JOHN WAIHEE
GOVERNOR

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
SEVEN WATERFRONT PLAZA, SUITE 300
500 ALA MOANA BOULEVARD
HONOLULU, HAWAII 96813
FAX (808) 543-6841

IN REPLY REFER TO:
90-DEV/2077

May 16, 1990

Dr. Marvin T. Miura, Ph.D
Director
Office of Environmental Quality Control
State of Hawaii
465 South King Street, Room 104
Honolulu, HI 96813

Dear Dr. Miura:

Chapter 343, HRS

Environmental Impact Statement (EIS)

Notice of Determination for

Affordable Housing Development Project in

Hanamaulu, Lihue District

Island of Kauai

Tax Map Key 3-7-03:20

The Housing Finance and Development Corporation has determined that the subject applicant action does not require an EIS pursuant to Chapter 343, HRS, because the proposal, which involves the use of state funds, will not have a significant impact on the environment. This letter, together with the enclosed copies of the environmental assessment, serves as a negative declaration. It should be published in the OEQC Bulletin under the "Register of Chapter 343, HRS Documents."

120

The contact person for the environmental assessment will be:

Brian Nishimoto
Amfac/JMB Hawaii, Inc.
4370 Kukui Grove Street, Suite 200
Lihue, Kauai, HI 96766

If there are any questions, please contact Al Ahana, Project Coordinator, at 543-2940.

Sincerely,

JOSEPH K. CONANT
Executive Director

AA:rh

1990-06-08-KA-FEA

FILE COPY

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai

ENVIRONMENTAL ASSESSMENT

PREPARED FOR:
AMFAC/JMB HAWAII, INC.

PREPARED BY:
HELBER HASTERT & KIMURA PLANNERS

FOR SUBMITTAL TO:
STATE OF HAWAII
HOUSING FINANCE AND DEVELOPMENT CORPORATION

MAY 1990

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai

Environmental Assessment

Prepared for:
Amfac/JMB Hawaii, Inc.

Prepared by:
Helber, Hastert & Kimura, Planners

For submittal to:
State of Hawaii
Housing Finance and Development Corporation

May 1990

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter I

INTRODUCTION AND SUMMARY

INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

Amfac/JMB Hawaii, Inc. is proposing to develop a primarily affordable housing community on approximately 60 acres at Hanamaulu, Kauai (Figure 1). The project will consist of approximately 450 single- and multi-family dwelling units and a 2-acre public park, and may include a number of housing units priced at prevailing market rates. The environmental impact analysis contained in this assessment is based on a maximum projected unit count of 450 units, and would remain applicable if market-priced units are introduced to the development.

The State of Hawaii, Housing Finance and Development Corporation (HFDC) will provide construction and permanent financing for the affordable housing units. Amfac/JMB will be the master developer of the project, providing the land, developing the housing, and selling the single-family house and lot packages to the public in accordance with HFDC guidelines. The multi-family turnkey rental units will be sold to HFDC, and subsequently turned over to the Hawaii Housing Authority, which will manage the rentals. The State HFDC is the accepting agency of this Environmental Assessment (EA).

For the purposes of this EA, the term "Affordable Housing" is used in accordance with the definition given in the State of Hawaii Housing Functional Plan (HFDC 1989) of "...housing for persons or families whose incomes are identified as one hundred forty percent or less of the area median income for each of the counties of Hawaii, Maui, Honolulu, and Kauai as determined by the United States Department of Housing and Urban Development from time to time, and as adjusted by family size."

1.2 INTENDED USES OF THIS DOCUMENT

This report is intended to comply with Chapter 343, Hawaii Revised Statutes which requires an environmental assessment for actions which "Propose the use of state or county lands or the use of state or county funds, other than funds to be used for feasibility or planning studies for possible future programs or projects which the agency has not approved, adopted, or funded, or funds to be used for the acquisition of unimproved real property; provided that the agency shall consider environmental factors and available alternatives in its feasibility or planning studies...." In addition, this document will be used in support of a petition for a State Land Use District Boundary Amendment to the State of Hawaii, Land Use Commission in accordance with State Land Use Commission Rules, September 1986, as amended. The petition will request the reclassification of approximately 30 acres of the subject property from Agriculture to Urban.

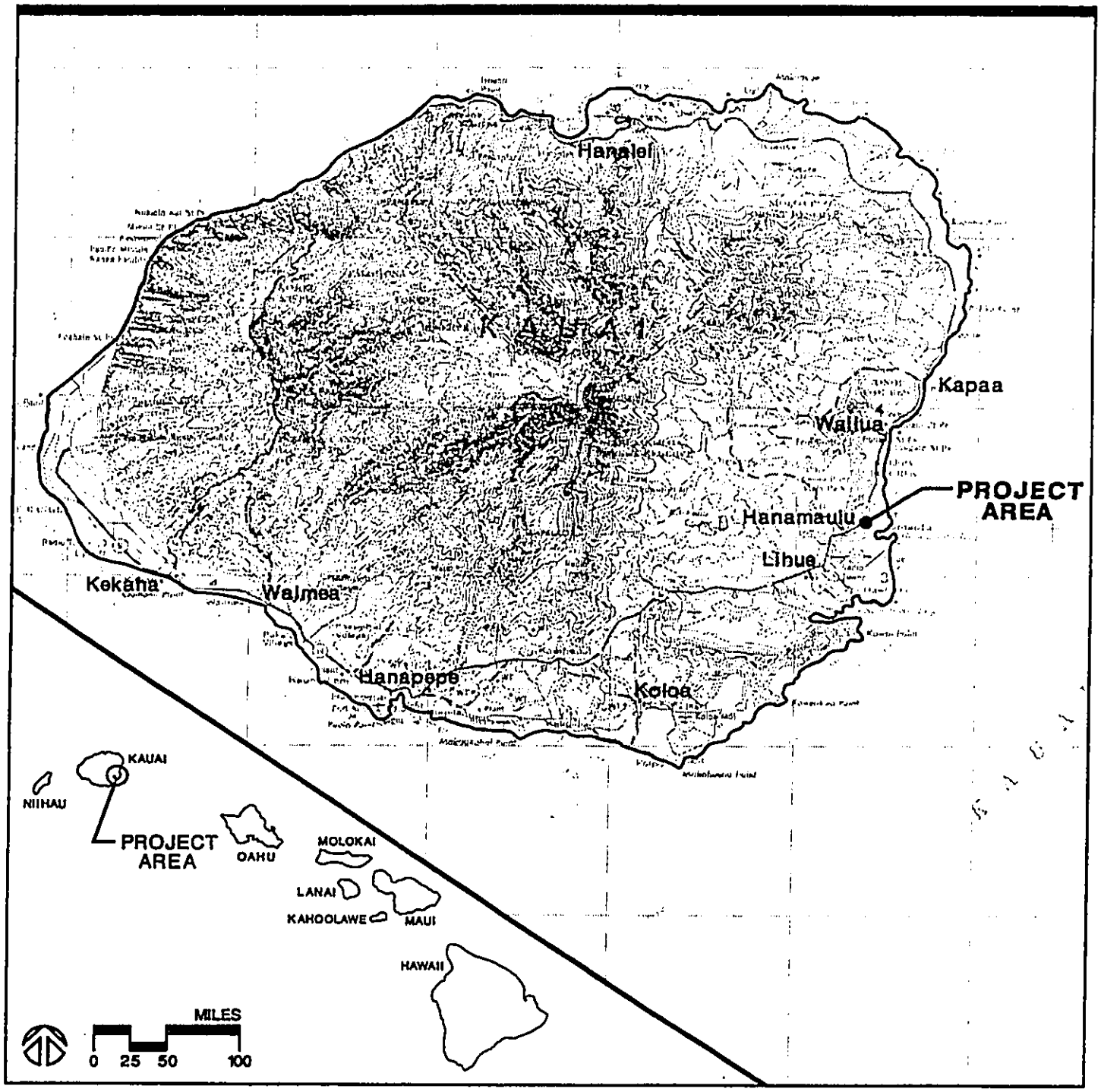


FIGURE 1

PROJECT LOCATION

MILES

2.5 0 5

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PRI TOWER • 733 BISHOP STREET • SUITE 2390
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 545-2055

1.3 DEVELOPMENT SUMMARY

Applicant:	Amfac/JMB Hawaii, Inc.	
Property Owner:	Amfac/JMB Hawaii, Inc.	
Property Location:	Hanamaulu, Lihue District, County of Kauai (north of Hanamaulu Town)	
Tax Map Key:	Fourth Tax Division, 3-7-03-20	
Size:	approximately 60 acres	
Existing Land Use Regulation:	*State Land Use District:*	Urban (Phase I), Agriculture (Phase II)
	Kauai General Plan:	Urban Residential
	Lihue Development Plan:	Residential single family, public use
	County Zoning:	R-6 (Phase I), Agriculture (Phase II)
Existing Land Uses:	Existing land use limited to sugarcane cultivation.	
Proposed Action and Land Uses:	Construction of 450 affordable single-family and multi-family residential units; construction of two acre park.	
EA Accepting Agency:	State Housing Finance and Development Corporation (HFDC)	

1.4 SUMMARY OF PROBABLE IMPACTS AND MITIGATION MEASURES

Flora and Fauna

No rare, threatened, or endangered flora or fauna are known to inhabit the site. While the proposed development will result in the loss of vegetation, primarily sugarcane, weedy associations, and planted trees, it is not expected to have a major adverse impact on the total island populations of plant and animal species.

Archaeological and Historical Resources

There are no surface indications of significant archaeological remains at the project site. The project is not expected to have effect on significant historical sites.

Visual Resources

The proposed residential development will alter the present unobstructed, open view corridors. Mitigation measures include landscaped buffers and the incorporation of an open park land adjacent to the Hanamaulu School site at Kuhio Highway.

Transportation/Circulation

Kuhio Highway is the only arterial street serving the corridor, and already exhibits traffic volumes at capacity for a two-lane road. Traffic demand along this corridor will continue to increase irrespective of the proposed project, resulting in LOS E conditions during peak hours. Therefore, it is likely that improvement of the Kuhio/Kapule intersection will be justified even if the project site is not developed.

The proposed project will contribute to cumulative regional traffic growth in the Hanamaulu area. At the proposed Main Access/Kuhio Highway intersection, only the left turn movement out of the project site is expected to exhibit LOS E conditions during peak hours. Although traffic volumes at both intersections are expected to warrant signalization during peak hours, signalization at the Hanamaulu Road/Kuhio Highway intersection is recommended in lieu of signalization at the proposed project access. The provision of a westbound left turn storage lane on Kuhio Highway and right turn deceleration and acceleration tapers at the project access point would maintain adequate levels of storage at the Main Access/Kuhio Highway intersection.

Mitigation measures addressing the anticipated LOS E conditions at the Kuhio/Kapule Highway intersection include installation of a second eastbound lane and a second northbound through lane at the intersection. According to the traffic study, capacity constraints in the area are endemic to the Lihue-to-Kapaa corridor, and would be most efficiently approached by a regional solution. Therefore, it should be noted that mitigation measures by the Department of Transportation addressing the Kuhio/Kapule Highway traffic conditions would be warranted even without the development of the affordable housing project. A detailed discussion of impacts and mitigation measures is presented in Chapter IV.

Land Use

Development of the property will convert the existing agricultural use to urban residential usage. The development will not adversely impact Lihue Plantation's operations and is consistent with county and community level public plans and policies for the area.

Air Quality

Air quality impacts from the residential development include short-term, on- and off-site impacts from construction activity, long-term impacts from increased traffic-related pollutants generated from the project, and electrical generation impacts from increased electricity demand requiring additional fuel combustion. On-site construction-related impacts can be mitigated through the frequent watering of exposed soils and unpaved roads, and timely landscaping after completion. Mobile generated impacts can be mitigated through highway improvements that reduce queuing and alternatives such as carpooling and public transit systems. At present, the only measure available to mitigate impacts from increased electrical generation is the reduction of energy demand by the user through the utilization of energy-saving devices and practices.

Noise

Increases in traffic noise along Kuhio Highway due to project traffic are equal to or less than those due to non-project traffic, and are expected to range between 0.2 to

0.7 Ldn. The expected setback distances to the 65 Ldn contour are predicted to range from 77 to 112 feet from the centerlines of Kapule and Kuhio Highways following project build-out in 1993. In addition to setbacks, future traffic noise impacts can be mitigated by terrain features, highway cuts, man-made obstructions, sound attenuating walls, total enclosure and air conditioning, and the use of sound-attenuating windows. Based on currently available existing and forecasted aircraft noise contours over the project site, special aircraft noise attenuation measures are not considered mandatory on the project site. However, a noise study recommended the implementation of airport noise disclosure provisions. Short term on-site construction noise is unavoidable during the project construction period. A noise study recommended the use of properly muffled construction equipment and the incorporation of construction curfew periods to keep these impacts at a minimum.

Public Utilities and Services

The addition of 450 housing units will increase demand for the County's solid waste disposal, fire, and police protection services, already operating at capacity. The County is currently negotiating additional landfill space, but will require additional collection personnel to service the new development. The present potable water source, storage facilities, and water pressure are adequate to accommodate the requirements of the development. Expansion of fire department facilities and personnel may be required to serve the new development. Additional police personnel may also be required. Sewage generated at the development will be treated by the County sewerage system. Storm water drainage from the Phase I portion will be conveyed into the County drainage system. Phase II drainage will flow toward the Kauai Hardwoods site to the northeast. The developer will continue to coordinate planning for public services with the County in order to assure provision of adequate services to the new development.

1.5 SUMMARY OF ALTERNATIVES CONSIDERED

Three major alternatives to the proposed project were examined. These included a "no action" alternative, a "limit development to the Phase I area" alternative, and an "alternative land uses" alternative. The "no action" alternative which would continue sugar cultivation was rejected in favor of residential development to alleviate Kauai's critical housing shortage. The alternative to develop only the Phase I portion, whereby only the area currently in a State Land Use Urban district is developed, is contrary to sound land use planning practices, as continued agricultural operations on the Phase II site would adversely impact the adjacent Phase I residents. In both of the above alternatives, the agricultural fields are separated from surrounding fields by Kuhio and Kapule Highways, which may cause logistical and operational difficulties. Alternative land uses (including cultivation of alternative crops, commercial, light industry, or resort uses) have questionable profitability and compatibility with existing residential development, and do nothing to alleviate the widely expressed need for affordable housing.

1.6 COMPATIBILITY WITH LAND USE PLANS AND POLICIES

Chapter 3 contains a detailed discussion of the relationship between government plans and policies and the proposed project. The proposed project is generally compatible with relevant land use controls and policies at the State and local levels.

1.7 DETERMINATION

Based on the analysis contained herein, it is determined that all significant environmental effects resulting from the proposed project will be sufficiently mitigated by the measures proposed.

1.8 NECESSARY PERMITS AND APPROVALS

The permits and approvals that must be secured by the applicant before development of the site can begin are discussed below.

State Land Use A State Land Use District boundary amendment authorized by the Land Use Commission will be required, reclassifying the portion of the property now in an Agriculture district to Urban.

Kauai County Zoning A County zoning amendment will be required, redesignating the new Urban area as a Residential district. The rezoning request is submitted to the Planning Commission, which makes a recommendation to the County Council. The Council has the authority to amend the zoning ordinance, which requires confirmation by the mayor.

Other In addition, subdivision approval, infrastructure building permits, and structural building permits will need to be secured for proposed project.

1.9 CONSULTED AGENCIES

The following agencies were consulted in the process of making this environmental assessment:

Civil Defense Agency, County of Kauai
Department of Business and Economic Development, State of Hawaii
Department of Education, State of Hawaii
Department of Public Works, County of Kauai
Department of Water, County of Kauai
Emergency Medical Service Branch, Department of Health, State of Hawaii
Fire Department, County of Kauai
GTE Hawaiian Tel, Kauai
Hawaii Housing Authority, State of Hawaii
Housing Finance and Development Corporation, State of Hawaii
Land Use Commission, State of Hawaii
Lihue Plantation Company, Ltd.
Planning Department, County of Kauai
Police Department, County of Kauai
Mahelona Memorial Hospital
Wilcox Memorial Hospital

Chapter II

PROJECT DESCRIPTION

PROJECT DESCRIPTION

2.1 LOCATION

The project area is a 60-acre triangular parcel located just north of Hanamaulu town, Lihue District, Island of Kauai (tax map key Fourth Tax Division, 3-7-03-20). It is owned in fee by Amfac/JMB Hawaii, Inc. The parcel is bounded by Kuhio Highway on the north and west, Kapule Highway (Hanamaulu-Ahukini Cutoff Road) on the east, and Hanamaulu River Valley, Hehi Road and the existing Hanamaulu residential houselots on the south (Figure 2).

2.2 EXISTING SITE CONDITIONS

The site is fairly level and until recently, was under sugarcane cultivation by Lihue Plantation Company, Ltd., a subsidiary of Amfac/JMB Hawaii, Inc. The fallow fields presently support patches of weedy species and resprouted plants of sugarcane, and are traversed by irrigation and drainage ditches.

2.3 ADJACENT LAND USES

A strip of private residential houselots is located across Kuhio Highway from the project site, beyond which rises Kalepa Ridge. The area to the south of the property is occupied by existing Hanamaulu residential development, Peter Rayno Park (also known as Hanamaulu Park), and the Hanamaulu School site (under construction). The southeastern corner of the project area, bordering Hehi Road, consists of the upper edge and steep slope of Hanamaulu River Valley. Cultivated sugarcane fields occupy the land to the east of the project site, across Kapule Highway.

2.4 DEVELOPMENT CONCEPT

The Hanamaulu Affordable Housing Project proposed by Amfac/JMB Hawaii, Inc. is a primarily affordable housing planned community, which will provide 330 single-family and 120 multi-family residential units in a 2-phase development plan (Figure 3). The project is being initiated by Amfac/JMB Hawaii, Inc. as master developer, in response to the demand for affordable housing on the island of Kauai, particularly in the Lihue area. In order to keep the project economically viable and to promote a diverse community, a portion of the project may be developed as market-priced units. Should the project include some market-priced development, the total unit count for the project is likely to be reduced. Thus, the environmental impacts discussed in the following sections would not increase as a result of incorporating market-priced dwellings into the project.

Each of the two project phases will include 165 single-family units and 60 multi-family units for a total of 450 residential units. Phase I of the project, encompassing approximately 30 acres, will include development of the southwestern portion of the parcel, which is currently in the State Urban District. In addition to the housing, Phase I includes development of a two-acre community park adjacent to the Hanamaulu School site, at the entrance to the development from Kuhio Highway.

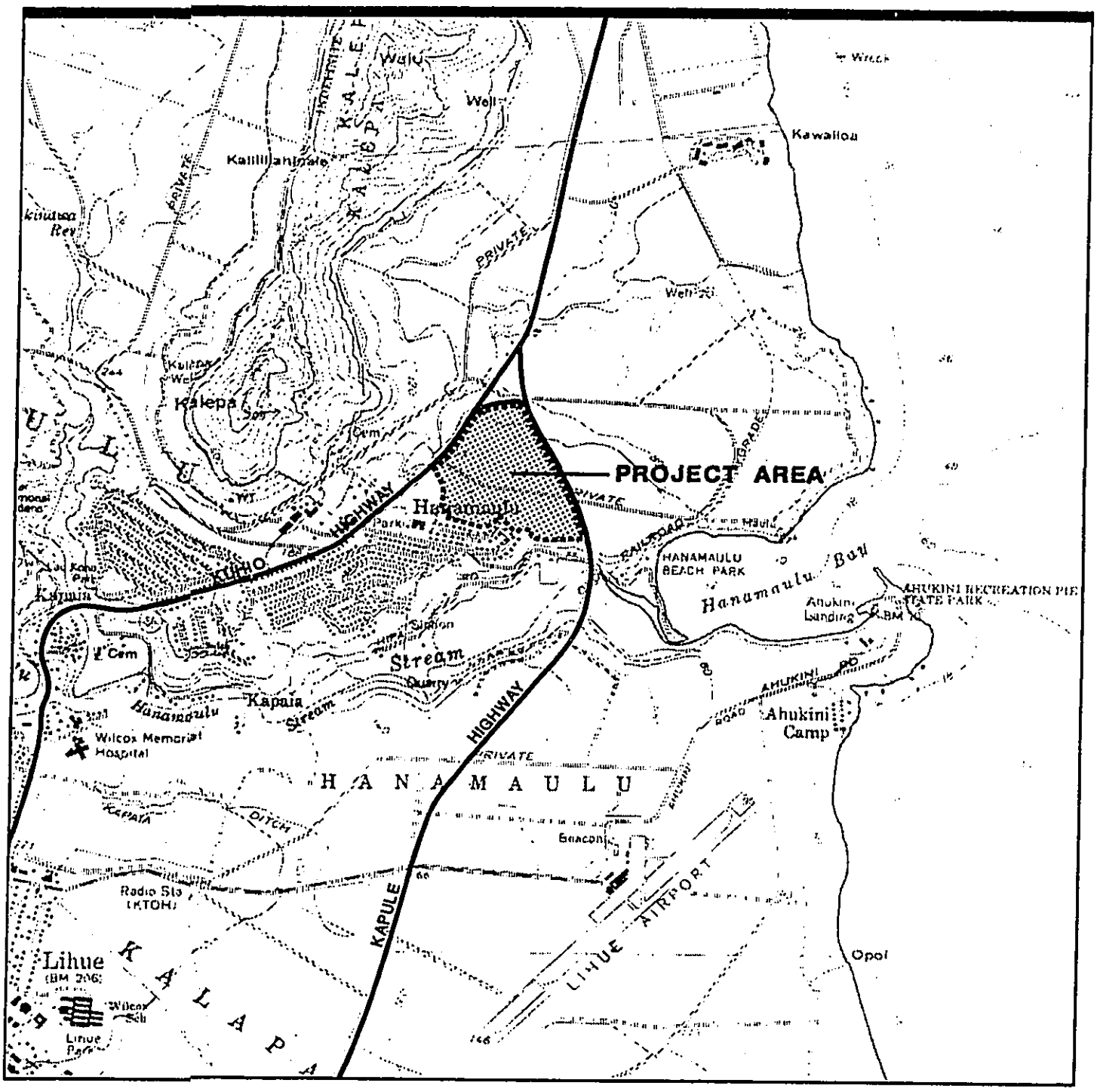


FIGURE 2

LOCATION MAP

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PRI TOWER • 733 BISHOP STREET • SUITE 2590
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 545-2055

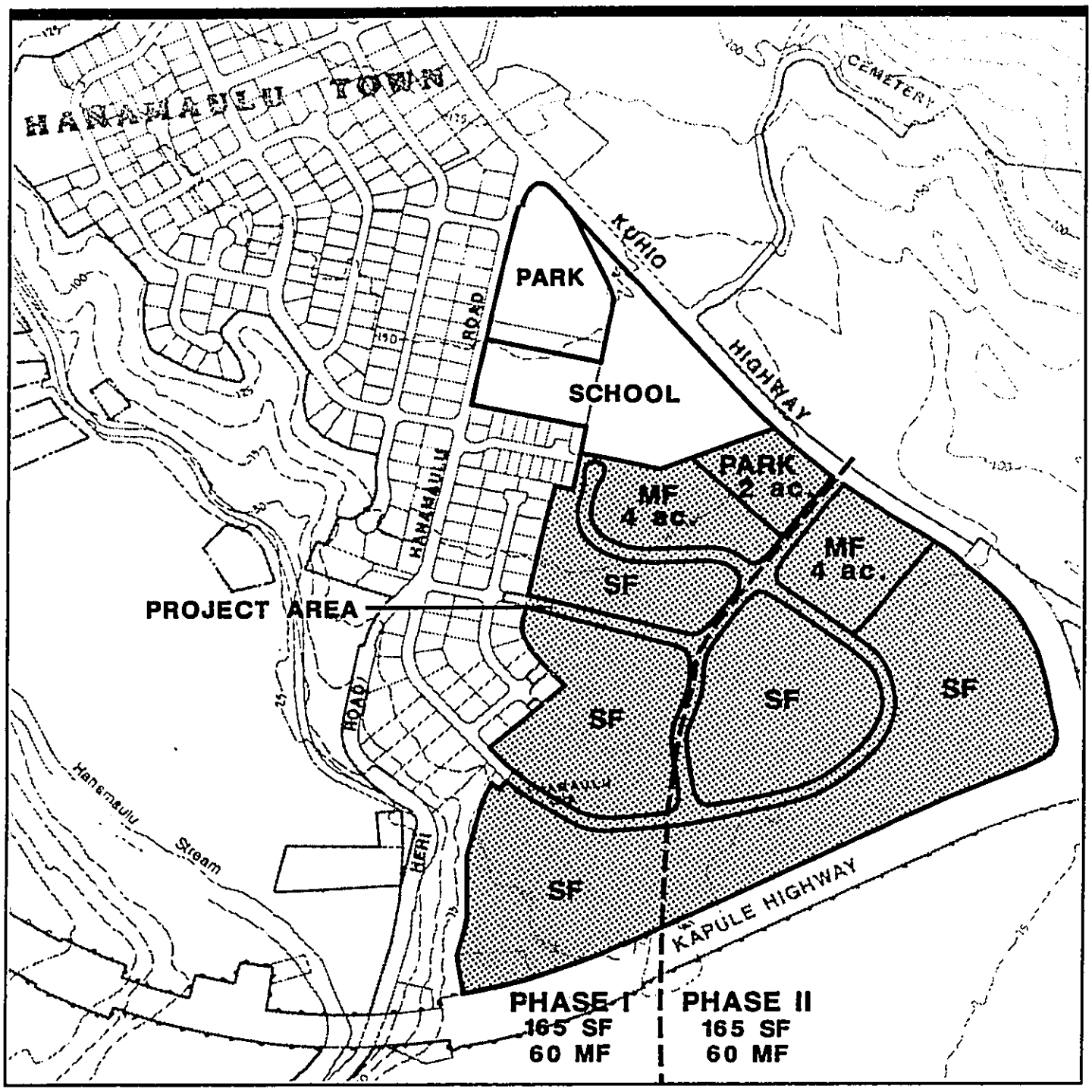


FIGURE 3

CONCEPTUAL PLAN

FEET

250 0 500

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PRI TOWER • 733 BISHOP STREET • SUITE 2560
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 545-2055

Phase II of the development, encompassing approximately 30 acres, will involve construction on the northwestern half of the site which is currently in the State Agriculture District. Development of Phase II will require a State Land Use Commission district boundary amendment as well as County zoning. This phase is expected to be completed in 1993.

The State Housing Finance and Development Corporation (HFDC) will be a project sponsor and will provide both construction and long-term financing for the project. The single-family affordable units will be sold to eligible persons by Amfac/JMB according to HFDC guidelines. The affordable housing units will be priced at levels affordable to households between 80% to 140% of the Department of Housing and Urban Development (HUD) median income. The multi-family rental units will be sold to HFDC, and managed by the Hawaii Housing Authority.

2.5 OBJECTIVES OF THE DEVELOPMENT PROGRAM

The objectives of the Hanamaulu Affordable Housing Project are to:

- o provide greater opportunities for home ownership and rental to the residents of Kauai through a master planned residential community consisting primarily of affordable housing units, and
- o assist HFDC in meeting the demand for affordable housing.

2.6 PROJECT RATIONALE

As indicated by the 1987 Kauai County Housing Agency assessment report on the need for affordable housing, there is a great demand for resident housing. The report predicts that the resident housing inventory will need to nearly double in the eighteen years between 1987 and 2005 in order to maintain an adequate supply of housing. The majority of this growth must take place by 1995, translating into a requirement of 1,500 new housing units required in the Lihue planning area alone by 1990.

The proposed development will provide 450 (approximately 27 percent of the total required 1,500) primarily affordable housing units specifically targeted at current County residents. The existing pent up demand will be partially alleviated without the loss of a significant portion of agricultural land (less than one percent of Lihue Plantation's cultivated lands) or a reduction in plantation staffing.

2.7 USE OF PUBLIC RESOURCES

The State HFDC will provide construction and permanent financing for the affordable housing units. The sale of the single-family units by Amfac/JMB will be conducted in accordance with HFDC guidelines. The multi-family rental units will be acquired by HFDC and managed by the Hawaii Housing Authority.

Chapter III

PROJECT CONFORMANCE WITH EXISTING GOVERNMENTAL PLANS, POLICIES AND CONTROLS

PROJECT CONFORMANCE WITH EXISTING GOVERNMENTAL PLANS, POLICIES AND CONTROLS

3.1 State Land Use Law

All lands within the State have been placed in one of the four land use districts (Urban, Rural, Agriculture, and Conservation) by the State Land Use Law (Chapter 201, HRS). The south half of the project parcel (30 acres), known as Phase I, is within the State Land Use Urban district. The north half of the site (30 acres), identified as Phase II, is within the Agriculture district. The boundary line passes down the existing cane haul road that bisects the site from east to west. In order to proceed with the Phase II portion of the project, a State Land Use district boundary amendment will be required from the State Land Use Commission. Figure 4 shows the State Land Use delineations of the parcel.

3.2 Hawaii State Plan

The Hawaii State Plan (Chapter 226 Hawaii Revised Statutes, as amended) establishes a set of guidelines for the statewide planning system, and provides the overall theme, goals, objectives, policies, and priority guidelines. The following describes the purpose of the State Plan.

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

In this section, proposed project is analyzed with respect to relevant State Plan goals, objectives and policies.

Socio-cultural Advancement. Relevant objectives of the State Plan in this area relate to the "achievement of greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary livable homes located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals" and the "orderly development of residential areas sensitive to community needs and other land uses". In order to achieve these housing objectives, it is a State policy to "stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households."

