JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

'91 OCT 25 A11:44

October 23, 1991

Mr. Brian Choy, Director
State of Hawaii
Office of Environmental
Quality Control (OEQC)
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

SUBJECT: Negative Declaration for
Kawaihae Residence Lots - Unit 1
Kawaihae, South Kohala,
Island of Hawaii

Enclosed are four copies of the Environmental Assessment for the proposed Kawaihae Residence Lots, Unit 1 project in Kawaihae, South Kohala Island of Hawaii. Upon our review and analysis of the conditions and impacts presented in the Environmental Assessment, we have concluded that the proposed project will have no significant effect on the environment. Therefore, we are filing a Negative Declaration for the proposed project.

We request that this Negative Declaration be published in the next OEQC Bulletin. A completed OEQC Bulletin Publication Form is enclosed as required.

Should you have any questions, please have your staff call Stanley H.S. Wong, Land Development Division, at 548-2686.

Warmest aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

HLD:RS:SW:lar

Enclosures

cc: R. M. Towill Corp.

195

3394B/1

1992-11-13-HI-FEA- Kawaihae Residence Lots, Unit 1 Project

ENVIRONMENTAL ASSESSMENT for the

KAWAIHAE RESIDENCE LOTS - UNIT 1
South Kohala, Hawaii

SEPTEMBER 1991

PREPARED FOR:

Department of Hawaiian Home Lands
State of Hawaii

RMTC
R. M. Towill Corporation

420 Waiakamilo Rd., Suite 411
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KAWAIHAE RESIDENCE LOTS - UNIT 1
Environmental Assessment
South Kohala, Hawaii

Prepared For:

Department of Hawaiian Home Lands
State of Hawaii

SEPTEMBER 1991

Prepared By:

R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

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SECTION 1

PROJECT DESCRIPTION

1.1 PURPOSE OF PROPOSED ACTION

The Hawaiian Homes Commission Act of 1920 (HHCA) was enacted by the Congress of the United States on July 9, 1921 to distribute benefits to native Hawaiians inhabiting the Hawaiian Islands previous to 1778. These benefits include establishing a government-sponsored homesteading program. The HHCA set aside approximately 200,000 acres of public land located on the five major Hawaiian Islands to return the native Hawaiians to the land and to the mode of living of their ancestors. The Hawaiian Homes Commission was established to administer the provisions of the HHCA and to establish broad operating policies for the State of Hawaii Department of Hawaiian Home Lands. Included in the Act are authorities to:

"1) lease, not sell, land to native Hawaiian beneficiaries for 99-year periods at a rental rate of $1 per year;

2) offer financial assistance to individual homesteaders through low-interest loans for agricultural development and home construction; and

3) provide agricultural and other experts to aid the beneficiary homesteaders in developing their farms and ranches."

Native Hawaiians more and more are favoring development and award of urban residential homestead houselots instead of agricultural or pastoral homesteads. Although residential lots can accommodate more beneficiaries on a given amount of land, they also require more capital improvement expenditures to bring them up to acceptable development standards.

Thus, the Department of Hawaiian Home Lands (DHHL) is now planning to develop 195, 1/2-acre to one-acre lots on the Kawaihae I Ahupuaa in South Kohala to provide residential homestead lots for the native Hawaiians. This subdivision will be developed with the infrastructure necessary for an urban residential development.

This Environmental Assessment (EA) has been prepared pursuant to Chapter 343 of the Hawaii Revised Statutes, and in accordance with the rules and regulations of the Office of Environmental Quality Control

1.2 PROJECT LOCATION

The 205-acre project is located about a mile north of Kawaihae Town in the South Kohala District on the western coastline of the Island of Hawaii (see Figure 1). The project site is situated on portions of Tax Map Keys 6-1-01:3 and 16. Parcel 3 covers 8,175 acres and parcel 16 approximately 35 acres. The project site is located mauka of the existing Akoni Pule Highway, which is the major coastal highway that passes through Kawaihae Town (see Figure 2). Access to the project site will be via two intersections with Akoni Pule Highway.

1.3 PROJECT DESCRIPTION

The Department of Hawaiian Home Lands is proposing to develop 195 single family residential lots on approximately 205 acres of land in Kawaihae (see Figure 3). These lots are for native Hawaiians who have qualified to lease land under the HHCA. These lessees are to construct their own home on the lot awarded them. Lot sizes will range from about 0.5 to 1.0 acre in size.

Access to the site will be provided by two T-intersections with Akoni Pule Highway. A storage lane will be provided on Akoni Pule Highway for left turn movements into the subdivision and a deceleration lane is planned for right turns into the project. All roadways within the project site will include water, electric, telephone and drain lines to service the project. The right-of-way widths for the internal roadways will range from 50 feet to 60 feet. Because of the rural nature of the area, curbs and gutters are not planned; however, 10- to 20-foot wide paved shoulders will be installed to serve as a drainage swales.

Storm water runoff resulting from the creation of impervious surfaces will be handled by routing the water to drywells within the roadway shoulders. The water will then infiltrate into the ground and contribute to groundwater recharge. Natural storm water

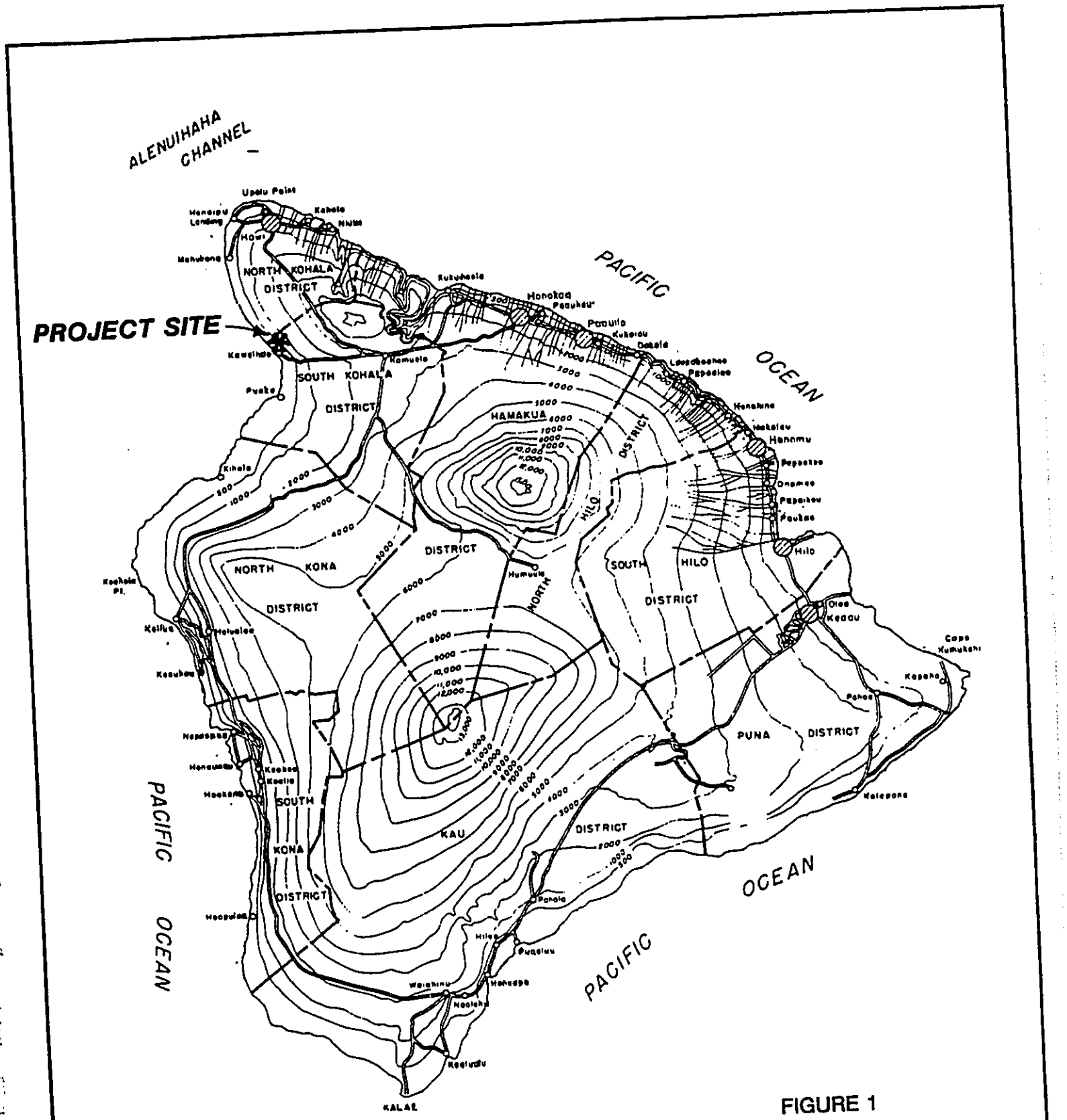

FIGURE 1

LOCATION MAP

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

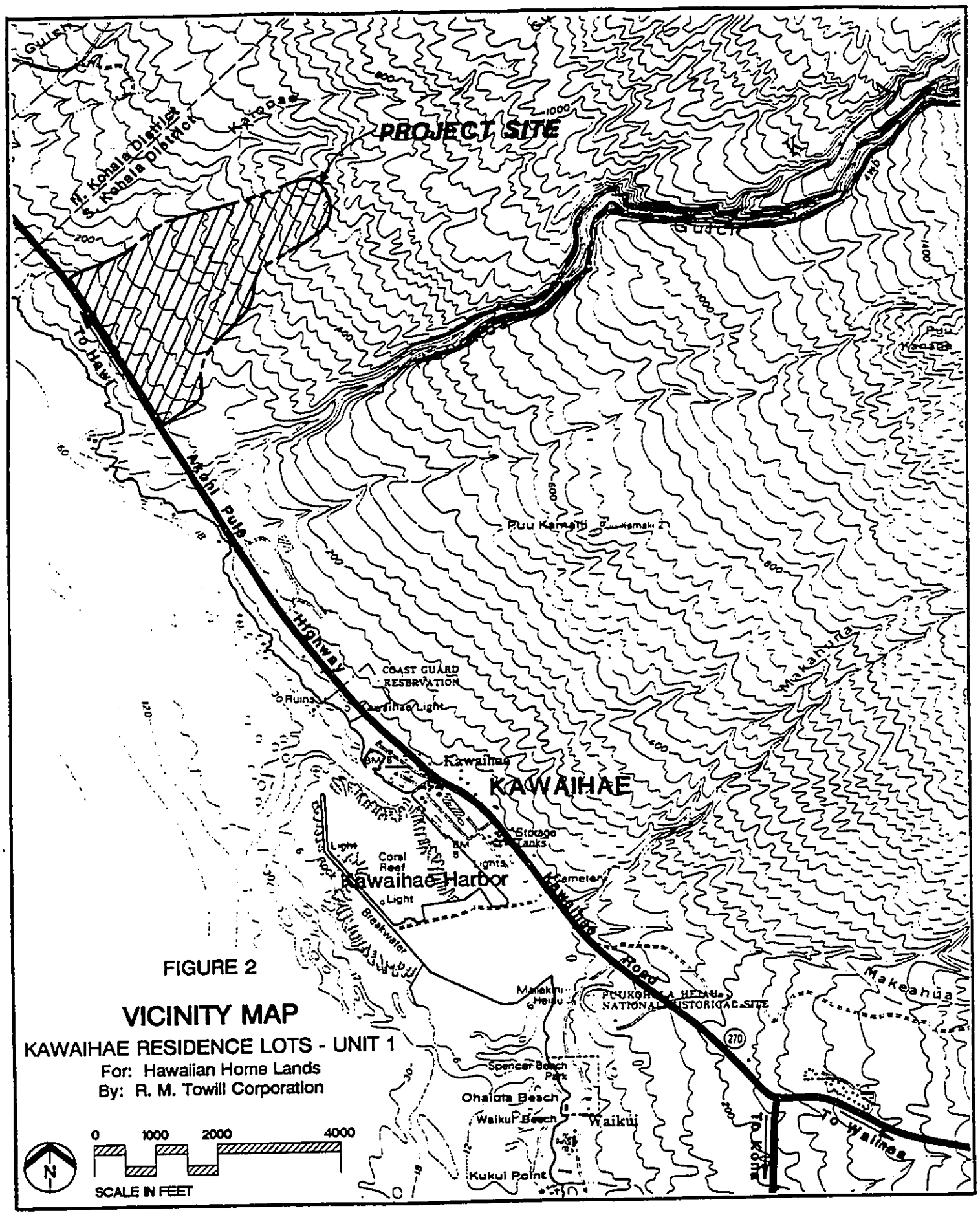

FIGURE 2

VICINITY MAP

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

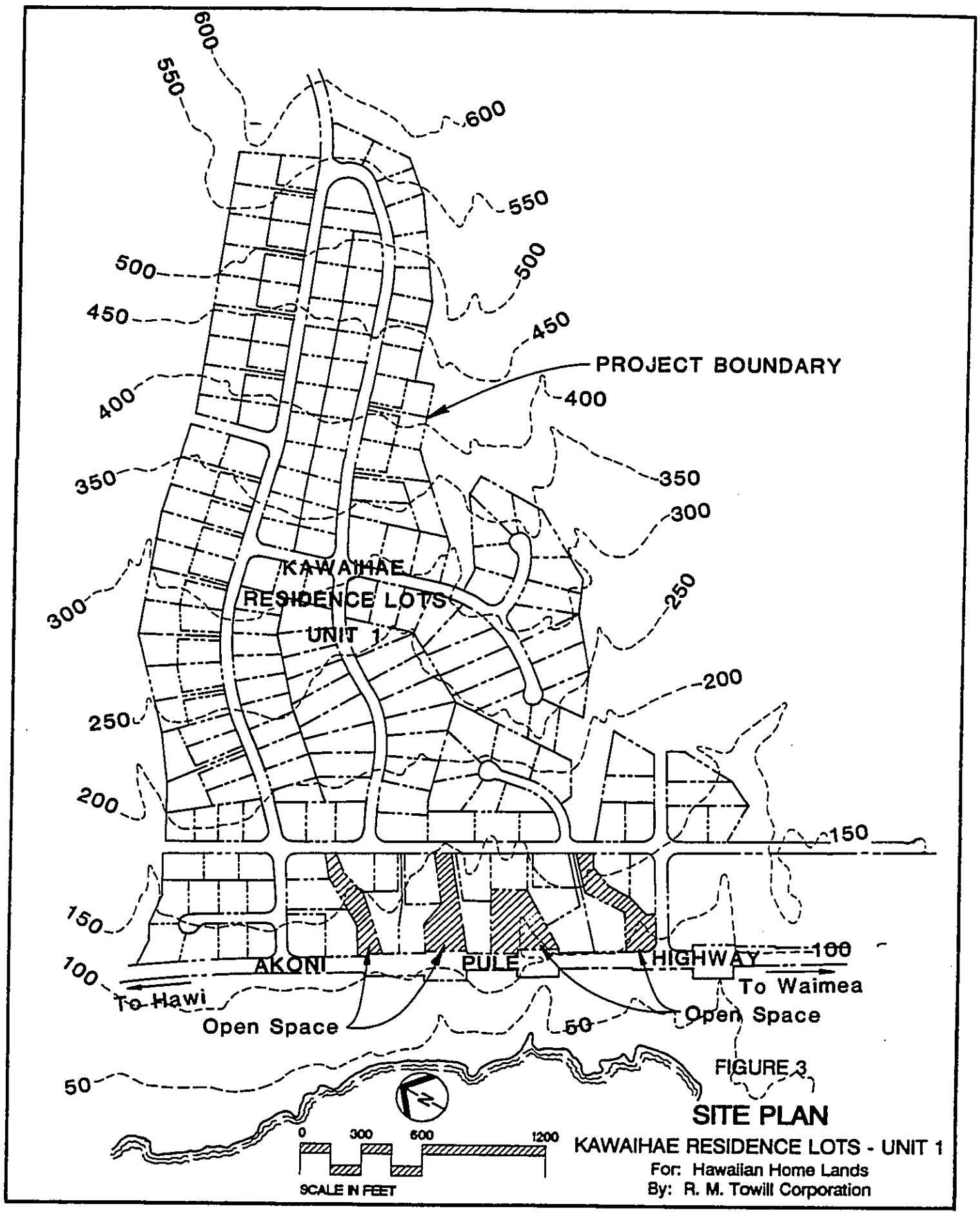

FIGURE 3

SITE PLAN

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

runoff will be routed to the existing gulches and drainageways in the vicinity of the project to maintain the natural drainage pattern in the area. One of the major gulches is the Kaiopae Gulch located adjacent to and north of the project site. Smaller drainageways occur on the southern and makai sides of the project site and will remain as open areas within the subdivision.

It is proposed that potable water to be supplied by a new water well to be developed within DHHL's 10,000-acre parcel. An exploratory well had been drilled southeast of the subdivision on the opposite side of Honokoa Gulch in 1990; however, the water tested to be brackish. A new test well is being planned above the subdivision at a higher elevation. It is expected this well will contain good potable water due to its proximity to other successful wells. As the water source will be located above the project site, a gravity flow system will be employed to service each of the lots. A reservoir is also planned above the project site to store sufficient amounts of potable water. The reservoir will service the proposed this subdivision as well as future developments on the Hawaiian Home lands. The distribution lines will be sized to accommodate fire flow protection requirements.

Because there is no county sewerage system in the vicinity of the proposed project, septic tanks will be used to receive and contain wastewater. As development occurs, septic tanks will be installed by each of the lessees. Periodically, the septage will be pumped out and disposed of at the Kealakehe Wastewater Treatment Plant which is being constructed for the West Hawaii region.

Solid waste is presently disposed of at the Kealakehe sanitary landfill. Solid waste will continue to be disposed of at the Kealakehe sanitary landfill until such time the new landfill being planned for the West Hawaii region is opened for operation.

Power will be provided by the Hawaii Electric Light Company via an existing overhead system. Street lights will be installed according to County standards. Communication

lines will also be provided via the existing overhead telephone line system and service will be provided by the Hawaiian Telephone Company.

SECTION 2

DESCRIPTION OF THE ENVIRONMENT AND POTENTIAL IMPACTS AND MITIGATION MEASURES

2.1 PHYSICAL ENVIRONMENT

2.1.1 Ownership and Existing Land Uses

The project is situated on portions of Tax Map Key 6-1-01:03 and 16, both of which are owned by the State of Hawaii, Department of Hawaiian Home Lands (see Figure 4). Tax Map Key 6-1-01:3 consists of 8,175 acres and Tax Map Key 6-1-01:16 contains about 35 acres. With the exception of 560 acres, the land is currently leased to the Kahua Ranch, Ltd., which in turn has sub-leased the property to Hoepaa, Inc. for cattle and horse grazing. The area which is used for grazing is at about elevation 1,000 to 4,000 feet above mean sea level, mauka of the project site.

Surrounding land uses include the Kohala Estates 750-acre agricultural subdivision consisting of 5- and 20-acre agricultural lots and the 3,900-acre Kohala Ranch subdivision containing 3-, 5-, 10- and 20-acre agricultural lots north of the project (see Figure 5). Kawaihae Harbor, one of only two deep water ports on the island, is located makai and south of the project site. This marine facility serves industrial, recreational and commercial sport fishing activities. The area immediately around the harbor supports industrial and commercial uses.

The proposed 205-acre development will not affect the available cattle grazing areas, because grazing generally occurs at higher elevations from about 1,000 feet and higher where cattle fodder is more abundant. However, even at higher elevations, the arid climate does not provide high quality cattle fodder.

Because DHHL owns the property on which the homestead lots will be developed, additional funds will not be necessary to acquire land. This property is one of many areas throughout the State of Hawaii that have been reserved for development of homestead lots for native Hawaiians.

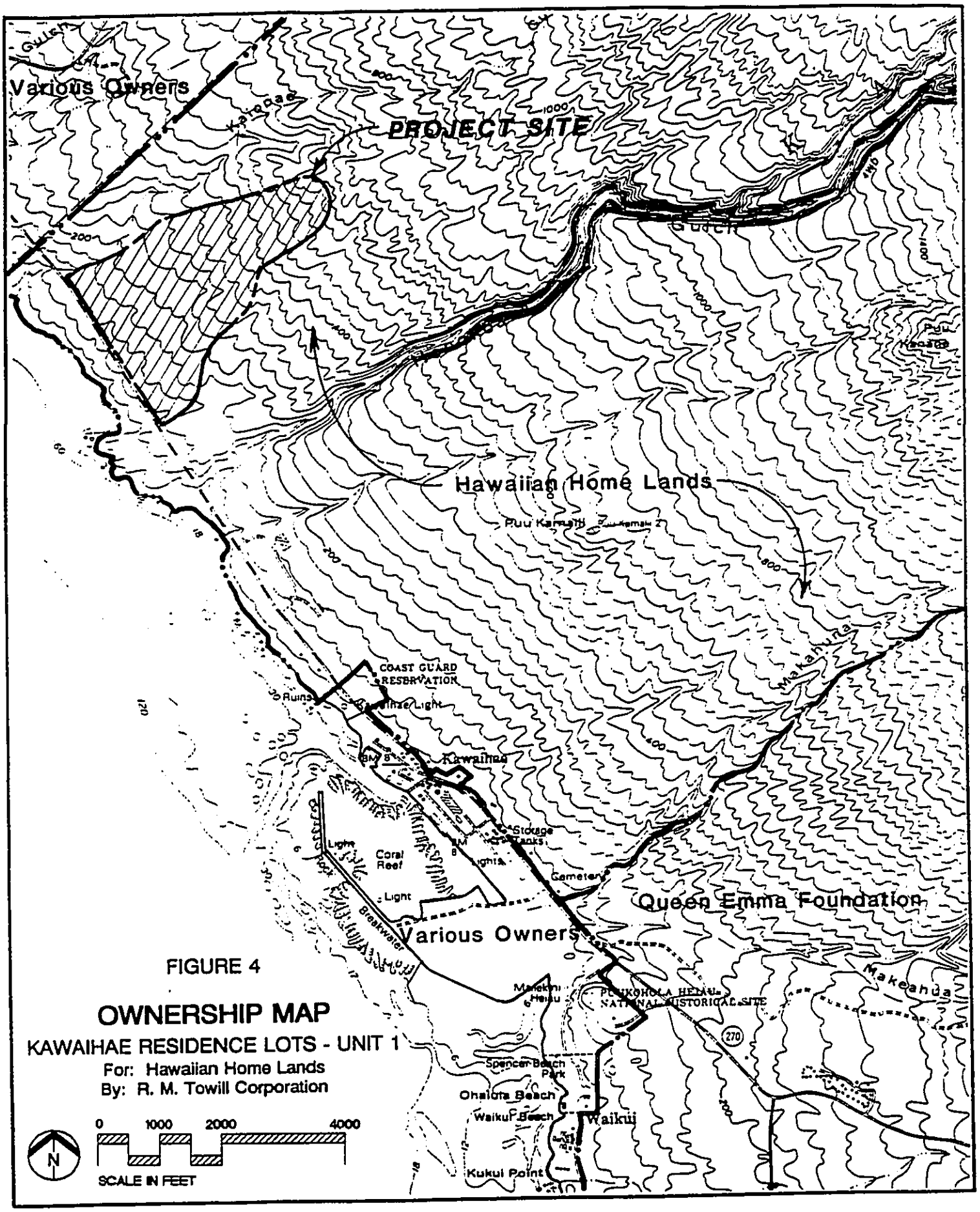

FIGURE 4

OWNERSHIP MAP

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

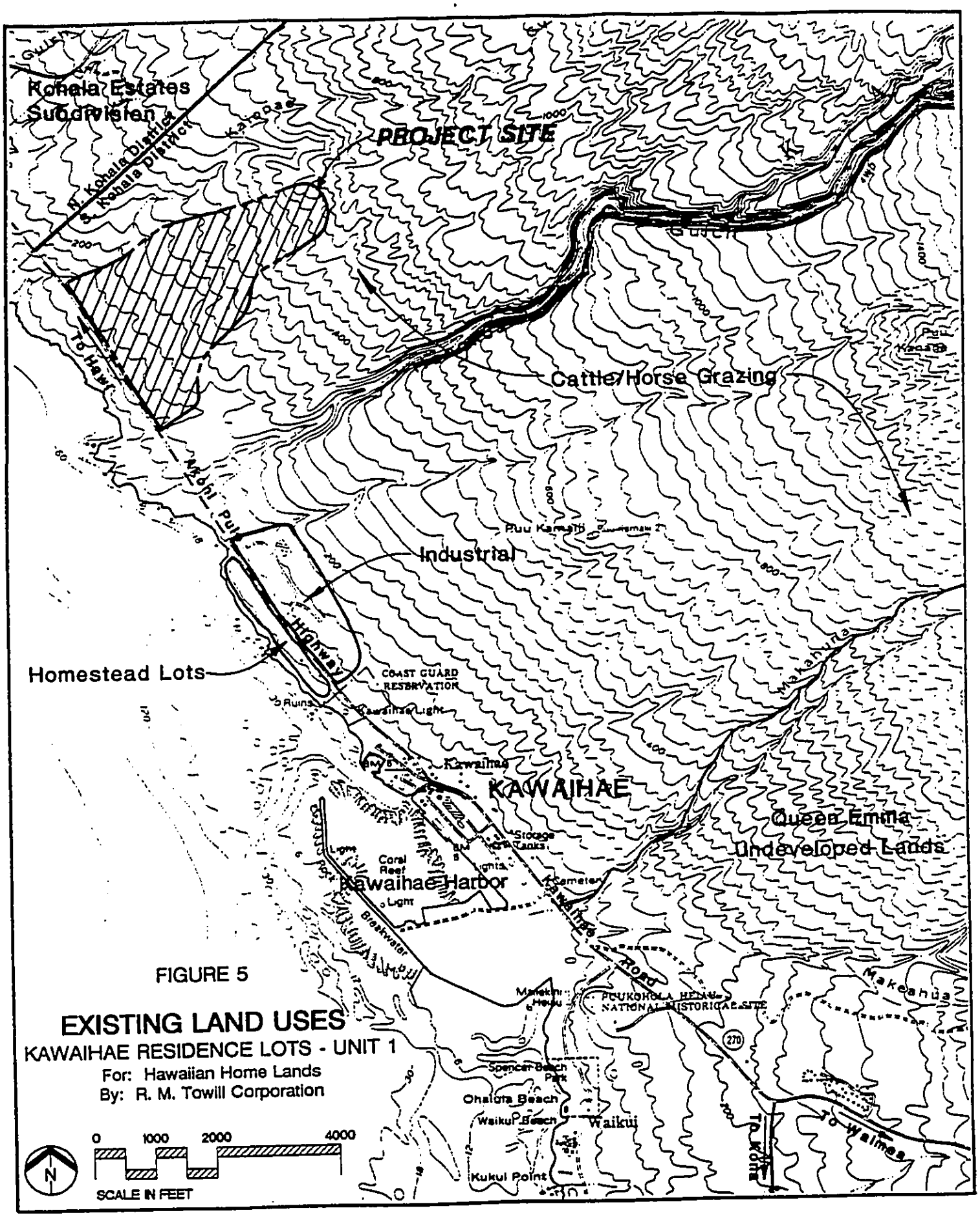

FIGURE 5

EXISTING LAND USES

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

2.1.2 Geography, Soils, Topography and Climate

The project site lies at the base of the Kohala Mountains, on its southwestern slopes. The entire site consists of the Kawaihae soil series (KOC), which is a very rocky, fine sandy loam with 6 to 12 percent slopes. Rock outcrops occupy 10 to 20 percent of the surface and severely eroded areas, which form the gullies, occupy up to 10 percent of the surface. Hard pahoehoe lava bedrock is at a depth of about 33 inches.

The average slope in the project area is approximately 11 percent. However, steep slopes up to about 30 percent occur along the edges of gullies. Elevations on the project site increase from 100 feet above mean sea level at the makai side to 590 feet msl on the mauka side.

The annual rainfall is 5 to 20 inches, most of which falls during the winter months. The mean annual temperature is between 74 and 77 degrees fahrenheit.

Impacts and Mitigation Measures

The proposed development will change the topographic conditions of the land. Impervious surfaces will be created by the construction of roadways and homes. However, the natural drainage pattern in the area will be maintained. Storm water runoff created by the development will be retained on site by routing the flows to drywells. Water will then infiltrate into the ground and contribute to the groundwater recharge. Natural flows will use existing drainageways to maintain the natural drainage pattern.

2.1.3 Flora and Fauna

A biological database and reconnaissance survey of the property was performed in July and August of 1989 (Appendix A). The report, prepared by Hawaii Heritage Program and dated April 1990, included a review of previous studies prepared for the project, interviews with botanists, malacologist and animal ecologists, and a site reconnaissance survey to verify the current status of older sightings. This study included an area of approximately 10,000 acres of land owned by the State Department of Hawaiian Home

Lands, which extends mauka of the project site to approximately elevation 4,800 feet above mean seā level.

Flora

The study indicated that the area is divided into three native natural plant communities. In the upper elevations (above 4,000 feet), adjacent to the Puu O Umi Natural Area Reserve, patches of 'Ohi'a/'Olapa Montane West Forest were observed. Between elevation 2,000 and 2,800 feet, one gulch contained patches of the rare Koai'a Lowland Dry Forest. The pasture lands, beginning at about elevation 1,000 feet to 4,800 feet, contained small patches of 'Akia/'A'ali'i'Ulei Lowland Dry Shrubland that generally occurred on rocky ridges scattered within the pasture lands.

The lower end of the study area, from Akoni Pule Highway to about elevation 1,000 feet, contained non-native plant communities of alien kiawe forest. The site of the 205-acre subdivision falls within this alien kiawe forest area.

The community of 'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland was observed in rocky outcrop areas in the pasture lands. It was reported that browsing by cattle and goats may have removed many of the palatable species of the native plants resulting in scattered patches of shrubland. In steep gulch areas where the plants were protected from grazing, native plants common to the shrubland were present. This community is not considered rare and is not known to contain rare plants.

The Koai'a lowland dry forest is dominated by koai'a which is a rare plant that occurs on the islands of Kauai, Molokai, Lanai and Hawaii. The koai'a forests occurred on the walls of steep-sided gulches where cattle did not appear to frequent and in the Keawewai Gulch. None of the other plants observed in the koai'a forest were considered rare.

Because the koai'a forest occurs on steep unbuildable slopes, preservation of this plant community is possible. However, edges of the forest have been disturbed by grazing animals.

The 'Ohi'a/'Olapa Montane Wet Forest was observed on the eastern base of Puu Lapalapa and smaller patches were found on Puu Mala and in Kilohana Gulch. Two rare Hawaiian lobelaids were observed during the survey. The *lobelia hypoleuca* was seen along the Waipahoehoe Stream in degraded pastures of the 'Ohia/Olapa Montane Wet forest and the *cyanea tritomantha* was observed in a gulch below Puu Mala.

Impacts and Mitigation Measures

This project is not in the vicinity of the koai'a forest (elevation 2,000 to 3,000 feet) and will not have an impact on the rare *acacia koaia* plant. Similarly, the two rare Hawaiian lobelaids seen among the 'Ohi'a/'Olapa Montane Wet Forest are not in the area of the project and will not be impacted. In addition, these rare plants were found on steep unbuildable slopes and in gulches where development is unlikely.

Fauna

No rare native animal species were observed on the property nor have they been reported within the parcel. However, rare animals have been reported in lands adjacent to the Hawaiian Home Lands property. These rare animals include the Hawaiian hoary bat, Hawaiian duck, Hawaiian hawk and the achatinellid land snail.

