and includes 77.3% marine gastropods, 2.3% bivalves, 15.9% other invertebrates, 2.9% Osteichthyes, 4.4% Mammalia, and 0.03% vegetal material. Patellidae and Thaididae are the most common invertebrates, and unidentified fish is the most common vertebrate taxon by weight. The remains recovered from Sites 19195, 19203 and 19220 and IF-1 are comparatively few, and represent less than 15% of the total assemblage combined. The remains from Feature B of Site 19195 consist of 97.1% marine invertebrates, 0.3% bivalves, 2.6% other invertebrates, and 0.05% vegetal remains; while those from Feature A of Site 19203 consist of 81.6% marine gastropods, 0.7% bivalves, 12.9% other invertebrates, 4.1% Osteichthyes and 4.7% Mammalia. Ecofactual material recovered from Site 19220 and IF-1 consist entirely of vegetal remains.

Discussion

The results of the ecofactual analysis indicate that subsistence patterns in the project area included the collection and consumption of a moderate variety of shell fish, ranging from several taxa of marine gastropods and bivalves to sea urchins and crustaceans. In general, the marine invertebrates included in the assemblage are common inhabitants of the shorelines, shallow-water areas, solution benches and fringing reefs of the windward islands of the Hawaiian chain and would have been easily accessible to local populations. The most common taxa are noted below, with comments on their occurrence and probable economic value (taken from Titcomb et al. 1978: 337-353):

Cypraeidae - Members of the family Cypraeidae were known as *leho* by the Hawaiians and were of major importance in the economy as food, ornaments, tools and octopus fishing lures. To prepare *leho* for consumption, the shells were broken open and the meat was removed and worked with salt. The flesh was then wrapped in ti leaves and cooked over coals. Some people merely boiled the shell and then removed the meat. The shells of small yellow and white *leho* were reserved for the *ali'i* to use as ornaments and were occasionally used as currency. Larger shells were used to make scrapers for removing the skin from cooked taro and breadfruit, and for grating coconut. Cowrie scrapers with a sharp, serrated edge were also used to incise *wauke* bark to remove it from the plant. The *mauritius*, and sometimes the tiger cowries, were used a part of octopus-lure assemblies.

In terms of habitat, the cowrie range from the intertidal zone to depths of about 100 m. The most common species in the Hawaiian Islands are found in shallow water under loose rocks and boulders, along the shoreline and in crevices at the seaward edge of solution benches and fringing reefs.

Patellidae - Members of the family Patellidae, or limpets, called *'opihi* by the Hawaiians. The *'opihi* were extremely well-liked as food and are reportedly the most commonly eaten shellfish. The favorite method of preparation was raw and salted, either with or without seaweed. They were sometimes washed clean and cooked in the shell, using a calabash with hot stones. The shells were picked out later. This method created a broth (*kai*) that could be used, especially by the sick and young. The meat was pulled from the shells or sometimes scooped out with a smaller, empty *'opihi* shell. *'Opihi*, especially *'opihi'awa*, were used extensively as medicine, and were also associated with sorcery. Although no utilized *'opihi* shells were identified in the current project area, empty *'opihi* shells were often used for scooping, peeling, and scraping because of their sharp edges.

Within the Hawaiian chain, *Cellana* spp. occur only on shorelines, and more commonly on basalt shorelines, from the spray zone seaward to the calcareous algal zone. An exception is *C. talcosa*, which is found at depths of one to ten centimeters along abrupt coastlines. Taxa recognized by the Hawaiians included *C. talcosa* (*'opihi ko'ele*), *C. sandwicensis* (*'opihi 'alinalina*), and *C. exarata* (*'opihi makaiauli*).

Neritidae - *Nerita picea* and *Theodoxus neglectus* are both known to the Hawaiians as *pipipi*. *Pipipi* is a general name for small mollusks; it is used with modifying terms to indicate various species whose habits and habitats are similar to nerites. *N. picea* is the most common taxon of *pipipi* and is the dominant nerite along Hawaiian shorelines. It is abundant on all rocky substrates from the splash zone to the high water mark just above the littorines. *Theodoxus neglectus* are euryhaline and are found not only at seaward edges, but also in brackish water. They are found immersed, both on the surface of the substratum and under rocks and rubble. *Pipipi* were eaten, and a needle or pick was required to remove the meat from the shell. Some were eaten as they were collected, while others were cooked by boiling or by wrapping the shell in leaves and broiling. Some people made a broth and added other shellfish for flavor. Empty shells were commonly strung in *lei* or bracelets.

Nerita polita is a larger nerite, known as *kupe'e*. *Kupe'e* were also eaten, much in the way described for *pipipi*, but they were most prized for their ornamental value. The Hawaiians had names for many *kupe'e*, according to their color or markings: *kupe'e 'ula* (red), *anuenue* (rainbow - red or black striped), *palaoa* (the color of whale tooth ivory, a cream color), *'ele'ele* (black), *kani'o* (vertical stripes), *mahiole* (warrior's helmet—white with red stripes) and the rare *puna*. The rarest of these were the *'ula*, *anuenue*, *mahiole* and *puna*, which were reserved for chiefs. Drilled and made into bracelets, the *kupe'e* were an emblem of mourning for the *ali'i*. *Kupe'e* live beneath the surface of the sand among boulders at the high tide line, and they are generally nocturnal, plowing through the sand and crawling up the algae-covered rocks where they feed.

Thaididae - Members of the Thaididae family were known variously as *aupupu*, *'awa*, *makaloa*, and *pupu makaloa*. They were primarily used as food, but larger specimens with a long, sharp, strong lip were often made into small adzes. *Morula* spp. are common in the intertidal zone, on hard substrates where there is strong wave action, while *Drupa* spp. are common on benches, reefs and basalt shores, where there is heavy surf action, and on rocky substrates to depths of 15 m. The shells are often covered with a growth of coralline algae.

Conidae - Members of the family Conidae were known either as *pupu-'ala* (cones that did not sting) or as *pupu poniuniu* (cones that did sting). Cones, although extremely common in the Hawaiian islands, were seldom used as food but were prized as ornaments. Kay (1949) reports that one species, C. *millepunctatus*, was used for food, but was not a preferred or common item in the diet. Cones are among the most conspicuous gastropods on reefs and benches that fringe the shoreline, and occur in deeper waters offshore. Of the 25 species identified in Hawaii, six are dominant on marine benches and two are dominant on subtidal reefs.

Littorinidae - Members of the family Littorinidae were known as *'akolea* by the Hawaiians and were used primarily as food. They are abundant in the supratidal region along all rocky shores from Midway Island to Hawaii, and are the most common mollusks of the high shoreline. They feed on algae, which they rasp from the surface of rocks, and detritus.

Bivalves - While none of the more common bivalves encountered in the current assemblage were extensively described by Titcomb, she does refer to use of bivalves as a general category. Bivalves were not extensively used as food, although members of the families Chamidae (rock oysters), Mytilidae and Isognomonidae (mussels) were eaten when available. More common uses of bivalves were as a raw material in fishhook manufacture, or as a source of pearls, which were found inside oysters. Most bivalves are found near the shorelines and within fringing reefs, where there are sandy areas for burrowing.

Fish provided an additional marine resource for inhabitants of Sites 19103, 19197 and 19203, with the majority being obtained from nearshore reefs. Inshore taxa were generally obtained using a variety of techniques, including gathering, trapping, poisoning, snaring, spearing, netting, or shallow-line angling; while deeper sea taxa were obtained with long-line angling and trolling from canoes (Kirch 1979:208). The actual contribution of fish to the diet cannot be determined, due to the differential preservation of fish remains compared to marine invertebrates in archaeological contexts. It should be noted that marine vertebrates are not abundant by weight, which suggests that invertebrates were the more important resource.

In addition to marine resources, the presence of terrestrial mammal and vegetal remains in the deposits from Sites 19103, 19195, 19197, 19203, and 19220 indicates that terrestrial resources were also utilized by local populations. All of the terrestrial taxa are prehistoric introductions, supporting the prehistoric to early historic calendric ranges derived from samples collected from these sites.

CONCLUSION

SUMMARY OF FINDINGS

One of the primary objectives of the present project was to determine to the extent possible the functions and periods of use for project area sites and features. A total of 185 separate sites, comprising 24 functional types, were identified in the project area. A wide range of formal feature types (23) were encountered (See Table 6, Frequencies of Formal Feature Types). Based on an evaluation of feature morphology, physical setting, associated cultural remains, associated features, combined with findings in other areas, the 23 formal feature types were assigned to five general functional categories. These general functional categories are habitation (including permanent residential and ancillary), temporary habitation, burial, transportation (including markers), and communication-recreation (including petroglyphs, *papamu*). A number of sites represented locations where the dominant function could not be determined or where more than one activity was represented. Table 7 summarizes the frequencies of the 24 functional site types within the project area. Criteria used to determine particular feature types have been described in preceding sections, and details concerning all recorded sites and features are summarized in Table B-1 and presented in detail in Appendix A.

Clearly, the archaeological landscape in Ka'ūpūlehu Lot 4 is characterized by areas of high density, and by areas of low site and feature density. This was expected, based on previous reconnaissance and inventory surveys (e.g., Carter 1985, Komori 1981, Reinecke n.d., Smith and Rosendahl 1992, Soehren 1963, Walker and Rosendahl 1988, 1990).

Generally, expectations outlined in areal settlement pattern models were largely supported by project data; the coastal zone contains both permanent habitations (with associated ancillary features) as well as scattered temporary habitations. No large ceremonial features (such as *heiau*) were identified in the project area. The cluster of probable habitations just *mauka* of the AD 1800 aa flow was not predicted. This cluster appears to be associated with the brackish water ponds upslope of Kahuwai Bay. These two anchialine ponds are located just outside of the study area. In the midlands, expectations were met in that there are indeed C-shapes and temporary habitation in lava tubes with shallow cultural deposits.

CHRONOLOGY

Project dating results conform generally with previous findings from the region. Forty-six radiocarbon age determinations from previous archaeological work (Walker and Rosendahl 1988, Sullivan and Goodfellow 1991, Head et al. 1992, and Goodfellow and Head 1992) (Table 10) were examined to determine the minimum, mean, and maximum ages represented in the *ahupua'a*. The four projects are situated on both sides of the Queen Ka'ahumanu Highway, with the Walker and Rosendahl and the Sullivan and Goodfellow projects *makai*, and the Head, et al. and the Goodfellow and Head located *mauka*.

The *makai* portion of Ka'ūpūlehu has produced probable age determinations ranging from AD 1030 to 1955. This early date (AD 1030) and other *makai* dates for Ka'ūpūlehu are from the work done by Walker and Rosendahl (1988) and Sullivan and Goodfellow (1991) and do not reflect findings in the current project area. The mean for Walker and Rosendahl is AD 1563–1756; for Sullivan and Goodfellow 1598–1812. Overall, twenty-one probable radiocarbon age determinations range between AD 1580–1784. On the *mauka* side of the highway, Head, et al. reported average findings of AD 1628–1836; Goodfellow and Head are earlier at AD 1599–1797. Twenty-five probable dates range from an early date of AD 1213 to a latter date of AD 1955. The overall mean for the upper portion is AD 1614-1817. When dates of these four projects are combined, age determinations range between AD 1597–1800.

When these age determinations are sorted by probable age, the most common age ranges begin in the 1700s, with fifteen examples, followed closely by 12 samples dating to the 1600s and 10 in the 1400s. The sixteenth century is not represented by this sample. A small number of dates begin in the eleventh (n=1), thirteenth (n=2), fourteenth (n=4), and nineteenth (n=2) century.

Although dating samples recovered from the current work are from surface contexts or slightly below (maximum recovery depth was 0.30 m, at Site 19103), the project results compare closely with findings in the other portions of the *ahupua'a*. For the present project, probable ages range from probable age determinations beginning in the fifteenth century (n=4), two in the seventeenth, and one in the eighteenth century. Initial occupation occurred during prehistoric times, possibly as early as AD 1441, at Feature F (mound) of Site 19150. This feature is interpreted as having an indeterminate function. Other dates from the project area indicate use during up until AD 1955. However, additional absolute dates are needed in order to further evaluate variation in the intensity of use of the area over time. Thus, one of the proposed goals of additional data collection and data recovery work is to supplement the dating results from the existing project with a much larger sample of absolute dates from a wider range of feature types. These data could then be integrated into the overall *ahupua'a*-wide chronological studies.

Archaeological work in areas surrounding Ka'ūpūlehu, as summarized in Kirch (1985) and used by him to construct a Hawaiian Cultural Sequence, suggests that Kaupulehu (and other marginal leeward areas) was first occupied probably in the coastal region sometime during the 15th or 16th centuries. The rapid dispersal of population throughout the islands, from ecologically favorable windward valleys to marginal regions, suggest a fast growing population. Kirch has suggested that throughout the island and the archipelago there may have been up to a tenfold increase in the population (1985:304), with a concomitant tenfold increase in the demand for food.

Evidence from Site 10959 (Walker and Rosendahl 1988) in the *makai* area indicates, however, that initial occupation of Kaupulehu occurred several hundred years earlier. Age ranges from Site 19151 (in the current project area) provide another date for initial occupation between AD 1443-1680, with a high probability. Results from Site 10959 on the coast (outside of the current project area) indicate initial occupation between AD 1030-1290. Both age ranges derive from cave shelters and have been interpreted as habitations, suggesting that initial use of the area focused on short-term or recurrent occupation and exploitation of available resources.

Kirch has argued that the first population centers (and probably the most permanent "base camps") in Ka'ūpūlehu were probably near the coast, because of the food the ocean and shoreline resources provided. The age determination results from nearby projects, however, suggest there is little temporal differentiation between coastal and upland areas. For example, Site 17932, a nearby *mauka* site in Ka'ūpūlehu, yielded ranges from AD 1213 to 1423 (Goodfellow and Head 1992).

DISTRIBUTION STUDIES

The distribution of sites and features in the project area suggests a degree of patterning with respect to both cultural and non-cultural variables, such as location (proximity to resources), elevation (microclimates) and to a lesser degree, geomorphology. In order to assess the distribution of sites and features throughout the study area, five functional feature types were selected for evaluation: habitation, temporary habitation, ceremonial-burial, transportation, and communication-recreation. The distribution of each functional category was first plotted onto the site location base map (Figure 6), to determine distribution patterns. This figure was overlaid by a 200 by 200 m grid. Using these data, five distribution maps were prepared (Figure 25a-e), one each for habitation, temporary habitation, burial, transportation, and communica-tion-recreation feature types. Generally, it is noted that the overall density among all categories of functional feature types decreases as elevation (and distance from the ocean) increases.

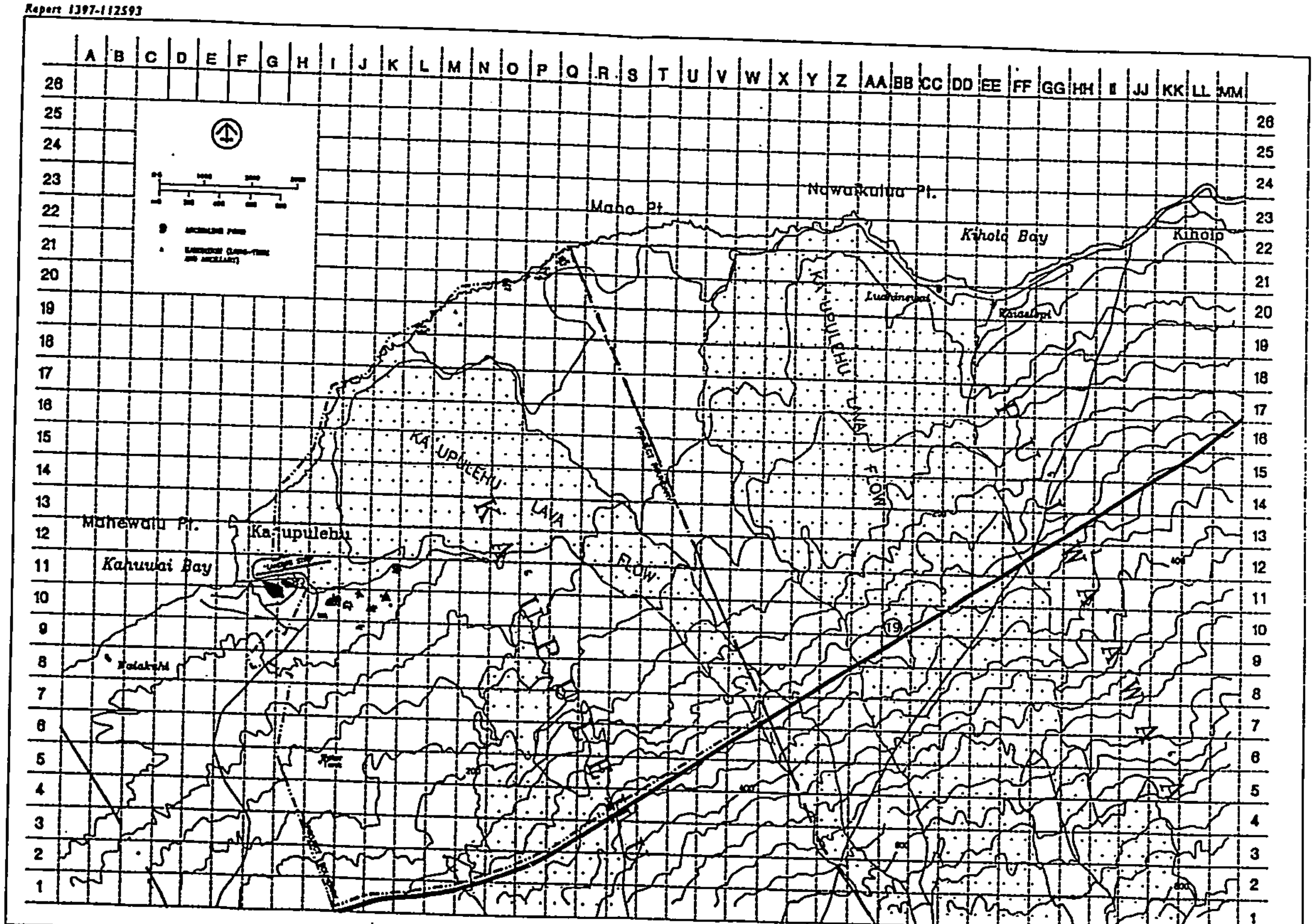
Habitation Features

The locations of residential complexes indicative of longer-term *(or permanent)* occupation appears to have been determined by the character of the lava flow types in the project area, along with the proximity to reliable resources. There are four separate lava flow types represented, with six different ages. (Table 1, Figure 23). Distance to the sea appears to be an important factor in residential complex location. Areas such as grid locations L19, M19, O20, P20, P21, and Q21 (Figure 23) are very near the present-day coast of Ka'ūpūlehu and were utilized by groups exploiting deep-sea and littoral resources. Grid locations J9, I10, J10, K10, and K11 appear to be another group of residential complexes, this one located much further from the ocean than the first, but still within easy distance of the brackish water ponds *mauka* of present-day Kahuwai Bay.

There are at least three possible reasons for the location of this second group. The first may be explained by a *kapu* imposed by a high-ranking individual, which did not allow settlement locations nearer Kahuwai than observed during the current project. If this high status residence was present, it may have been destroyed during the AD 1800 lava flow and/or construction of Kona Village in the early 1960's. A second explanation concerns its location with respect to the AD 1800 Ka'ūpūlehu lava flow. Maly's recent translation of *He Mo'olelo no Mākālei* (A Legend of Mākālei), set c. AD 1200, speaks of a canoe landing in Ka'ūpūlehu, at Hale'uki. Maly's researches have failed to indicate the location of Hale'uki, and he posits it to lie *under* the AD 1800 aa flow. Should this have been the case, it might also be posited that the shore was more *mauka* before the intrusion of the aa flow (modern examples of this include recent lava flows at Kalapana, Kaimu, or more recently, Kamoamoa, in Puna) and also the residential grouping. Finally, the group of sites could simply represent the inland-most extent of settlement around the braskish water ponds at Kahuwai, indicated in grid addresses J9, I10, J10, K10, and K11 would have been closer to the shoreline.

Temporary Habitation Features

As can be seen in Figure 24, other, temporary, habitation features are scattered throughout the remainder of the project area. There are clusters *mauka* of the intact shoreline in the northernmost portion of the project area (e.g. L19, M19, O19, P19, N18, O18, P18, Q18, etc.) as well as widely-spaced examples in the central and southern portions of the study area. There is a notable clustering around Site 19124, to be discussed further below.



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Kaʻupulehu Makai, Lot 4 Phased Inventory Survey

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Figure 23.
DISTRIBUTION OF HABITATION FEATURES

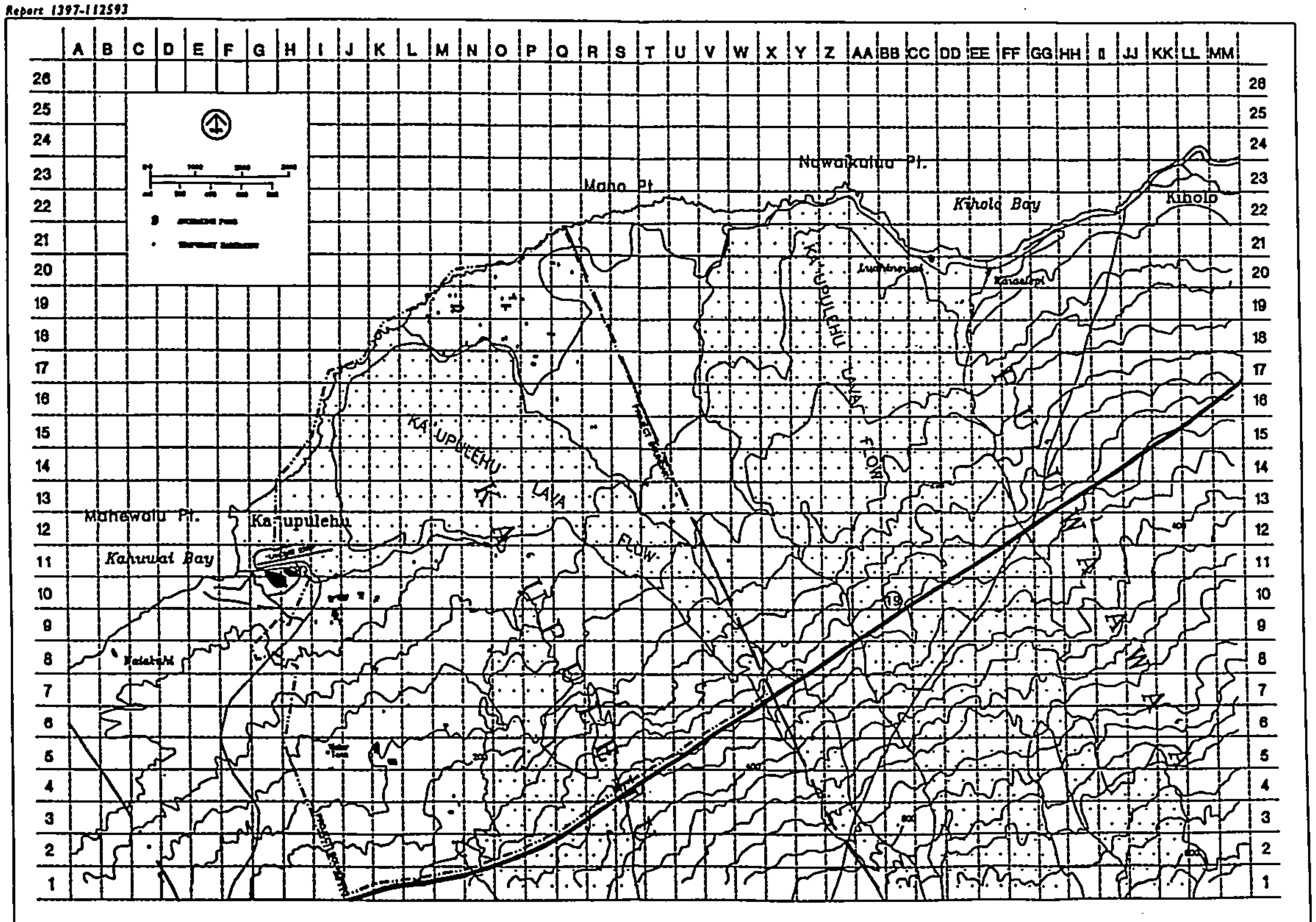

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Figure 24.
DISTRIBUTION OF TEMPORARY HABITATION FEATURES

Burial Features

As noted above, burials were present at various elevations and in differing lava flow types. As was expected, burials consisted of both human skeletal remains (HSR) and single and multiple burials. All are located below the surface in lava tube caves and blisters. Burials appear to cluster in areas similar to the areas containing clusters of habitation features, near the coastline in the north and near the preserve area *mauka* of Kona Village. The burials clearly co-occur with the numerous habitation features comprising the two habitation clusters. In addition examples of both HSR and multiple burials were found widely scattered throughout the middle and upper portions of the study area. Three of these locations are relatively near trail Site 19124, in M3, K5 and L7-L8. Another three, including Site 19143 (a multiple burial), are located in grid addresses M8, N8, and Q10, well away from this transportation route. These latter three sites do not appear to be associated with any significant habitations other than the small temporary habitations at the sites. All possible burial features were examined, as recommended in Phase I - Site Location, (Smith and Rosendahl 11990) with the exception of three at Site 19071 and one at Site 19093. Both of these site locations are within the recommended archaeological preserve and were not tested.

Feature C, Site 19101 (Grid address K10 on Figure 25) has been determined to be a burial site, although no actual human remains were observed. A small trunk was found in a lava tube with cultural material under Feature C. This trunk was locked, but resembled another trunk found at Feature F, Site 19084 found just to the north. The broken trunk at Site 19084, contained the remains of a small child, and the box at Site 19101 probably has similar contents.

Transportation

This category includes trails and trail markers (cairns). Trails noted in the study area include a significant *mauka-makai* trail running from the southeastern edge of the project area (M2) toward a large petroglyph panel and the brackish water ponds near Kahuwai Bay (Figure 26). Both the petroglyph panel and the ponds are outside of the present project area, in Grid addresses H10 and I10. The site (Site 19124) appears to be a Type A trail (Apple 1965) that passes through areas of site concentration. According to legendary accounts, an ancient trail once ran *mauka* from Ka'ūpūlehu, through a land named Kapi-pa, to Kilohana (see Appendix D Historical Documentary Research). There is a good chance that Site 19124 *is* that trail. It appears to be the only *mauka-makai* trail in Ka'ūpūlehu and appears to travel to the brackish ponds and Kahuwai Bay. Sites found along the trail are consistent of what would be expected with a major trail, that is, there are temporary habitations and petroglyphs in close association. The trail cannot be traced upslope of the project area since the upper portions (especially *mauka* of Queen Ka'ahamanu Highway) appear to have been cut off (or covered) by the AD 1800 flow. Another Type A trail roughly parallels the coast, crossing the AD 1800 flow from G13 to L18. Other examples are found throughout the area, and many were used to cross arms of, or in one case a narrow upland portion of, the AD 1800 flow in W8. These smaller trails often included pahoehoe steppingstones to enable crossing the aa.

Communication-Recreation

Much in same way as burial features, communication and recreation features tend to co-occur with habitation features. Approximately 120 examples of petroglyphs were noted in the project area (Figure 27). They are especially found near the northern coast (e.g., M19 and O20) and *mauka* of the AD 1800 flow (e.g., J10 & 11, K10 & 11). They also tend to be found near

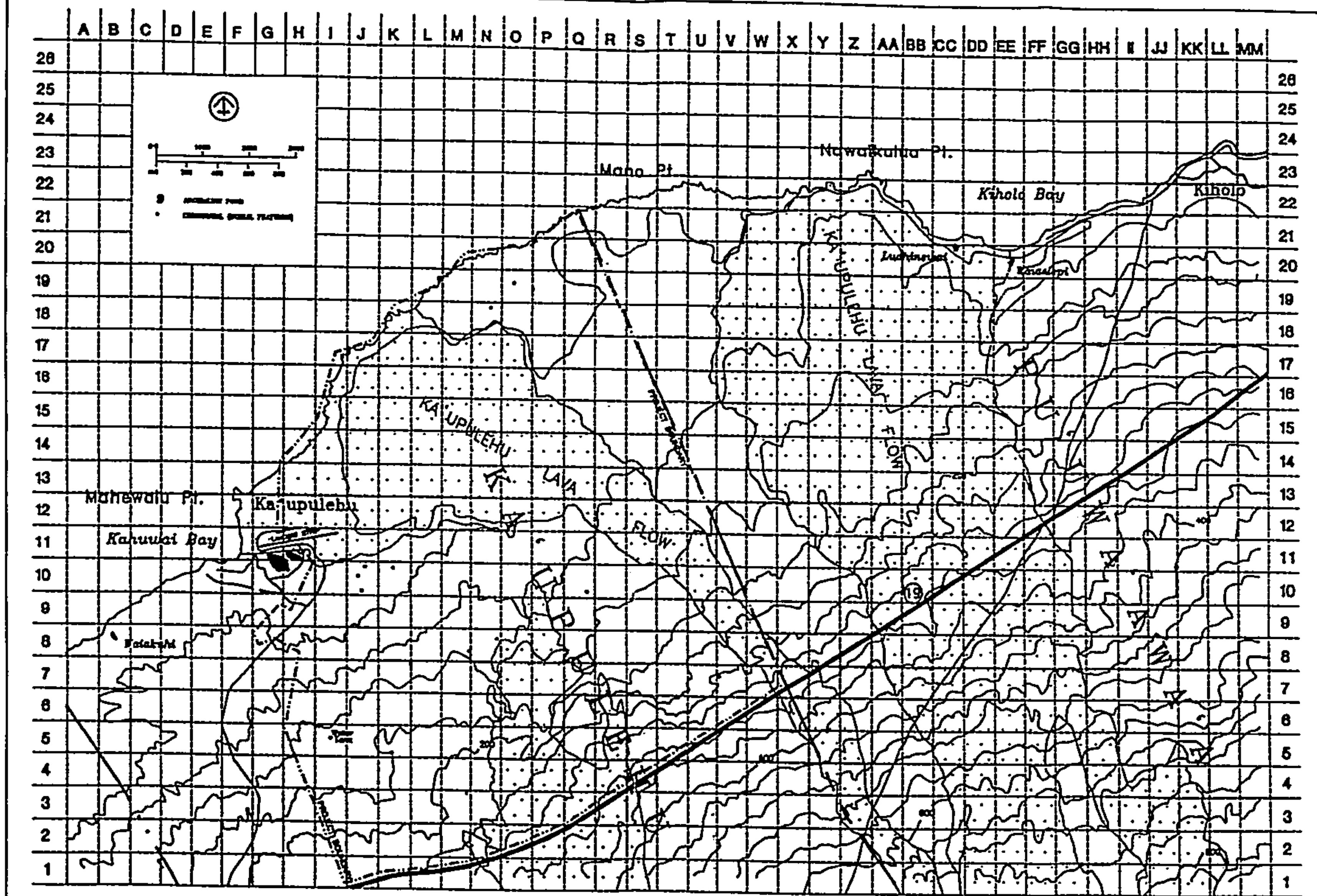

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Figure 25.
DISTRIBUTION OF BURIAL FEATURES

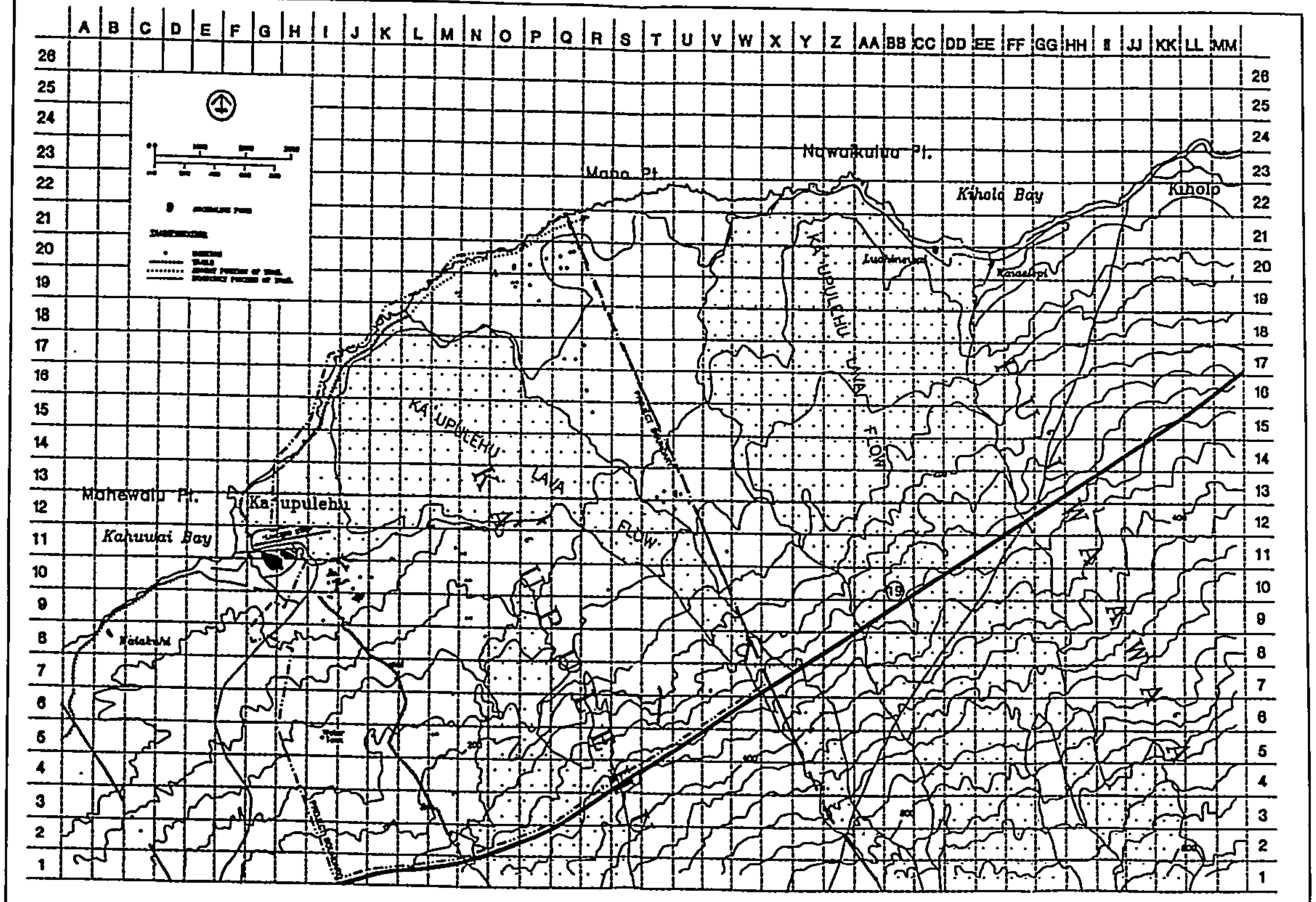

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Figure 28.
DISTRIBUTION OF TRANSPORTATION FEATURES

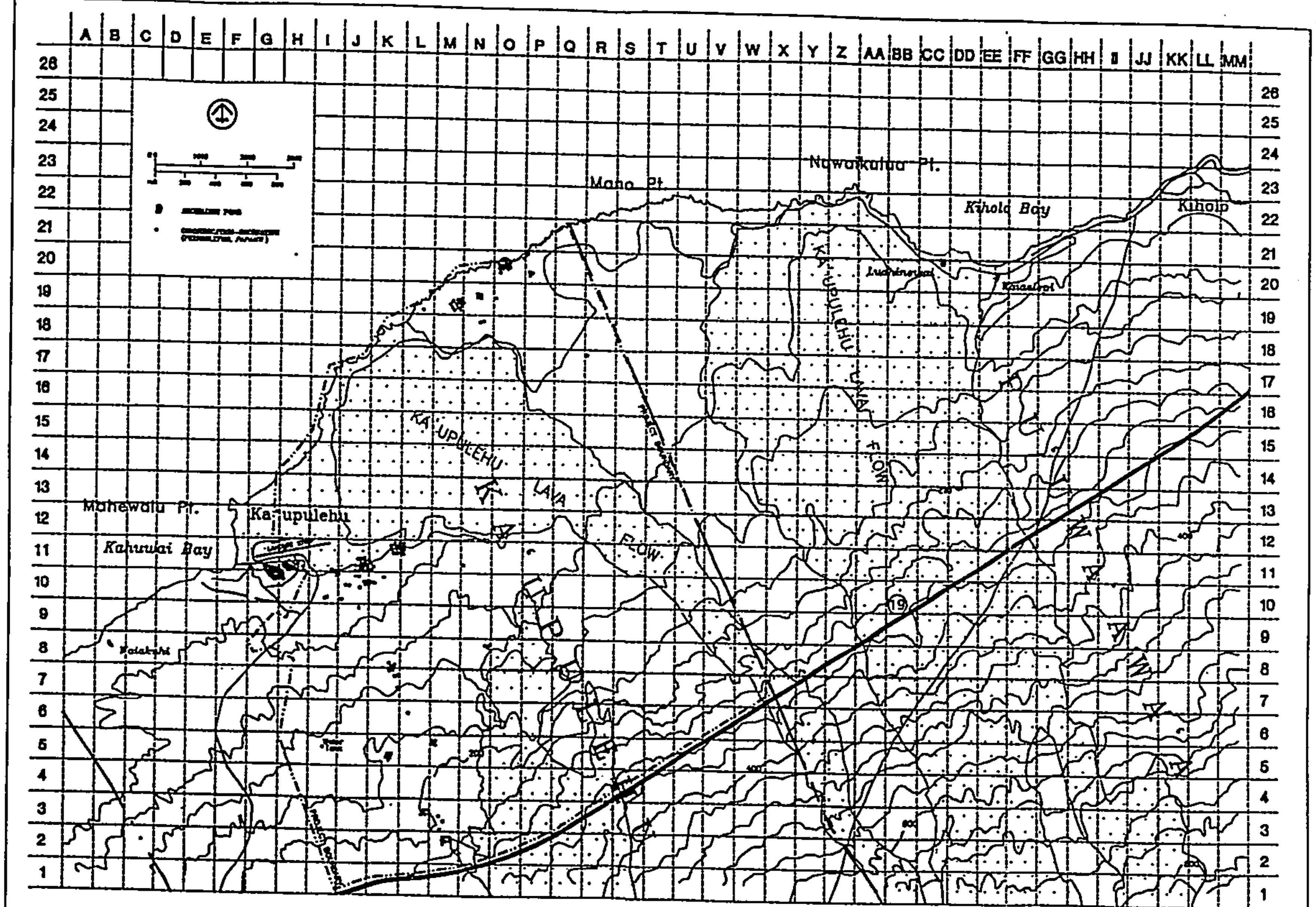

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Figure 27.
DISTRIBUTION OF COMMUNICATION-RECREATION FEATURES

trails, especially 19142, the *mauka-makai* trail (e.g. M2 & 3, L2, K7 & 8), but they can also be located at isolated and widely-spaced locations. Design elements of units suggested as communication features range from sails, circles, and anthropomorphs, to more recent graffiti. Recreation function features also are wide-spread and are often found in conjunction with habitation.

Site Density

In order to estimate the number of archaeological sites potentially destroyed by the 1800 flow, information on the relative age and distribution of sites was also used to calculate average site density for each elevation band within the project area (Table 11). The average number of sites represents the average number of sites present with the "non-1800 flow" portion of each elevation band, calculated per 200 by 200 m grid unit. The standard error associated with each average provides a minimum and maximum number of sites estimated for each grid unit within the elevation band, at a 95% confidence level (i.e., there is a 95% chance that the actual number of sites per grid unit falls within these values). The column Number of Grids column indicates the total number of 200 by 200 m grid units (per elevation band) covered by the 1800 flow and, when multiplied by the average number of sites and standard error values, provides an estimate of the minimum and maximum number of sites for the portion of each elevation band covered by the 1800 flow.

When Figures 23 through 27 and Table 11 are examined, it becomes apparent that the ahupua'a examined is only a part of what Ka'ūpūlehu must have looked like before the lava flow of AD 1800. Many sites were probably destroyed as a result of this natural disaster. It should also be noted here that the 40–80 ft elevation is probably skewed somewhat since the *AD 1800* lava flow has enlarged that elevational band. In other words, the surface area of the flow has *enlarged* the sample size area since a large portion is within this particular elevational range. This enlarged sample progresses further upslope than does the normal terrain, hence the skew. It appears from Table 11 that the site population has dropped significantly from 0-40 ft and then rises dramatically again at 80-120 ft. This discrepancy can be explained due to the enlarged examination area as explained above.

Summary of Site Distribution

Overall, the density of features of all functional types is weighted toward the lower elevations where resources are more plentiful. The distribution of site and feature types conformed to the expectations that had been generated based on ethnohistoric, legendary, and other relevant information.

The various settlement pattern models examined above generally suggested initial occupation of the northern end of North Kona at about AD 900 and this is generally confirmed by a initial occupation date of Site 10959 occurring at c. AD 1030 (Walker and Rosendahl 1988:66). It is then posited that the population of West Hawai'i remained fairly stable and low until around AD 1200, when population pressures forced generally uneven increases at favored locales (e.g., Kiholo, Ka'ūpūlehu, and Kūki'o) through AD 1600. Based on a limited number of probable age ranges for Ka'ūpūlehu, it appears the mean of all dates begins in the late 16th century, when it is believed that there was a substantial population. These averaged dates for the coastal portions and the upland sections appear to be only a generation apart.