Comment: The proposed project will contribute a total of 450 residential units to the existing inventory of single- and multi-family units, thereby increasing the currently limited home ownership and rental opportunities in the Lihue area. The intent of this project is to primarily serve Kauai's working class by providing affordably priced residential units which will expand the ability of families to afford housing in the area.

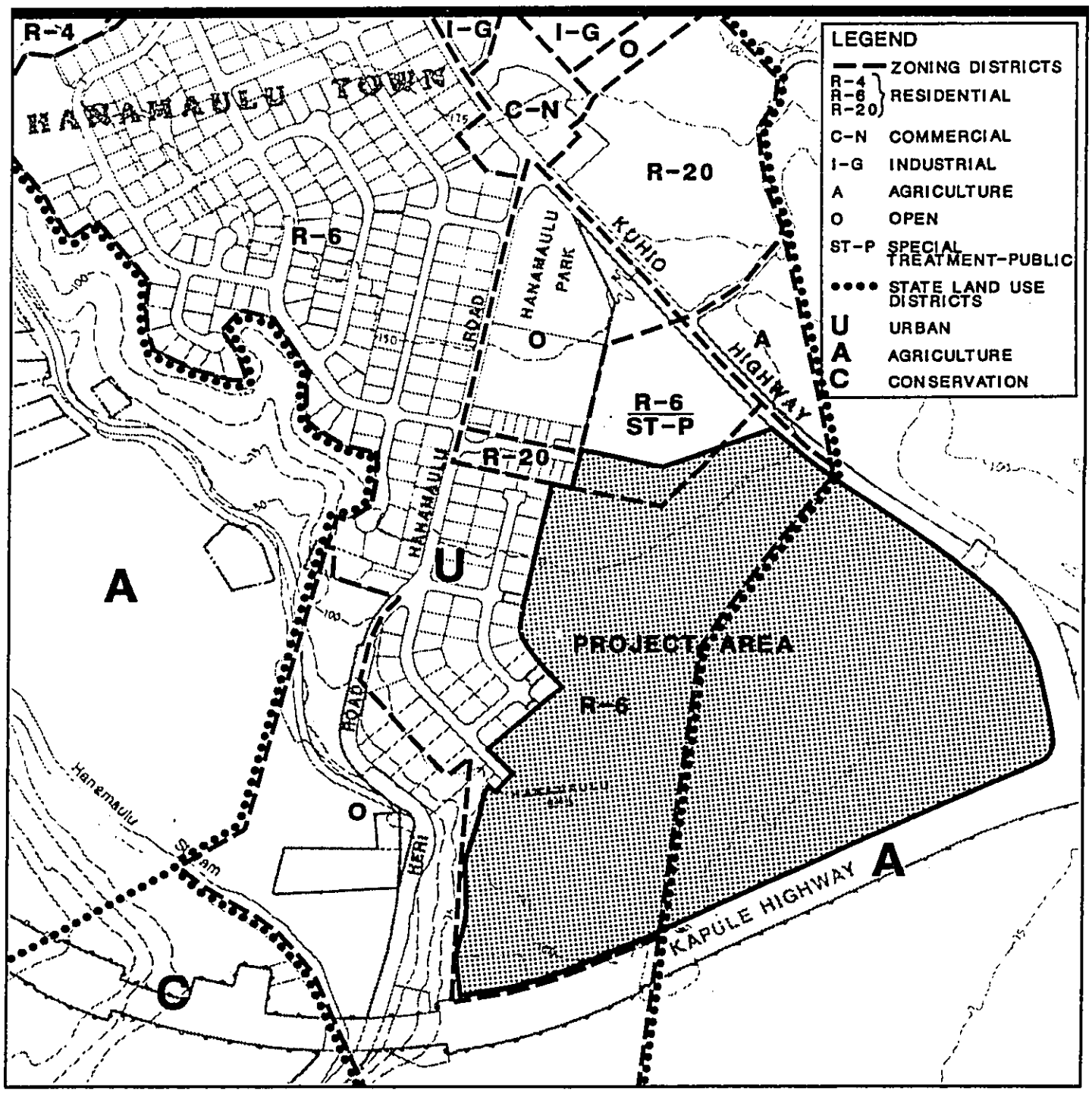


FIGURE 4

STATE LAND USE AND COUNTY ZONING MAP

FEET

250 0 500

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PRI TOWER • 733 BISHOP STREET • SUITE 2580
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 543-2055

Physical Environment. Included in the State Plan objectives in this area with respect to land, air and water quality is the encouragement of urban developments in close proximity to existing services and facilities.

Comment: The proposed project is located adjacent to an existing residential development, and will utilize and improve upon facilities currently serving this development as well as other operations (such as Lihue Plantation) in the area.

Facility Systems. Relevant objectives and policies of the State Plan in this area with respect to solid and liquid wastes are the provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas; and the encouragement of the adequate development of sewerage facilities that complement planned growth.

Comment: By providing affordable housing, the proposed project contributes to alleviating housing problems in the Lihue area. The developer will work closely with the appropriate state and county agencies to coordinate the proposed project with necessary improvements to infrastructure.

3.3 State Functional Plans

The Hawaii State Plan directs the appropriate State agencies to prepare functional plans for their respective program areas including: agriculture, transportation, conservation lands, housing, tourism, water resources, historic preservation, energy, recreation, education, higher education and health. These functional plans serve as the primary implementing vehicle for the goals, objectives and policies of the Hawaii State Plan. The following functional plans were found to have the most relevance to the proposed Hanamaulu development.

State Housing Functional Plan

The State Housing Functional Plan, prepared by the Housing Finance and Development Corporation, focuses its Implementing Actions on the following six broad areas: 1) increasing home ownership; 2) expanding rental housing opportunities; 3) expanding rental opportunities for the elderly and other special need groups; 4) preserving housing stock; 5) designating and acquiring land that is suitable for residential development; and 6) establishing and maintaining a housing information system.

Comment: The proposed project will increase home ownership and rental housing opportunities by adding approximately 450 affordably priced dwelling units to the existing inventory. Although a portion of the site is currently in an area designated State Land Use Agriculture, it is contiguous to a State Land Use Urban District, and in close proximity to an existing public facilities and infrastructure.

State Agriculture Functional Plan

The State Agriculture Functional Plan, prepared by the State Department of Agriculture, applies to lands "suitable and used (or potentially usable) for agricultural production." According to this functional plan, the State's primary objective in regards to land is the "Achievement of productive agricultural use of lands most suitable and needed for agriculture."

Comment: The soils at the project site have been classified under three systems: the Soil Conservation Service (SCS) Soil Survey, Detailed Land Classification by the Land Study Bureau (LSB), and the Agricultural Lands of Importance to the State of Hawaii (ALISH). Under SCS, the project area soils are classified as Lihue silty clay, which is in Sugarcane Group 1 (most suitable for sugarcane production). The LSB designates the soil as B41i. The State Department of Agriculture classifies the entire project area as Prime Agricultural Land, according to its ALISH system. Explanations of these classification systems and ratings are discussed in detail in Chapter 4 under Soils and Agricultural Potential.

The subject property was until recently under continuous sugarcane cultivation. However, it has been designated for residential use in the Kauai General Plan and the Lihue Development Plan. These designations appear to indicate that public policy makers have determined the site to be more suitable for urban residential use. In addition, the parcel is not contiguous to the surrounding cane lands and therefore may not be as well suited for continued agriculture use.

State Recreation Functional Plan

The State Recreation Functional Plan, prepared and maintained by the Department of Land and Natural Resources, seeks: (1) to assess the present and potential demand and supply of outdoor recreation resources and to guide State and County agencies in acquiring or preserving lands of recreational value; (2) to provide adequate recreation facilities and programs; and (3) to ensure public access to recreation areas.

Comment: The immediate Hanamaulu area has three existing community parks: the Peter Rayno Park (3.59 acres), the Laukona Park (2.59 acres) and the Wiliko Park (2.28 acres). These three parks provide a total 8.46 acres. In addition, the development includes a 2.0 acre park, adjacent to the Hanamaulu School. The three existing and one proposed park will be sufficient to serve the existing and future Hanamaulu residents. Hanamaulu Beach Park is less than one-half mile from the project site. Other beach parks within three miles of the development include the Nawiliwili Park, Nawiliwili Small Boat Harbor, Kalapaki Beach, and Niumalu Beach Park. These public beach facilities will provide ongoing recreational facilities for the residents of the development.

3.4 State Coastal Zone Management Objectives and Policies as Defined in Chapter 205A Hawaii Revised Statutes

The subject property is not within the Kauai County Coastal Zone Special Management Area. However, the proposed project is generally consistent with relevant objectives and policies of the State Coastal Zone Management Program in terms of providing public recreation areas, and providing for solid and liquid waste treatment, disposition and management to minimize adverse effects on Special Management Area resources.

3.5 Kauai County General Plan

The Kauai County Charter, adopted in 1968, required the preparation and adoption by resolution of a General Plan setting forth "policies to govern the future physical development of the County." The plan was to "serve as a guide for all future council action regarding land use and development regulations, urban renewal programs and

expenditures for capital improvements." In conformance with the Charter, a General Plan was adopted in 1971. This General Plan was updated in 1982.

The General Plan includes a land use section which designates specific types of uses for all parcels. These General Plan Land Use Designations distinguish between specific urban uses such as commercial, industrial, multi-family residential, and single-family residential, as well as non-urban uses such as agriculture and open. Appropriate zoning is required to implement General Plan Land Use Designations.

All of the subject site has an Urban Residential land use designation, including the Phase II area of the parcel, which is located in the State Agriculture District (Figure 5).

3.6 Lihue Development Plan

Since 1971, the County has been implementing regional Development Plans. These Development Plans are intended to be regional modifications or updates of the General Plan, rather than a separate land use regulation.

The Hanamaulu site is within the area covered by the Lihue Development Plan. The Lihue Development Plan of August 2, 1976 specifically states that the "...prime areas for new housing are...between the present Lihue Town and the airport, at Puhi, and toward Hanamaulu." The Development Plan shows the proposed land use for the majority of the site as residential single family with an area of public use to accommodate school and park expansion (located in the southwest sector of the parcel). Figure 6 shows the Development Plan designations.

Other sections in the Lihue Development Plan that may be applicable to the proposed Hanamaulu development, either in general or directly, are as follows: the Summary of Findings and Recommendations indicates that existing housing supplies are not adequate to meet the anticipated needs both in terms of quantity and price. It recommends that the County work closely with private developers to "effect timely construction of affordable housing units." The Lihue Development Plan, Water and Sewer Plan Section, indicates sewer service to be extended to the project site in the fourth phase of the recommended sewage development plan with water service to the area at approximately the same time.

3.7 Kauai County Zoning Ordinance

The Kauai County Zoning Ordinance designates twenty-three zoning districts to regulate land use. These include residential, resort, commercial, industrial, and special treatment districts.

Only the Phase I portion of the site (within the State Urban district) has been zoned by the County. The entire Phase I area is zoned R-6 residential which allows up to six units per acre. The Hanamaulu school site, at the far western portion of the parcel, is designated R-6 residential with a Special Treatment District-Public (ST-P) overlay (Figure 4).

In order to proceed with Phase II of the project, that portion of the site will need to be rezoned to R-6.

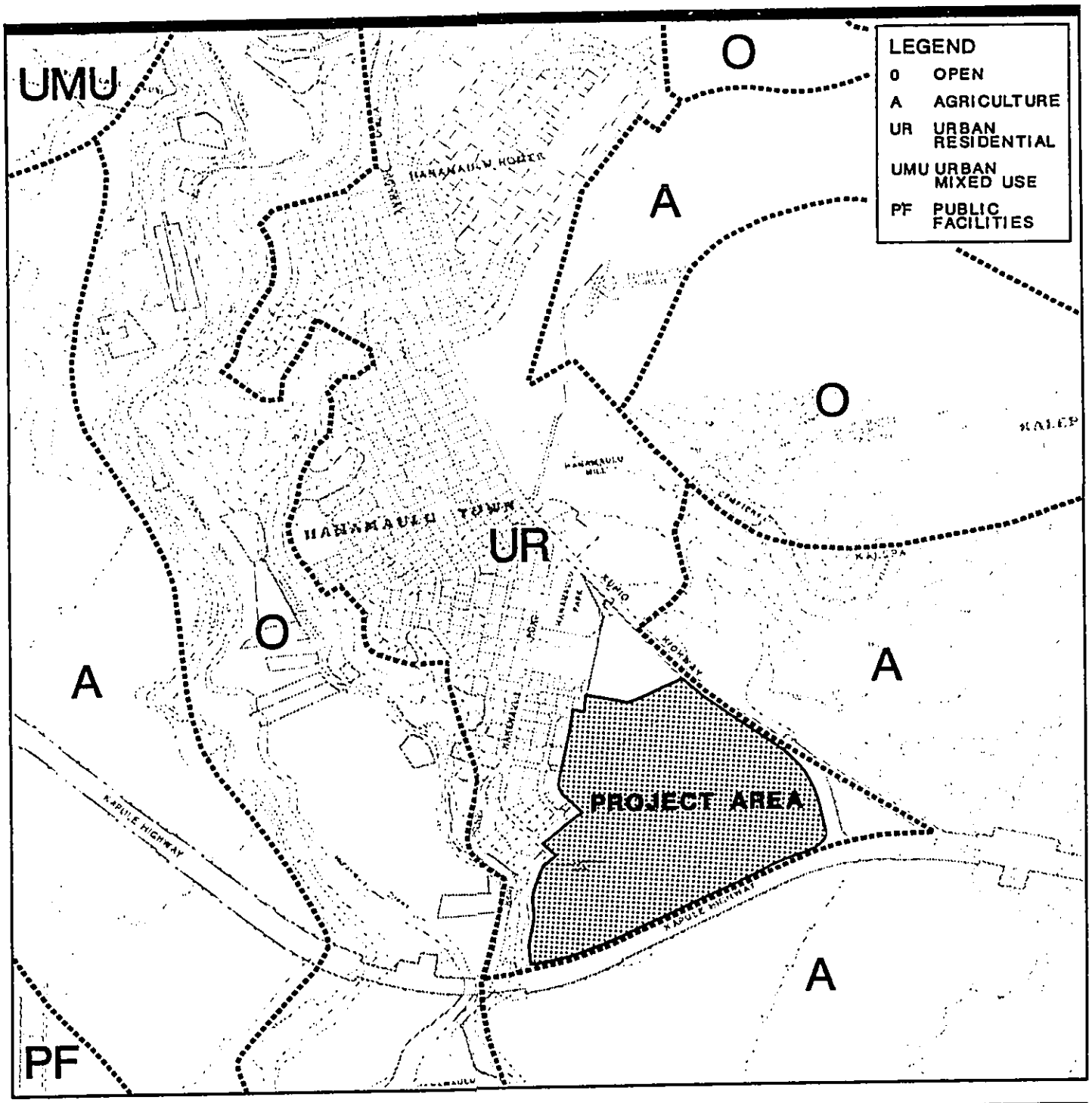


FIGURE 5

KAUAI GENERAL PLAN DESIGNATIONS

FEET
500 0 1000

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PRI TOWER • 733 BISHOP STREET • SUITE 2590
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 545-2055

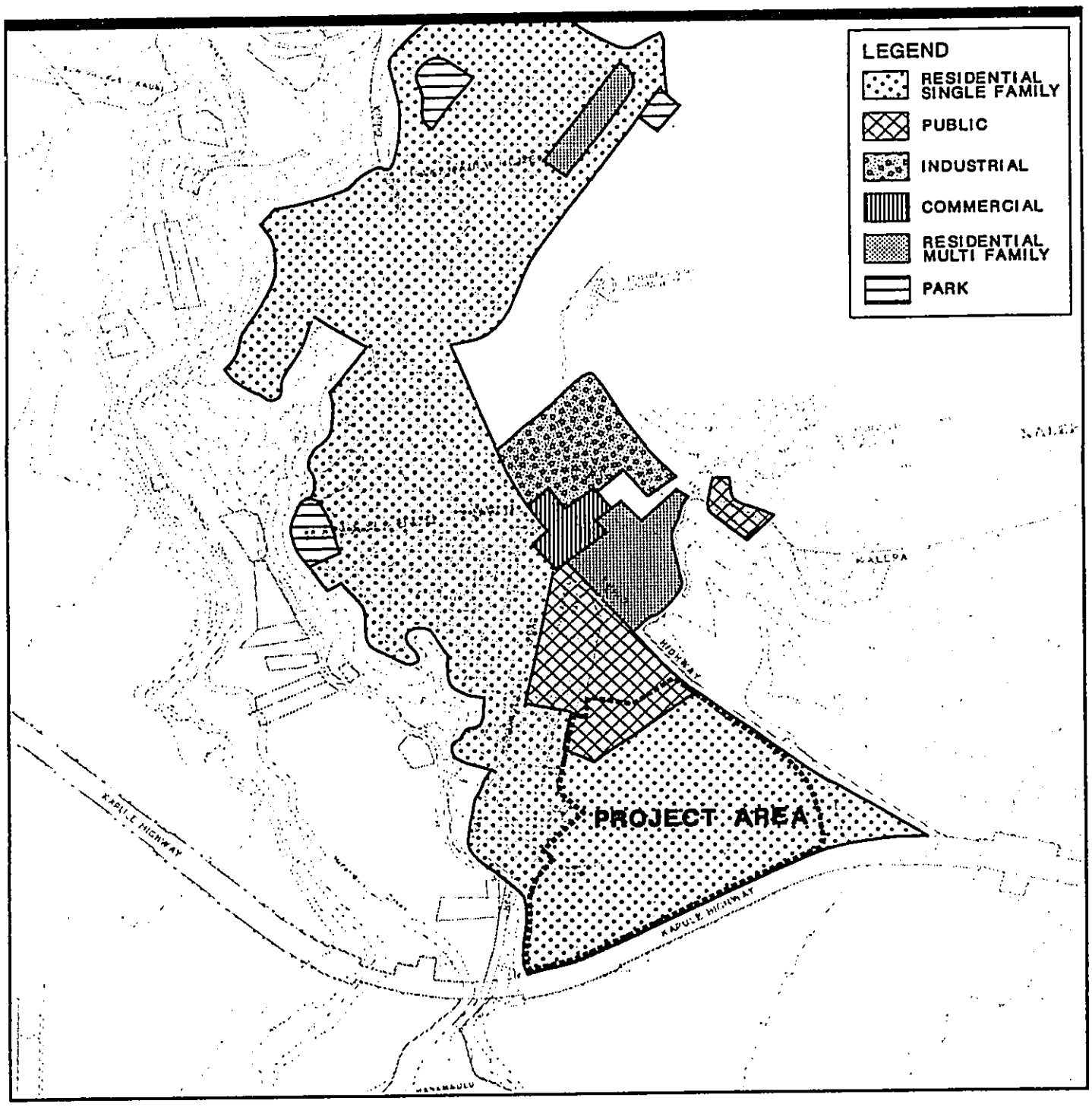


FIGURE 6

LIHUE DEVELOPMENT PLAN DESIGNATIONS

FEET
500 0 1000

Hanamaulu Affordable Housing Project

Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PRI TOWER • 733 BISHOP STREET • SUITE 2590
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 545-2055

Chapter IV

ENVIRONMENTAL IMPACT ANALYSIS

ENVIRONMENTAL IMPACT ANALYSIS

4.1 PHYSICAL GEOGRAPHY/CLIMATE

The subject site is on the Kalepa Plain just north of the Hanamaulu Stream and Hanamaulu community. The site ranges in elevation from approximately 80 to 150 feet above sea level. The property slopes to the northeast at approximately 2% to 3%, and is extremely flat with no distinguishing characteristics. The entire site was under sugarcane cultivation, but has been fallow for approximately one year.

4.2 SOILS AND AGRICULTURAL POTENTIAL

4.2.1 Existing Conditions

According to the U.S. Department of Agriculture Soil Conservation Service (SCS), soils in the project area consist of Lihue Silty clays (LhB). These soils are characterized by moderately rapid permeability, slow runoff, and slight erosion hazard. Engineering interpretations for this soil type indicate no unusual conditions that would affect construction. However, shrink-swell potential is indicated as moderate.

There exist three soil suitability studies for Hawaii which describe the physical attributes of land and the relative productivity of different land types. These are: Soil Conservation Service Soil Survey, Detailed Land Classification, and Agricultural Lands of Importance to the State of Hawaii.

Soil Conservation Service (SCS) Soil Survey SCS soil capability classifications are based on soil profile, topography, water holding capacity, drainage, erosion hazard, pH, workability, and depth of root penetration. The SCS soil capability classifications range from I to VIII, with I representing the best. Class I soils have no more than minimal limitations that restrict crop production. Class II soils have moderate limitations. Class III soils are marginal and Classes IV to VIII soils are unsuitable for crop production, with Class VIII having the most severe limitations.

The SCS classifies the Lihue silty clay in Sugarcane Group 1, indicating that this soils type is in the grouping most suitable for sugarcane production. The soils capability group is Subclass IIe. This indicates the soils are subject to moderate erosion if they are cultivated and not protected. Soils are 30" to more than 60" deep and have slopes of 0% to 8%.

Detailed Land Classification The Land Study Bureau (LSB) classifies soils by land type in which classifications are provided for an overall crop productivity rating, with and without irrigation, and for selected crop productivity ratings for seven crops. LSB overall ratings range from A to E, with A being the best.

The detailed land classification done by the Land Study Bureau for the island of Kauai in 1967 designates the project area as B41i; B indicating a productivity rating of B (second highest on scale); 41 indicating the soil type, Lihue silty clay; and i indicating it is irrigated.

Agricultural Lands of Importance to the State of Hawaii (ALISH) The ALISH system consists of the mapped identification of three broad classes of agricultural

land, which is based, in part, on the criteria established by the SCS. The category, "Prime Agricultural Land", is defined as "...land best suited for the production of food, feed, forage, and fiber crops. This class of land has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed (including water management) according to modern farming methods. Prime agricultural land gives the highest yields with lowest inputs of energy or money and with the least damage to the environment." The two other classes of ALISH are "Unique Agricultural Land" and "Other Important Agricultural Land". Both describe successively less productive soils.

The State Department of Agriculture classifies the entire project area as Prime Agricultural Land.

4.2.2 Probable Impacts

Development of residential units at the site would remove approximately 60 acres of agriculture land from sugarcane production. The impacts of the project on soils alone consist of two elements: erosion and indefinite loss of land for agricultural use. Erosion would result from changes in topography, drainage patterns and vegetative cover due to land clearing and construction.

The site constitutes less than one percent of Lihue Plantation's total acreage in cane production, estimated at 12,000 acres, and thus, will have a negligible impact on the number of jobs affected by the reduction of land available for agricultural use. Furthermore, Lihue Plantation is currently understaffed by approximately 10 percent, employing 500 persons but requiring an additional 50. The company is also having difficulty replacing its retirees due to Kauai's labor shortage. According to Lihue Plantation, the development of affordable housing will have a positive effect on its labor force; the island's lack of affordable housing is a factor contributing to the company's labor shortage (Telephone communication, James Shinno, Lihue Plantation Operations).

Development of the project site for housing would eliminate any conflict in the adjacent land uses of sugarcane farming operations and school and residential neighborhood. The continuation of sugarcane cultivation may pose a hazard to traffic traveling on the Kapule Highway during its harvesting activities which include the burning of canefields.

Although the proposed project would remove the subject parcel from sugarcane production, it would not adversely impact overall statewide or islandwide production levels. Likewise, because the parcel constitutes a very small percentage of Lihue Plantation's cultivated lands, and the conversion of the land from agricultural production to urban usage would not result in a reduction in plantation staffing.

4.2.3 Mitigation Measures

During the construction phase, soil erosion may be mitigated through frequent watering of unpaved roads and areas of exposed soil. After construction is completed and vegetative cover has been replaced through landscaping, the level of erosion will decrease.

4.3 NATURAL HAZARDS

The project site is not potentially susceptible to earthquake or flooding. The island of Kauai is classified as Zone 0, indicating minimal risk, on the Seismic Risk Map of the U.S. for the purpose of structural design. The classification system is based on a scale of Zones 0 to 4, with Zone 4 areas having the highest seismic occurrence and danger. All structures constructed on the site will be built in conformance with the County Building Code applicable to Zone 0.

According to the Flood Insurance Rate Map of Kauai County (published by the Federal Emergency Management Agency, Revised 3/4/87), the entire project site lies within Zone X, an area determined to be outside the 500 year flood plain. The lowest elevation of the project site is 80 feet above sea level, above the tsunami inundation line (Telephone communication, Clifford Ikeda, Operations Officer, Kauai Civil Defense Agency).

4.4 FLORA

A botanical assessment of the site was conducted on 9 December 1989 by Char and Associates, botanical and environmental consultants. The full Botanical Assessment Report is attached as Appendix A, and a summary of its findings is presented below.

4.4.1 Existing Conditions

The project site has been in sugarcane cultivation for an extended period of time, although at the time of the survey, recently harvested and not planned for replanting. The fallow fields support scattered patches of weedy species and resprouted plants of sugarcane. Along the irrigation ditches crossing the fields, weedy grass and herb association, scattered shrubs, and small trees, and cultivated vegetable plants were found. A narrow strip of border vegetation is found where the site borders Kuhio Highway and Kapule Highway, consisting of various shrubs, grasses, and planted trees.

Because the site has been actively cultivated for such a long period of time, no sensitive plant communities or rare native plant species occur on the site. No officially listed threatened or endangered plants protected by federal and/or state laws were found on the site; nor were any plants proposed or candidate for such status found (U.S. Fish and Wildlife Service 1985; Herbst 1987).

Only three species considered indigenous were inventoried. These were the 'uhaloa (Waltheria indica), beach pea or mohihihi (Vigna marina), and yellow wood sorrel or 'ihi (Oxalis corniculata). These three native species occur throughout the Hawaiian Islands in similar environmental habitats.

4.4.2 Probable Impacts

The loss of sugarcane at the site will be the major impact on the area's botanical inventory as a result of residential development. There is presently very little of botanical interest or concern on the site due to its disturbance by an extended period of agricultural activities. The proposed development is not expected to have a significant negative impact on the island-wide populations of the species involved. There is no reason to impose any botanical impediment to the development of the site.

4.4.3 Mitigation Measures

Since the project will have a negligible negative impact on island-wide populations of flora removed from the site, no mitigation measures are required.

4.5 FAUNA

A field survey of avifauna and feral mammals at the project site was conducted on 28-29 December 1989. The full Field Survey is attached as Appendix B, and a summary of its findings is presented below.

4.5.1 Existing Conditions

One species of migratory indigenous birds, the Pacific Golden Plover, was recorded during the field survey. Twelve species of exotic birds were recorded during the field survey: Ring-necked Pheasant, Cattle Egret, Spotted Dove, Zebra Dove, Common Myna, Western Meadowlark, Northern Cardinal, Japanese White-eye, Nutmeg Mannikin, Chestnut Mannikin, House Finch, and House Sparrow. The Short-eared Owl, Ruddy Turnstone, Black-crowned Night Heron, Common Barn Owl, and Red-crested Cardinal may occasionally be found on the site.

No evidence of rats or mice were found on the site, but these ubiquitous mammals undoubtedly occur on or near the property. The endemic and endangered Hawaiian Hoary Bat is fairly common on Kauai, although none were observed on the site.

The property provides a limited range of habitats which are utilized by the typical array of exotic species of birds one would expect at this elevation and in this type of environment in Kauai.

4.5.2 Probable Impacts

The Pacific Golden Plover, the only native bird recorded on the property, prefers open areas such as mud flats, fields, and lawns. If parks or other sizeable lawn areas are included in the development, plover may become more abundant at the site.

The proposed development will result in a more diversified range of habitats. Common Myna, Northern Cardinal, Japanese White-eye, House Finch, and House Sparrow should all become more abundant.

The change in land use of this property should have no measurable impact on the fauna of Kauai.

4.5.3 Mitigation Measures

No mitigation measures are warranted since the development will have negligible impact on Kauai's fauna.

4.6 ARCHAEOLOGICAL AND HISTORICAL RESOURCES

Paul H. Rosendahl, Ph.D., Inc. conducted a variable-coverage surface and limited subsurface archaeological inventory survey of the property on December 20, 1989.

The purpose of the survey was to identify all sites and features of potential archaeological significance present within the project site. The survey report is attached as Appendix C and is summarized below.

4.6.1 Existing Conditions

During the surface survey, no significant archaeological remains of any kind were encountered. The only cultural remains encountered were several small isolated coral pebbles. The report concluded that within the project area, human settlement was probably very limited if it took place at all. The lack of cultural remains, however, could also be due to the land modification (including sugarcane cultivation) that has taken place in the project area. Such extensive modification would normally preclude the possibility of finding any subsurface cultural deposits.

4.6.2 Probable Impacts

No impacts to archaeological or historical resources are expected as a result of the project, and no further archaeological work is recommended. In the event that any previously unidentified sites or remains are encountered during the course of future archaeological investigations or subsequent development activities, archaeological consultation should be sought immediately.

4.7 VISUAL RESOURCES

4.7.1 Existing Conditions

The present visual character of the project site can be described as flat, open, and covered with sugarcane and uncultivated vegetation. From the site, northern views are of sugarcane fields, a low-rise resort development, and the ocean. Westerly views are of the Kalepa Hills, which serve as a visual backdrop for the site when viewed from the east. Easterly views are of cultivated sugarcane fields and the ocean beyond, while southern views primarily include the Hanamaulu Elementary School (under construction) and the existing single family residential development.

4.7.2 Probable Impacts

The development of the site will change its visual character from its present agricultural appearance to a heavily landscaped residential development. Views of the sugarcane fields and ocean from Kuhio Highway will be inhibited along the site's western boundary. Some northern views of the sugarcane fields and ocean may be lost from the existing residential development along the site's southern boundary.