Only one sighting of the hoary bat was recorded in 1960 at the Spencer Beach Park, southwest of the project site. A single bat was seen hanging on a shrub in the beach area. These bats have also been seen along the Kona coast, south of the project.

The Hawaiian duck, Koloa, were part of captive propagation and release programs and were released in the Kohala Mountains to sustain the species. The program was successful and the Koloa has been seen regularly in the Kohala Mountains around Waimea and Waipio Valley.

The Hawaiian hawk, 'io, breeds only on the island of Hawaii. The 'io is common on the slopes of Mauna Loa. Few sightings have been recorded on the leeward side of the

Kohala Mountains. The 'io generally do not occur in dry shrublands, but can be seen in open forests, rainforests and agricultural areas.

The Kohala Mountains contain the greatest diversity of snail species on the island of Hawaii. The greatest number of tree snails were recorded south of the Hawaiian Home Lands property on the Waimea plains in 1903 where approximately 75,000 snails were seen. This colony of snails in Waimea is now extinct. A similar species may still exist in the Kohala Mountains. No rare land snails have been reported on the property, however, six specimens of tree snails were collected just north of the upper elevation of the Kawaihae lands near Puu Pili in 1984.

Impacts and Mitigation Measures

Because the project area is not known to contain any rare animals, impacts on rare animals are not expected. The relatively dry climate and sparse vegetation in the area does not provide good habitat for the rare animals known to exist in the vicinity.

2.1.4 Archaeology

An archaeological reconnaissance survey was performed in March 1990 by Cultural Surveys Hawaii. The "Recommendations" section of the report is included as Appendix B of this environmental assessment.

The archaeological survey covered the 205 acre site as well as areas makai of Akoni Pule Highway, south of the project to Makahuna Gulch and east of the project to approximately elevation 1,000 feet. Over two hundred sites were encountered in the vicinity of the project site with about 490 site features. Approximately 27 percent of the sites are possible or probable burials.

Cultural Surveys Hawaii recommended numerous sites for preservation. The most significant area recommended for preservation was the coastal area of Honokoa Gulch which contained numerous archaeological sites. This area is located south of the

proposed subdivision, on the makai side of Akoni Pule Highway. Significant features included a habitation complex, a canoe shed, four shrine features and a probable area of an observatory. Two caves, the Forbes and Mummy caves within the Honokoa Gulch at top of bank elevation 400 feet and 600 feet, respectively, were also recommended for preservation. Other sites recommended for preservation include two shelter complexes near the Makahuna Gulch, a high status and/or men's house and a cave shelter in the Kaiopae Gulch near the coastline.

Impacts and Mitigation Measures

one of the sites recommended for preservation are on the 205-acre parcel proposed for development. The only archaeological sites recommended for preservation in the vicinity of the proposed project lie to the south on the makai side of Akoni Pule Highway. The 20 significant sites that are within the project area will be subject to excavation and testing to extract cultural information of significance. Two of these sites are possible burials. Burials will be reinterred within the Kawaihae Ahupuaa with proper blessing ceremonies.

2.1.5 Air Quality

Because of the lack of significant stationary sources of air pollutants and the relatively low level of vehicular traffic in the project area, it is presumed that the air quality of the project area is good and meets all applicable Federal and State standards.

Impacts and Mitigation Measures

Short-term impacts to the ambient air quality will occur during construction. Construction activities will increase concentrations of air pollutants in the vicinity of the project. The entire project site will not be cleared, grubbed and graded. Construction will be limited to the roadways that will house the utilities and provide access to each of the lots. The tenants will be responsible for obtaining their own building permits for development of the lots.

To mitigate impacts on air quality during construction, dust control measures will be implemented in accordance with Department of Health regulations and applicable County ordinances. Frequent watering of the soil during construction will reduce the amount of fugitive dust emissions generated. EPA estimates that watering twice daily will reduce the amount of fugitive dust by 50 percent.

Exhaust emissions generated from construction equipment will be dispersed by the prevailing winds. The contractor will be responsible for ensuring that construction equipment is maintained and operated properly to minimize exhaust emissions.

Long-term impacts on air quality will occur from the increase in traffic from the 195-lot single family subdivision, however, the relatively small number of vehicle trips that will be generated from the increase in motor vehicles is not expected to significantly impact air quality. Improvements are planned at the two intersections with Akoni Pule Highway to provide storage lanes for right and left turn movements into the project. These improvements will reduce vehicle idle time, thereby minimizing carbon monoxide emissions.

2.1.6 Noise

The present noise quality of the proposed project is primarily affected by vehicular generated noise on Akoni Pule Highway, natural sounds from the surf and sounds from the wind moving through the vegetation on site. There are no significant man-made noise sources within the project boundaries or in the neighboring area. Ambient sound levels are typical of rural areas.

Impacts and Mitigation Measures

Short-term noise impacts will occur during construction. Construction related noise will be generated by the use of heavy equipment which will occasionally exceed allowable noise levels. With the exception of a few tenants who are already occupying lots within the subdivision, the nearest noise sensitive use is over 1,500 feet away; therefore, the impacts from construction noise will be

minimal. These short-term noise impacts will be mitigated by the use of mufflers on construction equipment and vehicles, and by designating specific start and curfew times in accordance with the State Department of Health regulations.

2.2 SOCIAL, ECONOMIC AND AGRICULTURAL CHARACTERISTICS

2.2.1 Population Characteristics

During the period 1980 to 1989, the resident population on South Kohala increased 95 percent, from 4,607 to 9,000. Much of this increase in population was attributed to the development of three major resorts: the Mauna Kea Beach Resort, Mauna Lani Resort and the Waikoloa Beach Resort. The basic population and commercial center within the South Kohala district is Waimea where a variety of small businesses serve the local population.

Recent social and economic trends indicate that Hawaii will continue to experience fairly rapid population growth. The County of Hawaii resident population is projected to increase significantly from 122,300 people in 1989 to 206,100 people in 2010, a 68.5 percent increase over the 1989 population figure.

Based on a 1987 Hawaii State Department of Health special tabulation, the ethnic group distribution for Hawaii County was: Caucasian (29,005 people), Japanese (25,810 people), Hawaiian (2,989 people), Filipino (10,703 people), Chinese (1,446 people), Korean (126 people), Puerto Rican (565 people), Black (174 people), Mixed Part Hawaiian (27,792 people), Mixed Non-Hawaiian (13,785 people), and 550 other unmixed and unknown. The State as a whole is dominated by Caucasians, Japanese, Part Hawaiian and Filipino.

Although the population of the South Kohala district is relatively high, population in the Kawaihae area is low (about 150 people) according to the 1985 Kawaihae Development Plan. Most of the residents in the South Kohala district reside in Waimea or near the resort developments south of Kawaihae.

Because the project has been reserved for the native Hawaiians, the ethnic group in this area will be dominated by people of Hawaiian ancestry. Kawaihae is believed to be the birth place of King Kamehameha and is known to have been an area of early Hawaiian settlement. Thus, with the proposed development, Hawaiians will return to lands of their ancestors, preserving the Hawaiian heritage in the area. This subdivision will be a unique settlement, compared to typical rural or urban subdivisions which allow people of all ethnic backgrounds to settle.

2.2.2 Economic Characteristics

Tourism and agriculture are Hawaii County's main industries. The tourist industry, here as with the other islands throughout the State, is the key industry in Hawaii County, particularly in West Hawaii where the Kona and Kohala coasts have almost all of the County's hotel room inventory.

The County of Hawaii received the least amount of westbound visitors of the four major islands, with 946,540 visitors in 1989 compared to the State total of 4,705,320 visitors. This volume of visitors was estimated to spend $1,004.8 million in direct expenditures in the County in 1989, which is 9.2 percent of the States' total. Direct, indirect and induced economic activity generated by visitor-related expenditures for the State of Hawaii totalled over $16.3 billion. Based on a 9.2 percent share of the States' total, direct, indirect and induced economic activity, the County of Hawaii received $1.5 billion of visitor related expenditures.

The agricultural industry in Hawaii includes sugar, flowers and nursery products, coffee, macadamia nuts, fruits and vegetables, and ranching. Hawaii County had the highest value of crop and livestock sales with over $203.4 million, followed by Oahu with $176.3 million, Maui with $132.5 million and Kauai with $64.8 million in 1989. The major crop for the island of Hawaii was unprocessed sugar cane with a crop sales of $56.9 million followed by flowers and nursery products ($29 million), fruits ($18.4 million, excluding pineapple), vegetables and melons ($13.7 million), coffee ($8.9 million), taro ($591,000) and field crops ($275,000).

Hawaii County has the highest cattle and calves inventory with 131,500. Other livestock inventory include milking cows, hogs and pigs, and chickens. Agricultural activity in the Kawaihae area consists mostly of cattle ranching.

The civilian labor force for Hawaii County totalled 56,900. Of this total, 54,700 were employed leaving 3.9 percent unemployed in 1989. This is the highest percent of unemployment compared to the other three counties. The job count for the County was 51,600 of which 45,750 were for non-agricultural employment and 5,850 were for agricultural employment. The per capita personal income for the County of Hawaii in 1988 was $13,331.

Impacts

The project will not affect the available cattle grazing areas. Grazing generally occurs in the higher elevations above the project site where cattle fodder is more abundant.

Hawaii's economy will increase because of the increase in tax revenues resulting from the improvements planned by the development. The change from passive agricultural use to residential will increase the land value. In addition, the increase in population caused by the settlement will indirectly increase economic activity in the area. Opportunity for small businesses will increase to support this community.

2.3 PUBLIC FACILITIES AND SERVICES

2.3.1 Flooding and Drainage

According to the Flood Insurance Rate Map panels 128 and 137, May 1982, there are no flooding problems in the project area. Flooding in the area is limited to the coastline where 100-year coastal flooding from wave action occurs.

Major gulches in the area include Keanahalululu Gulch, Kaiopae Gulch, Honokoa Gulch, Waipahoehoe Gulch, Keawewai Gulch, Makahuna Gulch and Palihae Gulch.

The Kaiopae Gulch occurs immediately to the north of the project and the Honokoa Gulch occurs to the south of the project site. Smaller drainageways occur within the project site and will be left open for the purposes of maintaining the natural drainage pattern in the area. Existing culverts under Akoni Pule Highway provide for the storm water runoff to leave the site and discharge into Class A coastal waters.

Impacts and Mitigation Measures

Increased on-site drainage caused by the creation of impervious surfaces will be routed to drywells that will be developed within the roadway shoulders. Natural storm water runoff will continue to use existing drainageways in areas that will be retained as open space. These open space areas generally occur on the makai side of the project.

Because the project will not increase runoff discharging into the coastal waters, no impact on the existing drainage pattern is expected. The drainage system within the project will maintain the natural drainage pattern in the area.

2.3.2 Potable Water

Currently there is no County water system to service the area. The nearest water system terminates south of the project site with an 8-inch distribution line which originates from the Lalamilo Wells to the south. The adjacent Kohala Ranch has developed their own private water system, which includes wells, reservoirs and a distribution system.

An exploratory well was drilled in 1990 at approximately elevation 1,400 feet above mean sea level on the south side of Honokoa Gulch; however, the water tested to be brackish. Another exploratory well is planned on the north side of Honokoa Gulch at about 1,600 feet msl. This well is expected to contain good potable water as it will tap into the same aquifer that supplies the adjacent Kohala Ranch agricultural subdivision.

When the new well is developed, water supply to the new residents will be provided by an internal water supply and distribution system. Support facilities, such as reservoirs

will also be developed on Hawaiian Home lands. Because the wells will be located at a higher elevation, the water will flow by gravity to provide service to the lots.

In the event the new water source is not developed on a timely basis, potable water may be acquired from the adjacent Kohala Ranch private water system. The Kohala Ranch water system has adequate capacity to accommodate the proposed subdivision for the interim. The subdivision will require approximately 117,000 gallons of water per day when fully occupied, based on 600 gallons per day per unit. When the new water source is developed for this project, it may continue its service from the existing Kohala Ranch system or terminate service and maintain a separate water supply system. Ongoing discussions with the developers of the Kohala Ranch will be needed to ensure water availability in the event a new water source is not developed.

Because there is no existing potable water system to tie into, there are no impacts on the existing water system. A new water source, storage and distribution system will be developed for the project. The new well will require testing and monitoring to assure adequate capacity for the subdivision and to protect the aquifer. The development of this new source will adhere to the requirements of the Board of Water Supply and the State Water Code. If the project ties in to the Kohala Ranch water system, no impacts are anticipated because the Kohala Ranch water system and the aquifer has sufficient capacity to accommodate this subdivision which will require approximately 117,000 gallons of water per day.

2.3.3 Wastewater Treatment and Disposal

Presently, there are no municipal sewage systems or sewage treatment facilities in the area. Residential development in the region relies primarily on private septic tanks, cesspools or private sewage treatment plants. The nearest municipal wastewater treatment facility for the West Hawaii region is located at Kealakehe in North Kona.

Because the current Department of Health regulations do not allow the use of cesspools, septic tanks are planned. Installation of the septic tanks will be the responsibility of the

lessee. The septage will be periodically pumped out and disposed of at the Kealakehe wastewater treatment plant (WWTP) which is the wastewater facility designated for the West Hawaii region. The first increment of the Kealakehe WWTP will have a capacity of 2.8 million gallons per day (mgd). The ultimate capacity of this WWTP is approximately 8.0 mgd for a 40-year design period to accommodate projected growth for the northern and southern zones of West Hawaii. Future plans for the West Hawaii region also include a second regional wastewater treatment facility to accommodate projected growth.

Impacts and Mitigation Measures

Approximately 5 percent of the wastewater generated by each of the units will remain in the septic tank as septage. Ninety-five percent is effluent that will be treated and disposed of in leaching fields. The Kealakehe WWTP has adequate capacity to accommodate the septage that will be generated by the subdivision at complete occupancy. Thus, no impacts on the regional wastewater treatment facilities are expected.

2.3.4 Solid Waste

Solid waste is currently disposed of at the Kealakehe Sanitary Landfill. This landfill is reaching capacity and some of the wastes are trucked to Hilo for disposal. A new solid waste landfill site is being planned for the West Hawaii region. When the new landfill is opened for operation, the solid waste will be disposed of at this site. The new sanitary landfill is being designed to provide service for a 20-year period. Until the new landfill site is opened, solid waste will continue to be disposed of at the Kealakehe landfill or trucked to Hilo for disposal.

Impacts and Mitigation Measures

The project will generate approximately 3,200 pounds of solid waste per day based on 5 pounds per capita per day and 3.25 persons per unit. The new sanitary landfill planned for the West Hawaii region is expected to be open for operation by the time the project is fully developed. Because the sanitary landfill

is planned to accommodate growth in the West Hawaii region, significant impacts on the sānitary landfill are not expected. In addition, resource recovery methods, such as recycling, will be encouraged to minimize solid waste impacts.

2.3.5 Circulation

The only roadway that provides access to the project site is Akoni Pule Highway, located makai of the property. This highway ties into the Queen Kaahumanu Highway and Kawaihae-Waimea Road to the south. Mauka of Akoni Pule Highway, approximately 3-1/2 miles east, is the Kohala Mountain Road.

In the future, when the mauka lands of Kawaihae are developed, a mauka/makai roadway may be developed to connect the Kohala Mountain Road to Akoni Pule Highway. However, at present, access to the site will be provided by two intersections with Akoni Pule Highway.

Impacts and Mitigation Measures

A traffic impact assessment report was prepared by Pacific Planning and Engineering, Inc., in June 1990 and is attached as Appendix C. The report concluded that the proposed project will not significantly impact Akoni Pule Highway when it is expected to be completed and fully occupied in 1995. The results of the rural highway analysis indicated that the existing conditions without the project would operate at a level of service (LOS) B, which means that drivers will experience slightly less freedom to travel their desired speed (which is 50 miles per hour on Akoni Pule Highway) than drivers in LOS A conditions, which is the best condition. With the project in 1995, vehicles driving along Akoni Pule Highway near the project location will experience LOS C, which results in platoon formation causing a decline in passing ability. The LOS at the intersections with the two project roads will operate at LOS A. Without the project in 1995, Akoni Pule Highway would remain at LOS B.

To minimize impacts and the possibility of rear-end accidents from the fast moving traffic on Akoni Pule Highway, it was recommended that designated left and right turn lanes into the project site be developed. Thus, modifications to the Akoni Pule Highway will be performed to provide deceleration lanes for right turn movements and storage lanes for left turn movements onto the project roadways. These improvements will contribute to the safety of drivers in the vicinity of the two intersections. An alternative mitigative measure could be to lower the speed limit of Akoni Pule Highway to 35 miles per hour from Kawaihae town to the subdivision, a distance of approximately 1/2 mile.

2.3.6 Power and Communication

Power is presently provided by Hawaii Electric Light Company via overhead power lines that traverses the makai side of the site at about elevation 400 feet. Communication lines are provided by Hawaiian Telephone Company along this same pole line. The nearest electrical substation is located at Kohala Estates and the nearest telephone switching station is at Kona Center.

Impacts and Mitigation Measures

The project will tie into the existing overhead electric and telephone lines traversing the project site within the 50-foot wide electric easement. Street lights will also be provided according to County standards. Both the existing electric substation and nearby telephone switching station have adequate capacity to accommodate this subdivision. No additional electrical substation will be required; however, switching units requiring approximately 600 square feet will be required for the telephone system. No significant impact on the present electric/telephone system is expected.

2.3.7 Emergency Facilities

Police services are located in Waimea, Kapaau and Kona. Both the Waimea and Kapaau stations are relatively new and both have room for expansion should it be required in the future.

Fire protection and emergency medical services are located in Kapaau, Waimea and Kona. The primary fire protection service for the South Kohala district is provided by the Waimea station.

Health care facilities in the Kohala area are served by two state-operated hospitals, the Kohala Hospital located in Kapaau in North Kohala and the Kona Hospital in Waimea. the Kona hospital is a "full-service" health care facility. The Lucy Henriques Medical Center is a privately owned, non-profit facility and provides outpatient health services. Honokaa hospital in Honokaa may also be used for health care services. These health care facilities serving the project area require upgrading and are presently being handled by the State Department of Health and private operators.

Impacts and Mitigation Measures

The project, at full build out, is not expected to significantly impact the police and fire facilities. As the resident population increases in the project the need for additional personnel will require evaluation in the context of a county department needs assessment. In addition, the water supply system will be designed to meet fire code and fire protection standards, that include necessary fire hydrants.

Because the State and private parties are assisting in upgrading the health care facilities, adequate health care facilities are expected when the improvements are completed. Thus, significant impacts on the health care facilities are not expected.

2.3.8 Recreational Facilities

Recreational facilities in the West Hawaii region consist of golf courses, tennis courts, hiking trails, historic sites, parks, boat launching ramps and beach parks. The majority of the golf courses and tennis courts occur around the resort developments in the region. Hiking is available at the Pololu-Honokane Valley Reserve and the Kohala Forest Reserve. Historic sites include the Pu'ukohola Heiau National Park and the Lapakahi

State Historic Park. Boat launching ramps in the vicinity consist of the Mahukona and Puako boat ramps, and the Kawaihae boat harbor and ramp. Beaches include Kapaa Beach, Mahukona Beach, Samuel Spencer Beach, and Hapuna Beach. Other recreational facilities are available in Waimea at the Waimea District Park, Waimea Playground, Thelma Park Gym and the Waimea Elementary/Intermediate Playground.

Impacts and Mitigation Measures

Additional recreational facilities are not part of this first phase of the development of the Hawaiian Home Lands parcel. Thus, during the interim, residents will be utilizing the existing recreational facilities in the region. However, as part of the overall master plan for this area, the recreational requirements will be met and impacts on the existing recreational facilities will be mitigated.

SECTION 3

RELATIONSHIPS TO STATE AND COUNTY LAND USE PLANS, POLICIES AND CONTROLS

3.1 HAWAII STATE PLAN

The Hawaii State Plan was developed to serve as a guide for future development of the State of Hawaii in areas of population growth, economic benefits, enhancement and preservation of the physical environment, facility systems maintenance and development, and socio-cultural advancement. The Plan identifies, in general, the goals, objectives, policies and priorities for the development and growth of the State. Guidelines have been provided in the Plan to give direction to the overall development of the State.

The Kawaihae homestead lots project is consistent with the objectives and policies of the Hawaii State Plan. The following pages describe the relationship and/or compatibility of the proposed project with the overall plans for the State of Hawaii, as set forth in the Hawaii State Plan.

3.1.1 Population (H.R.S., Section 226-5)

The project area has been reserved for the development of homestead lots for the native Hawaiians by the Hawaiian Homes Commission Act of 1920. It is in compliance with the objective of the Hawaii State Plan to guide population growth. The development of 195 homestead lots will serve to increase the opportunity for Hawaiian people to pursue their physical, social and economic aspirations. The project will provide house lots with roadways that contain the necessary infrastructure for settlement.

3.1.2 Economy (H.R.S., Sections 226-6, 7 and 10)

The economic objective of improving the standard of living for Hawaii's people is complied with by developing homestead lots which will be leased to the native Hawaiians. Because of the large 1/2-acre to 1-acre lots, future lessees will be able to perform limited agricultural activities on the land. Settlement in this relatively undeveloped area will result in an indirect increase in the economy, through the

expected development of other uses that will be necessary to support the growing population in the area.

3.1.3 Physical Environment (H.R.S., Sections 226-11, 12 and 13)

The development takes into account the physical attributes of the land by preserving the natural drainageways as open space and maintaining the natural drainage patterns in the area. Excess runoff resulting from the construction of roadways will be routed to drywells and natural runoff will use the existing drainageways in the area.

An archaeological survey was performed on the site and there were no significant historical sites in the area of the project. However, if subsurface cultural materials are uncovered, the State Department of Land and Natural Resources, Historic Sites Division, will be consulted.

A biological study was also performed and indicated no rare, threatened or endangered species in the area of the project site. Thus, no impacts on the biological resources in the area are anticipated.

3.1.4 Facilities System (H.R.S. Sections 14 to 18)

The facilities system objectives are met by developing the settlement lots in consonance with the State and County plans. The proposed urban development also accommodates the changing public demands and priorities away from the previous agricultural house lot settlement pattern.

Reuse and recycling methods will be encouraged to minimize impacts on solid waste facilities and to conserve resources. Solar heaters will also be encouraged to conserve energy.

A new water source, storage and distribution system is planned to be developed for this project. This new water source will be developed in accordance with Chapter 20, Title 11, Administrative Rules.

To provide a safe and efficient movement of traffic in the vicinity of the project, improvements are planned at the two intersections with Akoni Pule Highway. Storage lanes will be provided for left turn movements into the subdivision and deceleration lanes for right turn movements into the subdivision.

3.2 STATE FUNCTIONAL PLANS

The twelve State Functional Plans were adopted by the State Legislature in April 1984. These plans were formulated to specify in greater detail the policies, guidelines and priorities set forth in the Hawaii State Plan. The twelve functional plans include: Energy, Transportation, Water Resources, Historic Preservation, Health, Education, Housing, Conservation Lands, Higher Education, Agriculture and Tourism.

The project is consistent with the policies and objectives of the State Functional Plans. It will provide much needed infrastructure improvements, which in turn will afford housing development opportunities to the people of Hawaiian ancestry and return them to their land and to their desired mode of living.

3.3 STATE LAND USE LAW

The State Land Use Commission classifies the land proposed for development "agriculture" (see Figure 6). Hawaiian Home Lands are exempt from land reclassification requirements for homestead development purposes.

3.4 HAWAII COUNTY GENERAL PLAN

According to the Hawaii County General Plan, the project area lies within the "low density urban" designation (see Figure 7). Therefore, the 1/2-acre lots are consistent with the low density urban development designation.

3.5 COUNTY ZONING

The County zoning designation for the area is "agriculture" (see Figure 8). However, this project is exempt from the County zoning process.

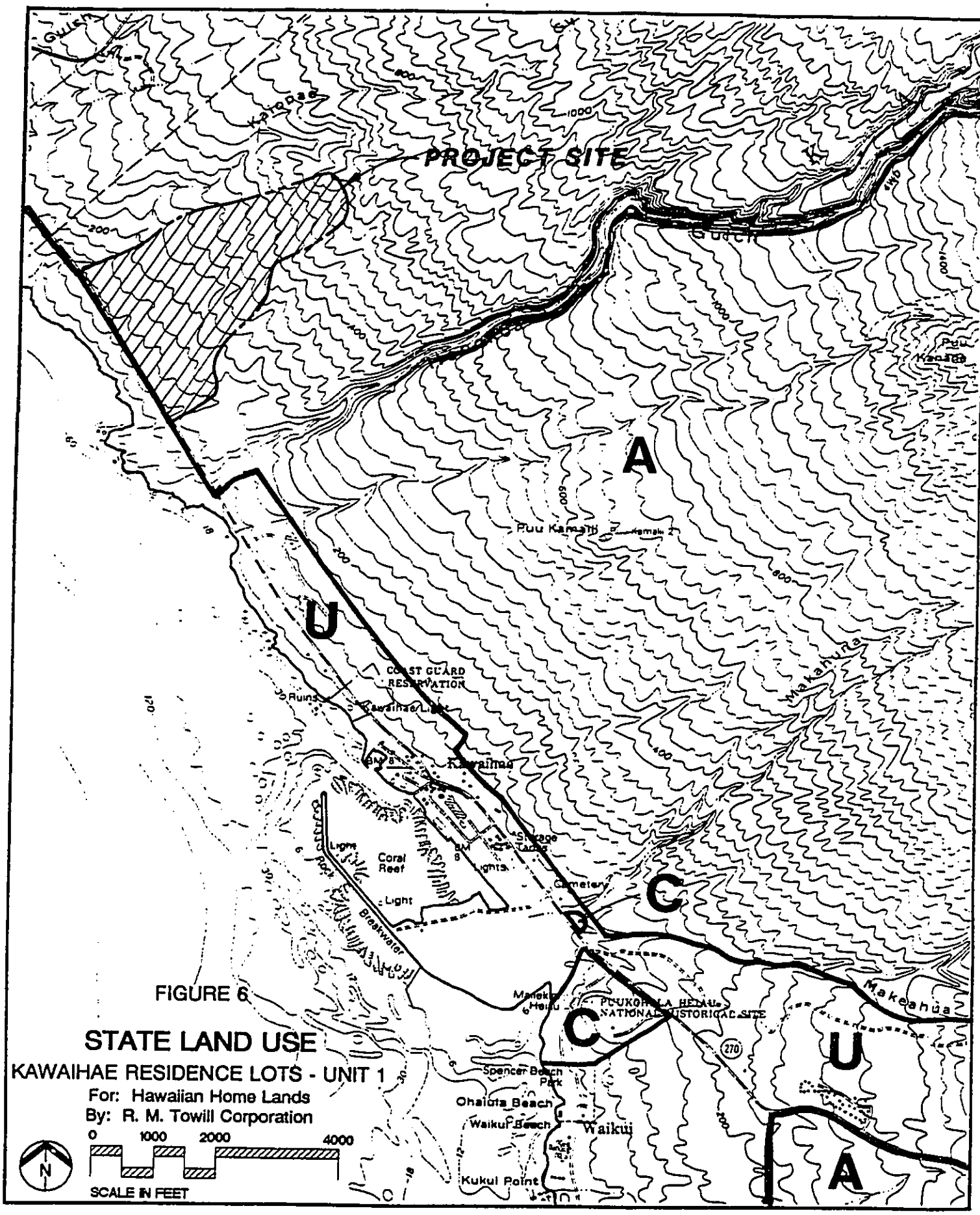

FIGURE 6

STATE LAND USE

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

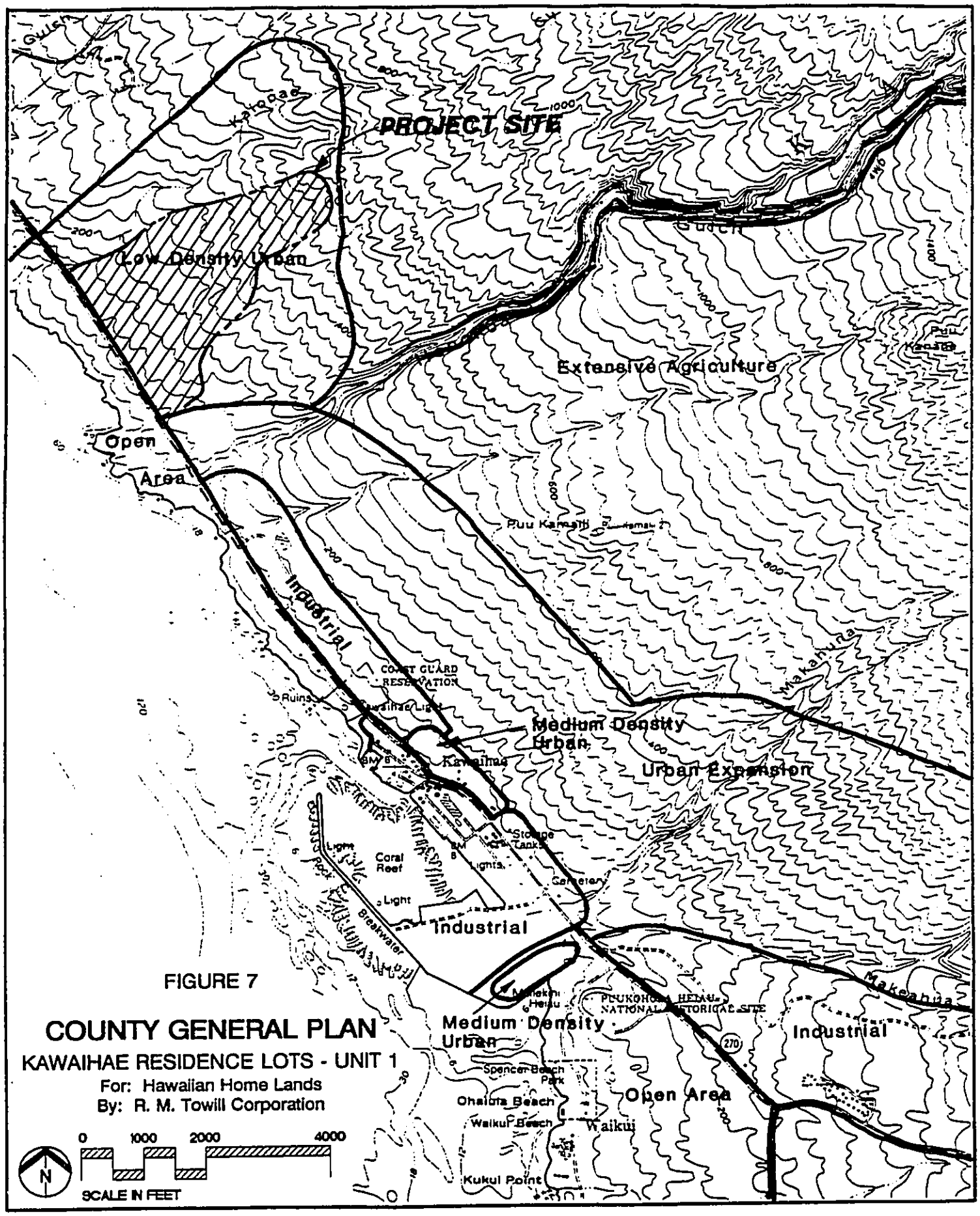

FIGURE 7

COUNTY GENERAL PLAN

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

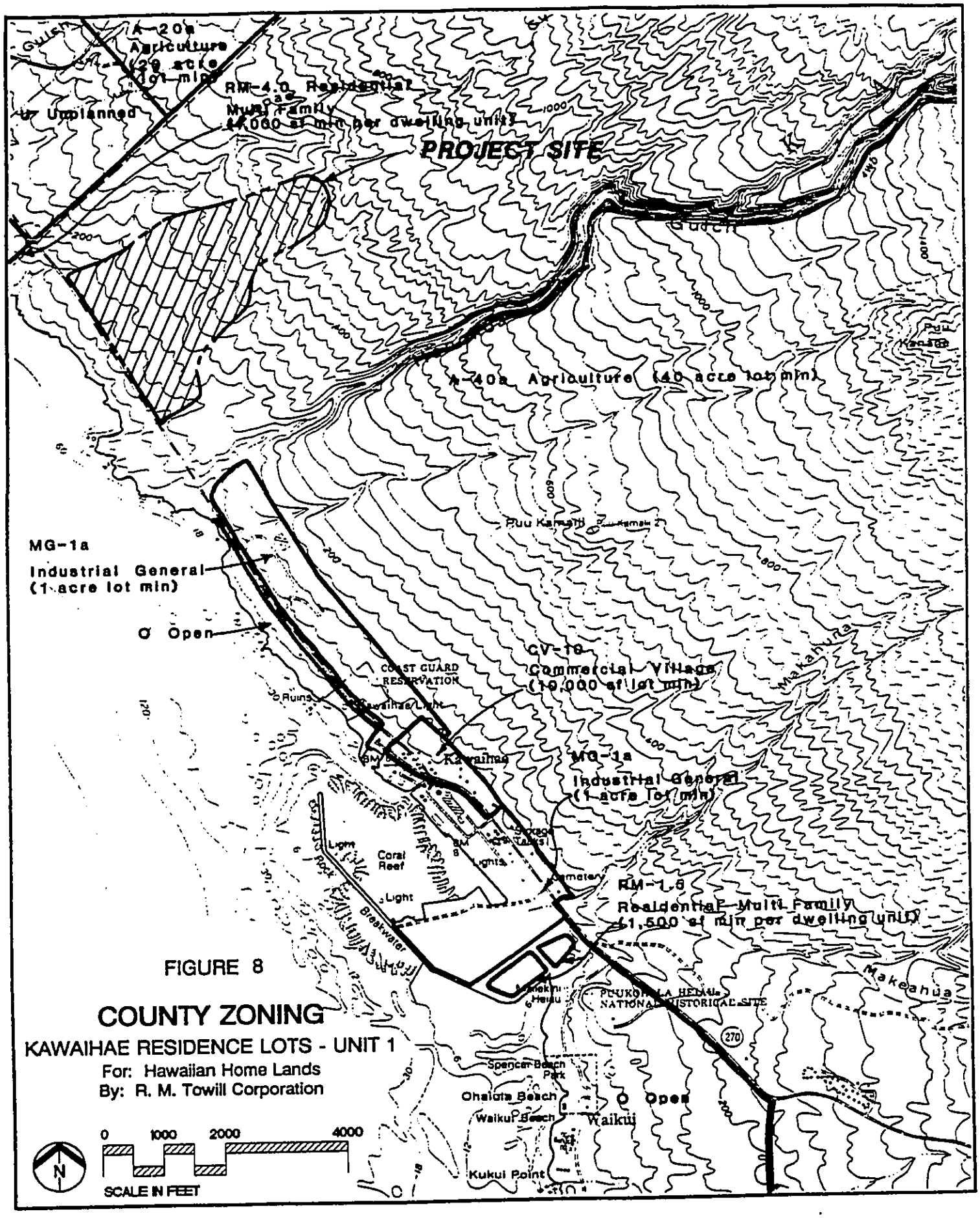

FIGURE 8

COUNTY ZONING

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

3.6 WEST HAWAII REGIONAL PLAN

The West Hawaii Regional Plan includes the districts of North Kohala, South Kohala and North Kona. This project is consistent with the West Hawaii Regional Plan by supporting and implementing the Hawaiian Home Lands development plans for the South Kohala District.