Postulated general patterns of settlement for the North Kona (Rosendahl 1973, Cordy 1985) have common elements, which were also observed in the Ka'ūpūlehu area. As suggested,

Table 11.
Site Density by Elevation

Contour Interval (ft. AMSL)	Average Number of Sites	Standard Error	Number of Grid Units	Minimum Number of Sites	Maximum Number of Sites
0-40'	3.25	0.40	30	85.50	109.50
40-80'	0.67	0.25	40	16.80	36.80
80-120'	1.07	0.29	10	7.80	13.60
120-160'	0.42	0.06	5	1.80	2.40
160-200'	0.33	0.09	3	0.70	1.30
200-240'	0.57	0.17	3	1.20	2.20
240-280'	0.25	0.76	1	0.00	1.01
280'+	0.08	0.04	1	0.04	0.12

inhabitants lived at least semi-permanently along the coast and were primarily engaged in marine exploitation and small-scale gardening. Interspersed among the residential complexes are temporary dwelling areas with feature types such as shelter caves and shaped walls. This location has fewer permanent habitations than Cordy found, but it is probable that many (probably including higher-status complexes) were buried in AD 1800.

Rosendahl (1973) and Cordy (1985) have called the next zone the Barren Zone, which is termed the Midlands in this report. The midlands are similar to of Rosendahl's and Cordy's Barren Zone. The features there are, for the most part, restricted to trails and associated temporary habitation and communication features. At Ka'ūpūlehu, however, burials appear to have been placed in caves in this zone as well.

Generally, findings of this inventory survey support the settlement models of Rosendahl (1973) and Cordy (1985). It is hypothesized, however, that Ka'ūpūlehu (and the surrounding areas of Kekaha), are unique because of the probable geologic changes caused in the last 200 years by historic flows from Hualalai (AD 1800 and 1801) and Mauna Loa (AD 1859). Other areas to the south also affected by Hualalai flows (AD 1801) include the upper portions of the Lands of Kūki'o, Manainiwaoli, and 'Awake'e, as well as the middle and *makai* portions of Makalawena, Mahaiula, Kaulana, 'Awalua, 'Ohiki, Pu'ukala, Kau, Makaula, Hale'ohi'u, Hamanamana, Kalaoa, and 'O'oma. To the north, the Land of Pu'uwa'awa'a was covered by the Ka'ūpūlehu flow of Hualalai Volcano (AD 1800) and portions of the Land of Pu'uanahulu were covered by the AD 1859 flow from Mauna Loa. The areas covered by historic flows became essentially uninhabitable when lava buried large vegetated areas. Originally, this vegetation, along with a lower forest line, would have served to retain more moisture on the slopes of Hualalai. Loss of the vegetation to lava flows, coupled with the depletion of the dry forest by hoofed herbivores, made the climate in these lands drier.

Speaking of similar conditions in Ka'u District, E. G. Handy writes:

> ...the endemic flora gave a continuous cover of forest and brush, between spots of prairie where the grasses grew.

This would mean that it was less windy and, undoubtedly, with such cover, there was much more rainfall, mistfall and dew, in comparison with the modern desiccation of bare, windswept, sun-baked plain flanked now to east and west and north by recent black lava which condenses the sun's heat and dries the air above it. The winds come in off the sea over the flank of the mountain, and in trade-wind season (March to November) would normally have been saturated with moisture from spray, when not desiccated in passing over arid land as now. The winter storms from the south still bring heavy rains...as recently as fifty years ago, after severe deforestation both on the seaward slopes and in the upland had taken place, dewfall was a recognized source of moisture, where it condensed off vegetation and cool rocks and dripped into low-lying holes to be collected in gourds for drinking and for watering nearby plants (Handy in Handy and Pukui 1972:211-212).

K. Maly's translations of historic information suggest

> ...potable water (*wai*), the wealth (*waiwai*) upon which life depended were primarily provided by springs (in both the uplands and on the shore), water caves, dew fall, and rain catchment. Legendary and historic accounts document that various water sources were available, and that the forests extended much further seaward than they do now. Legendary accounts indicate that the upland region was extensively cultivated, and provided, along with marine resources, the starches and other vegetable foods necessary for the inhabitants.

Maly summarizes:

> Initially, planting would have occurred in and around coastal communities, and as the population grew and the political and religious systems became more formalized, the communities spread out...Crops such as sweet potatoes, sugarcane, bananas, yams, breadfruit, gourds, and coconuts etc. provided the "bread" of the Hawaiian diet.

KEKAHA BEFORE AD 1800

Rev. William Ellis observed the Kekaha area in 1842 writes that Revs. Thurston and Bishop had noted that:

> The environs were cultivated to a considerable extent; small garden were seen among the barren rocks on which the houses were built, wherever soil could be found sufficient to nourish the sweet potato, the water-mellon, 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).

These gardening techniques sound much like the *pu'epu'e* planting technique as described by Maly. Ellis states that barren rocks were used in the cultivation of selected plants. It may therefore be assumed in Ka'ūpūlehu residents were also using "barren rocks" to grow certain plants. Since this occurred in 1824, it is logical to assume that similar methods had been used in the past. If, as has been suggested, conditions were more conducive to agriculture prior to the Ka'ūpūlehu flow of AD 1800, then Ka'ūpūlehu (and Kekaha) should have been able to produce the crops such as sweet potatoes (*'uala*), gourd (*ipu manolo*), and *wauke* (paper mulberry). Other possible cultigens are: *noni* (Indian mulberry), *mai'a* (banana), *kalo malo'o* (dryland taro), *uhi* (yam), and a host of others.

Handy (1940:163) writes:

> Whenever a little soil could be heaped together along the dry lava coast of North Kona, a few sweet potatoes were planted...in such places as...Ka'ūpūlehu...

Thus, the evidence indicates that Kekaha (and those areas around Ka'ūpūlehu) have not always been *wai-ole* (without fresh water). In times before the AD 1800–1801 flows and the depredations of grazing animals, it must have been a wetter and potentially more productive agricultural area. As Marion Kelly has written, Ka'ūpūlehu was used for generations, as an oasis with a brackish fishpond and as a sanctuary for canoe travelers. Most of the vegetable diet of those who lived there probably came from the uplands of Ka'ūpūlehu, but was at least supplemented by plants grown nearby. Legendary accounts indicate that the uplands were heavily cultivated and the ocean provided ample marine resources. Ka'ūpūlehu would have been more suitable for habitation. It is not suggested, however, that the *makai* portions of Kekaha was probably ever a "garden" such as Puapua'a near Kailua or even into South Kona.

At present, the dating of Ka'ūpūlehu sites suggests initial occupation of the area as early as AD 1030 (Site 10959), with the greatest intensity of occupation occurring during the period between c. AD 1500 and AD 1800. These results are largely similar to those obtained from coastal areas to the north at 'Anaeho'omalu (Jensen 1988, 1989) and Kalahuipua'a (Jensen 1989, Welch 1989). Moreover, the presumed intensification of occupation within these latter areas, initially suggested by Barrera (1971a) and subsequently confirmed by Kirch (1979), appears also to have occurred at Ka'ūpūlehū, at least on the basis of present evidence (Walker and Rosendahl 1988:197). However, present dating of Ka'ūpūlehū sites, with over 20 probable age determinations returned from work, is biased towards sites in the coastal areas.

Based on the results of the two upland inventory survey projects, almost concurrent upland and coastal residential settlement seems to have characterized most of the occupation history at Ka'ūpūlehu. A number of potential research issues relate to this finding. It is generally accepted that upland settlement did not occur on the islands of Hawai'i, O'ahu, and Moloka'i until c. AD 1400-1550 (Hommon 1976:249). For West Hawai'i, Rosendahl (1972:499) suggested that developing agricultural technology and associated agricultural expansion allowed permanent settlement of upland communities to occur at Lapakahi, in the North Kohala District, around AD 1500. Based on the initial dating of upland habitation sites in the southeast portion of Ka'ūpūlehu (Goodfellow and Head 1992), however, it seems likely that initial upland occupation of Ka'ūpūlehu could have occurred as early as AD 1231 and continued concurrently with coastal occupations at least through the early historic period.

Moreover, it is also generally assumed (e.g., Hommon 1976:258) that during the period of inland expansion, coastal residences were not abandoned, and that occupants of inland and coastal sites exchanged their specialized commodities. The precise nature of the interrelationships among upland and coastal sites during the period of upland agricultural expansion, however, has not been adequately determined. Historical Documentary Research may provide further data on this question, but as yet is unsubstantial. Work by Rosendahl (1972) suggested a general absence of permanent habitation in the rocklands between the coast and the uplands, but no studies have confirmed that coastal and upland zones were occupied by the same household groups. It is even possible that temporary habitation sites within the intermediate rocky zone were occupied prior to the establishment of permanent households within the coastal area, particularly if the initial impetus for occupation of the region was in response to increasing demand for additional agricultural land, as has been suggested by Kirch and others.

SUGGESTED FUTURE RESEARCH

Nature and Intensity of Occupation

The investigation of these topics entails, in part, analyzing and interpreting site-specific information such as dating results, data on subsurface horizontal feature distribution, and qualitative/quantitative values of various portable artifact types and midden constituents. Utilizing this information to further define the following specific objectives could ultimately contribute significantly to our understanding of the cultural and historical research issues outlined above:

1. Age, duration, and intensity of occupation at individual sites and features;

2. Portable artifact assemblages present at individual sites and features;

3. Ecofactual remains, including, in particular, the relative percentages of marine and terrestrial resources present at individual sites and features;

4. A refinement in the existing assessment, thus far based only on inventory-level survey data, of the variety of cultural activities conducted at various sites and features at different time periods; particularly at the numerous toolstone or building material procurement centers (pahoehoe excavations) in the current project area; and

5. Utilizing the above information to further refine the *ahupua'a* settlement model by focusing upon the distribution of and interrelationships among temporal, artifactual, ecofactual and architectural variables as these are manifest at individual sites and features. Subcomponents of such a settlement model would include:

    a. Further characterization of the coastal, midlands, and uplands of the Kekaha region in terms of the crops, cultivation techniques, and temporal sequencing;

    b. Further definition of the nature of occupation within the project area; i.e., the extent to which specific sites and features reflect temporary, semi-permanent, and/or permanent occupation, and single or recurrent episodes of use, or both;

    c. In combination with available data from higher elevation zones, further investigation of the *ahupua'a*-wide settlement pattern, in order to determine whether permanent occupation was exclusively coastal, or if it included both coastal and inland components, and if permanent occupation may have appeared within the midlands of the present project area.

Studies of human ecology of this area primarily would concern the definition of subsistence adaptation to the terrestrial zones, but would also focus on possible exchange of goods between the coast and the uplands. The midlands are agriculturally fairly marginal, but do contain sufficient soil for limited cultivation (especially in the upper ranges). The forested portions of the uplands provided materials gathered from birds and plants. Evidence for terrestrial exploitation of flora and fauna within the project area includes species found near the coast (coconut, pandanus, and gourd) and species further inland (*kukui*). Preliminary historical documentary research (Kelly 1985) indicates that residents may also have grown sweet potato, watermelon, and tobacco during the early historic period, although the relationship of these possible activities to prehistoric patterns of use/exploitation remains undetermined.

Research areas relevant to the terrestrial zone constitute the following:

1. Define the specific resources which were exploited;

2. Determine the intensity of exploitation relative to both terrestrial and marine resources;

3. Compare and contrast with other West Hawai'i sites the material culture-elements associated with that exploitation; and

4. Ascertain the methods and techniques of exploitation which were actually employed. This latter task will require:

   a. Characterization of the upland and coastal environment (especially before the AD 1800 Ka'ūpūlehu lava flow) through (1) documentary research of readily available sources and references, and (2) consultations with local informants and other knowledgeable individuals;

   b. Formulation of a model of terrestrial resource exploitation strategies. The model would require specification of the range of resources exploited, the intensity of exploitation, the methods and techniques employed, and the associated material hardware, and would be formulated by combining this information with (1) documentary research involving ethnohistoric and ethnographic sources, (2) review and analysis of comparable data from other areas, and (3) an evaluation of any special conditions that characterize the local environment.

One last historical question should be raised. Are any of the human remains present in Feature F, Site 19084 (the purported *Fair American* Cave) those of crewmen from that ship, captured in the AD 1790s by Kame'eiamoku? (The description of Feature F recorded for this project indicates the presence of "...a cranium that has a brown (belt-like material) sailor-like cap perched on the skull top."). Kelly (1975:90) reports that all the crew (with the exception of Isaac Davis) were killed and thrown overboard. Maly's interviews with authorities on Hawaiian history and local long-term residents of the area produced no information indicating that the remains of the ill-fated crew are in the cave. In fact information developed by Maly called into question the burial of the crew in the cave. Research has indicated that it was some time after Johnno Jackson developed Kona Village, at Kahuwai Bay, that the stories of the "*Fair American* Burial Cave" began to be circulate. Other informants have indicated that it was once common practice to "have your picture taken with the sailors."

Most of the portable remains in the cave have long been removed by relic hunters. Examination of the remains (especially in the western cave) to determine sex, age, race, and pathology could aid in determining an answer to the mystery.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

The Assessment Process

The six significance categories used in the site evaluation process are based on both the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60), and on criteria used by the State of Hawaii (DLNR 1989). The State Historic Preservation Office uses these criteria for evaluating cultural resources. The evaluation process is guided by two bulletins prepared by the National Register of Historic Places (NRHP) entitled "Guidelines for Evaluating and Documenting Traditional Cultural Properties" (*Bulletin 38*, Parker and King 1990) and "How to Apply the National Register Criteria for Evaluation" (*National Register Bulletin 15*. The National Register Criteria embody four types of cultural value: Criterion A through D. Criteria A and B define significance through *association*; Criterion C defines significance through *design* or *construction* value; and Criterion D defines significance in terms of *information* value. Sites may be considered significant under one or more of these criteria. A brief dicussion of each of these criteria will now be presented, including a presentation of the two additional criteria used in the State of Hawaii (Criterion E and NLS).

In conformity with the National Register criteria for evaluation, sites with potential cultural significance are evaluated first under Criterion A, which defines significant resources as those that are "associated with events that have made a significant contribution to the broad patterns of our history" (National Register Bulletin 15:12). These can be either a specific event in prehistory or history, or a pattern of events or a historic trend that made a significant contribution to the development of a community, a State, or the nation". Examples of sites in Hawai'i that are evaluated as significant under Criterion A include famous Hawaiian battlefields (e.g., Kuamo'o Battlefield), or landmarks (e.g., a mountaintop) important in Hawaiian legends, the first landing place of early explorers (e.g., Cook on Kaua'i), and important locations in the history of the Hawaiian monarchy (e.g., Thomas Square, where the Hawaiian kingdom was formally restored from England in 1843; or Iolani Palace, where the monarchy was overthrown in 1893), and structures related to World War II.

Sites associated with a important individual in history are evaluated under Criterion B, which defines significant resources as those that "are associated with the lives of persons significant in our past" (National Register Bulletin 15:14). Significant individuals in history "refers to individuals whose activities are demonstrably important within a local, State, or national historic context" (ibid.). Examples of sites evaluated as significant under Criterion B

Table 12. Summary of General Significance Assessments and Recommended General Treatments

SIHP* Site No.	A	B	D	NLS	C	E	FDC	NFW	PID	PAI
	Significance Category						Recommended Treatment			
19080	-	-	-	+	-	-	-	+	-	-
19097	-	-	-	+	-	-	-	+	-	-
19100	-	-	-	+	-	-	-	+	-	-
19107	-	-	-	+	-	-	-	+	-	-
19111	-	-	-	+	-	-	-	+	-	-
19112	-	-	-	+	-	-	-	+	-	-
19113	-	-	-	+	-	-	-	+	-	-
19114	-	-	-	+	-	-	-	+	-	-
19116	-	-	-	+	-	-	-	+	-	-
19117	-	-	-	+	-	-	-	+	-	-
19118	-	-	-	+	-	-	-	+	-	-
19120	-	-	-	+	-	-	-	+	-	-
19122	-	-	-	+	-	-	-	+	-	-
19125	-	-	-	+	-	-	-	+	-	-
19131	-	-	-	+	-	-	-	+	-	-
19132	-	-	-	+	-	-	-	+	-	-
19134	-	-	-	+	-	-	-	+	-	-
19135	-	-	-	+	-	-	-	+	-	-
19136	-	-	-	+	-	-	-	+	-	-
19137	-	-	-	+	-	-	-	+	-	-
19138	-	-	-	+	-	-	-	+	-	-
19140	-	-	-	+	-	-	-	+	-	-
19141	-	-	-	+	-	-	-	+	-	-
19144	-	-	-	+	-	-	-	+	-	-
19147	-	-	-	+	-	-	-	+	-	-
19154	-	-	-	+	-	-	-	+	-	-
19155	-	-	-	+	-	-	-	+	-	-
19161	-	-	-	+	-	-	-	+	-	-
19162	-	-	-	+	-	-	-	+	-	-
19165	-	-	-	+	-	-	-	+	-	-
19166	-	-	-	+	-	-	-	+	-	-
19167	-	-	-	+	-	-	-	+	-	-
19168	-	-	-	+	-	-	-	+	-	-

General Significance Categories:
A = Important for historical contribution to significant events and broad patterns of history;
B = Important for association with the lives of important individuals in history;
D = Important for information content, further data collection necessary (PHRI=research value);
NLS= No longer significant, significant data collected, important for information content only, no further data collection necessary (PHRI=research value, SHPO=not significant); and
C = Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value);
E = Culturally significant (PHRI=cultural value); and

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

* State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five- digit numbers prefixed by 50-10-19 (50=State of Hawaii; 10=Island of Hawaii; 19=USGS 7.5' series quad map ["Kiholo, Hawaii"]).

Table 12. (cont.)

SIHP Site No.	Significance Category A	B	D	NLS	C	E	Recommended Treatment FDC	NFW	PID	PAI
19169	-	-	-	+	-	-	-	+	-	-
19170	-	-	-	+	-	-	-	+	-	-
19171	-	-	-	+	-	-	-	+	-	-
19173	-	-	-	+	-	-	-	+	-	-
19174	-	-	-	+	-	-	-	+	-	-
19175	-	-	-	+	-	-	-	+	-	-
19176	-	-	-	+	-	-	-	+	-	-
19177	-	-	-	+	-	-	-	+	-	-
19178	-	-	-	+	-	-	-	+	-	-
19179	-	-	-	+	-	-	-	+	-	-
19180	-	-	-	+	-	-	-	+	-	-
19181	-	-	-	+	-	-	-	+	-	-
19182	-	-	-	+	-	-	-	+	-	-
19183	-	-	-	+	-	-	-	+	-	-
19184	-	-	-	+	-	-	-	+	-	-
19185	-	-	-	+	-	-	-	+	-	-
19186	-	-	-	+	-	-	-	+	-	-
19188	-	-	-	+	-	-	-	+	-	-
19191	-	-	-	+	-	-	-	+	-	-
19207	-	-	-	+	-	-	-	+	-	-
19209	-	-	-	+	-	-	-	+	-	-
19215	-	-	-	+	-	-	-	+	-	-
19218	-	-	-	+	-	-	-	+	-	-
19219	-	-	-	+	-	-	-	+	-	-
19220	-	-	-	+	-	-	-	+	-	-
19221	-	-	-	+	-	-	-	+	-	-
19222	-	-	-	+	-	-	-	+	-	-
19225	-	-	-	+	-	-	-	+	-	-
19227	-	-	-	+	-	-	-	+	-	-
19228	-	-	-	+	-	-	-	+	-	-
19229	-	-	-	+	-	-	-	+	-	-
19230	-	-	-	+	-	-	-	+	-	-
19232	-	-	-	+	-	-	-	+	-	-
19235	-	-	-	+	-	-	-	+	-	-
19236	-	-	-	+	-	-	-	+	-	-
19238	-	-	-	+	-	-	-	+	-	-
19239	-	-	-	+	-	-	-	+	-	-
19240	-	-	-	+	-	-	-	+	-	-
19241	-	-	-	+	-	-	-	+	-	-
19242	-	-	-	+	-	-	-	+	-	-
19243	-	-	-	+	-	-	-	+	-	-
19247	-	-	-	+	-	-	-	+	-	-
Subtotal	0	0	0	75	0	0	0	75	0	0
19085	-	-	+	-	-	-	+	-	-	-
19096	-	-	+	-	-	-	+	-	-	-
19098	-	-	+	-	-	-	+	-	-	-
19099	-	-	+	-	-	-	+	-	-	-
19110	-	-	+	-	-	-	+	-	-	-
19115	-	-	+	-	-	-	+	-	-	-
19119	-	-	+	-	-	-	+	-	-	-
19121	-	-	+	-	-	-	+	-	-	-
19123	-	-	+	-	-	-	+	-	-	-
19126	-	-	+	-	-	-	+	-	-	-
19127	-	-	+	-	-	-	+	-	-	-
19128	-	-	+	-	-	-	+	-	-	-

Table 12. (cont.)

SIHP Site No.	Significance Category A	B	D	NLS	C	E	Recommended Treatment FDC	NFW	PID	PAI
19133	-	-	+	-	-	-	+	-	-	-
19142	-	-	+	-	-	-	+	-	-	-
19145	-	-	+	-	-	-	+	-	-	-
19146	-	-	+	-	-	-	+	-	-	-
19148	-	-	+	-	-	-	+	-	-	-
19150	-	-	+	-	-	-	+	-	-	-
19152	-	-	+	-	-	-	+	-	-	-
19153	-	-	+	-	-	-	+	-	-	-
19156	-	-	+	-	-	-	+	-	-	-
19157	-	-	+	-	-	-	+	-	-	-
19159	-	-	+	-	-	-	+	-	-	-
19160	-	-	+	-	-	-	+	-	-	-
19163	-	-	+	-	-	-	+	-	-	-
19172	-	-	+	-	-	-	+	-	-	-
19187	-	-	+	-	-	-	+	-	-	-
19189	-	-	+	-	-	-	+	-	-	-
19190	-	-	+	-	-	-	+	-	-	-
19192	-	-	+	-	-	-	+	-	-	-
19195	-	-	+	-	-	-	+	-	-	-
19196	-	-	+	-	-	-	+	-	-	-
19197	-	-	+	-	-	-	+	-	-	-
19198	-	-	+	-	-	-	+	-	-	-
19199	-	-	+	-	-	-	+	-	-	-
19200	-	-	+	-	-	-	+	-	-	-
19204	-	-	+	-	-	-	+	-	-	-
19205	-	-	+	-	-	-	+	-	-	-
19206	-	-	+	-	-	-	+	-	-	-
19210	-	-	+	-	-	-	+	-	-	-
19211	-	-	+	-	-	-	+	-	-	-
19212	-	-	+	-	-	-	+	-	-	-
19213	-	-	+	-	-	-	+	-	-	-
19214	-	-	+	-	-	-	+	-	-	-
19216	-	-	+	-	-	-	+	-	-	-
19217	-	-	+	-	-	-	+	-	-	-
19223	-	-	+	-	-	-	+	-	-	-
19226	-	-	+	-	-	-	+	-	-	-
19231	-	-	+	-	-	-	+	-	-	-
19233	-	-	+	-	-	-	+	-	-	-
19237	-	-	+	-	-	-	+	-	-	-
19246	-	-	+	-	-	-	+	-	-	-
Subtotal	0	0	52	0	0	0	52	0	0	0
19065	-	-	+	-	+	-	+	-	+	-
19066	-	-	+	-	+	-	+	-	+	-
19067	-	-	+	-	+	-	+	-	+	-
19068	-	-	+	-	+	-	+	-	+	-
19069	-	-	+	-	+	-	+	-	+	-
19070	-	-	+	-	+	-	+	-	+	-
19071	-	-	+	-	+	-	+	-	+	-
19072	-	-	+	-	+	-	+	-	+	-
19073	-	-	+	-	+	-	+	-	+	-
19074	-	-	+	-	+	-	+	-	+	-
19075	-	-	+	-	+	-	+	-	+	-
19076	-	-	+	-	+	-	+	-	+	-
19077	-	-	+	-	+	-	+	-	+	-
19078	-	-	+	-	+	-	+	-	+	-

Table 12. (cont.)

SIHP Site No.	Significance Category A	B	D	NLS	C	E	Recommended Treatment FDC	NFW	PID	PAI
19079	-	-	+	-	+	-	+	-	+	-
19082	-	-	+	-	+	-	+	-	+	-
19083	-	-	+	-	+	-	+	-	+	-
19087	-	-	+	-	+	-	+	-	+	-
19088	-	-	+	-	+	-	+	-	+	-
19089	-	-	+	-	+	-	+	-	+	-
19090	-	-	+	-	+	-	+	-	+	-
19091	-	-	+	-	+	-	+	-	+	-
19092	-	-	+	-	+	-	+	-	+	-
19093	-	-	+	-	+	-	+	-	+	-
19094	-	-	+	-	+	-	+	-	+	-
19095	-	-	+	-	+	-	+	-	+	-
19102	-	-	+	-	+	-	+	-	+	-
19103	-	-	+	-	+	-	+	-	+	-
19104	-	-	+	-	+	-	+	-	+	-
19105	-	-	+	-	+	-	+	-	+	-
19106	-	-	+	-	+	-	+	-	+	-
19108	-	-	+	-	+	-	+	-	+	-
19109	-	-	+	-	+	-	+	-	+	-
19194	-	-	+	-	+	-	+	-	+	-
19201	-	-	+	-	+	-	+	-	+	-
19202	-	-	+	-	+	-	+	-	+	-
19203	-	-	+	-	+	-	+	-	+	-
19244	-	-	+	-	+	-	+	-	+	-
19245	-	-	+	-	+	-	+	-	+	-
Subtotal:	0	0	39	0	39	0	39	0	39	0
1140	-	-	+	-	-	+	+	-	-	+
19101	-	-	+	-	-	+	+	-	-	+
19130	-	-	+	-	-	+	+	-	-	+
19143	-	-	+	-	-	+	+	-	-	+
19151	-	-	+	-	-	+	+	-	-	+
19158	-	-	+	-	-	+	+	-	-	+
19208	-	-	+	-	-	+	+	-	-	+
19234	-	-	+	-	-	+	+	-	-	+
Subtotal	0	0	8	0	0	8	8	0	0	8
19129	-	-	+	-	-	+	-	+	-	+
19139	-	-	+	-	-	+	-	+	-	+
19149	-	-	+	-	-	+	-	+	-	+
19164	-	-	+	-	-	+	-	+	-	+
19224	-	-	+	-	-	+	-	+	-	+
Subtotal	0	0	5	0	0	5	0	5	0	5
19081	-	-	+	-	+	+	+	-	-	+
19084	-	-	+	-	+	+	+	-	-	+
19086	-	-	+	-	+	+	+	-	-	+
Subtotal	0	0	3	0	3	3	3	0	0	3
19124*	-	-	+	-	+	+	+	-	+	-
19193	-	-	+	-	+	+	+	-	+	-
Subtotal:	0	0	2	0	2	2	2	0	2	0
1138,1141	-	-	+	-	-	+	+	-	-	-
Subtotal	0	0	1	0	0	1	1	0	0	0
Total	0	0	110	75	44	19	105	80	41	16

** Selected segments only to be preserved* include the residences of famous past individuals, such as royalty (e.g., Kamehameha III, Queen Liliuokalani), famous writers, artists, educators, missionaries, politicians, and businessmen. The traditional residential complex of Keakealaniwahine (a chiefess of high rank) in Holualoa would be a good example of an example of a prehistoric residence known from oral history that would be evaluated under this criterion.

Sites that are potentially significant as representative examples of site types are evaluated under Criterion C, which defines significant resources as those that "embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction" (National Register Bulletin 15:17). Examples of the types of historic sites that might be evaluated as significant under Criterion C in Hawaii include, but are not limited to: (a) plantation structures—e.g., manager's residence or camp housing; (b) buildings specific to the ranching period—e.g., structures typical of a local style, such as turn-of-the-century ranch houses on Lana'i or those found in Waimea, Hawai'i; (c) historic churches with unique architecture—e.g., Mokuaikaua church in Kailua-Kona, or (d) a neighborhood that embodies the values of an ethnic group—e.g., Honolulu's Chinatown. Prehistoric sites that might be evaluated as significant under this criterion could be excellent examples of the various types of structures, including trails, walls, agricultural terraces, habitation platforms, or *heiau.*

Sites determined to be potentially significant for information content fall under Criterion D, which defines significant resources as ones that "have yielded, or may be likely to yield, information important in prehistory or history" (National Register Bulletin 15:21). While most archaeological sites are initially evaluated as significant under Criterion D, after the evaluative process of an inventory survey, or the data recovery process of a mitigation program, the research potential of some sites may be exhausted (i.e., after extensive mapping, testing, surface collection, historical research, etc.). In these cases, the sites may maintain their information content *value* but lose their information content *significance.* Hence, the sites will be considered as "No Longer Significant" (NLS).

Sites determined to be potentially significant for having cultural value to native Hawaiians and other ethnic groups of the State of Hawaii fall under Criterion E. While the previous four criteria are all presented in the federal guidelines, Criterion E was established by the State of Hawaii in a document entitled "Draft Rules Governing Procedures for Historic Preservation Review" (Draft Rules 1989). Criterion E defines significant resources as ones that "have an important traditional cultural contribution or value to the native Hawaiian people or to other ethnic groups of the state" (Draft Rules 1989: A:10). Examples of sites that could be evaluated as significant under Criterion E may include *heiau*, cemeteries, burials, and trails. Criterion E is concerned with a property's intrinsic value to a cultural group, rather than the property's being considered an example of a "type" *per se.*

In keeping with Federal and State guidelines, in addition to the strength of the evaluation based on the significance categories presented above, PHRI makes recommendations for further work on historic properties are made based on three considerations. First, properties can lose their cultural significance, or have their significance diminished, if the condition and integrity of the property, or of the property's setting, have been sufficiently altered. Second, the nature of the proposed impacts is considered in making recommendations for further work or preservation. If a site lies in an area slated for grading, it will more likely be recommended for further work than a site that can be preserved, and hence "data banked" for future research. Lastly, concerning the preservation and interpretation for the general public of sites and clusters of sites that are representative of general settlement patterns within a region (i.e., a discontinuous district), decisions for preservation of this type are made in consultation with the State Historic Preservation Office in order to meet long-term planning goals of that office.

Specific Assessments and Recommendations

Based on the above federal criteria, of the 185 sites identified in the project area, 75 are assessed as no longer significant and require no further work. These 75 sites lack cultural deposits and portable remains; they have been measured, described, and photographed, and their locations have been plotted. The data collected from them during the present survey are considered sufficient recovery of significant information. Although preservation of these sites is not essential, some sites could be considered for inclusion into development landscaping.

Fifty-two sites are assessed as significant solely for information content and are recommended for further data collection.

Thirty-nine sites assessed as significant for information content and as excellent examples of site types are recommended for further data collection followed by preservation with interpretive development. Three of these sites (19201, 19202, and 19203) are located outside of the recommended preserve area, near the seacoast, northwest of the AD 1800 Ka'upulehu Lava Flow.

Eight sites are assessed as significant for information value and for cultural value; they are recommended for further data collection followed by for preservation "as is". Seven of these are multi-component sites (1140, 19101, 19143, 19151, 19158, 19208, and 19234) and have assessments based on the presence of identified human burials at specific features within overall site complexes. Other features within the complexes warrant additional data collection and data recovery work, based on the presence of accumulated midden and the need for more detailed mapping and other recording. The eighth site (Site 19130) has been placed in this category based on the presence of a possible shrine or other ceremonial feature.

Five sites (Sites 19129, 19139, 19149, 19164, and 19224) are assessed as significant for information content and for cultural value but are recommended for preservation "as is," only. These are single-component sites that were identified as containing human burials. Because they have been mapped, recorded, photographed, and their locations accurately plotted, no further work is recommended for these five sites.

Three sites (19081, 19084, and 19086) are assessed as significant for information content, as excellent examples of site types, and as having cultural value. They are recommended for further data collection, to be followed by preservation "as is." The assessment of cultural value and recommendation for preservation "as is" are based on the presence of identified human burials or human skeletal remains at specific features within the site complexes. Two of the three sites (the exception being Site 19084) are located within the proposed archaeological preserve. Site 19084, contains Feature F, a large burial cave.

Two sites (19124 and 19193) are major trails and are also assessed as significant for information, site type, and cultural values. Site 19193, the coastal trail, is recommended for preservation with interpretive development. Preservation with interpretive development is also recommended for portions of Site 19124, but not for the entire trail. This trail will not be preserved for access purposes, but portions would be preserved because the trail is a good example of a probable prehistoric trail thought to have been used until the incursion of the AD 1800 Ka'ūpūlehu lava flow. It is recommended that distinctive portions of this *mauka-makai* trail be preserved (e.g., segments in especially good physical condition, as well as those portions of the trail clearly associated with other preservation sites and areas). Exactly which segments of trail are to be preserved will be determined as the development concept is refined and revised, and moves to the actual design stage. The actual segments to be preserved will be specified later in the detailed Archaeological Mitigation Plan that is anticipated will be required as part of the regulatory review and permitting process.

The final site (Site 1138, 1141) is assessed as significant for information and cultural values, but is recommended for further data collection, only. This site is a short trail segment across the AD 1800 Ka'upulehu Lava Flow.

Thirty-eight of the 57 project-area sites recommended for preservation are wholly contained in a designated preserve area. The preserve area will be approximately 34 acres (14 ha) and will contain the following archaeological sites:

Table 13. Preserve Area Sites

19065	19075	19088	19103
19066	19076	19089	19104
19067	19077	19090	19105
19068	19078	19091	19106
19069	19079	19092	19108
19070	19081	19093	19109
19071	19082	19094	19244
19072	19083	19095	19245
19073	19086	19101	
19074	19087	19102	

These preserve area sites have been accessed as significant for information content and as excellent examples of site types. Further data collection is recommended followed by preservation with interpretive development of selected features. In the case of Sites 19086 and 19101, a further recommendation of cultural value is given based on the presence of human remains (below). All of these sites are contained wholly within the boundaries of the recommended archaeological preserve

.

Three archaeological sites have been recommended as representative of excellent site type examples at the regional or island-wide level. Pending further data collection to determine eligibility, these sites are recommended for preservation and interpretive development. These sites all appear to be residential complexes located outside of the recommended preserve area. All are located near the seacoast, northwest of the AD 1800 Ka'ūpūlehu lava flow, and they include Sites 19201, 19202, and 19203.

On the subject of human remains identified within the project area, two types were found. Several of the sites consisted of multiple burial caves or mostly complete burials, while others consist of Human Skeletal Remains, in some cases only a small number of bones. In the former, it is probable that the interments are formal burials and should be preserved in place. The latter category which appears to include Sites 19081, 19129, 19139, and 19151, may consist of secondary or disturbed burials. The Hawai'i Island Burial Council may consider consolidating these remains in other burial caves in the area. Site 19081 is, however, located within the proposed Preserve Area boundaries

Seven multi-component sites (1140, 19101, 19143, 19151, 19158, 19208, and 19234) have been assessed as significant for information content and cultural value and are recommended for further data collection to be followed by preservation "as is." The assessment of cultural value and the recommendation for preservation "as is" are based on the presence of identified human burials at specific features within overall site complexes. Other features within the complexes warrant additional data collection and data recovery work, based on the presence of accumulated midden and the need for more detailed mapping and other recording.

One site has been provisionally placed in this category. Site 19130 is recommended for further data collection provisionally followed by preservation "as is." This assessment of cultural value and recommendation for preservation "as is" is based on the presence of a possible shrine or other ceremonial feature. Further data collection is recommended to determine the function of Feature B at the site. If it can be determined that this feature served a ceremonial function, then preservation "as is" is recommended.

Five single-component sites were identified as containing human burials and were assessed as having cultural value. The sites in this category are 19129, 19139, 19149, 19164, and 19224. Because they have been mapped, recorded, photographed, and their locations accurately plotted, no further data collection or data recovery work is recommended for these five sites.

Three additional sites complete the significance recommendations. Site 1138, 1141 (one site) is a trail across the AD 1800 Ka'ūpūlehu lava flow. It is assessed as important for information content and as having cultural value. Further data collection followed by preservation "as is" is recommended. Two additional sites (also major trails) are assessed as important for information content, are excellent examples of a site type, and possess cultural value. A recommendation of further data collection and interpretive development is given.

It should be noted that the above assessments and treatment recommendations are based on a phased archaeological inventory survey and are thus subject to the limitations of such surveys. There is always the possibility, however remote, that potentially significant unidentified cultural remains might be encountered during development activities involving the modification of the ground surface. In such situations, archaeological consultation should be sought immediately.

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Letter 1489-061794

June 27, 1994

Mr. Lee Sichter
Belt Collins Hawaii
680 Ala Moana Blvd., First Floor
Honolulu, Hawai'i 96813

Subject: Addendum to Head and Rosendahl (1994)
Phased Archaeological Inventory Survey - Phase II
Ka'ūpūlehu Makai - Lot 4
Land of Ka'ūpūlehu, North Kona District,
Island of Hawai'i (TMK: 7-2-03:1)

Dear Mr. Sichter:

At the request of Mr. Ed Kuniyoshi of your office, Paul H. Rosendahl, Ph.D., Inc. (PHRI) recently conducted a supplemental archaeological inventory survey in an area recently determined to be a portion of the Ka'ūpūlehu Makai-Lot 4 project area (Figure 1). The area, located *makai* (seaward) of the existing Kona Village Access Road, was initially inspected on April 18, 1994 during the Head and Rosendahl (1994) survey. The current inventory-level survey work was conducted on June 16, 1994 by Projects Supervisor James Head, B.A. The survey took about eight man-hours of labor to complete.

The primary objectives of the inventory survey were: (a) to determine the general nature and extent of archaeological remains present, and the implications of any such remains with regards to the feasibility of development; and (b) to estimate the general scope of any subsequent archaeological work that might be required in the course of future development.

The project area consists of c. 1.2 ha (2.9 acres) located approximately 2.1km (1.3 mile) *makai* (seaward) of Queen Ka'ahumanu Highway and immediately west of the old paved road to Kona Village. Vegetation in the project area is sparse and consists primarily of grasses (mostly fountaingrass *Pennisetum setaceum* [Fotsk.] Chiov, *'uhaloa* (*Waltheria indica* L.), *kiawe* (*Prosopis pallida* [Humb. and Bonpl. ex Willd.]) HBK., and *'ilima* (*Sida fallax* Walp.).

Previous archaeological work and historical documentary research conducted within or near the project area is discussed in detail in Head and Rosendahl (1994) and is only briefly summarized in the following.

Soehren (1963) examined the current project area in conjunction with his study of Ka'ūpūlehu and Makalawena *ahupua'a*. He identified Site D22-18 and D22-19 east of the pond at Kahuwai Bay. He describes Site 18 as "a stone walled structure, 2x3 fathoms, which outwardly resembles a house site. It is built of jagged chunks of lava piled about three feet high. The absence of any defineable door and the nearly half filled interior suggest that the structure is...a grave" (1963:28). Soehren described Site D22-19 as consisting of "numerous petroglyphs carved on the smooth pahoehoe.