4.7.3 Mitigation Measures

Bermed, appropriately landscaped buffers or walls can be established on both sides of the development adjacent to Kuhio Highway and Kapule Highway to mask the proposed subdivision, as well as act as a sound barrier to block traffic noises from reaching the housing areas.

4.8 TRANSPORTATION/CIRCULATION

A traffic impact analysis report on the proposed Hanamaulu affordable housing project was prepared by Kaku Associates (March 1990), and is included as Appendix D. The findings of the report are summarized below.

Traffic flow conditions are described in Level of Service (LOS), a qualitative measure ranging from completely uncongested conditions at LOS A to overloaded conditions at LOS F. Peak hour LOS is typically based on the analysis of intersections, since it is at these points that conflict flows of traffic interact.

4.8.1 Existing Conditions

Estimated traffic volumes for 1989 along Kapule Highway and Kuhio Highway are shown in Figure 7. As shown, Kapule Highway carries a slightly higher traffic volume than Kuhio Highway south of their intersection. Kuhio Highway carries approximately 26,900 vehicles per day (vpd) north of the intersection. Traffic volumes in the area exhibit peaks during the morning (7:00-8:00 a.m.) and afternoon (4:00-5:00 p.m.) periods, with the afternoon peak showing the highest volumes of the day. As shown in Figure 7, morning traffic volumes are heavier in the Lihue-bound direction, with afternoon volumes heavier in the reverse direction.

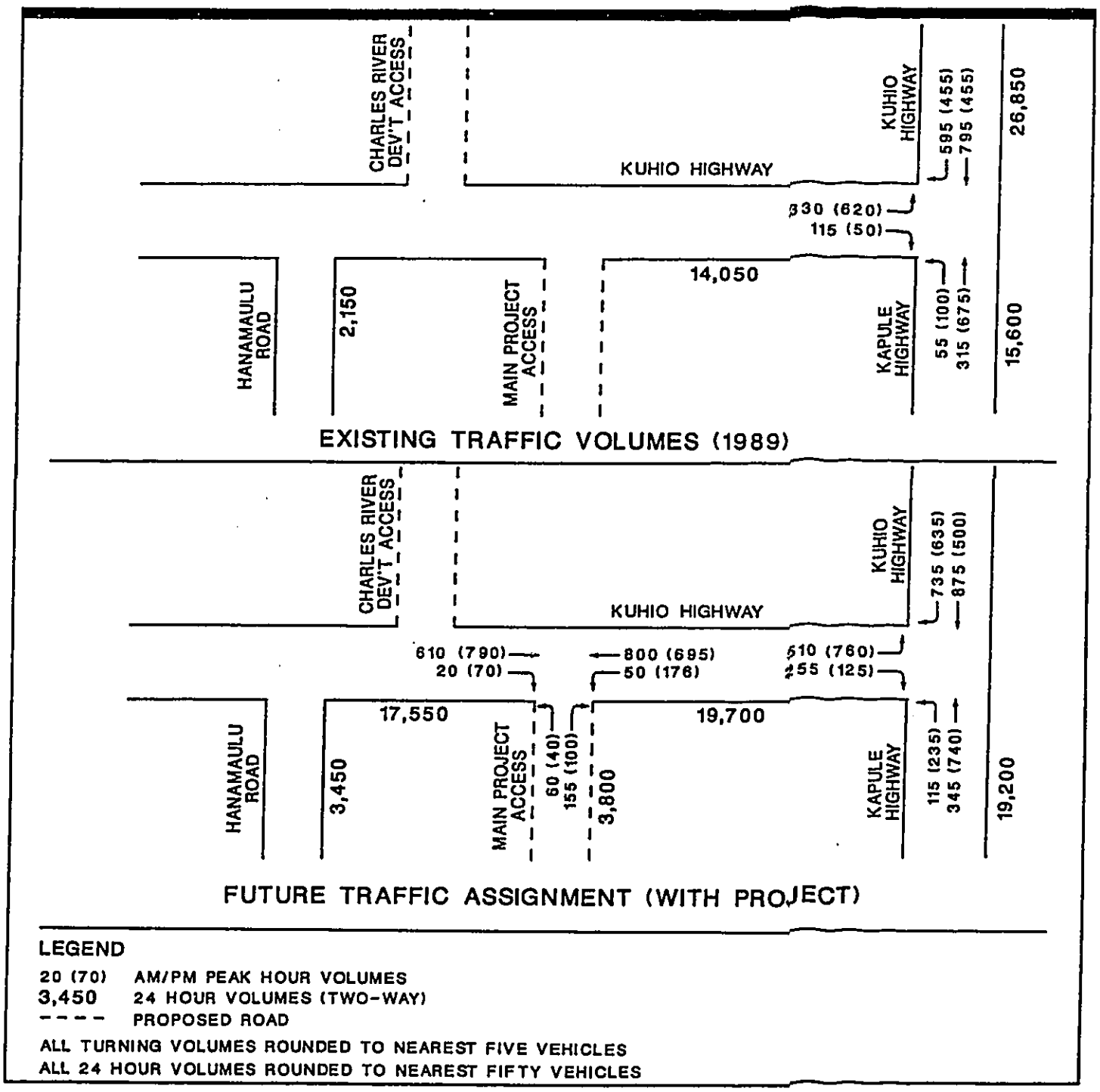
Current operating conditions at the intersection of Kuhio Highway and Kapule Highway during peak hours were found to be at LOS C (good to fair operation), with the PM peak hour LOS D somewhat poorer due to the higher volume of conflicting traffic.

4.8.2 Probable Impacts

The affordable housing project will have a minor impact on the traffic conditions of the area, although the same conditions (LOS E during peak hours) would be reached in the future without the project.

The study assigned project traffic to the surrounding street network according to proposed project traffic volumes. Regional traffic growth, accounting for increases in traffic due to developments outside the study area were analyzed and projected. Also included in the evaluation were cumulative traffic generation estimates for two other developments planned in the project vicinity which were determined to potentially affect traffic demands at the intersections analyzed. These projects were the Hanamaulu Elementary School (adjacent to the project site) and the Charles River Development (access located across Kuhio Highway from Hanamaulu Elementary School). Figure 7 illustrates the future (1993) traffic conditions resulting from project-related traffic along with traffic increases from regional traffic growth and cumulative projects traffic. The figure shows that east of the main project access at Kuhio Highway, the combination of all developments and regional growth will increase traffic volumes on Kuhio Highway substantially from existing conditions, to approximately 19,700 vpd.

The study analyzed two intersections for peak hour LOS with and without the project-related traffic: Kuhio Highway/Kapule Highway (signalized), and Main Access/Kuhio Highway (unsignalized). Without the project, operations at the Kuhio/Kapule intersection will deteriorate substantially from existing conditions, with LOS E (near capacity) conditions expected during both AM and PM peak hours. With the proposed project, operations at Kuhio/Kapule will also be at LOS E during



LEGEND

20 (70) AM/PM PEAK HOUR VOLUMES
3,450 24 HOUR VOLUMES (TWO-WAY)
- - - - PROPOSED ROAD

ALL TURNING VOLUMES ROUNDED TO NEAREST FIVE VEHICLES
ALL 24 HOUR VOLUMES ROUNDED TO NEAREST FIFTY VEHICLES

FIGURE 7

EXISTING AND FUTURE (1993) TRAFFIC VOLUMES

Hanamaulu Affordable Housing Project
Hanamaulu, Kauai Amfac/JMB Hawaii, Inc.

NOT TO SCALE

HELBER, HASTERT & KIMURA PLANNERS
GROSVENOR CENTER • PII TOWER • 733 BISHOP STREET • SUITE 2590
HONOLULU, HAWAII 96813 • TELEPHONE: (808) 545-2055

both peak periods. This resulting adverse condition warrants investigation into possible mitigation measures, the specifics of which are discussed below. At the Main Access drive on Kuhio Highway, the left turn out of the site is expected to show the worst Level of Service, E. All other movements will flow acceptably at LOS C or better during both peak hours.

The volumes expected at the Main Access are sufficiently high to warrant installation of a left turn lane and right turn deceleration taper on Kuhio Highway. Without these lanes, turning movements of project-related traffic could cause substantial delays to through traffic on Kuhio Highway.

Traffic volumes were also estimated under the assumption of a second point of access onto Kuhio Highway, to be located between the Main Access and Kapule Highway intersections. The study found that only turning volumes at the Main Access would be affected by the addition of an access point, and that through volumes would be increased. Because projected traffic capacities do not warrant an additional access point, and because the increased through traffic spread out by multiple access points is a contributing factor to poor levels of service on highways, the study recommended limiting project access onto Kuhio Highway to a single collector street.

4.8.3 Mitigation Measures

As the only arterial street serving the corridor, Kuhio Highway already exhibits traffic volumes at capacity for a two-lane road, and traffic demand along this corridor will continue to increase irrespective of the proposed project, to LOS E. It is therefore highly likely that improvement of the Kuhio/Kapule intersection will be justified even if the project site is not developed. Capacity constraints in the area are endemic to the Lihue-to-Kapaa corridor, and would be most efficiently approached by a regional solution. As such, mitigation measures addressing the traffic conditions at the Kuhio/Kapule intersection would constitute a public benefit and be best undertaken by the State Department of Transportation.

Mitigation measures include the provision of at least two street connections with Hanamaulu Road southwest of the site, and a traffic signal installed at the Kuhio Highway/Hanamaulu Road intersection. This would permit project-related traffic to use the protection of that signal to make the left turn onto Kuhio Highway. Since difficulty in making this movement from the proposed access onto Kuhio Highway is only expected during peak periods, the additional traffic will not overload the local streets abutting Hanamaulu Road. However, providing at least two street connections between the proposed project and the existing subdivision will ensure spreading of this traffic volume among the available streets.

Due to the projected high traffic volumes on Kuhio Highway, both Kuhio Highway intersections, at the proposed project access and at Hanamaulu Road, are expected to satisfy peak hour warrants for signalization, as specified in the Manual on Uniform Traffic Control Devices for Streets and Highways, Federal Highway Administration, 1988. Signalization of the Kuhio Highway at Hanamaulu Road is recommended in lieu of signalization at the proposed project access, since it will provide the following benefits:

- Provide protection for pedestrians crossing Kuhio Highway, the numbers of which are likely to increase after completion of the Hanamaulu Elementary School.

- o Reduce traffic delays for vehicles exiting Hanamaulu Road during peak periods.

- o Provide consistent spacing of traffic signals on Kuhio Highway, to be located at Laukona Street, Hanamaulu Road, and Kapule Highway. Consistent spacing generally permits smoother traffic flow on the major street. Signalization at both the project access and Hanamaulu Road would cause unjustified delays to through traffic on Kuhio Highway.

- o Increase platooning (grouping) of traffic moving on Kuhio Highway past the proposed project access. Platooning of major street traffic increases the frequency and size of gaps in this flow, and makes it easier for traffic to enter the flow from side streets.

Adequate levels of service will be maintained with provision of a westbound left turn storage lane on Kuhio Highway and right turn deceleration and acceleration tapers at the project access point. Installation of these turn lanes will permit smooth *movement of project-related traffic into and out of the main site access road,* without adversely affecting traffic flow on Kuhio Highway.

As discussed in the previous section, completion of the proposed project combined with traffic increases due to other developments and growth will result in peak hour Level of Service E, near LOS F, at the Kuhio/Kapule intersection. The maximum benefit would be realized by combining improvement of this intersection with the continuous widening of Kuhio Highway to four lanes from Kapule Highway north to Wailua/Kapaa. However, if the Kuhio Highway widening project cannot be completed in a timely manner, it may still be worthwhile to improve the Kuhio/Kapule intersection in the interim.

Acceptable operation at the Kuhio/Kapule intersection would be maintained by installation of a second eastbound lane (to be a shared left-right turn lane approaching the intersection) and a second northbound through lane at the Kuhio Highway/Kapule Highway intersection (see Appendix D). With these additional lanes, LOS C can be maintained during both peak hours. If this improvement precedes widening of Kuhio Highway, northbound traffic will be required to merge into a single north of the intersection. However, merging movements do not strain traffic capacity nearly as much as intersections, and overall traffic operations will still be significantly improved.

4.9 LAND USE

The desire to preserve agricultural land uses and the need for urban expansion sometimes create inevitable conflicts in land use. Given the finite amount of existing land, the issue becomes one of deciding which areas can be urbanized with the least threat to overall agricultural viability.

4.9.1 Existing Conditions

The entire project site was until recently under continuous sugarcane cultivation, with the exception of the future Hanamaulu School site in the far southwest section of the parcel (currently under construction).

4.9.1 Probable Impacts

The proposed 450 units of affordable housing will convert approximately 60 acres of land from sugarcane production to urban residential use. Thirty acres of this area is already zoned in the Urban classification with an R-6 zoning. The remaining 30 acres of agricultural land use will be replaced with urban usage. However, the loss represents less than one percent of the Lihue Plantation's total acreage, and according to Plantation officials, will not adversely affect operations. Future cultivation of the subject parcel could result in operational inefficiencies, since the site is separated from the surrounding fields by two major highways.

4.9.3 Mitigation Measures

No land use-related mitigation measures are needed, as the development will not adversely impact Lihue Plantation's operations. In addition, the development is consistent with public plans and policies for the area.

The need for affordable housing in the Lihue and Hanamaulu areas has been identified by the County as a high priority. The Hanamaulu area in general and the project site in particular is identified in the 1976 Lihue Development Plan as a future residential area to help meet this need. As such, the affordable housing development is consistent with the County's long-range land use plan for the area.

4.10 AIR QUALITY

An air quality impact report was conducted by J.W. Morrow (January 1990), and is attached as Appendix E. The findings of the report are summarized below.

4.10.1 Existing Conditions

Sampling done at the State Department of Health monitoring sites at Lihue indicate that both state and federal air quality standards for the monitored pollutants appear to be met. Carbon dioxide levels observed during additional air sampling conducted at the Kuhio Highway - Kapule Highway intersection in January 1990 also met both federal and state standards, although at some receptors, the state standard seems to be threatened.

4.10.2 Probable Impacts

Short-term Impacts The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along Kuhio and Kapule Highways as well as in the vicinity of the project site itself. The site preparation and earth moving will create particulate emissions as will building and on-site road construction. U.S. Environmental Protection Agency (EPA) studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and a precipitation/evaporation (P/E) index of 50. Since on-site soils are primarily Lihue silty clays which are likely to have a silt content substantially greater than 30%, there is a greater potential for fugitive dust emission than offered in the EPA example.

There will also be off-site impacts due to the operation of concrete and asphalt concrete batching plants needed for construction. It is not possible, at this stage, to identify the specific facilities that will be providing these materials, although based on the operations of a typical concrete batching plant, it appears that federal standards of particulate matter would be met.

Mobile Source Impact In 1993, carbon monoxide levels in the vicinity of the proposed main project access road are expected to increase substantially but remain below the stringent state standard. At the Kuhio - Kapule Highway intersection, however, the additional traffic generated by the project results in exceedance of state and federal standards at the same receptors which were high in 1990.

Electrical Generation Impact The estimated annual electrical load of 3.2 million kilowatt-hours will contribute to the demand on the local utility, necessitating additional fuel combustion. The Kauai Electric Company provides power for Kauai from several oil and diesel-fired facilities. Emissions from these facilities would eventually increase as a result of demands from this project and others.

4.10.3 Mitigation Measures

Short-term Impacts Since there is some potential for fugitive dust due to the fine soils, adequate dust control measures should be employed during the construction period. These measures include frequent watering of unpaved roads and areas of exposed soil, as well as the earliest possible landscaping of completed areas.

Mobile Source Impacts Although the project will contribute to an increase in automotive emissions in the region, ambient carbon monoxide levels are expected to generally remain in compliance with both state and federal ambient air quality standards. The state's 1- and 8-hour carbon monoxide standards be exceeded only at the "hotspots" close to the Kuhio Highway - Kapule Highway intersection under the worst case conditions of traffic and meteorology. Highway improvements designed to minimize queuing and keep traffic flowing reduce air quality impact in the short-term. In the long-term, as population and traffic grow, alternatives such as bicycles, carpooling and public transit systems could be employed to mitigate traffic impacts on air quality.

Electrical Generation Impact The proposed project will increase electrical demand which in turn will cause more fuel to be burned and more pollutants to be emitted into Kauai's air. Until other nonpolluting means of generating electricity are developed or higher efficiency control technologies are applied, such increases in emissions are inevitable. Emissions can be reduced to some extent by reducing electrical demand by the user through the utilization of solar water heating, heat pumps, and waste heat recovery. Ambient air quality standards, however, are predicted to be met despite the increased emissions.

4.11 NOISE

A noise study for the area was conducted by Y. Ebisu & Associates (January 1990), and is included as Appendix F. The existing and future noise environments in the vicinity of the proposed project were evaluated for their potential impact on existing and future residents. The study determined future traffic noise level increases associated with both project and non-project traffic, and possible impacts from noise resulting from aircraft operations at nearby Lihue Airport and from short term

construction noise at the project site. The study also provides recommendations for minimizing these noise impacts.

The study utilizes two noise descriptors to relate traffic noise levels to land use compatibility and to assess environmental noise in general. These are the Equivalent Noise Level (Leq) and the Day-Night Average Sound Level (Ldn). In traffic noise evaluations, the averaging period for the Leq descriptor is usually one hour, more specifically, the peak hour of traffic. The Federal Housing Administration (FHA), Department of Housing and Urban Development (HUD), and Veterans Administration (VA) exterior noise acceptability level of 65 Ldn or lower is applied nationally, including Hawaii. For aircraft noise, the State Department of Transportation, Airports Division, has recommended that 60 Ldn be used as the common level for determining land use compatibility with respect to noise sensitive uses near its airports. In addition, for those noise sensitive land uses which are exposed to aircraft noise greater than 55 Ldn, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. The study used the most conservative level of 55 Ldn to evaluate potential impacts from aircraft noise over the project site.

4.11.1 *Existing Conditions*

Existing traffic noise levels in the project environs along the Kuhio Highway Right-of-Way were measured at 65 to 75 Ldn. These levels fall within the "Significant Exposure, Normally Unacceptable" category for residential land use, established by the aforementioned government agencies. Setback distances greater than 62 to 87 feet from the centerline of Kuhio Highway is required to reduce traffic noise levels to the "Moderate Exposure, Acceptable" category, of levels less than 65 Ldn. Along the Kapule Highway Right-of-Way, existing traffic noise levels are in the "Moderate Exposure, Acceptable" category, Right-of-Way, with traffic noise levels between 50 to 65 Ldn. The existing Kapule Highway Right-of-Way is approximately 40 to 50 feet wider along the project's boundary line, and will accommodate the addition of future traffic lanes between the Hanamaulu Stream Bridge and the Kuhio Highway intersection. Because of the larger setback distance to the existing highway centerline from the mauka (or west) Right-of-Way, traffic noise levels are approximately 3 to 5 Ldn units lower along the mauka Right-of-Way of Kapule Highway in the vicinity of the project site.

Based on updated estimates of the Lihue Airport aircraft noise contours in the vicinity of the project site, it was concluded that the 60 Ldn aircraft noise contour is located outside but very close to the southeast corner of the project site. The 55 Ldn aircraft noise contour crosses through the project site, probably located just east of the Hanamaulu Elementary School property (see Appendix F).

4.11.2 Probable Impacts

Projections of future traffic noise levels were made using the traffic volume assignments shown in Appendix D (Kaku Associates) for 1993 with and without the proposed project. By 1993 and following complete project build-out, traffic noise levels on Kuhio Highway are predicted to increase by 1.0 dB, which is considered a moderate increase. Along Kuhio Highway and south of the Kapule Highway intersection, traffic noise levels are predicted to increase by 1.0 to 1.4 dB. North of the intersection, traffic noise levels are predicted to increase by 0.4 dB. The predicted increases in traffic noise levels along Kuhio Highway range from insignificant to moderate increases. Table 1 summarizes the predicted increases in

the future setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways servicing the project and attributable to both project plus non-project traffic in 1993. As indicated in the table, the setback distances to the 65 Ldn contour are predicted to range from 77 to 112 feet from the centerlines of Kapule and Kuhio Highways following project build-out in 1993.

The study also indicates that the increases in traffic noise along Kuhio Highway due to project traffic are equal to or less than those due to non-project traffic, and are expected to range between 0.2 to 0.7 Ldn.

Table 1

Existing and 1993 Distances to 60, 65, and 70 Ldn Contours

Street Section	*60 Ldn Setback (FT)* Existing	1993	*65 Ldn Setback (FT)* Existing	1993	*70 Ldn Setback (FT)* Existing	1993
Kapule Hwy. Fronting Project	167	193	77	90	36	42
Kapule Hwy. at Bridge	208	242	97	112	45	52
Kuhio Hwy. at Hanamaulu School	149	173	69	80	32	37
Kuhio Hwy. at Kapule Hwy.	134	165	62	77	29	36
Kuhio Hwy. North of Project	187	200	87	93	40	43

Source: Y. Ebisu & Associates, Noise Study for the Hanamaulu Affordable Housing Project

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) Ldn assumed to be equal to PM Peak Hour Leq plus 0.5 dB along Kapule and Kuhio Highways.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) Soft ground conditions assumed along all roadways.

According to currently available forecasts for aircraft noise over the project site, assuming no significant changes occur in the operational activity and forecasts for Lihue Airport, the project site is expected to remain outside the 60 Ldn aircraft noise contour through the 2005 time period. However, because the existing and forecasted 60 Ldn contours are very close to the southeast corner of the project site (see Appendix F), and because of the difficulty in accurately forecasting future

operations at Lihue Airport, there is some risk that future noise mitigation measures will be required following development of the project if operations increase significantly above the currently available forecasts.

The study also analyzed combined aircraft plus traffic noise contours over the project site boundaries. These contours were developed by combining 1995 aircraft noise contours with 1993 traffic noise contours (see Appendix F). The resulting 65 Ldn contour lines are located within the project site. In order to qualify for FHA/HUD financial assistance on residential developments, sound attenuation measures are normally required if total exterior noise levels exceed 65 Ldn. Whenever the total noise level exceeds 65 Ldn as a result of aircraft plus roadway traffic noise, it is usually more practical to attempt to attenuate the traffic noise component rather than the aircraft noise component so as to reduce the total noise level to the acceptable level. These attenuation measures are discussed in section 4.11.3.

Audible *construction noise will probably* be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing Hanamaulu residences and school southwest and west of the project site. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administration controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

4.11.3 Mitigation Measures

Potential future traffic noise impacts along Kuhio and Kapule Highways can be mitigated by the implementation of noise shielding measures such as increased setbacks, terrain features, highway cuts, man-made obstructions, sound attenuating walls, total enclosure and air conditioning, and the use of sound-attenuating windows.

Based on currently available existing and forecasted aircraft noise contours over the project site, special aircraft noise attenuation measures are not considered mandatory on the project site, the implementation of the airport noise disclosure provisions of Act 208 is recommended over the entire project area because the existing and forecasted 55 Ldn noise contours encompass essentially all of the project area. In the case that aircraft operations at Lihue Airport increase significantly above what is forecasted, possible sound attenuation features which may be built into the project's dwellings include: insulated, double exterior wall construction, heavy roof construction with gypboard ceilings and attic insulation; solid core, wood exterior doors with gasketing; 1/4" thick, laminated, casement or plate glass windows with gasketing; and electrical wiring to accommodate the addition of future central air conditioning units by the owner.

Mitigation of combined traffic and aircraft noise may be achieved by employing the measures addressing traffic noise and aircraft noise mitigation described above. In addition, a third method of sound attenuation is to insure that all rooms of affected dwellings, which face the traffic noise source and marginally (by 1 t 3 Ldn) exceed the FHA/HUD standard due to combined levels of traffic and aircraft noise, have at

least one ventilation opening per room which is restricted to a 90 degree field-of-view toward the traffic source.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 foot distance), and due to the exterior nature of the work. The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu, is another noise mitigation measure which can be applied to this project.

4.12 WATER SUPPLY

4.12.1 Existing Conditions

The Kauai Water Department provides potable water service to the Hanamaulu area from the Lihue town system and water source via 10" and 12" lines.

4.12.2 Probable Impacts

The present potable water source, storage facilities, and pressure are adequate to accommodate the requirements of the affordable housing development, although actual water allocations would be determined at the subdivision stage. Potable water service will be obtained from the existing system and will comply with the requirements of the County Department of Water.

4.12.3 Mitigation Measures

The developer will continue to coordinate its planning with the Department of Water to assure that the water requirements of the proposed project will be satisfied.

4.13 SEWERAGE

4.13.1 Existing Conditions

Sewerage service to the Hanamaulu area is provided by the existing 1.5 MGD design capacity Lihue Wastewater Treatment Plant. The plant presently processes approximately 1.2 MGD of effluent. The treated effluent is currently being accepted by the Westin Kauai Hotel complex for use as irrigation water.

4.13.2 Probable Impacts

Sewage generated at the proposed development will be disposed into and treated at the County sewerage system, with the effluent discharged at the Westin Kauai Complex.

4.13.3 Mitigation Measures

The developer will work closely with the Kauai County Department of Public Works to ensure that the sewerage requirements of the project will be met on a timely basis.

4.14 STORM WATER DRAINAGE

4.14.1 Existing Conditions

Present storm drainage on the site follows the natural drainage pattern which slopes gently toward Kapule Highway and into a silting basin, located near the south boundary of the parcel. The basin is connected to the State DOT Highways drainage system, which empties into Hanamaulu Stream.

4.14.2 Probable Impacts

Storm drainage for Phase I of the development will follow the present drainage pattern, flowing toward Kapule Highway and disposed of via the County drainage system. The Phase II storm water runoff will flow toward the Kauai Hardwoods site, across Kapule Highway to the east. Once the site is reconfigured for residential uses and landscaping is established, siltation and runoff will be less than that produced by sugarcane cultivation. The use of chemicals such as pesticides, herbicides and fertilizers on the site will also decrease with the cessation of sugar operations.

4.14.3 Mitigation Measures

The storm drainage system for the development will be planned and constructed according to County standards.

4.15 SOLID WASTE

4.15.1 Existing Conditions

Solid waste generated at the existing residential development at Hanamaulu is collected by the Kauai County Department of Public Works Refuse Division, and disposed at landfills in Lihue and Kekaha. According to the Department of Public Works, the Lihue landfill will be closed at the end of 1990 due to lease expiration. Lease negotiations are underway to secure additional landfill area at the Kekaha landfill (approximately 30 miles from the project site), which is approaching capacity.

4.15.2 Probable Impacts

The solid waste generated by the proposed project would require an additional refuse collection crew, as the present collection system is operating at capacity. Additional landfill space being negotiated at Kekaha will be sufficient to accommodate the solid waste disposal requirements of the development.

4.15.3 Mitigation Measures

The developer will coordinate closely with the appropriate county agencies to assure that the solid waste disposal requirements resulting from the proposed project will be satisfied.

4.16 ELECTRICAL POWER

4.16.1 Existing Conditions

Kauai Electric Company provides residential electrical service to the project area via overhead power lines located within the Kuhio Highway right-of-way.

4.16.2 Probable Impacts

Kauai Electric Company will provide electrical power to the affordable housing development. The existing electrical system may have to be upgraded to accommodate the new development. The applicant will work closely with Kauai Electric Company in order to find an appropriate on-site location for a substation, if required, as well as to ensure that timely service can be provided. The electrical system within the development will be built to County standards.

4.16.3 Mitigation Measures

Based on the availability of service and anticipated improvements to the system, the proposed project is not expected to have an adverse impact on Kauai's electrical power system.

4.17 TELEPHONE

4.17.1 Existing Conditions

GTE Hawaiian Tel provides telephone service to the project area via overhead lines located within the Kuhio Highway right-of-way. According to GTE Hawaiian Tel, the existing telecommunications distribution system to the Hanamaulu area is overextended due to overcrowding and greater than anticipated demand for services. GTE Hawaiian Tel is in the process of upgrading the present distribution system by locating a multiplexer unit at Rayno Park, adjacent to the project site. This project, scheduled for completion in mid-1990, will meet the present demand for services and pre-position GTE to extend service to future developments (Telephone communication, Gary Heu, Supervising Engineer).

4.17.2 Probable Impacts

The proposed project will be provided with telephone service via underground cables, with probable connection to the GTE Hawaiian Tel system at Kuhio Highway. The current multiplexer upgrading project will enable GTE Hawaiian Tel to accommodate future demand for telephone service created by the Hanamaulu residential development.

4.17.3 Mitigation Measures

Based on the availability of service and the current GTE Hawaiian Tel multiplexer project, the proposed project is not expected to have an adverse impact on Kauai's telecommunications system. Therefore, no mitigation measures are warranted on the part of the developer.

4.18 POLICE PROTECTION

4.18.1 Existing Conditions

The Lihue Police Station, approximately two miles from the project site, provides police services for the Hanamaulu area. The district served by the police station extends from Kealia to the north, to the Maluhia Junction, near Koloa, to the south. The district is divided into four beats, with one officer patrolling each beat per watch (three watches/day). The present system is adequately serving the community, and there are no plans at present to upgrade the system, although response time to calls has been increasing.

4.18.2 Probable Impacts

According to Chief Calvin Fujita, Kauai Police Department, one police officer is usually required for every 400 occupants. Thus, the proposed project may have an impact on the numbers of patrol officers required by the station, although depending on the location of the pent-up demand, the overall population of the Lihue area may not change significantly. Since subdivision developments are generally accompanied by an increase in the incidence of burglary, an increased demand for investigative services may also ensue.

4.18.3 Mitigation Measures

The developer will work with the appropriate county agencies to ensure that police services will be sufficient to meet the needs of the project population.