3.7 KAWAIHAE DEVELOPMENT PLAN

This project is one of the first developments to implement the Kawaihae Development Plan (see Figure 9) by providing 195 homestead lots on the Kawaihae Ahupuaa. This subdivision will be the first step towards achieving the goals of the Kawaihae Development Plan.

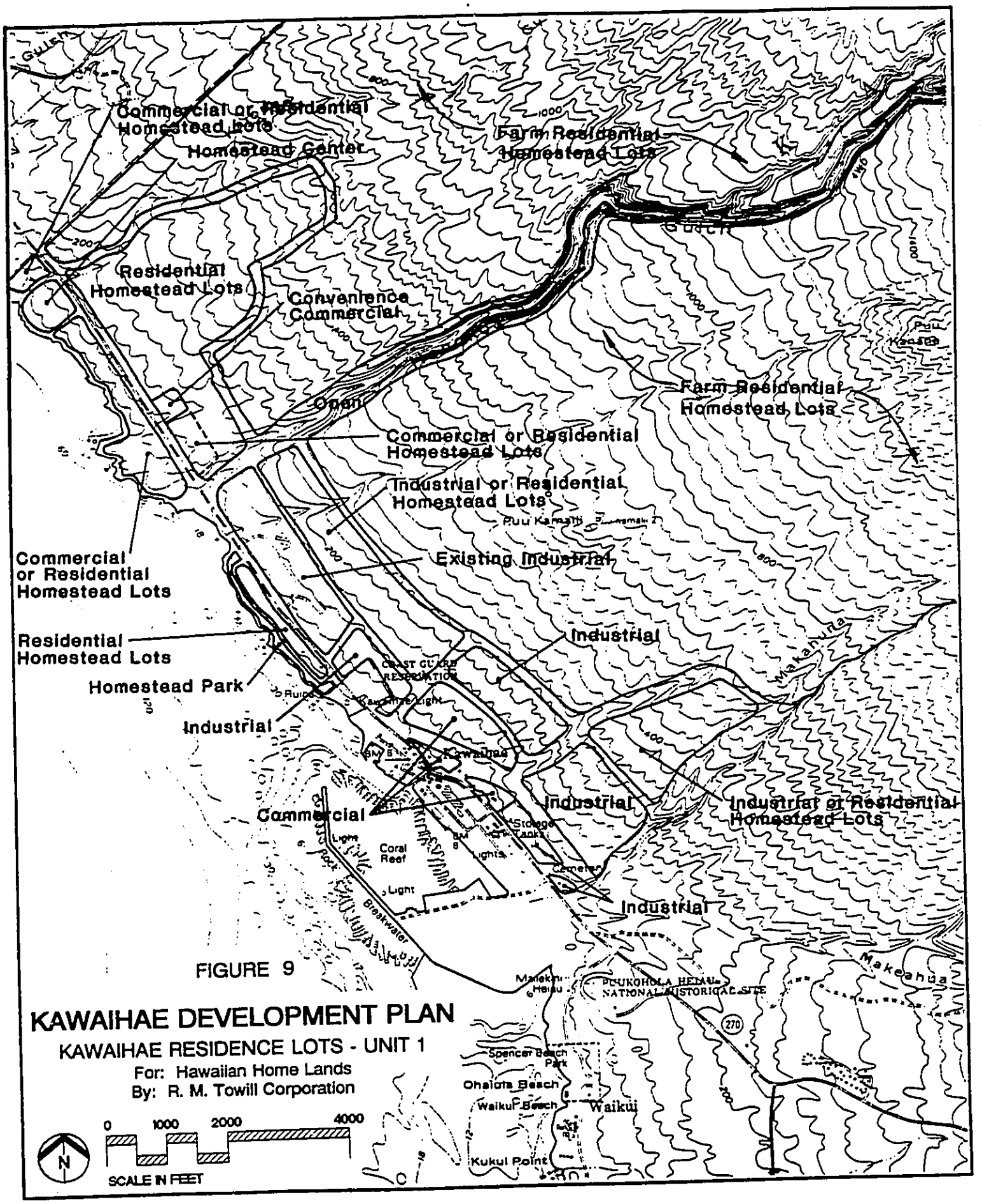

FIGURE 9

KAWAIHAE DEVELOPMENT PLAN

KAWAIHAE RESIDENCE LOTS - UNIT 1

For: Hawaiian Home Lands

By: R. M. Towill Corporation

SECTION 4

PERMITS REQUIRED

The following is a list of permits and approvals required prior to implementation of this project:

AUTHORITY	APPROVAL REQUIRED
State	
Dept. of Land & Natural Resources	Well Development
County of Hawaii	
Building Department	Building Permit
Dept. of Public Works	Grading Permit
	Erosion Control Plan

SECTION 5

ALTERNATIVES TO THE PROPOSED ACTION

5.1 NO ACTION ALTERNATIVE

Taking no action will continue the present conditions where awarded homestead lots cannot be fully utilized because of lack of infrastructure support. Without the proposed roadway and utilities improvements, lessees will not be able to develop their lots without great expense.

5.1 ALTERNATIVES CONSIDERED

During the preparation of the Kawaihae Development Plan, various land use alternatives were considered for the area and a land use plan was developed. Thus, alternatives were not considered for this environmental assessment. This environmental assessment is one of the implementing tools to carry out the goals of the Kawaihae Development Plan to expedite housing needs for the native Hawaiians.

SECTION 6

DETERMINATION

This environmental impact assessment indicates that there are no significant adverse long-term impacts that would be caused by the proposed 195 lot subdivision. Short-term impacts will occur as a result of construction activities. These impacts include increases in soil erosion, noise and air pollution. However, the impacts will be temporary in nature and are expected to be mitigated as described in the previous sections. This project will provide a long-term benefit to the native Hawaiian people by providing them house lots on which to live and making available the necessary infrastructure systems.

Design and construction will be performed in accordance with State and County rules and regulations.

APPENDICES

APPENDIX A

BIOLOGICAL DATABASE & RECONNAISSANCE SURVEY

OF THE

DEPARTMENT OF HAWAIIAN HOME LANDS

KAWAIHAE PARCEL

Prepared for:

State of Hawaii
Department of Hawaiian Home Lands
Honolulu, Hawaii

Prepared by:

Hawaii Heritage Program
The Nature Conservancy of Hawaii
Honolulu, Hawaii

April 1990

EXECUTIVE SUMMARY

In June 1989, the Department of Hawaiian Home Lands (DHHL) contracted with The Nature Conservancy's Hawaii Heritage Program (HHP) to prepare a biological inventory of their parcel in Kawaihae (DHHL parcel). This report briefly describes the methods used and summarizes the available information on these biological resources known or reported to occur in the DHHL parcel. The purpose of this report is to provide information useful in planning and general management of the biological resources in the DHHL parcel.

The vast majority of the DHHL parcel consisted of pasture or kiawe (Prosopis pallida) forest. And although most of the original vegetation of Kawaihae has been destroyed by hoofed animals and introduced plants, a few remnant native forest pockets do persist on the DHHL parcel. The three native natural communities observed in the DHHL parcel were the rare Koai'a Lowland Dry Forest, the 'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland, and the 'Ohi'a/'Olapa Montane Wet Forest. All native vegetation patches were small and were located on the upper slopes of cinder cones and in gulches; these patches were surrounded by alien (non-native) vegetation, usually made up of introduced range grasses. Only the Koai'a Lowland Dry Forest is considered rare and two populations of the rare plant Acacia koaia were observed during the survey. The largest population consisted of several hundred trees which compose the dominant cover of the Koai'a Lowland Dry Forest in Keawewai Gulch.

Two other rare plant species are known from the DHHL parcel and are restricted largely to gulches and cinder cones above 2400 feet elevations. These are Lobelia hypoleuca found at the base of Puu Lapalapa and Cyanea tritomantha seen on the slope of Puu Mala. Both taxa had not been previously reported from the DHHL parcel. Populations of these rare plants appear to be located mainly in steep areas, which are least accessible to grazing animals and human disturbance.

No rare native animal species were observed during the 1989 survey nor have they been reported within the DHHL parcel. Two common endemic forest birds, the 'apapane (Himatione sanguinea sanguinea) and the Hawaii 'amakihi (Hemignathus virens virens), were seen during the survey, along with numerous alien birds and invertebrates. Four rare animal species have been reported from lands adjacent to the DHHL parcel: Hawaiian hoary bat (Lasiurus cinereus semotus), Hawaiian duck (Anas wyvilliana), Hawaiian hawk (Buteo solitarius), and a rare land snail (Partulina physa). These species may also be found within the DHHL parcel with further surveys.

Threats that may decrease the long term survival of native plants, animals, and natural communities in the DHHL parcel include: human disturbance, grazing and disturbance by pigs, cattle, and goats; predation by mongeese and rats, and displacement by alien plants. Limited suitable nesting habitat may also contribute to reduced nesting success and decline in rare birds.

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INTRODUCTION

In June 1989, the Department of Hawaiian Home Lands (DHHL) contracted with The Nature Conservancy's Hawaii Heritage Program (HHP) to provide information on the unique biological resources known from or reported to occur on DHHL's Kawaihae parcel (DHHL parcel). This parcel is located in the South Kohala district of the island of Hawaii (Figure 1). The DHHL parcel consists of the northern section of the Kawaihae region, which extends southward to Highway 19. Results of both a literature review and a field survey of the DHHL parcel were included in this contract. From these data, HHP developed a database on the location and condition of rare elements (natural communities, plants and animals) in the area. This information can be used by DHHL in planning and general management activities.

This report summarizes the methods used and the results of the literature review and field survey. Its purpose is to provide an overview of the unique biological resources known to occur in the DHHL parcel and the adjacent area. Basic information relating to threats is also included.

The results presented in this report are based upon an extensive body of available information derived from publications, documents, museum collections and reports from knowledgeable individuals. Most of the observations discussed in this report were made within the last 15 years. Observations older than 15 years are also valid indications of the potential presence of rare plants or animals, unless an area has been radically altered. In areas not recently visited, field surveys are needed to determine, if possible, the current status of older sightings. HHP staff supplemented information from older observations with recent surveys of the DHHL parcel, conducted on five days between July 17-19 and August 3-4, 1989.

SPECIAL NOTICE

When using the information provided in this report, it is important to know that data collected by the HHP are dependent on the research and observations of many individuals and organizations. In most cases, this information is not the result of comprehensive or site-specific field surveys and has not been confirmed in the field by HHP staff. Many natural areas in Hawaii have never been thoroughly surveyed, and new species of plants and animals are still being discovered. For these reasons, the HHP cannot provide a definitive statement on the presence, absence or condition of biological elements in any part of Hawaii. HHP reports summarize the existing information known to HHP at the time of the request. They should never be regarded as final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. Furthermore, HHP reports do not represent or imply a position or policy taken by The Nature Conservancy of Hawaii on any related matter. If information from this report is distributed in any way, the above statements must accompany that information.

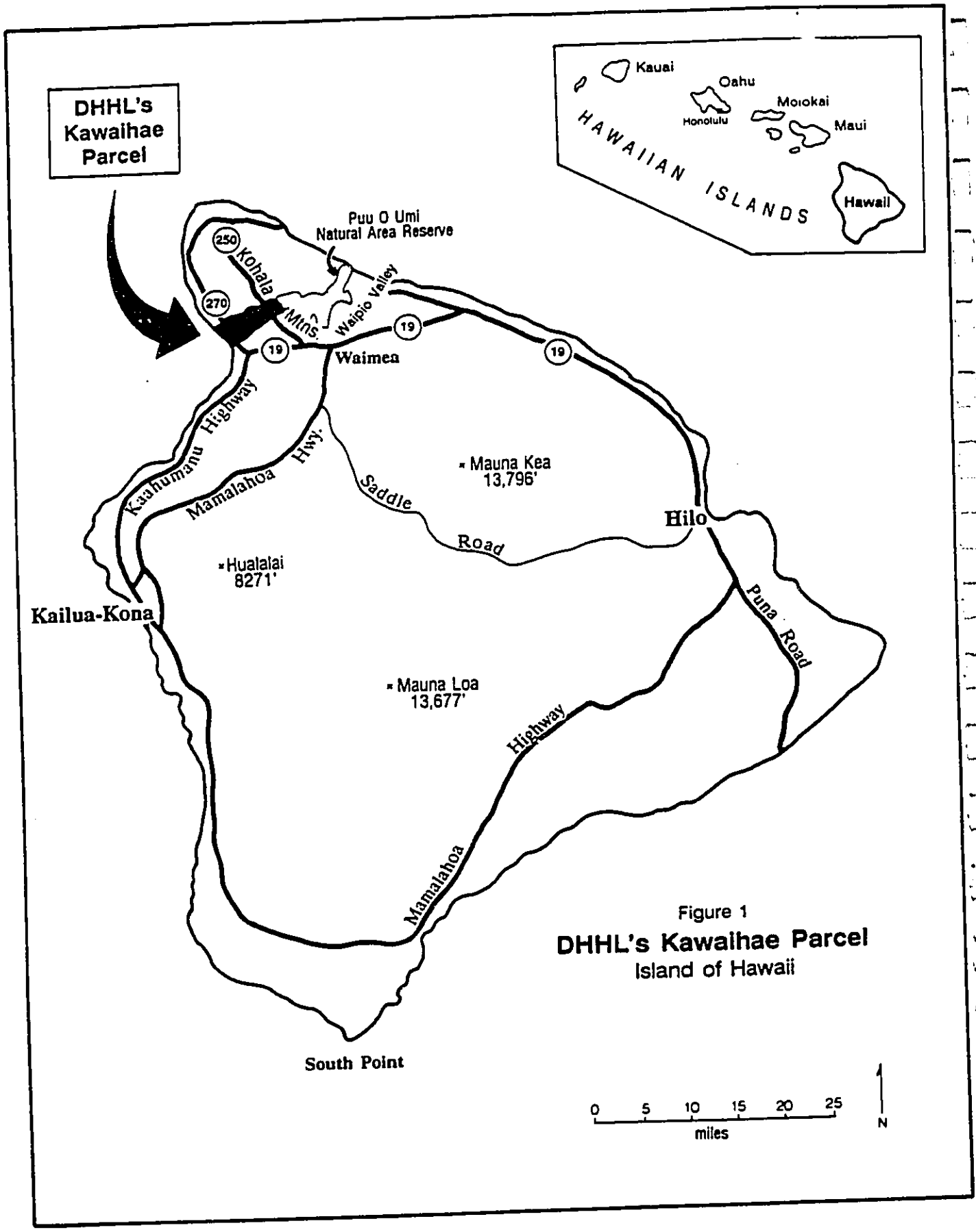


Figure 1

DHHL's Kawaihae Parcel

Island of Hawaii

REPORT ORGANIZATION

In the first section of this report, the natural history of the Kawaihae region is reviewed. The methods section then addresses the Heritage Program's definition of rarity for particular elements (plants, animals, and natural communities) and the methods used to collect this information, including major information sources consulted. Thereafter, Kawaihae's rare biological resources are highlighted in sections describing each of the major types of rare elements. Each section contains a discussion of:

- Rare elements known or believed to occur on DHHL's Kawaihae parcel
- Distribution of these rare elements
- Factors currently threatening the continued survival of these rare elements.

The final section identifies the areas of greatest biological significance and summarizes the report.

FOR MORE INFORMATION

A great deal of additional information is contained in the attachments provided with this report:

Attachment 1 is How to Read Heritage Database Reports (HHP 1989). This book explains the methods used by HHP staff to document plant, animal, and natural community locations and other pertinent information in the database.

Attachment 2 contains a map overlay and summaries (Element Occurrence Records) of the available information for each location where a rare natural community, rare plant or rare animal has been reported from Kawaihae or adjacent lands. A list of all information sources in the reference section of this attachment is included for cross referencing. Illustrations of plants known from the Kawaihae region are included (where available) to assist in plant identification.

Attachment 3 is the Natural Area Reserves System Inventory Field Manual (NARS 1988). This describes in detail the methods used by HHP staff on field surveys. General Kawaihae field survey methods are covered in the methods section of this report.

This report and its attachments contain the most recent information as of March 1990. If additional or updated information is needed at any time, the Hawaii Heritage staff and database are available for consultation.

NOTE ON TERMINOLOGY AND HAWAIIAN DIACRITICAL MARKS

Throughout this report, we have made a sincere effort to minimize the use of technical terms and HHP "jargon." However, the use of a small number of unfamiliar biological terms is unavoidable. For example, most people are familiar with "rare species." However this term is often inappropriate, as rare plants and animals are sometimes rare species, but they may also be rare subspecies or rare varieties of more common species. The term "rare taxa" is used to refer to subspecies and varieties in this report. To clarify terminology, a glossary of technical terms is included at the end of the report. If definitions are lacking for any unfamiliar terms or concepts contained in this report, please feel free to call the HHP staff for clarification.

This report uses the ʻuʻina (glottal stop) in Hawaiian names of plants and animals. The kaha ko (macron) has not been used due to word processing limitations. While HHP recognizes the importance of Hawaiian diacritical marks in place names as well, it has adopted a policy of excluding all marks from place names because U.S. Geological Survey (USGS) topographic maps do not include diacritical marks.

NATURAL HISTORY OF KAWAIHAE

The Hawaiian Islands are the most isolated archipelago of high islands on Earth. An ocean barrier of 2500 miles separates the islands from the nearest continent, and life arrived slowly via wind, waves and birds. The early colonizers diversified over millions of years into thousands of uniquely Hawaiian plants and animals. Scientists the world over have described the biota of Hawaii as one of the most outstanding examples of evolution.

Within this remarkable island chain, the island of Hawaii (Big Island) is the youngest of the main Hawaiian Islands. By latest accounting, the Big Island is less than 500,000 years old. In contrast, Mount Haleakala on Maui is nearly a million years old, and the mountains of Kauai about six million years old (Macdonald et al. 1983).

Kawaihae is a region that lies on the northwest end of the Big Island, which extends southward to Highway 19 (Figure 1). Highways 270 and 250 provide primary access to the region, with smaller ranch roads and various trails providing additional access. The region includes the DHHL parcel. The topography slopes gradually from sea level to approximately 4800 feet elevation (Figure 2). There are several gulches dissecting the middle to low elevations and scattered small volcanic cones at higher elevations. The major gulch draining this area is Honokoa. Several smaller gulches also cross the parcel. After heavy rains, some of these gulches have running streams. From north to south these gulches include: Kaiopae, Waipahoehoe, Kilohana, Keawewai, and Makahuna. Gulches at the north and south boundary of the parcel are Keahahalululu and Palihae respectively.

Situated on the leeward side of the Kohala Mountains, the Kawaihae region has a large rainfall gradient. The Kawaihae coast has virtually the lowest annual rainfall on the island (approximately 10 inches per year), equivalent to desert conditions. This is in sharp contrast to well over 75 inches of rainfall per year at 4800 feet elevation, where montane rainforest conditions prevail.

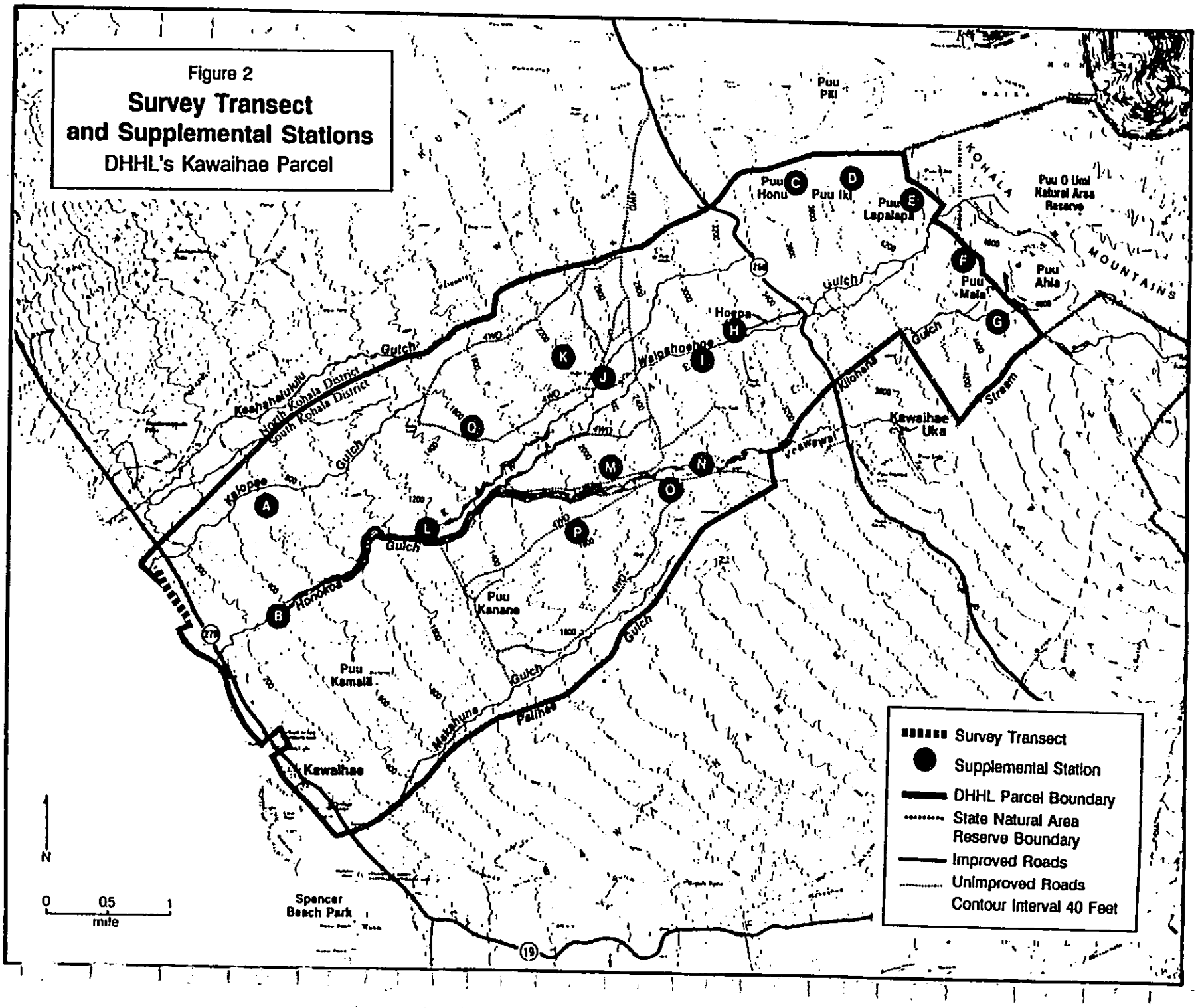
Prior to human settlement, the native vegetation of Kawaihae extended from the coast to the summit and was probably more diverse and abundant than today. Coastal dry shrublands and grasslands probably bordered the shoreline of Kawaihae, with scattered stands of wiliwili (Erythrina sandwicensis) forest. Further inland at lower elevations, lowland dry shrublands dominated by such species as 'akia (Wikstroemia pulcherrima), 'a'ali'i (Dodonaea viscosa), and 'ulei (Osteomeles anthyllidifolia) were likely present. Those shrublands probably gave way to lowland dry and mesic forests dominated by koai'a (Acacia koaia) and perhaps other trees such as naio (Myoporum sandwicense), lama (Diospyros sandwicensis), mamane (Sophora chrysophylla), olopua (Nestegis sandwicensis), and 'ala'a (Pouteria sandwicensis) at somewhat higher elevations. Upper Kawaihae was covered with a montane wet forest, dominated by 'ohi'a (Metrosideros polymorpha) and 'olapa (Cheirodendron trigynum).

When the Hawaiians settled in Kawaihae, they converted drier slopes into pili (Heteropogon contortus) grasslands for thatching. The moister land upslope was farmed for such crops as taro (Colocasia esculenta), yam (Dioscorea alata) and sweet potato (Ipomoea batatas). Other

Figure 2

Survey Transect and Supplemental Stations

DHHL's Kawaihae Parcel



plants introduced by the Hawaiians, such as kukui (Aleurites moluccana) and ti (Cordyline fruticosa), were encouraged in gulches where they displaced many native plants.

Post-Cook changes in the landscape reflected changing land use and continued introductions of alien species. The very large cattle populations of the 1800s severely damaged much of Kawaihae's native vegetation, which had never before been exposed to grazing and trampling by large, herbivorous, hoofed animals. As the native vegetation declined, a growing number of introduced plants, such as kiawe (Prosopis pallida), partridge pea (Chamaecrista nictitans), lantana (Lantana camara), koa haole (Leucaena leucocephala) and pasture grasses became established and displaced native plants.

Cattle ranching continues in Kawaihae, both within and outside of the DHHL parcel. Other land uses are horse pasture, housing, fishing along the beach areas, and light industrial and commercial enterprises around the harbor. The remainder of this report documents the biological diversity of the DHHL's Kawaihae parcel.

METHODS

To describe and summarize the biological richness of the DHHL parcel, all pertinent sources of biological information for the area were consulted. From these data, HHP developed a database which contains information on the location and population status of rare plants and animals. This database allows for a better understanding of existing biological resources.

Regardless of the element type, the following four steps were used to gather and process existing information:

1) Search and review all pertinent biological literature and specimen collections on rare elements reported from the DHHL parcel and adjacent lands.

2) Interview scientists and natural resource experts with knowledge of the area.

3) Survey the project area, using representative transects or supplemental stations, to characterize major vegetation types and ecosystems and update the status of rare elements through incidental observations.

4) Summarize this information in a database, including a map of the sites where rare elements have been reported to occur and detailed computerized records of location and status.

HHP compiles and maintains statewide information on all rare and imperilled Hawaiian natural communities, plants and animals. A natural community is considered rare and imperilled if it is known from 20 or fewer localities OR if it covers less than 2000 acres worldwide. More widespread natural communities that are threatened with destruction throughout their range are also considered imperilled. The definition of a rare plant or animal varies depending on professional opinion. HHP defines a plant or animal taxon as rare when available records indicate that its current distribution or abundance is limited. A species is considered rare if within the last 15 years it is known from 20 or fewer locations OR fewer than 3000 individuals. Other widespread taxa that are threatened with destruction throughout their range are also considered imperilled.

After rare elements have been identified and mapped, a "global rank" is assigned by HHP to represent an element's worldwide rarity and threat of extinction. The global rank is based upon the following six criteria and is described in detail in How To Read Heritage Database Reports (Attachment 1):

- Estimated number of sites (or occurrences)
- Estimated abundance
- Number of protected sites
- Range
- Threats
- Ecological fragility

This element ranking system is used by Heritage Programs throughout the United States, Canada and Latin America to identify communities and taxa in need of immediate protection.

The definition of an occurrence varies depending on the element type (natural community, plant or animal). Each of the following three sections first describes the element, lists the major information sources, and defines an occurrence depending on element type.

NATURAL COMMUNITIES

A natural community is an assemblage of plants and animals occurring together at a site. Because of their environmental requirements, particular taxa tend to occur at specific altitudes, or on certain soil types, or under limited ranges of moisture. Additionally, some taxa require the presence of other taxa in order to persist. For example, many native birds require the nectar of 'ohi'a trees, and many native plants require either native birds or native insects to pollinate them. These kinds of direct and indirect interactions between plants, animals and environment form the basis for a healthy natural community.

Classification of natural communities in Hawaii is relatively new. Useful information on the location and condition of natural communities is difficult to obtain because many field botanists focus on rare plants rather than natural communities. Since 1985, ecologists at the Hawaii Heritage Program and the Bernice P. Bishop Museum have been working together to identify and describe the many types of native and non-native communities in the Hawaiian Islands. More than 24 biologists from around the state have assisted in this effort. Known as the Hawaiian Natural Community Classification, it is the best available system for distinguishing native natural communities in the islands. A summary of the Hawaiian Natural Community Classification will formally appear in the Museum's Manual of the Flowering Plants of Hawaii (Wagner et al. In press), scheduled for publication in 1990. However, the classification will continue to change over the coming years, as it is tested and refined through direct field observations.