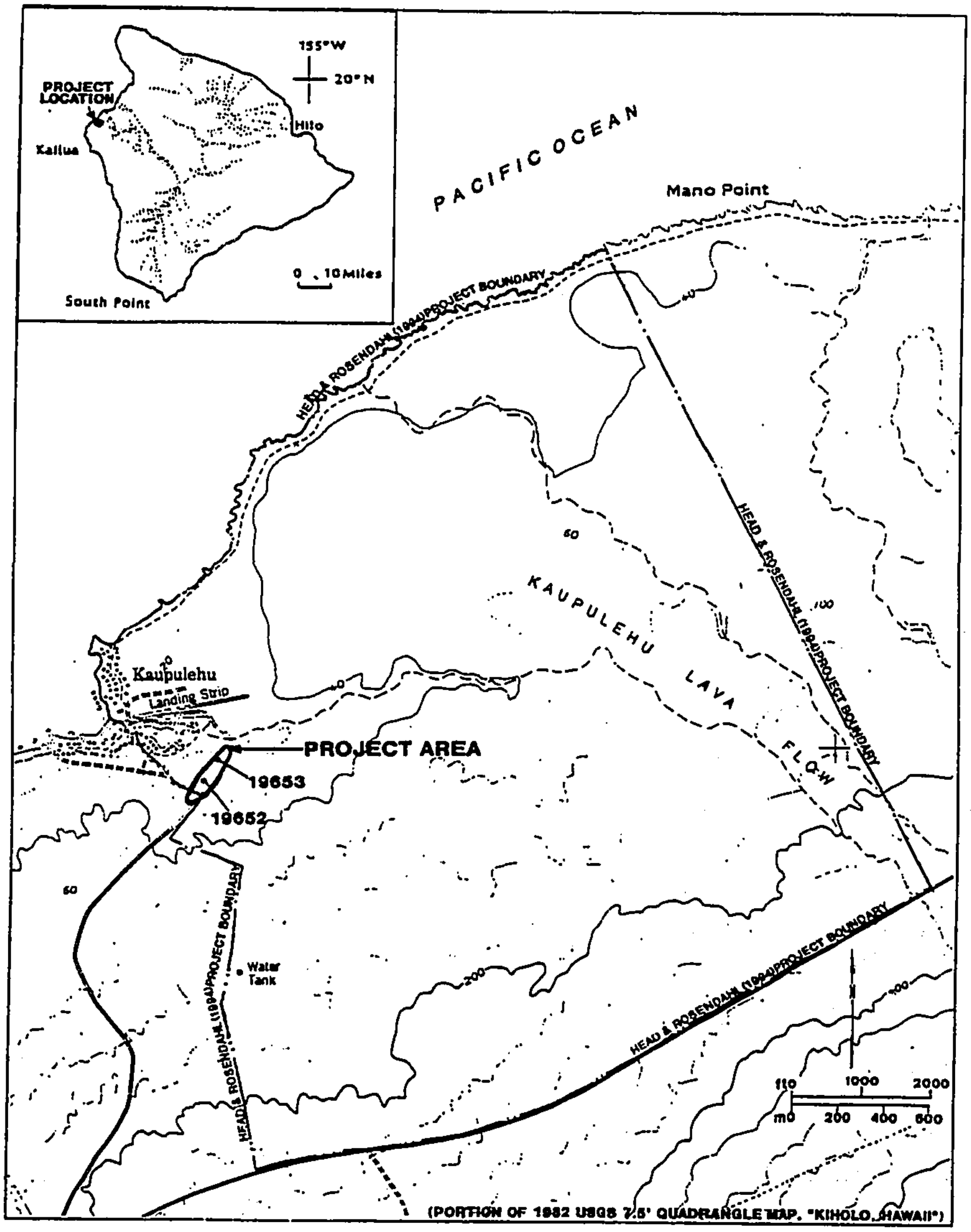

Figure 1. Project Area and Site Location Map

Carter (1985) found a trail segment (Site D22-152) near the immediate project area. Site D22-152 is a trail marked with branch coral along its length. The trail continued north and south for roughly 100 m and extended into the present Kona Village Resort property. During the current project, however, the trail could not be located on the *makai* side of the access road. Carter also identified Site D22-161 (pahoehoe clearings) and Site D22-162 (shelter cave with cairns). Both of these sites are located south of the current study area.

Walker and Rosendahl reidentified Carter's sites southwest of the current project area and assigned them State Inventory of Historic Places (SIHP) site numbers (1988:70-73). Site D22-161 was given SIHP number 10964, and D22-162 was assigned number 10965. Site 10964 is listed as a complex of six features, all of which are pahoehoe clearings. Site 10965 is a complex of seven features, of which six are cairns and one is a cave shelter. The cave shelter, Feature A, is about 50 meters at 277° from Feature A of Site 10964. The opening of the cave shelter is partially walled, and sparse amounts of Echinoidea, *Cypraea* spp., Isognomonidae, *Nerita picea*, and Thaididae were noted within the shelter. The site was assigned a tentative habitation function (Ibid.:18).

Smith and Rosendahl's (1991) Phase I archaeological survey work and Head and Rosendahl's (1994) work located several sites to the southeast of the present project area. These include Site 19124 (Carter's Site D22-152[?]), a prehistoric *mauka-makai* trail which extends from Kahuwai Bay to the uplands, where it is buried by the AD 1800 Ka'ūpūlehu aa lava flow. Associated with this trail are a number of other features, including marker cairns, petroglyphs, and possible temporary habitation caves. Just north of this trail is a complex of probable permanent and ancillary habitation sites that were recommended for preservation.

Historical documentation indicates that the general vicinity of the project area was well populated by c. 1200, when the small protected bays and shoreline areas were settled. Initially, planting probably occurred in and around the coastal communities, and as the population grew and the political and religious systems became more formalized, the communities spread out. The coastal and upland plains in the low forested zone were planted with important staple and supplemental crops that were less water-dependent than the *kalo wai* (wet taro), which was the staple of the *ko'olau* (windward) side of the island. *Pu'epu'e* (planting in built-up mounds), *mākālua* and *'umoki* (planting in dugout-mulched holes) are three methods of planting techniques that are recorded as having been extensively used in Kona.

Crops such as sweet potatoes, sugar cane, bananas, yams, breadfruit, gourds, and coconuts provided the "bread" of the Hawaiian diet. On the upper slopes were grown the endemic *olonā* (*Touchardia latifolia* Gaud.) for cordage, and *'awa* (*Piper methysticum* Forst. f.) for ceremonial and domestic use. Various woods and resources were collected from the upland forests and these were used to make spears, paddles, canoes, and tools.

Fishing in the region was considered some of the best on Hawai'i, and it is likely that a great deal of energy went into harvesting of other ocean resources. Though farmers gathered some ocean resources, and fishermen grew some food plants, it is generally accepted that the fishermen primarily provided fish and other ocean resources to the planters, who in turn supplied the fishermen with agricultural products. This division of labor appears to be supported in some of the legendary accounts. Indeed, legendary descriptions of this region depict viable communities and describe the various resources on which they depended for survival.

The areas just *mauka* of the current project area appear to have been utilized as hypothesized by Rosendahl (1973) and Cordy (1985). Both authors view this as a midlands or barren area through which trails extended from the coast to the uplands. The trails were used to transport agricultural and other products to consumers. As well, the zone has caves which were used for temporary shelter by people passing along the trail or involved in exploitation of the near-shore resources. Several of the caves in the general area were also used for a more extended stay, and some were used as burial caves. Some crops (especially sweet potato) may have been planted in scattered agricultural mounds near the current project area. The project also is near the ocean and very near the brackish water ponds at Kahuwai Bay; the area is probably associated with permanent housing complexes located seaward.

The current project area was inspected 100% by way of two pedestrian sweeps (oriented c. 35/215°). Intervals between sweeps were c. 10.0-15.0 meters. The inspection focused on identifying surface structural and portable remains. The survey was facilitated by an aerial photograph of the area (R.M. Towill Corp., No. KV-7, Scale 1"=400', 1979) and the USGS topographic quadrangle (Kiholo, Hawai'i, 7.5", 1982).

The inventory survey indicated the project area had been disturbed in modern times. Two access roads were in the area. One led to the Kona Village Parking Lot, and the other to Kona Village. During the survey, two archaeological complexes were identified (SIHP Sites 19652 and 19653)(Table 1). Site 19652 (Figure 2) is a complex of five features. Features A and D are C-shaped walls. Features C and E are modified depressions. Feature B is a mound. All of the features appear to be related to ancillary habitation probably associated with a permanent habitation complex located at the brackish ponds or at Kahuwai Bay. Site 19653 (Figure 3) consists of two features. One of the features (Feature A) appears to be Soehren's (1963) Site 22-18, which he described as "a stone walled structure...built of jagged chunks of lava piled about three foot high." Feature B is a low, C-shaped wall just to the west of Feature A. All of the sites and features identified during the current work are described in detail in "Site and Feature Descriptions," at the end of this report.

Sites identified during this survey were assessed for significance based on the National Register Criteria for Evaluation, as outlined in the Code of Federal Regulations (CFR Title 36, Part 60). The Department of Land and Natural Resources - State Historic Preservation Division (DLNR-SHPD) uses these criteria for evaluating cultural resources. To be assessed as significant a site must possess integrity of location, design, setting, materials, workmanship, feeling, and association and must be characterized by one or more of the following four criteria:

(A) It must be associated with events that have made a significant contribution to the broad patterns of our history;

(B) It must be associated with the lives of persons significant in the past;

(C) It must embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value or represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) It must have yielded or may be likely to yield, information important in prehistory or history.

Sites were assessed for cultural significance using: (a) guidelines prepared by the National Park Service (National Register Bulletin 38: "Guidelines for Evaluating and Documenting Traditional Cultural Properties; Parker and King 1990), and (b) guidelines established by the State of Hawaii ("Draft Rules Governing Procedures for Historic Preservation Review" [DLNR Draft Rules 1989])(see Category E, Table 2). The Hawaii State guidelines utilize an additional fifth criteria (E) which defines significant cultural resources as ones that "have an important traditional cultural contribution or value to the native Hawaiian people or to other ethnic groups of the state" (DLNR Draft Rules 1989:A:10).

Most archaeological sites are initially evaluated as significant under Criterion D. After the evaluative process of an inventory survey, or the data recovery process of a mitigation program, the research potential of some sites may be exhausted (i.e., after extensive mapping, testing, surface collection, historical research, etc.). In these cases, the sites may maintain their information content *value* but lose their information content *significance*. Hence, the sites would be considered as "No Longer Significant" (NLS)(see Table 2).

In addition, in order to assist clients in determining the relative significance of sites, the two sites were also assessed for significance using PHRI Cultural Resource Management (CRM) value modes. See Table 1 for CRM assessments.

Table 1. SUMMARY OF IDENTIFIED SITES

Site and Feature Desig.	Formal Feature Type	Tentative Functional Interpretation	CRM Value Mode Assessment R	I	C	Field Work Tasks DR	SC	EX
19652	Complex	Multiple	H	H	M	x	x	x
A	C-shaped wall	Ancillary habitation						
B	Mound	Indeterminate						
C	Modified depression	Ancillary habitation						
D	C-shaped wall	Indeterminate/ceremonial						
E	Modified depression	Ancillary habitation						
19653	Complex	Multiple	M	M	H	x	-	x
A	Enclosure	Indeterminate						
B	C-shaped wall	Indeteminate						

 # Cultural Resource Management Value Mode Assessment—Nature:
R = scientific research
I = interpretive
C = cultural

—Degree:
H = high
M = moderate
L = low

† Recommended further data collection field work tasks:
DR = detailed recording (scaled drawings, photographs, and written descriptions)
SC = surface collections
EX = limited excavations

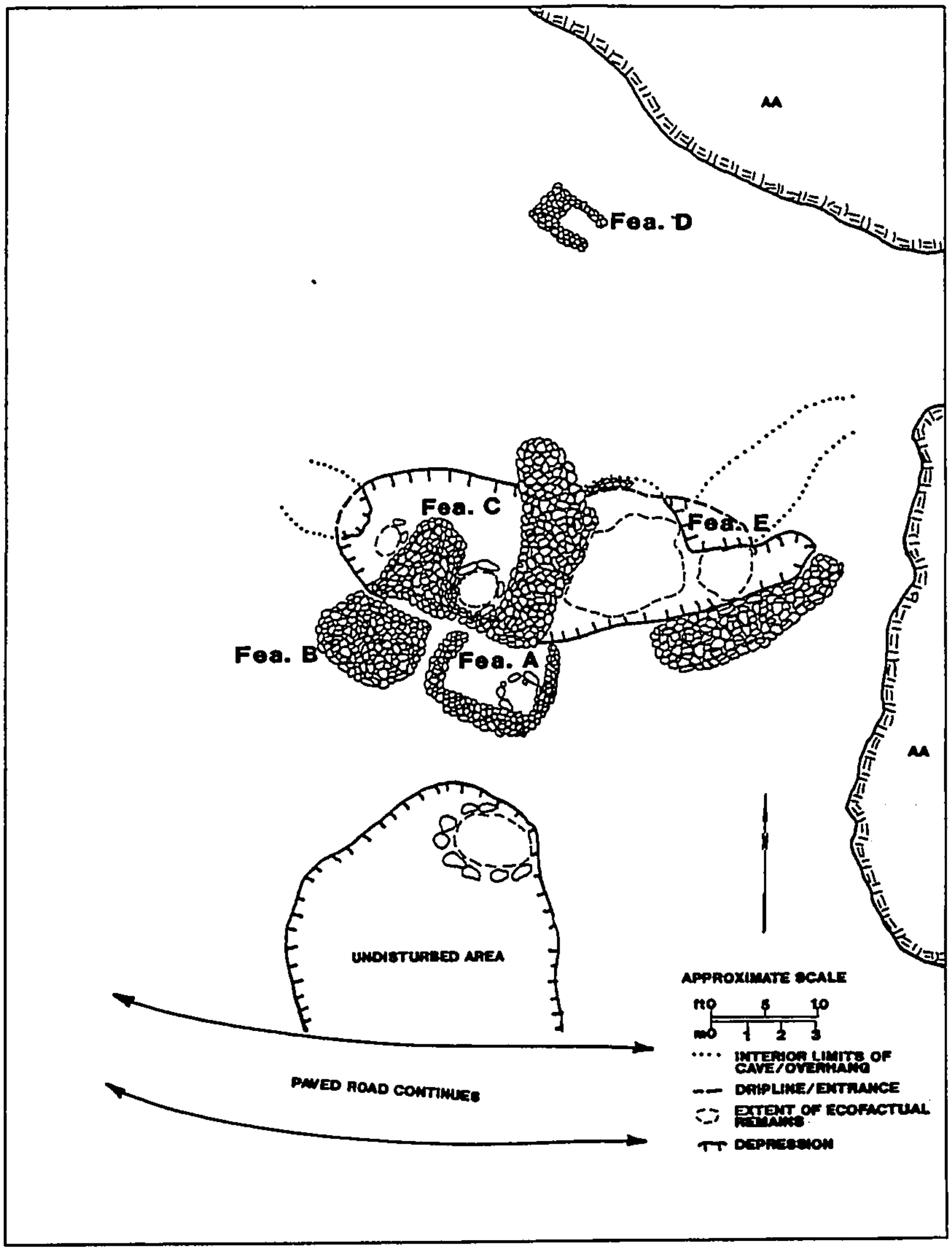

Figure 2. Plan View of Site 19652

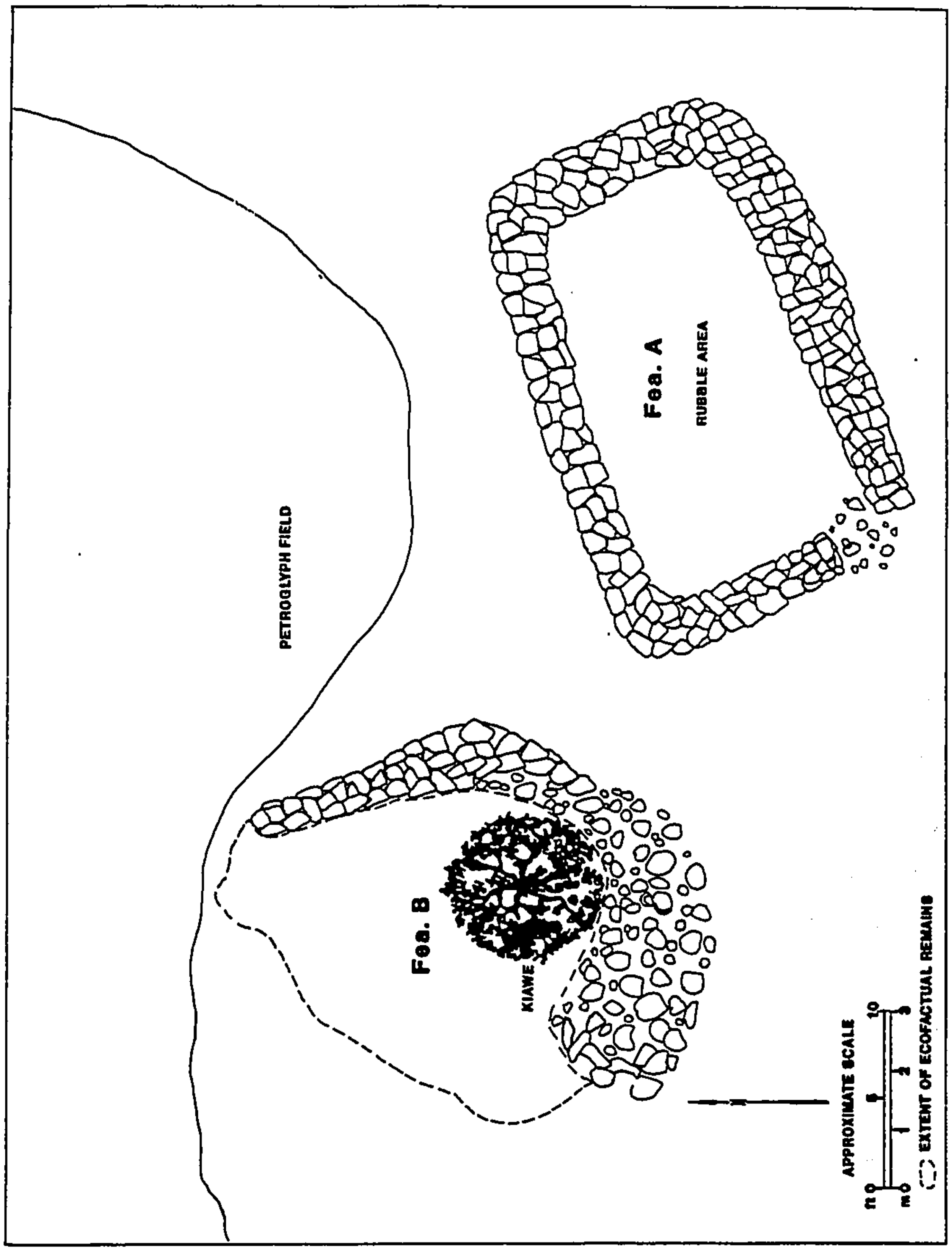

Figure 3. Plan View of Site 19653

Table 2. SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

*SIHP	Significance Category						Recommended Treatment			
Site Number	A	B	C	D	E	NLS	FDC	NFW	PID	PAI
19652	-	-	+	+	-	-	+	-	+	-
19653	-	-	+	+	-	-	+	-	+	-
Total:	0	0	2	2	0	0	2	0	2	0

* State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five- digit numbers prefixed by 50-10-19 (50=State of Hawaii; 10=Island of Hawaii; 19=USGS 7.5' series quad map ["Kiholo, Hawaii," 1982]).

General Significance Categories:
- A = Important for historical contribution to significant events and/or broad patterns of history;
- B = Important for association with the lives of important individuals in history;
- C = Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value)
- D = Important for information content, further data collection necessary (PHRI=research value)
- E = Culturally significant (PHRI=cultural value)
- NLS = No longer significant, significant data collected, important for information content only, no further data collection necessary (PHRI=research value, SHPD=no longer significant

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 no preservation potential
- PID = Preservation with some level of interpretive development recommended (including appropriate related data recovery work)
- PAI = Preservation "as is", with no further work (and possible inclusion into landscaping), or possibly minimal further data collection necessary

Based on the above federal and state criteria Sites 19652 and 19653 are assessed as significant for information content and as excellent examples of site types. Both sites are recommended for further data collection, to be followed by preservation with interpretive development. Should the further data collection effort at Site 19653 reveal the presence of human remains, the site will then be additionally assessed as significant for cultural value, and preservation "as is" with no interpretive development would be recommended. It is further recommended that these two sites be added to the Ka'ūpūlehu archaeological preserve (Head and Rosendahl 1993:102).

The evaluations and recommendations presented within this letter report are made solely on the basis of an inventory survey. It should be noted that there is always the possibility, however remote, that potentially significant, unidentified subsurface cultural remains and/or surface structural features will be encountered in the course of future archaeological investigations or subsequent development activities. In such situations, archaeological consultation should be sought immediately.

If you have any questions, please contact me at our Hilo office (808) 969-1763.

Sincerely yours,

Paul H. Rosendahl, Ph.D.
President and Principal
Archaeologist

JH:jh

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Site and Feature Descriptions

STATE NO.:19652 PHRI TNO.:1489-1
SITE TYPE:Complex (5+ Features)
TOPOGRAPHY:None
VEGETATION: *'Uhaloa*, sour bush, fountain grass
CONDITION:Good
INTEGRITY:Altered
PROBABLE AGE:Late prehistoric-historic
FUNCTIONAL INTERPRETATION:Ancillary habitation/Indeterminate/Indeterminate-ceremonial
DESCRIPTION: This site complex consists of two C-shaped walls (Feature A and D), two modified depressions (Features C and E), and one mound (Feature B). The overall site dimensions are c. 21.00 m (north-south) by 22.00 m (east-west).

FEATURE A:C-shaped wall
ADJACENT TERRAIN:Smoothly undulating pahoehoe with small collapsed areas exposing low tubes.
VEGETATION: *'Uhaloa*, sour bush, fountain grass
FUNCTION:Ancillary habitation
DIMENSIONS:3.80 m (north-south) by 4.60 m (east-west) by 1.00 m
CONDITION:Good
INTEGRITY:Unaltered
DESCRIPTION:The feature opens to c. 340 toward a large collapsed tube area where Feature C and Feature E are located. Feature A is constructed of both stacked and piled areas. The stacked areas include linear pahoehoe slabs (max-0.08 m by 0.40 m) up to seven courses high. This area of stacking is mostly on the east side; the north and south portions also consist of similar stacked areas. These are (especially on the north) piled areas with small boulders (0.40 m2) along the base, with smaller stones piled roughly on top. These roughly piled stones are present throughout the top of the structure. The structure is sitting on mostly smooth pahoehoe and a small circular alignment is present in the southeast interior corner. This alignment (one of several on the site) is full of broken ecofacts. Dimensions are roughly 1.00 m by 1.00 m and there is at least 0.15 m to 0.20 m of cultural deposits present. Walls are double-coursed with rubble core. All are at least 1.00 m thick. Surface remains consists of waterworn cobbles and many different shells including, *Cypraeidae, Thaididae, Conidae, Isognomon sp., Cellana sp.*, and others. Aforementioned deposits are in alignment area as well as scattered deposits in low spots throughout the structure interior. This feature is located 19 degrees to windsock; 206 degrees to stop sign from K.V. employees parking lot; 167 degrees to water tanks (*makai*).

FEATURE B:Mound
ADJACENT TERRAIN:Smoothly undulating pahoehoe with small collapses exposing low tubes.

VEGETATION:'*Uhaloa*, sour bush, fountain grass
FUNCTION:Indeterminate
DIMENSIONS:5.00 m (east-west) by 3.50 m by 1.00 m
CONDITION:Good
INTEGRITY:Altered
DESCRIPTION:This is a well preserved platform just to the west of Feature A and also along the eastern edge of the collapsed area. It is piled of stones ranging in size from small cobbles to small boulders with fairly steep sides and a mostly flat top. All sides are elevated as in a platform. Rough facing is present on the *mauka* (or south) side. The feature has been altered by a c. 1.00 by 1.00 m excavation of the surface on the west end. Surface remains consists of scattered ecofacts around the perimeter and surrounding area. Cultural deposits were not noted.

FEATURE C:Modified depression
ADJACENT TERRAIN:Smoothly undulating pahoehoe with small collapses exposing low tubes.
VEGETATION:'*Uhaloa*, sour bush, fountain grass
FUNCTION:Ancillary habitation
DIMENSIONS:
CONDITION:Good
INTEGRITY:Unaltered
DESCRIPTION:The "depression" is actually a collapsed lava tube which has been cleared and then two piled rubble walls have been built inside. Wall (on the west) ties in with the wall of the tube just below Feature B and then travels about 4.00 m at 340 degrees. The west side is roughly stacked four-six courses of pahoehoe slabs. It is also roughly faced. The east side is rougher and appears piled. To the west of the wall, about a meter away, is another circular alignment full of broken artifacts from processing. A small roofed portion of the tube extends to the west. It goes back at least 5.00 m to 7.00 m and is also full of ecofacts. Wall B is c. 4.50 to 5.00 m north of Wall A, but still within the depression. Wall B crosses the collapse from north to south (roughly) and divides the collapse into two sections. Feature C is on the west: Feature E is on the east. Between the two walls of Feature C is another alignment where processing has occurred. It is full of the usual ecofacts and a number of small waterworn basalts. Some facing of wall B is found just north of this processed area. Many other separate features can also be found within this depression.

FEATURE D:C-shaped wall
ADJACENT TERRAIN:Pahoehoe with broken a'a just to north.
VEGETATION:'*Uhaloa*, sour bush, fountain grass with addition of introduced flora near the parking lot to northwest.
FUNCTION:Indeterminate/ceremonial
DIMENSIONS:2.50 m (north-south) by 3.40 m (east-west) by 0.70 m
CONDITION:Good
INTEGRITY:Unaltered
DESCRIPTION:This small C-shaped wall is constructed of mostly a'a, although a few pieces of ropy pahoehoe were noted. The structure opens at c. 80 degrees toward *Pu'u Anahulu*. Construction consists of a basalt row a'a small and medium boulders stacked up to two courses high on the SW. All walls are roughly faced on the exterior. The walls are all at least two courses wide and the west (or back) wall is about 1.30 m wide. The north and south average 0.50 to 0.70 m. Feature is built on pahoehoe. Sparse waterworn stones and *Cypraeidae* remains were noted.

FEATURE E:Modified depression
ADJACENT TERRAIN:Smoothly undulating pahoehoe with small collapsed areas exposing low tubes.
VEGETATION:'*Uhaloa*, sour bush, fountain grass
FUNCTION:Ancillary habitation
DIMENSIONS:12.30 m by 9.00 m
CONDITION:Good
INTEGRITY:Unaltered

DESCRIPTION:As mentioned on the Feature C form, this is the northern portion of the depression beyond Wall B of Feature C. Modification here consists of a large cleared area on the west which appears to have been heavily used for ecofact processing. A small roughly piled or paved area is just north and another processing area is found near the lip of the depression. The thick ecofact material continues up out of the depression onto the pahoehoe above. There is also a small stacked and piled wall on the southeast side of the depression which may have functioned as a windbreak for individuals working in the depression. The tube appears to continue onto the north at least 15.00 m to 20.00 m. There are ecofacts present here as well. Volcanic glass, historic glass, waterworn basalts, and beach sand were noted.

STATE NO.:19653 PHRI TNO.:1489-2
SITE TYPE:Complex (2+)
TOPOGRAPHY:Slightly undulating pahoehoe. AD 1800 *Ka'upulehu* flow just to north: Kahuwai ponds to northwest.
VEGETATION:*Kiawe,'Uhaloa,'ilima*
CONDITION:Poor-good
INTEGRITY:Altered
PROBABLE AGE:Prehistoric
FUNCTIONAL INTERPRETATION:Indeterminate
DESCRIPTION: This site complex consists of an enclosure (Feature A) and one C-shape wall (Feature B). The overall site dimensions are c. 16.00 m (east/west) by 10.00 m (north-south).

FEATURE A:Enclosure
ADJACENT TERRAIN:Slightly undulating pahoehoe. AD 1800 *Ka'upulehu* flow just to north; Kahuwai ponds to northwest.
VEGETATION:*Kiawe,'Uhaloa,'ilima*
FUNCTION:Indeterminate
DIMENSIONS:7.00 m (east/west) by 5.50 m (north-south) by 1.20 m
CONDITION:Good
INTEGRITY:Altered
DESCRIPTION:This is a rectangular enclosure with sloping sides. It is constructed on pahoehoe using both stacked pahoehoe slabs (three to four rough courses,length ranging c. 0.15 m to 0.50 m) and piled pahoehoe pieces. There is currently no entrance, but an area on the southeast end may have once been open. That section may have been remodeled since there is no basal stones for a span of c. 1.00 to 1.20 m. The interior appears to be filled with rubble, but it didn't come from walls which still appear to be in good shape. Some of the interior walls are still nicely faced. Some coral and scattered ecofacts (*Cypraeidae, Thaididae*) were noted. Soehren (1963:28) suggests it may be a burial based on the presence of branch coral. This branch coral was not noted during this visit.

FEATURE B:C-shaped wall
ADJACENT TERRAIN:Slightly undulating pahoehoe. AD 1800 *Ka'upulehu* flow just to north; Kahuwai ponds to northwest.
VEGETATION:*Kiawe,'uhaloa,'ilima*
FUNCTION:Indeterminate
DIMENSIONS:9.00 m (north-south) by 9.00 m (east-west) by 0.60 m
CONDITION:Poor
INTEGRITY:Altered
DESCRIPTION:This is a very rough C-shaped wall that opens to c. 130 degrees. The north wall is in the best condition, it appears to be stacked and piled to approximately four courses high. As you move south, the wall becomes more indistinct, and about 5.00 m away, becomes more of a linear mound. It swings back to the northwest and just fades out. The interior has some broken shell (*Neritidae, Cypraeidae, Isognomon sp., Cellana sp.*) and beach sand. This may have been another processing station as at Site 19652

Appendix I

Market Study of the Proposed 1,120 Acre Kaupulehu Resort Expansion, North Kona, Hawaii

THE HALLSTROM GROUP INC.

REAL ESTATE
CONSULTANTS
& APPRAISERS

Market Study
of the
PROPOSED 1,120 ACRE KAUPULEHU RESORT EXPANSION
North Kona, Hawaii

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March 1, 1994

Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

**Market Study of the Proposed 1,120 Acre
Kaupulehu Resort Expansion,
North Kona, Hawaii**

Dear Ms. Mapes:

At your request on behalf of Kaupulehu Developments, we have completed a defined-scope market study and appropriateness evaluation of the proposed 1,120 acre* expansion of the under-construction Kaupulehu Resort, a mixed-use vacation and residential project located seven miles north of Keahole Airport, between Kahuwai Bay and Mano Point, in the North Kona District of the Big Island.

The envisioned subject development will contain an estimated 530 single family homes, 500 multifamily units, two championship golf courses and other amenities providing a quality lifestyle opportunity for local residents and second-home purchasers. The site offers excellent climatic traits, extensive ocean frontage, favorable view panoramas, and easy access to supporting services in the Kailua-Kona urban area.

The plan provides for 50 shoreline single family housing lots (a highly desirable but exceptionally limited inventory type), numerous near-water lots, and extensive golf course frontage for most buildable parcels in the project.

This expansion undertaking is viewed as a necessary contributor to the long-term vitality of the greater Kaupulehu Resort community, complementing the visitor-oriented Four Seasons complex now being built, and completing the basic master planning effort initiated in 1985 and associated with the "Kaupulehu Node" identified in the State of Hawaii Office of State Planning ***West Hawaii Regional Plan***, and designated for urban expansion in the General Plan for Hawaii County.

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* Of the total area, 65 acres are already within the Urban District and 45 acres will be placed in archeological preserves.

Although the recent economic downturn has dampened activity in the West Hawaii resort market relative to the peaks achieved in the late 1980s, the prospects for the area remain highly positive. And, the expressed intention of the developer to offer lower density, lower priced single and multifamily sites in the subject project than found elsewhere in the coastal corridor should enhance product absorption levels.

The purpose of our study was fundamentally four-fold:

1. To quantify the market demand for the various use-types planned for the subject lands (residential and golf course) in both regional and statewide sectors over the coming two decades given the anticipated market expansion in West Hawaii.

2. To identify the level of existing and proposed inventory supply which would be competitive with the subject offerings during the development and sales period.

3. To determine the appropriateness of the subject project from a market perspective in light of locational, physical and economic characteristics and alternatives.

4. To assess the probable competitiveness of the subject lots, units and courses relative to other regional inventory and estimate the likely speed of finished product absorption.

In completing this assignment, we have inspected the subject property, its environs and competitive developments; compiled historic and current market data from a variety of public and private sources; reviewed existing state and county regional plans and use guidelines; completed a media investigation of pertinent topics, and researched our extensive files regarding the study issues.

The results from our investigation and analysis are described in the attached narrative report covering the study parameters, methods and consequential conclusions. Eight chapters, describing our efforts and findings in further narrative and statistical detail, complete the document.

We note there are significant secondary, supporting or other additional data resulting from our investigation which were omitted from the presentation.

All conclusions presented herein are subject to the standard limiting conditions, assumptions, and certifications of The Hallstrom Group, Inc., in addition to any cited in the text. All work has been completed in conformance with the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute and the Uniform Standards of Professional Appraisal Practice.

<u>Perhaps the most critical assumption in our study</u> is the basic market perspective of the subject development relative to the existing Kaupulehu Resort lands. In 1987, some 623 acres of an 11,000 acre tract were re-classified to allow resort and related uses. The upscale Four Seasons Kaupulehu complex is currently under-construction on this holding which occupies the southerly portion of the Kaupulehu makai lands. The subject acreage will become the low density residential component of the resort community, connecting the under-construction project with an existing 65 acre urban parcel presently separated from the development area.

For the purpose of our analysis, we have viewed the subject as the reasonable expansion, or "rounding out", of the Kaupulehu Resort community, creating additional market attraction and a more diverse product base having only nominal overlap with the previously approved holdings.

The Four Seasons project will offer a highly upscale, hotel-focused ambiance specifically attracting wealthy non-resident guests and unit purchasers. Residential units by the Four Seasons Hotel and along the Jack Niklaus golf course will be similar in quality and character to existing resort units near luxury hotels at Kapalua, Mauna Lani, etc. These units will be comparable in price and character to those fronting world-class golf courses at Mauna Kea, Kapalua, Waikoloa, etc., and will appeal to the same market. They will contrast with the residential units in the lower density expansion area of Kaupulehu Resort. The subject project will be substantially less intense, of moderated exclusivity, and appealing to a wider purchaser group including local resident households. Average selling prices one-third to one-half below the Four Seasons Kaupulehu range are anticipated by the developer for the expansion area inventory.

In our estimates of subject inventory absorption we have given due consideration to the market and timing impacts arising from the potential contemporaneous offering of "Four Seasons" single and multifamily products. In this regard, the subject, while enjoying the benefits of being a part of a greater Kaupulehu community, is assumed to stand alone and be responsible for establishing its own market share among West Hawaii developments.

In general, based on our investigation and analysis of the proposed subject project, we conclude the master plan provides for an appropriate, economic and supportable use of a vacant lava site from a market and regional planning perspective. We estimate the 530 single family lots and 500 multifamily units would achieve market absorption within 18 years of offering. The golf courses and neighborhood commercial village also in the master plan are desirable amenities for the subject homes, enhance the appeal of the greater Kaupulehu Resort and the regional visitor community, and would reach stabilized operating capacity before the build-out of the residential component.

We appreciate the opportunity to be of assistance in regards to this prominent island holding. Please contact us if further detail or services are required.

Respectfully submitted,

THE HALLSTROM GROUP, INC.

James E. Hallstrom

James E. Hallstrom, Jr., MAI, SRA

JEH/as

Market Study

of the

PROPOSED 1,120 ACRE
KAUPULEHU RESORT EXPANSION

Located at

Kaupulehu Makai
North Kona, Hawaii

Prepared for

Kaupulehu Developments

March 1994

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STUDY CONCLUSIONS

Overview

Encompassing approximately 11,000 acres on the leeward flanks of Hualalai in the central portion of the West Hawaii coastal corridor, the greater Kaupulehu holding stretches from the shoreline to above the 2,000 foot elevation level. Some 2,829 acres of the site lie makai of Queen Kaahumanu Highway, having more than three miles of ocean frontage, of which about 1,745 acres are now being master planned for inclusion in the Kaupulehu Resort community.

The resort properties are well-located within a regional real estate market which has undergone dynamic expansion over the past 15 years, emerging as a focus of neighbor island development activity.

Since 1980, millions of dollars of real property investments have been made in the Kona and Kohala districts which comprise West Hawaii, with interest traversing the entire spectrum of use types--resort, residential, commercial, industrial, recreational and open space/park. State and county agencies have devoted considerable supportive resources to the effort through production of numerous long-range land use plans during the latter half of the last decade.

Although the market is currently at the nadir of a cyclic pattern, extended forecasts still predict tourism and population growth to more than double the economic base in the study area over the next 20 years. By the mid-21st century the region is anticipated to be the largest non-Oahu urban enclave in the state.

The Kaupulehu Resort property enjoys excellent climatic, locational, access and developability characteristics which would complement a variety of use types. It is well-sited for serving the projected increasing demand for makai-oriented resort, residential, recreational and support uses in West Hawaii.

Study Parameters and Methodology

The purpose of our study is to assess the probable marketability of the envisioned subject inventory within a comprehensive regional context in light of prevailing economic trends and competitive developments in the effective sectors. Our study program was essentially a three-phased investigation and analysis process.

First, quantification of demand. We completed an economic overview of the study region, focusing on public and private land use plans and goals. By coupling population, tourism and business growth forecasts with historic market trends, the level of demand for further development can be estimated.

On an elemental basis, there are two demographic groups which create demand in the West Hawaii real estate market, *local resident* and *non-resident* (vacation/investor) consumers and purchasers. The depth of each group was assessed in our analysis.

Secondly, quantification of supply. We identified the existing, approved and proposed inventory in the study region and statewide which would be competitive with the subject single family lots, multifamily units, neighborhood commercial center, and golf course facilities. The qualities and planning/construction history of each project was investigated, and the probability and extent of future development appraised.

There are four existing, two under-construction, and four undeveloped/approved resort communities in the West Hawaii coastal corridor which would offer the primary competitive inventory for the subject. Secondary competition would come from West Maui destination developments.

Thirdly, appropriateness of the subject project. Based on the comparison of demand and supply indicators, the level of market need for the subject can be quantified. However, success of a project is not dependent upon just numerical insights; the quality of a project and its ability to service specific market niches are equally relevant.

By offering low density, more moderately priced purchase opportunities, the subject will be affordable to a wider range of potential purchasers. Further, it will appeal to a segment of the local resident market which, though drawn to the near-water, amenitied benefits of a resort-type project, currently eschews higher intensity, hotel dominated destination developments.

Further, the plan provides for some 50 on or very near shoreline single family homesites, a much sought after but highly scarce commodity in major resort projects statewide. Additionally, most building sites will have extensive golf course frontage.

Presentation Format

The pertinent results of our study are presented in the following "Study Conclusions" paragraph. Supporting tabular and narrative discussion is contained in the topical sections comprising the body of the document.

The main presentation opens with a brief analysis of the status of the statewide real estate market since the onset of instability and recession beginning in 1990. The market data prior to this time is dominated by an unprecedented seven-plus years of expansion in activity. Circa decade long "growth, hyper-activity, slump" cycles have been the historic standards of the Hawaii economy and must be considered in the analytical and forecasting process to avoid undue favorable or pessimistic myopia in the projection process.

The discussion and analysis are intended to move from general market indicators to specific subject insights and conclusions, each step building on the foundation laid by the former.

Although Kaupulehu Resort is showing far greater progress than most of the other destination communities proposed/approved during the late 1980s, we understand it will not be developed in a void of competition. In this respect, we believe our analysis and opinions to be relatively conservative as they allow for each project (including the subject) to carve out a reasonable market share from total demand.

In reality, several of the West Hawaii resorts will likely be delayed, developed with far fewer units than originally intended, or prove to be nominally competitive. Any of these situations will result in lesser alternative supply and therefore increased demand for the subject inventory.

Study Conclusions

Based on our investigation and analysis of the subject property, its environs, and competitive real property market sectors, we have reached the following conclusions regarding the proposed 1,120 acre

Kaupulehu Resort expansion holding and its competitive market standing:

The General Sector

The subject lands are well-located in a regional market anticipated to increase in size several-fold over the coming decades as a result of tourism, economic and population expansion attracted by desirable climate, quality lifestyle, malleable land base and significant business opportunities.

During the 1980s, West Hawaii was the focus of a bulk land investment, development and planning surge unprecedented in the State of Hawaii.

As the regional and worldwide economies recovered from the recession of 1980-82, the Kona and Kohala districts of the Big Island, typified by vast raw lava and bunch grass holdings, truly became the "gold coast" long envisioned by public and private planners.

Tens of thousands of acres were transacted at rapidly appreciating prices, the subject of master planning, entitlement and/or active development efforts between 1984 and 1991. Although founded on a quality climate and solid transportation systems (as well as a scarcity of quality lands elsewhere in the neighbor islands), the surge was primarily a coalescence of external factors, notably the explosion of Pacific tourism and the Japanese economy.

Virtually every major landholding in the region was the topic of some activity across the use-type spectrum. The resort, residential, recreational, commercial, and industrial sectors all increased in size dramatically during the period, laying the groundwork for development in West Hawaii until the mid-21st century.

Since the onset of global recession in late 1990, the market has slumped significantly, although recovery is anticipated to be underway by mid-decade. Few analysts anticipate the hyper-appreciation and wide-ranging opportunities associated with the "feeding frenzy" of the last decade to be repeated in West Hawaii in the short term, but the mid- to long-term prospects for the region remain fundamentally strong.

The Primary Economic Sector

The 28 mile coastal corridor extending from Kailua-Kona to Kawaihae, stretching from the shoreline inland to about the 3,000 foot elevation, was the crux of investor and planning attention. Prior to 1980, the area had only two hotels (housing 410 total rooms), a single destination resort, fewer than 5,000 residents, and minimal long-range residential expansion plans outside of the Waikoloa Village lands.

By year-end 1993, six hotels with 3,122 rooms were in operation (with two under construction), six resort projects were in development or approved, the resident population had doubled, and major mixed-use communities were proposed at Keahuolu, Kealakehe, Kaloko, Kau, Puako, Kawaihae, and elsewhere.

More than 30,000 resort units (hotels, condominium, and resort/residential) were proposed from the mid-1970s through 1990, of which about two-thirds have been approved. Some 25,000 residential units were proposed during the period; most of which have received approvals. More than 20 golf courses were developed or announced, and upwards of 400 acres were master planned for commercial and industrial development.

Further, the escalation in the real estate market created demand vectors previously unseen on the leeward side of the Big Island. Gentlemen/equestrian estates, gated subdivisions, modern shopping centers, technology parks, and extensive golf course construction bore evidence of an evolutionary movement in the greater West Hawaii economy and resulting lifestyles; away from its agrarian past towards a tourism/service based future.

Regional Land Use Plans

In response to the emerging development pressures, governmental planning agencies expended considerable effort in attempting to formulate workable plans setting forth development guidelines and implementation strategies.