4.19 FIRE PROTECTION

4.19.1 Existing Conditions

Fire protection services for the Hanamaulu area are provided by the Lihue Fire Station in downtown Lihue, approximately two miles from the site, and the Kapaa Fire Station, approximately six miles from the site. The Lihue Fire Company would respond to a call in Hanamaulu in approximately five minutes with minimum traffic, and an additional one to two minutes if traffic is heavy. The Kapaa Fire Company has a response time of about eight minutes, with light traffic. The Lihue Station has a 1982 1,250 gallon per minute (GPM) pumper truck, a 1975 rescue truck, and a spare 1969 1,250 GPM pumper truck. The Kapaa Station has a 1987 1,250 GPM pumper truck and a 1974 mini pumper truck. There are seven fire fighters assigned to a shift at the Lihue Station and five fire fighters per shift at the Kapaa Station. In the case of a structural fire, 13 fire fighters would respond to the call. One truck would respond to a medical emergency.

4.19.2 Probable Impacts

According to the Fire Department, the existing fire protection services in the Lihue and Kapaa areas are presently operating near capacity, and the development of 450 units of housing on the subject site would strain these services by reducing the effectiveness of the fire stations in responding to calls (Telephone Communication, Capt. William Enoka). The addition of a fully-manned fire station serving Lihue and Kapaa, which augments the existing facilities should be considered with or without the development of the subject parcel. As an alternative to an additional station, the

capacity of the Lihue Fire Station can be enlarged to accommodate additional manpower and equipment.

4.19.3 Mitigation Measures

The developer will coordinate with the county in assuring that the fire protection requirements of the project will be satisfied.

4.20 MEDICAL FACILITIES

4.20.1 Existing Conditions

The Lihue Fire Station co-responds with Emergency Medical Services (a private ambulance service under contract to the State of Hawaii, Department of Health) to medical emergencies in the Hanamaulu area. Emergency hospital services are provided at Wilcox Memorial Hospital, less than two miles from the project site.

Wilcox Memorial Hospital is the nearest major medical facility to Hanamaulu. It consists of 75 acute care beds and 110 long term care beds. The hospital recently completed a $20 million remodeling/expansion project, which added 30 long term care beds to the facility. Future plans (10-20 years ahead) call for expansion of maternity and emergency room facilities, as well as the eventual addition of more acute care beds, all of which are presently adequate.

The area is also served by Mahelona Memorial Hospital, a State medical facility located in Kapaa, approximately 7 miles from Hanamaulu. Mahelona Hospital contains 65 long term care beds along with a 9 unit (room) acute psychiatric care wing. Presently, the demand for services does not exceed supply.

In addition to the hospital facilities, numerous private medical groups and practitioners are available in the Lihue-Kapaa area.

4.20.2 Probable Impacts

Emergency response service by the Kauai Fire Department is likely to become strained by the addition of 450 residential units in the Hanamaulu area. Although the project would have negligible impact on the present EMS facilities, because of other developments in the planning stages, the Department of Health is closely monitoring the future need for EMS facilities in the Kapaa-Koloa area. Presently, an additional EMS unit for the Kapaa area is programmed for Fiscal Year 92-93, which will accommodate current projected demand for services.

The project will primarily alleviate existing demand on the island, and is not likely to have significant impact on the facilities at Wilcox or Mahelona Hospitals. According to the Director of Marketing and Community Relations for Wilcox Hospital, Scot Roskelley, the project will have a positive effect on the high turnover of hospital staff by increasing the inventory of affordable housing on the island.

4.20.3 Mitigation Measures

The developer will coordinate closely with the State Department of Health and appropriate County agencies in order to assure that the future emergency medical needs of the Hanamaulu area are met.

4.21 HOUSING

The need for affordable housing on Kauai has been a primary concern of the County administration as well as of the State government. In 1987, the Kauai County Housing Agency prepared an assessment report on Kauai's housing needs. This report provided an assessment of the current availability of housing, and then estimated the immediate, short term and medium range needs for additional housing. The study illustrated the tremendous need for affordable housing both at the present and future, as discussed below.

Table 2 shows the existing (1980) household unit and household characteristics for the Lihue planning area, which includes Hanamaulu. The data shown on the table was used as baseline information for the report.

Table 2

1980 Housing Unit and Household Characteristics

	Island of Kauai	Lihue Planning Area
All Housing Units	14,787	2,899
Less Seasonal Homes	284	0
Year Round Housing	14,503	2,899
Single Family Dwellings	11,747	2,028
Multi-Family Dwellings	2,756	871
Occupied Units	11,979	2,570
Homeowner	6,429	1,591
Renter	5,550	979
Vacant Units	2,524	329
For Sale	98	6
For Rent	1,490	70
All Others	936	253
All Households	11,979	2,570
1&2 Person Household	5,227	1,113
3 or More Person Household	6,752	1,457
Mean Household Size	3.22	3.29
Deficient Housing Charac.		
Overcrowding	1,795	379
Incomplete Plumbing	514	146

Source: Kauai County Housing Agency, 1987

In order to project household and population growth, the study utilized baseline population growth estimates done by the State Department of Planning and Economic Development (DPED) (now Department of Business and Economic Development) as well as 1980 census data. Household incomes for 1990 were projected using current data. The purpose of this information was to target the income groups most likely to need housing assistance in the coming decade. Housing deficiencies were identified for the various income groups. According to the study, housing overcrowding was the primary cause of housing deficiency identified in 1980, and it is projected that this problem will worsen by 1990.

The study then estimated the housing "shortfall"; that is, the additional units which will be needed to address the problem of overcrowding. The housing planning goals calculated in the study were as follows:

Table 3

Additional Housing Need
Kauai County

Planning Period	Unit Need Per Planning Pd. Kauai	Lihue Area	Total Unit Need From 1987 thru Planning Period
Immediate 1987-1990	5,928	1,495	5,928
Short Term 1990-1995	4,350	1,500	10,278
Medium Range 1995-2005	4,600	950	14,878

Source: Kauai County Housing Agency, October 1987

In summary, the Housing Agency report predicts that the resident housing inventory will need to almost double in the eighteen years between 1987 and 2005 in order to maintain an adequate supply of housing. The majority of this growth must take place by 1995. Over 5,900 new housing units will be needed island-wide to meet the current housing shortage plus develop for growth to 1990. Of this number, nearly 1,500 are needed in the Lihue planning area alone. Then from 1990 to 1995, an additional 1,500 units will be needed in the Lihue planning area. During the period between 1995 and 2005, it is estimated that 950 units will be required in this area.

Overall, there is a great current and anticipated demand for housing both in the County as a whole and in the Lihue planning area. If this need is not adequately met, the lower income groups are likely to be most adversely affected.

The proposed residential development will provide 450 affordable housing units specifically targeted at current County residents. These 450 units will provide nearly 27 percent of the total 1,500 housing units which the study identified as needed for the short term (1990 to 1995). The Hanamaulu area has been identified in County planning documents (e.g., Lihue Development Plan) as one of the prime areas for new housing.

4.22 SCHOOLS

4.22.1 Existing Conditions

Hanamaulu is served by Wilcox Elementary School, and Kauai High and Intermediate School. The new Hanamaulu Elementary School, now under construction, is scheduled to open in September 1990 for kindergarten through second grade. Depending on enrollment, one or more grades will be added on until grade six is reached.

At present, conditions at Kapaa Elementary School are overcrowded, and Wilcox Elementary is at capacity. Kauai High School and Intermediate is also at capacity. The State of Hawaii, Department of Education (DOE) has programmed construction of a new intermediate school in Kapaa, which will alleviate the conditions at Wilcox Elementary and Kauai High School and Intermediate. It is scheduled to be opened in four years. Furthermore, the DOE is in the process of redistricting the island of Kauai, and the final impacts of the development on the school system should be based on the new delineations.

4.22.2 Probable Impacts

The development of 450 residential units is expected to generate an increase of 100-150 in the K-6 grades, 20-30 in the 7-8 grades, and 35-55 in the 9-12 grades. The Hanamaulu residential development is aimed at relieving pent up demand for housing on Kauai, mainly intra-island relocations, and not at attracting in-migration to the island. Thus, if the occupancy of these 450 units begins 2-4 years from now, as planned, the existing and planned facilities appear to be able to accommodate the increased enrollment.

4.23 RECREATIONAL FACILITIES

4.23.1 Existing Conditions

Existing recreational facilities within a four mile radius of the project site include: Hanamaulu Beach Park, Peter Rayno, Sr. Park, Isenberg Field Park, Lihue County Park, Kalapaki Beach, Nawiliwili Beach Park, Niumalu Beach Park, Wailua Golf Course, Nukolii Beach, Wiliko Park, Lihue Community Park, Lydgate Park, Wailua River State Park, Kauai War Memorial, Vidinha Stadium Complex, Laukona Park, and Kalepa Ridge Trail. Table 4 shows the facilities available at beach parks readily accessible to the project site.

Table 4

Beach Parks in the Hanamaulu Area

	COUNTY FACILITIES	STATE FACILITIES	CAMPING	GRILLS	PARKING	PAVILIONS	RESTROOMS	SANDY BEACH	ROCKY SHORELINE	FISHING	SNORKELING	SURFING	SWIMMING	MAINTAINED	UNIMPROVED
NIUMALU BEACH PARK	●		●	●	●	●	●		●	●				●	
NAWILIWILI PARK		●					●		●	●	●	●	●	●	
KALAPAKI BEACH								●		●	●	●	●	●	
HANAMAULU BEACH PARK	●		●	●	●	●	●	●		●			●	●	
NUKOLII					●			●		●			●	●	
LYDGATE PARK		●	●	●	●	●	●	●	●	●	●	●	●	●	

Source: Planning Department, County of Kauai, Kauai Beach Access Guide

The State Comprehensive Outdoor Recreation Plan (1985) projected a low need for action for inland based recreational resources within the Lihue planning area. A medium need for action for field games, playground activities, tennis, and golf was projected; while pool swimming was rated as having a high need for action over the short-term planning period. A high need for action for picnicking, walking and bicycling; and a medium need for jogging, and motorcycling were projected over the short-term period.

4.23.2 Probable Impacts

Because the proposed project is aimed at relieving existing pent up demand for housing in the Lihue-Kapaa area and not at attracting an influx of new residents to Kauai, the development of 450 residential units at the site will not have significant adverse impact on demand for the area's existing recreational resources.

According to Section 9-2.8 of the Kauai County Code (1987), there is a park and playground land dedication requirement of every subdivider. The area to be dedicated is based on the population density of the proposed subdivision. The total of the estimated existing population of Hanamaulu Town and projected population of the proposed development is calculated at 4,059 persons. According to the land dedication formula provided by the Kauai County Code, the required park land dedication is calculated as 7.10 acres. The three parks within the existing Hanamaulu residential development (Laukona Park, Wiliko Park, and Peter Rayno Park) provide a total of 8.46 acres of land. The project concept proposes the addition of a two-acre park adjacent to the Hanamaulu School site. This addition would increase Hanamaulu's park assets to 10.46 acres of park land. Although the addition

of 450 residential units to the area will increase the requirement for park land, the existing and proposed park assets will more than satisfy County requirements. An analysis of the park requirements and assets follows.

Estimated existing population:	
730 SF units x 3.5 persons/unit (assumed):	2555 persons
46 MF units x 2.1 persons/unit (assumed):	97 persons
Total existing population:	2,652 persons
Projected population	
330 SF units x 3.5 persons/unit:	1155 persons
120 MF units x 2.1 persons/unit:	252 persons
Total projected population	1407 persons
Total existing and projected population	**4,059 persons**
Park dedication requirement:	
0.00175 acres/person x 4,059 persons = 7.10 acres	
Existing park assets:	
Laukona Park	2.59 acres
Wiliko Park	2.28 acres
Peter Rayno Park	3.59 acres
Total existing park assets	8.46 acres
New proposed park	2.0 acres
Total park assets (existing and proposed)	10.46 acres

Net park dedication requirement:

Existing and proposed park assets	10.46 acres
Total park dedication requirement	-7.10 acres
Net Surplus	3.36 acres

As seen in the analysis above, existing park assets in the Hanamaulu area (8.46 acres) exceed the park dedication requirement for the proposed development (7.10 acres), for a surplus of 1.36 acres. With the addition of the proposed 2-acre park, the surplus of existing and proposed park assets increases to 3.36 acres.

4.24 SOCIOECONOMIC

Population The County of Kauai has experienced tremendous population growth in the last few years. According to First Hawaiian Bank's Research Department, the population on Kauai increased by 3 percent in 1988 alone, to 49,300 persons. This growth rate was twice as fast as the State's overall growth rate for that same period. The current population represents a 27 percent increase from the 1980 population of 38,856.

According to figures from the 1980 census, Hanamaulu had a total of 3,227 residents. (The largest towns on Kauai are Kapaa with 4,467 residents and Lihue with 4,000 residents.)

Projections through the beginning of 1992 indicate the County's population is likely to continue increasing at a greater percentage than the rest of the State. The State of Hawaii Department of Business and Economic Analysis (DBED) has forecast a population of 55,100 by the end of 1991. The U.S. Department of Housing and Urban Development (HUD) has projected a similar increase of about 55,200 by 1992. This HUD estimate represents an annual percentage increase of 1,500 persons, or 2.9 percent. This compares to the State's growth estimate of 2.0 percent.

The ethnic makeup of the County's population showed the following percentages in 1985: Japanese, 20.0%; Filipino, 22.8%; Caucasian, 21.1%; Hawaiian and part-Hawaiian, 23.0%; mixed (except part-Hawaiian), 11.0%; and other, 2.1%.

The approximately 450 residential units proposed at Hanamaulu is not expected to result in a significant net increase to the County's population. The affordable housing is primarily targeted at current County residents, although many of these current residents may presently be residing outside of Lihue/Hanamaulu. Therefore, the development is likely to increase the Hanamaulu area population.

Employment In 1988 Kauai experienced a nine percent increase in jobs, the greatest growth rate in the State. Through the third quarter of 1989 (January through September), the job count on Kauai increased by another five percent to 25,500 positions. During this period, the civilian labor force grew by three percent, and the unemployment rate declined to 3.3 percent. The low unemployment rate has made it difficult for some employers to find needed employees. Table 5 shows the overall characteristics of Kauai County's labor force.

Table 5

Labor Force Characteristics
Kauai County
1987-1989

	1987	1988	Jan-Sept 1989	% change (Jan-Sept) 1989/1988	% change (Annual) 1988/1987
Resident Pop.	47,900	49,300	n/a	n/a	2.9
Civilian Labor Force	25,000	26,200	26,900	2.9	4.8
Employment	23,850	25,250	26,000	3.4	5.9
Unemployment	1,150	950	900	-10.0	-17.4
Unemployment Rate	4.6%	3.7%	3.3%	-13.2	-19.6
Total Job Count*	22,450	24,450	25,500	5.2	8.9

---
*Refers to number of jobs rather than persons employed.
Source: First Hawaiian Bank Research Dept. 1989

Construction of the project is likely to have a short term impact on direct construction employment in the County. As shown in Table 6, it is estimated that the development of the estimated 450 residential units at Hanamaulu will generate approximately 98 FTE construction jobs.

Table 6

Construction Phase Employment

Construction Costs	$10,000,000/year	(1)
Average Cost per Worker	$101,960/worker/year	(2)
Direct Construction Jobs (Construction Costs divided by cost per worker)	98 jobs	(3)

Notes:

(1) Based on a total five-year construction cost estimate of $50 million by Amfac/JMB Hawaii, Inc.: $50 million/5 years = $10 million/year.

(2) Based on State of Hawaii Department of Business and Economic Development statewide construction jobcount and general excise tax base for contracting (Jan. - Sept. 1989). This figure reflects the value of output produced by one full-time construction worker over one year.

(3) This estimate is derived from gross multipliers related to total construction expenditures and jobs. Thus, the employment generated by a specific type of construction (e.g. affordable housing) may vary from this estimate.

Chapter V

ALTERNATIVES TO PROPOSED ACTION

ALTERNATIVES TO PROPOSED ACTION

Chapter 200 of Title 11, Environmental Impact Statement Rules, requires a discussion of "any known alternatives...which could feasibly attain the objectives of the action." The rules further specify that the alternatives be explored and evaluated in light of enhancement to the environmental quality of the avoidance or reduction of adverse environmental effects.

5.1 No Action Alternative

The "no action" alternative would result in the preservation of the site in its current agricultural state for the time being. However, given that the Phase I area is currently designated for urban/residential use, and given that it is contiguous to existing single family development, the Phase I portion of the site would most likely be developed in the near future.

Advantages: The primary advantages of the no action alternative would be that no further expenditures of resources would be required by the developer, and that sugarcane cultivation could continue on the site. Also, vehicular traffic in the area will not be increased because of the project.

Disadvantages: The no action alternative would do nothing to alleviate the critical shortage of affordable housing in the Hanamaulu and surrounding areas. This would be contrary to the objectives of the State Plan and State Housing Functional Plan.

Although the site would remain in agriculture, its proximity to existing residential uses and the fact that it is non-contiguous to the surrounding cane fields (i.e., separated by Kuhio Highway and Kapule Highway) creates a less than ideal environment for agriculture operations.

5.2 Limit Development to the Phase I Area

One alternative to "no action" is to develop only the "Phase I" portion of the site; that is, the portion of the site already in the urban district and zoned for residential development.

Advantages: The advantages to this alternative is that it would still provide 225 units of affordable housing, while retaining agriculture operations on the Phase II area. The reduced scope of this project would also minimize traffic impacts resulting from the development.

Disadvantages: This alternative is contrary to sound land use planning practices, as the Phase II parcel is contiguous to the Phase I parcel. Continued agricultural operations on the Phase II site would cause adverse impacts to the adjacent Phase I residents in terms of dust, noise, rodents etc. In addition, as stated earlier, the Phase II site is separated from surrounding agricultural fields by Kuhio Highway and Kapule Highway. This currently causes logistical and operational difficulties which will still exist.

5.3 Alternative Land Uses

An option to both the project as proposed and the "no action" alternative is to use the site for uses other than housing or sugarcane cultivation. Potential land uses include other types of agriculture, commercial, light industry, or resort.

Advantages: The primary advantage of this alternative is that it could result in potentially profitable activities which would create additional long term employment as well as increase the State and County tax base.

Disadvantages: Although alternative land uses create the potential for job creation and generation of public revenues, both the State and County administrations have expressed that the need for affordable housing is an overriding priority for Kauai. None of the alternative land uses would help alleviate the need for affordable housing.

Alternative agricultural uses have questionable marketability and profitability. Light industrial uses may be incompatible with the nearby residences. The feasibility of a large-scale commercial center in Hanamaulu is unknown at this time. In addition, a large commercial development on the site is likely to cause severe traffic impacts in the area.

5.4 Analysis and Conclusion

Four alternatives to the proposed development were considered here. The "no action" alternative would preserve the existing agricultural use of the site. However, there is no guarantee that the Phase I portion of the site, currently designated for residential development, would not be developed sometime in the future. Also, this alternative fails to meet the stated objectives of the development, to increase the inventory of affordable housing.

The alternative limiting development to Phase I would still provide 225 units of affordable housing while retaining agriculture operations on the remainder of the site. However, the continued agriculture operations could prove incompatible with the new adjacent residential uses.

Alternative land uses such as light industrial, commercial or resort could provide jobs and increase the local tax base. However, none of these would meet the stated need for affordable housing. In addition, the market support for these alternatives are questionable.

In general, none of the alternatives considered compared favorably to the proposed development in terms of meeting the project goals and objectives and in alleviating the critical need for affordable housing on Kauai.

Chapter VI

REFERENCES

REFERENCES

Bruner, Phillip L. Field Survey of the Avifauna and Feral Mammals at Hanamaulu, Kauai. January 2, 1990.

Char & Associates. Botanical Assessment Report ±66-Acre Parcel--Hanama'ulu Town, Lihu'e District, Island of Kauai. January 1990.

Y. Ebisu & Associates. Noise Study for the Hanamaulu Town Concept Plan, Hanamaulu, Kauai. January 1990.

First Hawaiian Bank, Research Deparment. Economic Indicators: County Profiles. November/December 1989.

Hawaii, State of, Department of Business and Economic Development. The State of Hawaii Data Book. November 1988.

Helber, Hastert, Van Horn & Kimura, Planners. County General Plan and Zoning Change Petition, Kauai County, Hanamaulu Area Environmental Assessment. July 1981.

Housing and Urban Development, Department of. Economic and Market Analysis Staff. Rental Market Overview - Island of Kauai. May 1989.

Kaku Associates. Traffic Study for Hanamaulu Affordable Housing Project. March 1990.

Kauai, County of. Kauai County Code, Chapter 9. Subdivision Ordinance. 1987.

Kauai, County of, Kauai County Housing Agency. Assessment Report on Kauai's Housing Needs. October 1987.

Kauai, County of, Planning Department. Kauai Beach Access Guide. June 1984.

Paul H. Rosendahl, Ph.D., Inc. Archaeological Inventory Survey Hanamaulu Affordable Housing Project Area, Land of Hanamaulu, Lihue District, Island of Kauai.

University of Hawaii, Land Study Bureau. Detailed Land Classification - Island of Kauai. December 1967.

United States Department of Agriculture Soil Conservation Service. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii. August 1972.

Appendices

Appendix A

BOTANICAL ASSESSMENT REPORT–
CHAR AND ASSOCIATES

CHAR & ASSOCIATES
Botanical/Environmental Consultants
4471 Puu Panini Ave.
Honolulu, Hawaii 96816
(808) 734-7828

January 1990

BOTANICAL ASSESSMENT REPORT
±66-ACRE PARCEL -- HANAMA'ULU TOWN
LIHU'E DISTRICT, ISLAND OF KAUA'I

The ±66-acre parcel proposed for development is roughly triangular in shape; it is bound by Kuhio Highway to the north, by the Hanama'ulu-Ahukini Cut-Off Road to the east, and by existing single family homes and actively cultivated sugar cane fields to the south. The concept plan for the project includes expansion of the existing single family neighborhood, development of multi-family housing and rental units as well as a neighborhood commercial center. The subject parcel is currently in sugar cane cultivation, although recently harvested at the time of the field studies.

On 09 December 1989, field studies to assess the botanical resources found on the ±66-acre parcel were made. A walk-through survey method was used. Plants were identified in the field; those which could not be positively identified were collected for later determination in the herbarium and for comparison with the taxonomic literature. The survey focused on the less actively cultivated areas as along irrigation ditches and the margins of fields.

The primary objectives of the field studies were to provide a description of the general vegetation and to search for rare, threatened, or endangered plant species. The results of that survey are summarized below. Species names used in this report are in accordance with Wagner et al. (in press).

DESCRIPTION OF THE VEGETATION

The project site was recently harvested and the fallow fields support scattered patches of weedy species, mostly annuals, and small plants of sugar cane (Saccharum officinarum) which have resprouted. The weedy association found on these fields includes pink bindweed (Ipomoea triloba), nutgrass (Cyperus rotundus), swollen finger grass (Chloris barbata), spiny amaranth (Amaranthus spinosus), Bermuda grass or manienie (Cynodon dactylon), sensitive plant or puahilahila (Mimosa pudica var. unijuga), two spurge species (Chamaesyce hirta, Chamaesyce hypericifolia), and wild bittermelon (Momordica charantia). Locally common on fields along the northern portion of the site is Mexican poppy (Argemone mexicana).

Several irrigation ditches cross the fields. These usually support a weedy grass and herb association with a few scattered shrubs or small trees along the banks. Common associates include Job's tears (Coix lachryma-jobi), red pualele (Emilia fosbergii), swollen finger grass, Guinea grass (Panicum maximum), Natal redtop (Rhynchelytrum repens), California grass (Brachiaria mutica), and spiny amaranth. Woody components are small trees of Java plum (Syzygium cumini), 6 to 12 ft. tall, and shrubs of pluchea (Pluchea symphytifolia), koa-haole (Leucaena leucocephala), and Christmas berry (Schinus terebinthifolius). A few vegetables, sown by the cane field workers, can usually be found near irrigation ditches. On the project site, these include Jack bean (Canavalia ensiformis), long squash (Lagenaria siceraria), and pumpkin (Cucurbita maxima).

Where the project site borders the Kuhio Highway and the Hanama'ulu-Ahukini Cut-Off Road, a narrow strip of border vegetation is found. Along Kuhio Highway this consists primarily of an oleander hedge (Nerium oleander), most of which is along the

right-of-way and outside the study site. Shrubs such as koa-haole, Christmas berry, castor bean (Ricinus communis), and pluchea are common along the border areas. Guinea grass, California grass, and Johnson grass (Sorghum halpense) fill in the matrix between the shrubs. Uncommon in these areas are a few plants of Chinese banyan (Ficus microcarpa), African tulip (Spathodea campanulata), star-of-Bethlehem (Hippobroma longiflora), and Ipomoea ochracea.

THREATENED AND ENDANGERED SPECIES

Because the site has been actively cultivated for such a long period of time, no sensitive plant communities or rare native plant species occur on the site. No officially listed threatened or endangered plants protected by federal and/or state laws were found on the site; nor were any plants proposed or candidate for such status found (U. S. Fish and Wildlife Service 1985; Herbst 1987).

Only three species considered indigenous, i.e., native to the islands and elsewhere throughout the Pacific, were inventoried. These were the 'uhaloa (Waltheria indica), beach pea or mohihihi (Vigna marina), and yellow wood sorrel or 'ihi (Oxalis corniculata). The 'ihi is questionably indigenous as it may also be of very early Polynesian introduction.

DISCUSSION AND RECOMMENDATIONS

The project site consists of agricultural lands. At present, it is fallow and supports a weedy assemblage of plants commonly associated with agricultural activities. Because the site is so disturbed, it does not harbor any sensitive native plant communities or threatened and endangered species. The three native species found on the site occur throughout the Hawaiian Islands in similiar environmental habitats.

There is very little of botanical interest or concern on the site

and the proposed development is not expected to have a significant negative impact on the island-wide populations of the species involved. There is no reason to impose any botanical impediment to the development of the site.

REFERENCES

Herbst, D. 1987. Status of endangered Hawaiian plants. Hawaiian Botanical Society Newsletter 26(2): 44-45.

U. S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; Review of plant taxa for listing as Endangered and Threatened Species; Notice of review. Federal Register 50(188): 39526-39527 plus 57-page table of species.

Wagner, W. L., D. Herbst, S. H. Sohmer. In press. Manual of the flowering plants of Hawaii. B. P. Bishop Museum and University of Hawaii Press, Honolulu.

Appendix B

FIELD SURVEY OF THE
AVIFAUNA AND FERAL MAMMALS–
PHILLIP L. BRUNER

FIELD SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT HANAMAULU, KAUAI

Prepared for

Helber Hastert and Kimura

by

Phillip L. Bruner
Assistant Professor of Biology
Director, Museum of Natural History
BYU-H
Laie, Hawaii 96762

2 January 1990

FIELD SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT HANAMAULU, KAUAI

INTRODUCTION

The purpose of this report is to summarize the findings of a two day (28, 29 December 1989) bird and mammal field survey at Hanamaulu, Kauai. Also included are references to pertinent literature as well as unpublished faunal reports from similar habitat elsewhere on Kauai.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the type of habitat available.

2- Provide some baseline data on the relative abundance of each species.

3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property identify what features of the habitat may be essential for these species and suggest how those resources may best be protected.

4- Determine if the property contains any special or unique habitats that if lost or altered by development might result in a significant impact on the fauna in this region of the island.

GENERAL SITE DESCRIPTION

The project site is located on approximately 66 acres at Hanamaulu, Kauai (see Fig.1). The property at the time of the survey had been recently plowed and was covered by grass and weeds. The southern and western sides of the land are bordered by Java Plum (Syzygium cumini) and Ironwood (Casuarina sp.).

Weather during the field survey was variable with partly clear mornings and cloudy afternoons. Winds were from the NNE.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mamal activity.

The property was traversed on foot and at various locations (see Fig.1) eight minute count stations were established where all birds seen or heard were tallied. These data provide the basis for the relative abundance estimates given in this report. Published and unpublished reports of birds known from similar habitat on lands nearby this site and elsewhere on Kauai were also consulted in order to acquire a more complete picture of the possible species that might occur in the area (Pratt et al. 1987, Bruner 1985, 1986,

1988a, 1988b, 1988c; Hawaii Audubon Society 1989). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution. One evening was devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinerus semotus).

Scientific names used herein follow those given in the most recent American Ornithologist's Union Check-list (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1989), A Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987), Mammals Species of the World (Honacki et al. 1982), Hawaiian Forest Plants (Merlin 1977).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land and Water Birds:

No endemic species were recorded during the field survey. The Short-eared Owl or Pueo (Asio flammeus sandwichensis) is the only species which might occur on occasion at this site.

Migratory Indigenous (Native) Birds:

A total of three Pacific Golden Plover (Pluvialis fulva) were recorded during the field survey. Plovers prefer open areas such as mud flats, fields and lawns. Johnson et al. (1981) and Bruner (1983) have shown plover are extremely site-faithful (returning each day to the same spot and maintaining this behavior throughout their life time). Plover also establish foraging

territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years.

No other migratory shorebirds were observed. The only other common species which might occur in the area is the Ruddy Turnstone (Arenaria interpres). This species forages in rocky intertidal habitat as well as in fields and on lawns.

Resident Indigenous (Native) Birds:

No indigenous species were recorded. Black-crowned Night Heron (Nycticorax nycticorax) may forage in the ditches that occur on the property. This species is very opportunistic and utilizes both natural as well as man-made wetlands.

Resident Indigenous (Native) Seabirds:

No seabirds were observed on the property nor would any be expected.