Review of 1977 aerial photographs, interviews with Linda Cuddihy, Winona Char and P. Quentin Tomich, and data collected from a 1988 survey of Puu O Umi Natural Area Reserve (DLNR 1990) were used to evaluate known and potential native natural communities in the DHHL's Kawaihae parcel. A map of 'ohi'a (Metrosideros polymorpha)-dominated vegetation compiled by the United States Fish and Wildlife Service (USFWS) provided significant information on the distribution of this native forest community in the DHHL parcel and adjacent area (Jacobi pers. comm.). These sources also helped to refine the locations and general distribution of natural communities. Although not exhaustive, the HHP survey sponsored by DHHL helped to confirm and augment the sparse available information.

For native natural communities, an "occurrence" is mapped when the vegetation of an area consists of at least 60% native plants. Stands are considered alien communities when alien plants occupy more than 40% of the area. These areas are mapped as alien vegetation and are not included in the natural community database.

For each native natural community reported in Kawaihae, approximate boundaries were plotted on topographic quad maps and on aerial photographs whenever available. Community descriptions and plant species lists were compiled when such information was available. Communities considered rare by HHP were located precisely and detailed computerized records (Element Occurrence Records) were completed (Attachment 2).

RARE PLANTS

Our understanding of Hawaii's native plants is continually being revised. Recently the Bernice P. Bishop Museum sponsored the preparation of the Manual of the Flowering Plants of Hawai'i (Wagner et al. In press), a reevaluation of taxonomic treatments by recognized botanists. Many significant changes in taxonomy were made as the result of these revisions. Upon the advice of Hawaiian botanists, HHP has adopted the taxonomy outlined in the Manual, subject to review by an advisory committee of knowledgeable botanists. Information on ferns comes from an unpublished paper by Wagner and Wagner (1987).

Information on rare plant locations comes from numerous sources. These include herbarium collections (Bernice P. Bishop Museum, the University of Hawaii's Botany Department and Harold H. Lyon Arboretum), published scientific materials, unpublished reports (environmental impact studies and government reports) and observations by field botanists.

Only native Hawaiian plants are included in HHP's rare plant database. Criteria in compiling this database are:

1) All plant taxa listed as endangered by the USFWS are included (USFWS 1987).

2) All plant taxa identified as candidates for listing by the USFWS are considered for inclusion (USFWS 1990). The final decision depends on the currently accepted taxonomy and the plant's reported abundance.

3) Additional native plant taxa recommended as rare by experienced botanists are considered for inclusion. Again, the final decision depends on the currently accepted taxonomy and the plant's reported abundance.

For rare plants, an "occurrence" is mapped wherever one or more individuals of a rare plant taxon are reported. Plants of a single taxon scattered along a cliff face, ridge top, or valley floor are considered a single occurrence. Each reported occurrence is classified as either "current" or "historic". Current populations are those observed in the last 15 years (1975-1990); historic populations are those observed prior to 1975. It is important to note that a historical sighting may simply mean that no one has looked recently for the plant at this location, or that the taxon is difficult to find due to habitat, seasonality or small size.

Scientific names are used throughout this report, because many native plants lack Hawaiian or other common names. Where available, common names for plants in the DHHL parcel are provided in Table 2 and Appendix A.

RARE ANIMALS

Animal species considered rare by federal or state wildlife agencies or by the scientific community are included in the HHP database. These include terrestrial animals (birds, snails, and one mammal) and marine animals (sea turtles and one mammal). Also included are fish and aquatic invertebrates, which are used as indicators of relatively pristine stream and anchialine pool habitats.

Only native Hawaiian animal species, subspecies or island populations are included in the HHP rare animal database. The following criteria are used:

1) All species, subspecies, or island populations listed as endangered or threatened by the USFWS (USFWS 1989) or by the State of Hawaii (DLNR 1986) are included in the list.

2) All species, subspecies, or island populations identified as candidates for listing by the USFWS are considered for inclusion.

3) Additional species, subspecies, or island populations regarded as rare by the scientific community are considered for inclusion. Final decision for inclusion is based on known abundance and rarity.

Major sources and the definition of an occurrence for each rare animal taxon from the Kawaihae region are included in the following sections. The definition of a rare animal occurrence varies, due to behavioral differences in animals. Recent records (since 1975) are considered to be "current"; those which are older than 1975 are historic. It is important to note that a historical sighting may simply mean that no one has looked recently for the sighting in this locale. It may also mean that the animal is difficult to find due to habitat, seasonality or behavior. Appendix B includes a list of the scientific, common and Hawaiian names for each species reported from the DHHL parcel and adjacent areas.

Hawaiian Hoary Bat

Information for the Hawaiian hoary bat (Lasiurus cinereus semotus) was obtained from both published literature and unpublished sightings collected by P. Quentin Tomich. An element occurrence for the bat consists of any reliable sighting.

Hawaiian Duck

The main sources of information on the distribution of the koloa or Hawaiian duck (Anas wyvilliana) used for this report are unpublished semi-annual survey data from the Division of Forestry and Wildlife (1986, 1988), USFWS 1976-83 forest bird survey data (USFWS n.d.) and miscellaneous published articles (Paton 1981, USFWS 1985). Any reliable sighting of Hawaiian duck is documented and considered an occurrence in the database. On the recommendation of the State Division of Forestry and Wildlife, only rare waterbird sightings

since 1954 are included in the database. Pre-1954 occurrences are omitted because the distribution of waterbird habitat has changed markedly since the first half of this century.

Hawaiian Hawk

The main sources of information for the 'io or Hawaiian hawk (Buteo solitarius) in the Kawaihae region are sightings from Banko (1980), USFWS 1976-83 forest bird survey (USFWS n.d.), USFWS Recovery Plan (1984) and a dissertation on the 'io (Griffin 1985). Only reliable sightings of 'io nest sites are mapped as an occurrences. Sightings of 'io in flight or perched along the roadside are not included in the database.

Native Land Snails

Since little malacological research has been done on the island of Hawaii during this century, no comprehensive inventory of the land snails in Kawaihae and surrounding areas exists. The only information available was obtained from the unpublished field notes and collection catalog of R.M. Severns' private collection (1988).

An occurrence of a rare land snail is any post-1945 observation or specimen of one or more snails, alive or recently dead. A recently dead specimen is one that has either a complete or partial periostracum.

FIELD SURVEY

After compiling existing information on rare, endangered or threatened natural communities and taxa in and around the DHHL parcel, specific areas were selected for surveys. The primary objectives of the field survey were to map, describe, and prepare species lists for all the native natural communities occurring within the DHHL parcel and to field check known populations of rare plants and animals.

The field survey was conducted by HHP biologists between July 17-19 and August 3-4, 1989, totalling five days (12 person-days). The first part of the HHP survey was conducted by Steve Perlman and Lyman Abbott; the latter by Steve Perlman, Sam Gon III, and Lyman Perry. To sample the vegetation, one coastal transect and 17 inland supplemental stations (A-Q) were surveyed (Figure 2). These areas were chosen to give good geographic representation of the parcel, as well as to look for rare species previously reported for this site.

During the survey, all plant taxa found within native natural communities were identified and recorded. All birds seen and identifiable calls heard were noted, and the vegetation and ground litter were searched for evidence of land snails or other notable invertebrates. During the field survey, general management needs were also identified. Feral ungulate activity and invasion by alien plants were recorded at each supplemental station. Other threats were noted where recognized. The data collection methods used during this survey are described in detail in the Natural Area Reserves System Inventory Field Manual (Attachment 3).

Limitations

The parcel covers a large area which includes rough and difficult terrain. Only a sample of the gulches could be examined in the available time. It is possible that small pockets of native vegetation were overlooked. And as in most field surveys, the plant and bird taxa recorded reflect the seasonal and environmental conditions existing at the time of the survey. Also, native land snails are small and easily overlooked. It was beyond the scope of this study to thoroughly inspect all native vegetation for native land snails.

NATURAL COMMUNITIES OF KAWAIHAE

Current conservation efforts recognize the need to identify and maintain intact natural communities as stable habitat for rare and common native plants and animals. In Hawaii, nearly all of our natural communities are endemic to the islands, meaning they occur nowhere else in the world.

HAWAIIAN NATURAL COMMUNITY CLASSIFICATION

The Hawaiian Natural Community Classification is hierarchical. There are aquatic, subterranean and terrestrial categories of natural communities. Aquatic communities include springs, streams, lakes and pools. The terrestrial community types are grouped and named according to elevation, moisture conditions and vegetation structure. For example, among the native communities of the DHHL's Kawaihae p[illegible] are lowland dry shrubland, lowland dry forest, and montane wet forest. Individual comm[illegible]ity types are named more specifically for the most common or dominant plants present. For example, one lowland dry forest in the DHHL parcel is located between 2000 and 3000 feet elevation and is dominated by the koai'a. In the Hawaiian Natural Community Classification, this community is named a Koai'a Lowland Dry Forest.

To date, approximately 150 native Hawaiian natural communities have been recognized and described. Of these, more than half (80-90) are believed to be rare or globally imperilled.

NATIVE NATURAL COMMUNITIES

The vast majority of the DHHL parcel consisted of pasture grasses or kiawe (Prosopis pallida) forest. Although most of the original vegetation of Kawaihae has been destroyed by hoofed animals and alien plants, a few remnant native forest pockets have persisted on the DHHL parcel. All of the native vegetation patches were surrounded by alien vegetation, usually made up of introduced range grasses. All of the native vegetation patches were small and were located on the upper slopes of cinder cones and in the gulches. The three native natural communities observed in the DHHL parcel were the 'Ohi'a/'Olapa (Metrosideros polymorpha/Cheirodendron trigynum) Montane Wet Forest, Koai'a (Acacia koaia) Lowland Dry Forest, and 'Akia/'A'ali'i/'Ulei (Wikstroemia spp./Dodonaea viscosa/Osteomeles anthyllidifolia) Lowland Dry Shrubland (Table 1 & Figure 3). Only the Koai'a Lowland Dry Forest is considered rare.

At the upper elevations (above 4000 feet), adjacent to the Puu O Umi Natural Area Reserve, patches of 'Ohi'a/'Olapa Montane Wet Forest were observed. Below 3000 feet elevation, one gulch contained patches of the rare Koai'a Lowland Dry Forest, while small patches of 'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland occurred on rocky ridges scattered within the pasture lands. At the lower end of the parcel, pasture gave way to alien kiawe forest. Along the coast, only the most common native coastal plants were present. These plants did not

TABLE 1. NATIVE NATURAL COMMUNITIES OF DHHL'S KAWAIHAE PARCEL: HERITAGE RANK AND NUMBER OF OCCURRENCES.

Natural Community Name	Heritage Global Rank (a)	Number of Occurrences (b)
'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland	G3	-
Koai'a Lowland Dry Forest	G2	1
'Ohi'a/'Olapa Montane Wet Forest	G3	-

(a) Key to Global Ranks:
G1 = Natural community critically imperilled globally (typically 1-5 current viable occurrences).
G2 = Natural community imperilled globally (typically 6-20 current viable occurrences).
G3 = Natural community with restricted range (typically 21-100 occurrences).
See Attachment 1 for more information.
(b) = Occurrences are compiled for rare native communities only.

form continuous stands of native coastal shrublands, but were scattered among alien vegetation.

Listed below (from upper to lower elevations) are descriptions of each native natural community. Each community description contains the known elevation and geographic range, the dominant and representative species generally associated with the natural community, and habitat specifics for the DHHL parcel. Appendix A contains plant species listed by natural community type.

'Ohi'a/'Olapa Montane Wet Forest
Metrosideros polymorpha/Cheirodendron trigynum Montane Wet Forest

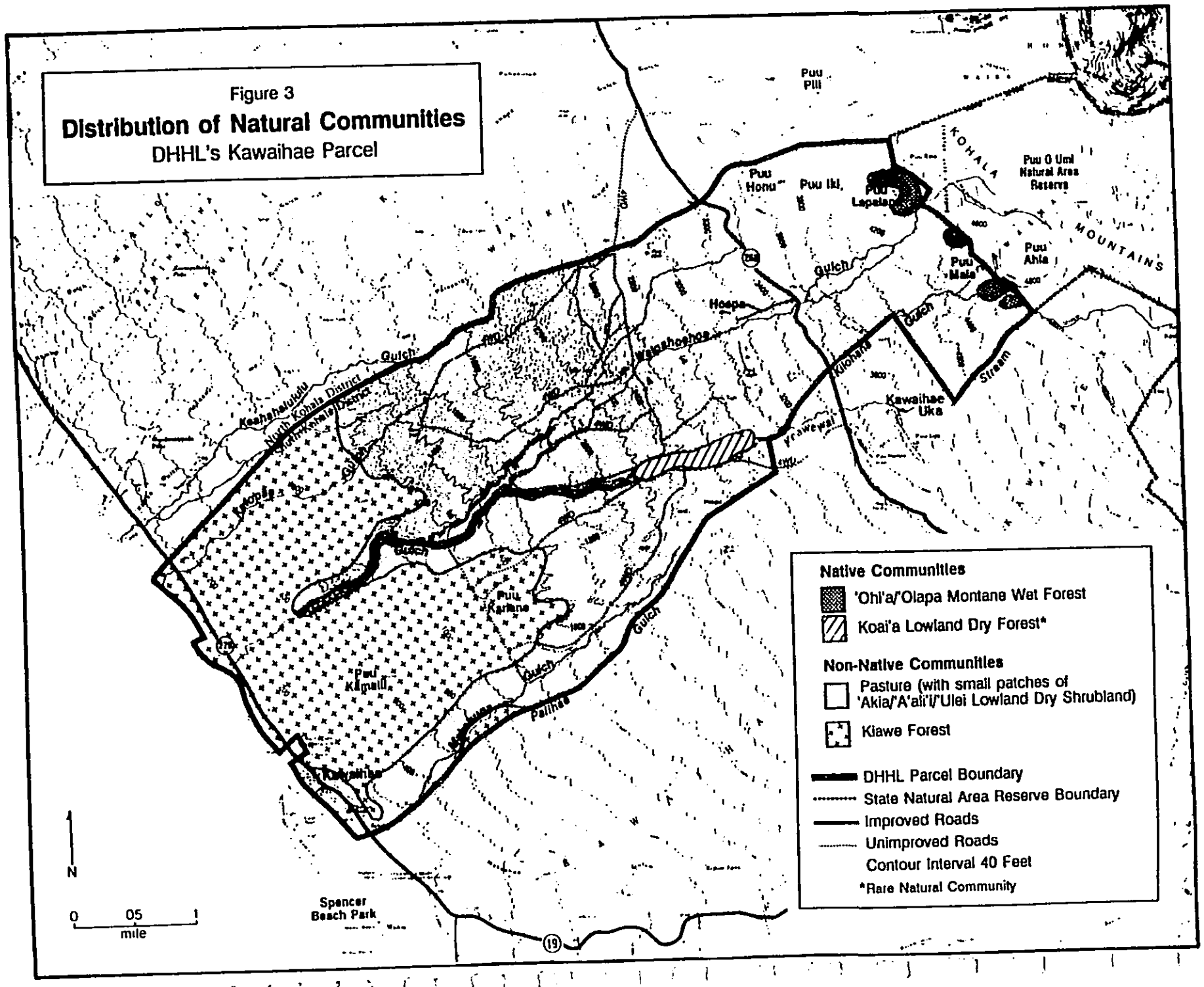
Wet forests above 3000 feet elevation dominated by 'ohi'a and either 'olapa or lapalapa (Cheirodendron platyphyllum) (rarely both) are known from the islands of Kauai, Oahu, Molokai, Maui, and Hawaii. Associated species of this forest type vary by location, but often include kawa'u (Ilex anomala), as well as, representative species of alani (Pelea spp.), 'ohelo (Vaccinium spp.), 'ohawai (Clermontia spp.), and a variety of ferns and mosses. The community is not considered rare, but some examples are known to contain rare plants. The 'ohi'a/'olapa montane wet forest is important habitat for forest birds and tree snails.

In the DHHL parcel, the demarcation between pasture and the adjacent Puu O Umi Natural Area Reserve was abrupt, with a nearly pure pasture of kikuyu grass (Pennisetum clandestinum) on the parcel side of a cattle fence and a dense 'ohi'a/'olapa forest on the reserve side. There were a few small patches of 'ohi'a/'olapa forest in the DHHL parcel, one of the largest on the east-facing flank of Puu Lapalapa. Other patches were found on Puu Mala and in Kilohana Gulch but were absent from Puu Honu and Puu Iki (Figure 3). The 'ohi'a and 'olapa formed a closed-canopy low stature forest of 2.5-5 meters (ca 8-16 feet).

Figure 3

Distribution of Natural Communities

DHHL's Kawaihae Parcel



Other trees included kopiko (Psychotria hawaiiensis), olomea (Perrottetia sandwicensis) and kolea (Myrsine lessertiana and M. sandwicensis). Hapu'u tree ferns (Cibotium glaucum) were common in the understory, as were a variety of shrubs and ground ferns including pu'ahanui (Broussaisia arguta), 'ohelo kau la'au (Vaccinium calycinum), manono (Hedyotis terminalis), kawa'u (Ilex anomala), 'akala (Rubus hawaiensis), mamaki (Pipturus albidus), 'ohawai (Clermontia parviflora), Athyrium spp., Asplenium spp., and Dryopteris spp. Two rare Hawaiian lobeliads were noted during the survey: Lobelia hypoleuca, observed along Waipahoehoe Stream in degraded pastures of these forests, and Cyanea tritomantha in a gulch below Puu Mala (Figure 4).

The major threats to the patches of 'ohi'a/'olapa forest on the DHHL parcel are disturbance by pigs and occasional browsing by cattle. An enclosure fence around the forest patches on Puu Lapalapa and Puu Mala might provide the needed protection from ungulates. Relatively little can be done to protect the remnant patches in gulches. The forest patches contained relatively few weeds, with banana poka (Passiflora mollissima) being the most serious weed observed. An active weed control program, possibly carried out by volunteer organizations, could help maintain the quality of these native forest patches.

Koai'a Lowland Dry Forest
Acacia koaia Lowland Dry Forest

Lowland dry forest dominated by koai'a is an imperilled and rare community that occurs on the islands of Kauai, Molokai, Lanai and Hawaii. Fewer than eight examples of this rare forest type are known. Its elevation range extends from about 2000 feet to just over 3000 feet. Rainfall in koai'a forests is generally less than 50 inches per year. Koai'a forest can occur on slight to steep slopes, with good soil development on gentle slopes and with rocky talus substrates on gulch sides. Associated species vary by location but typically include dryland trees, such as olopua (Nestegis sandwicensis) and lama (Diospyros sandwicensis) in the canopy, and dryland shrubs such as ko'oko'olau (Bidens spp.) in the understory. Lands adjacent to this forest type are often dominated by alien plants, such as pasture grasses.

In the DHHL parcel there were a few stands of remnant koai'a forest, typically on the walls of steep-sided gulches that cattle did not appear to frequent. Only one of these stands was considered large enough and healthy enough to be considered intact, i.e. capable of perpetuating itself. This stand in Keawewai Gulch occupied the north and northwest-facing slopes between 2200 and 2800 feet elevation. The most intact sections within this stand formed a closed-canopy, 5-10 meters (ca 16-33 feet) in height, with koai'a making up more than 60% of the canopy cover. Other trees observed included lama, olopua, mamane (Sophora chrysophylla) and naio (Myoporum sandwicense). The understory contained several native shrub species, including kulu'i (Nototrichium sandwicense), ko'oko'olau (Bidens menziesii), 'aweoweo (Chenopodium oahuense), 'a'ali'i and 'ulei. Koai'a is itself considered a rare plant. None of the other plants observed in the DHHL parcel's koai'a forest example are considered rare.

Cattle damage was observed at the edges of the koai'a forest stand located in Keawewai Gulch, but some portions were surprisingly intact. Goats were flushed from within the stand,

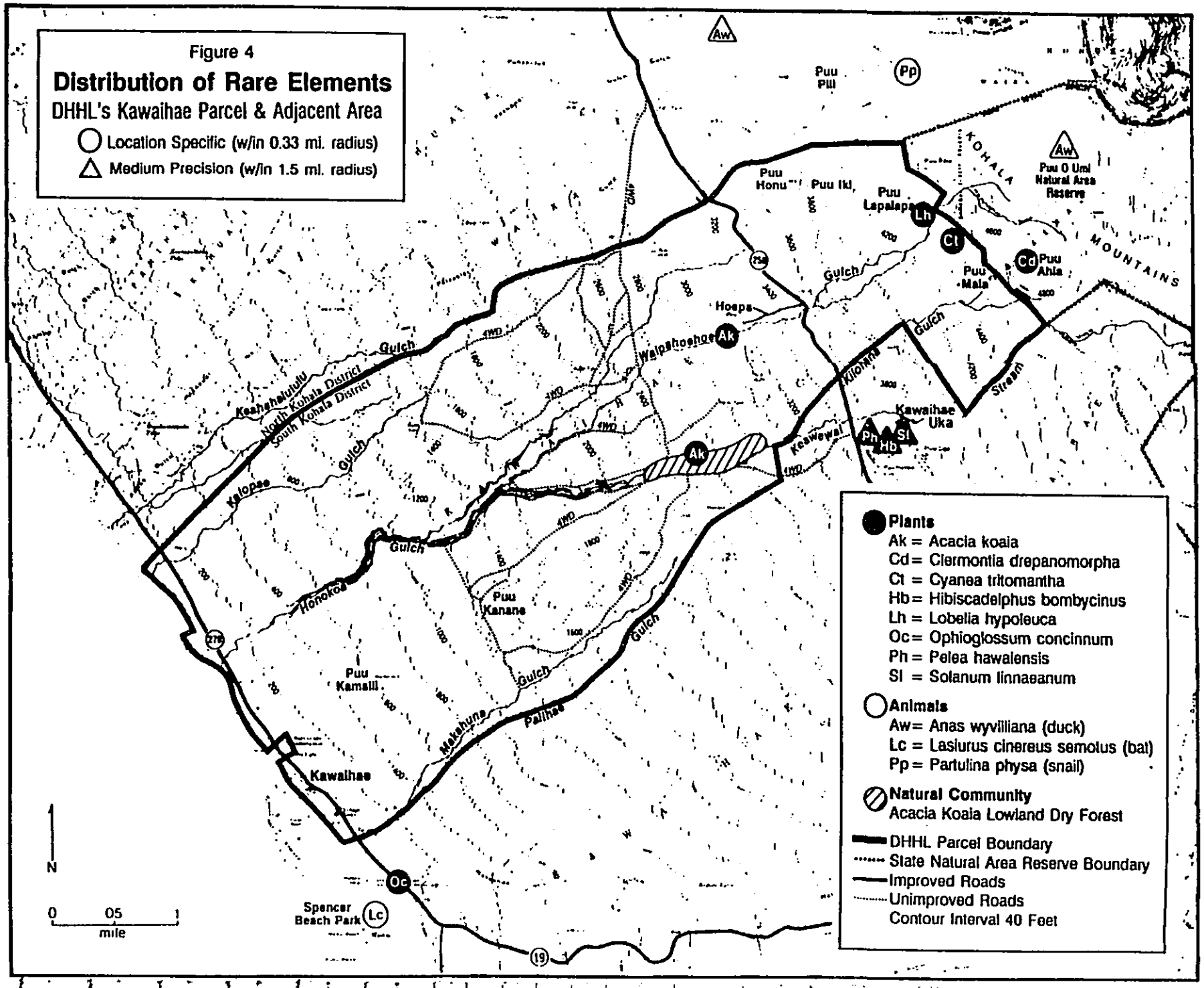
Figure 4

Distribution of Rare Elements

DHHL's Kawaihae Parcel & Adjacent Area

○ Location Specific (w/in 0.33 mi. radius)

△ Medium Precision (w/in 1.5 mi. radius)



indicating that they are probably an important threat. Alien plants such as lantana, molasses grass (Melinis minutiflora) and fountain grass (Pennisetum setaceum) covered portions of the understory, while kukui (Aleurites moluccana) was present along the gulch bottom.

Three management concerns for this rare natural community are to restrict grazers, prevent fire, and limit weed invasion into the area. An enclosure fence around the forest patches could provide the needed protection from cattle and goats. A fire break should be built and maintained and weeds kept under control in this area. Propagation and replanting of appropriate native species could also limit invasion of weeds. Again volunteer groups could provide labor for the management activities.

'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland
Wikstroemia spp./Dodonaea viscosa/Osteomeles anthyllidifolia Lowland Dry Shrubland

Dry shrublands in the lowland zone, dominated by 'akia (Wikstroemia spp.), 'a'ali'i and 'ulei are known from the islands of Kauai, Oahu, Molokai, Maui, Lanai and Hawaii. Generally this shrubland occurs on ridge tops below about 2500 feet elevation, in areas with annual rainfall below 50 inches. The particular species of 'akia may vary by island and location, and at times localized variants of this shrubland may lack one of the three co-dominant species. This occurs often as a result of chronic disturbance. This community is not considered rare and is not known to contain rare plants.

In the DHHL parcel, many disturbed patches of native shrubland dominated by a locally abundant species of 'akia (Wikstroemia pulcherrima) and the ubiquitous dryland shrub 'a'ali'i were observed on rocky outcrop areas in pastures below 2000 feet elevation. It may be that chronic browsing by cattle and goats has removed many of the more palatable species of native plants that once occurred in this shrubland. For example, although 'ulei was missing from the shrubland, it was present in steep gulches that were partially protected from grazing. Presumably, 'ulei was once a component of the shrubland outside of the gulches, but it was more palatable and eventually removed by grazing. Besides 'akia and 'a'ali'i, the only other native species observed were 'ilima (Sida fallax) and 'uhaloa (Waltheria indica).

The major threats to this shrubland are continued browsing by cattle and goats, and displacement by alien plants, especially lantana, Chamaecrista nictitans, molasses grass, and other grasses. Small enclosure fences could be built around the best examples of this shrubland if its preservation in the parcel is desired. Native plants typical of this shrubland could also be used as landscaping in the DHHL parcel (i.e. preserved Hawaiian cultural sites, not shown on map).

Alien Vegetation

At the time of the HHP survey in 1989, the parcel was covered almost entirely with alien vegetation, mainly introduced range grasses above 1000 feet elevation and kiawe forest below 1000 feet. Pasture lands of Kawaihae were vegetated by a mosaic of grasses and shrubs. At the higher elevations, the dominant grass was kikuyu grass (Pennisetum clandestinum), forming

a dense, nearly pure ground cover. This kikuyu grass zone extended down to about 3200 feet elevation.

At middle elevations, a mix of buffel grass (Cenchrus ciliaris), fountain grass and molasses grass replaced the kikuyu grass. Within this mixed grassland grew shrubs such as partridge pea, lantana, koa haole and apple of Sodom (Solanum linnaeanum). The mosaic of different grass and shrub dominants formed a patchwork appearance across the landscape. One rare plant species, koai'a, was observed in alien vegetation at middle elevations, and on steep gulch walls along Keawewai Stream.

At lower elevations, kiawe cover increased to form an open forest with a grass understory (fountain grass and/or buffel grass were the dominant understory species). The kiawe forest extended from sea level to about 1500 feet.

RARE PLANTS OF KAWAIHAE

The Hawaiian Islands are unique in that approximately 90% of the 1300 native species of vascular plants are endemic to these islands and occur nowhere else in the world. Almost half of the endemic native plants are believed to be rare or imperilled. Of the eight rare plant taxa known from the Kawaihae region, at present none are officially listed as endangered (USFWS 1987). However, five are currently candidates for listing as endangered or threatened (USFWS 1990), and three of these occur within the DHHL parcel boundaries (Table 2). Two other plant species are no longer officially being considered for listing by the USFWS but are included in the Heritage database because the available data indicate that they are rare. The remaining rare plant, a hibiscus relative (Hibiscadelphus bombycinus), is a candidate that is probably extinct, and was last collected in the area in the 1800s.

All three plants known from within the DHHL's Kawaihae parcel boundary were observed within the DHHL parcel during the present survey. One of these three species is endemic to the island of Hawaii.

DISTRIBUTION WITHIN THE DHHL PARCEL

Three rare plant species are known from the parcel and are restricted largely to gulches and cinder cones above 2400 feet elevation. These occurrences appear to be located primarily in steep areas, which are least accessible to grazing animals and least likely to experience human disturbance (Figure 4).

Lobelia hypoleuca was first reported in the parcel during this survey, where it was found at the base of Puu Lapalapa. The species was observed in 'Ohi'a/'Olapa Montane Wet Forest near the upper boundary of the DHHL parcel. Lobelia hypoleuca is ranked G1 (critically imperilled globally) by HHP. Generally a critically imperilled plant is known from five or fewer locations in the world. Lobelia hypoleuca is known from more than five locations throughout Hawaii, but all currently known occurrences are threatened by habitat destruction, predation and invasion by weeds.

Two individuals of Cyanea tritomantha were seen on the slope of Puu Mala. This rare plant was also previously unknown from the Kawaihae region. These plants occurred in 'Ohi'a/'Olapa Montane Wet Forest near the eastern boundary of the DHHL parcel. Cyanea tritomantha is endemic to the island of Hawaii.

Two occurrences of Acacia koaia were observed during the survey. The largest population consisted of several hundred trees which comprise the dominant cover of the Koai'a Lowland Dry Forest in Keawewai Gulch. This tree is closely related to the more common koa tree, and bears small whitish flowers in ball-shaped inflorescences. Several small pockets of Acacia koaia were also discovered scattered along the stream in Waipahoehoe Gulch. This population was not previously known from Waipahoehoe Gulch. Acacia koaia is ranked G2 (imperilled globally).

TABLE 2. RARE PLANTS OF DHHL'S KAWAIHAE PARCEL AND ADJACENT AREA: FEDERAL STATUS, HERITAGE RANK, AND NUMBER OF OCCURRENCES.

SCIENTIFIC NAME (a) (HAWAIIAN NAMES)	FEDERAL STATUS (b)	HERITAGE GLOBAL RANK (c)	# OF OCCURRENCES IN KAWAIHAE DHHL PARCEL Current (Total) (d)
+Acacia koaia (koa'oha koai'a, koai'e)	C2	G2	2 (3)
Clermontia drepanomorpha* ('oha, 'ohawai)	C2	G1	adj.
+Cyanea tritomantha* ('oha, 'haha, 'ohawai)	C2	G2?	1 (1)
Hibiscadelphus bombycinus* (hau kuahiwi)	3A	GH	adj.
+Lobelia hypoleuca ('oha, haha, 'ohawai)	3B	G1	1 (1)
Ophioglossum concinnum (pololei)	C1	G2	adj.
Melicope hawaiensis (alani)	3C	G2?	adj.
Solanum incompletum (-)	C1	G1?	adj.
TOTAL OCCURRENCES			4 (5)
TOTAL TAXA			8

+ Observed during survey.
* Endemic to the island of Hawaii.
adj. = Rare plants reported from lands adjacent to Kawaihae DHHL parcel.

(a) Scientific names of flowering plants according to the Manual of FLowering Plants of Hawaii (Wagner et al. In press), except Acacia koaia, which is not recognized by the Manual but is considered a separate and rare taxon by other botanists. Ferns follow the taxonomy used in the 1990 Federal Register.