The Office of State Planning ***West Hawaii Regional Plan*** (1989) was the definitive document, calling for the establishment of four resort destination "nodes" along the Kona/Kohala coastline (one of which was centered on Kaupulehu) containing up to 28,233 visitor-oriented units, and a series of support and general residential communities encompassing up to 15,000 housing units. The Plan affirmed the then-considered highly aggressive Hawaii County ***General Plan*** (drafted in 1986, adopted in 1989), which forecast a three-fold increase in the area's economy as a result of tourism and population growth over the ensuing two decades. The General Plan designates Kaupulehu Resort lands as an intermediate resort and urban expansion area.

Judging the lands just north of Kailua-Kona to be the central resident serving expansion area, the county completed the ***Keahole to Kailua Development Plan*** in 1989, covering 17,000 acres between the village and the airport. According to the program, by 2010 there would be a resident population of 16,800 persons, a 200 acre regional civic and commercial center, 200 acres of industrial development, 575 acres of parks and recreational facilities, and 280 acres of educational institutions in this area eight miles south of the subject.

A 1991 study undertaken for the state Land Use Commission as part of a periodic **District Boundary Review**, cited the need for 3,658 (net) acres of additional residential development in West Hawaii by the year 2010 beyond those developed and approved at that time, up to 334 more acres for commercial uses, 239 acres of new industrial lots, and 968 acres of resort lands.

This visionary stance of state and county agencies was unparalleled for the neighbor islands, matched only by the Ewa/Kapolei regional planning efforts on urbanized Oahu. Community and landowner support was strong for the most part, and investment capital flowed into West Hawaii based on the land use base being created.

The West Hawaii Housing Market

Although the construction surge of the last decade coupled with the recession of recent years has served to lessen the historically chronic and severe undersupply of housing units available for West Hawaii residents, mid to long-term forecasts still project the need for an exceptional number of new units to be constructed over the next two decades if the anticipated demand created by a growing local residential market is to be reasonably met.

In order to achieve stability in the sector, a wide spectrum of inventory types must be made available, ranging from affordable rental units to upscale estate opportunities. This diversity is necessary for the housing base to efficiently reflect and service the evolving West Hawaii economic and population structure. Should the market fail to service one or more of the pronounced regional demand segments, the dysfunctions seen in the past will rise again; specifically a shortage of units, an erratic pricing structure, and the domination of the local housing market by non-resident purchasers.

Using standard housing unit demand formulae, we have estimated West Hawaii will require an additional 25,214 to 31,231 new housing units by the year 2015 if a healthy market status is to be achieved with sufficient allowances made for vacancies, aging/dilapidated units and the unavoidable incursion of non-resident purchasers into the general marketplace. These forecasts are extrapolations consistent with published state and county projections made to years 2005 and 2010. Of the demand, approximately 54 percent will fall into a bracket having a current price of less than $250,000, with the remainder being focused towards "market" priced units.

At present, there are some 25,700 total units under-construction or approved in West Hawaii, with up to 3,000 others being considered in long-range plans. These units will provide a broad range model and pricing types, with a significant number oriented towards the moderate to lower end of the price spectrum.

However, it is highly unlike that all of these homes will be built in a timely manner. Many of the major developments (Waikoloa Village, Puako Residential Golf Community, Parker 2020 and others), will have development time-frames which extend far beyond the projection period. Others are experiencing severe financial difficulties and the likelihood of their actualization is minimal. Further, many of the approved "residential" units are actually in resorts (notably Waikoloa Beach, Mauna Lani and Mauna Kea Beach) not significantly oriented towards local resident purchase, and the final densities achieved in most developments will undoubtedly be less than the total approved.

It is our opinion that fewer than 80 percent of the total number of housing units approved for West Hawaii, or less than 21,000, have a reasonable chance of being constructed during the next 22 years. This will be insufficient, by 4,000 to more than 10,000 units to fully service the regional market needs over the study period.

By offering a low-intensity, moderately priced, near shoreline, amenitied setting, we believe the subject development will prove desirable to a pronounced segment of regional households to a far greater degrees (by design and default) than other West Hawaii oceanfront communities.

The Statewide Resort/Residential Homesite Sector

The resort/residential homesite sector was among the fastest growing of any use-type in Hawaii over the past decade, with inventory expanding nearly three-fold since the mid-1980s. A variety of factors, notably the 1986 Income Tax Reform Act, contributed to the golf course subdivision movement which soon became a focal point of destination community construction throughout the state.

At present there are some 1,859 subdivided lots in the eight existing major neighbor island resort projects and golf course developments, of which more than 95 percent have been successfully marketed. Current prices range from a low of $120,000 for an interior lot at Princeville to a maximum of $4 million-plus along the shoreline at Mauna Lani. Most parcels are priced from $275,000 to $500,000.

At the peak of the market in 1988-90, sales activity among all the properties totaled circa 400 original and resale transactions annually; however, over the past 15 recessionary months sales have slumped by more than 70 percent.

With the exception of selected lots being discounted for sale by owners under duress, prices have not shown significant abatement from the strong years, although selling prices as a ratio of list price have dropped nominally, and some programs offering lots for original sale are readily discounting prices by three to five percent.

We anticipate it will take several more years (or until mid-decade) for this market segment to begin notable recovery, increasing strongly thereafter until stabilization of demand is reached shortly after the turn of the century. Our projections call for cumulative demand for 6,700 additional new resort/residential lots throughout the outer islands by the year 2015. Of this demand, we forecast some 55 percent, or circa 3,700 lots, would be oriented towards West Hawaii.

Currently, there are some 10,073 total new competitive lots being proposed at neighbor island locales, or more than double the number needed to satisfy demand levels. But, many of these are in unproven locations (Molokai and Lanai), are in projects currently experiencing severe financial difficulties or not yet under-construction (Kohanaiki, Kukio Beach, and others), or within developments anticipated to extend well beyond the projection time frame (Mauna Lani, Mauna Kea Beach, Princeville).

About 46 percent of the proposed inventory, or 4,617 homesites, is planned for leeward Hawaii at the present time. However, we believe it is highly unlikely that more than 50 percent (or about 2,700 units) will be manifest during the study time frame. Mauna Kea Beach is notably conservative in its development speed, and along with Mauna Lani has consistently sought much lower densities than permitted. Further, several of the projects will lack oceanfront, amenities and comprehensive support services, decreasing their competitive appeal.

Many developments are additionally having difficulty "breaking ground" and moving towards inventory offering.

We therefore conclude, that despite the recent downturn in the sector, the mid- to long-term prospects for the subject property under its proposed development plan remain favorable, as the actual competitive inventory likely to be built in the highly desirable West Hawaii vacation area over the next two decades will be limited despite the gross level of regional inventory proposed, and it is unlikely sufficient lots will be developed to service all demand sectors, particularly for moderately priced lots (with current average non-oceanfront prices of circa $325,000). The subject lots will allow the expanded Kaupulehu Resort Community to offer a comprehensive diversity of single family residential product.

The Statewide Resort/Residential Condominium Market

Following meteoric growth in the mid- to late-1970s, the resort condominium sector underwent fundamental change during the past decade, with major evolutions in design and marketing thrust. Yet, with the exception of a brief high activity period at the peak of the recent boom market, development interest, construction levels and price appreciation (although strong) never sufficiently recovered to move this sector back into the dominating position it once held in the industry; a status lost to the resort homesite sector.

The evolution in condominium design was predicated by a scarcity of quality beachfront sites (which historically were the most favored locations), major changes in the tax code, the focusing of investor/speculator capital into other resort products, and the stabilization of the condominium versus hotel transient rental populations.

Today's Hawaii resort condominium is typically on the interior of the destination community, fronting a golf course, in low-rise, low density buildings, with larger units and a distinct "residential feel". The more spacious, better appointed, higher amenitied townhomes, generally came with prices previously reserved for on-water projects.

At present there are some 6,387 finished condominium units in the eight major neighbor island resorts, of which 93 percent have been absorbed to date. Only about 65 percent of those developed over the last five years have been successfully closed (Waikoloa Beach having the largest segment of unsold inventory).

Over the last four years, prices for units ranged from a low of $120,000 for an older, studio unit at Keauhou to $2,000,000-plus for a circa 3,000 square foot residence at Mauna Kea or Wailea. Most newer units range in size from 1,300 to 2,000 square feet and achieve prices from $275,000 to $600,000.

In the late 1970s, sales of resort multifamily units (original and resales) averaged more than 1,400 units per year. During the early to mid-1980's transactions declined by about 80 percent, until regaining momentum by late decade to reach an average of some 506 unit sales annually since 1987.

Over the past 15 months, activity has once again slowed, and sales have occurred at the cumulative rate of circa 125 units per year. The number of units being sold on a duress basis appears to be greater than in the homesite sector, and commensurately there have been greater price fluctuations for resales, and asking prices for original (new) units have softened considerably during the last 30 months.

We forecast the total demand for resort condominium units will reach 8,900 units over the next 22 years, the vast majority (74 percent) occurring after the turn of the century. While this demand figure is higher on a gross basis than the forecast demand for homesites, the condominium demand figure represents just more than a doubling of the existing inventory, while the lot demand projections is more than a tripling of the in-place inventory.

Of the total condominium unit demand to 2015, we project about 4,500 units worth will be directed towards West Hawaii; or some 50 percent of the total.

There are up to 15,647 total additional competitive neighbor island resort units proposed/approved, of which upwards of 8,000 to 10,000 are envisioned for construction during the period 1994 to 2010. As with resort homesites, it would appear the gross level of supply will outpace demand quotients. Again, however, it is doubtful if all of the projects will be built or built to approved density limits, or be competitive in the market.

We conclude, if actualized as low density units, the subject inventory will prove successful in the regional market, particularly as the amount of alternative supply in the area which will actually

be available to meet this price-sensitive demand is questionable at this time.

The West Hawaii Golf Course Market

Golf course facilities are considered a vital amenity for destination resort and master-planned community development, offering recreational opportunities and desirable frontage attributes.

Historically, courses were considered as a necessary "loss leader", a concept which changed with the meteoric rise in market demand during the later years of the 1980s. With the economic downturn, the market has essentially reverted to original form.

At present there are 11 operating golf courses in West Hawaii, or a slight to moderate oversupply relative to quantified demand levels which place current market requirements at about 9.5 courses. This conclusion is supported by the operational experience of the existing facilities. An additional 23 courses are proposed and have some level of approval, most as part of destination resort or master-planned developments.

We anticipate the oversupply condition will continue in the short to mid-term, until the visitor market recovers and resort and residential unit construction resumes a more vibrant pace. As the region becomes a more "modern" community, with expanding retiree and white-collar sectors, demand by residents will increase substantially, and the need for additional courses will be created.

From a tourism perspective, more courses mean an enhanced standing in the marketplace, particularly among Japanese/Asian visitors who seek a disproportionately high number of golfing opportunities, and course experiences. Given the vast expanses of raw land, scarcity of quality sandy beaches, and minimalist support communities, golf will be a vital contributor to the visitor plant amenity base.

Our analysis indicates that a total of 37 courses will be required by the year 2015, or three more than the current level of existing, under-construction and proposed/approved supply. As with the residential projects, it is highly unlikely all of these courses will be built as planned in the foreseeable future, particularly the seven proposed Nansay courses, which represent 30 percent of the total number proposed, and the Queen's Resort course which has recently undergone ownership change and is indefinitely on hold.

Analysis of Neighborhood Commercial Demand

The subject master plan contains approximately 11 acres (gross) of commercial lands well located at the central hub of the community along the neighborhood's major entryway. The site could support upwards of 120,000 square feet of finished floor space based, if developed at typical construction standards, using conservative Floor Area Ratios.

However, in keeping with the low-density nature of the Kaupulehu Expansion area master plan, the developer proposes a significantly smaller center having some 45,000 square feet of floor space within a high amenitied, easily accessed shopping village.

The designated commercial parcel, which enjoys favorable access and exposure characteristics would be used for development of a neighborhood retail/service center meeting the daily household shopping needs of all Kaupulehu Resort residents (primary and second-home owners), and guests, and tourists visiting the Four Seasons complex. Being oriented towards both resident and visitors, the center would include retail outlets (grocery store, drug store, gas station, sundry shops), assorted services (realty, travel agent, financial), and a selection of fast food and higher quality dining facilities.

Additional consumer demand at the subject shopping village would be provided by golfers at Kaupulehu courses and guests/users/residents of the other regional resort developments and future expansions of the greater coastal corridor community. Tertiary demand groups would include Queen Kaahumanu Highway passersby and workers or others employed at or using Kaupulehu community facilities.

As the main shopping area in the entire Kaupulehu master plan, it is critical to the overall project, and would serve as a focal point for subject activity and provide an excellent entry ("street appeal") aspect to the project. The Princeville Shopping Center and Keauhou Shopping Center are examples of the mixed resort and residential uses envisioned by the developers.

Demand for this subject component can best be quantified as a function of per capita spatial levels associated with the resident population of the effective neighborhood being serviced (Kaupulehu Resort) and for secondary center patrons.

Based on this method, which provides for resident shopping/service needs outside of neighborhood businesses and the capture of only a portion of on-site visitor expenditures, we estimate use by the greater Kaupulehu populace, community workers/visitors, by-pass travelers and regional residents would create demand for 45,000-plus square feet over the coming two decades. This is more than adequate to fill the effective gross leaseable center space proposed.

A two-phased center development plan would appear most reasonable, with an initial increment of 25,000 square feet by the fifth or sixth year of subject inventory sale, which is a balance between the desire to have the amenity immediately available for servicing the first residential offerings and the need to have an established nucleus of consumers in order to support tenants. The second phase of 20,000-plus square feet (in accordance with community needs) would follow about eight years later.

Analysis of the Subject Site and Project

The Kaupulehu Resort expansion lands are well-located in the central portion of the Kailua-Kona to Kawaihae coastal corridor, the focal point of West Hawaii development and investment activity, and in a solid position to capitalize on both resort and residential demand segments.

The holding enjoys an extensive ocean frontage, excellent access to the region's main arterial, favorable view panoramas, and is relatively close to the Keahole Airport, Kawaihae Harbor and urban Kailua-Kona. Its climate is highly desirable for resort and low-intensity residential-type uses, being warm, arid, and generally protected from the strong winds which plague holdings further north along the coast.

The ocean frontage is varied and contains both rock and sandy stretches, and the resort encompasses Kahuwai Bay, one of Kona's finer beach strands. The holding is within the designated Kaupulehu Resort Node (***West Hawaii Regional Plan***) and Urban Expansion area (Hawaii County General Plan) and is adjacent to a long-established destination use (Kona Village Resort).

With the ongoing construction of the 250-unit Four Seasons Kaupulehu Hotel and associated amenities, the subject is within a vital, developing destination area which will enhance its competitive qualities relative to other "new" projects along the coastline. The commitment of the Kaupulehu development team to complete significant golf course construction adjacent to the subject lands will provide a meaningful amenity foundation for the expansion area.

Importantly, the subject lands will provide many oceanfront and near-shoreline single family housing opportunities, a market segment which is both in exceptionally high demand and quite scarce; particularly in West Hawaii. We anticipate these premier homesites would be very well received and serve as a focal point for the marketing of the community.

The ability and willingness of the developer to undertake subject subdivision in the near- to mid-term and offer single and multifamily product at prices below that of competitive inventory in the region will also contribute to the success of the proposed expansion plan.

Our analysis indicates, from a market perspective, that the incorporation of the subject lands into the greater Kaupulehu Resort master plan is a supportable and efficient concept which will both enhance and benefit from the existing approved resort development effort. The subject adds needed diversity, supporting retail opportunities and a more comprehensive recreational environment to the Kaupulehu community, without being directly competitive with the exclusive and resort-oriented units in the Four Seasons phase.

Despite the apparent gross quantity of inventory proposed in West Hawaii, the actual level of competitive development likely to be constructed is much more limited. And, with the subject pursuing lower intensities and a moderated pricing structure, it will appeal to a much broader demographic market.

Subject Absorption Estimates

We conclude the subject will be able to obtain a reasonable, though minor, market share from both the statewide resort/residential and regional residential sectors, which will enable it to achieve full absorption within 18 years of offering. The project will need to receive only 15 percent of the regional resort/residential unit demand total, or less than four percent of the local residential demand quotient to reach these goals; levels which we consider both conservative and readily reachable.

The subject golf courses would be anticipated to reach full playing capacity within five to eight years of completion.

The neighborhood commercial village (likely built in two phases) would also reach stabilized capacity by the time the residential component is fully absorbed.

Table 1 summarizes our absorption (or demand) conclusions for the various subject master plan components.

TABLE 1

CONCLUDED ESTIMATED SUBJECT UNIT ABSORPTION
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Sales Year	Number of Multifamily Units Sold (1)			Number of Single Family Lots Sold (1)				Other Components
	Resident	Resort	Total	Resident	Resort	Oceanfront	Total	
1	6	9	15	5	5	6	16	(2)
2	7	12	19	7	8	8	23	
3	7	15	22	7	15	10	32	(3)
4	7	20	27	7	20	10	37	
5	7	23	30	7	22	10	39	
6	7	23	30	7	22	6	35	
7	7	23	30	7	22		29	(4)
8	7	23	30	7	22		29	
9	7	23	30	7	22		29	
10	7	23	30	7	22		29	
11	7	23	30	7	22		29	
12	7	23	30	7	22		29	
13	7	23	30	7	22		29	
14	7	23	30	7	22		29	
15	7	23	30	7	22		29	(5)
16	7	23	30	7	22		29	
17	7	23	30	7	22		29	
18	7	20	27	7	22		29	
Totals	125	375	500	124	356	50	530	

(1) Purchasers are shown divided between "resident", or buyers from the West Hawaii area and elsewhere on the island who would consider the unit their full-time or primary family home; and "resort", or buyers/investors who select the subject from among statewide resort/residential alternatives and who would consider their unit as a second/vacation home, rental unit or long-term investment.
(2) First golf course and clubhouse open.
(3) Second course opens.
(4) Initial phase of shopping village opens.
(5) Final phase of shopping village opens

Source: The Hallstrom Group, Inc.

ASSUMPTIONS, LIMITING CONDITIONS, AND CERTIFICATION

The research, analysis, and conclusions for valuation or market studies, performed by The Hallstrom Group, Inc., are subject to and influenced by the following:

- The report expresses the opinion of the signers as of the date stated in the letter of transmittal, and in no way has been contingent upon the reporting of specified values or findings. It is based upon the then present condition of the national and local economy and the then purchasing power of the dollar.

- Legal descriptions used within the report are taken from official documents recorded with the State of Hawaii, Bureau of Conveyances, or have been furnished by the client, and are assumed to be correct. No survey is made for purposes of the report.

- Any sketches, maps, plot plans, and photographs included in the report are intended only to show spatial relationships and/or assist the reader in visualizing the property. They are not measured surveys or maps and we are not responsible for their accuracy or interpretive quality.

- It is assumed that the subject property is free and clear of any and all encumbrances other than those referred to herein, and no responsibility is assumed for matters of a legal nature. The report is not to be construed as rendering any opinion of title, which is assumed to be good and marketable. No title information or data regarding easements which might adversely affect the use, access, or development of the property, other than that referenced in the report, was found or provided. The property is analyzed as though under responsible ownership and competent management.

- Any architectural plans and/or specifications examined assume completion of the improvements in general conformance with those documents in a timely and workmanlike manner.

- Preparation for, attendance, or testimony at any court or administrative hearing in connection with this report shall not be required unless prior arrangements have been made therefor.

- If the report contains an allocation of value between land and improvements, such allocation applies only under the existing program of utilization. The separate valuations for land and building must not be used in conjunction with any other purpose and are invalid if so used.

- If the report contains a valuation relating to a geographical portion or tract of real estate, the value reported for such geographical portion relates to such portion only and should not be construed as applying with equal validity to other portions of the larger parcel or tract; and the value reported for such geographical portion plus the value of all other geographical portions may or may not equal the value of the entire parcel or tract considered as an entity.

- If the report contains a valuation relating to an estate in land that is less than the whole fee simple estate, the value reported for such estate relates to a fractional interest only in the real estate involved, and the value of this fractional interest plus the value of all other fractional interest may or may not equal to the value of the entire fee simple estate considered as a whole.

- It is assumed that there are no hidden or inapparent conditions of the property, subsoil, or structures which would render it more or less valuable; we assume no responsibility for such conditions or for engineering which might be required to discover such factors.

- Nothing in the report should be deemed a certification or guaranty as to the structural and/or mechanical (electrical, heating, air-conditioning, and plumbing) soundness of the building(s) and associated mechanical systems, unless otherwise noted.

- Information, estimates, and opinions provided by third parties and contained in this report were obtained from sources considered reliable and believed to be true and correct. However, no responsibility is assumed for possible misinformation.

- Possession of the report, or a copy thereof, does not carry with it the right of publication, and the report may not be used by any person or organization except the client without the previous written consent of the appraiser, and then only in its entirety. If the client releases or disseminates the reports to others without the consent of the appraiser, the client hereby agrees to hold the appraiser harmless, and to indemnify the analysts from any liability, damages, or losses which the analysts might suffer, for any reason whatsoever, by reason of dissemination of the report by the client. Further, if legal action is brought against the analyst by a party other than the client concerning the report or the opinions stated therein, the client agrees, in addition to indemnifying the analysts for any damages or losses, to defend said analysts in said action at client's expense. However, nothing herein shall prohibit the client or analysts from disclosing said report or opinions contained therein as may be required by applicable law.

- Disclosure of the contents of this report is governed by the By-Laws and Regulations of the Appraisal Institute. Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the appraisers or the firm which they are connected, or any reference to the Appraisal Institute or to the MAI designation) shall be disseminated to the public through advertising media, public relations media, news media, sales media, or any public means of communication without the prior consent and approval of the appraisers.

- Unless otherwise stated in this report, the existence of hazardous material, which may or may not be present on the property, was not observed by the appraiser. The appraiser has no knowledge of the existence of such materials on or in the property. The appraiser, however, is not qualified to detect such substances. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value. No responsibility is assumed for any such conditions, or for any expertise or engineering knowledge required to discover them. The client is urged to retain an expert in this field, if desired.

- The Americans with Disabilities Act (ADA) became effective January 26, 1992. We have not made a specific compliance survey and analysis of this property to determine whether or not it is in conformity with the various detailed requirements of the ADA. It is possible that a compliance survey of the property together with a detailed analysis of the requirements of the ADA could reveal that the property is not in compliance with one or more of the requirements of the act. If so, this fact could have a negative effect upon the value of the property. Since we have no direct evidence relating to this issue, we did not consider possible noncompliance with the requirements of ADA in estimating the value of the property.

THE HAWAII REAL ESTATE MARKET 1990 TO 1993

Introduction

By late 1990, the Hawaii real estate market was beginning to show the first slowing movements following some seven consecutive years of robust growth. Through the first two quarters of 1990, the market continued to gain ground, with high activity levels and appreciating prices; however, by late summer ripples appeared in the economy which initiated a moderating trend.

By early 1991, a variety of negative political, market and financial issues began cascading through the worldwide economic structure. While the massive capital infusion of the late decade buoyed Hawaii businesses for most of the year, the islands' economy was clearly in recession by 1992.

Demand fell marginally to dramatically in all real property sectors statewide. Prices soon stabilized in the key residential and industrial base markets, but displayed volatility in the highly charged resort and speculative commercial investment sectors.

Just as the onset of Hawaii's recession matched historic cycles in following the mainland downturn by 12 to 18 months, it is anticipated it will return to a growth trend within two years of general U.S. recovery. The 1993 economic figures and corporate operating announcements point to such rebound beginning during 1994.

Gross State Product (GSP) figures support this insight. Hawaii was one of only two states to show expansion in 1991 as the depth of the mainland recession was experienced. In 1992, as other areas began recovery, Hawaii was the only state to show a declining GSP. 1994 forecasts call for economic growth of two to five percent statewide for the year increasing in strength thereafter.

However, the vitality of local real estate is dependent upon more than just a healthy general economy, with many contributing variables which must be considered in developing an appropriate market perspective. Availability of investment capital, demand for finished product, consumer and tourist spending, and levels of governmental support all are critical in assessing the future paths probable for Hawaii real estate.

In the following paragraphs, the factors contributing to the recent downturn in the statewide market are briefly identified, selected data illustrating the cycle are presented, recovery levels are projected, and implications these movements may have on our assignment are addressed.

The End of the Boom (Late 1990 to Late 1991)

The negative impacts from the Persian Gulf Crisis, the collapsing of the Japanese economy, indications of unexpectedly high East European reconstruction costs, and an apathetic domestic business agenda converged in Summer 1990. The world economy, overheated from eight years of exceptional growth, slipped quickly into a recessionary cycle.

Declining consumer and real estate demand, tightening of credit, instability in financial markets, increasing business insolvencies and unemployment levels typified most regions. According to virtually all indicators, the mainland U.S. economy contracted in 1991, significantly affecting real estate sales activity, pricing, construction and investment/development interest in most locales.

While the decline in Japanese tourists (due to the Gulf War and sudden *drop in new investment capital sources) provided glimpses into* potential near-term difficulties for the Hawaii economy, the state showed strong growth well into 1991, with the GSP up 6.2 percent from the previous year.

In-place capital commitments for the construction and opening of more than a dozen major office, hotel, residential and commercial projects throughout the islands continued the "boom" as other areas slowed. The unemployment rate in Hawaii had fallen to 2.8 percent by mid-1991, the lowest in the nation, and concern was expressed over having the necessary persons to staff the thousands of new resort positions being created.

In 1991, a record $4.305 billion in construction was "put in place" statewide, up nearly five percent from the previous year and more than triple the annual levels from early in the 1980s. Some 33,500 contract construction jobs were filled, up for the seventh consecutive year, and the median home price on Oahu reached $342,000, the highest for any county in America and showing appreciation of 15 percent compounded annually over the prior five years.

However, as these projects were completed and further developments delayed or abandoned, employment fell in many construction and professional sectors, and as the credit crunch of the mainland reached the islands, business expansion and consumer confidence dropped.

The first real estate sectors affected by the emerging downturn were the investor-oriented bulk land, resort, golf course and commercial markets being (for the most part) dependent upon access to off-island capital sources. Sales activity, which had been meteoric through the first three quarters of 1990, staggered by 1991.

The value of vacant land transactions statewide, which had increased five-fold from mid-decade, fell from the 1990 record of $15.48 billion to $8.3 billion in 1991. Demand for hotels, which averaged more than a dozen transactions annually over the previous six years, ceased, with only three major properties selling during 1991.

In retrospect, by the fourth quarter of 1990, the Hawaii economy was clearly into a slowing process, although its ultimate impact was unforeseen at the time. The lifeblood revenues flowing from the previously expanding visitor industry and foreign investor sources were rapidly shrinking, and the inflated real estate and business sectors becoming sluggish and less stable.

The Recessionary Movement (Late 1991 to Late 1993)

The first significant indicator that Hawaii was entering a severe recessionary period was the meager level of visitor arrivals and expenditures during Winter 1991-92, typically the high season of Hawaii tourism. While a similar slow-down the previous year could be blamed on the Gulf War, no such excuse was now available. Industry levels were off six to 15 percent from late decade figures, and only a short-lived, relatively strong return of high-spending Japanese travelers salvaged the market in the face of a drastic slump in westbound visitors.

Employment expansion virtually ceased apart from the inopportune opening of several major neighbor island hotels. However, these gains in modest paying jobs were more than offset by the loss of high wage construction positions, with no new projects for workers following completion of the facilities. By mid-year 1992, the unemployment level in the state had reached 3.6 percent; while still lowest nationally, it was the highest rate in Hawaii since 1987.

Numerous major construction projects were abandoned or delayed, notably several proposed mixed-use developments in Honolulu (Kakaako) and in West Hawaii (Kohanaiki, Kaloko and elsewhere). Construction spending began falling rapidly, and was off an estimated 22 percent for 1992 and an additional 20 percent in 1993.

Apart from resident housing units and well-located industrial inventory, real estate demand all but ceased. Prices in the bulk acreage and upper-end residential market softened dramatically.

Several major hotels fell into "foreclosure" action, including the Westin Maui, Kaanapali Embassy Suites and Waikiki Beachcomber; the first two being taken back by lenders at circa 60 percent of the prices paid for the properties during the previous two years. Many others, particularly some of the newer ultra-luxury facilities, struggled desperately to maintain financial integrity in the face of falling demand. Heavy room rate discounting programs only served to exacerbate the difficulties, and with few exceptions (specifically the Outrigger Hotels Hawaii system), hotels failed to achieve even their moderated operating projections.

In 1992-93, Japanese investment in island real estate dropped to the lowest level in eight years, totaling less than $400 million, with most of this being poured into under-construction projects. By the end of 1993 even this flow of capital was reduced as Japanese lenders sought to stem the losses being experienced worldwide by slowing development funding.

Lastly, the sugar industry, the historic foundation of the Hawaii economy continued its decline, with the closing of Hamakua Sugar at year-end 1993, an operation considered the most modern in the world.

Ironically, one of the first major positive occurrences in the Hawaii economy following a year of bad news, was the result of a natural disaster. When hurricane Iniki devastated Kauai in September 1992, it brought massive amounts of federal and insurance dollars to the islands, creating construction jobs, and increasing visitor arrivals elsewhere in the state as tourists traveled instead to Maui and the Big Island.

The Potential for Recovery (Late 1993 and Beyond)

Owing to a resurgent mainland economy, bookings to Hawaii have begun to restabilize, the first step towards near-term recovery in the state. Through the first quarter of 1994, a stiffening of air fares and diminishing numbers of scheduled "seats" limited any immediate recovery. However, the continued decline of interest rates began to spur resident and small business-related real estate activity.

By late spring, fares started falling, airlines added dozens of new flights weekly, and the strongest summer bookings in years were being recorded. Yet, with this apparent upsurge, interest rates also moved upwards.

While the Japanese market continues to be soft, relative to the late 1980s, its recovery has been pronounced in the first quarter of this year. Further, the depth of its integration within island real estate is so great, it is inevitable that as its national economy resumes growth, interest in Hawaii properties will resume.

Local corporations are displaying confidence once again in the economic future of the state, undertaking master planning for vast land holdings which will generate jobs over coming decades. Amfac/JMB's Puukolii Village (Maui), C. Brewer's Puueo Makai (Big Island), and The Campbell Estate's Kapolei Regional Plan (Oahu) are examples of this trend.

Retail sales levels at the five major Oahu shopping centers, which began to show recovery by late 1992, are projected by management to grow by five to ten percent during 1994; and, several recently opened shopping centers in Central and Ewa Oahu, and in South Maui have achieved full absorption.

Leading state bank economists project economic growth of three to six percent in 1994, with recovery strengthening by mid-decade as the Japanese markets regroup. In recent months, for the first time since 1990, new construction capital commitments have been made in the islands, a leading indicator of a rebounding real estate market.

Despite the near-term, undeniably deep recession which has gripped the islands over the past 20-plus months, every indication is that a return to vitality is probable during the coming two years.

Inherently, real estate is a trailing factor, particularly given the bloated pricing and inventory status in many sectors created by the hyper-activity of 1985-90 with West Hawaii providing a prime example. As occurred following the recession of 1980-82, it will likely require two to five years for the various market components to notably recover.

With more than 5,000 visitor units added to the statewide inventory over the past four years, tens of thousands more approved, and some 800,000 square feet added to the Honolulu office sector, there is significant product which must be absorbed throughout the islands before additional inventory is required. However, even with this oversupply, the hotel occupancy rate in Waikiki remains one of the highest in the nation and the Honolulu office vacancy rate near the national average.

The Analysis Perspective

Historically, the Hawaii real estate market has been highly cyclical, with periods of stagnation followed by growth and finally hyper-activity. These trends have been strongly evidenced over the past two-plus decades. Analysis indicates we have passed the nadir of this cycle and moving towards a growth period once again.

During slumps in the market it is typical for sales activity to cease, owners electing to hold onto properties awaiting the inevitable return to appreciation and demand levels seen in the past. This creates analytical difficulties as there is a lack of timely evidence to support market movements.

Our experience indicates the most appropriate perspective to adopt is to place greatest weight on data taken from the latter end of the "growth" stage before the "hyper-appreciation" stage comes into full bloom. Or, conversely, to adjust the recent data in accordance with the level of speculation and aggressiveness which has been sapped from the market.

Most importantly though, is resisting myopia in building a foundation for study, not allowing either the depth or height of the short-term market to overwhelm the long-term outlook and its associated implications.

SUBJECT PROPERTY ENVIRONS

General Market Sector Overview (The West Hawaii Region)

Covering some 1,000 square miles of the Big Island's leeward and northerly sides, West Hawaii stretches 100 miles across the districts of South and North Kona and South and North Kohala. The region ranges in elevation from the shoreline to 13,000 feet, and includes vast rain forests, ranch lands, and lava deserts.

Protected from the easterly storms by the central mountain range which forms the island, West Hawaii provides highly desirable mid-elevation agricultural and housing opportunities, and an excellent arid resort-type climate along the waterfront.

The North Kona and South Kohala Districts, at the center of West Hawaii, have been the particular focus of a significant real estate, economic, and population expansion cycle that has quickly transforming the previously desolate lava fields and mauka farmlands into urban communities fueled by tourism dollars and resident income growth.

Beginning slowly in the 1960s and 70s, as the visitor industry focused on Waikiki and West Maui, interest in West Hawaii bloomed as the economy recovered from the 1980-82 recession.

Virtually every aspect of the regional real estate market had begun to strengthen by the mid-1980s, a movement which irrevocably altered the land use and economic bases of the area by 1990. Especially vibrant activity became increasingly evident in the residential, resort and bulk acreage sectors, with the demand for supporting industrial and commercial uses also reaching record levels during the expansion cycle.

Table 2 displays a summary of historic population and economic data in the study region from 1960 through 1990.

Despite the momentary downturn which rocked nearly every sector since 1991, the combination of intensive investor interest and governmental policies promoting reasonable growth in West Hawaii has laid a significant foundation for continued economic upward movement in coming decades.

TABLE 2

SUMMARY OF HISTORIC POPULATION AND ECONOMIC INDICATORS
FOR THE WEST HAWAII REGION 1960 TO 1990 (1)
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

	1960	1970	1980	1990
Resident Population				
Hawaii County	61,332	63,468	92,053	120,317
% Annual Compounded Change		0.34%	3.79%	2.71%
West Hawaii Region	14,167	14,472	27,518	43,373
% Annual Compounded Change		0.21%	6.64%	4.66%
% of County Total	23.10%	22.80%	29.89%	36.05%
Economic Indicators				
1. Tourism				
Hawaii County Room Count	581	3,166	5,889	8,952
% Annual Compounded Change		18.48%	6.40%	4.28%
West Hawaii Region	152	1,584	3,844	6,825
% Annual Compounded Change		26.41%	9.27%	5.91%
% of County Total	26.16%	50.03%	65.27%	76.24%
Hawaii County Visitor Arrivals	119,000	477,720	761,103	1,170,830
% Annual Compounded Change		14.91%	4.77%	4.40%
West Hawaii Region (2)	27,000	254,720	442,483	779,360
% Annual Compounded Change		25.16%	5.68%	5.82%
% of County Total	22.69%	53.32%	58.14%	66.56%
2. Job Count				
Hawaii County Job Count	22,293	28,410	38,200	57,200
% Annual Compounded Change		2.45%	3.01%	4.12%
West Hawaii Region (est.)	3,300	8,600	17,300	34,200
% Annual Compounded Change		10.05%	7.24%	7.05%
% of County Total	14.80%	30.27%	45.29%	59.79%

(1) Includes the districts of North Kohala, South Kohala, North Kona and South Kona.
(2) Estimated according to port of entry. The actual percentage of visitors days staying in West Hawaii represents circa 85 percent of the islandwide total.

Sources: US Census (population figures), Hawaii Visitors Bureau (tourism)
County of Hawaii and State DBED (employment), and
The Hallstrom Group, Inc.

Regional master plans prepared by state and county agencies, calling for extensive pods of urban development, have been approved, and large holdings have been reclassified to permit numerous projects of all use types. The substantial, ongoing capital expenditures by developers of approved planned communities insures a vigorous market into the foreseeable future.

Studies by state and county agencies, other professional analysts, and ourselves, estimate that upwards of 30,000 new jobs could be created in West Hawaii as a result of regional business growth over the next two decades, if the movement into a renewed economic growth cycle is underway by 1994-95. The employment opportunities will be somewhat evenly distributed between tourism-related services, and general/supporting businesses.

As shown on Table 3, the population of the Kona and Kohala Districts is expected to double by the year 2010, approaching 100,000 full-time residents. This expansion will be fueled by natural family growth, in-migration pursuing favorable lifestyle and job environments, and transfer associated with statewide and international concerns seeking a foothold in the expanding market. These individuals, coupled with upward moving resident incomes, will create the need (in conjunction with non-resident purchasers) for more than 20,000 additional housing units in a market which is at present underserviced by upwards of several hundred homes. Demands for commercial and industrial uses will top six million square feet of finished space during the next two decades, and large amounts of land will be required for civic, recreational, and open-space uses.

The table provides a tabular summary of pertinent West Hawaii indicators which depict the large-scale growth anticipated for the region over the next 17 years until 2010. These estimates are in line with state and county forecasts over the same time frame. Our specific residential demand projections run to 2015 in order to depict the entire absorption period of the subject inventory. They are conservative extrapolations of the 2010 forecasts.

Apart from a substantial and prolonged economic downturn, we believe the lifestyle, employment and investment opportunities are in place to fuel the ongoing transition of West Hawaii from an agrarian-based economy into a modern service-based community.

TABLE 3

SUMMARY OF PROJECTED POPULATION AND ECONOMIC INDICATORS
FOR THE WEST HAWAII REGION 1995 TO 2010 (1)
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

	1995	2000	2005	2010
Resident Population				
Hawaii County				
State DBED Series M-K	142,500	160,400	180,800	206,100
% Annual Compounded Change		1.19%	1.20%	1.32%
County General Plan Series A	138,000	155,000	173,000	192,415
% Annual Compounded Change		2.35%	2.22%	2.15%
County General Plan Series B	148,000	180,000	217,000	237,830
% Annual Compounded Change		1.98%	1.89%	1.85%
West Hawaii Region				
County General Plan Series A	52,000	65,837	78,715	92,365
% Annual Compounded Change		4.83%	3.64%	3.25%
% of County Total	37.68%	42.48%	45.50%	48.00%
County General Plan Series B	58,000	77,250	98,729	120,119
% Annual Compounded Change		5.90%	5.03%	4.50%
% of County Total	39.19%	42.92%	45.50%	50.51%
Economic Indicators				
1. Tourism				
West Hawaii Region Room Count	7,400	9,500	12,000	15,000
% Annual Compounded Change		5.12%	4.78%	4.56%
West Hawaii Region Visitor Arrivals	850,000	1,150,000	1,500,000	1,900,000
% Annual Compounded Change		6.23%	5.46%	4.84%
2. Job Count				
West Hawaii Region	36,500	43,000	50,500	60,000
% Annual Compounded Change		3.33%	3.27%	3.51%

(1) Includes the districts of North Kohala, South Kohala, North Kona and South Kona.

Source: The Hallstrom Group, Inc.

As noted throughout our presentation, the subject lands enjoy view, climatic, locational, and access characteristics superior to many sites proposed for development in the region. Its good quality coupled with lower prices would enable finished inventory on the holding to be strongly competitive despite the sheer quantity of product planned/approved for West Hawaii.

Given the fundamental planning and financial decisions of the last decade, specifically the commitment to quality resort development, the failure to provide sufficient lands in acceptable locations for **all facets** of market demand could denigrate the success of regional master plans.

The state and county have recognized these needs through extensive planning efforts in respectively creating the **West Hawaii Regional Plan** and **Keahole to Kailua Development Plan.**

These plans call for extensive expansion of the existing Kailua/Keauhou urban pod, and establishing several new development enclaves in the northerly portions of the coastal corridor. Kaupulehu resort is a focal point of one of these resort destination nodes.

A major result of this ongoing evolution in the regional real estate market has been evidenced by the increasingly wider spectrum of purchaser demands, and the type of inventory being made available.

For example, whereas ten years ago residential opportunities were mostly limited to "agricultural" or minimally serviced subdivisions, as a result of the planning, there are now residential developments ranging in quality from below county standard to world class resort opportunities, with many projects between.

Analysis indicates a need to continue providing diversity in order to maximize economic opportunities being created. Commercial and industrial lands must be provided for development of on-island businesses, previously limited to Honolulu or the mainland, which will be drawn to the region by the expanding consumer base.

The subsequent sections summarize our investigation and analysis of the leading land use types in West Hawaii which may be suitable for portions of the subject property, focusing on resort and residential opportunities. There can be no doubt long-term prospects for the region remain upbeat and the evolving West Hawaii economy will emerge into another growth cycle by later in the decade.

Primary Market Sector Overview (West Hawaii Resorts)

While the bays along the Kona/Kohala coastline were long-favored by the Hawaiian Alii, and the area's potential for resort development recognized since statehood, the level of interest in destination development activity in West Hawaii remained minor relative to Waikiki and Maui through the mid-1970s.

With the exception of the isolated and exclusive **Mauna Kea Beach Resort** and **Kona Village Resort**, the tourism plant was focused on moderate-quality construction in the Kailua-Kona to Keauhou urban corridor. And, though the two northerly resorts enjoyed strong acceptance, demand in central Kona was cyclical and modest.