Exotic (Introduced) Birds:

A total of 12 species of exotic birds were recorded during the field survey. Table One shows the relative abundance of each species. The most abundant species were Zebra Dove (Geopelia striata), Chestnut Mannikin (Lonchura malacca) and Nutmeg Mannikin (Lonchura punctulata). Given the data from surveys elsewhere on Kauai (Reuner 1985, 1986, 1988a, 1988b, 1988c) and information provided in Berger (1972), Hawaii Audubon Society (1989) and Pratt

et al. (1987) the following exotic bird species might also be expected to occur on or near the property: Common Barn Owl (Tyto alba) and Red-crested Cardinal (Paroaria coronata).

Feral Mamals:

No evidence of rats or mice were found but these ubiquitous mammals undoubtedly occur on or near the property. No trapping was conducted in order to assess the relative abundance of mammals at this site. One feral(?) cat was seen on the southern boundary of the site.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus semotus) are sketchy but the species is fairly common on Kauai (Tomich 1986). None were observed on this field survey. This species roosts solitarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements here in Hawaii.

CONCLUSION

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are

migratory will quite obviously be a part of the faunal picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987). Thus only long term studies can provide a comprehensive view of the bird and mammal populations in a particular area. However, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

The following are some general conclusions related to birds and mammals on this property.

1- The property provides a limited range of habitats which are utilized by the typical array of exotic species of birds one would expect at this elevation and in this type of environment in Kauai. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief or that their numbers are so low that they went undected or a combination of these and other factors.

2- The only native bird recorded on the property was the Pacific Golden Plover. This species utilizes lawns. If parks or other sizeable lawn areas are a part of the development plover may become more abundant at this site.

3- The proposed development will result in a much more diversified range of habitats. Common Myna (Acridotheres tristis), Northern

Cardinal (Cardinalis cardinalis), Japanese White-eye (Zosterops japonicus), House Finch (Carpodacus mexicanus) and House Sparrow (Passer domesticus) should all become more abundant.

4- In order to obtain more definitive data on mammals, a trapping program would be required. No endangered species were observed.

5- The change in land use of this property should have no measurable impact on the fauna of Kauai.

TABLE 1

Exotic species of birds recorded at Hanamaulu, Kauai.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Ring-necked Pheasant	Phasianus colchicus	R = 1
Cattle Egret	Bubulcus ibis	R = 16
Spotted Dove	Streptopelia chinensis	C = 8
Zebra Dove	Geopelia striata	A = 14
Common Myna	Acridotheres tristis	C = 6
Western Meadowlark	Sturnella neglecta	U = 3
Northern Cardinal	Cardinalis cardinalis	R = 4
Japanese White-eye	Zosterops japonicus	U = 2
Nutmeg Mannikin	Lonchura punctulata	A = 12
Chestnut Mannikin	Lonchura malacca	A = 24
House Finch	Carpodacus mexicanus	U = 5
House Sparrow	*Passer domesticus*	R = 4

* (see page 10 for key to symbols)

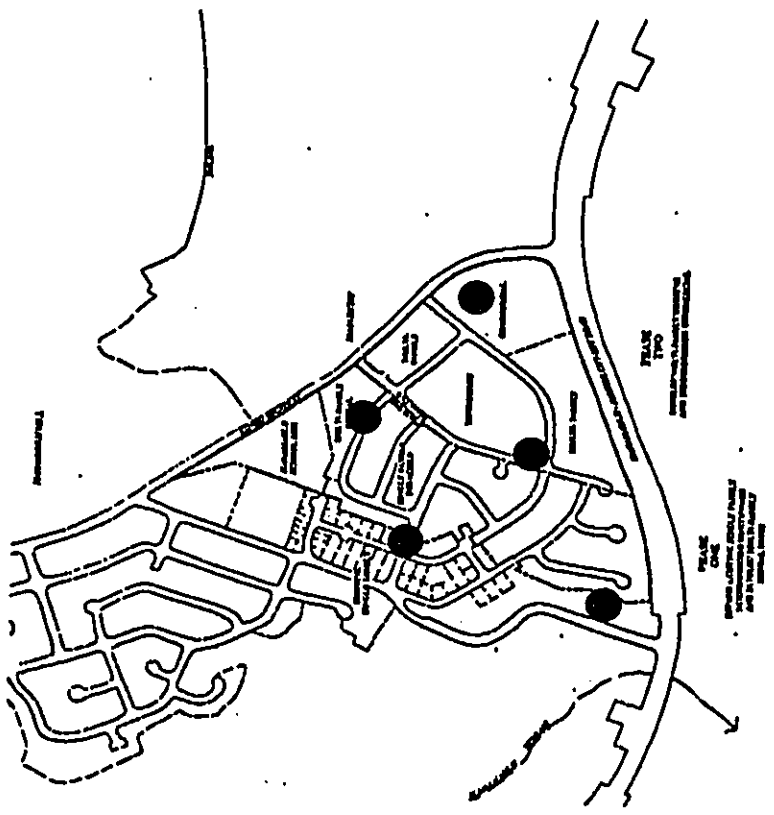


Fig. 1. Project site with census (count) stations marked by solid circles.

KEY TO TABLE 1

Relative abundance = number of times observed during survey or average number on eight minute counts

A = abundant (ave. 10+)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

R = recorded (seen or heard at times other than on 8 min. counts. number which follows is the total number seen or heard over the duration of the survey).

SOURCES CITED

American Ornithologist's Union 1983. Check-list of North American Birds. 6th edition. American Ornithologist's Union, Washington, D.C.

Berger, A.J. 1972. Hawaiian Birdlife. The Univ. Press of Hawaii, Honolulu.

Bruner, P.L. 1983. Territorial behavior of wintering Pacific Golden Plover in Hawaii. ms. (Paper presented at the 100th meeting of the Amer. Ornith. Union).

_____ 1985. An Avifaunal and feral mammal survey of the Foster Petroleum Corporation proposed Light Industrial Park Property Tmk 5-2-05 (Parcel 23,24 and 40) Kilauea, Kauai, Hawaii. Unpubl. ms.

_____ 1986. Faunal survey of Makaleha Valley. Kapaa, Kauai. Unpubl. ms.

_____ 1988a. Survey of the avifauna and feral mammals at Grove Farm Properties, Poipu, Kauai. Unpubl. ms.

_____ 1988b. Survey of the avifauna and feral mammals for the Kauai Lagoon's proposed third golf course, Lihue, Kauai. Unpubl. ms.

_____ 1988c. Field survey of the avifauna and feral mammals at Grove Farm Properties, Lihue/Puhi, Kauai. Unpubl. ms.

Hawaii Audubon Society. 1989. Hawaii's Birds. Fourth Edition. Hawaii Audubon Society, Honolulu.

Honacki, J.H., K.E. Kinman and J.W. Koeppl ed. 1982. Mammal species of the world: A taxonomic and geographic reference. Allen Press, Inc. and the Association of Systematic Collections, Lawrence, Kansas.

Johnson, O.W., P.M. Johnson, and P.L. Bruner, 1981. Wintering behavior and site-faithfulness of Golden Plovers on Oahu. 'Elepaio 41(12): 123-130.

Merlin, M.D. 1977. Hawaiian Forest Plants. Oriental Publishing Co. Honolulu, Hawaii.

Pratt, H.D., P.L. Bruner, and D.G. Berrett. 1987. A field guide to the birds of Hawaii and the tropical Pacific. Princeton Univ. Press.

Tomich, P.Q. 1986. Mammals in Hawaii. Bishop Museum Press. Honolulu.

Williams, R.N. 1987. Alien Birds on Oahu. 1944-1985. 'Elepaio 47(9): 87-92.

Appendix C

ARCHAEOLOGICAL
INVENTORY SURVEY–
PAUL H. ROSENDAHL, PHD., INC.

Archaeological Inventory Survey
Hanamaulu Affordable Housing
Project Area

Land of Hanamaulu
Lihue District, Island of Kauai
(TMK:3-7-03:Por.20)

Report 729-122689

Archaeological Inventory Survey
Hanamaulu Affordable Housing
Project Area

Land of Hanamaulu
Lihue District, Island of Kauai
(TMK:3-7-03:Por.20)

by

Alan T. Walker, B.A.
Supervisory Archaeologist

and

Paul H. Rosendahl, Ph.D.
Principal Archaeologist

Prepared for

Amfac, Inc.
c/o Helber, Hastert & Kimura, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

January 1990

PHRI
Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services
365 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 • FAX (808) 961-6998

PHRI
Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services
365 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 • FAX (808) 961-6998

SUMMARY

At the request of Ms. Leslie Kurisaki of Helber, Hastert & Kimura, Planners, for their client, Amfac, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted a variable-coverage surface and limited subsurface archaeological inventory survey of the Hanamaulu Affordable Housing project area, situated in the Land of Hanamaulu, Lihue District, Island of Kauai (TMK:3-7-03:Por.20). The basic objective of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Assessment (EA).

The survey field work was conducted December 20, 1989. Approximately 16 man-hours of labor were expended on the field work. During the surface survey, the only cultural remains identified were isolated coral fragments. No structural features or cultural deposits were encountered. The subsurface survey entailed excavating nine backhoe trenches. The trenches yielded no cultural matrices, buried pondfields, subsurface horizontal features, portable cultural remains, or datable materials of any kind.

As a result of the negative findings of the inventory survey, no further archaeological work is recommended for the project area.

CONTENTS

Page

ILLUSTRATIONS

Figure

TABLES

Table

INTRODUCTION

BACKGROUND

At the request of Ms. Leslie Kurisaki of Helber, Hastert & Kimura, Planners, for their client, Amfac, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted a variable-coverage surface and limited subsurface archaeological inventory survey of the Hanamaulu Affordable Housing project area, situated in the Land of Hanamaulu, Lihue District, Island of Kauai (TMK:3-7-03:Por.20). The basic objective of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Assessment (EA).

The survey field work was conducted December 20, 1989 under the supervision of Supervisory Archaeologist Alan T. Walker, B.A., and Supervisory Field Archaeologist Amy Dunn. Principal Investigator Dr. Paul H. Rosendahl provided overall direction for the field work. Approximately 16 man-hours of labor were expended on the field work.

SCOPE OF WORK

The basic purpose of an inventory survey is to identify—to discover and locate on available maps—all sites and features of potential archaeological significance present within a specified project area. An inventory survey comprises an initial level of archaeological investigation, and can entail both surface and subsurface investigations. It is extensive rather than intensive in scope, and is conducted to determine the presence or absence of archaeological resources within a specified project area. An inventory survey indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains; it permits a preliminary evaluation of the archaeological resources, and facilitates formulation of realistic recommendations and estimates for any subsequent mitigation work as might be necessary or appropriate. Such work could include intensive data collection involving detailed recording of sites and features, and selected test excavations; and possibly subsequent data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The principal objectives of the present survey were fourfold: (a) to identify (find and locate) all sites present within the project area, (b) to evaluate the potential significance of all identified archaeological remains, (c) to determine the possible impacts of any proposed development upon the identified remains, and (d) to define the scope of any subsequent archaeological work that might be necessary or appropriate.

Based on a review of available background literature, on familiarity with the project area, on discussions with Ms. Kurisaki, and on previous experience with Hawaii State Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office (DLNR-HSS/SHPO) requirements and standards for archaeological work, the following specific tasks were determined to constitute an adequate and appropriate scope of work for the inventory survey:

1. Review readily available background archaeological and historical literature relevant to the immediate project area;
2. Conduct variable-coverage (sample), variable-intensity (30-90 ft intervals) ground reconnaissance (pedestrian) of the project area, with actual extent and intensity of coverage determined on the nature and distribution of identified remains;
3. Conduct limited subsurface testing for buried prehistoric agricultural deposits, cultural deposits, and features (e.g., firepits), by means of mechanical backhoe trenching; and
4. Analyze background and field data, and prepare appropriate reports.

PROJECT AREA DESCRIPTION

The Hanamaulu Affordable Housing project area consists of approximately 66 acres situated in the Land of Hanamaulu, Lihue District (formerly known as the Puna District), Island of Kauai (TMK:3-7-03:Por.20) (Figure 1). Specifically, the project area is located about two-tenths of a mile (1,000 ft) inland of Hanamaulu Bay. The project area is bounded on the north and west by Kuhio Highway, on the east by Kapule Highway extension (Hanamaulu-Ahukini cutoff road), and on the south by Hanamaulu River Valley, Hehi Road, and private residential houselots.

The terrain in the project area generally consists of a raised plateau of level soil. Approximately 2.8 acres in the

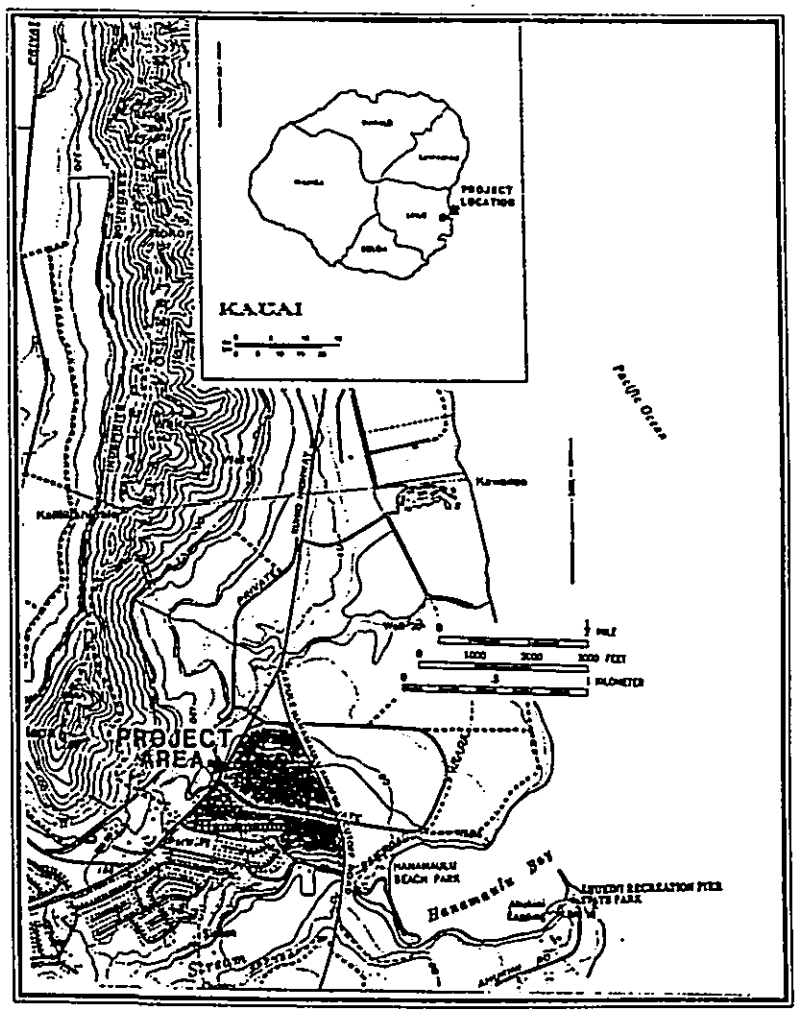


Figure 1. Project Location Map

ARCHAEOLOGICAL INVENTORY SURVEY
HANAMAULU AFFORDABLE HOUSING PROJECT AREA
Land of Hanamaulu, Lihue District
Island of Kauai (TMK:3-7-03:Por20)

PHRI Project 89-729 *January 1990*

consists of the upper edge and steep slope of Hanamaulu River Valley. The soil in the area consists of Lihue silty clay (0-8% slopes), representing the Lihue series of well-drained upland soils which developed in material weathered from basic igneous rock (Foote et al. 1972:82). According to Foote et al., Lihue silty clay (0-8% slopes) is found:

> ...on the tops of broad interfluves in the uplands...[i]n a representative profile the surface layer is dusky-red silty clay about 12 inches [0.3 m] thick. The subsoil, more than 48 inches [1.22 m] thick, is dark-red and dark reddish-brown, compact silty clay that has subangular blocky structure. The substratum is soft, weathered rock (1972:82).

Although the project area ranges in elevation from c. 20-100 ft AMSL (above mean sea level), the major portion of the area is level and situated between 80-100 ft AMSL. Rainfall in the general vicinity of the project area is 40-50 inches per year, and the mean annual temperature is approximately 70-75 degrees F (Armstrong 1983:62). The project area consists predominately of formerly cultivated sugarcane land; as such, vegetation within the area generally consists of scattered uncultivated sugarcane (*Saccharum officinarum* L. hybrid) and various grasses (Figure 2). A stand of Java plum (*Eugenia cuminii* [L.] Druce) and koa-haole (*Leucaena leucocephala* [Lam.] deWit) trees is present on the upper edge and steep slope of Hanamaulu River Valley, in the southeast portion of the project area.

PREVIOUS ARCHAEOLOGICAL WORK

The present survey comprises the initial archaeological work conducted within the Hanamaulu Affordable Housing project area. Previous archaeological work in the general vicinity of this project area includes, but is not limited to, Thrum (1907), Bennett (1931), Neller and Palama (1973), Handy and Handy (1972), and Walker and Rosendahl (1988).

FIELD METHODS AND PROCEDURES

Field work for the current project was conducted December 20, 1989 by Supervisory Archaeologist Alan T. Walker, B.A., and Supervisory Field Archaeologist Amy Dunn. Principal Investigator Dr. Paul H. Rosendahl provided overall direction for the field work. Sample-coverage surface survey of the project area was accomplished by way of a series of pedestrian transects oriented both east-west and north-south. Intervals between sweeping crew members were 15.0-20.0 m. Thirty-two point seven percent of the project area was subjected to ground survey (Figure 3). This percentage was deemed adequate due to (a) the absence of surface structural remains in the project area, (b) the paucity of identified portable remains in areas ground surveyed, and (c) past land use patterns and the disturbed nature of the subsurface deposits (cultivated sugarcane land).

Subsequently, subsurface testing by means of mechanical backhoe was conducted. The trenches were placed in order to determine the presence or absence of buried prehistoric agricultural deposits, cultural deposits, and/or features (e.g., firepits), and in order to recover datable material. Nine backhoe trenches were dug in the project area; all were numbered sequentially, beginning with BT-1. The backhoe trenches were placed c. 60.0-90.0 m apart (Figure 3).

To aid in the identification of cultural deposits, matrix samples from the trenches were processed through 1/4-in mesh and were searched for shell midden, charcoal fragments, bone, and/or artifacts. Layer descriptions were compiled on PHRI stratigraphy forms through a combination of field examination and laboratory analysis of representative fill samples; all layers were described in accordance with procedures and terminology as set forth in the Soil Survey Manual (Soil Survey Staff 1962). All trenches were terminated in sterile subsurface matrices.

The surface survey and the plotting of backhoe trenches were aided by a USGS 7.5 series quad map ("Kapaa, Hawaii"; 1"=2,000'; 40-ft contours). The general project area was photographed, and at least one 35 mm black-and-white photograph was taken of selected backhoe trenches (Roll No. 1337).

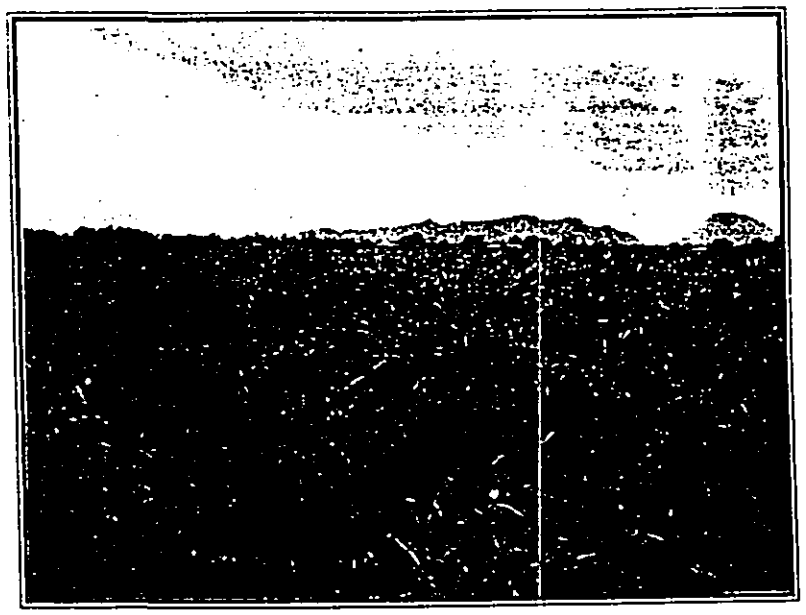


Figure 2. PROJECT AREA OVERVIEW. View to South. (PHRI neg. 1337-21a)

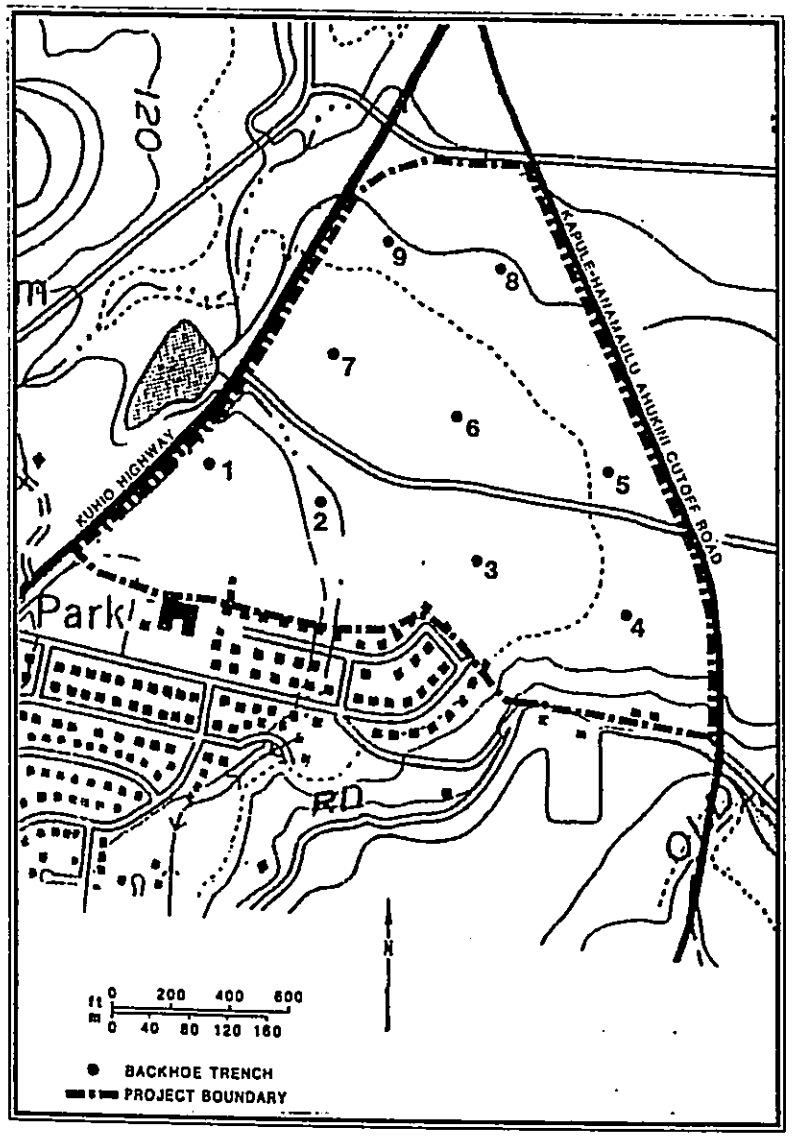


Figure 3. PROJECT AREA AND BACKHOE TRENCH LOCATION MAP

FINDINGS

During the surface survey, no significant archaeological remains of any kind were encountered. The only cultural remains encountered were several small isolated coral pebbles.

The backhoe trenching entailed excavating c. 29 sq m of surface area; during the trenching no cultural matrices, buried pondfields, subsurface horizontal features, portable cultural remains, or datable materials were identified. The trenches displayed three general stratigraphies (Types A-C). The stratigraphies all contained dark reddish-brown silty clay (Layer I) and red silty clay (II) matrices. Type A consisted solely of these two clay matrices. Type B contained a slight variation of Layer II (a strong brown silty clay), while Type C displayed a Layer III, a yellowish-red silty clay. Stratigraphy Types A, B, and C are apparently slight variations of representative subsoil profiles of Lihue silty clay described in Foote et al. (1972). A summary of backhoe trench excavation results is presented in Table 1, and detailed soil descriptions for backhoe trenches are presented in the appendix. Detailed stratigraphies of the three representative types are presented below.

Backhoe Trenches 1-4, and -6 displayed Type A stratigraphies. The following is a detailed stratigraphy for BT-1:

LAYER	DESCRIPTION
I	20 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	200+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots

Type B stratigraphy was present in BT-5, -7, and -9. BT-9 displayed the following stratigraphy:

LAYER	DESCRIPTION
I	30 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	160 cm thick; clear, smooth lower boundary red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
III	70+ cm thick; yellowish-red (5 YR 4/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, slighty sticky, and of slighly plastic plastic consistence; very few fine roots

Type C stratigraphy was present solely in BT-8, detailed here:

LAYER	DESCRIPTION
I	50 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	190+ cm thick; strong brown (7.5 YR 5/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm,

Table 1.

SUMMARY OF BACKHOE EXCAVATION RESULTS

Backhoe Trench No.	Layer Designation		Max. Trench Depth
	Non-cultural	Cultural	
1	I, II	----	220
2	I, II	----	200
3	I, II	----	200
4	I, II	----	220
5	I-III	----	275
6	I, II	----	240
7	I-III	----	290
8	I, II	----	240
9	I-III	----	260

CONCLUSION

DISCUSSION

As indicated in historical documentary references (Bennet 1929, Handy and Handy 1972), prehistoric settlement in the area of Hanamaulu seems to have taken place primarily in Hanamaulu River Valley and along the coast. Habitation and agriculture, as evidenced by house sites and agricultural terraces, took place in the river valley. The higher lands surrounding the river valley were probably used for dryland agriculture (crops such as sweet potato and breadfruit [Handy and Handy 1972]). Along the coast, burial (in sand dunes) and habitation activities probably took place.

In the project area, settlement was probably very limited, or perhaps it did not take place at all. The stratigraphies for the backhoe trenches excavated during the current project attest to the probability of the latter being the case—no cultural matrices, subsurface horizontal features, portable cultural remains, or buried poodfields were identified. The lack of cultural remains, however, could also be due to the land modification—including sugarcane cultivation—that has taken place in the project area. Such extensive modification usually would preclude the possibility of finding any kind of subsurface cultural deposits at all, much less intact ones.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Significance categories used in the site evaluation process are based on the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). The DLNR-HSS/SHPO uses these criteria for evaluating cultural resources. Sites determined to be potentially significant for information content fall under Criterion D, which defines significant resources as ones which "...have yielded, or may be likely to yield, information important in prehistory or history." Sites potentially significant as representative examples of site types are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction...or that represent a significant and distinguishable entity whose components may lack individual distinction."

Sites with potential cultural significance are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Geidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (Draft Report, August 1985). The guidelines define cultural value as "...the contribution made by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth." The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value."

Because the only cultural remains identified in the project area were several small isolated coral fragments, the area is assessed as significant solely for information content. Because archaeological and historical documentary data collected on the present project area during the present survey is considered sufficient, no further work is recommended.

The above evaluation and recommendation were discussed with Ms. Nancy McMahon, DLNR-HSS/SHPO staff archaeologist for Kauai County, on January 10, 1988. Upon submission of this report, Ms. McMahon will formally review the findings and conclusions presented here.

It should be noted that the evaluations and recommendations presented within this final report have been based on a variable-coverage surface and limited subsurface inventory survey of the project area. There is always the possibility, however remote, that potentially significant, unidentified subsurface cultural remains will be encountered in the course of future archaeological investigations or subsequent development activities. In such situations, archaeological consultation should be sought immediately.

REFERENCES CITED

ACHP (Advisory Council on Historic Preservation)

1985 Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review. Washington, D.C.: Advisory Council on Historic Preservation. (Draft report, August)

Armstrong, R.W. (ed.)

1983 Atlas of Hawaii. Honolulu: University Press of Hawaii. (Second edition)

Bennett, W.C.

1931 Archaeology of Kauai. Bernice P. Bishop Museum Bulletin 80. B.P. Bishop Museum, Honolulu.

CFR (Code of Federal Regulations)

36 CFR Part 60 National Register of Historic Places. Washington, D.C.: Dept. Interior, National Park Service.

Foote, D.E., E.L. Hill, S. Nakamura, and F. Stephens

1972 Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii. U.S. Dept. Agriculture-Soil Conservation Service and University of Hawaii Agricultural Experiment Station. Washington, D.C.: Government Printing Office.

Handy, E.S.C., and E.G. Handy

1972 Native Planters in Old Hawaii, Their Life, Lore, and Environment. B.P. Bishop Museum Bulletin 233. B.P. Bishop Museum Press, Honolulu.

Neller, E., and S. Palama

1973 The Archaeology of Puna, Kaua'i, From the ahupua'a of Niumalu to the ahupua'a of Kipu. Archaeological Reconnaissance of the Huleia River Valley Area. Archaeological Research Center Hawaii. Prepared for Community Planning, Inc.

Soil Survey Staff

1962 Soil Survey Manual. U.S. Dept. Agriculture-Soil Conservation Service. Handbook No. 18. Washington, D.C.: Govt. Printing Office.

Thrum, T.G.

1907 Heiaus and Heian Sites Throughout the Hawaiian Islands. Hawaiian Annual 1907:36-48.

Walker, A.T., and P.H. Rosendahl

1988 Interim Report: Summary of Findings, and General Significance Assessments and Recommended General Treatments, Archaeological Surface and Subsurface Inventory Survey, Grove Farm Lihue/Puhi Project Area, Land of Nawiliwili, Niumalu, and Haiku, Lihue District, Island of Kauai. PHRI Report 498-120788. Prepared for Grove Farm Properties, Inc. and Belt, Collins & Associates.