(b) Key to Federal Status (USFWS 1990):
C1 = Candidate for endangered or threatened status.
C2 = Same as C1, more information needed to complete listing package.
3A = Likely extinct, USFWS has persuasive evidence of extinction.
3B = No longer being considered for listing as threatened or endangered on the basis of current taxonomic understanding (plants that do not represent distinct taxa).
3C = No longer being considered for listing as threatened or endangered.

(c) Key to Global Ranks:
G1 = Species critically imperilled globally (typically 1-5 current viable occurrences).
G2 = Species imperilled globally (typically 6-20 current viable occurrences).
GH = Species known only from hist[illegible]occurrences (not observed since 1973).
G#?= Global rank tentative, insuffic[illegible]a available to assign definite rank.

(d) Current occurrences are those observ[illegible]e last 15 years (1974-1989). Total number of historic and current reported occurren[illegible]given in parentheses. Rare plants may still be present at the localities identified by [illegible]ese older observations.

The major threats to native rare plants are browsing by cattle and goats, disturbance by pigs and displacement by alien plants, especially lantana, partridge pea, molasses grass, and other grasses. Plant populations may be protected by building small enclosure fences around the best preserved examples. Feral animals should be monitored and controlled in the parcel.

DISTRIBUTION ADJACENT TO THE DHHL PARCEL

It was beyond the scope of this study to survey the entire DHHL parcel. Therefore observations from adjacent lands may provide additional information on rare plants that may exist within the DHHL parcel and are discussed below.

Five rare plants have been reported from areas adjacent to the DHHL parcel but have not yet been observed within it. Only one of these has been seen since 1975. The rare fern Ophioglossum concinnum was seen in 1985, near the coast south of the DHHL parcel. Clermontia drepanomorpha was last reported in 1932 from only one location in the Kohala Mountains, Puu Ahia, just east of the DHHL parcel. Melicope hawaiensis and Solanum incompletum are known historically from Kawaihae Uka (have not been seen since 1955 and 1888 respectively). These four species may well be found within the DHHL parcel with further surveys. The remaining rare plant, Hibiscadelphus bombycinus, was last collected in the Kawaihae region in the 1800s and is believed to be extinct.

In addition, 16 rare plants are known from the general south Kohala area, but no specific locations in the Kawaihae region are known at present (Appendix A). These plants may also be found within the DHHL parcel with further surveys.

RARE NATIVE ANIMALS OF KAWAIHAE

Hawaii supports a unique assemblage of native animals including two mammals, 49 land birds, hundreds of land snails, and thousands of insect species. Most of these animals are endemic and exist nowhere else in the world. Because of Hawaii's isolated mid-Pacific location and small size, the native animal population is a result of relatively few colonizations.

Human arrival introduced numerous other species to Hawaii. Competition with these alien species, along with numerous other factors such as habitat loss, introduced disease, and predators have resulted in restriction of many of the endemic populations in both size and range. A number of endemic animals are considered rare and/or in danger of extinction.

Today, over half of Hawaii's 49 surviving endemic bird species are considered threatened or endangered (USFWS 1989). The State of Hawaii has identified island populations of three additional endemic species that they consider at risk of extinction (DLNR 1986). Thirteen of 21 endemic bird species on the Big Island are considered endangered while eight are relatively common (Scott et al. 1986).

No rare native animal species were observed during the 1989 HHP survey nor have they been reported within the DHHL parcel. One common endemic bird, the 'apapane (Himatione sanguinea sanguinea) was observed in flight during the survey, along with numerous alien birds and invertebrates (Appendix B). In areas adjacent to the parcel, however, one rare mammal, two rare bird species (a waterbird and raptor) and a rare land snail have been reported (Table 3 and Figure 4). These animals may also be found within the DHHL parcel with additional surveys.

The following section supplies background information on rare animal species reported from areas adjacent to the DHHL parcel, species distribution and possible threats to these species.

HAWAIIAN HOARY BAT

The ancestral species of the Hawaiian hoary bat or 'ope'ape'a (Lasiurus cinereus semotus) ranges throughout the Americas (van Riper and van Riper 1982). 'Ope'ape'a is found only in Hawaii where its distribution is not well known. The largest population of 'ope'ape'a probably occurs on the Big Island, where it is found in all districts. Large concentrations of this species have been observed in some areas (Tomich 1986a).

The only recorded sighting of 'ope'ape'a in the Kawaihae region occurred in 1960 about 0.5 miles southwest of the parcel in Spencer Beach Park (Figure 4). A single bat was seen hanging on a shrub in the beach area. There also have been sightings along the Kona coast south of the parcel (Tomich pers. comm.).

Threats to the 'ope'ape'a are not well known, but the greatest threat may be the reduction of roosting trees when land is cleared due to agriculture and urbanization (Tomich 1986a, 1986b).

TABLE 3 RARE ANIMALS FROM LANDS ADJACENT TO DHHL'S KAWAIHAE PARCEL: FEDERAL STATUS, HERITAGE RANK AND NUMBER OF OCCURRENCES.

SCIENTIFIC NAME (a) (HAWAIIAN NAME) [COMMON NAME]	FEDERAL STATUS (b)	HERITAGE GLOBAL RANK (c)	# OF OCCURRENCES ADJACENT TO KAWAIHAE PARCEL Current (Total) (d)
MAMMALS Lasiurus cinereus semotus ('ope'ape'a) [Hawaiian hoary bat]	LE	G2	0 (1)
BIRDS Anas wyvilliana (koloa) [Hawaiian duck]	LE	G1	2 (2)
Buteo solitarius ('io) [Hawaiian hawk]	LE	G2	*
LAND SNAILS Partulina physa (-) [Achatinellid land snail]	-	G1	1 (1)

(a) Taxonomic names of birds are according to Pyle 1988; others according to 1989 Federal Register.

(b) Key to Federal Status (USFWS 1989):
LE = Taxa formally listed as endangered.

(c) Key to Global Ranks:
G1 = Species critically imperilled globally (typically 1-5 current viable occurrences).
G2 = Species imperilled globally (typically 6-20 current viable occurrences).

(d) Current populations are those observed in the last 15 years (1974-1989). Total number of historic and current reported populations is given in parentheses. Rare animals may still be present at the localities identified by these older observations.

* Hawaiian hawks seen flying, no nest discovered to date.

Human built structures have been noted as hazardous and insecticides used in orchards may also be a possible threat (Tomich 1986a).

HAWAIIAN DUCK

The koloa (Anas wyvilliana) was once a common species on all major islands except Lanai and Kahoolawe. Koloa are now found only on Kauai, Oahu and Hawaii. On Hawaii they can be found in marshes, reservoirs, ponds, irrigation ditches, taro patches, streams and river valleys, although they prefer streams between 500 and 4000 feet elevation (Paton 1981).

Koloa numbers declined dramatically early in this century and by 1949 they were considered only visitors on the Big Island. Captive propagation and release programs have been successful. Koloa have been released in the Kohala mountains and have been seen regularly in the Kohala Mountains around Waimea and Waipio Valley (Paton 1981). Koloa were observed during the 1979 USFWS survey in Puu O Umi Natural Area Reserve and during the semi-annual DOFAW surveys (1.5 miles northeast of the parcel) since 1980.

Direct threats affecting koloa are predation, human disturbance and land use changes. Waterbirds are particularly prone to the lack of suitable nesting habitat, changes in water levels within suitable areas and toxic chemicals (USFWS 1985, DOFAW 1988).

HAWAIIAN HAWK

The 'io (Buteo solitarius), one of Hawaii's two endemic raptors, breeds only on the Big Island, and is widely distributed in a broad range of both native and alien habitats. It is locally common on the slopes of Mauna Loa, on both the windward and Kona coasts, and to a lesser extent on Mauna Kea. Few sightings have been recorded in the leeward Kohala Mountains. Generally 'io does not occur in dry shrubland zones, but can be seen in open forests, rainforests, and agricultural areas. Nesting occurs in a variety of habitats from lowland agricultural areas and alien forests to pastures and rainforests at higher elevations (USFWS 1984).

'Io nests have not been found within the parcel; therefore observations of this species were not mapped. However, in the late 1960s, an observation of 'io was reported near Puu Pili, about 0.5 miles beyond the northeast boundary of the DHHL parcel (Banko 1980). In 1972 (Banko 1980) and again in 1979 (USFWS n.d.), an 'io was reported within two miles of the upper eastern boundary of the parcel. Although nest sites are not known from within or near the DHHL parcel, 'io defend their territories year round, so frequent observation of this hawk in an area could indicate the presence of nesting sites.

Threats to 'io include land conversion to agriculture and urbanization which has likely decreased available nesting areas. Past harassment and shooting may have had the greatest influence on Hawaiian hawk populations. Environmental contaminants, such as rodenticides, which have severely affected mainland populations of raptors, are not used commonly in

Hawaii and the present level of use is probably not a major factor affecting the population (USFWS 1984).

NATIVE LAND SNAILS

Relatively few native land snails inhabit the geologically young island of Hawaii. However, the relatively old Kohala Mountains contain the greatest diversity of snail species on the island (Chung pers. comm.). There has been little malacological research on the island of Hawaii this century and a comprehensive inventory of the molluscs in the Kawaihae region does not exist. It is worth noting that the greatest concentration of tree snails in the Hawaiian Islands was recorded south of the DHHL parcel on the Waimea Plains in 1903, where approximately 75000 Partulina confusa were seen in an area of 0.5 square mile on 150 olopua (Nestegis sandwicensis) trees (Pilsbry and Cooke 1912-1914). This species is very similar to Partulina physa and may still exist in the Kohala Mountains, even though the colony in the Waimea Plains is now extinct.

Including the July 1989 HHP survey, no rare land snails have been reported from the DHHL parcel since 1945. However, six specimens of the tree snail Partulina physa were collected in 1984 near Puu Pili within 0.5 miles of the northeast boundary (Severns 1988).

In recent years, many land snails have disappeared and are believed to have fallen victim to rats and Euglandina rosea, an introduced predatory snail. Land snails are also threatened by another alien predator, the garlic snail (Oxychilus alliarius), which may have been largely responsible for the reduction of native ground-dwelling snails (Severns, pers. comm.). Rats also seem to be a serious threat to the survival of the beautiful and unique Hawaiian land snails. Loss and destruction of habitat through the spread of alien vegetation, forest clearing and fire also threaten the survival of Hawaii's remaining endemic snail species.

Because many Hawaiian land snails have beautiful shells, they are very attractive to collectors and hikers. In the past, snail populations have been reduced by collectors. In order to protect these animals from the threat of extinction from over-collecting, detailed locality and habitat information were omitted from the Element Occurrence Records in Attachment 2. If additional information is required, please consult HHP staff.

BIOLOGICALLY SIGNIFICANT AREAS

The DHHL's Kawaihae parcel contained few biologically significant areas. However, the cinder cones above 4200 feet elevation and gulches with steep slopes proved to be sanctuaries for rare plants and a rare natural community.

In the DHHL parcel there were two stands of remnant koai'a forest, primarily on the walls of steep-sided gulches that cattle did not appear to frequent. Only one of these stands was considered large enough and healthy enough to be considered viable, i.e. capable of perpetuating itself. This population of koai'a (Acacia koaia) consisted of several hundred trees and was located in Keawewai Gulch on the north and northwest-facing slopes between 2200 and 2800 feet elevation. This population was large enough to form a rare native natural community, the Koai'a Lowland Dry Forest. Another smaller population of Acacia koaia was located in Waipuehoe Gulch.

Two additional rare plants, Lobelia hypoleuca and Cyanea tritomantha, were found on the slopes of Puu Lapalapa and Puu Mala respectively. Populations of these rare plants appear to be located primarily in steep areas, which are least accessible to grazing animals and least likely to experience human disturbance. Similarly, other rare plants known from adjacent lands may persist in small inaccessible pockets undetected by this survey.

'Ope'ape'a, koloa, and 'io may also use portions of the DHHL parcel (i.e. foraging). However, the significance of the DHHL parcel to these animal species is unknown.

Within or adjacent to the DHHL parcel, only a few remaining rare native plants are located on steep slopes and rock outcroppings. These occur where threats by grazing animals are minimized. Possible factors that may enhance the biological significance of the DHHL parcel are areas with adequate water suitable for waterbird nesting, as well as, adequate trees for raptor nesting and bat roosting.

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GLOSSARY

Alien: (same as **exotic, introduced, or non-native**) a species that is not native, i.e., one introduced accidentally or purposefully by man. In Hawaii, these include Polynesian introductions (such as kukui, coconut, pig, rat and jungle fowl) and many post-Cook introductions (such as guava, Christmas berry, mosquitoes, pigs, goats, cattle, deer and sheep). See **Endemic, Indigenous, Native.**

Avian: relating to birds.

Biota: all plants and animals of a given area. A general term for living things.

Biotic: pertaining to plants and animals, and to characteristics related to their presence.

Canopy: the highest vegetation cover of a community. In a forest, the canopy is made up of the tallest and most numerous trees. In a shrubland, the canopy is the tallest shrub layer. Closed canopies are those where the foliage interlocks to form a continuous layer over the underlying vegetation or ground. Open canopies are those where there are gaps in the foliage, and more light may reach the lower vegetation layers or ground.

Coastal: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian coastal zone extends from sea level to 30 m. (roughly 100 ft.) elevation, but varies with the extent of coastal influence (waves, sea spray, sea cliffs). See **Elevation Zones.**

Current Occurrence: see **Element Occurrence.**

Degraded: physically altered in such a way as to decrease the habitat quality for native species, or invaded by alien species. A community is considered degraded if alien weeds constitute more than 40% of the vegetation cover.

DHHL: Department of Hawaiian Homelands.

DLNR: Department of Land and Natural Resources.

DOFAW: Division of Forestry and Wildlife: a division of the State Department of Land and Natural Resources (DLNR).

Dominant: in a vegetated community, the plant species contributing the most canopy cover in a given area. Dominant species may also be the most numerous in a natural community. By Heritage definition, a dominant species must make up 25% or more of the total vegetation cover. See **Natural Community.**

Dry: a moisture category describing habitat in areas with less than 50 inches annual rainfall, or subject to seasonal drought, or bearing generally dry prevailing soil conditions. See **Mesic, Wet.**

Ecosystem: an assemblage of animals and plants and its interaction with the environment. See **Natural Community.**

Element: a plant, animal or natural community (collectively, the elements of natural diversity).

Element Occurrence (EO): a place where an element is found. It is a location or area which sustains or otherwise contributes to the survival of a population of a particular element. Typically, "current" occurrences are EOs that have been observed within the past 15 years.

Element Occurrence Record (EOR): the basic building block of the Heritage database. The EOR is a summary of all available information for a single element at a singe location or occurrence.

Elevation Zones: broad regions defined by elevation range and used to classify natural communities (ecosystems). There are five elevation zones defined by the Hawaiian natural community classification: coastal, lowland, montane, subalpine and alpine. Each is defined separately.

Endangered: a species officially recognized by federal or state officials to be in immediate danger of extinction due to natural or man-made factors. See **Federal Status.**

Endemic: naturally restricted to a locality. Most of Hawaii's native plants and animal are endemic (restricted) to the Hawaiian islands. Many are restricted to a single island, mountain range or even gulch. See **Alien, Native, Indigenous.**

Endemism: the extent to which the species of a region are unique to that region. See **Endemic.**

Exotic: not native. See **Alien.**

Fauna: the animals of a specified region.

Federal Status: official U.S. Fish and Wildlife Service categories for endangered and candidate endangered taxa according to the Federal Register 1987, 1990:

LE	=	Taxa formally listed as endangered
C1	=	Candidate Taxa for which the USFWS has substantial information on biological vulnerability and threats to support the proposal to list them as endangered or threatened species.
C1*	=	Same as C1, possibly extinct.
C2	=	Candidate Taxa for which the USFWS has information which indicates that proposing to list them as endangered or threatened species is possibly appropriate. More data on biological vulnerability and threat(s) are needed before they can be proposed for listing as endangered or threatened.
3A	=	Taxa for which the USFWS has persuasive evidence of extinction. If rediscovered, such taxa might acquire high priority for listing.

3B	=	Taxa that are no longer being considered for listing as threatened or endangered species on the basis of current taxonomic understanding (i.e. species do not represent distinct taxa).
3C	=	Taxa that are no longer being considered for listing as threatened or endangered species.
-	=	No federal status. Recommended as rare by Hawaiian biologists and confirmed by Heritage data.

Feral: formerly domesticated animals reverted to wild state, or living in wild habitat.

Feral Ungulate Activity: detectable damage or sign of feral ungulates including: seat, browsing, trails, trampling, wallows, and rooting.

Global Rank: an indicator of rarity or imperilment of an element on a world-wide level. This ranking system is used by Heritage Programs throughout the country to establish The Nature Conservancy's protection priorities.

G1	=	Species critically imperilled globally (typically 1-5 current viable occurrences).
G2	=	Species imperilled globally (typically 6-20 current viable occurrences).
G3	=	Restricted range (typically 21-100 occurrences).
G#?	=	Global rank tentative, insufficient data available to assign definite rank.
GH	=	Species known only from historical occurrences (typically, no observations in past 15 years).
GX	=	Extinct.
G1G2	=	Global rank tentative, 1-20 current viable occurrences, insufficient data available to assign definite rank.
T1	=	Subspecies or variety critically imperilled globally.
T2	=	Subspecies or variety imperilled globally.
TH	=	Subspecies or variety known only from historical occurrences.
T#?	=	Global rank of subspecies or variety tentative, insufficient data available to assign definite rank.

For more details on the definitions and criteria for global ranks, please refer to Attachment 1.

HHP: Hawaii Heritage Program.

Imperilled: rare or threatened by extinction; in Heritage terminology, a plant, animal, or natural community with 20 or fewer viable occurrences, all or most of which are immediately threatened by such factors as alien invasion, direct destruction or loss of habitat.

Indigenous: naturally occurring in a given area as well as elsewhere. Indigenous Hawaiian taxa also occur naturally outside of the Hawaiian Islands (e.g., naupaka kahakai (Scaevola sericea) is indigenous to Hawaii, found in Hawaii and throughout the South Pacific). See **Alien, Endemic, Native.**

Ined.: abbreviation for "ineditus," referring to a scientific name that has not been published, or a manuscript prepared for publication that has not yet received formal review.

Intact: maintaining at least 60% cover in native species.

Introduced: See **Alien.**

Invertebrate: animals without backbones, including such groups as insects, spiders, shrimps, and snails. Some Hawaiian invertebrates are rare and endangered.

Lobeliads: members of the Lobelioideae subfamily of plants in the family Campanulaceae, commonly known as lobelias. There are many lobeliad species endemic to the Hawaiian Islands.

Lowland: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian lowland zone lies above the coastal zone, up to about 1000 m. (roughly 3000 ft.) elevation. There is lowland zone on all of the main islands. See **Elevation Zones.**

Malacological: having to do with the branch of zoology dealing with mollusks, including snails.

Malacologist: one who studies mollusks, including snails.

Mesic: an area receiving from 50-75 inches of annual rainfall, or otherwise provided with sufficient water to result in moist soil conditions. See **Wet, Dry.**

Mollusk: invertebrates in the phylum Mollusca. Common representatives are snails, mussels, clams, oysters, squids and octopuses.

Monotypic genus: a genus with only a single species.

Montane: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian montane zone lies above the lowland zone and runs from 1000 m. (roughly 3000 ft.) to 2000 m. (roughly 6000 ft.) elevation. There is a montane zone on Kauai, Oahu, Molokai, Maui, Lanai and Hawaii. See **Elevation Zones.**

Multizonal: a community typically occupying more than one broad elevation zone. For example, streams may run from montane sources to sea level. See **Elevation Zones.**

NARS: Natural Area Reserves System: state lands designated to protect Hawaiian ecosystems, native plants and animals and other natural features in perpetuity.

Native: found naturally in an area, not introduced accidentally or purposefully by man; includes both indigenous and endemic taxa. See **Alien, Endemic, Indigenous.**

Natural Community: a natural assemblage of plants and animals that occurs within certain elevation, moisture and habitat conditions; sometimes used loosely as another term for

"ecosystem," however "ecosystem" includes abiotic environmental factors, so that (natural community + environment) = ecosystem.

Non-native: See **Alien.**

Occurrence: See **Element Occurrence.**

Periostracum: the external layer of most mollusk and brachiopod shells.

Physiognomy: general descriptive term for habitat, including categories such as bog, grassland, shrubland, forest, desert, and cliff.

Priority weed: an alien plant with known ability to disrupt the vegetation of native ecosystems. Control of such weeds is a high priority. For example, Clidemia hirta is a priority weed that has displaced native understory plants in much of Oahu's forests.

Pristine: undisturbed by humans and completely lacking alien taxa; entirely native.

Protected: legally dedicated to the perpetuation of native resources and managed to mitigate or remove threats to those resources, if necessary. Areas lacking either legal protection or management are considered incompletely protected.

Puu: hill or volcanic cone.

Rare: imperilled or threatened by extinction due to low numbers; in Heritage terminology, a plant, animal or natural community with 20 or fewer viable occurrences, all or most of which are immediately threatened by such factors as alien invasion, direct destruction or loss of habitat.

Riparian: pertaining to or associated with streams.

Sexual dimorphism: a condition in which obvious morphological or color differences are seen between sexes.

spp.: abbreviation for more than one species.

ssp.: See **Subspecies.**

Subalpine: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian subalpine zone lies above the montane zone and runs from 2000 m. (roughly 6000 ft.) to 3000 m. (roughly 9000 ft.) elevation. There is a subalpine zone only on the islands of Maui and Hawaii. See **Elevation Zones.**

Subspecies: (abbreviated ssp.) a taxonomically distinguishable geographic or ecological subdivision of a species. See **Variety.**

Taxon (plural= **Taxa**): a group of plants or animals making up one of the categories or formal units in taxonomic classification. In this report, a taxon can be a species, subspecies, variety, or form. This distinction is important because certain species have endemic Hawaiian subspecies, and varieties that are considered rare.

Ungulate: a subdivision of hoofed mammals including pigs, goats, cattle, sheep, mouflon and deer.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

Variety: (abbreviated var.) a taxonomically distinguishable subdivision of a species or subspecies. See **Subspecies.**

Vertebrate: an animal with a backbone; r. ve terre.rial vertebrate species in Hawaii include fish, birds, a bat, and a seal. See **Invertebrate.**

Viable: Capable of persisting and reproducing under favorable conditions.

Weed: an undesirable plant. In native ecosystems, all alien plants are weeds. See **Priority Weed.**

Wet: an area receiving more than 75 inches of annual rainfall, or situated near groundwater or surface water, such that availability of water is not a major limiting factor to plants or animals there. See **Dry, Mesic.**

APPENDIX A

DHHL's Kawaihae Parcel
Plant Species List

This species list documents the plants observed or previously reported from DHHL's Kawaihae Parcel. It is compiled from available literature sources, personal communication with botanists familiar with the area (backed by specimen verification for rare plants) and field identification during this field survey. Rare plants (typically less than 3,000 individuals, or known from fewer than 20 locations worldwide) are noted by '+' when specific location in the DHHL parcel or adjacent lands is known (see the rare plants table for those confirmed in the parcel). Rare plants whose location information denotes a large general area that may include the parcel are are noted by '#' in the status column.

Due to imprecise location information, some plant species included on this list may not actually be present in the survey area. Plants and their associated vegetation types confirmed during the study are noted by '*'; those plants and their associated vegetation types reported from the literature for the area, but not confirmed during this survey, are noted with an 'x'. Plants recorded for the area without an associated vegetation type are assigned to the natural community in which they would probably occur and are noted with a '?'.

Descriptions of natural communities are in the text. Taxonomy of the native and naturalized non-native flowering plants follows Wagner et al. (in press). Taxonomy of gymnosperms and non-naturalized non-native flowering plants follows St. John (1973). Taxonomy of the Pteridophytes (ferns and fern allies) follows Wagner and Wagner (1987).

RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Uki Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
#	E	Abutilon menziesii	ko'oloa'ula	?	?		?
+	E	Acacia koaia	koaia		*		*
	N	Acacia mearnsii	black wattle	?	?		?
	N	Adiantum hispidulum	rough maidenhair		*		*
	N	Adiantum raddianum	maidenhair fern				*
	N	Agave sisalana	sisal, malina				*
	N	Ageratina riparia	hamakua pamakani				*
	N	Aleurites moluccana	candlenut, kukui		*		*
	E	Alyxia oliviformis	Maile			*	
	N	Amaranthus spinosus	slender amaranth, pakai				*
	N	Ambrosia artemisiifolia	common ragweed				*
	N	Anagallis arvensis	scarlet pimpernel				*

+ = Rare # = Known from Kawaihae Region N = Non-native I = Indigenous E = Endemic

* Confirmed in field survey x = Cited in literature sources
? Cited in literature sources; needs confirmation in natural community

RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Ulei Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	E	Argemone glauca	pua kala				*
	E	Artemisia australis	hinahina kuahiwi		*		
	E	Asplenium acuminatum				*	
	E	Asplenium kaulfussii				*	
	I	Asplenium lobulatum				*	
	E	Athyrium microphyllum	'akolea			*	
	E	Athyrium sandwichianum	ho'i'o, pohole			*	
	N	Atriplex semibaccata	Australian saltbush				*
	N	Axonopus fissifolius	narrow-leaved carpet grass				*
	E	Bidens menziesii ssp. filiformis	ko'oko'olau		*		*
	N	Bidens pilosa	Spanish needle		*		
	N	Blechnum occidentale					*
	E	Broussaisia arguta	pu'ahanui			*	
	N	Broussonetia papyrifera		?	?		?
	N	Calopogonium mucunoides			*		
	I	Canthium odoratum	alahe'e		?		?
	E	Carex alligata				*	
	E	Carex wahuensis				*	
	N	Cenchrus ciliaris	buffel grass		*		*
	N	Cenchrus echinatus	common sandbur, 'ume'alu				?
	N	Chamaecrista nictitans	partridge pea, lauki	*			*
	E	Chamaesyce celastroides var. amplectans	'akoko, koko, kokomalei	?	?		?
	N	Chamaesyce hirta	hairy spurge, koko kahiki		*		*
	E	Charpentiera ovata	papala		?	?	
	E	Cheirodendron trigynum ssp. trigynum	'olapa			*	
	N	Chenopodium murale					*
	E	Chenopodium oahuense	'aweoweo, 'aheahea		*		*
	E	Cibotium chamissoi	treefern, hapu'u 'i'i			*	
	E	Cibotium glaucum	treefern, hapu'u pulu			*	
	N	Cirsium vulgare	bull thistle				*
	E	Claoxylon sandwicense	po'ola			?	
+	E	Clermontia drepanomorpha	'oha, 'ohawai			?	
	E	Clermontia parviflora	'oha, 'ohawai			*	
	N	Cocos nucifera	coconut				?
#	E	Colubrina oppositifolia	kauila		?		?
	N	Commelina diffusa	honohono		*		
	N	Conyza bonariensis	hairy horseweed				*
	E	Coprosma pubens	pilo			*	
	N	Cordia subcordata	kou				?

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RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Ulei Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	N	Cordyline fruticosa	ti		?	?	?
	N	Crotalaria sp.					*
	E	Ctenitis rubiginosa				*	
	N	Cuphea carthagenensis	tarweed		*		
#	E	Cyanea pycnocarpa	'oha, haha, 'ohawai			?	
+	E	Cyanea tritomantha	'oha, haha, 'ohawai			*	
	N	Cynodon dactylon	bermuda grass	*			
#	E	Cyrtandra kohalae	ha'iwale			?	
	E	Cyrtandra platyphylla	ha'iwale			*	
#	E	Delissea parviflora	'oha, haha, 'ohawai			?	
	I	Dicranopteris linearis	uluhe			*	
	N	Digitaria pentzii					?
	E	Diospyros sandwicensis	lama, elama		*		*
	E?	Diplopterygium pinnatum	uluhe lau nui			*	
	I	Dodonaea viscosa	'a'ali'i	*	*		*
#	E	Doodia lyonii				?	
	N	Drymaria cordata var. pacifica	pipili, pilipili			?	?
	E	Dryopteris glabra				*	
	E	Dryopteris wallichiana				*	
	E	Dubautia sp.	na'ena'e			?	
	N	Ehrharta stipoides	meadow ricegrass			*	
	E	Elaphoglossum hirtum var. micans				*	
	E	Embelia pacifica	kilioe			?	
	N	Emilia sonchifolia var. javanica	Flora's paintbrush	*			*
	N	Eragrostis tenella	Japenese lovegrass				*
	E	Eragrostis variabilis	kawelu, 'emoloa	?	?		?
	E	Erythrina sandwicensis	wiliwili		?		?
	N	Eucalyptus sp.					?
#	E	Eurya sandwicensis	anini			?	
	N	Festuca sp.					?
	N	Foeniculum vulgare	sweet funnel		*		
	I	Freycinetia arborea	'ie'ie			?	
	N	Grevillea robusta	silk oak				?
	N	Hedychium flavescens	yellow ginger,'awapuhi me		*		
	E	Hedyotis terminalis	manono			*	
	I	Heteropogon contortus	pili				*
+	E	Hibiscadelphus bombycinus	hua kuahiwi		?		
	I?	Hibiscus tiliaceus	hau		?		?
	N	Holcus lanatus	common velvet grass				*

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RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Ulei Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	N	Hypochoeris radicata	gosmore, hairy cat's ear		*	*	*
	E	Ilex anomala	kawa'u			*	
	N	Indigofera suffruticosa	indigo	*			*
	I	Ipomoea indica	koali 'awa, koali 'awahia		*		
	E	Jacquemontia ovalifolia ssp. sandwicensis	pa'u-o-hi'iaka				*
	N	*Kyllingia brevifolia*	kili'o'opu				*
	E	Labordia hedyosmifolia	kamakahala			*	
	N	Lantana camara	lantana	*	*		*
	N	Lepidium virginicum		*			
	N	Leucaena leucocephala	koa haole		*		*
	E	Lipochaeta lavarum	nehe				*
+	E	Lobelia hypoleuca	'opelu, mo'owahie			*	
	N	Ludwigia octovalvis	primrose willow, kamole				?
	E	Luzula hawaiiensis				*	
	I	Lycopodium cernuum				*	
	E	Melicope clusiifolia	alani			*	
	E	Melicope hawaiensis	alani			?	
+	N	Melinis minutiflora	molasses grass	*	*		*
	N	Merremia aegyptia					*
	E	Metrosideros polymorpha	'ohi'a			*	*
	I	Microlepia strigosa	palapalai			?	
	N	Mirabilis jalapa	four-o'clock, marvel of Per		*		*
	N	Muhlenbergia repens					*
	N	Musa sp.				?	?
	I	Myoporum sandwicense	naio		*		*
	E	Myrsine lanaiensis	kolea		?		
	E	Myrsine lessertiana	kolea			*	
	E	Myrsine sandwicensis	kolea			*	
	I	Nephrolepis exaltata	kupukupu, ni'ani'au				*
#	E	Neraudia ovata	ma'aloa, ma'ola, 'oloa		?		?
	E	Nestegis sandwicensis	olopua		*		
	E	Nototrichum sandwicense	kulu'i		*		
	I	Odontosoria chinensis	pala'a			*	
+	E	Ophioglossum concinnum	poloei	?			
	N	Opuntia ficus-indica	prickly pear, panini	*	*		*
	I	Osteomeles anthyllidifolia	'ulei		*		*
	I	Pandanus tectorius	screw pine, hala				?
	N	Panicum maximum	guinea grass	*	*		*
	N	Paspalum conjugatum	hilo grass		?	?	?