The availability of beachfront infrastructure-serviced sites in West and South Maui communities, and the attraction created by the intensity of Waikiki, focused much of the rapid visitor industry investment and activity in these locales.

By the late 1970s, outside of West Hawaii there remained few quality, bulk acreage oceanfront sites in the state which could support the significant resort uses needed to fuel the rapidly expanding tourism market. Further, the accessibility to sites in the "gold coast" corridor stretching from Kailua-Kona to Kawaihae had been steadily advanced over the prior decade with the opening of Queen Kaahumanu Highway, Keahole Airport and the increasing importance of Kawaihae Harbor.

The first two new projects attempting to capitalize on the regional opportunity during the early to mid-1970s were: the **Waikoloa Beach Resort**, part of the vast Waikoloa holding, on 500 acres fronting Anaehoomalu Bay; and **Mauna Lani Resort** a 3,200 acre consolidation, northerly adjacent to Waikoloa.

The land use approval process encountered by these proposed "major" resort developments extended over six and seven years, respectively, pushing construction and opening into the early 1980s, after the bull tourism market had ebbed and the state was in the midst of recession.

The initial financial difficulties encountered by the Royal Waikoloan and Mauna Lani Bay Hotels, in the face of a stagnant economic cycle, severely slowed further investor interest in the region through mid-decade.

In early 1985, only six major landholdings had destination resort-type land use designations in West Hawaii; the four in-development cited above, **Keauhou Resort**, and the proposed Kaloko-Honokohau National Historic Park site. There was no notable, sales, investor or development interest in the region reported by the media, in public agency records or as indicated in our files for studies from the period.

However, during that year things began changing dramatically in the area's resort real property market, and by 1987 seven additional resort communities had been proposed for the Kona/Kohala coastline, not including the South Kohala Resort which is an extension of the existing Mauna Kea Beach project.

While not all were able to achieve approvals, the exceptional volume of petitions in such a short period bespeaks of the meteoric move beginning in the sector and the recognition by landowners of the critical long-range nature of pursuing planning opportunities at that time.

Eight factors were primarily responsible for the dramatic surge in the West Hawaii resort market during 1985-87, which continued through 1990:

- The exceptional dry, warm climate of the region (it is a Kekaha or desert) which is most favored by visitors;
- The availability of large unified "raw" oceanfront sites capable of being shaped with relative ease;
- The commensurate scarcity of quality bulk acreage shoreline lands elsewhere on the major islands;
- The enhancement of the regional transportation grid, notably Queen Kaahumanu Highway and Keahole Airport which turned the previously inaccessible coastline to one of the most easily reachable in the state;
- Highly supportive state and county land use agencies which processed and approved proposed developments at unprecedented speeds, cutting the process time required in half and issuing regional plans assuming massive new resort uses which would stimulate the economy islandwide;

- An historic influx of Japanese investment capital into the state soon found its way into West Hawaii, which along with the existing "players" in the region created an international mix of highly-recognized corporations and developers which poured more than a billion dollars into site purchases, joint ventures and projects over the next several years;

- The momentum created by the strong reception of ultra-luxury multifamily development at Mauna Kea Beach and Mauna Lani, increasing visitor expenditures and (most influentially) the announcement of the Hyatt Regency Waikoloa project, fueled investor/speculator interests; and,

- The West Hawaii resident community generally favored the economic benefits which would be provided through resort development, particularly through employment opportunities, access to previously unreachable shoreline areas, and required construction of affordable housing units for worker families.

Sales, planning, and development activity continued strongly through 1990, becoming a trickle and then stagnant by the end of 1991, due to the effects of the Persian Gulf War, instability of national economies worldwide and deep recession in the U.S. and Japan. On-site construction was interrupted at Kaupulehu, ground breaking was delayed at Kohanaiki and Kukio Beach, finished condominium units sat unsold at Waikoloa Beach and Keauhou, and plans at Mahukona were significantly down-scaled.

As noted in a foregoing section of the report, the Hawaii tourism industry and its related real estate components have always been highly cyclical. In West Hawaii, the past two cycles have each been about a decade long; with a three to four year long "slow" period followed by a year or two of moderate growth and culminating in three to five years of strong activity.

Based on this history, a return to upward trends in the study region should be under way by mid-decade, although we consider it unlikely the great zenith of the cycle seen in 1988-90 will be repeated in the next surge. Several projects have reported an influx of development capital in the first months of 1994, the first major investments in the subject region in several years.

We anticipate stabilizing then increasing visitor count and expenditure levels in West Hawaii over the next several years (as was shown on Table 3), resulting in increasing demand for additional development and quickened investor activity. Visitor counts are expected to more than double by the year 2010, reaching some 1,900,000 tourists annually, creating demand for upwards of 15,000 hotel rooms, or twice the current level.

A tabular presentation of the basic data describing the existing and proposed/approved West Hawaii resort projects is provided on Table 4. Additional narrative, maps, and informational documents about each are on file.

Specific information on the sales activity associated with single family lots and multifamily units in the study region and in competitive neighbor island developments is presented in subsequent sections of the report.

TABLE 4

SUMMARY OF MAJOR EXISTING AND PROPOSED RESORT DEVELOPMENTS IN WEST HAWAII (1)

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Development Name	Location	Resort Acreage	Number of Units (2) Hotel	Condo	SFR	Year Open or Proposed	Amenities (3)	Developer/Owner
Existing								
Mauna Kea Beach	Kaunaoa Bay							Mauna Kea Properties/Seibu
Existing		600	310	40	72	1965	A,C	
Proposed (4)		6,400		(5)				
Mauna Lani	Makaiwa, Puako,							Tokyu Corp.
Existing	Honokaope Bays	800	876	230	66	1982	A,B,C,D	
Proposed (4)		3,600		(5)				
Waikoloa Beach	Anaehoomalu Bay							Transcontinental/Bass Bros.
Existing		500	1,786	464	0	1981	A,B,C,D	
Proposed		883		(5)				
Kona Village	Kaupulehu Beach	60	150	0	0	1966	C,D	Taku Hawaii Inc.
Keauhou	Keauhou and							Kamehameha Invst./Bishop Est.
Existing (6)	Kahaluu Bays	2,000	1,330	1,252	159	1970	A,B,D	
Proposed		----		(5)				
Under Construction								
South Kohala Resort (7)	Hapuna Beach	500	350	42	9	1984	A,C,D	Mauna Kea Properties/Seibu
Four Seasons Resort (8)	Kaupulehu	624	250	585	415	1985	A,C	Kaupulehu Makai Venture
Proposed/Approved								
Regent Kona Coast Resort (9)	Kukio Beach	667	350	1,450	415	1985	A,B,C,D	Long-Term Credit Bank of Japan
Kohanaiki (9,10)	Keahole Point	470	1,050	300	300	1984	A,B,C,D	Nansay Hawaii, Inc.
Other Proposed — Inactive or Unable to Achieve Approvals							Status	
Mahukona	North Kohala	1,043	1,500	1,500	520	1985	(11)	Chalon International
Ooma II	Keahole Point	313	600	300	---	1984	(12)	Kahala Capital Corp.
Kealakehe	Honokohau Bay	697	1,500	500	800	1986	(13)	State of Hawaii

Source: The Hallstrom Group, Inc.

TABLE 4
CONTINUED

SUMMARY OF MAJOR EXISTING AND PROPOSED DEVELOPMENTS IN WEST HAWAII

Market Study of the Proposed Kaupulehu Resort Expansion

FOOTNOTES TO TABLE:

(1) Summary data based on EIS and other public documents, press notices, discussion with developer and other sources. Master plans for bulk acreage projects, which often take decades to absorb, are typically altered many times during the development process in acccordance with changing market trends. Does not include proposed South Kona or Kau projects considered as either uncompetitive or having nominal chance of obtaining approvals. Subject is also omitted.

(2) The data shown is based on either the most recent and/or most frequent master plan summary available as of the study date.

(3) Key: A = Golf Course(s), B = Free-standing Retail and Restaurant, C = Tennis Courts, D = Historical/Cultural/Park Facilities

(4) Mauna Kea Beach and Mauna Lani resorts have reputations for low-density development. It is unlikely they will achieve maximum densities permitted.

(5) Approved as "Major" resort area under General Plan, and can be developed with up to 3,000 total resort units (hotel & condo) and 3,000 residential units.

(6) Two of three Keauhou hotels are currently either closed or in nominal operation awaiting resumption of plan to integrate the facilities.

(7) Although designed as a separate project, the South Kohala Resort is part of the approved Mauna Kea Beach "major" Resort lands and unit allocations. Long-term residential development may total as many as 450 units/homes, much on the mauka side of Queen Kaahumanu Highway.

(8) Initial approved plans called for two hotels housing 950 rooms, two golf courses and up to 500 resort/residential units. Significant revisions to master plan, with 1,120 acre subject expansion, currently being designed.

(9) Approved as "intermediate" resort.

(10) Experiencing legal problems. Court recently voided Shoreline Management Permit until adequate native fishing provisions made. Water source developed.

(11) After several denials for land use reclassification, Mahukona is now seeking approvals for a small portion of site to permit 240-room hotel, 150-lot subdivision and golf course. Community opposition is strong, but Planning Department recommends approval.

(12) Has been denied on several occasions at both state and county levels, primarily due to airport noise and beach access concerns. Master plan has been revised numerous times, focusing on a variety of uses, to no avail. Currently inactive.

(13) Shoreline portion of 2,500 acre state-owned Kealakehe holding considered for long-term private resort development. No specific land use petition has been filed and concept is currently on hold. Use of nearby sites for sewage plant and dump limit desirability.

Source: Various, and The Hallstrom Group, Inc.

ANALYSIS OF THE WEST HAWAII RESIDENTIAL SECTOR

Quantification of Market Demand

We have projected the demand for residential units in West Hawaii using standardized formulae employing population forecasts, household size trends, and other market-based factors as follows:

RP/AHS = TRUR X (1 + (VA + NRPA)) = TMUD

Where:

RP is the **Resident Population**
AHS is the **Average Household Size**
TRUR is the **Total Resident Units Required**
VA is a **Vacancy Allowance**
NRPA is a **Non-Resident Purchaser Allowance**
TMUD is a **Total Market Unit Demand**

Each of the variables in the formula is based on historic statistics compiled by the Federal Home Loan Bank, U.S. Census Bureau, State of Hawaii DBED, other recognized governmental sources, and researched market data.

These past and current indicators were translated into estimates based on temperate trending interpretations. Our emphasis was on letting the data "speak for itself" through our projections, as opposed to making large-scale adjustments for subjectively anticipated lifestyle or market evolutions.

In this regard, our forecasts are representative of moderate future housing requirements, and could be understated if some movements continue as strongly as in recent years; such as the trend towards smaller household sizes and an increasing influx of non-resident (foreign) purchasers into the market.

Additionally, as noted, public and private planners consider governmental population projections to be restrained relative to probable occurrence.

The "Total Market Unit Demand" conclusions resulting from equation application are intended to quantify the total number of residences which will be needed in the study region over a 22-year

projection period (through 2015) in order to manifest a reasonably stable market with all purchaser/tenant demand segments served.

Although chronic undersupply in virtually all market segments was somewhat rectified by the construction surge of the last decade, it is generally recognized the West Hawaii housing market has been historically typified by exceptionally low vacancy rates and rapidly escalating prices over time. The "affordable" segment of the housing market remains significantly undersupplied, but the ongoing recession has hampered the development and sale of such units. Most analysts and public agencies view the present condition, without the extreme urgency of prior years, as but a breather in the long-term regional demand for more housing opportunities. Stated governmental policy is to alleviate the perceived low end and forecast long-range unit shortage through increased densities of urban lands and development of feral or nominal agricultural lands at as rapid a pace as the infrastructure and community will bear.

The factors comprising our housing demand equation can be summarized as follows:

> **Resident Population (RP)** -- This variable utilizes the islandwide population forecasts made by ourselves based on analysis of past state (Series MK), county, and district forecasts. The concluded figures are comparable to levels projected in the Office of State Planning West Hawaii Regional Plan and ongoing General Plan regional update efforts of the Hawaii County Planning Department. The only significant adaptation is the extension of the time frame to the year 2015, which goes beyond the existing horizon of public agency forecasts by five to ten years. This was necessary to establish a projection period of two decades, which is the standard in making long-term land use estimates and fully covers the anticipated subject inventory absorption period.
>
> **Average Household Size (AHS)** -- This factor was calculated using the data as provided by the above-cited sources and census figures. At year-end 1992 (the most recent figures available), the AHS in West Hawaii was an estimated 2.90 persons.

The trend has been towards smaller households in the region, a nationwide phenomenon, and it would undoubtedly be lower in the region were sufficient units made available.

Most Hawaii-oriented sociologists contend this movement will continue unabated into the future until stabilizing near 2.5 persons, due to longer life-spans, the influx of single persons attracted to the climate and employment opportunities in West Hawaii resort projects, the urbanization of North Kohala and South Kona, and the tendency towards fewer children.

We have forecast that the average household size level would stabilize by the year 2010 at from 2.70 to 2.80 persons.

Total Resident Units Required (TRUR) -- This figure is arrived at by dividing the subject area resident population (RP) by the average household size (AHS). It is indicative of the minimum number of residences which would be required to meet basic market needs, assuming there were no vacant units, none uninhabitable due to ongoing repair or deleterious conditions, and none occupied by non-resident persons.

For a market to be considered stable (and nominally operative) with acceptable appreciation rates and quality lifestyle opportunities, allowances for such factors must be made.

Vacancy Allowance (VA) -- Federal, state, and local governments went on record in the late 1980s calling West Hawaii one of the tightest residential market sectors in the nation, referring to the situation as "abysmal" in published reports, and expressing fears of a deteriorating economy and community structure unless major steps are taken to address this "acute shortage."

The historic undersupply condition is a primary reason West Hawaii housing prices are on average among the highest of any locale in the country, although they are considered moderate or reasonable by statewide standards.

According to HUD, the Urban Land Institute, and other sources, a "healthy" market has a minimum vacancy level of five to six percent of the total number of units in the inventory. This allows for uninhabitable units, units under repair, seasonal fluctuations, a transitional housing margin, a degree of mobility potential, and the ability to service periodic unanticipated population increases. A "slack" in unit occupancy also serves as a margin to cushion against hyper-appreciation during strong demand periods.

Given the history of the West Hawaii housing market, and the market's difficulty in keeping a consistent and acceptable vacancy pool available, we believe it is unrealistic to expect a standard vacancy allowance in excess of six percent to be achieved on the island during the foreseeable future; although portions of the market (notably in greater Kailua-Kona) are experiencing near-term vacancies as high as ten percent in some projects due to the effects of the recession over the past two years.

In our demand formula, we have tested more conservative vacancy rate allowances of four and six percent of the Total Resident Units Required figure.

Non-Resident Purchaser Allowance (NRPA) -- While most investors strongly desire to rent purchased units to residents in an effort to minimize debt service obligations, there are those who buy a Hawaii home or condominium for personal (family and friends) use, business reasons, or for periodic rental to non-resident "visitors."

These units are not available to meet resident housing demands and are effectively withdrawn from the inventory pool. An allowance must be made for these residences in the general community, which are not to be confused with those specifically intended for tourist-oriented transient rentals (i.e., a "resort/residential" unit within a condominium/hotel project or single family subdivision in a destination community).

On the neighbor islands and in Waikiki, there are many units in complexes or subdivisions designed for general residential use, which have been purchased by non-residents and often sit vacant the vast majority of the time.

Our research indicates some neighbor island non-resort projects have upwards of thirty percent vacant investor-owned units/homes. In resort communities (particularly Mauna Lani and Wailea) up to eighty percent of selected complexes are so held.

The proximity of residential developments in West Hawaii to world-class resorts, beaches, and recreational opportunities, coupled with the superior views and climate throughout the region will draw significant interest from West Coast and Japanese purchasers over time despite efforts to restrict vital units for local residential use only. Based on historic trends, the NRPA should be at a minimum of ten-plus percent in the Kona-Kohala corridor. However, public policies and community pressure should serve to help in moderating this trend. We have therefore tested exceptionally conservative, non-resident allowances of six to eight percent of total resident household demand.

Total Market Unit Demand (TMUD) -- The solution to our demand formula, it is quantified by adding the Vacancy Allowance (VA), and Non-Resident Purchaser Allowance (NRPA), to the Total Resident Units Required (TRUR) figure. This is the total number of units which will be needed in the study region in order to meet all reasonable market demands.

The application of the housing demand formula to the subject region is shown on Table 5.

Based on our analysis, the actualization of a healthy and stable housing market in the study area will require the construction of some 25,214 to 31,231 additional housing units in West Hawaii by the year 2015; the mid-point demand would be for 28,223 units.

Conversion of this estimate of gross demand into pricing equivalents can be completed using available data from the U.S. Census, Hawaii Board of Realtors, and the U.S. Dept. of HUD.

Table 6 illustrates this striation of West Hawaii regional housing demand to 2015 into probable percentile demand by sales prices at current dollar levels. The figures correlate both historic actual buying trends and theoretical "affordability" quotients derived using government pricing formulae.

The high cost of housing in Hawaii traditionally requires a purchaser to pay slightly to much more than is conventionally affordable; hence, the

TABLE 5

QUANTIFICATION OF HOUSING UNIT DEMAND FOR WEST HAWAII 1993 to 2015 (1)

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

	1993 (2)	1995	2000	2005	2010	2015	Additional Units Required by 2015 (3)
Scenario One: Minimum Projections Using Low Population Estimates and Conservative Allowance Factors							
Resident Population	48,000	53,917	64,860	77,806	94,050	110,000	
Average Household Size	2.90	2.88	2.85	2.82	2.80	2.80	
Total Resident Units Required	16,552	18,721	22,758	27,591	33,589	39,286	
Vacancy Allowance (4% of resident unit demand)	662	749	910	1,104	1,344	1,571	
Non-Resident Purchaser Allowance (6% of resident unit demand)	993	1,123	1,365	1,655	2,015	2,357	
TOTAL MARKET UNIT DEMAND	18,207	20,593	25,034	30,350	36,948	43,214	25,214
Scenario Two: Maximum Projections Using High Population Estimates and Optimistic Allowance Factors							
Resident Population	48,000	55,535	67,454	81,696	99,693	116,600	
Average Household Size	2.90	2.85	2.80	2.75	2.70	2.70	
Total Resident Units Required	16,552	19,486	24,091	29,708	36,923	43,185	
Vacancy Allowance (6% of resident unit demand)	993	1,169	1,445	1,782	2,215	2,591	
Non-Resident Purchaser Allowance (8% of resident unit demand)	1,324	1,559	1,927	2,377	2,954	3,455	
TOTAL MARKET UNIT DEMAND	18,869	22,214	27,464	33,867	42,093	49,231	31,231

CONCLUDED HOUSING UNIT DEMAND RANGE

	Existing	1993-1995	1996-2000	2001-2005	2006-2010	2011-2015	Totals
MINIMUM DEMAND							
Periodic	207	2,386	4,440	5,316	6,598	6,266	
Cumulative	207	2,593	7,034	12,350	18,948	25,214	25,214
MAXIMUM DEMAND							
Periodic	869	3,345	5,250	6,403	8,226	7,139	
Cumulative	869	4,214	9,464	15,867	24,093	31,231	31,231
MID-POINT DEMAND							
Periodic	538	2,866	4,845	5,860	7,412	6,702	
Cumulative	538	3,404	8,249	14,108	21,520	28,223	28,223

(1) Includes the districts of North and South Kohala, and North and South Kona.
(2) Estimate.
(3) There were an estimated 18,000 habitable resident housing units in West Hawaii at year-end 1992. Resulting in a latent market demand for a minimum of 207 units needed to achieve market stability.

Source: Various, and The Hallstrom Group, Inc.

TABLE 6

STRIATED PROJECTIONS OF HOUSING UNIT DEMAND BY SALES PRICE EQUIVALENT FOR WEST HAWAII

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

	Periodic Demand					Total
Period	1993 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	2011 to 2015	Demand 1993-2015
1. Minimum Demand						
Less Than $125,000	724	1,076	1,233	1,461	1,389	5,883
Percent of Total Demand	30.00%	24.00%	23.00%	22.00%	22.00%	23.33%
$125,000 to $250,000	724	1,346	1,608	1,993	1,894	7,564
Percent of Total Demand	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%
$250,000 to $350,000	603	1,166	1,447	1,860	1,767	6,844
Percent of Total Demand	25.00%	26.00%	27.00%	28.00%	28.00%	27.14%
$350,000 to $500,000	290	673	804	996	947	3,710
Percent of Total Demand	12.00%	15.00%	15.00%	15.00%	15.00%	14.71%
Over $500,000	72	224	268	332	316	1,212
Percent of Total Demand	3.00%	5.00%	5.00%	5.00%	5.00%	4.81%
Total Market Demand	2,413	4,485	5,361	6,643	6,312	25,214
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
2. Maximum Demand						
Less Than $125,000	1,037	1,305	1,516	1,851	1,612	7,322
Percent of Total Demand	30.00%	24.00%	23.00%	22.00%	22.00%	23.44%
$125,000 to $250,000	1,037	1,632	1,978	2,525	2,198	9,369
Percent of Total Demand	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%
$250,000 to $350,000	864	1,414	1,780	2,356	2,052	8,466
Percent of Total Demand	25.00%	26.00%	27.00%	28.00%	28.00%	27.11%
$350,000 to $500,000	415	816	989	1,262	1,099	4,581
Percent of Total Demand	12.00%	15.00%	15.00%	15.00%	15.00%	14.67%
Over $500,000	104	272	330	421	366	1,492
Percent of Total Demand	3.00%	5.00%	5.00%	5.00%	5.00%	4.78%
Total Market Demand	3,457	5,439	6,592	8,415	7,328	31,231
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Various, and The Hallstrom Group, Inc.

striated demand figures across the board show market-based prices moderately above means-testing criteria.

Inherently, demand is focused towards the lower- to middle-income groups who have difficulty competing in the competitive and high-priced marketplace. Upper-middle and above-income households at least have some limited purchase alternatives, although often in neighborhoods dominated by second home (non-resident) buyers.

Identification of Competing Supply

In response to the historic extreme undersupply of residential housing units in West Hawaii, the exceptional investor interest in the area during the 1980s, and the large projected demand for the region, the amount of inventory which was proposed for development to service the West Hawaii market was exceptionally large during the last decade. This was due to a variety of market and public-sector considerations, including a large agriculturally limited land base, a relatively diverse historic ownership pattern, recently expanded regional transportation systems, and a notable county-wide and public agency support for further urban expansion in the area.

For years, the result of insufficient supply in the face of strong demand was seen in rapidly appreciating prices, low vacancy rates, overcrowded units, and destabilized family structures.

In an attempt to service the obvious need for resident housing, as stressed in federal, state, and county surveys of the sector conducted in the mid-1980s, a variety of market and public-sponsored projects were proposed beginning in 1983-84.

Prior to this, there were exceptionally few quality residential development opportunities available in West Hawaii, with even the in-fill areas of Kailua-Kona and Waimea generally having agricultural or unplanned land use status. Only at Waikoloa Village, with some 2,800 acres of residential zoned lands, were sites ready for subdivision, and until late in the decade, the village was considered too outlying and lacking in commercial services to attract meaningful market interest.

As with the makai resort-potential lands, there was a surge by inland landowners to pursue land use approvals for properties throughout Hawaii beginning in 1985-86. More than a dozen major projects entered the pipeline, promising a full spectrum of inventory from low-cost apartment units to gentlemen/equestrian estates.

Virtually every major holding/owner announced long-term development plans, including public agencies, established ranches and local families, and new investors in the region. Further, the demand for houselots in existing subdivisions (particularly in the "Ag" projects of Kalaoa-Kealakehe) soared and the vast number of vacant parcels were rapidly built upon.

The cumulative effect was to move a chronically undersupplied market into a more stable condition by the onset of recession in 1991. While there remains significant need for affordable-priced units in urban Kailua-Kona and Waimea, the moderate and market-priced segments actually have a marginal oversupply in some neighborhoods for the first time in a decade or more.

A summary of the currently proposed residential (non-resort) supply available to service future housing needs in West Hawaii is shown on *Table 7*. The under-construction and approved projects total some 25,709 units. Additionally, there are another 3,000-plus units being considered in long-range plans.

If one assumes <u>all</u> of these homes are built in a timely manner and <u>all</u> serviced vacant and under-developed available lots in the area are used, there are a minimum of 27,000 existing and potential housing opportunities available or proposed in coming decades in West Hawaii.

Not only are there substantial numbers of units proposed for the study area, but the inventory planned will provide a wide range of types and alternatives, ranging from subsidized rental apartments to upper-end market price single family homes.

Overall, if the market recovers as expected and regional population grows towards forecast levels, it is reasonable to expect that as many as 15,000 to 18,000 of the proposed units to be developed. This means there are prudently 16,000 to 20,000 total unit supply potentials for West Hawaii over the coming two decades.

TABLE 7

SUMMARY OF MAJOR EXISTING AND PROPOSED RESIDENTIAL DEVELOPMENTS IN WEST HAWAII

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Development Name	Location	Number of Units: Single Family	Number of Units: Condominium	Number of Units: Total	Developer Estimated Absorption	Market Orientation	Comments
Existing							
Kohala Ranch	Waika, North Kohala					Ranch Lots/Estates	Upscale equestrian project. Next phase includes denser housing, golf, comm. center.
Existing		412	0	412			
Proposed		962	528	1,490	15+ yrs.		
Mailu Ridge	North Kohala	170	0	170		Ranch Lots/Estates	Well-received, fully absorbed.
Waikoloa Village	Waikoloa, South Kohala					General Residential	Quality from affordable to upscale. 1 golf course, more planned. New shopping center.
Existing		1,450	880	2,330			
Proposed		4,815	1,481	6,296	25+ yrs.		
Waikii Ranch	Waikii, South Kohala					Ranch Lots/Estates	Minimum 10 acre lots in upscale equestrian community.
Existing		129	0	129			
Proposed		75	0	75	6 yrs.		
Under-Construction or Having Some Level of Approval (All are in the North Kona District)							
Lands of Kau (19)	Kau	2,300	300	2,600	20+ yrs.	General	Nansay Hawaii project.
Puuhonua Subdivision	Kalaoa	347	142	489	5 yrs.	General	Initial 15 acres subdivided.
Hawaiian Kona Coast	Kaloko	950	0	950	10+ yrs.	Upscale	
Pualani Subdivision	Kailua-Kona	546	0	546	5 yrs.	Aff/Gen	
Taiyo Fudosan	Kailua-Kona	300	0	300	5 yrs.	General	
HHA Projects	Kailua-Kona	0	218	218	3 yrs.	Affordable	State-sponsored projects.
Alii Kona	Kailua-Kona	73	510	583	7 yrs.	Aff/Gen	
Gamlon Subdivision	Kailua-Kona	215	475	690	10 yrs.	Aff/Gen	Initial systems complete.
Keauhou View Estates	Keauhou-Kona	387	0	387	5 yrs.	Upscale	
Maryl Development	Various	450	0	450	10+ yrs.	Gen/Upscale	Two projects in sales.

MIXED-USE MASTER PLANNED COMMUNITIES

Development Name	Location	Number of Units: Single Family	Number of Units: Condominium	Number of Units: Total	Gross Acreage Planned: Commercial	Gross Acreage Planned: Industrial	Comments
Under-Construction/Approved							
Hawaiian Home Lands	Kawaihae	535	0	532	82	307	Has most approvals, on hold.
Parker 2020	Waimea	580	150	730	100	50	Has most initial approvals.
Puako Residential/Golf Community	Puako Mauka	570	970	1,540	14	0	2 golf courses, full approval.
YO Inc./TSA	Kaloko	1,203	340	1,543	6	250	55 ind. lots and road complete.
Villages of Laiopua	Kealakehe	---	---	4,358	Open	Open	100 ag lots, civic & recreation ctr.
QLT Project	Keahuolu	---	---	1,932	200+	100+	758 acs, state bought res. land.

Source: County of Hawaii, Various, and The Hallstrom Group, Inc.

Comparison of Demand/Supply Indicators

Our analysis indicates that some 25,214 to 31,231 additional housing units (28,223 mid-point) must be built in West Hawaii over the next 22 years if the regional demand situation is to be adequately addressed.

At present there is a quantifiable shortage of about 200 to 800 units, almost exclusively among resident households in the low to moderate income groups.

Apart from any subject use, there are nearly 26,000 units being proposed for development, and if all available "in-fill" was undertaken, there are (perhaps) as many as 1,200-plus other opportunities in the region. However, it is unlikely more than 70 to 80 percent of these potentials will be actualized in a sufficiently timely manner to meet regional market demand over the next two decades.

The net comparative result is that long-term supply and demand on a quantitative basis are generally equitable, although an additional one to three thousand units could reasonably be absorbed beyond those proposed given the probable timing of the planned projects. A more significant shortfall would occur should one or more developments encounter financial difficulties or state-funding cutbacks, a highly probable event.

In comparison with striated market demand indicators, the proposed inventory will adequately service most purchaser segments. From a timing perspective, a supply shortfall would be most likely to take place as recovery begins in the short-term, before major projects come on-line, and by later in the projection period as the inability of some developers to perform becomes apparent.

The Resale Market

Tables 8, 9, and 10, respectively, suppress resale activity for single family residences, multifamily units and vacant lots in South Kohala and North Kona from 1985 through mid-1993. The pattern reflects the general market cycle, peaking in 1989-90, falling in 1991-92 and now showing signs of stabilization and growth.

TABLE 8

SUMMARY OF DEMAND FOR SINGLE FAMILY RESIDENCES IN NORTH KONA AND SOUTH KOHALA 1985 THROUGH JUNE 1993 (1)

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Total North Kona And South Kohala	1985	1986	1987	1988	1989	1990	1991	1992	1993 (2)
Number Sold (3)	308	428	623	629	648	691	300	281	152
Percent Change	N/A	38.96%	45.56%	0.96%	3.02%	6.64%	-56.58%	-6.33%	N/A
Sales Volume	$21,833,700	$30,460,063	$56,417,685	$76,681,135	$89,735,945	$104,093,696	$96,121,450	$78,867,708	$44,344,632
Average Sales Price	$132,325	$127,983	$150,047	$190,749	$223,192	$260,688	$320,405	$280,668	$291,741
Percent Change	N/A	-3.28%	17.24%	27.13%	17.01%	16.80%	22.91%	-12.40%	3.95%
Average Days on Market	96	186	171	165	112	104	134	158	167
List Sales Price Ratio	91.2%	92.6%	91.8%	93.3%	95.7%	95.2%	93.4%	93.8%	92.9%

(1) Includes all units (residential, agricultural and resort) transacted on a re-sale basis. Does not include "original" sales.
(2) Through June 30, 1993.
(3) Includes units currently in escrow. All other figures are for sold units only.

Source: Hawaii Island Board of Realtors Multiple Listing Service, and The Hallstrom Group, Inc.

TABLE 9

SUMMARY OF DEMAND FOR MULTIFAMILY UNITS IN NORTH KONA AND SOUTH KOHALA 1985 THROUGH JUNE 1993 (1)

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Total North Kona And South Kohala	1985	1986	1987	1988	1989	1990	1991	1992	1993 (2)
Number Sold (3)	159	200	406	486	661	684	315	227	118
Percent Change	N/A	25.79%	103.00%	19.70%	15.43%	3.48%	-53.95%	-27.94%	N/A
Sales Volume	$10,183,850	$11,897,257	$32,643,586	$81,020,555	$97,621,980	$97,621,980	$60,544,400	$50,496,150	$26,647,940
Average Sales Price	$117,056	$104,362	$146,384	$140,627	$173,810	$186,040	$192,204	$222,450	$225,830
Percent Change	N/A	-10.84%	40.27%	-3.93%	23.60%	7.04%	3.31%	15.74%	1.52%
Average Days on Market	95	194	248	222	174	152	125	157	173
List Sales Price Ratio	89.0%	92.3%	93.1%	93.7%	94.2%	95.3%	94.4%	92.2%	93.1%

(1) Includes all units (residential and resort) transacted on a re-sale basis. Does not include "original" sales.
(2) Through June 30, 1993.
(3) Includes units currently in escrow. All other figures are for sold units only.

Source: Hawaii Island Board of Realtors Multiple Listing Service, and The Hallstrom Group, Inc.

TABLE 10

SUMMARY OF DEMAND FOR DEVELOPABLE VACANT LOTS IN NORTH KONA AND SOUTH KOHALA 1985 THROUGH JUNE 1993 (1)

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Total North Kona And South Kohala	1985	1986	1987	1988	1989	1990	1991	1992	1993 (2)
Number Sold (3)	363	421	933	951	991	1,056	210	224	123
Percent Change	N/A	10.83%	222.80%	2.80%	2.95%	4.19%	-80.11%	6.67%	-45.09%
Sales Volume	$10,855,800	$18,589,661	$32,046,460	$37,962,162	$44,123,578	$52,278,500	$58,645,650	$56,548,800	$31,440,276
Average Sales Price	$54,827	$74,358	$61,243	$88,904	$102,580	$122,126	$279,265	$252,450	$255,612
Percent Change	N/A	69.78%	-27.20%	47.81%	12.70%	21.42%	128.67%	-9.60%	1.25%
Average Days on Market	89	200	220	175	120	85	125	157	168
List Sales Price Ratio	90.3%	86.2%	88.4%	94.5%	95.6%	94.7%	94.4%	92.2%	92.5%

(1) Includes all lots (residential, ag. and resort) transacted on a re-sale basis. Does not include "original" sales.
(2) Through June 30, 1993.
(3) Includes units currently in escrow. All other figures are for sold units only.

Source: Hawaii Island Board of Realtors Multiple Listing Service, and The Hallstrom Group, Inc.

THE NEIGHBOR ISLAND RESORT/RESIDENTIAL MARKET

Single family Homesites

Until the mid-1980s, the upper-end, master-planned residential and resort homesite market was considered as an incidental component within neighbor island, freestanding, and destination communities, overshadowed by hotel, condominium, commercial, and amenity development.

However, late in the decade activity in this sector surged to the forefront of the resort-oriented market. Several factors contributed to the rapid emergence and success of this product type; most notably, the 1986 U.S. Tax Reform Act, the escalating financial status of individuals in the prime Hawaii markets of Japan and the West Coast, and diversification of project orientation and profit potentials.

The result was a meteoric expansion of developer, investor, and purchaser interest in moderately-high to upscale, full-time residences and vacation homes on the outer islands, with the number of "premier"/golf course lots subdivided, sold and proposed increasing many-fold since mid-decade. The resort, finished house market also dramatically widened.

As with property types, demand for resort/residential lots and homes dropped in 1991, with activity levels off sharply over the last two years. The dependency of the sector on Japanese, investor, and corporate purchasers groups heavily hit by the recession, exacerbated the trend.

Understanding the long-term demand levels, supply considerations, and demographic strength is critical in making meaningful interpretations for such a notably cyclical market subsector.

In 1981, there were only 640 competitive neighbor island resort homesites, with total sales of only 54 lots during the year at prices ranging from $40,000 to $135,000--most towards the lower end of the spectrum.

At present, the total number of prime homesites has increased to 1,811, the majority developed during the 1987-91 period, and 334 transactions were recorded at the peak of the market in 1990. Selling prices now extend from $115,000 to $5,340,000, with most in the range of $400,000 to $800,000.

While prices have not moved significantly beyond a marginal slumping, activity has plummeted over the past several years, with only 92 sold in the 18 months from the beginning of 1992 through mid-1993; a decline of more than 80 percent. A summary of the activity in those neighbor island developments, which we consider most competitive with the proposed subject sites, is shown on Table 11.

As might be anticipated, the market activity of finished, luxury residences on premier neighbor island homesites has also varied wildly during the past decade.

In 1981, seven such homes were sold, at prices ranging from $215,000 to $495,000, with an average near $325,000.

By the peak of the market in 1990, sales increased to 95 residences annually at prices extending from $400,000 to $3,150,000 and an average approaching $1,000,000.

But with the onset of the recession, sales dropped to a 78 percent decline over the last 18 months (through mid-1993) with only 30 sales recorded in the Maui and Big Island projects.

Most of the homes sold in recent years were marketed either prior to, at, or shortly after completion of construction. In essence, they were individual "spec" undertakings by a custom home builder, which permits these figures to be indicative of finished home buyer demand.

Approximately 300 of these homes have been completed since 1989, are currently under-construction, or have received building permits. Almost without exception, the houses were built on an individual basis by a custom contractor or as contracted by the lot buyer.

A summary of the activity at the three West Hawaii resorts offering single family lot subdivision, Keauhou, Mauna Lani, and Mauna Kea Beach are displayed on Tables 12, 13, and 14, respectively.

Our analysis indicates the demand for new resort-quality homesites on the neighbor islands from 1994 through 2015 will be as follows:

TABLE 11

SUMMARY OF NEIGHBOR ISLAND GOLF COURSE/RESORT HOMESITE ACTIVITY

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Development	Total Subdivided Lots	Range in Size (Sq. Ft.)	Current Price Range		Percent of Lots Offered Absorbed	Average Annual Sales	
			Low	High		Original Sales (1)	1/1987 to 3/1993 (2)
Wailea	342	10,000 to 18,000	$270,000	$1,000,000	89%	29.3	30.0
Kaanapali Beach	253	10,500 to 40,000	$185,000	$850,000	95%	25.8	26.1
Kapalua	143	10,000 to 350,000	$305,000	$5,200,000	98%	80.5	32.0
Mauna Lani	66	15,000 to 83,000	$495,000	$5,340,000	100%	Immediate	28.6
Mauna Kea Beach	69	20,000 to 57,000	$590,000	$875,000	100%	8.3	5.3
Keauhou	159	15,000 to 23,000	$175,000	$325,000	100%	28.5	36.1
Waikoloa Village (3)	127	10,000 to 16,000	$120,000	$165,000	100%	21.4	14.9
Princeville	700	10,000 to 31,000	$115,000	$275,000	100%	59.2	46.5

(1) Average lots sold yearly during original sales program.
(2) Average lots sold yearly from January 1987 through March 1993, original and resales; or since lot sales began.
(3) Golf course fronting lots only, considered as secondary indicator.

Source: Various, and The Hallstrom Group, Inc.

TABLE 12

SUMMARY OF SINGLE FAMILY RESIDENTIAL DEVELOPMENT AND MARKET ACTIVITY AT KEAUHOU RESORT, NORTH KONA

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

1. VACANT HOMESITES

Project Name	No. of Lots	Tax Map Plat	Date Finished	Original Sales: Price Range Low	Original Sales: Price Range High	Original Sales: Marketing Period (months)	Original Sales: Avg. Annual Absorption	1992-93 Resales
Keauhou Subdivision	24	7-8-20	1974	$18,000	$32,000	18	16.00	0
Keauhou Estates	135	7-8-21	1985	$94,000	$265,000	49	33.06	12

2. FINISHED HOMES

Project Name	No. of Homes (1)	No. Sold in 1992-93
Keauhou Subdivision	24	0
Keauhou Estates	60	6

(1) Existing, under-construction or with approved permits.

Source: Board of Realtors, and The Hallstrom Group, Inc.

TABLE 13

SUMMARY OF SINGLE FAMILY RESIDENTIAL DEVELOPMENT AND MARKET ACTIVITY AT MAUNA LANI RESORT, SOUTH KOHALA

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

1. VACANT HOMESITES

				Original Sales				
				Price Range		Marketing Period		
Project Name	No. of Lots	Tax Map Plat	Date Finished	Low	High	(months)	Avg. Annual Absorption	1992-93 Resales
Champion Ridge	33	6-8-27	1992	$390,000	$500,000	Immediate	66.00	5
The Point Estates	19	6-8-24	1992	$350,000	$500,000	Immediate	38.00	6
The Cape Estates	14	6-8-24	1991	$2,800,000	$5,000,000	Immediate	28.00	2

2. FINISHED HOMES

Project Name	No. of Homes (1)	No. Sold in 1992-93
Champion Ridge	6	0
The Point Estates	8	2
The Cape Estates	6	0

(1) Existing, under-construction or with approved permits.

Source: Board of Realtors, and The Hallstrom Group, Inc.

TABLE 14

SUMMARY OF SINGLE FAMILY RESIDENTIAL DEVELOPMENT AND MARKET ACTIVITY AT MAUNA KEA BEACH RESORT, SOUTH KOHALA

Market Analysis of South Beach Mauka Development Alternatives
Kaanapali Beach Resort, Maui, Hawaii

1. VACANT HOMESITES

Project Name	No. of Lots	Tax Map Plat	Date Finished	Original Sales: Price Range Low	Original Sales: Price Range High	Original Sales: Marketing Period (months)	Original Sales: Avg. Annual Absorption	1992-93 Resales
Fairways South	33	6-2-04	1973	$37,000	$60,000	40	9.90	0
Fairways North	36	6-2-08	1984	$175,000	$500,000	60	7.20	5

2. FINISHED HOMES

Project Name	No. of Homes (1)	No. Sold in 1992-93
Fairways South	32	6
Fairways North	18	1

(1) Existing, under-construction or with approved permits.

Source: Board of Realtors, and The Hallstrom Group, Inc.