APPENDIX A

DETAILED STRATIGRAPHIES OF BACKHOE TRENCHES

BT-2, EAST FACE

LAYER	DESCRIPTION
I	15 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	185+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots

BT-3, SOUTHWEST FACE

LAYER	DESCRIPTION
I	23 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	177+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots

BT-4, SOUTH FACE

LAYER	DESCRIPTION
I	30 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	190+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots

BT-5, SOUTHEAST FACE

LAYER	DESCRIPTION
I	25 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	150+ cm thick; clear, smooth lower boundary; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
III	100+ cm thick; yellowish red (5 YR 4/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, slighty sticky, and of slightly plastic plastic consistence; very few fine roots

BT-6, NORTHWEST FACE

LAYER	DESCRIPTION
I	22 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	218+ cm thick; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slighly sticky, and of plastic consistence; few fine roots

BT-7, SOUTHEAST FACE

LAYER	DESCRIPTION
I	22 cm thick; clear, smooth lower boundary; dark reddish-brown (2.5 YR 3/4 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, friable, sticky, and of plastic consistence; common medium roots
II	148+ cm thick; clear, smooth lower boundary; red (2.5 YR 4/8 dry); silty clay; moderate, fine, subangular blocky structure; hard, friable, slightly sticky, and of plastic consistence; few fine roots
III	120+ cm thick; yellowish red (5 YR 4/6 dry); silty clay; strong, fine to medium, subangular blocky structure; hard, firm, slighty sticky, and of slightly plastic plastic consistence; very few fine roots

APPENDIX B

LIMITED HISTORICAL DOCUMENTARY RESEARCH

by Helen Wong Smith

The ahupua'a of Hanamaulu translates literally as "tired (as from walking) bay," and it is said to be the birthplace of the hero Kawelo (Pukui et al. 1974). Few sources refer specifically to Hanamaulu, and these are rather general in nature. For this reason, it has been necessary to consult references on Kauai to provide background information.

In Archaeology of Kauai, William Bennett has this to say on the island's history:

> Two factors separate the archaeological history of Kauai from the political history: the scarcity and inaccuracy of the genealogies, and the lack of accurate legendary knowledge about the ruins and artifacts. Some of the heiaus are said to have been built by such and such a chief, but it has been possible to place few of these chiefs in chronological sequence.
>
> The mythical origins of Kauai, together with legends relating to its famous chiefs, have been recorded generally by Fornander...and locally by Rice....Fornander (pp. 291-2) writes:
>
> The legendary history of Kauai is very unsatisfactory in any effort to restore historical form and sequence. The legends are disconnected and the genealogies are few.... That the ruling families of Kauai were the highest tapu chiefs in the group is evident from the avidity with which chiefs and chiefesses of the other islands sought alliance with them. They were always considered as the purest of the "blue blood" of the Hawaiian aristocracy; ...but of the exploits and transactions of most of the chiefs who ruled over Kauai during this period, there is little preserved to tell.
>
> As to actual history the most significant point is that Kauai remained politically independent up to 1824. The island was never conquered, though in 1810 Kaumualii ceded the island to Kamehameha I to prevent an invasion. With the death of Kaumualii in 1824 the independence of Kauai ceased (Bennett 1931:7-8).

At this point, it might be of interest to relate in greater detail the events surrounding and following the cession of Kauai. Following are two references that tell the story:

> By the mid-1700s, Kaumualii had become Ruling Chief of Kaua'i, and the lands of the entire island were his. In 1810 Kaumualii sailed to Honolulu to acknowledge the sovereignty of the King of Hawaii. It appears that no change took place in the established land tenure as Kaumualii returned to Kaua'i still in charge of his lands. There was a promise on his part, however, that the island would be left eventually to the Kamehameha line.
>
> On the death of Kamehameha I, Liholiho came to Kaua'i to check on the loyalty of Kaumualii. Kaumualii proposed in a formal manner to surrender himself, his island, and all that he had to Liholiho. Bingham (1822:244) recorded the colorful scene: "...Do with them as you please. Place what chief you please as governor here." Liholiho: "...I did not come to take away your island. I do not wish to place anyone over it. Keep your island and take care of it just as you have done, and do what you please with your vessels."
>
> Kaumualii was married to Kaahumanu, one of the strongest political forces in the kingdom. To strengthen the political tie with Kaua'i, she also wed Kealiiahonui, son of Kaumualii. Kaumualii died in May 1824, leaving his Kaua'i lands to the Kamehameha heir. Apparently though, lands in the hands of Kaua'i chiefs were to be administered by them. Sept. 13, 1824, Hoapili wrote from Waimea to Kamehameha II in London: "...Your servant Kaumualii is dead. He left word that Paalua (also known as Kalanimoku, who with Kaahumanu were the two strongest political forces) was to take care of your land..." This indicates Kaumualii fulfilled the land agreement of 1810. The lands were to be held in trust by Kaahumanu and Kalanimoku for Kamehameha II and that those chiefs who had lands would keep them, those who were landless would remain so. This disposition of

land brought about the Insurrection of 1824 when landless chiefs attempted to overthrow the forces of Kamehameha II. The revolt brought disaster for all Kaua'i chiefs as they lost their holding to the relatives & retainers of the Kamehameha line, who took over the lands of Kaua'i (Neller and Palama 1973:13).

Landless Kauai chiefs induced Kaumualii's son Humehume, to join them in revolt; but reinforcements from the other islands under Kalanimoku defeated the insurgents. "...and the loafers and hangers-on (palauuleo) of Oahu and Maui obtained the rich lands of Kauai" (ibid.).

As an indication of the seriousness of this uprising, it should be noted that it made news across the world in Europe. The following article was placed in The Edinburgh Evening Courant on Monday, June 6, 1825:

> By Capt. Gardiner, of the Maria, from the Sandwich Islands, which he left about the middle of November some interesting particulars have been received concerning the late disturbances occasioned by the attempted rebellion of Prince George Tamoree, in the island of Atooi. The last advices from that quarter left this chief, at the head of a considerable body of followers, lurking in the mountains. Krimakoo, the William Pitt of the nation, and acting Regent, happening to be on Atooi in the commencement of the rapture, immediately placed the missionaries & their families on board certain vessels, & sent them to Oahu for safety; at the same time dispatching orders for reinforcements from all the cirumjacent [sic] islands. Such was the zeal and enthusiasm of the natives, on receiving this intelligence, that the vessels intended to convey them to the scene of action could not contain half of the volunteers - many of whom hung upon the vessels' sides and thus reached Atooi. In a short time, the malcontents laid down their arms, & Prince George was made prisoner. He had not arrived at Oahu, the seat of government, when Capt. Gardiner sailed but was daily expected. It was believed at Oahu that nothing but the protection of the Prime Minister would insure his life. George, disdaining to be escorted by a guard, had promised to proceed voluntarily to Oahu. The young Prince, son of RhioRhio, had been established King of Atooi; and when the news of the demise of their Sandwich Islands majesties arrives, he will be placed on the throne of his father, under the guidance of a Regency. He is about 12 years old. As to the fate of George, it was thought he would finally be marooned, a sort of banishment to a distant island, where he will be strictly watched.

In another reference, Bennett notes the following facts:

> It seems...that there was much more communication between all parts of Kauai than between Kauai and the other islands. In other words Kauai may be considered as a cultural unity (Bennett 1929:54)

> The river valleys were all inhabited, where there is any semblance to land that could be cultivated. The distance of occupation up the river valleys is only limited by the irrigable lands, and the remains of house sites and taro terraces indicate occupation 10 or 15 miles up such valleys as the Waimea and Hanapepe (ibid).

> The extent of the agricultural terraces seems to indicate that the water conditions were somewhat altered, as valleys that are today watered by intermittent streams show the remains of undoubted terraces. The amount of land that could be terraced and cultivated was remarkable....(ibid:55).

Thrum lists 124 heiau for the island of Kauai. The list also includes sacred places and small heiau not listed on the other islands. There seem to be many more small type of heiau, that is those under 50 feet in size, on Kauai than on the other islands. Of these there is the simple platform, the enclosure and the two terrace type. They are at all times hard to distinguish from house sites (ibid:57).

Bennett briefly describes two sites in the Hanamaulu area:

> Site 182. Kalaaokamanu heiau, in Hanamaulu above the present mill. Described by Thrum as "A large walled heiau that stood above the present mill; destroyed about 1855. Of pookanaka class."

> Site 183. Dune burials. In the sand dunes that run along the shore half way between Hanamaulu and Wailua River are many burials (Bennett 1931:125).

Another reference to Hanamaulu is contained in Olelo No'eau:

> No Hanama'ulu ka ipu puehu.
>
> The quickly emptied container belongs to Hanama'ulu.
>
> Said of the stingy people of Hanama'ulu, Kaua'i - no hospitality there. At one time, food containers would be hidden away and the people of Hanama'ulu would apologize for having so little to offer their guests (Pukui 1983).

Farming in the Hanamaulu area included the raising of taro, sweet potatoes, breadfruit, and coconuts. The Hanamaulu stream flows through a broad gulch which was extensively terraced in olden times. Before the advent of sugarcane, the stream delta was very likely an important area for wet taro cultivation. Upland slopes would have been ideal for planting sweet potato (Handy and Handy 1972).

During the reign of Kamehameha III, the most important event in the reformation of the land system was incorporated. The Great Mahele separated and defined the undivided land interests of the King and the high-ranking chiefs and konohiki (this originally referred to the person in charge of a tract of land on behalf of the king or a chief; it is in the later statutes that the chiefs or landlords were referred to as "konohikis.") (Chinen 1958:vii and Chinen 1961:13). More than 240 of the highest ranking chiefs and konohiki in the kingdom joined Kamehameha III in this division. The first mahele was signed on Jan. 27, 1848 by Kamehameha III and Princess Victoria Kamamalu by her guardians Mataio Kekuanaoa and Ione Ii. The last mahele was signed by the King and E. Enoka on March 7, 1848 (Chinen 1958:16).

The mahele did not convey any title to any land. The chiefs and konohiki were required to present their claims to The Land Commission and to receive awards for the lands quit-claimed to them by Kamehameha III. Until an award for these lands was issued, title remained with the government. Because of the lack of surveyors at the time of the Mahele, the lands were divided by name only, with the understanding that the ancient boundaries would control until a survey of such lands could be made in the future. This was done to expedite the work of the Land Commission to issue to the chiefs and konohiki awards of lands. However, these chiefs and konohiki were still required to pay commutations to the government for them to receive Royal Patents on their awards. These lands awarded to the chiefs and konohiki became known as Konohiki Lands (Chinen 1961:13).

The volume Indices to Land Commission Awards, a compendium of data listing the land and awardees, contains the following awards for Hanamaulu:

LCA	Awardee	Acreage
3648	Kala	1.25 Acs 30 rods
3650	Kaluhiwaha	3 roods, 35 rods
3649	Kamalo	1.75 Acs 20 rods
7713	V. Kamamalu	9177 Acs (Ap 2) ahp
3644	Kaualupa	1.25 Acs 23 rods
3558	keke	3 roods 1 rod
3600	Keolanui	1.75 Acs 30 rods
3653	Kolu	1 Ac 37 rods
5089	Kuhaimoana	3 roods 17 rods
3640	Kumakahaohao	1 Ac 1 rood 12 rods
3271	Lalahilimoku, Leimoku	1 Ac 1 rood 21 rods
3657	Niho	1 Ac 1 rood 13 rods
3423	Paka	1.50 Acs 33 rods
3426	Pelekane	1 Ac 17 rods
3371	Naehu	1.25 Ac 19 rods (Kapuia)
3647	Kapuohi	4 Acs 32 rods (Moala)
3647	Kapuohi	38 rods (Papuaa)

The listing of V. Kamamalu represents Victoria, sister of Alexander Liholiho (King Kamehameha IV), Lot Kamehameha (King Kamehameha V), Moses Kekuaiwa, and half sister of Ruth Keelikolani (Indices 1929:3). Whenever ali'i procured an entire ahupua'a, they were bound to respect the rights of the existing tenants. These tenants, if they filed a claim to the Board of Commissioners to Quiet Land Titles, could continue to cultivate and reside on their parcels. The following are excerpts from testimonies for awards that were granted in Hanamaulu:

LCA 3558 to Keke - Foreign Testimony, Vol. 13:160
> Kanalapa sworn, he has seen [this land]...[it] consists of three lois in the ili of Waiaoao and...also a small kula adjoining. Claimant has also a house lot at Hoeua...Claimant had his land from his friend Pekue in 1846. His house lot he had from Keo. Claimant held a house lot at Opai which was disputed by Keo the Konohiki. Claimant agreed to give him the lot above described at Hoeua.

LCA 3600 to Keolanui - Foreign Testimony, Vol. 13:153
> ...[This land is] in the ili of Palaka and consists of lois and house lot, all family but one piece....Claimant had his land from Daniela Okloa, in the days of

good old Kaihiaena (?) & has occupied it ever since without opposition....

LCA 3653 to Kolu - Foreign Testimony, Vol. 13:151
...it consists of four lois in the ahupuaa of Hanamaulu and consists of four loi in the ili of Maulele, with small kula, adjoining the kula is not cultivated being exhausted to the depredations of cattle. Claimant has also a house lot in the village of Kamakahanahana which is surrounded by a fence. No. 1 is bounded...Koloa - auwai of Keoki. No. 2 is kula of Kamakahanahana....Claimant had his land from Keo, konohiki, in the days of Kaikioewa [and] had peaceable possession ever since, his claim has never been disputed. Keo says I am a luna under Kanoa and know the land and gave the land to Claimant according to the testimony of Keolauui which is all true.

LCA 3426 to Pelekane - Foreign Testimony, Vol. 13:156
....consists of 4 loi and [is] in the ili of Kapuhala. Claimant has also a house lot near the sea shore at a place called Kabo....Lot 2 (bounded by)...North - fish pond...land from his konohiki Pau soon after Kanoa came to Kauai and occupied it in peace till Keo became konohiki again in 1849 who took away from Claimant two lois and gave them to Aumoana Keke sworn declares the testimony of Lalahilimoku to be all true. Keo sworn says it is true that Pelekane held and occupied said lois....

LCA 3371 to Naehu and heirs - Foreign Testimony, Vol. 13:155
...consists of 10 lois and small kula adjoining on which Claimants house [is] in the ili of Kapaia. Claimant had his land from his son-in-law Kalihania (?) soon after Kanoa came to Kauai and he occupied it in peace till his death which occurred in 1849. He gave land to his daughter Kaipu.

LCA 3647 to Kapuohi - Foreign Testimony, Vol. 13:151
...consists of 8 lois and 23 loi not now cultivated. These lois lie in two pieces, being divided kuekes [a small land unit farmed by a tenant for the chief]. No. 1 contains one loicalled Moala in the ili of Waiea. No. 2 contains all the other lois. No. 3 house lot in the ku of Papuaa....Claimant had his land from Pau, the konohiki about 5 years ago. That part of the Claimant's land lying south of the Hanamaulu stream had never been disputed to this day. But the land laying on the Wailua side is disputed by the konohiki. Witness says there never was any dispute about [it] until within the last few days. He says Claimant gave the land to his friend Luakini who held it several years till his death about a year or two ago when he returned the land to Kapuohi the present Claimant. Papawaa, sworn says, I am a Kamaaina of Hanamaulu and know the land of Claimant and never heard of any dispute about the claim till Tuesday last when I heard that Keo disputed it and I believe the testimony of Kupule is all true.

LCA 3271 to Lalahilimoku - Foreign Testimony, Vol. 13:161
... consists of six lois in the ili of Kuka. Claimants house lot is in the village of Puako...[he] had his land from Daniela Aleloa in the days of Kaikioewa and has occupied it ever since in peace....

LCA 3423 to Paka - Foreign Testimony, Vol. 13:155
...consists of 8 loi in the ili of Peaiki and small kula adjoining. Claimant also has a house in Peaiki...land from Keo his konohiki in the days of Kaikioewa....

The Land File of the State Archives contains Document 336, among the papers of Governor Dominis (Governor of Oahu, d. 1891). This book provides us with the survey notes of various ahupua'a on Kauai. Figure 1 is a copy of the description of the boundaries of Hanamaulu.

Also found in the Land File at the Archives were various references to Hanamaulu. The following is a summary of the documents at the Archives regarding this ahupua'a:

Interior Dept. Aug. 19, 1862 In letter from M. Kekuanaoa to W. Webster, informing that the above land which is claimed as belonging to the King has been surveyed and awarded by the Land Commissioner and a Royal Patent issued to V. Kamamalu.

Interior Dept. Aug. 4, 1863 In letter from H. A. Widemann to Webster, that he had seen his name on a lease to the Lihue Plantation for the above lands, which leads him to think he has something to do with Victoria's lands.

Interior Dept. July 20, 1870 In letter from Paul Isenburg (sic) to J. O. Dominis enclosing a draft for $7250 being the purchase price for the above ahupua'a.

Hanamaulu

Commencing upon the Sea, at the mouth of the small stream called Nawailoa, and upon the Southerly bank of the said stream, running from thence S. 71° W. 90 Chains, to the top of the hill called Kailiilichinale bounded by the land called Wailua, belonging to His Majesty the King; from thence N. 82° W. 454 Chains, passing over the pikoes to the top of the Mountain range called Waialeale thence S. 16° E. 224 Chains following along the top of the said Mountain range called Waialeale to a certain peak, standing upon the Southwesterly corner of land called Kailiki from thence E. 76° E. 366 Chains to the top of the hill called Momakukaua bounded by the said Kailiki, thence S. 84° E. 114 Chains crossing the Mountain Road leading to Kilauhaua, and passing down the ridge of hills on the makai side of Kilauhaua, and through a small ravines, to a certain koa tree, a short distance South of the Hanamaulu River, thence S. 82° E. 186 Chains crossing the plantation of H. A. Peirce & Co. to a certain Kukui tree, standing alone on the plains makai of the above plantation of H. A. Peirce & Co. marked K. bounded by the land called Kalafaki, thence N. 75 45' E. 102 Chains passing over the plains to the point of Rock, upon the Sea called Opoi, which forms the North easterly corner of land called Kalafaki, from thence following the Sea to the point of commencement.
Comprising an area of 2,177 Acres

Figure B-1. DOCUMENT 336

Indices

1929 Indices of Awards Made by the Board of Commissioners to Quiet Land Titles in the Hawaiian Islands. Honolulu.

Neller, E., and S. Palama

1973 The Archaeology of Puna, Kaua'i: From the ahupua'a of Niumalu to the ahupua'a of Kipu; Archaeological Reconnaissance of the Hulcia River Valley Area. Archaeological Research Center Hawaii. Prepared for Community Planning, Inc.

Pacific Commercial Advertiser

1906 History of Lihue Plantation Company. 50th Anniversary Edition. July 2, 1906. Honolulu.

Pukui, M.K.

1983 'Olelo No'eau. Honolulu: Bishop Museum Press.

Pukui, M.K., S.H. Elbert, and E.T. Mookini

1974 Place Names of Hawaii. Honolulu: University of Hawaii Press.

Interior Dept. Oct. 4, 1870 In letter from Duncan McBryde to C. C. Harris, that Mr. Isenburg has inquired of him if he knew the mauka Boundary of the Crown Land of Wailua that part which adjoins the above ahupua'a lately sold to Lihue Plantation. Desiring to know whether the said ahupua'a was held by the late Princess Victoria by Royal Patent according to survey by Pease, or by the Ancient Boundary, &c.

Interior Dept. July 20, 1871 In letter from E. Krull to the Commissioner of Crown Lands stating that he is holding the Wailua Estate under two leases from the Hawaiian Govt. first from J. Young to Thos. Brown for 99 years & second from Kamehamahea IV, to Hoffschlaeger for 50 years but since a royal patent had been granted to the Lihue Plantation for the above ahupua'a containing about 800 acres which is included in his 2 leases & which hampers the pasturage of his cattle, he desires to have said leases cancelled & asking that he be allowed to enter into a new Indenture of lease for the same lands with the exception of the lands granted to said plantation for a term of 25 years at a yearly rate of not more than $300.

Int dept Bk 15 p. 109 In list of Konohiki lands, showing that V. Kamamalu is owner of the above land & that it has a sea coast frontage of 3.55 miles.

Public Instruction Jan 24, 1891 J. K. Burkett to Min of Public Instruction - Have talked with Mr. Wilcox & Mr. Isenberg in regard to a lot for a school house at the above place, &c.

Public Instruction Feb. 11, 1893 A. S. Wilcox to Min of Pub Instr Think it best to send a copy of the former survey of the above school lot, as the corner stones have all disappeared & will be difficult to find the exact spot without it &c.

Public Instruction April 3, 1907 Registrar of Conveyances to Supt. of Publ Inst. Submitting Abstract of Title in re a portion of R. P. 4481, Land Claim Award No. 7718, Ap. 2, Part 7, of land situate at the above tract, Kauai, claimed to be owned by the Lihue Plantation Co. Ltd. &c. Notes of Survey of School lot in said tract, attached.

Public Instruction Aug 25, 1909 Supt of Pub Instr to J. K. Farley To assist the Dept in suggesting valuation of 2.03 acres of school lot at the above tract, valued at $300 per acre &c. Doc's relating thereto attached.

Executive Pinkham Aug 4, 1915 Commissioner of Public Lands to Governor Pinkham Informing that the Lihue Plantation Co., delivers to the Koloa Sugar Co., waters rising & flowing on the above lands, paying a little over $10,000 a year &c.

As the above entries indicate, Lihue Plantation had much involvement in Hanamaulu. A brief history of Lihue Plantation Company is presented here, taken from the 50th Anniversary Edition of the *Pacific Commercial Advertiser*, dated July 2, 1906:

> Lihue sugar plantation is interesting because of its phenomenal success and the many obstacles which have been encountered and overcome all through its progress, and especially during the early years when the sugar industry in Hawaii was in its experimental stages.
>
> The early records of the plantation show that in 1854 Messrs. Henry Peirce, Wm. L. Lee, Wm. C. Parke, Edwin O. Hall, C. R. Bishop, C. W. Austin, and W. H. Bates formed a co-partnership under the name of Henry A. Peirce & Co. whose business should be to plant sugar cane, manufacturing sugar, and all other branches of business theretofore carried on by the proprietors of the said plantation, which indicates that the plantation had been in operation prior to that date. Mr. Rice was the manager. The mill which stood on the present site, was run by water power; the crop amounted to 120 tons of sugar. The plantation store stood near the site of the present manager's residence on the road to Koloa, and was conducted by Mr. Samuel T. Alexander. In front of the store was a large open space surrounded by a grove of koa and kukui trees where natives from all parts of the island congregated on Saturday afternoons, bringing products of all kinds for sale. Wailua produced hau rope; Kapaa was noted for its rush hats and mats, while bullock cart loads of melons were brought from Anahola and Kealia. The taro and sugar cane from Wahiawa was regarded by the natives as especially fine in quality and was in demand for the use of the chiefs not only in Kauai, but in Honolulu as well. The salt produced in the ponds of Makaweli took the color of the soil blown from the land and was regarded as a luxury because of its red tinge. Opihi's from the mountains were then, as today, regarded by Hawaiian epicures as particularly toothsome, and all these staple supplies, foods and delicacies found their way to Lihue market.
>
> It was Mr. Rice who first introduced irrigation on the cane fields in Hawaii. The average yield of sugar per acre was, at that time, one and one-half tons and was insufficient to make the industry a profitable one and he conceived the idea of bringing the waters of the Kikihana stream on to the plantation for irrigation, and he built a ditch for that purpose. Even with irrigation the outlook for the place was evidently dark, for in 1861 a proposition was considered to abandon the planting of sugar cane. Mr. Paul Isenberg was an employee of the plantation at the time and it was due to his advice and efforts that the proposition to abandon was given up, and planting was continued.
>
> In the year 1862 Mr. Rice died and Mr. Isenberg succeeded to the management of the estate. Mr. Isenberg was a man of strong character, clear foresight and indomitable will and energy, who, by his perseverance and example, not only pulled Lihue plantation through difficulties of extraordinary success, but he inspired his neighbors with pluck to plod along to a successful issue against conditions, at times, most discouraging. So great was his faith in the future of the sugar industry in Hawaii that, when later he had acquired an interest in the plantation, and his proposal to purchase the Hanamaulu [emphasis own] lands was opposed by his partners, he entered into an agreement with them whereby any loss which might be incurred in the planting of these lands was to be borne by him individually, whereas any profit arising from the same was to go in as a general realization to the several partners. The tract in question contains 17,000 acres and was bought for $8,500, which price was regarded by some members of the firm as too high.
>
> Men of Mr. Isenberg's discernment rarely err in such matters. It was this purchase which gave to Lihue plantation its present water supply, and added thousands of acres of fine cane land....
>
> The purchase of Hanamaulu lands, referred to above, was effected during the sixties. In 1877 Mr. A. S. Wilcox was given a contract to plant the tract on shares; the mill was erected by Lihue plantation....and in 1899 Mr. A. S. Wilcox, giving up Hanamaulu, the cultivation of that place was taken up by Lihue plantation, since which time the two places have been run in conjunction, although the cane of the respective places have been ground at its own mill....Mr. Wolters (manager) succeeded in increasing the crop of the combined places, Lihue and Hanamaulu, to 18,000 tons (Advertiser 1906:60-61).

REFERENCES CITED

Bennett, W.C.

1929 Kauai Archaeology. Papers of the Hawaiian Historical Society No. 17. Printshop Co., Ltd., Honolulu.

1931 Archaeology of Kauai. Bishop Museum Bulletin 80. B.P. Bishop Museum.

Chinen, J.J.

1958 The Great Mahele: Hawaii's Land Division of 1848. Honolulu: University of Hawaii Press.

1961 Original Land Titles in Hawaii. Privately published.

Handy, E.S., and E.G. Handy

1972 Native Planters in Old Hawaii: Their Life, Lore and Environment. Bishop Museum Bulletin 233. B.P. Bishop Museum.

Appendix D

TRAFFIC STUDY–
KAKU ASSOCIATES

MARCH
1990

TRAFFIC STUDY FOR

HANAMAULU AFFORDABLE HOUSING PROJECT

Prepared for:

AMFAC/JMB Hawaii, Inc.

Prepared by:

KAKU ASSOCIATES

TRAFFIC STUDY FOR
HANAMAULU AFFORDABLE HOUSING PROJECT
Lihue, Kauai, Hawaii

Revised March, 1990

Prepared for:

Amfac/JMB Hawaii, Inc.

Prepared by:

KAKU ASSOCIATES
1453 Third Street, Suite 400
Santa Monica, California 90401
(213) 458-9916

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

This report documents the findings of a study conducted by Kaku Associates to evaluate potential traffic impacts of the proposed residential development in Lihue, Kauai. The study estimated the level of traffic which will be generated by the project, and evaluated the impact of this additional traffic on overall Kuhio Highway traffic operations.

PROJECT DESCRIPTION

The project site is located southeast of the intersection of Kuhio Highway & Kapule Highway, immediately northeast of the existing Hanamaulu Road residential subdivision. The site is currently undeveloped. Figure 1 shows the general project location.

The proposed development will consist of approximately 330 single family residential and 120 multi-family dwelling units, to be developed in two equal phases. Access to the project would be provided from Kuhio Highway via a single street, planned to be located roughly midway between the existing intersections at Hanamaulu Road and Kapule Highway.

STUDY SCOPE

The scope of analysis for this traffic study was developed cooperatively with staff from the State of Hawaii Department of Transportation - Highways Division, and intended to satisfy the requirements for an Environmental Assessment (EA) of the project. The study focused on identifying the impact of the proposed project on Kuhio Highway traffic conditions, with detailed peak hour Level of Service (LOS) analyses conducted at two intersections:

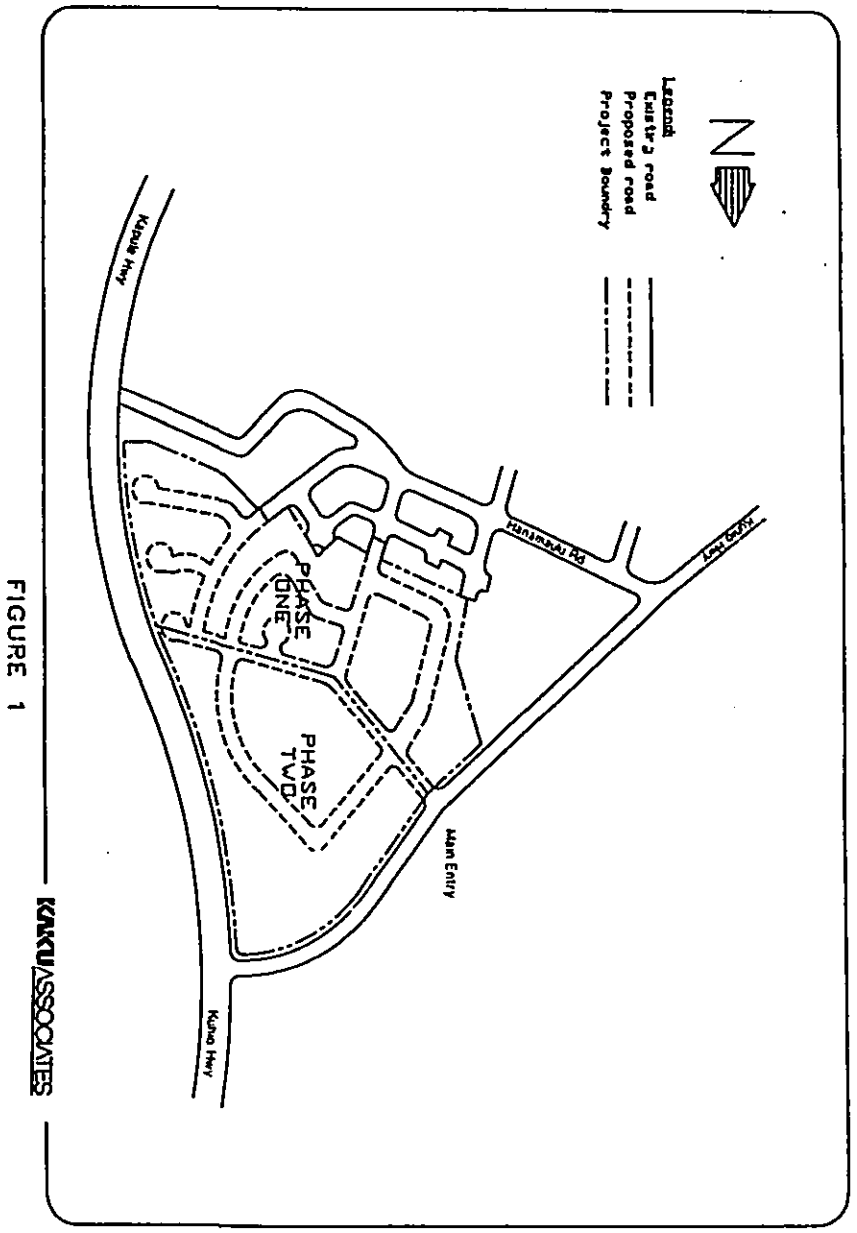


FIGURE 1

- Kuhio Highway & Kapule Highway, and
- Kuhio Highway & the proposed site access point (called "Main Access" in this report).