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RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Uki Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	N	Passiflora mollissima	banana poke			*	
	N	Pennisetum clandestinum	kikuyu grass		*		*
	N	Pennisetum setaceum	fountain grass		*		*
	E	Peperomia sp.	'ala'ala wai nui			*	
	E	Perrottetia sandwicensis	olomea			*	
#	E	Phyllostegia floribunda				?	
#	E	Phyllostegia vestita				?	
	N	Physalis peruviana	poha, cape gooseberry		*		
	E	Pipturus albidus	mamaki			*	
	E	Pittosporum sp.	ho'awa		?	?	
	N	Plantago lanceolata	narrow-leaved plantain	*	*	*	*
#	E	Platydesma remyi	pilo kea			?	
#	E	Pleomele hawaiiensis	halapepe		?		
	I	Pleopeltis thunbergiana	pakahakaha, 'ekaha 'akolea			*	
	N	Pluchea symphitifolia	sourbush				*
	I	Plumbago zeylanica	'ilie'e				*
	N	Polygonum punctatum	water smartweed		*	*	
	E	Polypodium pellucidum	'ae			*	
	N	Portulaca oleracea	pigweed, 'ihi	*	*		*
	N	Portulaca pilosa	pigweed, 'ihi	*	*		*
#	E	Portulaca sclerocarpa	pigweed, 'ihi	?	?		?
	E	Pouteria sandwicensis	'ala'a		?		
#	E	Pritchardia lanigera	loulu			?	
	N	Prosopis pallida	kiawe				*
	N	Psidium guajava	guava, kuawa		*		
	I	Psilotum nudum	moa		*		
	E	Psychotria hawaiiensis	kopiko			*	
	E	Pteridium decompositum	kilau				*
	I	Pteris cretica				*	
	E	Pteris excelsa				*	
	N	Ranunculus repens	creeping buttercup			*	
	N	Rhus sp.		?	?	?	?
	N	Rhynchelytrum repens	natal redtop	*	*		*
	N	Richardia brasiliensis		*			*
	N	Ricinus communis	castor bean, pa'aila, koli				*
	E	Rubus hawaiensis	'akala			*	
	N	Rubus rosifolius	thimbleberry			*	
	N	Rumex crispus	curly dock, yellow dock			*	
	N	Sacciolepis indica	glenwood grass			?	?

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RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Ulei Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	E	Sadleria cyatheoides	'ama'u, ma'u			*	
	E	Sadleria pallida	'ama'u, ma'u			*	
	N	Salvia coccinea	scarlet sage, Texas sage, lili		*		
#	E	Santalum paniculatum	sandalwood, 'iliahi		*		*
	N	Schinus terebinthifolius	christmas berry, wilelaiki			?	
	N	Senna occidentalis	coffee senna, mikipalaoa, '		*		*
	N	Setaria gracilis	yellow foxtail		*		*
	I	Sida fallax	'ilima		*		*
	N	Sida spinosa	prickly sida	*	*		*
	E	Smilax melastomifolia	hoi kuahiwi		*		
+	E	Solanum incompletum	popolo ku mai			*	
	N	Solanum linnaeanum	apple of Sodom	?	?		?
	E	Sophora chrysophylla	mamane				*
	N	Sporobolus africanus	smutgrass, West Indian dro		*		
	N	Stachytarpheta jamaicensis	Jamaica vervain, oi	?	?		?
	E	Sticherus owhyensis			*		
	I	Styphelia tameiameiae	pukiawe			*	
	E	Thelypteris cyatheoides	kikawaio			*	
	I?	Thespesia populnea	milo			*	
	E	Touchardia latifolia	olona				?
	N	Trifolium repens var. repens				?	
	I	Uncinia uncinata			*		*
	E	Urera glabra	opuhe			?	
	E	Vaccinium calycinum	'ohelo kau la'au			*	
	E	Vandenboschia draytoniana				*	
	N	Verbena litoralis	ha'uoi, oi			?	
	N	Vicia sativa	common vetch, spring vetc		*		
	I?	Waltheria indica	'uhaloa				*
	E	Wikstroemia pulcherrima	'akia	*	*		*
#	E	Zanthoxylum hawaiiense	hea'e, a'e	*	*		*
	N	Zinnia peruviana	piapihi		?	?	
							*

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APPENDIX B

DHHL's Kawaihae Parcel
Animal Species List

The animals listed are native species (excluding insects) that have been reported from visual and audio identification in or near DHHL's Kawaihae Parcel. The list also includes information on rare animals compiled from the literature. Bird taxonomy follows Pyle (1988).

RARE	STATUS	SCIENTIFIC NAME	HAWAIIAN &/OR COMMON NAME	SOURCE
		MAMMALS		
+	E	Lasiurus cinereus semotus	'ope'ape'a, Hawaiian hoary bat	x
		BIRDS		
	E	Anas wyvilliana	koloa, Hawaiian duck	x
+	E	Buteo solitarius	'io, Hawaiian hawk	x
+	N	Cardinalis cardinalis	northern cardinal	*
	N	Carpodacus mexicanus	house finch	*
	E	Chasiempis sandwichensis sandwichensis	Hawaii 'elepaio	?
	N	Columbia livia	rock dove	*
	N	Geopelia striata	zebra dove	*
	N	Francolinus erckelii	Erckel's francolin	*
	E	Hemignathus virens virens	Hawai'i 'amakihi	*
	E	Himatione sanguinea sanguinea	'apapane	*
	N	Mimus polyglottos	northern mockingbird	*
	N	Phasianus colchicus	ring-necked pheasant	*
	N	Streptopelia chinensis	spotted dove	*
	N	Tyto alba	common barn-owl	?
	E	Vestiaria coccinea	'i'iwi	*
	N	Zosterops japonicus	Japanese white-eye	
		NATIVE LAND SNAILS		
+	E	Partulina physa	Achatinellid land snail	x

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? Cited in literature sources; needs confirmation in DHHL's Kawaihae Parcel

APPENDIX C

List of Preparers

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APPENDIX B

Documents Relating to the Cultural Surveys Hawaii's Inventory of Hawaiian Home Lands at Kawaihae Excluded from the Main Body of the Report

by

Hallett H. Hammatt, Ph.D
David W. Shideler, M.A.

Prepared for

Department of Hawaiian Home Lands
State of Hawai'i

by

Cultural Surveys Hawaii
Revised June 1991

Contents

I. Significance Evaluations

EXPLANATION OF CRITERIA FOR SITE SIGNIFICANCE

The 147 new sites identified by Cultural Surveys Hawaii are evaluated in terms of significance in the following table (IB) according to Federal and State criteria for site significance. The rationale for assigning of significance codes is briefly discussed below:

NS *Not Significant.* All Hawaiian sites were regarded as having been significant. In the field a number of trail segments were given temporary site numbers but were later decided to be livestock trails and thus were not given state site numbers and are regarded as not significant. Only one site was given a state site number (Site 13,925) and was later evaluated as not significant. This L-shaped wall was determined to be the result of 20th century ranching activity and may be less than 50 years old.

NLS *No Longer Significant.* A number of sites were evaluated as no longer significant because the sites were significant solely for their information content, and sufficient amounts of this information were recorded in the survey. These NLS sites were typically small cairns, single use shelters or WWII fortifications with no or minimal deposits. Experience with similar sites at Kawaihae tested extensively in the Waimea Kawaihae road Corridor research (cf. Welch, 138ff in Clark and Kirch, 1983) suggests that further research at these sites would be highly unlikely to yield further data important to prehistory or history. It is because of this lack of further potential to yield information that these sites are declared no longer significant. We note, however, that all Hawaiian sites are regarded as significant by some people and recommend that where possible, even these minor sites be left undisturbed.

A *Site reflects major trends or events in the history of the state or nation.* No sites were given this designation.

B *Site is associated with the lives of persons significant in our past.* No sites were given this designation.

C *Site is an excellent example of a site type.* A number of sites were regarded as excellent examples of site types in their regional context of coastal sites in Kohala District. Typically these sites (which included trails, overhang shelters, graves, shelter caves, habitation enclosures, habitation complexes, agricultural areas, and midden/lithic scatters were more formal in construction, better preserved and appeared to have been utilized more extensively than other sites of the same type.

D *Site may be likely to yield information important in prehistory or history.* Any site which was regarded as likely to contain a stratified cultural deposit or to yield a significant quantity or quality of midden or artifacts or charcoal suitable for carbon dating was regarded as significant under code D.

E *Site has cultural significance.* Any site which was regarded as having a probable grave or shrine component was given this significance code assessment.

? *Signifies site is only a possible burial or religious feature.*

Temporary field numbers and site tags are presented in parentheses

❖ IB. Kawaihae Significance Table ❖

Site#	Description	Recommendations	Significance
13,785 (1)	Midden Scatter & Ahu, Activity Area	No further work	NLS
13,786 (2)	Shelter & Agricultural Complex	No further work	NLS
13,787 (3)	Habitation Enclosure	Data Recovery	C,D
13,788 (4)	Shelter	No further work	NLS
13,789 (5)	Habitation & Shelters	Data Recovery	D
13,790 (6)	Shelter Complex	Data Recovery	D
13,791 (7)	Habitation & Shelter Complex	Data Recovery	D

Site #	Description	Recommendations	Significance
13,792 (8)	Historic Wall	No further work	NLS
13,728 (9)	Pu'uhe Trail	Preserve a portion?	C
13,793 (10)	Shelter Complex	No further work	NLS
13,794 (11)	Shelter Complex	No further work	NLS
13,795 (12)	Historic Wall	No further work	NLS
13,796 (13)	Overhang Shelter	Data Recovery	C,D
13,797 (14)	Overhang Shelter	No further work	NLS
13,798 (15)	Overhang Shelter	No further work	NLS
13,799 (16)	Probable Grave	Data Recovery	C,D
13,800 (17)	Hearth	No further work	NLS
13,801 (18)	Shelter Cave	Data Recovery	C,D
13,802 (19)	Overhang Shelters	Data Recovery	C,D
13,803 (20)	Shelter Cave	Preserve	C,D,E
13,804 (21)	Habitation Enclosure	Data Recovery	C,D
13,805 (22)	Shelter Complex	Data Recovery	D
13,806 (23)	Shelter Enclosure	No further work	NLS
13,807 (24)	Habitation Complex	Data Recovery	C,D,E
13,808 (25)	Habitation Enclosure Remnant	No further work	NLS
13,809 (26)	Shelter Enclosure	No further work	NLS
13,810 (27)	Clearance Mound	No further work	NLS
13,700 (28)	Historic Wall	No further work	NLS
13,811 (29)	Habitation Enclosure	Preserve/Stabilize	C,D,E
13,812 (30)	Shelter/Habitation Complex	Data Recovery	C,D
13,813 (31)	Habitation Platform	Data Recovery	D
13,814 (32)	WWII Observation Post	No further work	NLS
13,815 (33)	Agricultural C-shape	No further work	NLS
13,816 (34)	Small Ahu	No further work	NLS
13,817 (35)	Small Ahu	No further work	NLS
(36)	Livestock Trail	No further work	NS
13,818 (37)	Overhang Shelter	No further work	NLS
13,819 (38)	Cave & Overhang Shelter	Data Recovery	C,D
13,820 (39)	Overhang Shelter	No further work	NLS
13,821 (40)	Shelter & Activity Area	No further work	NLS
(41)	Livestock Trail	No further work	NS
(42)	Livestock Trail	No further work	NS
13,822 (43)	Shelter Complex	Data Recovery	D
13,823 (44)	Shelter & Agricultural Area	No further work	NLS
13,824 (45)	Shelter Complex	Data Recovery	D
13,825 (46)	Shelter Complex	No further work	NLS

Site #	Description	Recommendations	Significance
13,826 (47)	Shelter Complex	Data Recovery	D
13,827 (48)	Shelter & Shrine	Data Recovery	D,E
13,828 (49)	Wall	No further work	NLS
13,829 (50)	Shelter	No further work	NLS
13,830 (51)	Shelter Complex	Data Recovery	D
13,831 (52)	Shelter Complex	Data Recovery	C,D
13,832 (53)	U-shape Shelter	No further work	NLS
13,833 (54)	C-shape Shelter	No further work	NLS
13,834 (55)	Enclosure Shelter	Data Recovery	D
13,835 (56)	Terrace & Coral Scatter	Data Recovery	E
13,836 (57)	Enclosure Shelter	Data Recovery	D
13,837 (58)	Agricultural Enclosure	No further work	NLS
13,838 (59)	Enclosure Shelters	No further work	NLS
13,839 (60)	Prehistoric Trail	No further work	NLS
13,840 (61)	Agricultural Enclosure	No further work	NLS
13,841 (62)	Agricultural Enclosure	No further work	NLS
13,842 (63)	Shelter	No further work	NLS
13,843 (64)	Habitation Enclosure , Agricultural Terraces	Data Recovery	D
13,844 (65)	Shelter Complex	Data Recovery	D
13,845 (66)	Shelter Complex	No further work	NLS
13,846 (67)	Shelter Complex	Data Recovery	D
8,824 (68)	Activity Area	Data Recovery	D
13,847 (69)	Shelter Complex	No further work	NLS
13,848 (70)	Shelters	No further work	NLS
13,849 (71)	Midden & Lithic Scatter	Data Recovery	D
13,850 (72)	Habitation & Shelter Complex	Data Recovery	C,D
13,851 (73)	Habitation Enclosure	Data Recovery	C,D
13,852 (74)	Habitation Complex	Data Recovery	C,D
13,853 (75)	Habitation Complex	Data Recovery	C,D
13,854 (76)	Shelter Complex	Data Recovery	D
13,855 (77)	Activity Area	Data Recovery	D
13,856 (78)	Habitation Enclosure	Data Recovery	D
13,857 (79)	Shelters	Data Recovery	D
13,858 (80)	C-shape Shelter	No further work	NLS
13,859 (81)	Shelter Complex	Data Recovery	C,D
13,860 (82)	Shelter Complex	No further work	NLS
13,861 (83)	Shelter Complex	Data Recovery	D
13,862 (84)	WWII Fortifications	No further work	NLS
13,863 (85)	Shelter Complex	No further work	NLS

Site #	Description	Recommendations	Significance
13,864 (86)	Shelter Complex	Data Recovery	C,D
13,865 (87)	Midden Lithic Scatter	Data Recovery	C,D
13,866 (88)	Shelter Complex	Data Recovery	C,D
13,867 (89)	C-shape Shelter	No further work	NLS
13,868 (90)	WWII Fortification	No further work	NLS
13,869 (91)	Shelter Complex	Preserve	D
13,870 (92)	Shelter Complex	No further work	NLS
13,871 (93)	WWII Fortification	No further work	NLS
13,872 (94)	Shelter Complex	Preserve	C,D
13,873 (95)	Shelter & Activity Area	Data Recovery	D
13,874 (96)	Historic Agricultural Mounds	No further work	NLS
13,875 (97)	Shelter & Agricultural Area	Data Recovery	C
13,876 (98)	*Habitation Complex*	*Preserve*	D
13,877 (99)	Shelter Complex	Data Recovery	D
13,878 (100)	Shelter Complex	Data Recovery	D
13,879 (101)	WWII Fortification	No further work	NLS
13,880 (102)	Habitation & Shelter Complex	Data Recovery	D
13,881 (103)	Shelter Complex	Data Recovery	D
13,882 (104)	WWII Fortifications	No further work	NLS
(105)	Site # Unused		
13,883 (106)	C-Shape Shelter Remnant	No further work	NLS
13,884 (107)	Shelter Complex Remnant	No further work	NLS
13,885 (108)	Shelter & Agricultural Complex	Data Recovery	D
(109)	Site # Unused		
13,886 (110)	Historic Wall	No further work	NLS
13,887 (111)	Historic Wall	No further work	NLS
13,888 (112)	Cave Shelter	Data Recovery	D
13,889 (113)	Historic Wall	No further work	NLS
13,890 (114)	Terrace	Data Recovery	D,E
13,891 (115)	2 C-Shapes & an Ahu	No further work	NLS
13,892 (116)	Wall Shelter	No further work	NLS
13,893 (117)	C-Shape	Preserve	C
13,894 (118)	Oval Enclosure & C-shape	Preserve	C
13,895 (119)	Habitation Site Complex	Preserve	C,D
13,896 (120)	C-shaped Shelters	No further work	NLS
13.897 (121)	C-shaped Shelters	No further work	NLS
13,898 (122)	Small Ahu	No further work	NLS
13,899 (123)	Shelter Complex	Data Recovery	D
13,900 (124)	Wall Shelter	No further work	NLS

Site #	Description	Recommendations	Significance
13,901 (125)	Shelter Site	No further work	NLS
13,902 (126)	C-shaped Shelter	No further work	NLS
13,903 (127)	C-shaped Shelter	Data Recovery	D
13,904 (128)	Activity Area	Data Recovery	D
13,905 (129)	Wall Shelter	No further work	NLS
13,906 (130)	C-shaped Shelter	No further work	NLS
13,907 (131)	Shrine Remnant	Data Recovery	D,E?
13,908 (132)	WWII Fortification	No further work	NLS
13,909 (133)	Shelter Enclosure	No further work	NLS
13,910 (134)	Burial Mounds	Data Recovery	D,E
13,911 (135)	Shelter Enclosure	No further work	NLS
13,912 (136)	Shelter Enclosures	No further work	NLS
13,913 (137)	Shelter Complex	Data Recovery	D
13,914 (138)	Burial Terrace	Data Recovery	D,E
13,915 (139)	Habitation Remnant	No further work	NLS
13,916 (140)	Burial Mound	Data Recovery	D,E
13,917 (141)	Burial Mound	Data Recovery	D,E
13,918 (142)	Burial Complex	Data Recovery	D,E
13,919 (200)	Habitation U-shape	Data Recovery	C,D
13,920 (201)	Habitation Enclosure	Data Recovery	C,D
13,921 (202)	Burial Platform	Data Recovery	D,E
13,922 (203)	Habitation & Shelter Complex	Data Recovery	C,D
13,923 (204)	WWII Serpentine	No further work	NLS
13,924 (205)	Shelter C-shape	Data Recovery	D
13,925 (206)	Shelter L-shape	No further work	NS
13,926	Forbes Cave	Preserve	C,D,E
13,927	Mummy Cave	Preserve	C,D,E

II. Recommendations

Recommendations presented below include the following: A) recommendations for preservation including proposed preservation areas for excellent examples of site types, burial preservation, and recommendations for the preservation of For-

bes and Mummy Caves; B) recommendations for archaeological data recovery; and C) recommendations for erosion control.

IIA. Preservation Recommendations

1. Proposed Preservation Areas for Excellent Examples of Site Types

We have identified only a few areas that we feel should be set apart for archaeological preserves on the basis of containing excellent examples of archaeological site types. These are listed in the following table (IIA2) and are located on the map in the back pocket of this report. Foremost of these is Honokoa Gulch. We agree with Allen (1987:66) that Honokoa Gulch should be preserved, including the Habitation Complex, 13,895; the Canoe Shed 13,746; four shrine features at Sites 13,730, 13,737, and 13,742; and the probable area of the Observatory set up by the scientists of the L'Uranie, Site 13,737. We recommend that at a minimum this preserve area includes Sites 13,730-13,747, and 13,893-13,895 and Sites 13,926 and 13,927. This area is recommended for preservation because of the number of probable religious structures (shrines) and/or burials present and because there are excellent examples of several site types including permanent habitations, a canoe shed, shrines and burial caves. This area appears to be thematically linked with the royal center in the Pu'u Kohala area on the basis of the Forbes cave artifact cache, the historic interment of the *konohiki* of Kawaihae in Honokoa Gulch and by the number of probable religious structures in the proposed Honokoa preserve area.

We also recommend the preservation of Sites 13,872 and 13,876 as particularly good examples of sites at the *mauka* edge of coastal habitation at Kawaihae with particularly dense scatters of features.

We also recommend the preservation of Site 13,811 as a particularly good example of a high status and/or men's house (*Hale mua*) site. Site 13,811 is the most architecturally impressive traditional (pre 1778) site within the project area. We recommend that this site be stabilized.

The State Historic Preservation Office has made it clear that a solid program of preservation of fragile cave sites is desired and thus we recommend that Caves Sites 13,803; 13,926; and 13,927 be sealed.

❖ IIA2. Table of Sites Recommended for Preservation

State Site Number	Description	Location By Lot	Rationale
13,730	Residential Complex	7	Probable religions structure
13,731	Shelter & Ag. Features	7	In Proposed Preservation Area
13,732	Shelter	7	In Proposed Preservation Area
13,733	Shelter	7	In Proposed Preservation Area
13,734	Canoe Shed	4	Excellent Example of Site Type
13,735	Trail	4	In Proposed Preservation Area
13,736	Shelter Complex	4	In Proposed Preservation Area
13,737	Shelter Complex	4	Historical Importance, Probable Religious Structure
13,738	Shelter	4	In Proposed Preservation Area
13,739	Shelter Complex	4	In Proposed Preservation Area
13,740	Shelter or Ag. Complex	4	In Proposed Preservation Area
13,741	Modern Fireplace	4	In Proposed Preservation Area
13,742	Agricultural Complex	4	Probable Religious Structure
13,743	Shelter	4	In Proposed Preservation Area
13,744	Shelter	4	In Proposed Preservation Area
13,745	Shelter Complex	4	In Proposed Preservation Area
13,746	Shelter Complex	4	In Proposed Preservation Area
13,747	Shelter Complex	4	In Proposed Preservation Area
13,803	Shelter Cave	1	Excellent Example of Site type, Burials?
13,811	Massive Rectangular Enclosure	9	In Proposed Preservation Area
13,869	Shelter Complex	22	Excellent Example of Site Type
13,872	Habitation and Ag. Complex	22	Excellent Example of Site Type
13,876	Habitation Complex	22	Excellent Example of Site Type
13,893	Shelter	4	In Proposed Preservation Area
13,894	Shelter	4	In Proposed Preservation Area
13,895	Habitation Complex	26	Excellent Example of Site Type
13,926	Forbes (burial) Cave	26	Burials, Excellent Example of Site Type
13,927	Mummy (burial) Cave	26	Burials, Excellent Example of Site Type

IIA3. Burials Introduction

Burials are commonly encountered features in the uplands of Kawaihae, particularly north of Makahuna Gulch. Clark (1983: 133 and Table 4.15) recorded 88 probable burial monuments within or in close proximity to (within 1-30 meters) Section 1 of the proposed highway right-of-way (ROW). Indeed, 43% of all archaeological features identified by Clark in the ROW were thought to be burials. All but one of these burials (Site 2680) lie north of Makahuna Gulch within Lot 21. The Bishop Museum field crew (Allen, 1987:54ff) identified a total of 37 probable or possible burials in the course of their study which documented 381 archaeological features. We have identified an additional 11 possible or probable burial features amongst the 491 features we have described. In addition, there are burials in Mummy and Forbes caves. All suggested burials are listed below with general comments, location and source of information and are located on the map in the back pocket of this report.

❖ IIA 4. Table of Burials at Kawaihae ❖

Site No.	Number of Burial Features ▼	Description	Comments	Location	Source
5998	4	high platforms		NW end Lot 21	Clark
6516	1	high platform		NW end Lot 21	Clark
6522	39	many different types, 8 identified as burials	possibly 918 (CSH 142)	Lot 21	Clark
6521	12	mostly low platforms, 12 identified as burials		Lot 21	Clark
8824	10	mostly mounds	(CSH68)	Lot 21	Clark
8823	2	mounded platforms		Lot 21	Clark
5980	9	different types, 2 identified as burials		Lot 21	Clark
2732	4	different types, 2 identified as burials		Lot 21	Clark
2733	3	different types		Lot 21	Clark
2722	1	low platform		Lot 21	Clark
2727	1	low platform		Lot 21	Clark
8822	1	low platform	burial found by CSH	Lot 21	Clark
13700	5	mounds	A-25	Lot 8	Allen
13749	4	platform	B-20,examined by CSH	Betw. Lots 19, 20	Allen
13750	1	platform	B-21	Lot 19	Allen

Site No.	Number of Burial Features ▼	Description	Comments	Location	Source
13751	5	mostly terraces	B-22	Lot 19	Allen
13755	2	platform & terrace	no longer exists	Lot 18	Allen
2730	1	platform	burial found by CSH	Lot 19	Allen
13756	1	terrace	B28, burial found by CSH	Lot 19	Allen
13782	9	historic cemetery	W of Lot 20		Allen
13703	1	platform	burial found by CSH	NW Lot 10	Allen
13736	2	platform & mound	B-7	Lot 4	Allen
13737	2	mounds	B-8, Feature C	Lot 4	Allen
13742	1	mound	B-13	Lot 4	Allen
13745	1	mound	B-16	Lot 4	Allen
13763	1	mound/platform	No burial found by CSH	Lot 16	Allen
13769	1	terrace	examined by CSH, B-40	Lot 16	Allen
13775	1	platform	burial found by CSH, B-46	Lot 16	Allen
13799	1	terrace	possibly a shrine, CSH16	Lot 6	Hammatt
13803	1	shelter cave	CSH20	Lot 1	Hammatt
13807	1	filled crevice	CSH24	E of Lot 4	Hammatt
13835	1	terrace	CSH56	SW Lot 27	Hammatt
13890	1	terrace	CSH114	SE corner Lot 19	Hammatt
13910	2	mounds	CSH134	*mauka* bound. Lot 12	Hammatt
13914	1	terrace	CSH138	mid *makai* Lot 16	Hammatt
13916	1	crypt	CSH140	Lot 18	Hammatt
13917	1	mound	CSH141	Lot 16	Hammatt
13918	8	mounds	CSH142	bound. Lots 21, 16	Hammatt
13921	1	platform	CSH202	S.central Lot 25	Hammatt
13926	Forbes Cave				
13927	Mummy Cave				

Thus, some 132 extant archaeological features within the project area are presently identified as burials (not including Forbes' & Mummy Caves). Of these, all but 19 lie within 152 m. (500') of the proposed Kawaihae-Waimea Realignment Cor-

ridor. Obviously, these suggested burials require special consideration in planning. Where possible, we recommend that burials be left *in situ*. We tested seven supposed burial features and found burials in 5 (71%) of these. When areas are to be developed it may well be desirable to test identified burials in the light of the suggested probability that 30% of these features are in fact not burials.

The major importance of the distribution of burials at Kawaihae is that it seem highly probable that the proposed realignment route will never be developed. We must recommend a different route as there are simply too many identified burial features (approximately 80) within the 4,000' strip between Makahuna Gulch and where the proposed realignment corridor meets the existing Highway 270. In addition to these burials, there are a great number of other archaeological sites within the corridor which would be costly in time and money to salvage.

Two alternative routes are suggested. If the realignment could follow the corridor just *makai* of Lots 23 and 24 (just *mauka* of Lots 13, 17, and 22) at about 240' elevation it would impact virtually no archaeology and would still run within 0.8 km (1/2 mile) of the coast. Another possibility — which would be less preferable archaeologically but probably more preferable from a traffic engineering perspective — would be a route crossing Makahuna Gulch at, or near the "Old Waimea—Kawaihae Road" bridge and then following the old road corridor, or just NE of it, until reaching the vicinity of Site 8824 (CSH68), at which point the route would jog just *mauka* of Sites 775 and 773 (B46 & B44), and then just *makai* of Sites 769 and 763 (B40 & B34) to rejoin Highway 270 at the previously suggested location. Such a route would require some archaeological salvage but might be accomplished without requiring the destruction of any designated burial features.

The resolution of a burial treatment plan for DHHL at Kawaihae is perhaps best worked out between DHHL, SHPO, and the Big Island Burial Council. We note only that there is a precedent for the movement of burials at Kawaihae and a precedent for the collective reinterment of Hawaiian burials in burial caves. Honokoa Gulch has previously been recommended as a reinterment site (Allen, 1987:67).

IIA5. Recommendations for Forbes' and Mummy Caves

We recommend that these two caves be sealed soon. We recommend that barriers with lockable doors be constructed out of steel and cement at the entrances to Forbes' and Mummy Caves with signs asking for respect for the Hawaiian dead. We recommend limited archaeological research prior to sealing which would have as its primary objective the acquisition of samples for carbon isotope dating. It would be desirable that the cave systems be mapped and described in greater detail.

IIB. Recommendations for Archaeological Data Recovery

1. Limited Program

We recommend that a limited program of archaeological data recovery targeted at cave sites and overhang shelters be coordinated with data recovery of specific areas planned for immediate development. The rapid development of lands at Kawaihae will have an ancillary effect of adversely impacting cultural resources as the population in the area increases. It would seem quite feasible to preserve three caves sites (13,801; 13,926; 13,927), however, there are several shallow overhang shelters that would, because of the configuration, be very difficult to seal effectively. Because of the natural isolation of these sites form range fires and sheet wash which have adversely affected so many sites at Kawaihae, we recommend testing at five of these sites (13,796; 13,801; 13,802; 13,819; 13,888). These sites are not expected to prove rich in cultural material but they may offer uncontaminated and perhaps even stratified carbon samples. The primary purpose of this testing would be to determine the chronological sequence for occupation at Kawaihae. To our knowledge there are still only three carbon isotope dates for coastal Kawaihae which predate the historic (post 1778) period. It would seem highly desirable to acquire carbon samples from the few sites which are free of range fire and sheet wash contamination to improve our understanding of the history of settlement at Kawaihae. We recommend that testing of these sites be coordinated with data recovery of specific lots slated for development.

2. Table of Recommended Data Recovery Sites

All CSH designated sites recommended for data recovery are listed in the following table (IIB2) and are located on the map in the back pocket of this report. A determination of which sites designated by Bishop Museum researches (Clark in Clark & Kirch, 1983 and Allen, 1987) should be data recovered or preserved is to be accomplished by the State Historic Preservation Office (SHPO). Of the 71 sites designated by CSH for data recovery, some 44 (62%) lie within the area considered in den-

sity studies for the town center and industrial areas (Lots 10-22 inclusive). It seems very probable that a number of Bishop Museum designated sites in this area will also be recommended for data recovery by the SHPO. because of the large number of sites in this area which will require data recovery it is recommended that archaeological data recovery be planned at least one year in advance of any proposed development of this area. It may well be highly desirable to develop this area in phases to minimize the delay of archaeological mitigation on development plans. As previously discussed under "Burials" a number of sites in this area may be problematic.