Neighbor Island New Resort/Residential Homesite Demand			
	Average Annual Demand	Total Periodic Demand	Cumulative Demand
1994 to 1995	100	200	200
1996 to 2000	200	1,000	1,200
2001 to 2005	300	1,500	2,700
2006 to 2010	400	2,000	4,700
2011 to 2015	400	2,000	6,700

The substantial portion of total demand (up to 90-plus percent) would be anticipated to flow to leeward Maui and West Hawaii, with about 50 to 60 percent of this amount, or 3,100 to 3,700 total homesites, directed to the competitive subject region.

Significant numbers of competitive, moderately-high to upscale single family subdivisions are proposed for the neighbor islands over the coming two-plus decades, the majority in West Hawaii. A summary of the approved projects are shown on Table 15.

If all of the developments were built according to publicly-announced development plans (including long-term expansion areas), the total number of new homesites offered over the next 20-plus years would be 10,073, or equivalent to 150 percent of the indicated demand. Additionally, significant competitive homesites are being considered at Wailea Ranch, Maui (600 lots).

Beyond this large quantity of proposed development, both quality and likelihood of occurrence must be considered. We consider it highly unlikely that all of the projects will be built to maximum densities, particularly at Mauna Lani, Mauna Kea Beach, and Keauhou, or that all of the proposed communities will be constructed in a timely fashion, such as Kauai Lagoons, Kohanaiki, and Kukio Beach. Additionally, 1,800 of the homesites are proposed for unproven locations on Lanai

TABLE 15

SUMMARY OF PROPOSED NEIGHBOR ISLAND
SINGLE FAMILY RESORT/RESIDENTIAL DEVELOPMENT
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
Approved Projects Only (1)

Project	Residential Development Proposed To Begin	Single Family Sites Existing	Proposed/ Approved	Total
MAUI COUNTY				
Wailea	Underway	342	346	688
Kaanapali Beach (2)	Underway	253	585	838
Kapalua	Underway	143	325	468
Kaluakoi (Molokai) (3)	Underway	15	800	815
Koele (Lanai) (4)	Late 1990s	0	600	600
Manele Bay (Lanai) (4)	Late 1990s	0	400	400
BIG ISLAND				
Mauna Kea Beach (5)	Underway	69	131	200
Mauna Lani	Underway	66	1,400	1,466
Waikoloa Beach	Mid-1990s	0	800	800
Keauhou	Underway	159	841	1,000
Kukio Beach	Mid-1990s	0	500	500
Four Seasons Kaupulehu	Mid-1990s	0	415	415
Kohanaiki	Mid-1990s	0	380	380
Maniniowali	Mid-1990s	0	150	150
KAUAI				
Princeville	Underway	700	2,100	2,800
Kauai Lagoons	Mid-1990s	0	300	300
TOTALS		1,747	10,073	11,820

(1) Only those projects having SLU and/or County General Plan approvals considered. Vacation areas (such as Poipu) are excluded. Where proposed units range in number, mid-point is shown. "Existing" totals include units under construction.
(2) Assumes up to 325 additional lots within South Beach Mauka increment, and circa 250 in North Beach Mauka project, actual number may be from 0 to 500.
(3) Proposed units based on current near-term plans. 4,500 acre holding could support significantly more development over long-term.
(4) Proposed units based on estimate of density of development parcels. Three units/acre.
(5) Includes the under-construction South Kohala Resort.

Source: Various, and The Hallstrom Group, Inc.

and Molokai, and more than 1,000 are in resorts that have yet to break ground.

Apart from the subject, there are 4,617 total resort/golf course lots proposed for the West Hawaii coastal corridor, or some 25 percent more than the maximum demand quantified during our study time frame. However, we consider it improbable that Mauna Lani (1,800 lots), Keauhou (841), or Waikoloa Beach (800) will be developed to full densities or built-out within the projection period.

It is further unlikely that more than 50 percent of the proposed lots will be actualized over the next two decades. This level would fail to service expected demand.

Given their view potentials, arid climate, and inclusion within a quality destination community, subdivision of resort-quality lots on the subject holding would be highly comparable with those found in Maui and West Hawaii's finest projects. Based on its probable pricing levels and competitive attributes, we estimate the subject project could attain absorption levels of approaching 30 golf course/interior lots annually on a stabilized basis if offering could begin by late decade.

The demand for on- and near-water lots, a different market sector, remains generally high due to supply scarcity, and sales of these sites at the rate of eight to ten each year while product lasts is achievable.

Multifamily (Condominium) Units

For two decades, condominiums were the focal point of resort/residential development on the neighbor islands. At times, particularly in the late 1970s, the market became so heated the sector moved from the real property to the pure commodity realm, with pre-selling units being sold by lottery and reservation rights heavily traded.

Large, dense oceanfront projects were the norm (particularly in West Maui), with a major attraction for the investor/buyer being intense, transient rental pool operations within the projects. These operations effectively transformed the development into a "hotel," a move which revolutionized the neighbor island lodging industry.

Rental pools typically offered a significantly greater return to the unit purchaser than long-term tenant leasing, and increased the exposure of the unit to potential re-sale investors.

Units solely employed by "second home" users were a rarity, and full-time resident owners almost non-existent. Few buyers wanted to spend long periods living in a hotel situation, and most seemed to need the rental income to offset debt service.

Only a select few projects (notably at Wailea and Kapalua) offered the low-key, exclusive setting appealing to upper-income purchasers not driven by transient rental prospects.

For a variety of reasons, the resort/residential condominium market slumped badly early in the 1980s, emerging only by late decade in a markedly different form. While not experiencing the "feeding frenzy" demand of a decade prior, the sector was nonetheless vibrant during the general market upsurge of 1986-1990, with average prices at record highs, the quality of inventory at unmatched levels, and developer and purchaser interest strong.

However, as with the resort/residential homesite sector, the activity level in the condominium market has slumped dramatically over the past two years.

The evolution in the resort multifamily sector in recent years has resulted in smaller, low-density, high-amenitied projects having densities of 8 to 12 units per acre instead of 15 units and up. Spacious condominium "residences," not mere "units," featuring exclusive, secure environments at the interior of resorts and master-planned communities, fronting the golf course, and having desirable views are now the dominant design type.

This is keeping with changes in the buyer preference profiles. Rather than mere investors, many purchasers are now full-time residents, second home users, retirees, or other (often childless) households, who favor a low-key setting, a full range of recreational amenities, more expansive landscaped grounds, and distance from the transient population (if the project is in a resort).

In the last instance, while buyers may enjoy access to the benefits of a resort, they do not wish to be constantly immersed in its visitor-fueled intensity.

In essence, the condominium purchaser of today is seeking the "feel" of a single family residence for personal gratification, not the "hotel" sought by buyers of years past for income return potentials.

We do note, however, many recent projects have developed secondary rental pool operations. Generally, they are without or have a minimal front desk (often being administered from off-site) and have multi-day minimum stay requirements. Overall, they are operated in a highly inconspicuous manner, nominally affecting de facto population or work force levels.

Without exception, all of the major high-quality neighbor island condominium projects developed over the last decade have been designed in adherence to the low-key, residential-feel concept, a trend we anticipate to continue.

A model site for such a resort/residential condominium development would have golf course frontage, superior views, sufficient size to permit amenity development in an unintensive setting, access to shoreline resort facilities, and an exclusive/secure environment.

The proposed Kaupulehu Resort Expansion acreage multifamily pods would generally embody these characteristics.

The cyclical nature of the sector is evident in the level of sales activity since mid-decade.

In 1984, only 308 competitive units within neighbor island master-planned communities were sold, at an average price of circa $340,000.

In 1990, 1,568 such units transacted, ranging in price from $78,000 to $2,500,000, with most in the $350,000 to $750,000 spectrum. Of the 896 units offered on a pre-sale basis during 1989-90, 840 (or 93.75 percent) were reserved.

By 1991, the initial waves of the recession began breaking strongly against the resort-condominium sector, making it one of the first casualties of the downturn. Over the last 30 months, only 391 total units have transacted in the major destination communities, original and resale, the equivalent of 150 per year; a decline of 90 percent from the brief market peak. Also, many of the units "sold-out" during pre-sale campaigns failed to close when buyers walked away. The Waikoloa Beach Resort was among the hardest hit by the fall-out.

Most brokers feel market resurgence is still several years away, with the existing available overhang in supply sufficient until mid-decade outside of a selected few premium projects.

A summary of the sales activity for the 6,387 units of resort/residential condominiums in the developments considered as most competitive with any potential makai-oriented subject inventory is shown on Table 16.

Because of the fundamental shift that has occurred in this sector from a design and purchaser perspective, long-term demand figures (which have been highly cyclical) can be misleading. Since 1975, the average annual number of units sold on an original and resale basis in the identified projects has been at just over 1,000 units, with most activity occurring from 1975 through 1980. Over the past six full years, the average sales per year has been just above 700 units, with most transactions occurring during the 1988-90 sector surge.

The development and sales activity for multifamily units in West Hawaii resorts is summarized on Tables 17 through 20; presented from south to north, Keauhou, Waikoloa Beach, Mauna Lani, and Mauna Kea Beach.

In consideration of the evolution of this market sector and our analysis of demographic and economic factors, we have concluded the demand for additional resort/residential condominium units will be as shown in the chart below over the coming two decades:

Neighbor Island Resort/Residential Condominium New Unit Demand

	Average Annual Demand	Total Periodic Demand	Cumulative Demand
1994 to 1995	200	200	400
1996 to 2000	300	1,500	1,900
2001 to 2005	400	2,000	3,900
2006 to 2010	500	2,500	6,400
2011 to 2015	500	2,500	8,900

TABLE 16

SUMMARY OF NEIGHBOR ISLAND RESORT CONDOMINIUM ACTIVITY
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Development	Total Finished Units	Number of Projects	Recent Sales Price Range: Low	Recent Sales Price Range: High	Percent of Lots Offered Absorbed	Average Annual Sales: Original Sales (1)	Average Annual Sales: 1/1987 to 3/1993 (2)
Wailea	1,184	6	$245,000	$2,800,000	90%	48.7	86.7
Kaanapali Beach	1,407	8	$245,000	$1,250,000	100%	25.8	101.5
Kapalua	528	4	$315,000	$1,800,000	100%	176.0	46.3
Mauna Lani	230	3	$535,000	$1,500,000	100%	40.5	19.7
Mauna Kea Beach	40	1	$1,500,000	$3,600,000	100%	8.3	3.9
Keauhou	1,252	14	$120,000	$475,000	95%	53.2	147.8
Waikoloa Beach	464	4	$240,000	$675,000	62%	37.2	13.1
Princeville	1,282	18	$128,000	$840,000	98%	62.4	87.4

(1) Average units sold yearly during original sales program.
(2) Average units sold yearly from January 1987 through March 1993, original and resales; or since lot sales began.

Source: Various, and The Hallstrom Group, Inc.

TABLE 17

SUMMARY OF CONDOMINIUM DEVELOPMENT AND MARKET ACTIVITY
AT KEAUHOU RESORT, NORTH KONA
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

			1992–93 Resales					Total Project Current Listings		
						Sales Price			Price Range	
Project Name	No. of Units	Date Finished	Total Project Resales	Model Type (Br/Bath)	Average Size in Sq.Ft. (1)	Low	High	Number	Low	High
Keauhou Resort	48	1970	0					4	$125,000	$150,000
Keauhou Akahi	48	1974	0					3	$145,000	$189,750
Keauhou Kona Surf & Racquet	218	1976	6	2/2	921	—	$170,000	22	$124,950	$335,000
				2/2	1,188	$135,000	$285,000			
Keauhou Palena	56	1978	3	2/2	878	$120,000	$132,000	13	$129,000	$184,000
Keauhou Punahele	93	1978	6	2/2	1,242	$189,000	$245,000	5	$210,000	$395,000
Country Club Villas	116	1979	6	2/2	1,000 to 1,400	$230,000	$280,000	12	$235,000	$370,000
Keauhou Kai	18	1980	3	2/2	1,244	$240,000	$255,000	1	—	$250,000
Keauhou Gardens	112	1982	6	1/1	1,101	—	$265,000	10	$225,000	$365,000
				2/2	1,527	$279,000	$320,000			
Kanaloa at Keauhou	166	1982	5	1/1	1,104	$150,000	$200,000	14	$159,000	$600,000
				2/2	1,550	$200,000	$205,000			
				3/2	1,450	—	$475,000			
Hale Kehau	30	1989	0					1	—	$950,000
Holua at Mauna Loa	72	1990	2	2/2.5	1,326	$285,000	$345,000	1	—	$208,000
The Villas at Keauhou	58	1990	3	2/2	1,612	—	$399,000	13	$399,000	$795,000
				3/2	1,800	$600,000	$725,000			
Kaulana at Keauhou	44	1990	5	2/2	1,200	$250,000	$335,000	12	$275,000	$475,000
				2/2.5	1,500	—	$325,000			
				3/2.5	1,860	$365,000	$475,000			

(1) Net living area.

Source: Board of Realtors, and The Hallstrom Group, Inc.

TABLE 18

SUMMARY OF CONDOMINIUM DEVELOPMENT AND MARKET ACTIVITY
AT WAIKOLOA BEACH RESORT, SOUTH KOHALA
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

			1992–93 Resales					Total Project Current Listings		
						Sales Price			Price Range	
Project Name	No. of Units	Date Finished	Total Project Resales	Model Type (Br/Bath)	Average Size in Sq.Ft. (1)	Low	High	Number	Low	High
The Shores	120	1986	1	2/2	1,283	—	$300,000	17	$315,000	$1,200,000
Waikoloa Vista	122	1991	0					1	—	$450,000
Waikoloa Bay Club	172	1991	0					No Listings at Present.		

(1) Net living area.

Source: Board of Realtors, and The Hallstrom Group, Inc.

TABLE 19

SUMMARY OF CONDOMINIUM DEVELOPMENT AND MARKET ACTIVITY AT MAUNA LANI RESORT, SOUTH KOHALA

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Project Name	No. of Units	Date Finished	1992–93 Resales: Total Project Resales	Model Type (Br/Bath)	Average Size in Sq.Ft. (1)	Sales Price		Total Project Current Listings: Number	Price Range	
						Low	High		Low	High
The Terrace	80	1983	4	2/2.5	1,450	$850,000	$1,050,000	19	$550,000	$1,750,000
The Point	104	1986	10	1/1.5	1,129	—	$650,000	18	$595,000	$2,500,000
				2/2.5	1,534	$650,000				
				3/3	1,988	$1,200,000	$1,260,000			
The Islands	46	1992	0							
								2	$985,000	$1,390,000

(1) Net living area.

Source: Board of Realtors, and The Hallstrom Group, Inc.

TABLE 20

SUMMARY OF CONDOMINIUM DEVELOPMENT AND MARKET ACTIVITY AT MAUNA KEA BEACH RESORT, SOUTH KOHALA

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

			1992-93 Resales					Total Project Current Listings		
						Sales Price			Price Range	
Project Name	No. of Units	Date Finished	Total Project Resales	Model Type (Br/Bath)	Average Size in Sq.Ft. (1)	Low	High	Number	Low	High
Villas at Mauna Kea	40	1984	1	2/2.5	2,683	—	$1,800,000	5	$1,900,000	$3,450,000

(1) Net living area.

Source: Board of Realtors, and The Hallstrom Group, Inc.

As with the homesites, we anticipate the significant majority of this demand, in excess of 90 percent, will be directed towards leeward Maui and West Hawaii. Assuming that West Hawaii receives 50 to 60 percent of the division between the locales, **the demand for moderately-high to upscale condominium units within master-planned communities in the Kona-Kohala vacation area is projected at 4,100 to 4,900 during the coming 22 years; with a mid-point of 4,500 units, or about half the total demand.**

The anticipated buyer demographics for this inventory are also comprised of the same groups as for the homesites.

Displayed on Table 21, the currently proposed supply of competitive condominium development could reach as high as 15,647 new units if maximum densities were sought, of which about 10,000 to 12,000 are reasonably/optimistically being planned for construction during the study period (1994 to 2015). As with the homesites, many of the planned resort/condominium-quality units are in unproven minor island locations, are in off-water communities, or in projects yet to break ground. Also, it is highly unlikely the densities proposed in the big resorts will be fully achieved.

After adjustment for these factors, the supply will meet to moderately out-pace demand levels statewide.

Of the 9,098 approved potential units in West Hawaii, 1,800 (or 20 percent), are in resorts that have yet to break ground, and the projects at Keauhou will have less competitive locations.

Further, we again consider it highly unlikely than Mauna Lani (2,955 units) or Keauhou (2,750) will achieve either full densities or build-out by the end of the study period. Even with these adjustments, it is difficult to conclude there will be a gross undersupply of units relative to demand. Yet, there would seem to be room for the subject units on a quantifiable basis given the timing, density, delays, and other constraints impacting the proposed projects.

As with homesite subdivision potentials, we believe the subject units would prove reasonably to strongly competitive in the regional resort condominium market on a qualitative basis.

TABLE 21

SUMMARY OF PROPOSED NEIGHBOR ISLAND RESORT CONDOMINIUM DEVELOPMENT
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
Approved Projects Only (1)

Project	Development To Begin	Multifamily Units Existing	Proposed/ Approved	Total
MAUI COUNTY				
Wailea	Underway	1,184	1,939	3,123
Kaanapali Beach (2)	Underway	1,407	500	1,907
Kapalua	Underway	528	500	1,028
Kaluakoi (Molokai) (3)	Underway	120	1,200	1,320
Makena	Mid-1990s	0	500	500
Koele (Lanai) (4)	Late-1990s	0	220	220
Manele Bay (Lanai) (4)	Late-1990s	0	190	190
BIG ISLAND				
Mauna Kea Beach (4)	Underway	40	260	300
Mauna Lani	Underway	230	2,955	3,185
Waikoloa Beach	Underway	464	2,750	3,214
Keauhou	Underway	1,252	748	2,000
Kukio Beach	Mid-1990s	0	650	650
Kaupulehu	Mid-1990s	0	585	585
Maniniowali	Mid-1990s	0	850	850
Kohanaiki	Mid-1990s	0	300	300
KAUAI				
Princeville	Underway	1,282	1,200	2,482
Kauai Lagoons	1992-93	0	300	300
TOTALS		6,507	15,647	22,154

(1) Only those projects having SLU and/or County General Plan approvals considered. Vacation areas (such as Poipu) are excluded. Where proposed units range in number, mid-point is shown. "Existing" totals include units under construction.
(2) Proposed units will be part of North Beach Mauka increment. Total may range from 300 to 800 units.
(3) Proposed units based on current near-term plans. 4,500 acre holding could support significantly more development over long-term.
(4) Proposed units based on estimate of density of development parcels.

Source: Various, and The Hallstrom Group, Inc.

A subject resort community, if diligently pursued, would likely come on line later in the decade, the period forecast as having the best market potentials, and could anticipate achieving absorption levels of some 30 units annually, on average, over the long term.

THE WEST HAWAII GOLF COURSE SECTOR

Market History

Golf course facilities are considered as a vital amenity for destination resort and master-planned community development, offering recreational opportunities and desirable frontage attributes which enhance the values of adjoining residential, resort, and commercial properties. However, until recently, courses rarely offered a strong, positive return-producing potential relative to construction cost, but were viewed as necessary expenditures, infrastructure items that were fortunate if "worth" the cost to create.

At least one golf course would be a critical component for any resort-oriented development of the subject lands. Two championship-quality courses will serve as view, recreational and open-space amenities to adjoining residential pools within the proposed Kaupulehu expansion project.

Trailing marketwide trends for resort-type properties in the mid-1980s, the surge in golf course facilities and potential course sites began later in the decade. From 1988 through 1990, the statewide golf course market was one of the most vibrant real estate sectors in Hawaii, with demand, prices, and controversy regarding development exploding to a degree rarely seen even in hyper-appreciation cycles of other use-types. Investor interest in finished courses, raw land suitable for course development, and membership programs was at record heights.

By mid-1993, some 68 courses were offering private, public, and military tee times in the islands, nearly one-quarter of which had opened within the previous seven years. Another two dozen courses are under construction or have been approved for development, and an equal number are contained in long-term plans under consideration.

Prices being paid, sought, and offered for existing and proposed courses escalated wildly during the brief surge, in many instances at annualized appreciation rates reaching into triple digits. Meaningful interpretation of the volatile market was problematic, and speculation, rumors, and unsubstantiated "sales" dominated the market.

It is estimated that up to 100 courses were being planned throughout the islands at the peak of the market, with reports of offers as high as

$4.5 million per hole for finished facilities, $1 million for approved course sites.

Commensurate with the slump in other real property sectors, the golf course market floundered disproportionately. While construction continued on many proposed courses statewide, virtually all other activity ceased. Investor interest plummeted, and the sector "bubble" obviously burst, with no meaningful activity during the last two years apart from completion of several upper-end resort courses planned during the late 1980s expansion phase, and selected courses owned by deep-pocket Japanese investors.

Numerous factors contributed to the sudden downturn which affected this market more than others, including:

- Most notably, the Japanese interest fueling meteoric demand stagnated with the onset of their national recession, a sudden Asian capital crunch, and the veritable collapse of the wild "club membership market." Realistically, all of the investor capital and much of the anticipated, expanded end-user demand evaporated within several months time in 1990-91.

- So many courses were being proposed/developed, it was apparent the historic pent-up demand would be adequately serviced and a near-term oversupply situation was going to emerge. This would hamper the income-producing potentials of all operations.

- The rush in proposed courses during 1988-90 created exceptional public controversy throughout the islands. Fears of foreign domination of the land base, loss of significant agricultural holdings, and allocation of scarce water supplies, ignited opposition on many fronts. Excessive "impact fees" and moratoriums were considered/implemented, making most undertakings financially unfeasible.

- The cost of course acquisition, construction, and operation resulted in green fees beyond the reach of most residents and tourists; which, when coupled with slackening tourism, hurt the financial results of existing and new courses. Similar to the oversupplied luxury hotel market, deep discounting of fees and/or nominal escalation policies were adopted by the operators.

Following a re-adjustment period of several years, allowing tourism to recover and the existing course over-supply to be absorbed, we foresee an extended above-inflation increase in green fees into the next century. When coupled with generally fixed operational costs, this will create escalating net operating profit ratios.

The long-term base demand for course time is so large, and a central aspect of any tourism industry, the risk of ownership is moderate over a several decade period. And importantly, with proper care, a course "matures", typically appreciating in desirability (value), in comparison with most other improved real estate types that depreciate and become less desirable over time or more costly to upkeep.

Perhaps the most insightful aspect to the instability of the golf course market relates to the envisioned bonanza associated with the selling of club memberships worldwide. Despite significant publicity, there have been no successful large-scale attempts to market memberships in a Hawaii course to Japanese nationals to date.

Regardless of all the current speculation and uncertainty, we believe the "Japanese connection" still enhances potential values of course properties over the long term; however, moreso in an indirect fashion in the future as opposed to the dominant position held in recent years. Even with the recession, golf play in Japan has remained strong, surpassing 100 million rounds on its 1,926 courses for the first time in 1992; a two percent growth over the prior year even with an average green fee of $200.

We anticipate Hawaii courses will increasingly be used (as by Otaka at Keauhou and Waimea on the Big Island) for promotional/shared privilege purposes in conjunction with Japanese country clubs or other products, or in conjunction with jointly owned hotel/resort properties and other tourism services.

Analysis of Statewide Play

The game of golf enjoys one of the highest participation rates of any sport in the developed world, and the demand for courses is expanding at an unprecedented rate. The total number of players in the United States is now some 26 million, equating to more than ten percent of the total population of the country.

In Japan, with an estimated 11.7 million golfers, the demand is so great that memberships in select clubs ran as high as $3 million during the maximum upswing in 1990 (averaging among all clubs at more than $103,000), and tee times must be reserved up to six months in advance. The shortage of facilities is so extreme, many players have never actually experienced the sport on a course, being limited to large driving range centers. However, prices have become unstable, and demand has slackened in the past two years.

As a product of the obvious long-term need for additional recreational opportunities, and in light of its year-round temperate climate, Hawaii has emerged as a major golfing destination, with nearly 70 regulation courses. Three of the busiest public courses in the country, including the most played course in the world (the Ala Wai, some 200,000 per year) are located on Oahu, and the "resort" links throughout the state are considered among the best designed anywhere.

An estimated 650,000 of the 6.5 million visitors to the islands enjoyed at least one round of golf during their stay in 1992, up more than two percent from the previous year, but below the 700,000 player levels of the late 1980s. By the year 2000, this number is anticipated to increase to over 1.075 million, according to Robert E. Yoxall, Inc., a California-based recreational consulting firm.

Additionally, it is estimated that there are 120,000 resident golfers in the state, or about 12 percent of the population, substantially greater than the nationwide average. These players accounted for several million rounds last year.

A major draw of Hawaii from a tourism and lifestyle perspective is the attraction it holds for golfers, and despite the currently sated sector, the long-term inability to secure tee times (demand) on limited number of courses (supply) could destabilize or lessen the desirability of various communities to segments of the market.

Indicative of the perceived demand for golf facilities over coming decades is that there have been some 37 courses proposed for Oahu over the past five years, more than doubling the existing inventory. The outerislands have been similarly deluged with course development proposals. If all proposed and envisioned courses were constructed, the statewide inventory would increase by some 100 additional courses.

In addition to existing courses, there are 72 holes (four courses) recently completed, under construction, or firmly proposed on Kauai; 198 holes (11 courses) on Maui; and 468 holes (26 courses) on the Big Island. Additional facilities are in planning stages.

The demand for golfing opportunities and the ability of courses to generate operational or sales profits has resulted in all of the many proposed major bulk acreage residential and resort developments in the state incorporating a course as a central amenity in master plans.

As such, the golfing sector has become a vital part of the statewide real property development and tourism industries, with a course being considered as a required component of any competitive bulk acreage development.

Analysis of Resort and West Hawaii Golf Course Supply/Demand

The level of play at statewide golf courses varied widely from one facility to the next between 1986 and 1992, ranging between 48,000 and 200,000 rounds annually in our survey of 26 resort, private, municipal, and semi-private facilities throughout the islands. The greatest percentage (19 of the 26) averaged between 50,000 and 70,000 rounds per 18 holes per year.

Resort-quality courses, which experience a strong demand and maintain stringent tee time separation to enhance patron enjoyment, particularly follow this average round trend, as shown by recent year-end statistics:

Resort Course	No. of Holes	Average Annual Rounds Total	Per 18 Holes
Mauna Lani	18	57,500	57,500
Keauhou	27	95,000	63,300
Kapalua	36	142,000	47,300
Kaanapali Beach	36	90,000	45,000
Wailea	36	107,000	53,500
Makena	18	48,000	48,000
Kiahuna (Poipu)	18	59,600	59,600
Princeville	27	74,000	49,333

Generally, a resort-quality or "championship" course is considered fully utilized ("sold out") when the number of rounds reaches 50,000 to 60,000 rounds per 18 holes per year. Non-resort courses, which do not provide as large a separation in tee times and offer expanded hours of play, typically view 100,000 rounds annually as a maximum use level.

In answer to the perceived long-term shortfall in course supply relative to existing and anticipated demand, and stimulated by the current active course investment market, 23 additional courses are currently under construction, have been approved, or are in the advanced planning stages in West Hawaii. They are listed on Table 22.

However, it is unlikely all of these courses will be built, as several have yet to receive approvals, and others are in projects that have stalled, are experiencing extreme financial difficulties, or are dependent upon outside developer interest for course construction. But, regardless of the ultimate level of construction, West Hawaii will be a "golf capital" of the resort world in coming decades.

A summary of the existing West Hawaii golf courses is displayed on Table 23.

Despite the number of new courses proposed, it is not anticipated that supply will stay ahead of increasing demand over the long term; as for the most part, course developers contend all available starting times will be absorbed by the abutting resort or residential development. This means all other potential players residing outside these proposed projects, or visitors who are guests at non-resort accommodations, will have difficulty obtaining consistent starting times.

Further, with the large influx of inmigrating residents and retirees anticipated for the study region over the next several decades, and a generally upwardly mobile economic structure, the number of residents playing golf will significantly increase.

However, it is readily apparent that <u>the opening of five new courses (90 holes) in West Hawaii during the last three years has created a near-term, oversupply situation</u>.

In quantifying demand for golf times among visitors, Yoxall and the University of Hawaii study opined an appropriate ratio of supply would be one 18-hole golf course per 400 to 500 visitor units (a ratio of 22 to 28 units per golf hole), and that 11 percent of all tourists are desirous of obtaining starting times on any given day.

TABLE 22

SUMMARY OF PROPOSED AND UNDER-CONSTRUCTION GOLF COURSES IN WEST HAWAII (1)
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Course Name	Location	No. of Courses	No. of Holes
Kohala Ranch Golf Club	Kohala Ranch Estates, North Kohala	1.5	27
Unnamed Course	Mahukona Resort, North Kohala	1	18
Queen's Resort Course	Near Mauna Kea Beach Resort, South Kohala	1	18
Nansay Puako Courses	Puako Res. Golf Community, South Kohala	6	108
Ouli Golf Club	Nansay/Ouli, South Kohala	1	18
Unnamed Course	Hapuna Beach State Park, South Kohala	1	18
Unnamed Course	Waikoloa Beach Resort, South Kohala	1	18
The Highlands Golf Club	Waikoloa Village, South Kohala (2)	1	18
Unnamed Course	TSA/Y.O. Kaloko Community, North Kona	1	18
Kona Municipal Course	Villages of Laiopua, North Kona	1	18
Royal Vista Country Club	Puuwaawaa Ranch, North Kona	1.5	27
Four Seasons Resort Course	Kaupulehu Resort, North Kona	1	18
Unnamed Course	Kaupulehu Resort, North Kona	1	18
The Regent Courses	Kukio Beach Resort, North Kona	2	36
Nansay Kau Golf Club	Lands of Kau, North Kona	1	18
Unnamed Courses	Kohanaiki Resort, North Kona	1	18
	Totals	23	414

(1) Includes all major course developments which have been announced and are considered at least nominally pursuing approvals and/or development. It is unlikely all of these listed will be approved and/or constructed during the study period.

The previously proposed Kealakekua Bay Course land use approval effort was effectively abandoned concurrent with this study.

The list does not include the proposed subject courses. The Queen's Resort course approved for (then) Mauna Kea Property lands north of the existing courses is shown, however, as the land has reverted back to The Queen Emma Foundation, it is questionable this facility will be constructed in a timely manner.

(2) Long-term village master planing assumes future course development, although definite proposals are not being solidly pursued at this time.

Source: Various, and The Hallstrom Group, Inc.

TABLE 23

SUMMARY OF EXISTING WEST HAWAII GOLF COURSES
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Course Name	Location	Type	No. of Courses	No. of Holes
Kona Country Club	Keauhou Resort, North Kona	Resort	2	36
Makalei Golf Course	Huehue Ranch, North Kona	Semi-Private	1	18
The Resort Course	Waikoloa Beach Resort, South Kohala	Resort	1	18
The King's Club	Waikoloa Beach Resort, South Kohala	Resort	1	18
Mauna Lani South Course	Mauna Lani Resort, South Kohala	Resort	1	18
Mauna Lani North Course	Mauna Lani Resort, South Kohala	Resort	1	18
The Village Course	Waikoloa Village, South Kohala	Semi-Private	1	18
Mauna Kea Golf Course	Mauna Kea Beach Resort, South Kohala	Resort	1	18
Hapuna Bay Golf Course	South Kohala Resort, South Kohala	Resort	1	18
Otaka Golf Course	Waimea, South Kohala	Semi-Private	1	18
		Totals	11	198

Source: Various, and The Hallstrom Group, Inc.

The National Golf Foundation has published figures indicating the average number of rounds played per year by Americans is 20.2 per golfer. Based on the ability to play year-round and the attraction of the islands to golfers and retirees, we believe this figure to be an understatement relative to the long-term potential.

We have adapted these statewide indicators to the West Hawaii market for use in the demand model. Because of its recent rural roots, not as high a percentage of residents are golfers as on urbanized Oahu; although, the level will increase in coming years. Conversely, an increasing intensity of the regional tourism plant over time will attract a more diverse visitor profile, with a lower percentage of golfers than currently enjoyed at the area's exclusive destination resorts.

Application of these figures to our projections of the West Hawaii and resident populations over the next 22 years is shown on Table 24.

By the year 2015, the region will require a minimum of 37 full courses *(or 666 total holes) in order to meet the total anticipated levels of* demand created by tourists and the local population.

This will require an additional 26 courses (468 holes) to be developed over the next two decades beyond those presently existing, and three courses (or 54 holes) beyond those planned, if all sectors are to be fully serviced over the long term and stable pricing and supply/demand relationships are to be maintained.

Based on our analysis, we conclude there is sufficient demand in West Hawaii over the long term to support construction of the subject golf courses.

TABLE 24

QUANTIFICATION OF DEMAND FOR GOLF COURSES IN WEST HAWAII

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Year	1993	1995	2000	2005	2010	2015
Demand Created By Regional Residents (1)						
Number of Residents	48,000	54,726	66,157	79,751	96,872	113,300
Percentage of Golfers	7.50%	7.75%	9.00%	10.50%	12.00%	12.00%
Total Golfers	3,600	4,241	5,954	8,374	11,625	13,596
Avg. Rounds Per Year	25	28	30	33	35	35
Total Resident Rounds Per Year	90,000	118,755	178,624	276,337	406,860	475,860
Demand Created by Regional Tourists						
Number of Tourist Days/Year	4,400,000	5,750,000	8,050,000	11,250,000	13,775,000	15,900,000
Percentage of Daily Golfers (2)	11.00%	11.00%	11.00%	11.00%	11.00%	11.00%
Total Tourist Rounds Per Year	484,000	632,500	885,500	1,237,500	1,515,250	1,749,000
TOTAL PROJECTED ANNUAL ROUNDS	574,000	751,255	1,064,124	1,513,837	1,922,110	2,224,860
Divided by Avg. Course Capacity	60,000	60,000	60,000	60,000	60,000	60,000
TOTAL COURSES REQUIRED TO MEET EXPRESSED DEMAND	9.57	12.52	17.74	25.23	32.04	37.08

(1) North/South Kona and Kohala Districts. Does not include demand for golfing opportunities created by residents living elsewhere on the island.

(2) Based on expressed desire to play, the actual number of participants may be less due to scarcity of starting times or other factors.

Source: The Hallstrom Group, Inc.

ANALYSIS OF SUBJECT NEIGHBORHOOD COMMERCIAL DEMAND

Given the relative isolation of Kaupulehu from non-resort supporting urban development, a neighborhood shopping center will be a vital amenity to the subject and greater Kaupulehu community. It will provide access to necessary everyday goods and services, be a valuable marketing tool, and serve as a thematic and activity focal point for the project.

The inclusion of an 11 acre commercial site at the hub of the expansion area, epitomizes the master planning design for the subject development. Just as the residential-oriented units of the subject will complement and add diversity to the resort-oriented units in the initial phase of Kaupulehu, the commercial village will fill a niche for guests within the Four Seasons complex who would otherwise be limited to hotel retail/dining/service offerings.

A quality, mixed tenant shopping center is proven to attract local purchasers to resort-type communities, as evidenced at Keauhou Resort, Princeville, and Waikoloa Village. The need to overcome the feeling of isolation, a source of major complaint in West Hawaii resorts, spurred freestanding complexes at Waikoloa Beach and Mauna Lani.

Demand for the subject commercial village would be a function of four groups:

- Residents and guests within the subject property (primary);
- Resident and guests of the Four Seasons Kaupulehu project (primary);
- Tourists staying at other West Hawaii resorts (secondary); and
- Queen Kaahumanu passerbys (tertiary).

Focusing on the primary patron groups, spatial demand can best be quantified as a function of per capita needs for basic and supporting goods of the de facto Kaupulehu population.

The most reasonable indicators can be drawn from Oahu data, which is drawn from a broad-based, stable market made of mixed resident and tourist consumer groups. As shown on Table 25, the per capita allowance for shopping center and retail space on Oahu is currently at an all-time high level of 17.71 square feet per person, with a growth rate of 1.47 percent annually compounded.

Of this demand, studies show about 60 per cent is oriented towards neighborhood-type centers, 20 percent to regional centers, and the remainder to a collection of freestanding, specialty, and discount businesses.

Upon build-out, the Four Seasons Kaupulehu project and subject resort expansion area will have an average daily de facto population upwards of 3,500 persons, of which about 1,200 would be full-time residents and the remainder part-time residents, guests, and tourists. These consumers represent direct demand for more than 61,000 square feet of commercial (non-office) space.

The neighborhood component of this demand would equate to some 36,750 square feet. To this figure is added an allowance for other West Hawaii tourists visiting the complex (including golfers) of 15 percent of the community total, and highway passersby who may stop in, at ten percent of the community spatial base.

The total estimated minimum demand for subject commercial space would be 45,938 square feet using this conservative method, as displayed on Table 26.

This is sufficient to absorb the space proposed by the subject developers. The demand for floor space at the center could increase higher if it contains sufficient amenities and cumulative mass to become a destination shopping village, or if the ratio of full-time residents at Kaupulehu increase beyond the projected levels.

TABLE 25

SUMMARY OF RETAIL, SHOPPING AND SERVICE CENTER SPACE
ON OAHU FOR SELECTED YEARS 1977 TO 1993
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Year	Gross Leaseable Floor Space Area in Sq. Ft. Retail, Restaurant and Center (1)	Service (2)	Total	Resident Population of Island	Ratio of Retail and Service Space Per Person
1977	7,422,000	2,911,000	10,333,000	737,000	14.02
1978	7,492,000	2,944,000	10,436,000	742,600	14.05
1979	7,806,000	3,002,000	10,808,000	756,000	14.30
1980	7,953,000	3,021,000	10,974,000	764,800	14.35
1981	8,537,000	3,052,000	11,589,000	767,600	15.10
1982	—	—	—	776,100	—
1983	—	—	—	789,100	—
1984	—	—	—	797,800	—
1985	9,014,000	3,242,000	12,256,000	804,300	15.24
1986	9,180,000	3,308,000	12,488,000	810,400	15.41
1987	9,280,000	3,384,000	12,664,000	818,400	15.47
1988	9,460,000	3,488,000	12,948,000	824,100	15.71
1989	9,612,000	3,621,000	13,233,000	831,300	15.92
1990	9,850,500	3,720,000	13,570,500	839,400	16.17
1991	10,000,000	3,800,000	13,800,000	852,000	16.20
1992	10,206,000	3,830,000	14,036,000	864,800	16.23
1993	11,636,000	3,950,000	15,586,000	880,000	17.71
Compounded Annual Growth Rate for 1977 through 1993	2.85%	1.93%	2.60%	1.11%	1.47%
Average Annual Addition for 1977 through 1993	247,882	61,118	309,000	8,412	

Note: Complete data not available for all study years. 1993 figures are year-end estimates.

(1) Includes all significant Neighborhood, Strip, Specialty, Community, Regional and Super Regional" malls and centers. Excludes hotels.
(2) Includes all significant "Business and Health" services, excludes hotels.

Source: State of Hawaii Department of Business and Economic Development,
Hawaii Real Estate, and
The Hallstrom Group, Inc.

TABLE 26

QUANTIFICATION OF SUBJECT "NEIGHBORHOOD CENTER" SPACE DEMAND

Market Study of the Proposed Kaupulehu Resort Expansion

Kaupulehu, North Kona, Hawaii

	1996 to 2000	2001 to 2005	2006 to 2010	2011 to 2015
Projected Subject Absorption				
All Kaupulehu Resort Units Absorbed (1)	819	576	527	358
De Facto Kaupulehu Resort Population (2)	1,269	2,150	2,957	3,500
Per Sq Ft Demand	16.75	17.00	17.25	17.50
Total Resident Retail/Service Space Demand	21,256	36,555	51,001	61,250
Capture Rate	60.00%	60.00%	60.00%	60.00%
Cumulative Resident Space Demand	12,753	21,933	30,601	36,750
Periodic Kaupulehu Resort Demand	12,753	9,179	8,668	6,149
Plus Regional Resort Visitors Allowance (15%)	1,913	1,377	1,300	922
Plus Passer-By/Other Allowance (10%)	1,275	918	867	615
Total Periodic Demand (Sq. Ft.)	15,942	11,474	10,835	7,687
Cumulative Demand (Sq. Ft.)	15,942	27,416	38,251	45,938

(1) Includes all hotel, resort and residential units in the Kaupulehu Resort community; within both the under-construction Four Seasons Kaupulehu and proposed subject expansion area projects.
(2) Average number of full-time and part-time residents, guests and tourists present in the community.

Source: The Hallstrom Group, Inc.

SUBJECT DESCRIPTION AND ANALYSIS

The Site

The irregularly-shaped Kaupulehu Resort lands are located along the North Kona shoreline, makai of Queen Kaahumanu Highway approximately eight and sixteen miles north, respectively, of the Keahole Airport and urban Kailua-Kona. The subject site is in the central portion of the Kona/Kohala coastal resort corridor.

The property is flat to minimally sloping, a generally featureless lava finger, for the most part less than two centuries old. With the exception of kiawe thickets and pockets of various grass types near the ocean, the holding has nominal vegetation, being typified by young a'a and pahoehoe lava stratum.

As with most regional properties, the waterfront is rocky, with seacliffs ranging up to 30 feet above mean sea level. Pockets of crushed coral and/or rock sand are scattered along the shoreline, generally just behind the wave action zone, with the largest located at the northerly edge of the subject lands. There are no significant on-site beach strands providing direct water access, and near-shore activities would be limited due to the difficult egress and seasonal large waves.