In addition, Average Daily Total (ADT) traffic volumes were also estimated on several street segments, including Kuhio Highway, Kapule Highway, Hanamaulu Road, and Main Access.

Assessment of the development's impact required evaluation of prevailing traffic conditions before and after project completion. This involved analysis of the following scenarios:

- Existing - This includes assessment of physical street characteristics, major travel patterns, traffic volumes and peak hour levels of service.
- Cumulative Base - This step in the analysis forecasts future traffic conditions after completion of other known nearby developments, combined with regional traffic growth. This represents future conditions without the proposed project, or the "no project" alternative. For the purpose of this traffic assessment, the forecast year is 1993.
- With Proposed Project - This scenario reviews the resulting operations with traffic volumes from the proposed project added to Cumulative Base conditions. This traffic study evaluates the impact of the entire proposed development and does not separate the individual project phases.

The report is organized into five sections. Section II describes the existing conditions relating to traffic and circulation in the vicinity, and introduces the measures used to quantify traffic operations. The methodology and results of traffic forecasts are presented in Section III. Section IV describes the level of service analysis, evaluating the impact of the project. Section V discusses and recommends potential mitigation measures.

II. EXISTING CONDITIONS

ENVIRONMENTAL SETTING

The project site is located approximately two miles northeast of the Lihue urban center, immediately northeast of the primarily residential Hanamaulu Town. Parcels north and east of the site are currently in agricultural use.

DESCRIPTION OF STREETS & HIGHWAYS

The site is southeast of the intersection of two major highways, Kuhio Highway (State Route 56) and Kapule Highway (State Route 51). Brief descriptions follow for the streets of primary importance to this study. The Appendix provides schematic lane configurations at the relevant intersections.

- Kuhio Highway (Route 56/560) - Kuhio Highway is a rural two-lane minor arterial (State of Hawaii designation) which generally follows the coastline north from the site to Haena. West and south of the site, Kuhio Highway passes through Hanamaulu Town and enters the commercial district of Lihue, providing a truck climbing lane between Hanamaulu and Lihue and four travel lanes between Eha Street and its terminus at Kaumualii Highway. The posted speed limit is 35 mph between Lihue and Kapule Highway, and 50 mph north to Wailua. In this area, Kuhio Highway is controlled by traffic signals (signalized) at Kapule Highway and Laukona Street.
- Kapule Highway (Route 51) - Kapule Highway is a two-lane rural minor arterial which runs north-south between Kuhio Highway and Rice Street. The section of Kapule Highway between Kuhio Highway and Ahukini Road was opened in the fall of 1988, and is frequently called the Hanamaulu-Ahukini Cutoff Road. The posted speed limit is 50 mph. Kapule Highway is signalized at Kuhio Highway and Ahukini Road.
- Hanamaulu Road - Hanamaulu Road serves the existing residential subdivision south of Kuhio Highway, providing collector street width (roughly 24' pavement on a 56' right-of-way) between Kuhio Highway and Hanamaulu Place. Hanamaulu Road T-intersects Kuhio Highway and is stop-controlled (unsignalized) at that intersection.

EXISTING TRAFFIC VOLUMES AND LEVEL OF SERVICE

Existing traffic counts were obtained from the State of Hawaii Department of Transportation for the year 1989 and cross-checked against previous 1988 and 1987 counts. The reconciled 1989 volumes are displayed in Figure 2.

As shown, Kapule Highway carries a slightly higher traffic volume than Kuhio Highway south of their intersection. Kuhio Highway carries approximately 26,900 vehicles per day (vpd) north of the intersection.

Traffic volumes in the area exhibit peaks during the morning (peak hour roughly 7:00-8:00 a.m.) and afternoon (peak hour roughly 4:00-5:00 p.m.) periods, with the afternoon peak showing the highest volumes of the day. As shown on Figure 2, morning traffic volumes are heavier in the Lihue-bound direction, with afternoon volumes heavier in the reverse direction.

Level of Service Methodology

Level of Service (LOS) is a qualitative measure used to describe traffic flow conditions, ranging from completely uncongested conditions at LOS A to overloaded conditions at LOS F. Peak hour LOS is typically based on the analysis of intersections, since it is at these points that conflict flows of traffic interact. Tables 1 and 2 provide brief descriptions of the Level of Service concept as it applies to signalized and unsignalized (stop-controlled) intersections. The Critical Movement Analysis (CMA) methodology, specified in Research Circular 212 of the Transportation Research Board, was used to calculate Volume-to-Capacity (V/C) ratios and LOS at signalized intersections. The 1985 Highway Capacity Manual (HCM) method was used to quantify LOS at unsignalized intersections.

Existing Level of Service

Table 3 shows the current operating conditions at the intersection of Kuhio Highway & Kapule Highway during peak hours. As shown, the intersection currently

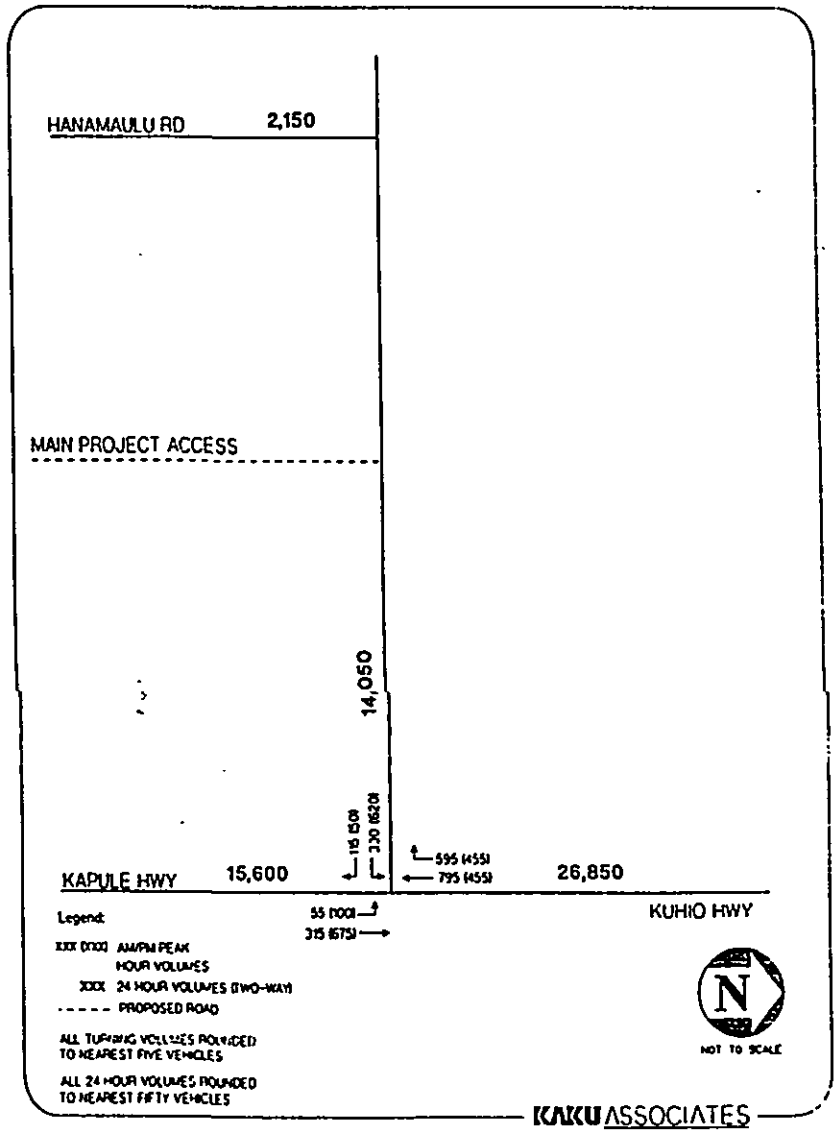


Figure 2
EXISTING TRAFFIC VOLUMES

TABLE 1

LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTIONS

Level of Service	Volume/Capacity Ratio	Definition
A	0.00 - 0.60	EXCELLENT. No vehicle waits longer than one red light and no approach phase is fully used.
B	0.61 - 0.70	VERY GOOD. An occasional approach phase is fully utilized; many drivers begin to feel somewhat restricted within groups of vehicles.
C	0.71 - 0.80	GOOD. Occasionally drivers may have to wait through more than one red light; backups may develop behind turning vehicles.
D	0.81 - 0.90	FAIR. Delays may be substantial during portions of the rush hours, but enough lower volume periods occur to permit clearing of developing lines, preventing excessive backups.
E	0.91 - 1.00	POOR. Represents the most vehicles intersection approaches can accommodate; may be long lines of waiting vehicles through several signal cycles.
F	Greater than 1.00	FAILURE. Backups from nearby locations or on cross streets may restrict or prevent movement of vehicles out of the intersection approaches. Tremendous delays with continuously increasing queue lengths.

Source:
Transportation Research Board, Transportation Research Circular No. 212, Interim Materials on Highway Capacity, January 1980.

TABLE 2

LEVEL OF SERVICE DEFINITIONS FOR
TWO-WAY STOP-CONTROLLED INTERSECTIONS

Available Reserve Capacity	Level of Service	Expected Delay to Minor Street Traffic
400 or more	A	Little or no delay.
300 to 399	B	Short traffic delays.
200 to 299	C	Average traffic delays.
100 to 199	D	Long traffic delays.
0 to 99	E	Very long traffic delays.
Less than 0	F	Failure - extreme congestion.

Source: Transportation Research Board, Highway Capacity Manual, Special Report 209, 1985.

Source: Transportation Research Board, Highway Capacity Manual, Special Report 209, 1985.

exhibits good to fair operation, with the PM peak hour LOS somewhat poorer due to the higher volume of conflicting traffic.

TABLE 3

EXISTING PEAK HOUR INTERSECTION LEVELS OF SERVICE

Intersection	Peak Hour	Existing V/C Ratio	Existing Level of Service
Kuhio Highway and Kapule Highway	AM	0.79	C
	PM	0.86	D

III. FUTURE TRAFFIC PROJECTIONS

Evaluating the impact of the proposed project involved estimating the traffic volume which will be generated, and distributing this traffic onto the surrounding street system. The project traffic was then added to the on-street traffic conditions anticipated at the time of project completion. The methodology and key assumptions used in this analysis are described below.

PROPOSED PROJECT TRAFFIC VOLUMES

Traffic forecasts for the proposed development were developed using the specific assumptions and techniques described in this section. This methodology was also used to estimate traffic due to the other nearby development projects identified.

Traffic Generation

Project-related traffic generation projections were based on the procedures set forth in "Trip Generation," Fourth Edition, 1987, by the Institute of Transportation Engineers. Table 4 shows the generation estimates for the project, as well as the "per unit" rates used to calculate the generated traffic volumes. As indicated in Table 4, the development is expected to generate approximately 4,060 trips per weekday. Of this total, 310 trips (80 inbound and 230 outbound) are expected during the morning peak hour, and 420 trips (270 inbound and 150 outbound) are expected during the afternoon peak hour.

Traffic Distribution

The directional distribution of traffic generated by a development is dependant on numerous factors, such as the site location in relation to employment, shopping, and other residential developments in the area, as well as the

TABLE 4
PROPOSED PROJECT TRAFFIC GENERATION

Land Use	Size	Daily Trips	AM Peak Hour Total	AM In	AM Out	PM Peak Hour Total	PM In	PM Out
Phase I:								
SF-Residential	165 DU	1,660	125	35	90	165	105	60
MF-Residential	60 DU	370	30	5	25	45	30	15
		2,030	155	40	115	210	135	75
Phase II:								
SF-Residential	165 DU	1,660	125	35	90	165	105	60
MF-Residential	60 DU	370	30	5	25	45	30	15
		2,030	155	40	115	210	135	75
Total (Phases I & II)		4,060	310	80	230	420	270	150

Applicable Traffic Generation Rates:

Land Use	Rate Per	Daily Trips	AM Peak Hour Total	AM In%	AM Out%	PM Peak Hour Total	PM In%	PM Out%
MF-Residential	DU	6.1	0.53	18%	82%	0.67	68%	32%
SF-Residential	DU	10.1	0.75	27%	73%	1.01	63%	37%

1. Rate Source: Institute of Transportation Engineers, "Trip Generation," Fourth Edition, 1987.
2. SF = Single Family; MF = Multi-Family; DU = Dwelling Unit.
3. Traffic volumes rounded to nearest 5 vehicles.

placement of site access points to the surrounding streets. Given the planned residential use, the directional distribution used in this analysis was based on the geographic distribution of surrounding employment and shopping. The following summarizes the expected distribution:

Direction	Percent
North on Kuhio Hwy	33%
West on Kuhio Hwy	33%
South on Kapule Hwy	34%
Total	100%

Traffic Volume Assignment

Using the traffic generation and distribution figures described above, project traffic was assigned to the surrounding street network. Figure 3 illustrates the assignment of peak hour project-related traffic.

Additional Access onto Kuhio Highway

The proposed development could also potentially provide additional access onto Kuhio Highway. In order to investigate the implications of this, project-related traffic volumes were also estimated under the assumption of two points of access, with the second to be located between the Main Access and Kapule Highway intersections. Figure 4 shows the resulting traffic assignment.

As can be seen by comparing Figures 3 and 4, the second access would not affect traffic volumes at any intersection other than at the Main Access. At the Main Access/Kuhio intersection, turning volumes would be reduced, but through volumes increased. This phenomenon of increased through traffic when spread out by multiple access points is a contributing factor to poor levels of service on highways, and the reason that access onto major highways is limited to the extent possible.

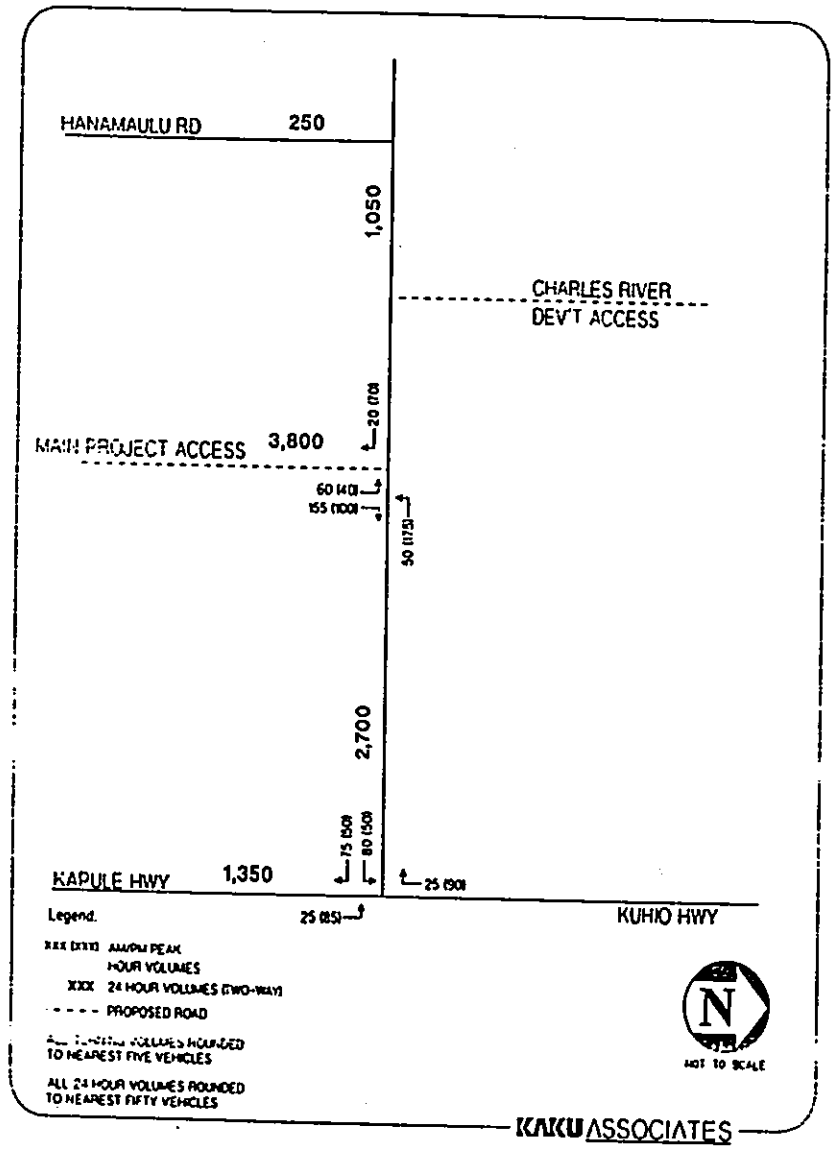


Figure 3
PROPOSED PROJECT TRAFFIC VOLUMES
13

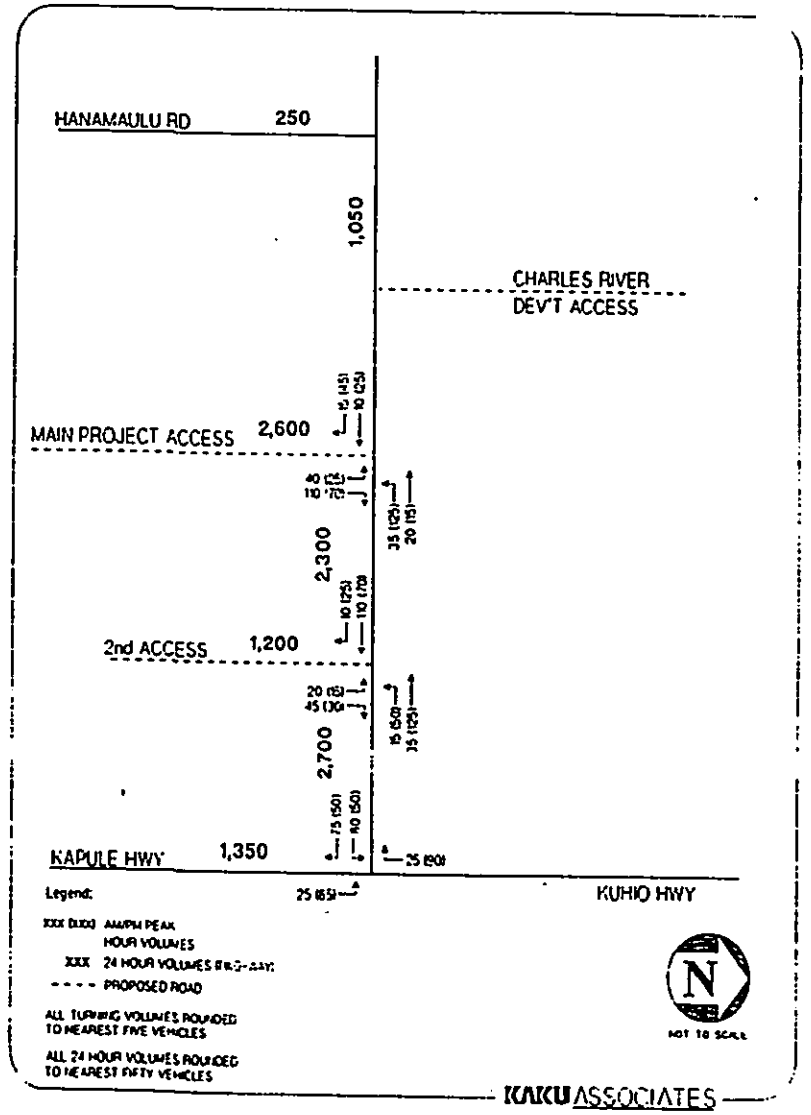


Figure 4
PROPOSED PROJECT TRAFFIC VOLUMES
WITH TWO ACCESS POINTS

14

The total volume of traffic on the Main Access road expected under the condition of one access, 3,800 vpd, is within the range acceptable for collector streets. Subsequent sections of this report also discuss in more detail the finding that peak hour traffic operations at the Main Access will be acceptable with one access.

Furthermore, due to the alignment of Kuhio Highway at this location, it is likely that the second site access would be located on the inside of a horizontal curve. While manageable, this location could raise safety issues due to the potential for limited sight distance along horizontal curves. Since the additional access is not necessary on the basis of traffic capacity, project access onto Kuhio Highway should be limited to a single collector street.

CUMULATIVE BASE TRAFFIC PROJECTIONS

Traffic increases from the proposed project must be evaluated within the context of traffic increases from regional growth, as well as specific other developments in the area. These factors are discussed below.

Regional Traffic Growth

To account for growth in traffic due to developments outside the study area, traffic volumes at each analyzed location were inflated by 10% to the horizon year of 1993. The selection of this factor was based on observed trends in traffic volumes in the area.

Cumulative Projects Traffic

In order to evaluate the impact of the proposed project relative to other specifically planned developments in the vicinity, a list of cumulative projects was prepared through consultation with the State Department of Transportation and others. The developments included are sufficiently near the proposed project to potentially affect traffic demands at the intersections analyzed. Two

projects were included, listed in Table 5 and located as shown in Figure 5. Traffic generation estimates for these projects are also included in Table 5, with the appropriate rates provided for reference. The directional distribution for the Hanamaulu Elementary School was based on the planned service area for the school. For the Charles River development, the same distribution pattern used for the proposed project was assumed.

The resulting total traffic volumes, illustrated in Figure 6, represent the 1993 "Cumulative Base" traffic projections at the locations evaluated. This represents the expected future traffic conditions within the study area <u>without</u> the addition of project-related traffic.

CUMULATIVE PLUS PROJECT TRAFFIC PROJECTIONS

Project-related traffic was then added to the Cumulative Base volumes, as shown in Figure 7. This represents future traffic conditions <u>with</u> the proposed project. The figure shows that east of the Main Access, the combination of all developments and regional growth will increase traffic volumes on Kuhio Highway substantially from existing conditions, to approximately 19,700 vpd.

TABLE 5
CUMULATIVE PROJECTS TRAFFIC GENERATION

Land Use	Size	Daily Trips	AM Peak Hour Total	In	Out	PM Peak Hour Total	In	Out
Charles River Development								
MF-Residential	242 DU	1,480	130	25	105	160	110	50
Hanamaulu Elementary School								
Elementary School	900 Stds	900	210	125	85	50	20	30
Total		2,380	340	150	190	210	130	80

Applicable Traffic Generation Rates:

Land Use	Rate Per	Daily Trips	AM Peak Hour Total	In%	Out%	PM Peak Hour Total	In%	Out%
MF-Residential [1]	DU	6.1	0.53	18%	82%	0.67	68%	32%
Elem. School [2]	Student	1.0	0.23	60%	40%	0.05	40%	60%

1. Rate Source: Institute of Transportation Engineers, "Trip Generation," Fourth Edition, 1987.
2. Rate Source: San Diego Association of Governments, "Trip Generators," September 1989.
3. SF = Single Family; MF = Multi-Family; DU = Dwelling Unit.
4. Traffic volumes rounded to nearest 5 vehicles.