❖ IIB2. Table of Kawaihae Sites ❖
❖ Recommended for Data Recovery ❖

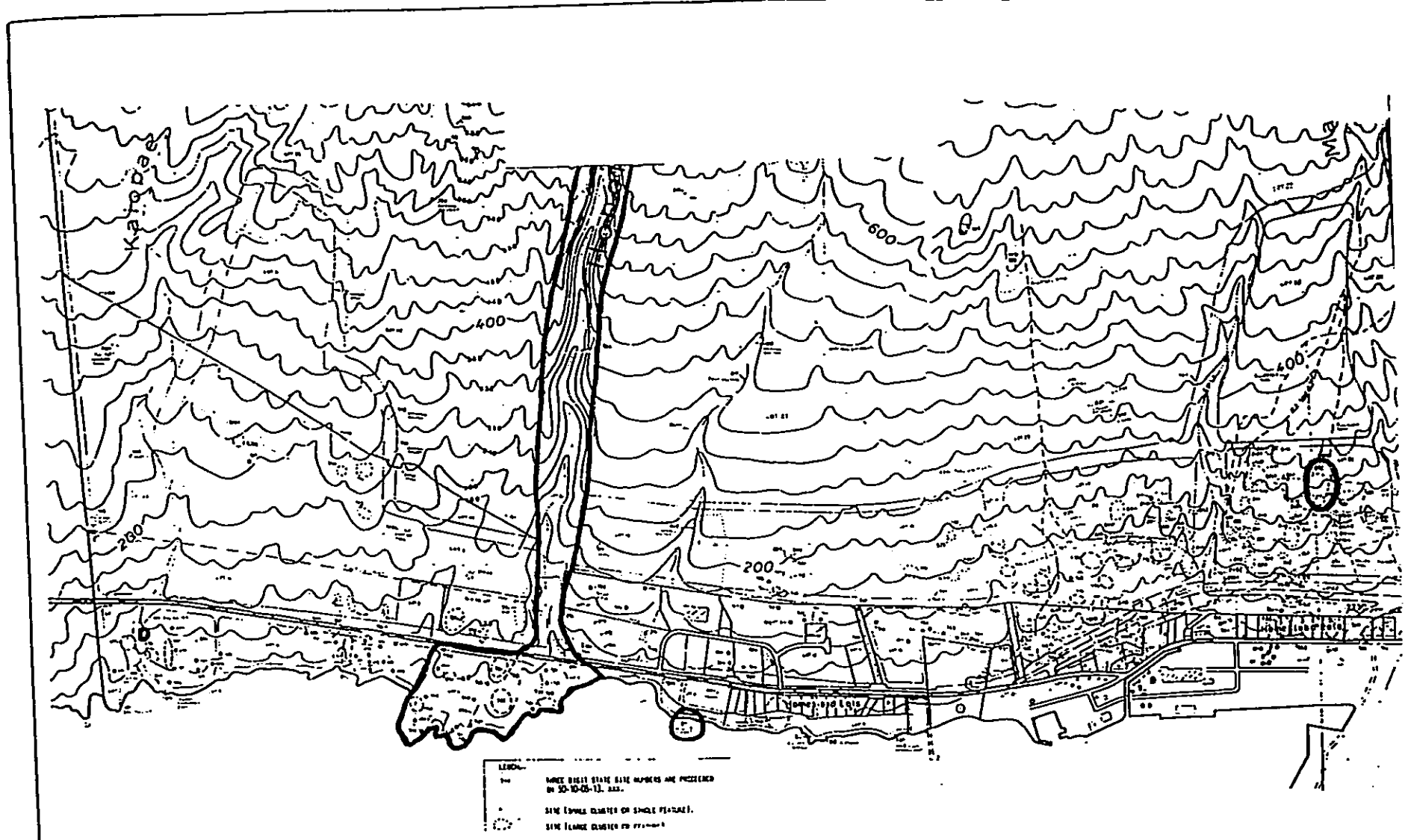
Site#	Description	Recommendations	Significance	Lot#
13,787 (3)	Habitation Enclosure	Data Recovery	C,D	SW6
13,789 (5)	Habitation & Shelters	Data Recovery	D	S of 5
13,790 (6)	Shelter Complex	Data Recovery	D	S of 5
13,791 (7)	Habitation & Shelter Complex	Data Recovery	D	6S
13,796 (13)	Overhang Shelter	Data Recovery	C,D	6/25
13,799 (16)	Probable Grave	Data Recovery	C,D	6S
13,801 (18)	Shelter Cave	Data Recovery	C,D	1
13,802 (19)	Overhang Shelters	Data Recovery	C,D	1/2
13,803 (20)	Shelter Cave	Data Rec./Pres.	C,D,E	1
13,804 (21)	Habitation Enclosure	Data Recovery	C,D	3
13,805 (22)	Shelter Complex	Data Recovery	D	3 makai
13,807 (24)	Habitation Complex	Data Recovery	C,D,E	4
13,811 (29)	Habitation Enclosure	Data Rec./Pres./Stabilize	C,D,E	9
13,812 (30)	Shelter/Habitation Complex	Data Recovery	C,D	9
13,813 (31)	Habitation Platform	Data Recovery	D	9
13,819 (38)	Cave & Overhang Shelter	Data Recovery	C,D	27
13,822 (43)	Shelter Complex	Data Recovery	D	13
13,824 (45)	Shelter Complex	Data Recovery	D	13SW
13,826 (47)	Shelter Complex	Data Recovery	D	13
13,827 (48)	Shelter & Shrine	Data Recovery	D,E	13SW
13,830 (51)	Shelter Complex	Data Recovery	D	17SW
13,831 (52)	Shelter Complex	Data Recovery	C,D	17 cent.
13,834 (55)	Enclosure Shelter	Data Recovery	D	27SW
13,835 (56)	Terrace & Coral Scatter	Data Recovery	E	27SW
13,836 (57)	Enclosure Shelter	Data Recovery	D	16/17

Site#	Description	Recommendations	Significance	Lot#
13,843 (64)	Habitation Enclosure, Agricultural Terraces	Data Recovery	D	17/22
13,844 (65)	Shelter Complex	Data Recovery	D	16
13,846 (67)	Shelter Complex	Data Recovery	D	22
8824 (68)	Activity Area	Data Recovery	D	23
13,849 (71)	Midden & Lithic Scatter	Data Recovery	D	21
13,850 (72)	Habitation & Shelter Complex	Data Recovery	C,D	22NW
13,851 (73)	Habitation Enclosure	Data Recovery	C,D	22NW
13,852 (74)	Habitation Complex	Data Recovery	C,D	22NW
13,853 (75)	Habitation Complex	Data Recovery	C,D	22NW
13,854 (76)	Shelter Complex	Data Recovery	D	22NW
13,855 (77)	Activity Area	Data Recovery	D	22NW
13,856 (78)	Habitation Enclosure	Data Recovery	D	22NW
13,957 (79)	Shelters	Data Recovery	D	22NW
13,859 (81)	Shelter Complex	Data Recovery	C,D	22W
13,861 (83)	Shelter Complex	Data Recovery	D	22W
13,864 (86)	Shelter Complex	Data Recovery	C,D	22 cent.
13,865 (87)	Midden Lithic Scatter	Data Recovery	C,D	22W
13,866 (88)	Shelter Complex	Data Recovery	C,D	22 cent.
13,873 (95)	Shelter & Activity Area	Data Recovery	D	22W
13,875 (97)	Shelter & Agricultural Area	Data Recovery	C	22
13,877 (99)	Shelter Complex	Data Recovery	D	22SE
13,878 (100)	Shelter Complex	Data Recovery	D	22SE
13,880 (102)	Habitation & Shelter Complex	Data Recovery	D	22SE
13,881 (103)	Shelter Complex	Data Recovery	D	22SE
13,885 (108)	Shelter & Agricultural Complex	Data Recovery	D	22SE
13,888 (112)	Cave Shelter	Data Recovery	D	24W
13,890 (114)	Terrace	Data Recovery	D,E	19SE
13,899 (123)	Shelter Complex	Data Recovery	D	10NW
13,903 (127)	C-shaped Shelter	Data Recovery	D	10W
13,904 (128)	Activity Area	Data Recovery	D	10W
13,907 (131)	Shrine Remnant	Data Recovery	D,E?	10
13,910 (134)	Burial Mounds	Data Recovery	D,E	12E
13,913 (137)	Shelter Complex	Data Recovery	D	12/15
13,914 (138)	Burial Terrace	Data Recovery	D,E	16W
13,916 (140)	Burial Mound	Data Recovery	D,E	18
13,917 (141)	Burial Mound	Data Recovery	D,E	16
13,918 (142)	Burial Complex	Data Recovery	D,E	21/16
13,919 (200)	Habitation U-shape	Data Recovery	C,D	25 cent.

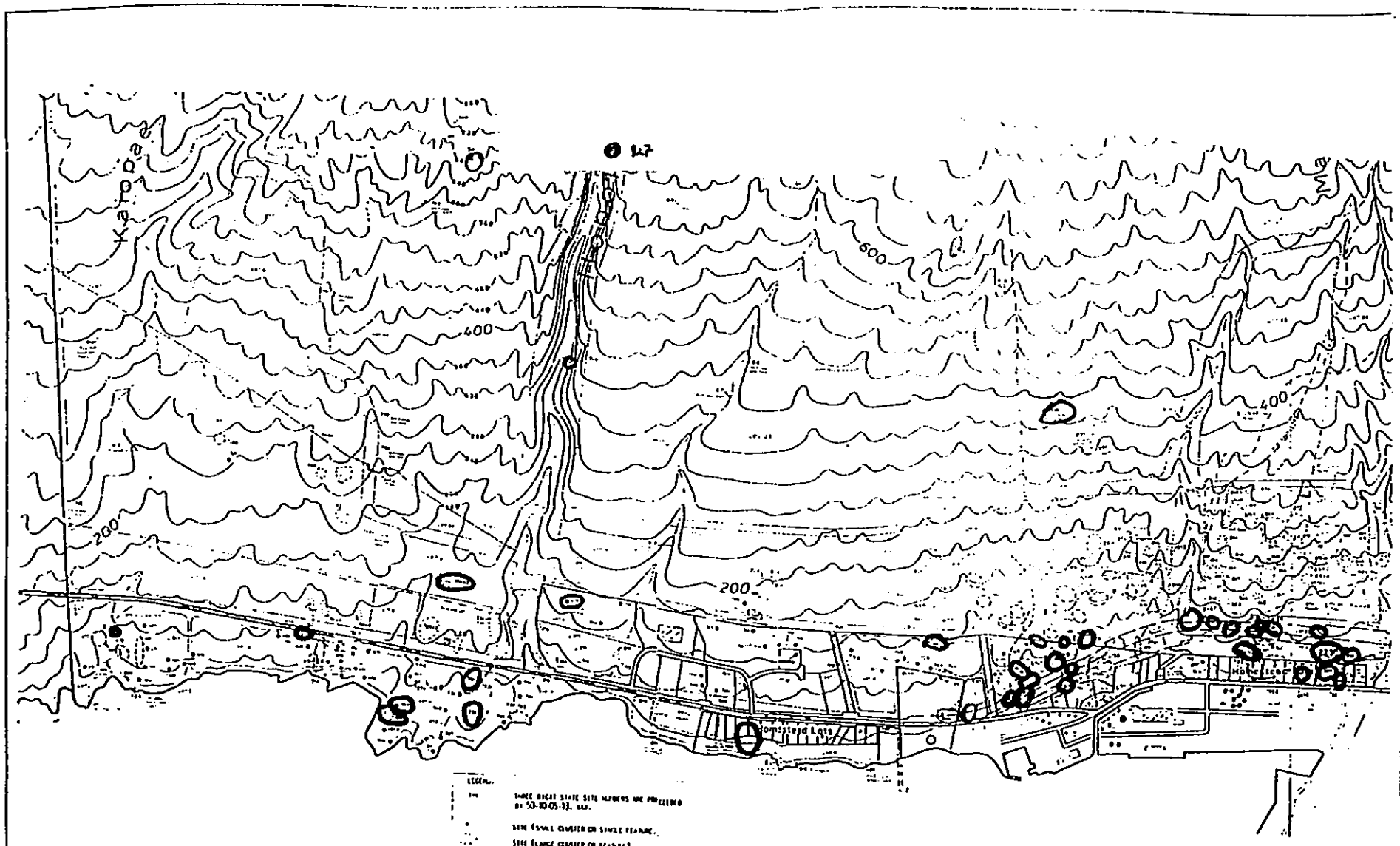
Site#	Description	Recommendations	Significance	Lot#
13,920 (201)	Habitation Enclosure	Data Recovery	C,D	25 cent.
13,921 (202)	Burial Platform	Data Recovery	D,E	25S
13,922 (203)	Habitation & Shelter Complex	Data Recovery	C,D	27
13,924 (205)	Shelter C-shape	Data Recovery	D	27
13,926	Forbes Cave	Data Rec./Pres.	C,D,E	26
13,927	Mummy Cave	Data Rec./Pres.	C,D,E	26

IIC. Recommendations for Erosion Control

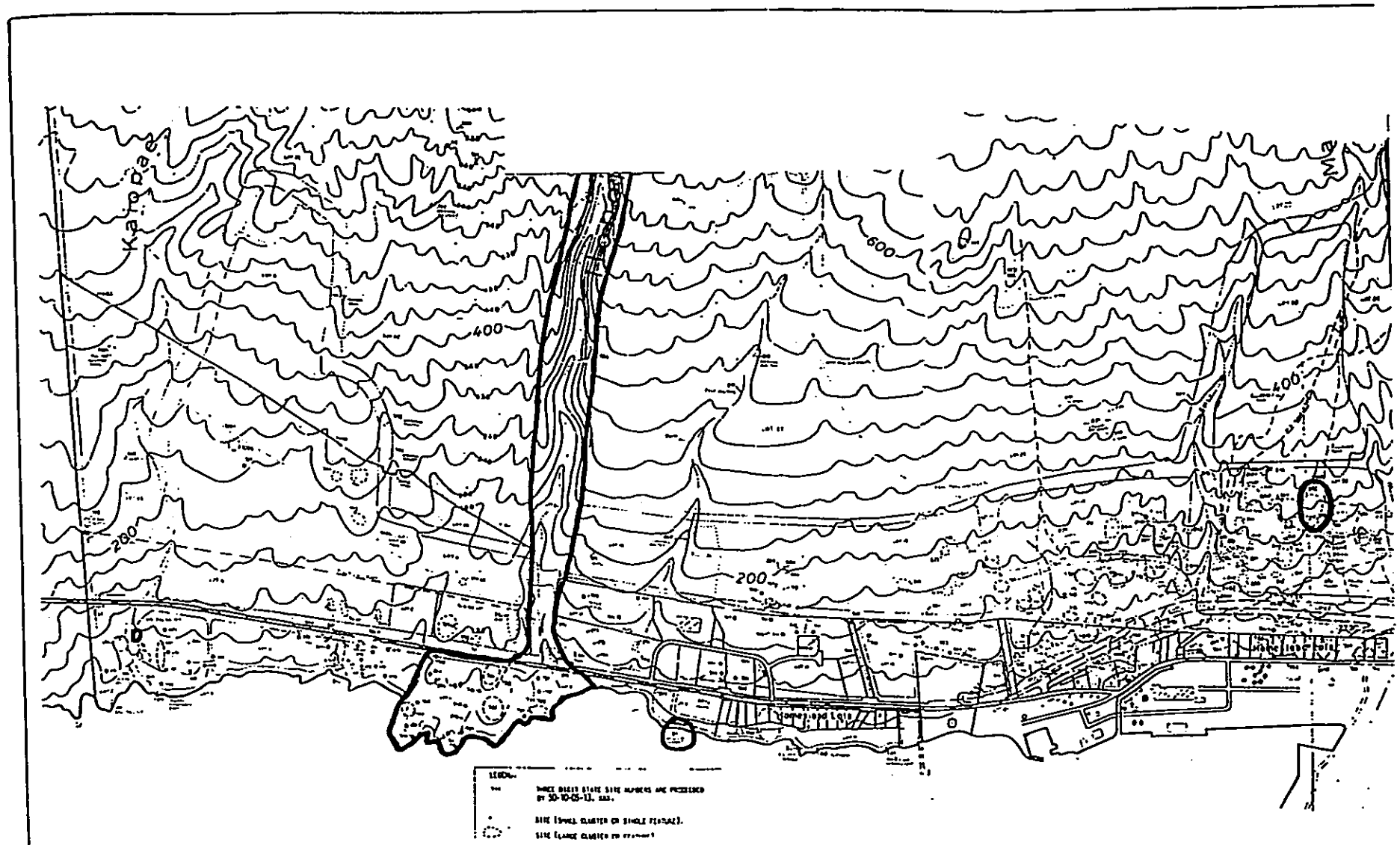
A major concern is the ongoing damage to archaeological sites by unchecked erosion. During the brief period of our fieldwork we saw sites being destroyed before our eyes as erosion gullies washed away boulder alignments. Sheetwash continues to adversely impact sites downslope. The absence of sound land management practices with regards to erosion may well do more damage to archaeological sites than presently proposed development. We recommend that any proposed development of DHHL at Kawaihae have a strong component of land management and erosion control.



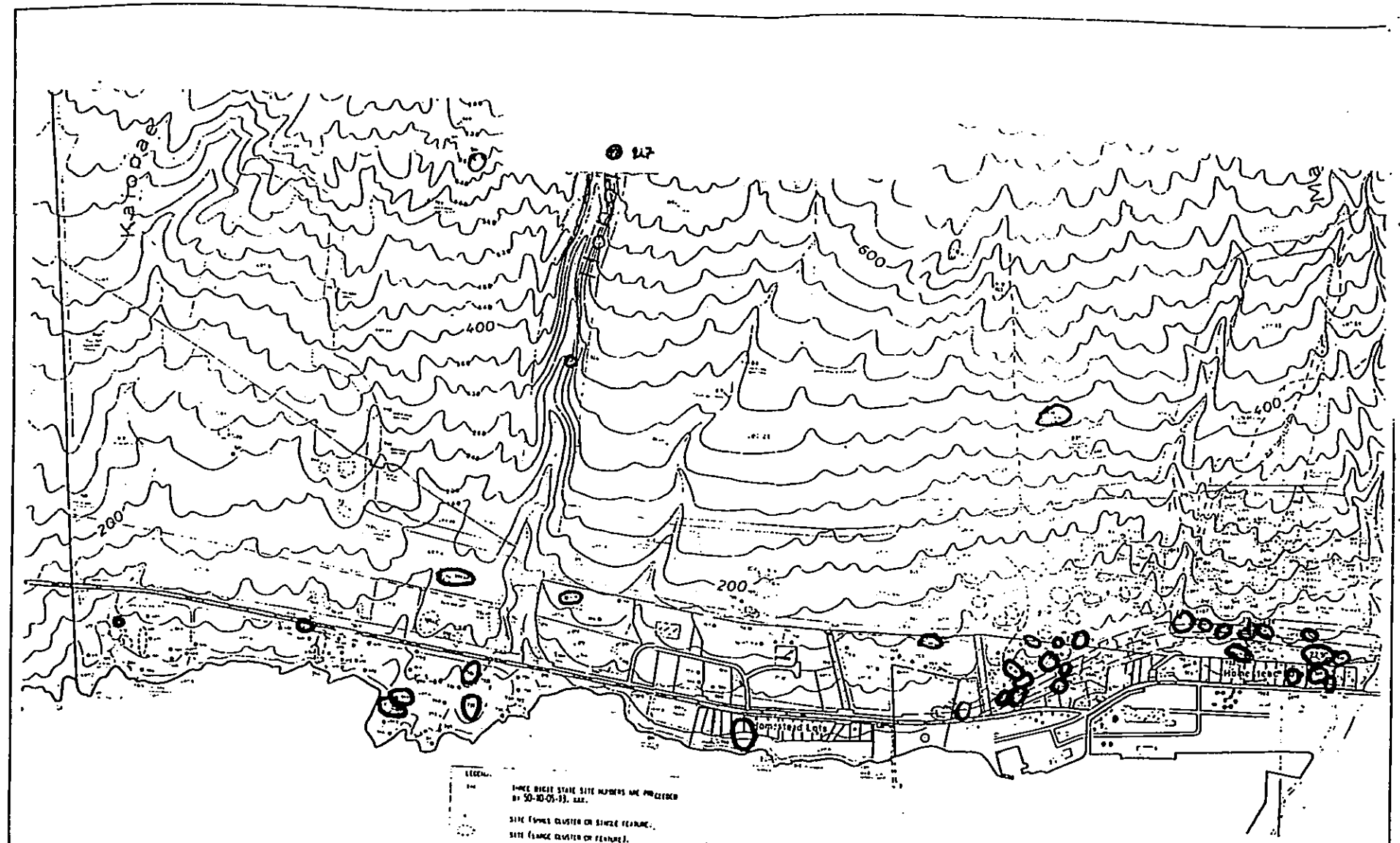
Suggested Preserve Areas for Hawaiian Home Lands at Kawaihae



Locations of Indicated Possible, Probable, and Known Burials at Kawaihae



Suggested Preserve Areas for Hawaiian Home Lands at Kawaihae



Locations of Indicated Possible, Probable, and Known Burials at Kawaihae

APPENDIX C

TRAFFIC IMPACT ASSESSMENT REPORT

for

KAWAIHAE RESIDENCE LOTS, UNIT 1

Kawaihae, Hawaii

June 1990

Prepared for:

R.M. Towill Corporation

Prepared by:

Pacific Planning & Engineering, Inc.
1144 Tenth Avenue, Suite 202
Honolulu, Hawaii 96816

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EXECUTIVE SUMMARY

Pacific Planning & Engineering, Inc. (PPE) was engaged to identify and assess future traffic impacts on Akoni Pule Highway resulting from the proposed "Kawaihae Residence Lots, Unit 1" (referred herein as the "project"). The study focused on the traffic impacts at the future intersection of Akoni Pule Highway with the two project access roads planned for the project. This report presents the findings and recommendations of the traffic study.

Project Description

The State Department of Hawaiian Home Lands is proposing to construct a residential subdivision in Kawaihae, Hawaii. The project will be located in the southern tip of the North Kohala District, north of the Honokoa Gulch and mauka of Akoni Pule Highway. Figure 1 shows the project location and the roadway network in the vicinity. There will be 195 single family homes built in all, on over 205 acres. The residential lots are for the lessees who have qualified under the Hawaiian Homes Act and each home owner is to construct his or her own home. Akoni Pule Highway is the only major roadway in the vicinity.

Conclusions & Recommendation

The proposed Kawaihae Residence Lots, Unit 1 will not significantly impact Akoni Pule Highway in 1995 when the project is expected to be completed and fully occupied.

Currently, there are no existing intersections providing access to the project site. With the project, there will be 2 new T-intersections. The existing and without project conditions were analyzed using the Two-Lane Rural Highway Analysis Method (from the Highway Capacity Manual) to determine its Level-of-Service (LOS) for Akoni Pule Highway. The with project condition was also analyzed for comparison purposes.

The Unsignalized T-Intersection Analysis Method (from the Highway Capacity Manual) was used to find the Level-of-Service for the turning movements for the new intersections. (While both analysis methods yields a Level-of-Service, the LOS for Rural Highways is not comparable to the LOS for Unsignalized Intersections.)

The results of the rural highway analysis indicate that for the existing and without project conditions, vehicles travelling on Akoni Pule Highway experience Level-of-Service (LOS) B. This means that drivers on Akoni Pule Highway, in the vicinity of the project, experience slightly less freedom to travel at their desired speed than drivers in LOS A conditions. Also, there is less opportunity to pass slow moving vehicles than in the free flow conditions of LOS A.

With the project in 1995, vehicles on the highway near the project location will experience LOS C. At this Level-of-Service, platoon formation increases causing a decline in passing ability.

With the project in 1995, there will be two new access roads leading to the project, Access Road A and Access Road B. See Figure 2. The analysis for unsignalized T-intersections indicates that the turning movements at the new intersections with Akoni Pule Highway will operate at LOS A. Therefore, through traffic on Akoni Pule Highway will experience little or

no delays due to vehicles turning into the new intersections.

Although the intersections will operate with little overall delay, vehicles slowing down or stopping to turn into the subdivision will cause traffic on the highway to slow down. We recommend two alternative methods to minimize the impact of the project.

Recommendation #1

Due to the level of developments and number of access points along Akoni Pule Highway in the vicinity of the project, including Kawaihae Town and the industrial subdivision, the following recommendation is made:

- Lower the speed limit of Akoni Pule Highway from Kawaihae Town to 1/2 mile north of the project to 35 miles per hour.

Recommendation #2

If, however, the lowering of the speed limit is not an acceptable alternative at this time, the following recommendations are made for each intersection:

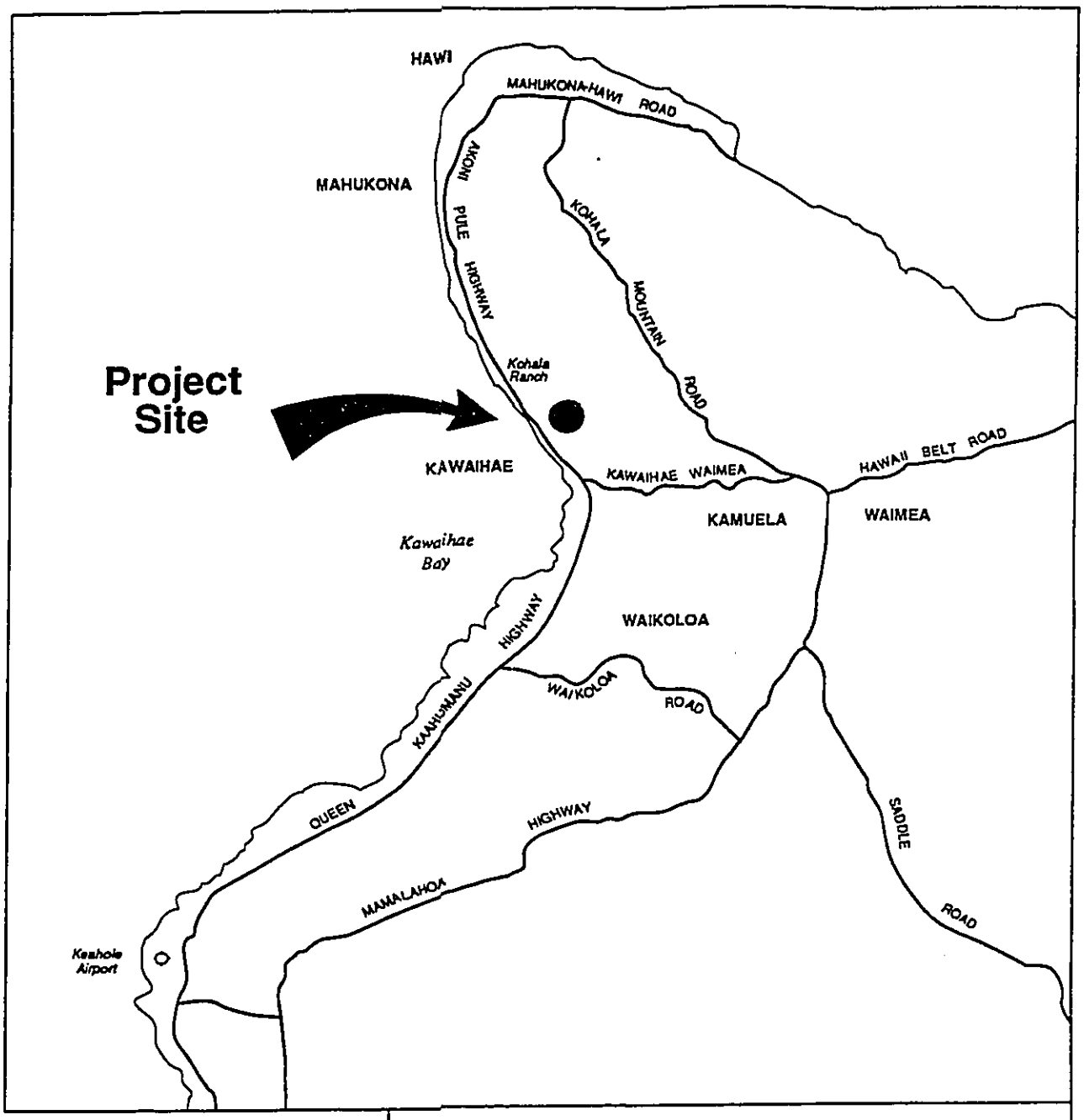
- Provide left turn storage lanes on Akoni Pule Highway.
- Provide right turn deceleration lanes on Akoni Pule Highway.
- Provide adequate sight distance.

These recommendations will help to minimize the possibility of rear-end accidents.

PROJECT DESCRIPTION

The State Department of Hawaiian Home Lands is proposing to construct a residential subdivision in Kawaihae, Hawaii. The project will be located on the southern tip of the North Kohala District, north of the Honokoa Gulch and mauka of Akoni Pule Highway. Figure 1 shows the project location and the roadway network in the vicinity. There will be 195 single family homes built in all, on over 205 acres. The residential lots are for the lessees who have qualified under the Hawaiian Homes Act and each home owner is to construct his or her own home. Akoni Pule Highway is the only major roadway in the vicinity.

Construction of the subdivision roadways for the proposed project are expected to be completed in 1993 with construction and full occupancy of the homes by 1995. The subdivision will be served by two roadways, Road A and B, connecting to Akoni Pule Highway, each access intersecting Akoni Pule Highway as T-intersections. Figure 2 shows the site plan of the proposed development.



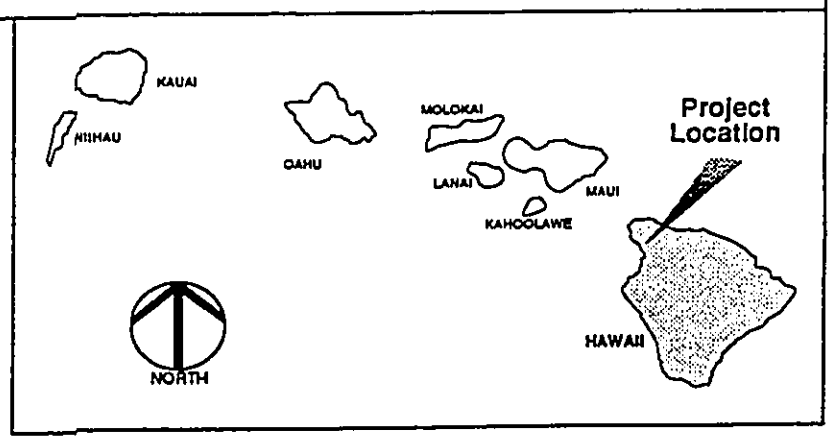


Figure 1. Project Location Map

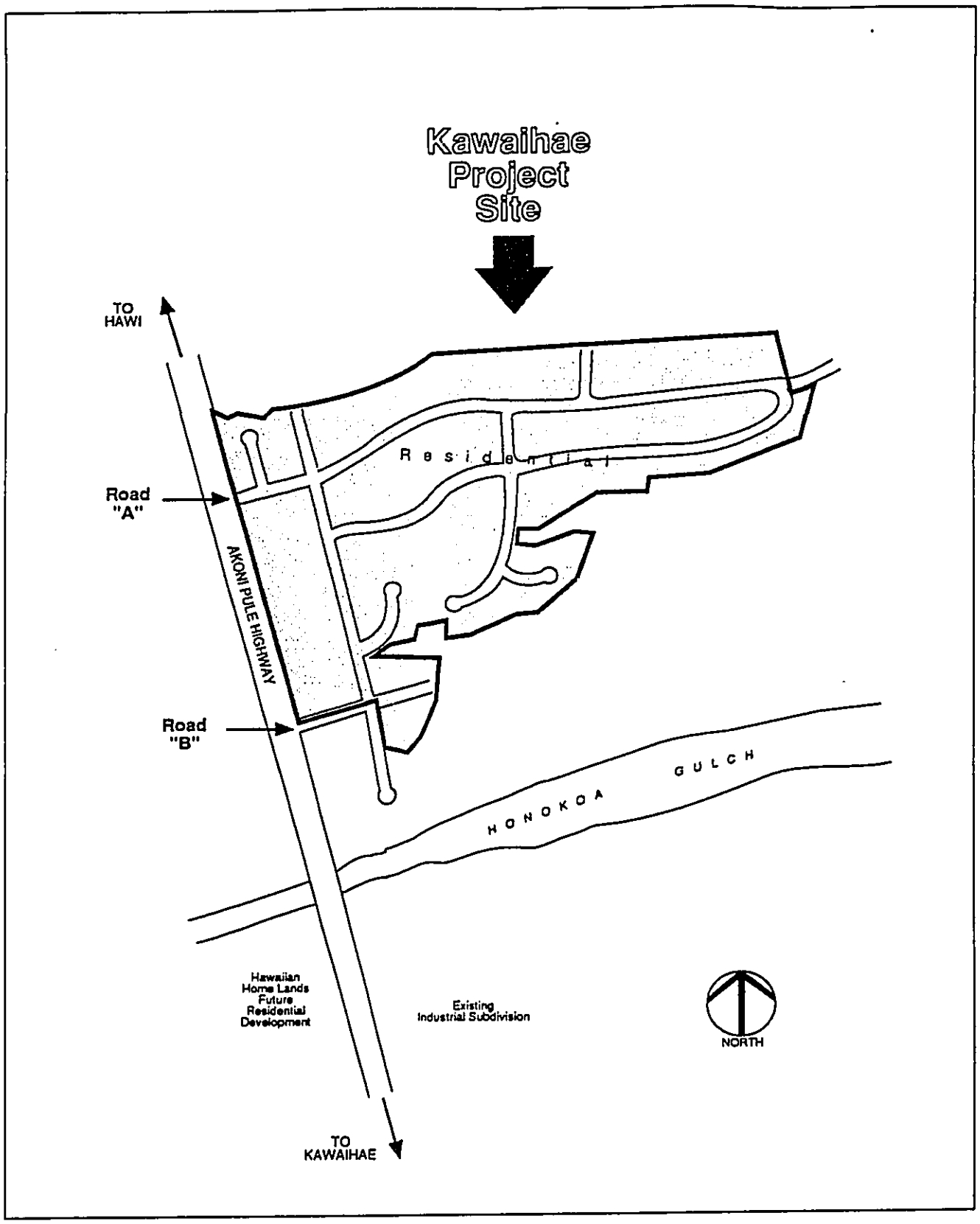


Figure 2. Project Site Plan

AREA CONDITIONS

A survey of the existing conditions was conducted to evaluate the traffic impact of the proposed project. The survey included the land uses of the area, roadway facilities, and existing traffic conditions.