Vehicular access onto the site is currently available via the re-aligned entryway to the Kona Village Resort which leads from Queen Kaahumanu Highway. Upon development, the subject property will be served through expansion of the under-construction Four Seasons Kaupulehu roadway system.

Kaupulehu is in a "kekaha" (or desert), which is typified by average rainfall of less than ten inches per year and average daily temperatures above 80 degrees. The effects of the tradewinds, which plague the more northerly resorts, is mitigated somewhat by the subject's location in the lee of Hualalai.

Beyond the existing Kona Village, under-construction Four Seasons, and the proposed Kukio Beach Resort, there are no other uses existing or planned for the immediate Kaupulehu "neighborhood" at the present time. Given its location and characteristics, it is unlikely any uses other than destination resort or master-planned community would be considered.

A comprehensive description of the subject property and the surrounding lands was presented in the ***Final Environmental Impact Statement for the Proposed Kaupulehu Resort*** (1986), as well as other documents prepared by the developer. The reader is referred to these narratives for further information.

From a market perspective, the subject lands appear to possess the traits necessary to be competitive with other projects along the Kona/Kohala coastline. Among the primary advantages are:

- The property enjoys **excellent climatic conditions,** the fundamental requirement for successful resort/residential development.

- The site has more than **two miles of direct ocean frontage,** another critical amenity. While lacking quality beaches, this is not a significant concern as the orientation of the project is resort/residential and not resort/hotel use. On-water sandy beaches are conveniently nearby at Kahuwai and Kukio.

- **View potentials are average to good,** with extensive ocean and mountain panoramas presently available. However, due to the nearly level topography of the site, view planes will become obstructed as development takes place. With proper planning and grading, quality territorial (golf course) and mountain panoramas can be maintained, as evidenced at Mauna Lani.

- Until the opening of the Kukio Beach and Kohanaiki projects (both currently on hold), Kaupulehu will have the **most accessible and best supported location** among the existing coastal resorts, with easy high-speed highway access to the airport and the shopping, services and restaurants of Kailua-Kona. This is a vital market factor, as the most common complaint among guests and unit purchasers at the more northerly resorts is their relative isolation. This attribute will markedly enhance the desirability of the project for local residents.

- The Four Seasons Kaupulehu Resort complex, southerly adjacent, will provide **high-quality resort amenities** for finished subject units, including restaurants, retail and recreational opportunities, while enhancing the prestige of the entire development. This immediately places the planned homesites and units in a more desirable position than Maniniowali or the Puako Residential Golf Community (which represent 23.4 percent of the regional competitive inventory) which lack this benefit.

- By encompassing the well-recognized Kona Village Resort project, the subject possesses **immediate market identification** with a long-established and highly successful development.

The Proposed Master Plan

The envisioned land use design covering the subject lands will include:

- **530 Single Family Homesites** on 220 net acres, with approximately 50 having direct ocean frontage and the majority of the remainder golf course frontage.

- **500 Multifamily Units** on 94 acres in low density projects spread across interior course-fronting sites.

- **Two Championship Golf Courses**, *415 total acres, sharing* a clubhouse facility (on 12 acres) which will form an entryway facility to the subject community.

- **An Eleven acre Neighborhood Commercial Site**, which would serve both in-project owner/guest needs and have destination restaurants and shops attracting off-site patrons.

- **A Three acre Club**, for residents and guests.

- **369 Acres of Archeological Preserves, Recreation Area, Open Space and Community Set-Asides.**

On a general basis, the preliminary master plan prepared by Belt Collins Hawaii is an appropriate and reasonable layout given the physical constraints of the subject property and its effective market standing.

The master plan envisions a moderate- to high-quality, low-density residential community having a recreational lifestyle theme and limited-resort ambiance appealing to both local residents and second home purchasers. The project would function independent of the under-construction Four Seasons Kaupulehu complex, but would derive benefit from shared name-recognition and amenities.

From a market perspective, the plan embodies modern resort-type land use designs characteristic of leading Hawaii developments. Among the primary favorable traits of the current land use map are:

- The **overall density ratio** is exceptionally low, averaging only .93 units per acre over the entire project site. This is a fraction of the level approved for other developments in the study area.

- The **finished site density ratio** is also well below regional market standards, with subdivided single family lots averaging 2.33 per acre, and multifamily units 5.26 per acre.

- Every development pod will have **direct and extended golf course frontage**. The plan maximizes the amenity in regards to efficiency, supply of fronting units, and creation of territorial view potentials.

- The project will include some **50 oceanfront homesites,** the most for any existing or proposed project in the islands. These lots are highly sought after in the market and should achieve rapid absorption.

- The **neighborhood commercial village** will provide the services necessary to stabilize the subject project while attracting outside consumers.

- The **golf courses and clubhouse** will attract players, diners and visitors which will form a major potential purchaser group. The facility will also serve as the gateway/central hub to the community and as a secondary retail, restaurant and service complex.

- The **archeological preserves** will add to the sense of Kaupulehu identity, and provide a thematic opportunity.

- The **club and beach recreation area** will give residents and guests water access availability, a crucial trait in sector marketing.

COMPETITIVENESS OF THE SUBJECT PROJECT

Based on our market investigation and analysis we have determined:

- The West Hawaii economic and population base is in a long-term expansion mode, with significant demand forecast for resort/residential and general residential purchase opportunities in coming decades;

- There are numerous existing and proposed projects which anticipate "capturing" a portion of the envisioned market for their respective developments during the same time-frame; and,

- The proposed Kaupulehu Resort Expansion site and master plan have the necessary attributes to be competitive in the regional homesite, condominium and golf course sectors.

The final step in the market study process is to quantify the probable market demand for the finished subject units by correlating defined statistical sector "needs" and subjective competitive insights into absorption estimates using two analytical techniques: **The Residual Method** and **The Market Shares Method.**

The Residual Method

In this approach, all of the major proposed resort and golf-course residential projects in the competitive market area are placed on a time-line depicting the sales absorption anticipated by the developers (as stated in their EIS, reported in the media, or through interviews). To the extent the total units in these projects fall short of forecast demand for units in the study area, an undersupply situation exists. Should the proposed supply total more than the estimated demand, there would be an oversupply condition.

Having accounted for virtually all of the proposed units in the market, it can be asserted the subject development will "capture" a significant (or all) of the residual demand in the region.

This approach is inherently conservative, as it assumes the subject will only garner what is left after all of the competitive projects receive their share. Given the nature of the Kaupulehu site, its ongoing construction efforts, and the likelihood of delay for several of the competitive developments, we believe the subject will be a market leader, not a follower.

Table 27 displays the residual demand model we consider most applicable to the analysis. The model covers all regional resort/residential demand, both single and multifamily "units".

The annual forecast unit demand is shown along the bottom of the table along with the yearly and cumulative over/under supply figures and the probable demand for the subject under several residual capture rate assumptions.

In 17 of the 21 years of the study period, there will be a regional supply shortfall. Most importantly, the undersupply condition will continue from the turn of the century onward, when the majority of the subject inventory would come on-line. The model indicates the subject should be able to achieve a reasonable absorption level of 25 to 70-plus lots/units annually.

Only in the near-term years of the study period is there an oversupply; however, this assumes the three proposed projects which have yet to break-ground will all be able to offer inventory in a timely and effective manner, an outcome we do not presently believe credible.

If revisions were made to the model to account for probability and timeliness of competitive development occurrence, the residual demand available to the subject inventory would markedly increase and speed overall absorption beyond the concluded levels.

Based on the various residual method models tested, the 1,030 subject residential units could be absorbed within a 15 to 20-year marketing period.

The Market Shares Method

This technique accounts for the probable competitiveness of the subject residential inventory regardless of the total level of other finished product being offered. In essence, it is an estimate of how much of the total latent and new unit resort/residential and general residential unit demand existing and anticipated for West Hawaii the subject could expect to receive on an annual basis given its location, amenities and pricing characteristics.

TABLE 27

QUANTIFICATION OF SUBJECT UNIT DEMAND USING THE RESIDUAL METHOD
BASED ON TOTAL DEMAND FOR RESORT/RESIDENTIAL UNITS IN WEST HAWAII
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
Assuming Moderate Regional Demand Trends

Competitive Project	Total Unabsorbed Units	Units Sold in 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	1995-2015 Totals
Mauna Kea Beach/South Kohala	391	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	16	16	16	16	16	320
Market Share %		9%	9%	5%	4%	4%	4%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	5%	5%	5%	
Mauna Lani	4,355	50	50	50	50	50	50	50	50	50	50	50	60	60	60	60	60	60	60	60	60	60	1,150
Market Share %		30%	30%	17%	15%	14%	14%	16%	15%	15%	15%	15%	16%	16%	16%	16%	16%	17%	16%	17%	18%	18%	
Waikoloa Beach	3,550	50	50	50	50	50	50	50	50	50	50	50	60	60	60	60	60	60	60	60	60	60	1,150
Market Share %		30%	30%	17%	15%	14%	14%	16%	15%	15%	15%	15%	16%	16%	16%	16%	16%	17%	16%	17%	18%	18%	
Keauhou	1,589	50	50	50	50	50	50	50	50	50	50	50	70	70	70	70	70	70	70	70	70	70	1,250
Market Share %		30%	30%	17%	15%	14%	14%	16%	15%	15%	15%	15%	18%	18%	18%	18%	18%	19%	19%	20%	21%	21%	
Kohanaiki	680				15	25	30	30	40	40	40	40	40	40	40	40	40	40	45	45	45	45	680
Market Share %					4%	7%	8%	10%	12%	12%	12%	12%	10%	10%	10%	10%	10%	11%	12%	13%	13%	13%	
Kukio Beach	1,150				15	25	30	30	40	40	40	40	50	50	50	50	50	50	50	50	50	50	760
Market Share %					4%	7%	8%	10%	12%	12%	12%	12%	13%	13%	13%	13%	13%	14%	14%	14%	15%	15%	
Maniniowali	1,000			15	20	25	30	35	40	40	40	40	40	40	40	40	40	40	40	40	40	40	685
Market Share %				5%	6%	7%	8%	11%	12%	12%	12%	12%	10%	10%	10%	10%	10%	11%	11%	11%	12%	12%	
Four Seasons Kaupulehu	1,000			116	120	106	100	52	52	52	52	52	46	46	46	46	46	26	26	14			1,000
Market Share %				39%	36%	31%	28%	17%	15%	15%	15%	15%	12%	12%	12%	12%	12%	7%	7%	4%			
TOTALS	13,715	165	165	296	335	346	355	312	337	337	337	337	381	381	381	381	381	362	367	355	341	341	6,995
Periodic Annual Regional Demand		255	260	260	260	260	260	365	365	365	365	365	470	470	470	470	470	470	470	470	470	470	8,080
Shortage or (Excess) Supply		90	95	(36)	(75)	(86)	(95)	53	28	28	28	28	89	89	89	89	89	108	103	115	129	129	1,085
Residual Subject Demand																							
at 100% Residual Capture Rate		90	95	(36)	(75)	(86)	(95)	53	28	28	28	28	89	89	89	89	89	108	103	115	129	129	1,085
at 95% Residual Capture Rate		86	90	(34)	(71)	(82)	(90)	50	27	27	27	27	84	84	84	84	84	103	98	109	123	123	1,031
at 90% Residual Capture Rate		81	86	(32)	(68)	(77)	(86)	48	25	25	25	25	80	80	80	80	80	97	93	104	116	116	977

Source: The Hallstrom Group, Inc.

This "pure competitiveness" approach is generally moderate in application and required some subjective variables, but it is often the most appropriate and is considered the "classic" method.

As indicated by the foregoing residual table, annual market shares of 4 to 30 percent of total sector demand are envisioned by developers for the competitive projects, most being in the 12 to 20 percent range. Our analysis indicates the Kaupulehu Resort Expansion units should be able to achieve overall average levels at the mid- to upper-end of this median share spectrum, in the 14 to 20 percent range, particularly if the lots/units are more moderately-priced as presently proposed. Annual shares would be anticipated to range from 10 to 22 percent of total demand.

Application of these market share rates against the subject single family homesite inventory relative to total annual regional demand estimates is shown on Table 28.

Using this method the 530 subject lots would require some 16 to 21 years to achieve full absorption. The subject market share is inflated higher than general market standards in the first years of the project due to the availability of high demand oceanfront lots.

Application of the market share rates to the proposed subject multifamily units is shown on Table 29. The models indicate the 500 units could achieve successful absorption within 14 to 18 years.

The market share method is limited in regards to the regional residential market, due to its size and diversity. However, the models indicate the subject would have to capture only two to less than four percent of the entire regional residential demand in order to be fully absorbed within a 15 to 20 year period. We believe this nominal share to be readily achievable.

Correlation

We conclude the subject inventory would be competitive in the West Hawaii real estate market, and should achieve full absorption of all salable components (single family, multifamily, golf course and neighborhood commercial) within 18 years of initial offerings. The speed would be increased if one or more of the proposed competitive projects is notably delayed, as seems likely.

TABLE 28

QUANTIFICATION OF POTENTIAL SUBJECT DEMAND
FOR RESORT/RESIDENTIAL HOMESITES USING THE MARKET SHARES METHOD
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Scenario One: Assuming Minimum Regional Lot Demand

Conservative			
Year	Total Regional Demand (1)	Estimated Subject Share	Total Subject Demand (2)
1996	80	20.00%	16
1997	80	20.00%	16
1998	80	20.00%	16
1999	80	20.00%	16
2000	80	20.00%	16
2001	120	20.00%	24
2002	120	20.00%	24
2003	120	16.00%	19
2004	120	16.00%	19
2005	120	18.00%	22
2006	160	18.00%	29
2007	160	20.00%	32
2008	160	20.00%	32
2009	160	20.00%	32
2010	160	20.00%	32
2011	160	20.00%	32
2012	160	20.00%	32
2013	160	20.00%	32
2014	160	20.00%	32
2015	160	20.00%	32
2016	160	15.50%	25
	2,760	19.19%	530

Optimistic			
Year	Total Regional Demand	Estimated Subject Share	Total Subject Demand (2)
1996	80	22.00%	18
1997	80	22.00%	18
1998	80	22.00%	18
1999	80	22.00%	18
2000	80	22.00%	18
2001	120	22.00%	26
2002	120	18.00%	22
2003	120	18.00%	22
2004	120	18.00%	22
2005	120	20.00%	24
2006	160	20.00%	32
2007	160	20.00%	32
2008	160	20.00%	32
2009	160	20.00%	32
2010	160	20.00%	32
2011	160	20.00%	32
2012	160	20.00%	32
2013	160	20.00%	32
2014	160	20.00%	32
2015	160	20.00%	32
2016	160	4.50%	7
Totals	2,760	19.22%	530

Scenario Two: Assuming Maximum Regional Lot Demand

Conservative			
Year	Total Regional Demand (1)	Estimated Subject Share	Total Subject Demand (2)
1996	110	20.00%	22
1997	110	20.00%	22
1998	110	20.00%	22
1999	110	20.00%	22
2000	110	20.00%	22
2001	165	20.00%	33
2002	165	20.00%	33
2003	165	16.00%	26
2004	165	16.00%	26
2005	165	18.00%	30
2006	220	18.00%	40
2007	220	20.00%	44
2008	220	20.00%	44
2009	220	20.00%	44
2010	220	20.00%	44
2011	220	20.00%	44
2012	220	5.50%	12
	2,915	18.19%	530

Optimistic			
Year	Total Regional Demand	Estimated Subject Share	Total Subject Demand (2)
1996	110	22.00%	24
1997	110	22.00%	24
1998	110	22.00%	24
1999	110	22.00%	24
2000	110	22.00%	24
2001	165	22.00%	36
2002	165	18.00%	30
2003	165	18.00%	30
2004	165	18.00%	30
2005	165	20.00%	33
2006	220	20.00%	44
2007	220	20.00%	44
2008	220	20.00%	44
2009	220	20.00%	44
2010	220	20.00%	44
2011	220	14.00%	31
Totals	2,695	19.67%	530

(1) Based on total projected demand for resort/residential homesites in West Hawaii.

(2) Assuming subject single family component is comprised of 530 lots.

Source: The Hallstrom Group, Inc.

TABLE 29

QUANTIFICATION OF POTENTIAL SUBJECT DEMAND FOR RESORT/RESIDENTIAL MULTIFAMILY UNITS USING THE MARKET SHARES METHOD

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii

Scenario One: Assuming Minimum Regional Unit Demand

Conservative

Year	Total Regional Demand (1)	Estimated Subject Share	Total Subject Demand (2)
1996	135	10.00%	14
1997	135	12.00%	16
1998	135	12.00%	16
1999	135	12.00%	16
2000	135	14.00%	19
2001	180	14.00%	25
2002	180	14.00%	25
2003	180	15.00%	27
2004	180	15.00%	27
2005	180	15.00%	27
2006	225	16.00%	36
2007	225	16.00%	36
2008	225	16.00%	36
2009	225	16.00%	36
2010	225	16.00%	36
2011	225	16.00%	36
2012	225	16.00%	36
2013	225	16.00%	36
Totals	3,375	14.83%	500

Optimistic

Year	Total Regional Demand	Estimated Subject Share	Total Subject Demand (2)
1996	135	12.00%	16
1997	135	15.00%	20
1998	135	15.00%	20
1999	135	15.00%	20
2000	135	15.00%	20
2001	180	18.00%	32
2002	180	18.00%	32
2003	180	18.00%	32
2004	180	20.00%	36
2005	180	20.00%	36
2006	225	20.00%	45
2007	225	20.00%	45
2008	225	20.00%	45
2009	225	20.00%	45
2010	225	20.00%	45
2011	225	4.00%	9
Totals	2,925	17.11%	500

Scenario Two: Assuming Maximum Regional Unit Demand

Conservative

Year	Total Regional Demand (1)	Estimated Subject Share	Total Subject Demand (2)
1996	162	10.00%	16
1997	162	12.00%	19
1998	162	12.00%	19
1999	162	12.00%	19
2000	162	14.00%	23
2001	216	14.00%	30
2002	216	14.00%	30
2003	216	15.00%	32
2004	216	15.00%	32
2005	216	15.00%	32
2006	270	16.00%	43
2007	270	16.00%	43
2008	270	16.00%	43
2009	270	16.00%	43
2010	270	16.00%	43
2011	270	10.75%	29
Totals	3,510	14.24%	500

Optimistic

Year	Total Regional Demand	Estimated Subject Share	Total Subject Demand (2)
1996	162	12.00%	19
1997	162	15.00%	24
1998	162	15.00%	24
1999	162	15.00%	24
2000	162	15.00%	24
2001	216	18.00%	39
2002	216	18.00%	39
2003	216	18.00%	39
2004	216	20.00%	43
2005	216	20.00%	43
2006	270	20.00%	54
2007	270	20.00%	54
2008	270	20.00%	54
2009	270	6.75%	18
Totals	2,970	16.83%	500

(1) Based on total projected demand for resort/residential multifamily units in West Hawaii.
(2) Assuming subject multifamily component is comprised of circa 500 units.

Source: The Hallstrom Group, Inc.

CERTIFICATION

The undersigned do hereby certify that, to the best of our knowledge and belief, the statements of fact contained in this report are true and correct. It is further certified that the reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are our personal, unbiased professional analyses, opinions, and conclusions. We further certify that we have no present or prospective interest in the property that is the subject of this report, and have no personal interest or bias with respect to the parties involved. Our compensation is not contingent on a predetermined value or direction in value that favors the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event. The appraisal analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute and the Uniform Standards of Professional Appraisal Practice. The use of this report is subject to the requirements of the Appraisal Institute relating to review by duly authorized representatives. The undersigned certify that they have made personal inspections of the property that is the subject of this report. No persons provided significant professional assistance other than the undersigned.

The Appraisal Institute conducts programs of continuing education for their designated members. As of the date of this report, James E. Hallstrom, Jr., has completed the requirements of the continuing education program of the Appraisal Institute.

THE HALLSTROM GROUP, INC.

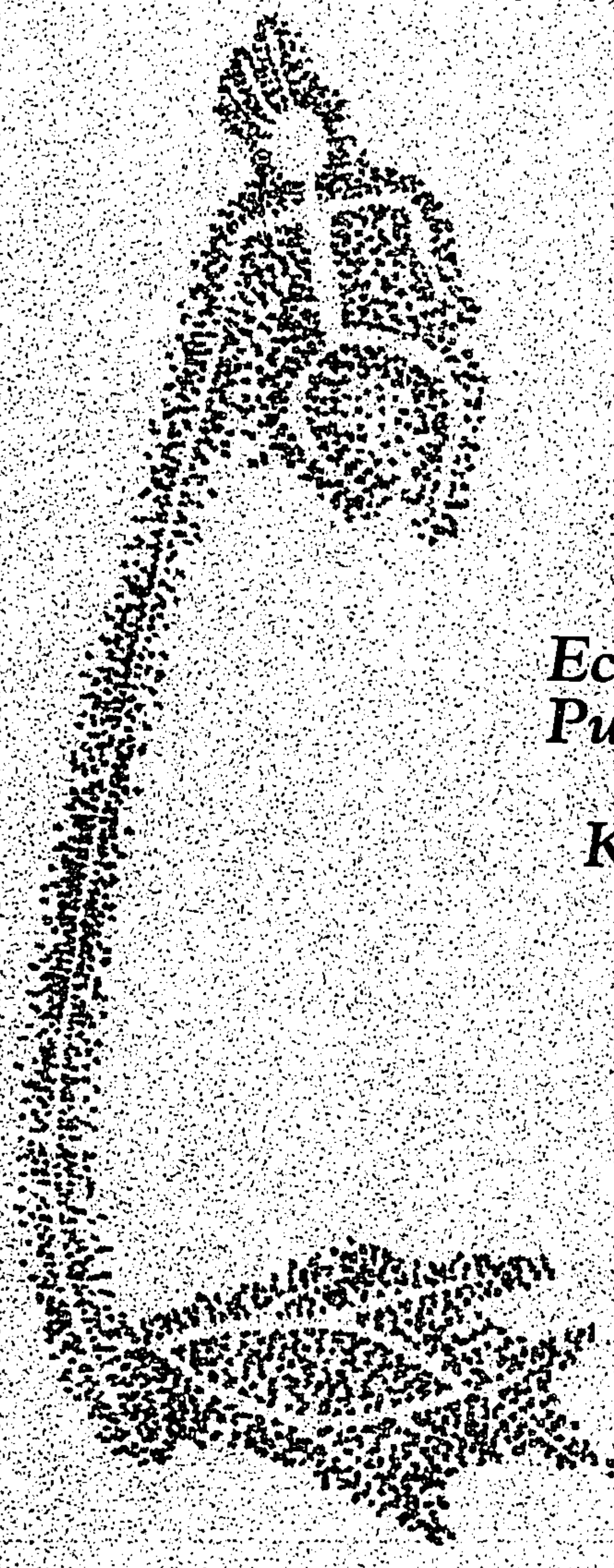
James E. Hallstrom, Jr., MAI, ~~SRA~~
Hawaii State Certified
General Appraiser, CGA-178
Exp. Date December 31, 1995

Tom W. Holliday

Tom W. Holliday

JEH/twh/as

3419_R03



Appendix J

Economic Impact Analysis and Public Cost/Benefit Analysis of the Proposed 1,120 Acre Kaupulehu Resort Expansion

THE HALLSTROM GROUP INC.
REAL ESTATE
CONSULTANTS
& APPRAISERS

ECONOMIC IMPACT ANALYSIS
and
PUBLIC COST/BENEFIT ANALYSIS
of the
PROPOSED 1,120 ACRE KAUPULEHU RESORT EXPANSION

ARBITRATION
VALUATION AND
MARKET STUDIES

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March 1, 1994

Ms. Anne Mapes
Belt Collins Hawaii
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Economic Impact Analysis and Public Cost Benefit Analysis of the Proposed 1,120 Acre Kaupulehu Resort Expansion, Kaupulehu, North Kona, Hawaii

Dear Ms. Mapes:

At your request, we have completed a defined-scope assignment addressing the general economic and public purse impacts associated with the proposed Kaupulehu Resort Expansion project. The results from our investigation, analysis, and modeling efforts are summarized in the attached report; a presentation relying primarily on tabular estimates.

We have considered the development as an independent, freestanding component of the greater Kaupulehu Resort Expansion community. The "economic" product of the subject project entails 530 single family homesites, 500 multifamily units, a two course golfing/recreation complex and a 45,000 square foot commercial village.

Our study addresses how the construction, operation, and use of the subject components will affect the economic standing of the region and the tax revenue and expenditure base of Hawaii County and the state.

The following brief report builds on the conclusions contained in our preceding market study, in addition to citing industry-based and other factors contributing to the study formulae and applications.

Please contact us if further discussion is required.

Sincerely,

THE HALLSTROM GROUP, INC.

James E. Hallstrom, Jr., MAI, SRA

JEH/as

ECONOMIC IMPACT ANALYSIS

and

PUBLIC COST/BENEFIT ANALYSIS

of the

PROPOSED 1,120 ACRE
KAUPULEHU RESORT EXPANSION

Located at

Kaupulehu Makai, North Kona, Hawaii

Kaupulehu Developments

as of

March 1994

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ECONOMIC IMPACT ANALYSIS

Summary of Findings

The development of the subject project will favorably impact the West Hawaii, Big Island, and statewide economy on both a **direct** and **indirect** basis, increasing the level of capital investment and capital flow in the region.

From a **direct** perspective, the proposed 530 single family homes, 500 multifamily units, and 36-hole golf facility and circa 45,000 square feet of neighborhood retail space in the development will create thousands of worker/years in construction jobs during the emplacement of the Kaupulehu Resort Expansion infrastructure and building of the improvements. After completion of the units and commercial areas over an extended development period, there will be more than 1,100 full-time equivalent employment positions created by the golf course facility, tenant businesses in the finished shopping village space, and by the occupied residences which will generate service and maintenance needs during their use.

Furthermore, significant profit opportunities will arise for regional companies in the construction trades who would build the community improvements, and for local businesses which would supply a substantial portion of the materials needed in the building efforts.

Indirectly, the subject development will attract a middle- to upper-income population of residents and other users, which will undoubtedly spend large amounts of discretionary income in on- and off-site shops, restaurant and service establishments throughout West Hawaii.

As these wages, profits and expenditures move through the Big Island economy they will have a ripple, or "multiplier", effect, increasing the amount of capital flowing through the entire labor and business communities.

Construction workers and others earning wages from the Kaupulehu Resort Expansion effort will spend the majority of their income on living and entertainment expenses while supporting and patronizing other County of Hawaii businesses. Much of this spending would be re-directed by these retailers and service providers to suppliers and other island-based industries. As most of the proprietors, administrators, and workers of the secondary and tertiary enterprises are also island or other in-state residents, significant portions of these fully off-site monies will be further plowed back through the region's economic structure.

The direct and indirect increases in capital flow over the several generation life-span of the subject project are the result of the capital and entrepreneurial investment undertaken by Kaupulehu Developments to convert their landholdings which have no current economic benefit for the county into a desirable mixed-use and resort/residential project.

In essence, the Big Island (primarily) and statewide (secondarily) economies would be stimulated by the construction expense and on-going lifestyle requirements of middle- to upper-income home purchasers and general consumers frequenting the Kaupulehu community.

Employment Opportunities Created

Based on indicators provided by the construction of comparable-sized projects throughout the state, and Hawaii industry averages, we have estimated the demand for **full-time equivalent** on-site employment positions associated with construction of initial infrastructure systems, golf course and community facility developments, and finished homes; operational jobs within on-site retail, restaurant, and service centers; and the maintenance of the homes and other improvements.

Land planners and engineers for the subject project anticipate the basic infrastructure servicing the individual components comprising the Kaupulehu Resort Expansion community site would be emplaced in two consecutive phases, the increments extending from mid-decade onward over a period of three to four years. This effort would include access roadways, subdivision improvements, utilities, golf course facilities, and the beach club.

Assuming stable economic conditions and favorable market acceptance, the individual developments (homesite subdivisions, condominium projects, and retail space) would be offered in phases following one another as finished inventory is absorbed by the market, and to maintain reasonable market diversity. The speed of project development would be commensurate with the absorption levels forecast in our previously published market study.

Our market analysis indicated the entire project could be successfully absorbed within 18 years of initial project offering, with a multifamily complex, oceanfront subdivision, interior subdivision, and the first golf course coming on line after an infrastructure development period of 18 months to two years. The second course would be ready for play by year three of the sales program, with the neighborhood commercial village being built in two increments opening in years seven and 15, respectively.

By their very nature, the condominium units will be completed by sell-out and closing, or within 20 years of ground-breaking for the project. The construction of finished homes on the subdivided lots will likely require an additional several years beyond the completion of lot sales. However, for consistency in presentation, we have also "squeezed" the home construction period into the 20-year time frame basis for all our models. As the dollars are constant with no appreciation, inflation or discounting, there is no net effect.

Estimates on construction workers are based on full-time "man-years", although one man-year (about 2,000 working hours) may be comprised of many employees involved in specialized tasks of a much shorter duration.

Our conclusions converting the anticipated speed and scope of project construction into an estimate of employment opportunities created in conjunction with the Kaupulehu Resort Expansion are displayed on the top of Table 1. The five components of construction are infrastructure, single family, multifamily, golf course, and commercial.

Also shown are the number of full-time equivalent employment opportunities which will be provided within the on-going golf course operation, commercial businesses, and the maintenance/service workers serving the residential and common area components of the finished project.

We consider these ratios, founded on the experience of actual West Hawaii and statewide projects, studies completed for the State of Hawaii and leading financial institutions, and nationwide indicators, to be generally moderate.

TABLE 1

EMPLOYEE JOBCOUNT AND WAGE ESTIMATES
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
In Constant Year-End 1993 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10
Worker Requirements (1)										
Infrastructure	30	30	20	10						
SFR Construction			36	52	72	83	88	79	65	65
MF Construction			23	29	33	41	45	45	45	45
Golf Course Construction (2)	30	30	20	15	5					
Comm. Construction							.13	5		
Golf Course Operation (2)			60	60	85	85	85	85	85	85
Commercial Tenants								60	100	100
Condo. Staff & Maint.			3	6	10	5	11	16	21	26
Off-Site Employees (3)	105	105	282	300	359	374	422	508	553	562
TOTAL EMPLOYMENT CREATED	165	165	443	471	565	588	663	798	870	883

Development Year	1	2	3	4	5	6	7	8	9	10
Worker Wages										
Infrastructure	$1,353,660	$1,353,660	$902,440	$451,220	$0	$0	$0	$0	$0	$0
SFR Construction	$0	$0	$1,624,392	$2,335,064	$3,248,784	$3,756,407	$3,959,456	$3,553,358	$2,944,211	$2,944,211
MF Construction	$0	$0	$1,015,245	$1,285,977	$1,489,026	$1,827,441	$2,030,490	$2,030,490	$2,030,490	$2,030,490
Golf Construction	$1,353,660	$1,353,660	$902,440	$676,830	$225,610	$0	$0	$0	$0	$0
Comm. Construction	$0	$0	$0	$0	$0	$0	$564,025	$241,725	$0	$0
Golf Course Operation	$0	$0	$1,440,000	$1,440,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000
Commercial Users	$0	$0	$0	$0	$0	$0	$0	$934,260	$1,557,100	$1,557,100
Condo. Staff & Maint.	$0	$0	$60,813	$143,310	$249,568	$125,863	$261,489	$389,115	$504,741	$620,368
Off-Site Employees	$2,940,000	$2,940,000	$7,890,660	$8,389,840	$10,064,535	$10,485,720	$11,816,123	$14,225,692	$15,497,763	$15,733,834
TOTAL ANNUAL WAGES PAID	$5,647,320	$5,647,320	$13,835,990	$14,722,240	$17,317,523	$18,235,431	$20,671,582	$23,414,640	$24,574,305	$24,926,002

(1) All jobcounts expressed as "full-time" equivalent positions.
(2) Includes two courses with clubhouse and tennis center, and beach clubhouse.
(3) Includes all off-site jobs created by work efforts at the project; direct and indirect.

Source: Various, and The Hallstrom Group, Inc.

Table 1
Contd.

EMPLOYEE JOBCOUNT AND WAGE ESTIMATES
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
In Constant Year-End 1993 Dollars

11	12	13	14	15	16	17	18	19	20	Total 1-20	Stabilized
										90	
65	65	65	65	65	65	65	65	65	65	1,193	
45	45	45	45	45	45	45	45	45	41	750	
										100	
		10	4							32	
85	85	85	85	85	85	85	85	85	85	1,480	85
100	100	100	140	180	180	180	180	180	180	1,780	180
31	35	40	45	45	50	55	60	64	69	592	69
570	579	605	673	736	744	753	761	769	770	10,530	770
896	910	950	1,058	1,156	1,169	1,183	1,196	1,209	1,209	16,547	1,103

$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,060,980	
$2,944,211	$2,944,211	$2,944,211	$2,944,211	$2,944,211	$2,944,211	$2,944,211	$2,944,211	$2,944,211	$2,944,211	$53,807,985	
$2,030,490	$2,030,490	$2,030,490	$2,030,490	$2,030,490	$2,030,490	$2,030,490	$2,030,490	$2,030,490	$1,827,441	$33,841,500	
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,512,200	
$0	$0	$451,220	$193,380	$0	$0	$0	$0	$0	$0	$1,450,350	
$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$2,040,000	$35,520,000	$2,040,000
$1,557,100	$1,557,100	$1,557,100	$2,179,940	$2,802,780	$2,802,780	$2,802,780	$2,802,780	$2,802,780	$2,802,780	$27,716,380	$2,802,780
$735,994	$851,621	$967,247	$1,082,874	$1,082,874	$1,198,500	$1,314,126	$1,429,753	$1,545,379	$1,655,243	$14,218,876	$1,073,908
$15,969,905	$16,205,975	$16,932,046	$18,848,117	$20,598,117	$20,834,188	$21,070,258	$21,306,329	$21,542,400	$21,546,205	$294,837,706	$21,546,205
$25,277,699	$25,629,396	$26,922,314	$29,319,011	$31,498,471	$31,850,168	$32,201,865	$32,553,562	$32,905,260	$32,815,879	$469,965,977	$27,462,892

Significant off-site employment will also be created by on-site construction and maintenance workers. A multiplier of 1.75 off-site jobs per on-site positions was used in our model. This is commensurate with historic indicators derived from the Department of Business Economic Development and Tourism, and First Hawaiian Bank data.

During the 20-year projection period covering the 1,120 acre subject development, the number of full-time equivalent jobs directly created on- and off-site varies from 165 to 1,209 positions annually, totaling 16,547 worker/years during the time frame.

On a stabilized basis, after the completion of construction, the project will generate some 1,103 permanent employment opportunities; 333 on-site and 770 elsewhere on the island.

Addendum I provides a brief description of the formulae used in making our Economic Impact estimates and cites the data sources used for the individual assumptions comprising the models.

Labor Pool Demographics

Initially, during the first increments of the project, the labor force required to construct and operate improvements would be drawn from the existing West Hawaii and (to a lesser degree) islandwide worker pool. Due to the steep decline in construction activity over the past three years resulting from recessionary influences, the number of contract construction jobs on the Big Island has decreased by more than 23 percent since the peak of 1989-90, with fewer than 2,500 positions available in December 1993.[1] Most forecasts call for an additional 800-plus (or one-third) of the present total to be lost as projects are completed in 1994.

Existing construction workers, as a result of the economic cycle and the lagging supply sectors, would strongly benefit from the near- to mid-term opportunities arising from infrastructure and unit development at Kaupulehu. Over time, as the project matures, additional workers would be obtained through apprenticeship of younger, entry-level tradesmen and the re-training of displaced agricultural employees.

(1) *Labor Area News*, January 1994, p.2.

Overall, Hawaii County has experienced virtually no net gain in employment over the past four years (45,650 jobs in 1989-90, 46,000 in 1993-94) with most sectors stagnating or losing positions and only the government showing significant increase; up nearly 2,000 jobs or 22 percent during the comparison period.

As the regional economy recovers later in the decade, and construction activity increases at the many existing and proposed projects, workers will again become in higher demand and the availability of jobs will attract laborers from off-island (in conjunction with the quality lifestyle of the region). At first, most will in-migrate from other islands in the state, followed by mainland individuals.

This movement is in keeping with the employment and population trends projected in state and county plans for the region over the past decade.

Most importantly, perhaps, as an under-construction community, Kaupulehu offers a true opportunity to provide much needed work for currently displaced construction laborers. While the promise of jobs is strong in conjunction with Kohanaiki, Kukio Beach, Maniniowali, the Puako Residential Golf Community, and others, they have yet to begin significant on-site activity.

From a geographical perspective, we would anticipate workers in the initial phases would be drawn from a triangular area defined by Captain Cook, Honokaa, and Hawi, or within a 40 mile radius from the project. As the study region and Kailua-Kona began the multi-decade infilling process, a smaller radius of community workers would be expected.

Wage Income Generated

In accordance with data compiled by the state Department of Labor and Industrial Relations, Labor Area News, and as revealed through our research, we have estimated the personal income (in the form of wages) which will flow to Big Island workers as a result of the Kaupulehu Resort Expansion project.

Investigation indicates the December 1993 average annual wage of a full-time contract construction worker (all skills and positions) was about $45,122, for commercial employees $15,571, and for full-time maintenance/service workers, the figure is $24,096. These figures are based on December 1993 publications further discussed in Addendum I.

Off-site administrative and office employee average annual wages were included at a mid-point wage of $28,000 (rounded).

Application of these wage estimates to the employment forecasts generates personal income (wage) projections from the subject project as shown at the bottom of Table 1. **The wage figures are all presented in constant year-end 1993 dollars, and will undoubtedly escalate over time in accordance with inflationary pressures.**

In the first year of the project, the "Total Annual Wages Generated" by the subject development effort would be $5,647,320, increasing to a high of $32,905,260, as the number of construction, commercial business and maintenance/service workers peak at the end of the 20-year projection build-out project. After completion of all construction, the on-going golf operations, retail/service tenants and use of the residences would result in the annual wages in the "stabilized" column at the right of the table, which would average $27,462,892 annually thereafter in current dollars; mostly in off-site supplemental employee wages.

Over the 20 years of the model development build-out period, total on- and off-site worker wages would be $469,965,977.

Construction Costs as Project Income

While a significant portion of the materials needed to build the subject homes must be imported to West Hawaii, much of the construction costs spent in the development will flow to local businesses in the form of **contractor profits** and **supplier profits.**

We estimate the rounded average direct construction costs for the various improvement types as follows (in 1993 dollars):

Single family Homes -- $300,000 ($140 per sq. ft. x 2,150 sq. ft.)

Multifamily Units -- $165,000 ($110 per sq. ft. x 1,500 sq. ft.)

Commercial Space -- $200 per square foot basic and finishing costs.

For modeling purposes, we have forecast infrastructure costs for the subject on a magnitude basis at $113,000,000. This figure which includes all central system and "on-site" subdivision improvements (utilities, roads, gutters, landscaping, etc.) is based on a figure of $100,000 cost per lot, $30,000 cost per multifamily unit, $25 million for the first course and clubhouse, $15 million for the second course, and $5 million for the beach club and other community facilities.

Generally, of the construction costs amount, about 20 to 25-plus percent flows to labor, 35 to 50 percent to materials, 20 percent to **contractor profit**, and 5 to 10 percent to other items.

Assuming that virtually all finished unit construction supplies are imported, and supplier profits on merchandise is an average of ten percent, the amount of **supplier profit** equates to about four percent of the total construction cost.

Application of these construction cost and regional contractor/supplier profit estimates to the forecast development parameters of the subject project is shown on Table 2. *Again, all figures are in constant year-end 1993 dollars.*

The total **Contractor's Profit** ranges from $2,631,000 to $8,000,000 per year, with a cumulative profit of $72,700,000 over the forecast period. The total annual **Supplier's Profit** ranges from a low of $526,000 to a high of $800,000, and equates to $12,280,000 over the two decade projection time frame.

Indirect Economic Impacts

These figures are somewhat problematic to quantify due to their nature, but will undoubtedly be substantial. There are three basic types of indirect impacts:

- **household income** flowing to the full-time residents of the development generally in the form of wages;
- **discretionary expenditures by the de facto population of the project**; and
- the **capital multiplier effect** in the community as these introduced funds pass through various businesses on the island.

TABLE 2

CONSTRUCTION COSTS AND CONTRACTOR AND SUPPLIER PROFIT ESTIMATES
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu North Kona, Hawaii
In Constant Year-End 1993 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10
Construction Costs (1)										
Infrastructure (2)	$40,000,000	$40,000,000	$20,000,000	$13,000,000						
SFR Construction			$4,800,000	$6,900,000	$9,600,000	$11,100,000	$11,700,000	$10,500,000	$8,700,000	$8,700,000
MF Construction			$2,475,000	$3,135,000	$3,630,000	$4,455,000	$4,950,000	$4,950,000	$4,950,000	$4,950,000
Comm. Construction							$2,500,000	$2,500,000		
TOTAL CONSTRUCTION COSTS	$40,000,000	$40,000,000	$27,275,000	$23,035,000	$13,230,000	$15,555,000	$19,150,000	$17,950,000	$13,650,000	$13,650,000
CONTRACTOR'S PROFIT	$8,000,000	$8,000,000	$5,455,000	$4,607,000	$2,646,000	$3,111,000	$3,830,000	$3,590,000	$2,730,000	$2,730,000
SUPPLIER'S PROFIT	$800,000	$800,000	$691,000	$661,400	$529,200	$622,200	$766,000	$718,000	$546,000	$546,000

Development Year	11	12	13	14	15	16	17	18	19	20	Totals
Construction Costs (1)											
Infrastructure (2)											$113,000,000
SFR Construction	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$8,700,000	$159,000,000
MF Construction	$4,950,000	$4,950,000	$4,950,000	$4,950,000	$4,950,000	$4,950,000	$4,950,000	$4,950,000	$4,950,000	$4,455,000	$82,500,000
Comm. Construction			$2,000,000	$2,000,000							$9,000,000
TOTAL CONSTRUCTION COSTS	$13,650,000	$13,650,000	$15,650,000	$15,650,000	$13,650,000	$13,650,000	$13,650,000	$13,650,000	$13,650,000	$13,155,000	$363,500,000
CONTRACTOR'S PROFIT	$2,730,000	$2,730,000	$3,130,000	$3,130,000	$2,730,000	$2,730,000	$2,730,000	$2,730,000	$2,730,000	$2,631,000	$72,700,000
SUPPLIER'S PROFIT	$546,000	$546,000	$626,000	$626,000	$546,000	$546,000	$546,000	$546,000	$546,000	$526,200	$12,280,000

(1) Direct costs only. Estimated and allocated over construction period.
(2) Includes golf course, tennis and beach facilities.

Source: Various, and The Hallstrom Group, Inc.

A meaningful issue in quantifying **expenditures of the resident and guest/consumer population** of the subject is whether these monies would be spent on Big Island if the Kaupulehu Resort Expansion master plan was not implemented; i.e., if the project was not pursued, would these dollars flow to other regional developments or go elsewhere in Hawaii or outside the state?

As the purchasers of the subject units would be of the middle- to high-income classes, the amount of discretionary expenditures would be high relative to the number of units built.

Conservative extrapolation of studies indicates the average resident in a moderate to upscale community on the Big Island spends some 60 percent of total net wages in discretionary funds for food, beverages, services, recreation and goods.

Full-time project resident incomes were estimated at $110,000 annually per household in year-end 1993 dollars. These totals equate to three times the median Big Island household income for 1993, placing these *households in the upper 20 to 25 percent of island families--the target* market.

Table 3 displays our population, discretionary expenditures and household income estimates for the subject project, based on typical household (family) size for permanent residential units of the type proposed; 3.1 persons for the single family homes, 2.2 persons for condominiums.

The de facto population of the Kaupulehu Resort Expansion node will be made up of a combination of full-time residents and part-time second home purchasers and their guests. Establishing a meaningful transient rental pool would not be a desired goal of the project. The average number of persons daily residing in the community would increase from an estimated 47 by the end of the third year of development, to 1,555 persons by the end of the projection period. Roughly, 47 percent would be in the multifamily units, 53 percent in the single family homes.

In year-end 1993 dollars, the total annual amount of discretionary expenditures from the subject population would range from a low of $770,664 to $25,603,756 by the end of study period.

TABLE 3

POPULATION, DISCRETIONARY EXPENDITURES AND RESIDENT INCOME ESTIMATES
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu North Kona, Hawaii
In Constant Year-End 1993 Dollars

Development Year	3	4	5	6	7	8	9	10	11
Cumulative Residential Development									
Single Family Homes	16	39	71	108	147	182	211	240	269
Multifamily Units	15	34	56	83	113	143	173	203	233
Total Residential Units	31	73	127	191	260	325	384	443	502
Resident/Guest Population									
Single Family	25	60	110	167	228	282	327	372	417
Multifamily	22	50	82	122	166	210	254	298	342
Total De Facto Population (1)	47	110	192	289	394	492	581	670	759
Total Resident Population (2)	23	55	96	145	197	246	290	335	379
RESIDENT/USER DISCRETIONARY EXPENDITURES	$770,664	$1,816,582	$3,164,624	$4,761,048	$6,480,987	$8,098,863	$9,563,644	$11,028,425	$12,493,207
FULL-TIME RESIDENT INCOME	$642,028	$1,513,412	$2,636,589	$3,966,684	$5,399,657	$6,747,534	$7,967,769	$9,188,004	$10,408,238

Development Year	12	13	14	15	16	17	18	19	20
Cumulative Residential Development									
Single Family Homes	298	327	356	385	414	443	472	501	530
Multifamily Units	263	293	323	353	383	413	443	473	500
Total Residential Units	561	620	679	738	797	856	915	974	1,030
Resident/Guest Population									
Single Family	462	507	552	596	641	686	731	776	821
Multifamily	386	430	474	518	562	606	650	694	733
Total De Facto Population (1)	847	936	1,025	1,114	1,203	1,292	1,381	1,470	1,555
Total Resident Population (2)	424	468	513	557	601	646	690	735	777
RESIDENT/USER DISCRETIONARY EXPENDITURES	$13,957,988	$15,422,769	$16,887,550	$18,352,332	$19,817,113	$21,281,894	$22,746,675	$24,211,457	$25,603,756
FULL-TIME RESIDENT INCOME	$11,628,473	$12,848,708	$14,068,943	$15,289,178	$16,509,413	$17,729,648	$18,949,882	$20,170,117	$21,330,023

(1) Average daily resident and overnight guest population in project.
(2) Full-Time residents only.

Source: Various, and The Hallstrom Group, Inc.

The annual full-time resident household income would reach a yearly level of $21,330,023 by the end of the project build-out.

The **capital multiplier effect** of all the direct and indirect expenditures as they flow through the Big Island and statewide economies cannot be precisely quantified, as a myriad of unknown factors must be considered. However, First Hawaiian Bank studies indicate the multiplier for resident consumer dollars in Hawaii ranges from 1.2 to 3.5 times in accordance with community structure. We believe a multiplier effect rate of 2.0 times of base expenditures is appropriate for the subject area.

For the subject, these base expenditures includes the total wages, contractor's and supplier profits, and subject population discretionary expenditures.

Total Economic Impacts

The various economic impacts which will flow to the effective subject market region as a result of the 1,120 acres of the Kaupulehu Resort Expansion development are summarized on Table 4.

The **Total Base Economic Impact** increases from $14,447,320 in the first year of construction to a high of $123.15 million (in 1993 dollars). Fueled by the household income levels, the estimated stabilized annual on-site base impact after completion of development would be more than $31 million. Over the 20-year study period, the total base impact is $791.4 million.

Application of the "Multiplier Effect Ratio" results in a **Total Overall Economic Impact** of $28.9 million in the first year of the project, increasing to a maximum of $123.15 million development in year 20 and stabilizing thereafter at some over $60 million.

PUBLIC COST/BENEFIT ANALYSIS

Introduction

The purpose of this section of study is to delineate the areas in which the proposed subject mixed-use development will potentially impact the

TABLE 4

SUMMARY OF ECONOMIC IMPACTS ASSOCIATED WITH DEVELOPMENT

Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu North Kona, Hawaii
In Constant Year-End 1993 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10
ANNUAL WAGES GENERATED (See Table 1)	$5,647,320	$5,647,320	$13,835,990	$14,722,240	$17,317,523	$18,235,431	$20,671,582	$23,414,640	$24,574,305	$24,926,002
CONTRACTOR'S PROFIT (See Table 2)	$8,000,000	$8,000,000	$5,455,000	$4,607,000	$2,646,000	$3,111,000	$3,830,000	$3,590,000	$2,730,000	$2,730,000
SUPPLIER'S PROFIT (See Table 2)	$800,000	$800,000	$691,000	$661,400	$529,200	$622,200	$766,000	$718,000	$546,000	$546,000
DISCRETIONARY EXPENDITURES (See Table 3)			$770,664	$1,816,582	$3,164,624	$4,761,048	$6,480,987	$8,098,863	$9,563,644	$11,028,425
TOTAL BASE ECONOMIC IMPACT	$14,447,320	$14,447,320	$20,752,654	$21,807,222	$23,657,347	$26,729,679	$31,748,569	$35,821,502	$37,413,949	$39,230,427
Multiplier Effect Ratio	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
TOTAL OVERALL IMPACT	$28,894,640	$28,894,640	$41,505,309	$43,614,444	$47,314,693	$53,459,358	$63,497,138	$71,643,005	$74,827,898	$78,460,855

Development Year	11	12	13	14	15	16	17	18	19	20	Total 1-20
ANNUAL WAGES GENERATED (See Table 1)	$25,277,699	$25,629,396	$26,922,314	$29,319,011	$31,498,471	$31,850,168	$32,201,865	$32,553,562	$32,905,260	$32,815,879	$469,965,977
CONTRACTOR'S PROFIT (See Table 2)	$2,730,000	$2,730,000	$3,130,000	$3,130,000	$2,730,000	$2,730,000	$2,730,000	$2,730,000	$2,730,000	$2,631,000	$72,700,000
SUPPLIER'S PROFIT (See Table 2)	$546,000	$546,000	$626,000	$626,000	$546,000	$546,000	$546,000	$546,000	$546,000	$526,200	$12,280,000
DISCRETIONARY EXPENDITURES (See Table 3)	$12,493,207	$13,957,988	$15,422,769	$16,887,550	$18,352,332	$19,817,113	$21,281,894	$22,746,675	$24,211,457	$25,603,756	$236,459,578
TOTAL BASE ECONOMIC IMPACT	$41,046,906	$42,863,384	$46,101,083	$49,962,561	$53,126,802	$54,943,281	$56,759,759	$58,576,238	$60,392,716	$61,576,835	$791,405,555
Multiplier Effect Ratio	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
TOTAL OVERALL IMPACT	$82,093,811	$85,726,768	$92,202,165	$99,925,122	$106,253,605	$109,886,562	$113,519,519	$117,152,476	$120,785,433	$123,153,669	$1,582,811,111

Source: Various, and The Hallstrom Group, Inc.

sphere of public agency resources, and quantify (where possible) the **costs of providing expanded services** to the project, versus the **economic benefits that accrue to the community** through an increase in "tax" and fee payments.

Potential costs to governmental services and programs include:

- **Police Protection**
- **Fire Protection**
- **Recreational Demands**
- **Educational Needs**
- **Public Facility Costs**
- **Various Other Services and Financial Commitments**

Tax benefits to the state and county coffers will flow from four major sources:

- **Real Property Taxes**
- **Gross Excise Tax Receipts**
- **State Income Taxes**
- **Sales Conveyance Taxes**

Some cost/benefit issues are considered as off-setting, or "a wash", as the cost of the services to the government is theoretically directly reimbursed in the form of user fees. **Building permits** and **utility hook-up** fees are two prime examples. Such items are excluded from study.

A major concern of this analysis is the integration of the subject project into the overall West Hawaii regional plan.

The 1,030 units of the Kaupulehu Resort Expansion community, while seemingly a large number, represent a minor component of the entire existing and proposed regional inventory. Given the vast number of units approved in leeward Hawaii, it is difficult to say that of themselves the subject homes will create the need for significant amounts of expanded public services. However, the need for enhancing services is a cumulative effect, each project adding to the community base until a "need threshold" is reached.

In regards to some services, the effective impact from a cost perspective may not be readily apparent, but merely creates greater stress on existing agencies and facilities. In order to realistically depict the true cost, we have adopted the moderate perspective that the subject development should be a proportionate contributor to the needed regional public service and facility net, including expansion costs which may or may not be actually incurred.

Public Costs

We have based our governmental cost assessments on the per capita expenditures incurred by the State of Hawaii and County of Hawaii in accordance with the de facto population area of the jurisdiction.

According to the Tax Foundation of Hawaii, the state spent a total of $4,459,808,000 on services, salaries, infrastructure and financing in 1991 (the most recent year data available), up more than 12 percent from 1990.

The total de facto population in the state on an average daily basis in 1991 was 1,277,600 persons, including residents, tourists and military personnel.

The per capita expenditure by the state was thus $3,490 for 1991, an increase of 19.03 percent from the 1991 figure of $3,184 per person. From 1979 to 1991, costs increased at the rate of 7.5 percent annually compounded.

It could be argued that there should be a division of costs between full-time residents and tourist populations; however, we consider such highly speculative; and while tourists may not avail themselves of every governmental service, they enjoy the benefits brought to the general community. Also, as the subject will have a mixed resident and non-resident population, this analysis seems appropriate.

Escalating the 1991 costs forward to year-end 1993 at a rate of six percent yearly compounded, the per capita state expenditure as of the study date would be some $3,925 (rounded). This figure is then multiplied by the estimated population of the subject property.

In the first year of occupancy (third project year), state costs would be $183,659, increasing to a level of $6,101,684 by build-out in Year 20 of the project life-span.

Similarly, the County of Hawaii spent a total of $103,791,000 in 1991, also representative of a major increase of 32.16 from the 1990 levels.

The de facto population for the two years on the Big Island was at 138,000 and 147,300, respectively. The resulting per capita county expenditure was therefore $705 in 1991, a substantial jump from the $569 figure for 1990.

From 1984 through 1991, county expenditures grew at a compounded annual rate of just over four percent. Application of a five percent compounded growth rate to the 1991 total, results in an estimated county per capita expense of $775 in 1993.

The total county cost, on a constant dollar basis, associated with the subject would be $36,264 in Year 3, escalating to $1,204,791 by the end of the study period.

Total Public Costs

Based on our analysis, the reasonable gross annual cost to the public from the proposed subject project, expressed in 1993 dollars, would range from $219,922 effective in project Year 3 (at the commencement of residential occupancy) to $7,306,475 by the end of the study period.

Over the two decade development time frame (from the beginning of infrastructure emplacement until all the homes are built), the entire direct cost to the public purse resulting from implementation of the Kaupulehu Resort Expansion area master plan would be $67,477,840.

Public Benefits

Real Property Taxes

Property taxes paid by landowners in the subject project were calculated using the 1993-94 tax rates for both land and buildings, improved and unimproved. Assessed values are based on the estimated average sales cost for the single family ($700,000 per home) and multifamily ($325,000 per unit) components. The commercial product assessment is based on its reproduction cost and each golf course at $50 million.

The taxes are applied against the developed units effective as of the date of sale, which is anticipated to be commensurate with their completion date.

Prior to the development and/or sale of the components, the entire 751 acre usable subject holding area (all lands except open space and set-asides) is assumed to be assessed at an approximate market value of $50,000 per acre, or $37,550,000 overall. The size of the base holding and its assessment diminishes as it decreases in area as the various project phases are undertaken.

All real property value of the subject holding is assumed to be vested in the subdivided sites, with no assessment placed against open spaces, parks, or other community systems.

The total real property tax paid to the County of Hawaii in 1993 dollars ranges from $375,000 in Year 1, to $11,019,315 at build-out. The aggregate taxes paid over the study time frame is $120,778,523.

State Income Tax -- The state will receive income taxes from three sources:

- the **wages of the workers** associated with the construction, operation and maintenance of the Kaupulehu Resort Expansion master plan components;
- the **household income** of the development's full-time residents; and
- the **corporate profits** from contractors and suppliers serving the construction phase of the development, and the operating businesses and facilities in the completed project.

The effective tax rate for the personal income (wages) generated by the subject is estimated at 5.0 percent of gross wages as projected in a foregoing section. The effective tax rate for the corporate income is estimated at 7.5 percent of gross operating profits, which is assumed to be ten percent of the forecasted gross revenues.

The total income tax revenues received by the state are projected at $597,366 in Year 1 of development increasing to a maximum level of $3.63 million. Over the study period, the cumulative income taxes paid are estimated at $49.87 million.

We have not included any corporate income or other taxes which will be paid by the development venture or commercial tenant businesses, as a result of their profits from undertaking the subject development and operations. Such items have the potential to be substantial contributions to the state coffers.

State Conveyance Tax

A conveyance tax of One Dollar ($1.00) per $2,000 of the estimated unit purchase prices were allocated for this revenue item.

Over the 18 year residential product absorption period, this fee will total $187,250, with a maximum annual amount of $10,675.

State Gross Excise Tax

This four percent of expenditures tax was applied against:

- the **total estimated construction contract costs;**
- the **golf facility commercial tenant operational revenues;** and
- the **discretionary expenditures of the resident population** of the subject.

The state excise tax receipts arising from the subject development range from an estimated $320,000 to a peak of $6,291,644 towards the end of the projection time-frame. Over the study period, the receipts total $61.57 million.

We have not included any excise tax revenues associated with "multiplier effect" expenditures throughout the Big Island.

Total Public Benefits (Revenues)

In constant 1993 dollars, the aggregate annual tax revenues flowing from the subject development range from:

- **$375,500 to $11,019,315 per year for the County of Hawaii, totaling $120,778,523 over the projection time-frame.**
- **$917,366 to $8,931,064 annually for the State of Hawaii, cumulatively at $111,629,700 over the two decade build-out period.**
- **$1,292,866 to $19,950,379 per year total tax receipts (county and state), totaling $232.4 million during the study time frame.**

Correlation

The correlation of the public costs with the anticipated tax benefits is shown on Table 5.

The net benefit (revenues less costs) to the County of Hawaii ranges from an annual/stabilized high of $9,814,524, with an aggregate benefit of $109.65 million during the study period.

The net benefit to the State of Hawaii ranges from an annual low of $917,366, to a high of $3,722,207, totaling a net overall gain of $55,278,526 over the forecast time-frame.

The overall annual net benefit to local governmental agencies (state and county) varies from $1,292,866 to $12,643,903, with a cumulative "profit" figure of $164,930,383.

In no single year do public coffers as a whole suffer a net loss.

ADDENDUM I – ECONOMIC IMPACT ANALYSIS

Introduction

This addendum identifies the various formulae and variables contributing to our **Direct** and **Indirect Economic Impacts Assessments** created in West Hawaii (primarily) and throughout the state (secondarily) as a result of the development of the proposed Kaupulehu Resort Expansion community.

The study is, for the most part, merely the application of statistical formulae in a series of tabular models. Each table builds on the former, eventually forming the basis of our final phase assessment of public cost/benefit issues.

The foundational goals and processes of the analysis were narratively described in the foregoing narrative summaries, and are self-explanatory in application. Only the variable derivations are presented in this addendum, stressing sources for the numerous factors. Please refer to the summary and Tables 1 through 4 for utilization discussion.

TABLE 5
Continued

PUBLIC COST BENEFIT SUMMARY TABLE
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
In Constant Year-End 1993 Dollars

Development Year	12	13	14	15	16	17	18	19	20	Total 1-20
PUBLIC BENEFITS (Revenues)										
1. REAL PROPERTY TAXES										
Cumulative Assessed Values										
Improvements	$316,785,000	$352,185,000	$387,585,000	$410,845,000	$426,605,000	$443,350,000	$461,080,000	$478,810,000	$494,570,000	
Land (1)	$215,260,000	$226,785,000	$238,310,000	$249,835,000	$261,360,000	$272,885,000	$284,410,000	$295,935,000	$307,250,000	
Total Assessed Value	$532,045,000	$578,970,000	$625,895,000	$660,680,000	$687,965,000	$716,235,000	$745,490,000	$774,745,000	$801,820,000	
TOTAL REAL PROPERTY TAXES	$7,215,055	$7,914,818	$8,614,580	$9,107,963	$9,473,845	$9,856,473	$10,255,845	$10,655,218	$11,019,315	$120,778,523
2. STATE INCOME TAXES										
Taxable Personal Income	$37,257,870	$39,771,022	$43,387,954	$46,787,649	$48,359,581	$49,931,513	$51,503,445	$53,075,377	$54,145,902	$450,496,569
Taxable Corporate Profits	$12,694,000	$12,914,000	$14,014,000	$13,794,000	$13,794,000	$13,794,000	$13,794,000	$12,292,500	$12,292,500	$220,327,200
Personal Taxes Paid	$1,862,893	$1,988,551	$2,169,398	$2,339,382	$2,417,979	$2,496,576	$2,575,172	$2,653,769	$2,707,295	$33,348,014
Corporate Taxes Paid	$952,050	$968,550	$1,051,050	$1,034,550	$1,034,550	$1,034,550	$1,034,550	$921,938	$921,938	$16,524,540
TOTAL STATE INCOME TAXES	$2,814,943	$2,957,101	$3,220,448	$3,373,932	$3,452,529	$3,531,126	$3,609,722	$3,575,706	$3,629,233	$49,872,554
3. STATE CONVEYANCE TAX	$10,675	$10,675	$10,675	$10,675	$10,675	$10,675	$10,675	$10,675	$10,188	$187,250
4. STATE GROSS EXCISE TAX										
Taxable Transactions										
Construction Materials	$5,460,000	$6,260,000	$6,260,000	$5,460,000	$5,460,000	$5,460,000	$5,460,000	$5,460,000	$5,262,000	$122,800,000
Golf & Commercial Operations	$33,385,000	$33,385,000	$44,385,000	$44,385,000	$44,385,000	$44,385,000	$44,385,000	$44,385,000	$44,385,000	$566,662,000
Discretionary Expenditures	$51,132,241	$56,688,516	$62,244,791	$66,293,747	$69,371,459	$72,641,528	$76,103,954	$79,566,380	$82,644,092	$849,785,416
Total Taxable Transactions	$89,977,241	$96,333,516	$112,889,791	$116,138,747	$119,216,459	$122,486,528	$125,948,954	$129,411,380	$132,291,092	$1,539,247,416
TOTAL STATE EXCISE TAX	$3,599,090	$3,853,341	$4,515,592	$4,645,550	$4,768,658	$4,899,461	$5,037,958	$5,176,455	$5,291,644	$61,569,897
TOTAL GROSS PUBLIC REVENUES										
To Hawaii County (Item #1)	$7,215,055	$7,914,818	$8,614,580	$9,107,963	$9,473,845	$9,856,473	$10,255,845	$10,655,218	$11,019,315	$120,778,523
To State (Items #2,3 & 4)	$6,424,708	$6,821,117	$7,746,714	$8,030,157	$8,231,862	$8,441,262	$8,658,355	$8,762,837	$8,931,064	$111,629,700
AGGREGATE TAX REVENUES	$13,639,763	$14,735,934	$16,361,294	$17,138,120	$17,705,707	$18,297,734	$18,914,200	$19,418,054	$19,950,379	$232,408,223
PUBLIC COSTS (Expenses)										
State	$3,326,357	$3,675,432	$4,024,507	$4,373,582	$4,722,657	$5,071,733	$5,420,808	$5,769,883	$6,101,684	$56,351,175
County	$656,797	$725,722	$794,648	$863,574	$932,499	$1,001,425	$1,070,351	$1,139,276	$1,204,791	$11,126,665
TOTAL PUBLIC COSTS	$3,983,154	$4,401,155	$4,819,155	$5,237,156	$5,655,157	$6,073,157	$6,491,158	$6,909,159	$7,306,475	$67,477,840
TOTAL NET PUBLIC BENEFITS										
To State	$3,098,351	$3,145,685	$3,722,207	$3,656,575	$3,509,205	$3,369,529	$3,237,548	$2,992,954	$2,829,379	$55,278,526
To Hawaii County	$6,558,258	$7,189,095	$7,819,932	$8,244,389	$8,541,346	$8,855,048	$9,185,494	$9,515,941	$9,814,524	$109,651,857
AGGREGATE NET BENEFITS	$9,656,609	$10,334,780	$11,542,139	$11,900,964	$12,050,551	$12,224,577	$12,423,042	$12,508,895	$12,643,903	$164,930,383

TABLE 5

PUBLIC COST BENEFIT SUMMARY TABLE
Market Study of the Proposed Kaupulehu Resort Expansion
Kaupulehu, North Kona, Hawaii
In Constant Year-End 1993 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10	11
PUBLIC BENEFITS (Revenues)											
1. REAL PROPERTY TAXES											
Cumulative Assessed Values											
Improvements			$39,815,000	$60,820,000	$97,585,000	$124,310,000	$152,020,000	$189,580,000	$219,260,000	$248,940,000	$282,370,000
Land (1)	$37,550,000	$37,550,000	$82,535,000	$87,585,000	$145,770,000	$155,930,000	$166,950,000	$176,670,000	$184,440,000	$192,210,000	$203,735,000
Total Assessed Value	$37,550,000	$37,550,000	$122,350,000	$148,405,000	$243,355,000	$280,240,000	$318,970,000	$366,250,000	$403,700,000	$441,150,000	$486,105,000
TOTAL REAL PROPERTY TAXES	$375,500	$375,500	$1,378,403	$1,778,413	$2,897,990	$3,438,675	$4,003,415	$4,724,555	$5,295,160	$5,865,765	$6,532,038
2. STATE INCOME TAXES											
Taxable Personal Income	$5,647,320	$5,647,320	$14,478,018	$16,235,652	$19,954,112	$22,202,115	$26,071,238	$30,162,173	$32,542,074	$34,114,006	$35,685,938
Taxable Corporate Profits	$4,200,000	$4,200,000	$5,271,500	$5,786,850	$8,920,800	$10,767,050	$11,924,000	$11,792,000	$12,694,000	$12,694,000	$12,694,000
Personal Taxes Paid	$282,366	$282,366	$723,901	$811,783	$997,706	$1,110,106	$1,303,562	$1,508,109	$1,627,104	$1,705,700	$1,784,297
Corporate Taxes Paid	$315,000	$315,000	$395,363	$434,014	$669,060	$807,529	$894,300	$884,400	$952,050	$952,050	$952,050
TOTAL STATE INCOME TAXES	$597,366	$597,366	$1,119,263	$1,245,796	$1,666,766	$1,917,634	$2,197,862	$2,392,509	$2,579,154	$2,657,750	$2,736,347
3. STATE CONVEYANCE TAX			$5,638	$7,688	$9,975	$11,788	$12,675	$11,875	$10,675	$10,675	$10,675
4. STATE GROSS EXCISE TAX											
Taxable Transactions											
Construction Materials	$8,000,000	$8,000,000	$6,910,000	$6,614,000	$5,292,000	$6,222,000	$7,660,000	$7,180,000	$5,460,000	$5,460,000	$5,460,000
Golf & Commercial Operations			$6,775,000	$8,295,000	$16,590,000	$18,112,000	$19,635,000	$19,635,000	$33,385,000	$33,385,000	$33,385,000
Discretionary Expenditures			$7,035,218	$10,273,751	$16,589,995	$20,698,863	$25,000,089	$31,224,884	$35,910,823	$40,596,762	$45,768,323
Total Taxable Transactions	$8,000,000	$8,000,000	$20,720,218	$25,182,751	$38,471,995	$45,032,863	$52,295,089	$58,039,884	$74,755,823	$79,441,762	$84,613,323
TOTAL STATE EXCISE TAX	$320,000	$320,000	$828,809	$1,007,310	$1,538,880	$1,801,315	$2,091,804	$2,321,595	$2,990,233	$3,177,670	$3,384,533
TOTAL GROSS PUBLIC REVENUES											
To Hawaii County (Item #1)	$375,500	$375,500	$1,378,403	$1,778,413	$2,897,990	$3,438,675	$4,003,415	$4,724,555	$5,295,160	$5,865,765	$6,532,038
To State (Items #2,3 & 4)	$917,366	$917,366	$1,953,710	$2,260,794	$3,215,620	$3,730,737	$4,302,340	$4,725,979	$5,580,062	$5,846,096	$6,131,555
AGGREGATE TAX REVENUES	$1,292,866	$1,292,866	$3,332,112	$4,039,206	$6,113,610	$7,169,412	$8,305,755	$9,450,534	$10,875,222	$11,711,861	$12,663,592
PUBLIC COSTS (Expenses)											
State			$183,659	$432,913	$754,168	$1,134,615	$1,544,498	$1,930,057	$2,279,132	$2,628,207	$2,977,282
County			$36,264	$85,480	$148,912	$224,032	$304,964	$381,094	$450,020	$518,945	$587,871
TOTAL PUBLIC COSTS			$219,922	$518,393	$903,080	$1,358,648	$1,849,462	$2,311,151	$2,729,152	$3,147,152	$3,565,153
TOTAL NET PUBLIC BENEFITS											
To State	$917,366	$917,366	$1,770,051	$1,827,880	$2,461,452	$2,596,121	$2,757,843	$2,795,922	$3,300,930	$3,217,889	$3,154,273
To Hawaii County	$375,500	$375,500	$1,342,139	$1,692,933	$2,749,078	$3,214,643	$3,698,451	$4,343,461	$4,845,140	$5,346,820	$5,944,167
AGGREGATE NET BENEFITS	$1,292,866	$1,292,866	$3,112,190	$3,520,813	$5,210,530	$5,810,764	$6,456,293	$7,139,383	$8,146,070	$8,564,708	$9,098,439

(1) Includes golf courses, tennis center and related clubhouses/improvements.

Source: The Hallstrom Appraisal Group, Inc.

In the following brief outlined sections, each component comprising the models is presented as identified by their line-by-line "titles" from the tables (shown in the left-hand margin) on an individual basis.

The tables are referenced by number according to their presentation in the foregoing summary.

In general, our tables depict a 20-year study period extending from the anticipated beginning of on-site infrastructure construction by mid to late decade through built-out two decades later, by which time all components of the project will be absorbed and operating at a stabilized level.

All dollar values are expressed in constant year-end 1993 dollars, uninflated and unescalated.

In completing this portion of study we have researched published data from the State of Hawaii Department of Business, Economic Development & Tourism; the State of Hawaii Department of Labor and Industrial Relations; and various other state and federal agencies. We have also interviewed developers/contractors, business persons, and other knowledgeable parties, and reviewed published EIS and similar public and private documents.

Additionally, we have accumulated substantial data from past experience with comparable projects in pursuing our appraisal assignments.

Table 1 -- Employee Job Count and Wage Estimates

The purpose of this table is to estimate the number of employment opportunities which will be created by the 1,120 acre subject project both during the construction (infrastructure and finished unit) and operational (stabilized) phases, and the direct wages which will be generated by these positions.

We note, our wage estimates do not include benefits and other non-cash aspects associated with employment.

All jobs are expressed as "full-time" equivalent positions, requiring about 2,000 hours of labor annually, even though several part-time persons/tasks may be required during the course of the work effort. We note, according to the U.S. Department of Labor, the typical

American employee has averaged between 1,890 and 1,950 hours "on the clock" over the past five years. The vast majority of labor positions in the state fall within this range, tending towards the upper end. Retail employees were at the low end of the scale in the islands averaging only 1,450 hours, with communication and utility workers averaging 2,180 hours in 1993.

Worker Requirements

Infrastructure -- Based on discussions with contractors, developers and engineers for recently constructed and proposed major community developments; including, Amfac/JMB; Austin Tsutsumi & Associates; M&E Pacific, and others.

SFR Construction -- In accordance with the anticipated complexity of the average single family house at Kaupulehu, it is estimated that each home will require 2.25 worker/years to build. The average detached residence is assumed to contain 2,150 square feet of gross enclosed living area.

The worker figure is based on discussions with contractors and our appraisal experience.

MF Construction -- Each unit is estimated to require 1.5 worker/years, and would average 1,500 square feet of living area.

Comm. (Commercial) Construction -- Estimated employee requirement is one worker/year for every 1,400 square feet of gross leaseable area, spread over a two-year construction period. This total includes both basic development and tenant improvements.

Golf Course Operations -- According to numerous appraisals our firm has recently completed, it requires approximately 25 full-time positions to upkeep, service equipment, and run the various aspects of an operating course. Even with sharing a clubhouse, the two subject courses would still create up to 50 full-time opportunities. An additional 25 jobs would be associated with the clubhouse restaurant/lounge, and an allowance of ten additional positions is made to provide beach club and tennis court attendants.

Commercial Users -- Employees in the retail, restaurant and service commercial tenants of the neighborhood shopping village (commercial center) and any retail opportunities in the golf clubhouse are estimated at one full-time worker equivalent per 250 square feet of gross leaseable floor area. This figure is supported by BOMA, the Urban

Institute, and our survey of statewide retail centers. A two-year lease-up period for each center phase is anticipated.

Maintenance Workers -- Gardeners, service/repair, domestic and other workers who would service the finished homes/units and community amenities.

Requirement is estimated at one full-time position per 12 single family homes and one per 15 condominium units. We consider this figure, based on our survey of comparable resort/upscale communities in Hawaii, to be moderate.

Off-Site Employees -- Employment positions outside of Kaupulehu directly created by economic activity within the community, including support personnel for on-site workers.

The standard multiplier is estimated from 1.25 to as high as 2.0 full-time positions per on-site worker by the state's DBED. Given the status envisioned for the subject development, we have used a mid-point of 1.75 off-site to on-site ratio.

These are not necessarily "new" positions in the community, but includes "new" business for existing supply, service, and other concerns. Companies in the various Kailua and Kawaihae industrial parks, as well as shipping and landscaping suppliers, would likely benefit most.

Worker Wages

All wages are based on data from the Hawaii Department of Labor and Industry, interviews with business persons, and our review of operational profit and loss ledgers for similar businesses. We specifically cite the "Hours and Earnings of Workers in Selected Industries, December 1993 (Preliminary)" published in the January 1994 edition of the Labor Area News.

Workers are assumed to be unionized, where applicable. Again, figures exclude non-cash benefits.

Infrastructure, SFR, MF and Comm. (Commercial) Construction -- Average direct wage for all worker types, including laborers, journeymen and supervisory personnel, is estimated at $23.44 per hour, or $45,122 per year (rounded).

Commercial Users -- Average annual wage of $15,571 or $8.67 hourly. This figure does not include operational profits flowing to entrepreneurs or tips to restaurant employees.

Maintenance Workers -- Estimated average annual wage of $24,096, or circa $12 per hour.

Off-Site Employees -- Estimated at about $14 per hour, or $28,000 per year.

Table 2 -- Contractor and Supplier Construction Profit Estimates

Intended to illustrate the construction costs associated with the various phases of subject development primarily for use in the public cost/benefit portion of our analysis, this undertaking quantifies the level of regional contractor and supplier profits anticipated.

Construction Costs

Infrastructure -- Complete on- and off-site infrastructure costs including the golf courses and community facilities were estimated at $118 million, as broken down in the narrative summary.

SFR Construction -- Estimated at an average of $140 per square foot for 2,150 square foot average-sized residence, or $300,000 (rounded) cost total. All structure costs based on data provided by marketplace developers, but are commensurate with that estimated for similar quality homes by Wayne Herlick & Associates and others.

MF Construction -- Average condominium construction cost of $165,000 per unit (rounded), based on average size of 1,500 square feet and $110 per square foot cost.

Comm. (Commercial) Construction -- Estimated at $150 to $175 per square foot base construction cost, with tenant improvements at $25 to $50 per square foot.

Contractor's Profit

Estimated at 20 percent of total construction costs for all items. Taken from review of historic construction contracts and discussion with Honolulu and neighbor island contractors.

Suppliers Project

Estimated at four percent of non-infrastructure construction costs. Based on 10 percent of 40 percent of costs allocated to supplies in finished unit construction. Supported by various sources.

Table 3 -- Population, Discretionary Expenditures and Resident Income Estimates

Intended to illustrate the resident population which will inhabit the Kaupulehu Resort Expansion community, their probable discretionary expenditures in the West Hawaii economy, and the household income levels of the full-time residents of the community.

Cumulative Residential Development

Based on the speed of construction discussed in description of Table 1 factors.

Resident Population

Single Family -- The total number of homes built times a factor composed of:

- 25 percent of the homes being occupied by full-time residents having 3.1 persons per household; and,
- 75 percent of the homes being occupied by part-time residents (second-home) users one-third of the time, with an average household size of 3.1 persons.

Multifamily -- The total number of units built times a factor composed of:

- 33 percent of the units being occupied by full-time residents having an average household size of 2.2 persons; and
- 67 percent of the units being occupied by part-time (second home) 50 percent of the time with an average household size of 2.2 persons.

Resident Income

These are the household wages and other monies received by the full-time residents of the community.

This figure is estimated at $110,000 per purchaser household. This is about three times the median 1993 Big Island income, commensurate with the market share forecast.

We have used a higher than median figure to account for the upper-income households anticipated to comprise the second-home purchasers of the subject product. Despite this additional allowance, we still consider this level conservative.

Resident Population Discretionary Expenditures

Based on surveys undertaken by Hawaii Visitors Bureau, Robt. Charles Lessor & Co., ourselves and others. For households in this income bracket (mid- to upper-class), it was estimated discretionary expenditures equal 60 percent of total household income.

Table 4 -- Summary of Economic Impacts Associated With Development

Annual Wages Generated -- From Table 1.

Contractor's Profit -- From Table 2.

Supplier's Profit -- From Table 3.

Discretionary Expenditures -- From Table 3.

Total Base Impact -- Sum of above four totals, this is the base economic benefit flowing to the private economic sector arising from the development of the subject project.

Multiplier Effect Ratio -- As the "base impact" dollars move through the local economy they will be spent and re-spent by the recipients, further contributing to the growth and vitality of the private and public sector.

A myriad of variables must be considered in quantifying this number, primarily on how fast (through how many "hands") the capital moves before it is sent out-of-state. First Hawaiian Bank studies indicate the multiplier for resident consumer and business dollars in Hawaii ranges from 1.2 to 3.5 times in accordance with the source and focus of the expenditure and the community structure.

We have utilized a conservative 2.0 multiplier effect for the subject.

Total Overall Impact -- The Base Economic Impact total times the Multiplier Effect Ratio. This figure is the gross direct and indirect economic benefit flowing to the island from undertaking the subject development.

ADDENDUM II -- PUBLIC COST/BENEFIT ASSESSMENT

As with Addendum I, this section is a summary presentation of the variables contributing to the table and discussion in the **Executive Summary**.

Table 5 -- Public Cost Benefit Summary Table

Public Benefits (or Revenues)

Real Property Taxes -- The "improvements" total is based on assessments at the estimated construction cost of the finished structures (all types) taxed at the currently prevailing rate of assessed value. The improvements are taxed beginning in the year of their anticipated construction. A land assessment for the subject holding prior to its final development and disposal is also included.

All value was assumed vested in the completed components, with no value in any community systems or amenities.

State Income Taxes

Taxable Personal Income/Taxes Paid -- Taxable income is taken from two sources:

-- Total Wages generated through employment associated with the subject project, as taken from Table 1; and,

-- Resident Income received by the full-time residents of the community. From Table 3.

The prevailing state income tax rate was estimated at five percent of total personal income. This figure is based on Tax Foundation of Hawaii ("Government in 1991") figures.

Taxable Corporate Profits/Taxes Paid -- Corporate profits associated with the subject community are produced by several operations:

-- Contractor's Profits, from Table 2, with a net operational profit estimated at 50 percent of gross profits based on interviews;

-- Supplier's Profits, also from Table 2, with a net operational profit estimated at 25 percent of gross profits; and,

-- Golf Course and Retail/Service/Business Operations, estimated based on our appraisal/market survey experience of comparable properties. Net profit levels estimated at average of 10 percent of gross sales.

Extrapolation of State of Hawaii Department of Taxation and Tax Foundation of Hawaii data indicates the effective corporate profits tax rate in 1991 was circa 7.5 percent. We have employed this rounded rate in our analysis.

State Conveyance Taxes

According to ordinance, this tax is assessed at $1 per $2,000 of real property sales transactions. It was applied against the anticipated sales of the subject components in the projected year of sale.

We have not assumed any sale of the commercial components, which could generate substantial additional taxes of this type.

State Gross Excise Tax

A compilation of taxable transactions by residents of the community, we acknowledge, there may be some minimal double-counting as portions of the forecast discretionary expenditures will undoubtedly be spent in the subject commercial operations. However, we have mitigated this concern by employing a moderate discretionary income level for the anticipated upscale subject project residents (as noted in Addendum I).

This may result in a minor overstatement in total gross excise taxes.

The effective tax rate applied against these items is four percent.

Construction Materials -- Based on 40 percent of total finished single family, multifamily and commercial component construction costs, along with a 20 percent allowance for materials for the infrastructure and golf course items. The 40 percent figure, as an allocation for materials of total construction cost, is taken from discussions with major contracting and engineering firms, and our experience.

Golf Course and Commercial Operations -- See "Corporate Profits" item foregoing.

Discretionary Expenditures -- From Table 3.

Total Public Revenues

To the County of Hawaii-- Real Property Taxes.

To State -- State Income Taxes, State Conveyance Taxes, and State Gross Excise Taxes.

CERTIFICATION

The undersigned do hereby certify that, to the best of our knowledge and belief, the statements of fact contained in this report are true and correct. It is further certified that the reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are our personal, unbiased professional analyses, opinions, and conclusions. We further certify that we have no present or prospective interest in the property that is the subject of this report, and have no personal interest or bias with respect to the parties involved. Our compensation is not contingent on a predetermined value or direction in value that favors the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event. The appraisal analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute and the Uniform Standards of Professional Appraisal Practice. The use of this report is subject to the requirements of the Appraisal Institute relating to review by duly authorized representatives. The undersigned certify that they have made personal inspections of the property that is the subject of this report. No persons provided significant professional assistance other than the undersigned.

The Appraisal Institute conducts programs of continuing education for their designated members. As of the date of this report, James E. Hallstrom, Jr., has completed the requirements of the continuing education program of the Appraisal Institute..

THE HALLSTROM GROUP, INC.

James E. Hallstrom, Jr., MAI, SRA
Hawaii State Certified
General Appraiser, CGA-178
Exp. Date December 31, 1995

Tom W. Holliday / LR
Tom W. Holliday

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