Existing Land Uses

The project site is presently undeveloped natural land. To the North of the project lies Kohala Ranch which consists mostly of homes on 5 to 10 acre lots. These lots are expected to be used mostly as vacation homes and owned by second home homeowners. To the immediate south of the project is Honokoa Gulch and further south is an industrial subdivision and the town of Kawaihae. To the west of the project site is Akoni Pule Highway, a major roadway in the vicinity which extends past Hawi to the north and Kawaihae to the south.

Future Land Uses

Based on research of land use data and other development information sources, the known future major developments in the immediate area that would generate additional future traffic by the year 1995 were determined. One residential development of 22 single family units is also being developed by the Department of Hawaiian Home Lands. It will be constructed and fully occupied by 1993 and will be located south of the project, and west of Akoni Pule Highway. See Figure 2.

Kohala Ranch is another development which will contribute to traffic along Akoni Pule Highway. Kohala Ranch is located north of the project site north of the North and South Kohala border. See Figure 1. It is

estimated that approximately 300 new homes will be built by 1995. Landowners of Kohala Ranch are mostly second home homeowners who must build their own homes.

Roadway Facilities

Akoni Pule Highway is the major roadway providing access to the project along the Kohala coast and is one of two major highways accessing the major population centers at the northern tip of the Big Island including Hawi, and Kapaau. The other highway is the Kohala Mountain Road which parallels Akoni Pule Highway.

Akoni Pule Highway is a State maintained highway with a 24-foot wide pavement and 3-foot wide grassed shoulders on either side of the Highway near the project site. This major roadway into Hawi contains two 12-foot wide lanes, one 12 foot wide lane Hawi bound and one 12 foot wide lane Kona bound. The posted speed of Akoni Pule Highway is 45 miles per hour (mph) in both directions along this section of the highway. Currently, there are no road accesses to the proposed project site.

Traffic Conditions

Traffic volume data from the Highways Division, State Department of Transportation (DOT) were used to determine traffic trends on Akoni Pule Highway near the project site. Figure 3 summarizes the growth trend in daily traffic along Akoni Pule Highway at the intersection of Akoni Pule Highway with Queen Kaahumanu Highway (Station 11E) for the even years from 1976 to 1988. The plotted data shows an increase in traffic growth on the order of 4% per year. The trend line was estimated using linear regression analysis.

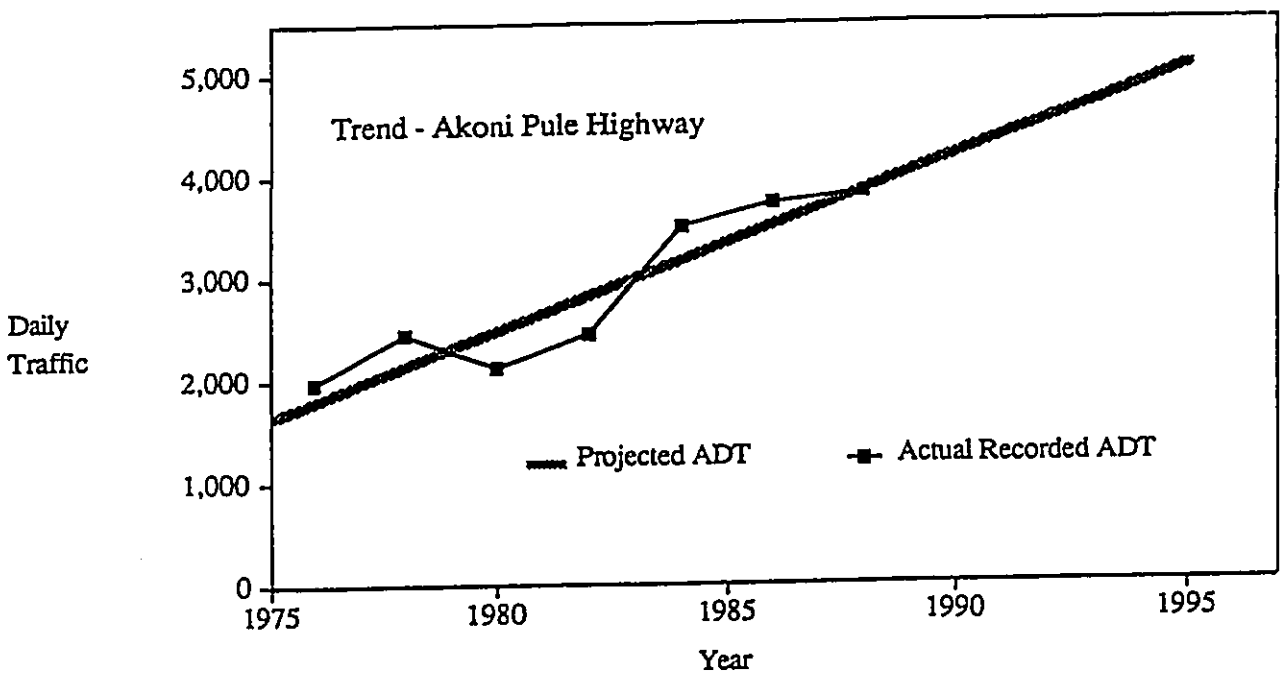


Figure 3. Growth Trend Along Akoni Pule Highway Near Kawaihae

A review of the 1988 State Department of Transportation (DOT) traffic count data for the intersection of Akoni Pule Highway with Queen Kaahumanu Highway and Kawaihae Road (Station 11E) indicated that the peak weekday traffic volumes along Akoni Pule Highway in the vicinity of the project occurs between 3:30-4:30 in the afternoon.

Manual traffic counts were taken for Akoni Pule Highway near the proposed project site on May 15, 1990. These counts were used as the baseline condition upon which future estimated traffic volumes were added. Figure 4 shows the present volumes of traffic at the study area for the observed 3:15-4:15 peak hour.

The manual traffic count data are summarized in Appendix B. Manual counts were taken of passenger cars, trucks, buses, bicycles, motorcycles and pedestrians by approaches. The difference in time of the manual afternoon peak hour from the peak hour found by the DOT data is due to normal variations in daily traffic. During the field counts, the weather conditions were sunny with a few clouds and the pavement was dry.

Observed Traffic Conditions

The following observations were made during the field survey:

1. Road construction for the shoulders near the North and South Kohala District border held up traffic in both directions. The release of vehicles at intervals created platoons of southbound vehicles.

2. Vehicle speed ranged between 35-55 mph with an average speed of approximately 50 mph.

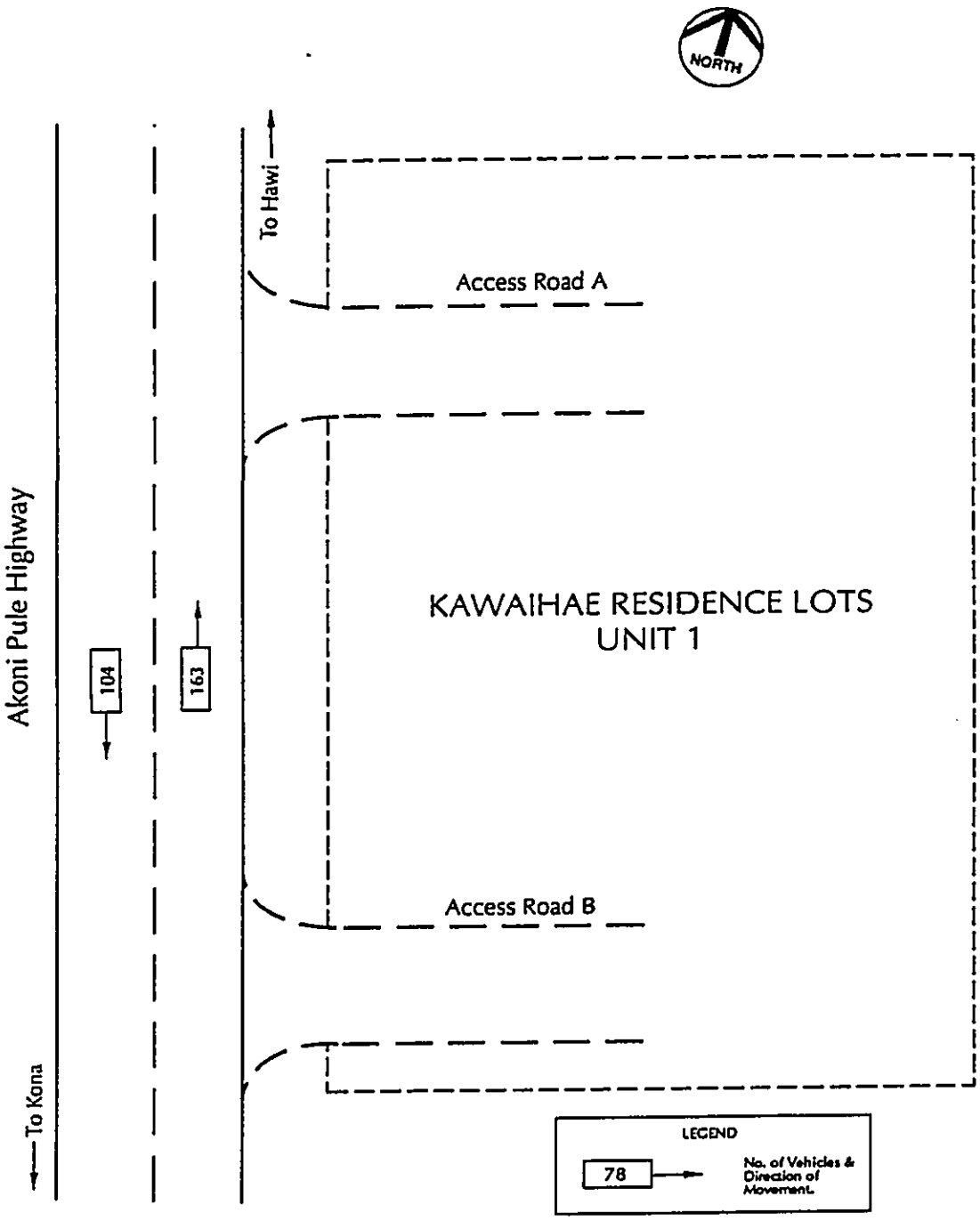


Figure 4. 1990 Existing Weekday Peak Hour Traffic

PROJECTED TRAFFIC CONDITIONS

Future traffic forecasts without and with the project were estimated for the year 1995, when the project is expected to be fully occupied.

Future Ambient Traffic

Ambient traffic is the traffic which would occur even if the proposed project were not built. The ambient traffic was forecasted by increasing the existing traffic volumes by the traffic growth trend along Akoni Pule Highway and by adding traffic generated by developments within the immediate area.

The traffic growth trend is used to account for the increase in traffic due to developments outside of the immediate area. The existing Akoni Pule Highway peak hour through traffic volumes were increased by 4% to obtain the traffic growth trend for 1995. Figure 5 shows the growth trend for Akoni Pule Highway near the proposed project site.

The three step procedure of trip generation, distribution, and assignment was used to forecast traffic by developments within the immediate area.

Trip Generation calculates the number of trips that would be generated during the afternoon peak hour by the future developments. The number of trips were calculated based on data from the ITE Trip Generation Report (Fourth Edition, 1987).

The trip generation data for the weekday afternoon peak hour of

adjacent street traffic for single family detached housing was used to generate the ambient traffic for Akoni Pule Highway for the future Hawaiian Home Lands 22 unit single family subdivision expected to be built and fully occupied by 1995.

For the Kohala Ranch developments, the trip generation data for the weekday afternoon peak hour of adjacent street traffic for recreational homes was used. Table 1 shows the ITE trip generation rates and number of trips generated by the proposed land uses during the weekday peak hour.

Table 1. Trip Generation for 1995 Development

	Dwelling	ITE Rate		Number of Trips	
Land Use	units	Enter	Exit	Enter	Exit
Residential	22	0.73	0.45	16	10
Kohala Ranch	100	0.10	0.16	10	16

Trip distribution and traffic assignment allocates the generated trips to different directions of travel and specific turning movements on the roadway. Since most of the attractions such as shopping centers and employment are located in the direction of Kona, 75% of the trips were assigned southbound and 25% of the trips were assumed to travel northbound, in the direction of Hawi. It was assumed that 50% of the Kohala Ranch trips will exit and enter Kohala Ranch through Kohala Mountain Road.

Figure 5 shows the future traffic volumes for the afternoon peak hour without the project for 1995.

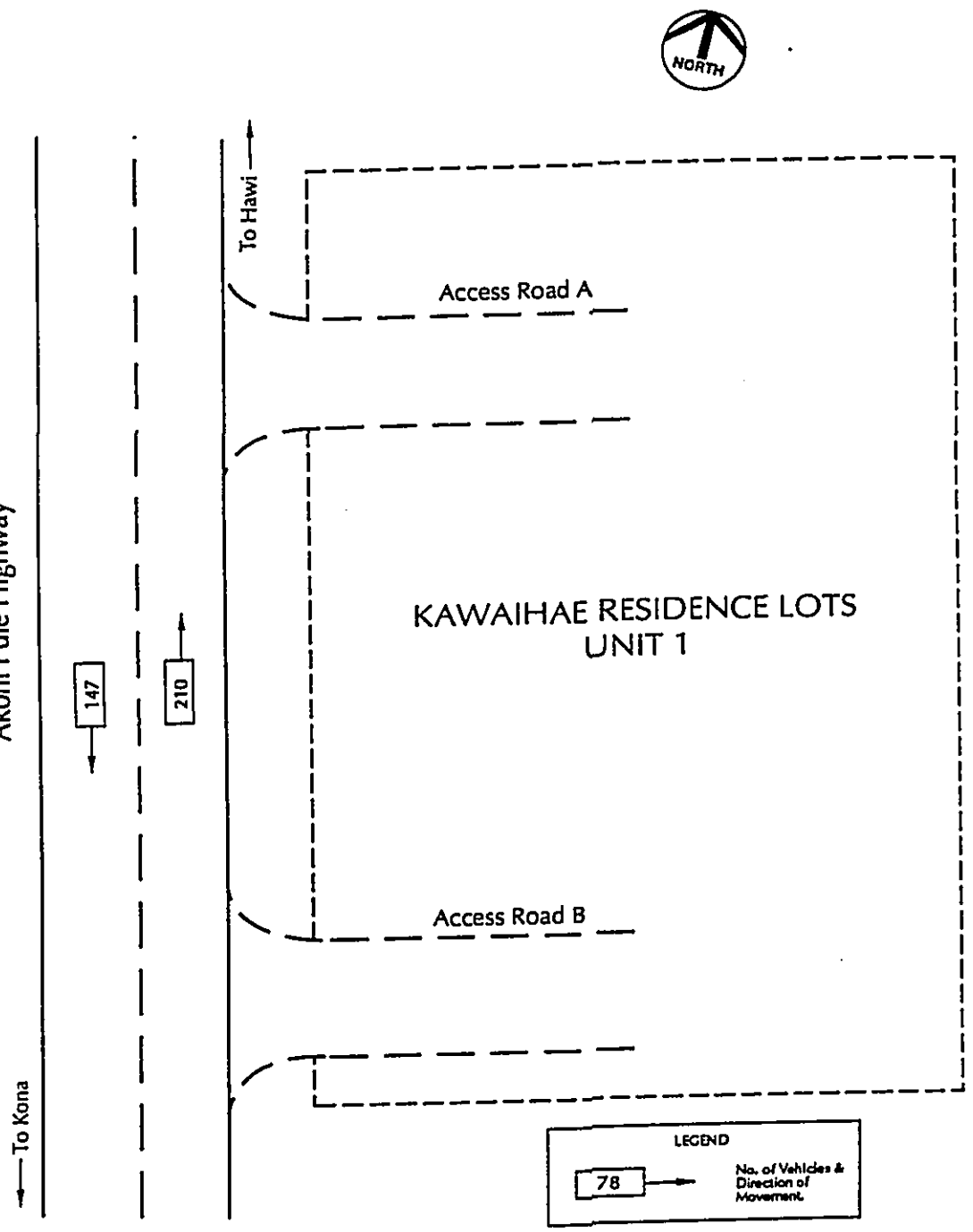


Figure 5. 1995 Weekday Peak Hour Forecast Traffic Without Project

Project Generated Traffic

The three-step procedure of trip generation, distribution and assignment was used to forecast future peak hour traffic caused by the proposed project.

Trip Generation data for the afternoon peak hour of adjacent street traffic for single family detached housing was used to generate the traffic caused by the proposed project. Table 2 shows the number of trips generated during the weekday afternoon peak hour using the ITE trip generation data.

Table 2. Trip Generation for Project

Land Use	Dwelling units	ITE Rate Enter	ITE Rate Exit	Number of Trips Enter	Number of Trips Exit
Residential	195	0.66	0.38	129	75

The trip distribution and traffic assignment steps allocates the project generated trips to the different directions of travel and specific turning movements on the roadway. The trips were distributed based on the locations of attractions such as employment, and shopping. About 25% of the trips were assumed to travel to/from the Hawi direction and 75% to/from the direction of Kona. Since there are two access roadways to and from the project, the trips were distributed between them according to the most direct route. It was assumed that 70% of the trips would exit from the northern access and that 30% of the trips would exit from the southern access. Of the vehicles coming from the Kona direction, it was assumed

that 70% would enter the project through the southern access to avoid backtracking in the residential area and that the remaining 30% would enter through the northern access. For the vehicles coming from the direction of Hawi, it was assumed that 70% of the vehicles would enter through the northern access and that 30% of the vehicles would enter through the southern access, again presuming that the vehicles will want to avoid backtracking.

Total Traffic

The ambient traffic volumes for the year 1995 were added to the project generated volumes to obtain the total forecast volumes with the project. Figure 6 shows the resulting turning movement volumes *with* the project for the weekday peak hour for 1995.

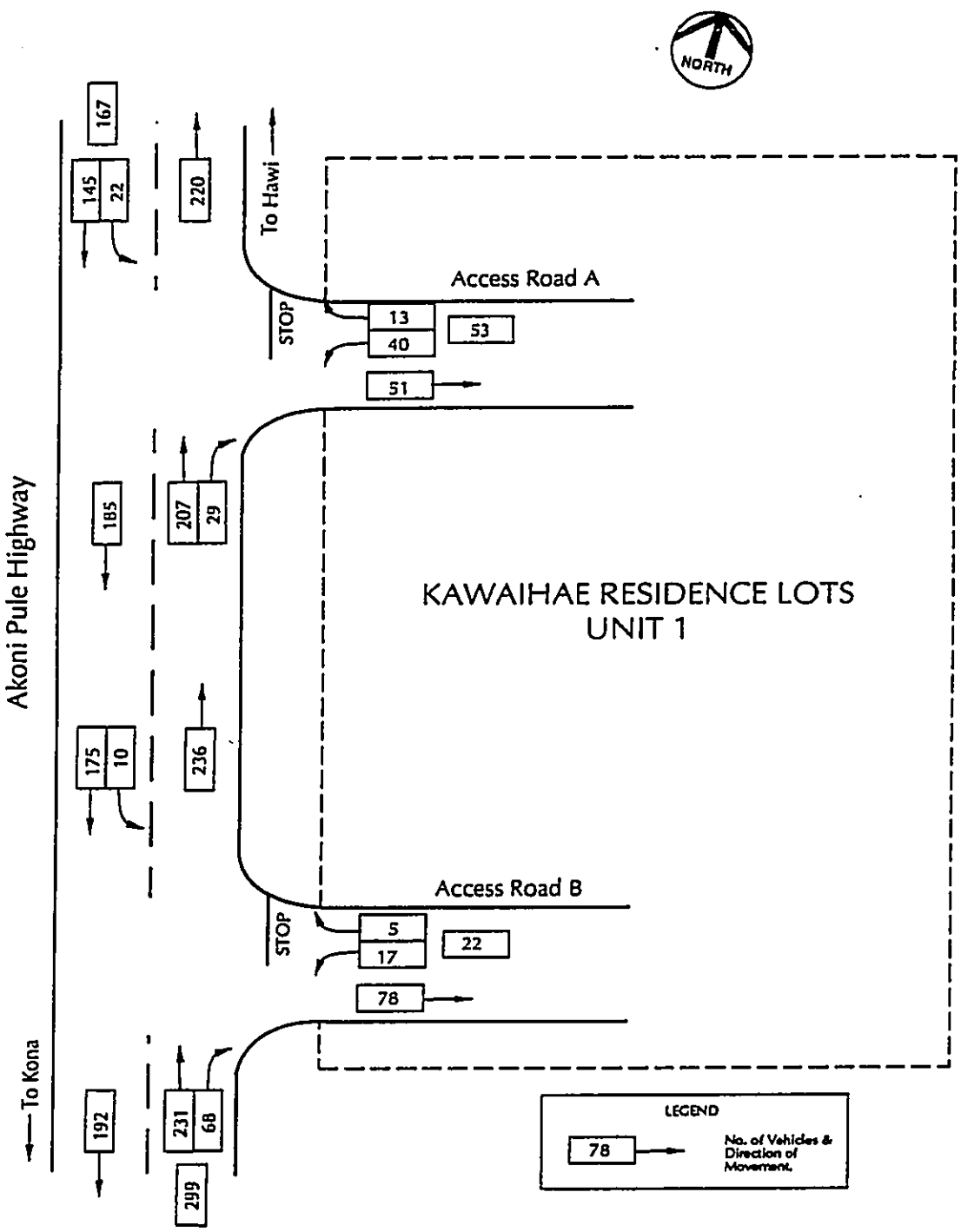


Figure 6. 1995 Weekday Peak Hour Forecast Traffic With Project

TRAFFIC IMPACT ANALYSIS

Impacts on traffic resulting from the Kawaihae Residential Lots Unit 1 were measured by comparing existing traffic conditions, future traffic conditions without project and future traffic conditions with project.

These conditions were analyzed using the Two-Lane Rural Highway and Unsignalized Intersection analysis from the Highway Capacity Manual[1]. These analysis methods determine level-of-service (LOS) which is classified into six categories ranging from LOS A to LOS F (summarized in Appendix A). The LOS for Rural Highways is not comparable to the LOS for Unsignalized Intersections.

Existing and Without Project Conditions

For the existing and without project conditions, there are no project intersections. Therefore, Akoni Pule Highway was analyzed only using the Two-Lane Rural Highway[2] analysis to determine its level-of-service. Table 3 shows the service flow rates and their corresponding LOS for Akoni Pule Highway in the vicinity of the project.

The results of the analysis shows that under existing conditions, the LOS of Akoni Pule Highway is LOS B. This means that vehicles travelling along the highway in the vicinity of the project experience slightly less

[1] Highway Capacity Manual, Special Report 209, 1985 Edition, by the Transportation Research Board

[2] The Rural Highway analysis considers the design speed, percent of no passing zones, type of terrain, and the traffic composition among other variables. The LOS is determined by the service flow rate of the highway, or the amount of vehicles that can travel on the highway within one hour.

freedom to travel at their desired speed than drivers in LOS A conditions. Also, there is less opportunity to pass slow moving vehicles than in the free flow conditions of LOS A. Even without the project, the LOS of the highway remains at LOS B. Users of the highway are still relatively unaffected by other vehicles on the highway.

Table 3. LOS at Various Flow Rates on Akoni Pule Highway *in the vicinity of the Project Site*

Level-of-Service	Service Flow Rate
A	≤155
B	≤420
C	≤770
D	≤1145
E	≤2210
F	>2210

Traffic Conditions	Flow Rate	Level-of-Service
Existing	281	B
1995 Without Project	376	B
1995 With Project	538	C

With Project Conditions

With the project, the LOS for Akoni Pule Highway in the vicinity of the project will drop to LOS C. At LOS C traffic flow is stable but congestion may occur due to turning traffic and slower moving vehicles.

The project will add two new unsignalized T-intersections which were analyzed using Unsignalized Intersection Analysis[3]. This analysis determines the LOS for the turning movements for each intersection.

The results of the analyses, summarized in Table 4, indicates that in 1995 the intersections of Akoni Pule Highway with Access Roads "A" and "B" will operate at LOS A for all turning movements. Vehicles turning left from Akoni Pule Highway into the residential subdivision and vehicles exiting the subdivision will experience little or no delays. Therefore the project traffic will cause little or no delays for through vehicles on Akoni Pule Highway.

Table 4. Level-of-Service for Akoni Pule Highway & Project Access Roads

	With Project 1995
Akoni Pule Highway/Northern Access Road	
Akoni Pule Highway LT[1]	A
Northern Access Road LT, RT[2]	A
Akoni Pule Highway/Southern Access Road	
Akoni Pule Highway LT	A
Southern Access Road LT, RT	A

[1] Left Turn

[2] Right Turn

[3] The Unsignalized Intersection Analysis considers the average running speed of the highway, the number of lanes of all approaches, and other variables. The LOS is determined by the reserve capacity of the various turning movements of the intersections under study.

CONCLUSIONS AND RECOMMENDATIONS

The proposed Kawaihae Residence Lots, Unit 1 will not significantly impact Akoni Pule Highway in 1995 when the project is expected to be completed and fully occupied.

Currently, there are no existing intersections providing access to the project site. With the project, there will be 2 new T-intersections. The existing and without project conditions were analyzed using the Two-Lane Rural Highway Analysis Method (from the Highway Capacity Manual) to determine its Level-of-Service (LOS) for Akoni Pule Highway. The with project condition was also analyzed for comparison purposes.

The Unsignalized T-Intersection Analysis Method (from the Highway Capacity Manual) was used to find the Level-of-Service for the turning movements for the new intersections. (While both analysis methods yields a Level-of-Service, the LOS for Rural Highways is not comparable to the LOS for Unsignalized Intersections.)

The results of the rural highway analysis indicate that for the existing and without project conditions, vehicles travelling on Akoni Pule Highway experience Level-of-Service (LOS) B. This means that drivers on Akoni Pule Highway, in the vicinity of the project, experience slightly less freedom to travel at their desired speed than drivers in LOS A conditions. Also, there is less opportunity to pass slow moving vehicles than in the free flow conditions of LOS A.

With the project in 1995, vehicles on the highway near the project location will experience LOS C. At this Level-of-Service, platoon formation

increases causing a decline in passing ability.

With the project in 1995, there will be two new access roads leading to the project, Access Road A and Access Road B. See Figure 2. The analysis for unsignalized T-intersections indicates that the turning movements at the new intersections with Akoni Pule Highway will operate at LOS A. Therefore, through traffic on Akoni Pule Highway will experience little or no delays due to vehicles turning into the new intersections.

Although the intersections will operate with little overall delay, vehicles slowing down or stopping to turn into the subdivision will cause traffic on the highway to slow down. We recommend two alternative methods to minimize the impact of the project.

Recommendation #1

Due to the level of developments and number of access points along Akoni Pule Highway in the vicinity of the project, including Kawaihae Town and the industrial subdivision, the following recommendation is made:

- Lower the speed limit of Akoni Pule Highway from Kawaihae Town to 1/2 mile north of the project to 35 miles per hour.

Recommendation #2

If, however, the lowering of the speed limit is not an acceptable alternative at this time, the following recommendations are made for each intersection:

- Provide left turn storage lanes on Akoni Pule Highway.
- Provide right turn deceleration lanes on Akoni Pule Highway.
- Provide adequate sight distance.

These recommendations will help to minimize the possibility of rear-end accidents.

APPENDIX A

Definition of Level-of-Service

Two-Lane Highways
Unsignalized Intersections

TWO-LANE HIGHWAYS

The highest quality of traffic service occurs when motorists are able to drive at their desired speed. Without strict enforcement, this highest quality, representative of *level-of-service A*, would result in average speeds approaching 60 mph on two-lane highways. ...almost no platoons of three or more vehicles are observed. Drivers would be delayed no more than 30 percent of the time by slow-moving vehicles.

Level-of-service B characterizes the region of traffic flow wherein speeds of 55 mph or slightly higher are expected on level terrain. Drivers are delayed up to 45 percent of the time on the average.

Level-of-service C results in noticeable increases in platoon formation, platoon size, and frequency of passing impediment. Average speed still exceeds 52 mph on level terrain. While traffic flow is stable, it is becoming susceptible to congestion due to turning traffic and slow-moving vehicles.

Level-of-service D traffic approaches unstable traffic flow. ...passing becomes extremely difficult. Mean platoon sizes of 5 to 10 vehicles are common, although speeds of 50 mph can be maintained under ideal conditions. Maximum service flow rates of 1,800 passenger cars per hour, total in both directions, can be maintained under ideal conditions. This is the highest flow rate that can be maintained for any length of time over an extended section of level terrain without a high probability of breakdown.

Level-of-service E is defined as traffic flow conditions having a percent time delay of greater than 75 percent. Passing is virtually impossible under these conditions, and platooning becomes intense when slower vehicles or

other interruptions are encountered. The highest attainable volume under E is the capacity of the highway. Under ideal conditions, capacity is 2800 pcph, total in both directions. This value decreases as the directional split of traffic changes from a 50/50 split to 0/100.

When traffic demand exceeds capacity, *Level-of-service F* is heavily congested flow. Volumes are lower than capacity, and speeds are below capacity speed.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX A

LEVEL OF SERVICE FOR UNSIGNALIZED INTERSECTIONS

For unsignalized intersections, the traffic most impacted will be the minor or cross-street with the stop or yield control. The major roadway will have the right-of-way. The level-of-service is the amount of delay expected for the average vehicle desiring to cross or enter the major road. The following gives a general description of the measure.

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause

breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Location: Akoni Pule Highway

Date: May 15, 1990

	Akoni Pule Highway	
	Northbound	Southbound
Time (pm)	TH	TH
3:00-3:15	21	25
3:15-3:30	47	23
3:30-3:45	40	29
3:45-4:00	35	23
4:00-4:15	41	29
4:15-4:30	39	16
4:30-4:45	38	18
Peak Hour		
(3:15-4:15)	163	104