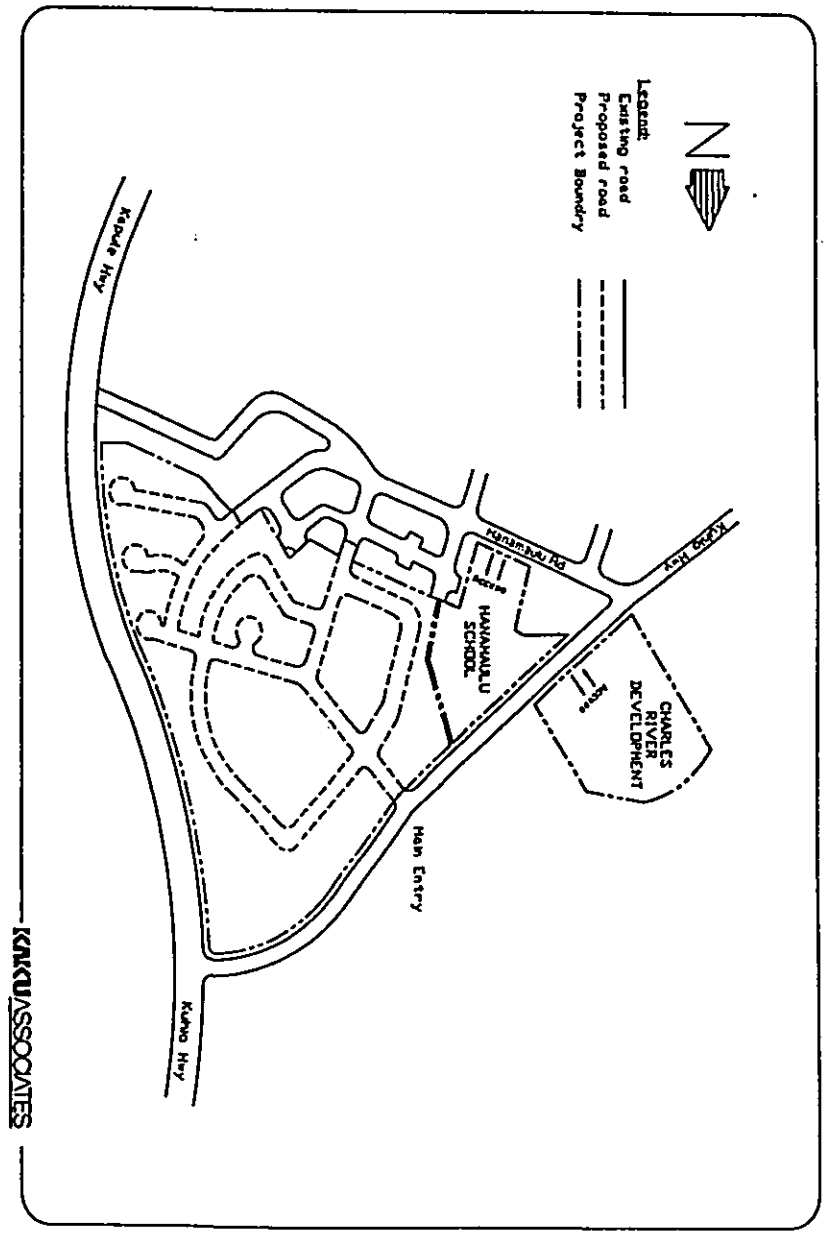


FIGURE 5

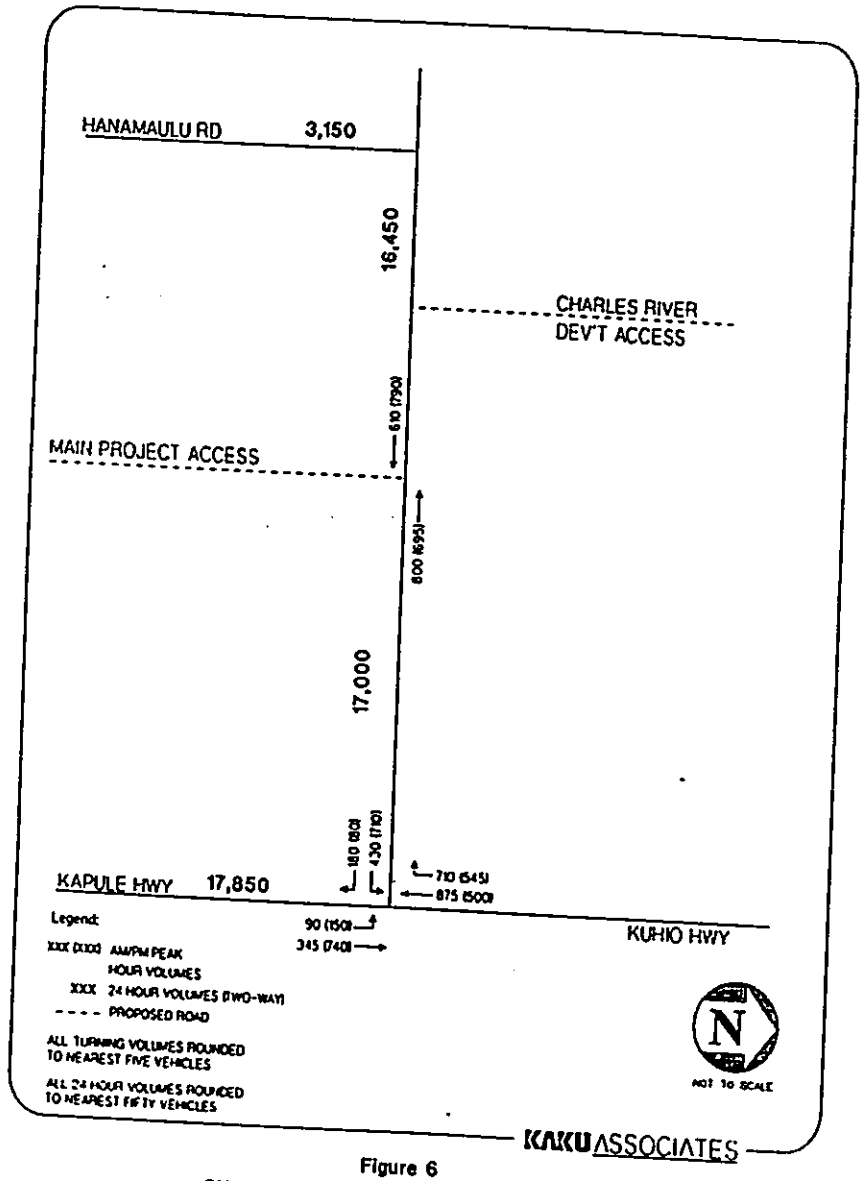


Figure 6
CUMULATIVE BASE TRAFFIC VOLUMES

19

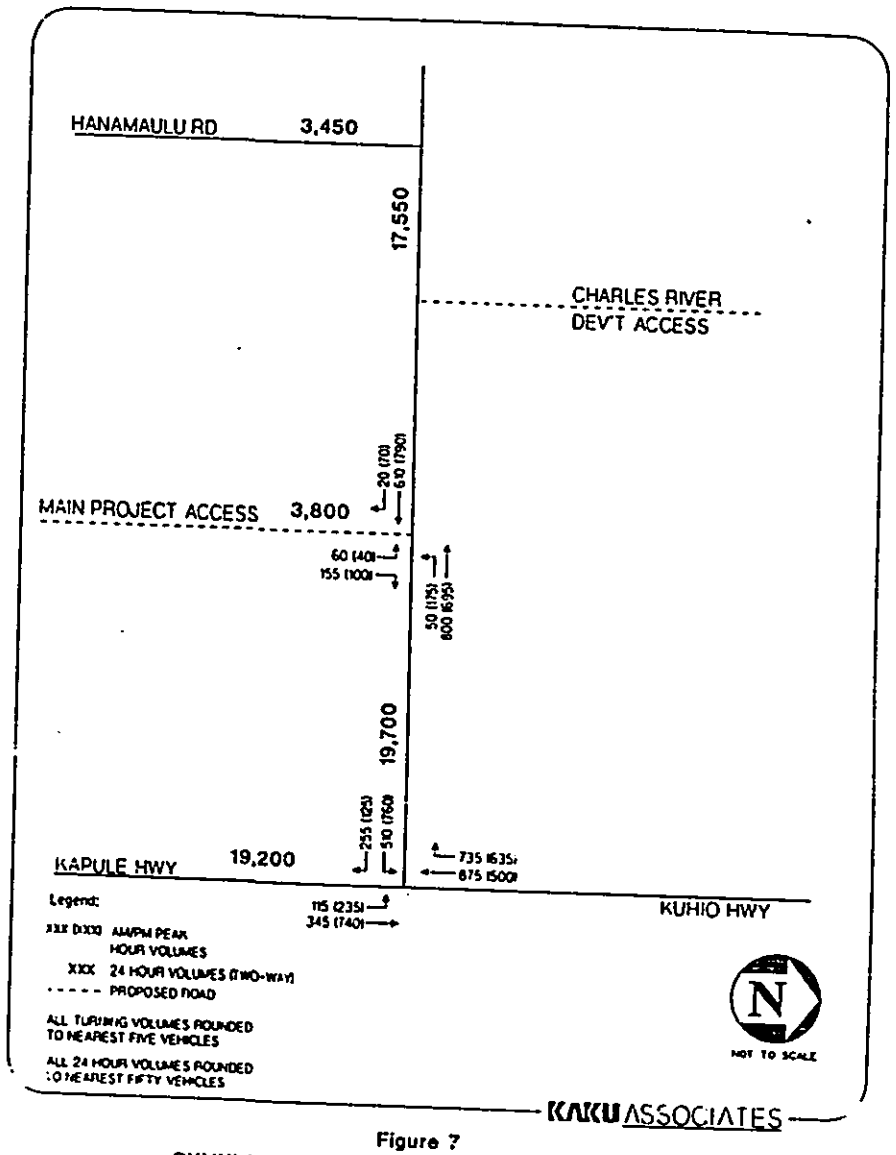


Figure 7
CUMULATIVE BASE PLUS PROPOSED PROJECT TRAFFIC VOLUMES

20

IV. TRAFFIC IMPACT ANALYSIS

This section presents the results of capacity analyses at the intersections for conditions before and after project completion. Two intersections were analyzed for peak hour LOS: Kuhio Hwy/Kapule Hwy (signalized), and Main Access/Kuhio Hwy (unsignalized). A description and discussion of the resulting Levels of Service is provided below.

LEVEL OF SERVICE ANALYSIS

Cumulative Base Conditions

Table 6 shows the expected LOS at the Kuhio/Kapule intersection under cumulative base conditions. Table 6 also repeats the existing (1989) LOS data presented in Table 3. As shown, operations at the intersection will deteriorate substantially from existing, with LOS E (near capacity) conditions expected during both peak hours.

TABLE 6

CUMULATIVE BASE PEAK HOUR INTERSECTION LEVELS OF SERVICE

Intersection	Peak Hour	Existing V/C Ratio	Existing Level of Service	Cumulative Base V/C Ratio	Cumulative Base Level of Service
Kuhio Highway and Kapule Highway	AM	0.79	C	0.93	E
	PM	0.86	D	0.97	E

With Proposed Project

Table 7 shows the expected LOS after project completion as well as a comparison to "before project" operations. The V/C ratio at Kuhio/Kapule will increase by 0.07 during the morning and 0.03 during the afternoon peak hours for a total V/C ratio of 1.00, at capacity, during both peaks. This resulting adverse condition warrants investigation into possible mitigation measures, the specifics of which are discussed in the following section.

Table 7 also shows the expected LOS at the Main Access drive on Kuhio Highway. Of the movements which yield to through traffic, the left turn out of the site is expected to show the worst level of Service, E. All other movements will flow acceptably at LOS C or better during both peak hours.

While not reflected in Table 4, the volumes expected at the Main Access are sufficiently high to warrant installation of a left turn lane and right turn deceleration taper on Kuhio Highway. Without these lanes, turning movements of project-related traffic could cause substantial delays to through traffic on Kuhio Highway.

TABLE 7

CUMULATIVE PLUS PROJECT PEAK HOUR INTERSECTION LEVELS OF SERVICE

Intersection	Peak Hour	Cumulative Base V/C	Cumulative Base LOS	Cumulative Plus Project V/C	Cumulative Plus Project LOS	Increase in V/C
Kuhio Highway and Kapule Highway	AM	0.93	E	1.00	E	+ 0.07
	PM	0.97	E	1.00	E	+ 0.03

Intersection	Peak Hour	Move-ment	Cumulative Base Res. Cap.	Cumulative Base LOS	Cumulative Plus Project Res. Cap.	Cumulative Plus Project LOS
Kuhio Highway and Main access	AM	LT Out	No Conflicting		50	E
		RT Out	Moves at		398	B
		LT In	This Location		561	A
	PM	LT Out			25	E
		RT Out			336	B
		LT In			295	C

V. MITIGATION MEASURES

The previous section indicated that traffic increases due to regional growth and pending developments will result in at-or-near capacity operations at the intersection of Kuhio Highway & Kapule Highway. Substantial delays could also be experienced by motorists who attempt to turn left out of the Main Access onto Kuhio Highway during peak periods. This section discusses possible mitigation measures to improve traffic operations at these locations.

PROJECT ACCESS ONTO KUHIO HIGHWAY

Due to the high traffic volumes on Kuhio Highway, the Main Access intersection will satisfy peak hour warrants for signalization, as specified in the Manual on Uniform Traffic Control Devices for Streets and Highways, Federal Highway Administration, 1988. However, this traffic control would increase delays on Kuhio Highway for marginal benefit on the minor street, since only the left turn movement out of the site would experience significant delays without a traffic signal. Signalization is therefore not recommended. Adequate levels of service will be maintained by providing a westbound left turn storage lane, and a right turn deceleration lane at the Main Access on Kuhio Highway (diagrammed in the Appendix). Installation of these turn lanes will permit smooth movement of project-related traffic into and out of the main site access road, without adversely affecting traffic flow on Kuhio Highway.

In addition, the project should provide at least two street connections with Hanamaulu Road southwest of the site, and a traffic signal should be installed at the Kuhio Highway/Hanamaulu Road intersection. This would permit project-related traffic to use the protection of that signal when necessary to make the left turn onto Kuhio Highway. Since difficulty in making this movement from the Main Access is only expected during peak periods, the additional traffic will not overload the local streets abutting Hanamaulu Road. However, providing at least two street connections between the proposed project and the existing

subdivision will increase spreading of this traffic volume among the available streets.

Both Kuhio Highway intersections, at the proposed project access and at Hanamaulu Road, are expected to marginally warrant traffic signals under future conditions. Signalization of the Kuhio Highway at Hanamaulu Road is recommended in lieu of signalization at the proposed project access, since it will provide the following benefits:

- Provide protection for pedestrians crossing Kuhio Highway, the number of which is likely to increase after completion of the Hanamaulu Elementary School.
- Reduce traffic delays for vehicles exiting Hanamaulu Road during peak periods.
- Provide consistent spacing of traffic signals on Kuhio Highway, to be located at Laukona Street, Hanamaulu Road, and Kapule Highway. Consistent spacing generally permits smoother traffic flow on the major street. Signalization at both the project access and Hanamaulu Road would cause unjustified delays to through traffic on Kuhio Highway.
- Increase platooning (grouping) of traffic moving on Kuhio Highway past the proposed project access. Platooning of major street traffic increases the frequency and size of gaps in this flow, and makes it easier for traffic to enter the flow from side streets.

KUHIO HIGHWAY/KAPULE HIGHWAY INTERSECTION

As discussed in the previous section, traffic increases due to regional growth and the completion of pending developments including this proposed project will result in peak hour Level of Service E, near LOS F, at this intersection. The maximum benefit would be realized by combining improvement of this intersection with the continuous widening of Kuhio Highway to four lanes from Kapule Highway north to Wailua/Kapaa. However, if the Kuhio Highway widening project cannot be completed in a timely manner it may still be worthwhile to improve the Kuhio/Kapule intersection in the interim.

Acceptable operation at the Kuhio/Kapule intersection would be maintained by installation of a second eastbound lane (to be a shared left-right turn lane

approaching the intersection) and a second northbound through lane at the Kuhio Highway/Kapule Highway intersection, as shown schematically in the Appendix. With these additional lanes, LOS C can be maintained during both peak hours. If this improvement precedes widening of Kuhio Highway, northbound traffic will be required to merge into a single north of the intersection. However, merging movements do not strain traffic capacity nearly as much as intersections, and overall traffic operations will still be significantly improved.

It should be noted, however, that as the only arterial street serving the corridor, Kuhio Highway already exhibits traffic volumes at capacity for a two-lane road, and traffic demand along this corridor will continue to increase irrespective of the proposed project (LOS E under Cumulative Base conditions, Table 6). It is therefore highly likely that improvement of the Kuhio/Kapule intersection will be justified even if the project site is not developed. Capacity constraints in the area are endemic to the Lihue-to-Kapaa corridor, and would be most efficiently approached by a regional solution.

SETBACK ALONG KUHIO HIGHWAY

The County of Kauai and State Of Hawaii Department of Transportation are currently developing a long range highway plan for Kauai, evaluating and prioritizing needed highway projects. Among the long range highway projects currently under consideration is the widening of Kuhio Highway to four lanes between Kapule Highway and Maalo Road. Since it is possible that this widening will be incorporated into the plan, the proposed development should reserve sufficient right-of-way along its Kuhio Highway frontage to accommodate this widening.

The following points summarize the recommended project-related design criteria:

- The project should provide a single access road onto Kuhio Highway, and should be constructed to County standards for a collector street.
- At least two street connections should be provided to Hanamaulu Road.
- At the main access intersection with Kuhio Highway, a westbound left turn lane and eastbound right turn lane should be provided. The main access should be striped to provide sufficient width so that vehicles turning

right onto Kuhio Highway would not be blocked by vehicles waiting to turn left.

- Sufficient right-of-way should be preserved along the site's frontage to permit the widening of Kuhio Highway to four lanes.

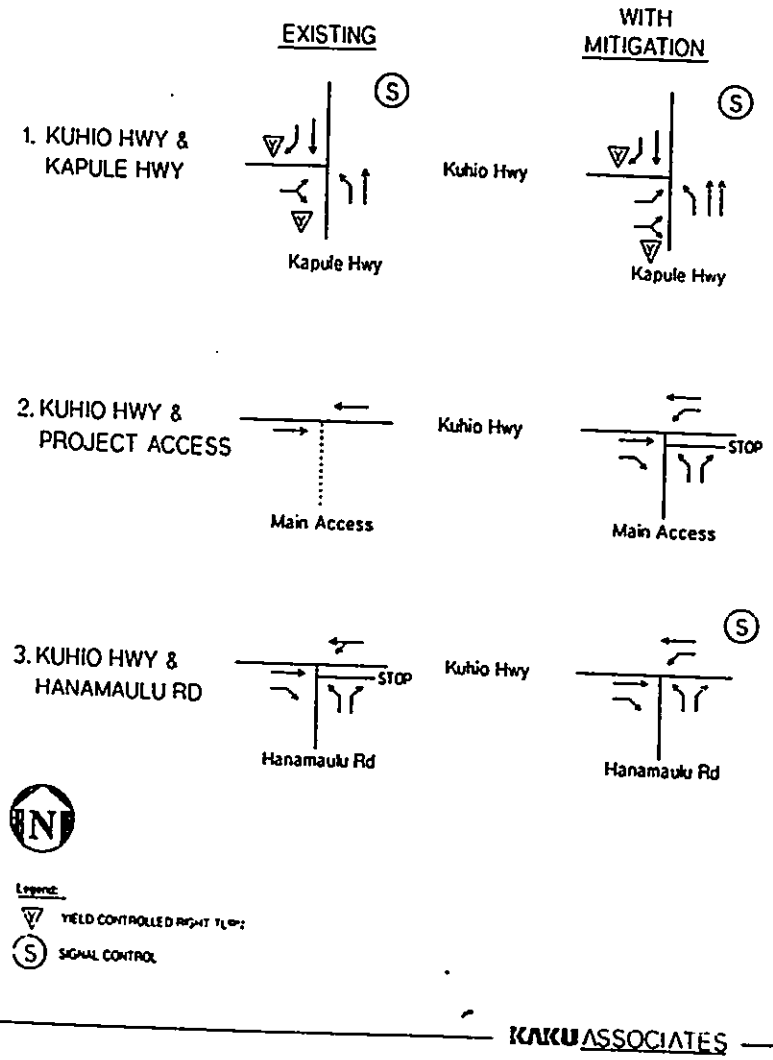
Related off-site improvements which will be necessary to accommodate traffic increases due to regional growth and pending developments include:

- A traffic signal should be installed at the intersection of Hanamaulu Road & Kuhio Highway.
- The Kuhio Highway/Kapule Highway intersection should be widened to provide an additional eastbound lane (to be a shared left-right turn lane approaching the intersection) and an additional northbound through lane, with the longer-range goal of widening Kuhio Highway to four lanes north to Wailua/Kapaa.

APPENDIX

INTERSECTION LANE CONFIGURATIONS

Intersection Lane Configurations



KAKU ASSOCIATES

Appendix E

AIR QUALITY IMPACT REPORT–
J.W. MORROW

AIR QUALITY IMPACT REPORT
AMPAC RESIDENTIAL PROJECT
Hanamaulu, Kauai

January 22, 1990

Prepared for

Helber, Hastert & Kimura

Prepared by

J. W. MORROW
ENVIRONMENTAL MANAGEMENT CONSULTANT
KAILUA, HAWAII

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

AMFAC is proposing to develop a 450-unit residential project on a parcel of land situated between the Kuhio and Kapule Highways at Hanamaulu, Kauai (Figure 1). The property was formerly used for sugar cane cultivation, but is currently fallow (Figure 2). Plans call for construction of approximately 120 multi-family and 330 single-family units. Completion and occupancy is estimated to occur by 1993.

The purpose of this report is to assess the impact of the proposed development on air quality on a local and regional basis. The overall project can be considered an "indirect source" of air pollution as defined in the Federal Clean Air Act [1] since its primary association with air quality is due to its inherent generation of mobile source, i.e., motor vehicle activity. Much of the focus of this analysis, therefore, is on the project's ability to generate traffic and the resultant impact on air quality. Air quality impact was evaluated for existing (1990) and future (1993) conditions.

A project such as this also has off-site impacts due to increased demand for electrical energy which must be met through the combustion of some type of fuel. This combustion process results in pollutant emissions to the air which have been addressed.

Finally, during construction of the various buildings and facilities air pollutant emissions will be generated due to vehicular movement, grading, concrete and asphalt batching, and general dust-generating construction activities. These impacts have also been addressed.

2. AIR QUALITY STANDARDS

A summary of State of Hawaii and national ambient air quality standards is presented in Table 1 [2, 3]. Note that Hawaii's standards are not divided into primary and secondary standards as are the Federal standards.

Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [4].

Some of Hawaii's standards are clearly more stringent than their Federal counterparts but, like their Federal counterparts, may be exceeded once per year. It should also be noted that in April, 1986, the Governor signed amendments to Chapter 59 (Ambient Air Quality Standards) making the State's standards for particulate matter and sulfur dioxide the same as national standards. In the

case of particulate matter, however, this uniformity did not last long. On July 1, 1987, the EPA revised the Federal particulate standard to apply only to particles 10 microns or less in diameter (PM-10) [5], leaving the State once again with standards different than the Federal ones.

In the case of the automotive pollutants [carbon monoxide (CO), oxides of nitrogen (NOx), and photochemical oxidants (Ox)], there are only primary standards. Until 1983, there was also a hydrocarbons standard which was based on the precursor role hydrocarbons play in the formation of photochemical oxidants rather than any unique toxicological effect they had at ambient levels. The hydrocarbons standard was formally eliminated in January, 1983 [6].

The U.S. Environmental Protection Agency (EPA) is mandated by Congress to periodically review and re-evaluate the Federal standards in light of new research findings [7]. The last review resulted in the relaxation of the oxidant standard from 160 to 240 micrograms/cubic meter (ug/m3) [8]. The carbon monoxide (CO), particulate matter, sulfur dioxide (SO2), and nitrogen dioxide (NO2) standards are under review, and no formal proposed changes have been made yet [9].

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [10]. There simply can be no visible emissions from fugitive dust sources.

3. EXISTING AIR QUALITY

3.1 General. The State Department of Health maintains a network of air monitoring stations around the State to gather data on the following regulated pollutants:

- o total suspended particulates (TSP)
- o particulate matter - 10 microns (PM-10)
- o sulfur dioxide (SO2)
- o carbon monoxide (CO)
- o ozone (O3)
- o lead (Pb)

In the case of TSP, PM-10, and SO2, measurements are made on a 24-hour basis to correspond with the averaging period specified in State and Federal standards. Samples are collected once every

six days in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide and ozone, however, are measured on a continuous basis due to their short-term (1-hour) standards. Lead concentrations are determined from the TSP samples which are sent to an EPA laboratory for analysis. It should also be noted that the majority of these pollutants are monitored only in Honolulu.

3.2 Department of Health Monitoring Sites. During the 1970's and early 80's there was routine monitoring of TSP and SO2 at Lihue town not far from the project site; however, the State ceased most monitoring on the Neighbor Islands, including Kauai, in October, 1985. A new PM-10 sampler was installed in Lihue and has operated since 1986. The most recent annual data from that station are summarized in Tables 2 and 3. Both State and Federal air quality standards for the monitored pollutants appear to be met.

3.3 Onsite Carbon Monoxide Sampling. In conjunction with this study, air sampling was conducted at the Kuhio Highway - Kapule Highway intersection in January, 1990.

The actual sampling site was approximately 10 meters from the road edge and on the southwest side of the intersection due to the northeasterly winds prevailing at the time. A continuous carbon monoxide (CO) instrument was set up and operated during the a.m. and p.m. peak traffic hours based on a review of State Department of Transportation data [11]. An anemometer and vane were installed to record onsite surface winds at a 2.5 meter height. A simultaneous manual count of traffic along Queen Kuhio Highway was also made. The variability of each of the measured parameters during the peak hours is clearly seen in Figures 3 and 4.

During the January 9th p.m. peak hour, winds were 2 - 3 m/sec NE tradewinds and the CO level averaged about 3.3 milligrams per cubic meter (mg/m3). On January 10th during the a.m. peak hour, winds continued to be northeasterly but somewhat lower velocity (1.5 - 2 m/sec), and the CO concentration averaged 2.7 mg/m3. The observed CO levels were slightly lower than the computer-generated "worst case" estimates reported in Section 6 of this report due primarily to the higher windspeeds occurring during the field sampling. Traffic volumes were somewhat higher than those found by the State DOT in their September, 1989 counts [11]. The p.m. peak-hour volume on Kuhio Highway was about 23% higher than reported only a few months earlier.

4. CLIMATE & METEOROLOGY

4.1 Temperature & Rainfall. The project area is typical of Hawaii's climate with little seasonal or diurnal temperature

variation. Monthly temperature averages vary by only about 6 degrees from the warmest months (July and August) to the coolest (January and February) [12]. The mean annual temperature of 75.2 degrees Fahrenheit (F) is slight cooler than Honolulu's 77.0 F. This is due to Lihue's greater cloudiness (130.9 vs. 97.7 days) and annual rainfall (44.02 vs. 23.47 inches). Lihue also experiences some 201 days per year with rainfall of 0.01 inch or more [13]. With this temperature and rainfall profile, the area has a Thornwaite precipitation/evaporation (P/E) index of [14].

From an air pollution standpoint, the greater cloudiness means more neutral atmospheric stability conditions which can contribute to higher pollutant levels. On the other hand, the greater rainfall can contribute to more efficient removal of particulates and water-soluble gases from the atmosphere.

4.2 Surface Winds. Wind data from the nearby Lihue Airport indicate the typical predominance of northeasterly tradewinds in the Hawaiian Islands (Table 3). On an annual basis, winds from the NE and ENE prevail 56% of the time. From an air quality viewpoint, the most significant factors, however, are the relatively high percentage of winds less than 7 knots and calms, i.e., 55%. Such conditions are more conducive to pollutant concentration buildup.

5. SHORT-TERM IMPACTS

The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along Kuhio and Kapule Highways as well as in the vicinity of the project site itself.

Because of the moderate level of existing traffic volumes, the additional construction vehicle traffic should not exceed road capacities although the presence of large trucks can reduce a roadway's capacity as well as lower average travel speeds.

The site preparation and earth moving will create particulate emissions as will building and on-site road construction. Construction vehicles movement on unpaved on-site roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and a precipitation/evaporation (P/E) index of 50 [14,15].

Onsite soils are primarily Lihue silty clays which are likely to have a silt content substantially greater than the 30% cited above [16]. This suggest a somewhat greater potential for fugitive dust emission than offered in the EPA example.

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

It was possible, however, to estimate ambient air impact using design and operating features of a typical concrete batching plant. This plant (Rex Transit Mix Batch Plant, Model LO GO 5) [17], is a portable unit capable of producing up to 100 cubic yards of concrete per hour. Assuming 8 hours/day operation and published EPA emission factors [15] for both direct plant emissions and fugitive dust emissions, estimates of worst case ambient impact were derived using the PTPLU screening model [18]. Ninety percent control of particulate emissions from the plant itself and 60% control of fugitive dust emissions from the process were assumed. One-hour concentration estimates were adjusted to 8-hour averages using an EPA-recommended factor [19] and then to 24-hour averages based on a weighted averaging technique. The worst case concentration of total suspended particulates (TSP) was thus estimated to be 105 micrograms/cubic meter (ug/m3) due to the plant operation.

Assuming that the plant would be located near the project site, existing data from the DOH Lihue monitoring site were reviewed (Tables 2 and 3). Adding the second highest TSP concentration from the 1984 data (76 ug/m3) to the 105 ug/m3 yields 181 ug/m3 which exceeds the State 24-hour TSP standard of 150 ug/m3. If the conservative assumption that all of the particulates emitted are less than 10 microns, then adding the 105 ug/m3 to the second highest PM-10 measurement (24 ug/m3) from the 1988 data yields a cumulative PM-10 impact of 129 ug/m3 which is less than the federal standard of 150 ug/m3.

Design and operating data for a typical asphalt concrete batch plant (Astec Industries Model PDM-636-C) were also obtained and reviewed. This plant has a production capacity of 186 T/hour. The two primary emission sources associated with such a plant are the drum mix asphalt plant and a 600 Kw diesel generator.

The modeling technique employed for the concrete batch plant was again employed for the asphalt plant with the results as shown in the following table.

ESTIMATED IMPACT OF AN ASPHALT CONCRETE BATCH PLANT

Pollutant	24-hour Concen. (ug/m3)	Existing Concen. (ug/m3)	Total (ug/m3)
Particulates (TSP)	34.9	76	110.9
Sulfur dioxide	13.6	<5	13.6
Nitrogen dioxide	203	n/a	203
Carbon monoxide	44.2	n/a	44.2
Volatile organic compounds	16.2	n/a	16.2

The existing concentrations for particulates and SO2 are 1984 Lihue data (Table 3).

6. MOBILE SOURCE IMPACT

6.1 Mobile Source Activity. The principal roads serving the area is the Kuhio and Kapule Highways. These are both two-lane rural highways with capacities of about 1,500 vehicles per hour. Kapule Highway was only recently improved and extended to link with Kuhio Highway at the northern corner of the project property. This primary intersection has been in operation for less than two years. Current plans call for the project to have a major and minor access to Kuhio Highway. Photographs of existing conditions at the Kuhio - Kapule intersection are presented in Figure 5.

Existing and projected traffic data for this project were obtained from the State DOT [11] and traffic consultant [20] and served as the basis for this mobile source impact analysis.

6.2 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 1990 and 1993 using the Mobile Source Emissions Model (MOBILE-3) [21]. To localize the emission factors as much as possible, the August, 1988 age distribution for registered vehicles in the City & County of Honolulu [22] was input in lieu of national statistics.

6.3 Microscale Analysis. Analyses such as this generally involve estimation of concentrations of non-reactive pollutants. This is due to the complexity of modeling pollutants which undergo chemical reactions in the atmosphere and are subject to the effects of numerous physical and chemical factors which affect reaction rates and products. For projects involving mobile sources as the principal source, carbon monoxide is normally

selected for modeling because it has a relatively long half-life in the atmosphere (ca. 1 month) [23], and it comprises the largest fraction of automotive emissions.

Due to the generally low level of urbanization in the area which would otherwise contribute to a "heat island" effect and increased turbulence, a stable atmosphere (Category "F") and neutral atmosphere (Category "D") [24], 1 meter per second (m/sec) wind speed, and an acute wind-road angle were assumed for morning and afternoon peak hours, respectively. Review of the traffic data, and the potential for queuing in particular, indicated that a southwest wind direction was most likely to produce the maximum CO concentrations near the intersections under study; thus, these wind directions were input for the modeling.

An updated version of the EPA guideline model CALINE-4 [25, 26] was employed to estimate near-intersection carbon monoxide concentrations. An array of receptor sites at distances of 10 to 40 meters from the road edge were input to the model. Because of the growing level of urbanization in the area, a background CO concentration of 1.0 milligram per cubic meter (mg/m3) was assumed.

A summary of the results of this modeling are presented in Figures 6 and 7. The figure depicts the estimated maximum 1-hour CO concentrations in milligrams per cubic meter (mg/m3) at 12 receptor locations on the northeast side of the intersection for each of the existing or future scenarios.

The results indicate that both state and federal 1-hour standards are currently being met although at some receptors within 10 meters of the roadway the state standard of 10 mg/m3 seems to be threatened. In 1993, CO levels in the vicinity of the proposed main project access road increase substantially but remain below the stringent state standard. At the Kuhio - Kapule Highways intersection, however, while the percentage increase is less, the additional traffic results in exceedance of the state standard at the same close-in receptors which were high in 1990.

Compliance with federal and state 8-hour standards can also be determined by applying a "persistence" factor of 0.6 to the 1-hour maximum CO values. This "persistence" factor is recommended in an EPA publication on indirect source analysis [27]. When using this approach, any CO concentration greater than 8.4 mg/m3 would indicate exceedance of the State's 8-hour standard. Similarly, any 1-hour concentration over 15.7 mg/m3 would indicate exceedance of the federal 8-hour standard.

In this case, the procedure again suggests compliance at the project access road but exceedance of the state's 8-hour standard

at the same two receptor locations which were "hotspots" for the 1-hour CO levels at the Kapule - Kuhio intersection.

7. ELECTRICAL GENERATION

Electrical Generation Impact. The estimated annual electrical load of 3.2 million kilowatt-hours (Kwhr) will contribute to the demand on the local utility necessitating additional fuel combustion. The Kauai Electric Company provides power for Kauai from several oil and diesel-fired facilities. Emissions from these facilities would eventually increase as a result of this and other projects' electrical demand. Estimates of the annual emissions resulting from fuel combustion to meet the project's electrical demand are presented in the following table and have been compared with the county emissions inventory (see also Table 5):

Estimates of Annual Emissions Due to Electrical Generation

Pollutant	Emissions (T/yr)	Percent of 1980 County Emissions
Nitrogen oxides	55.0	2.10 %
Carbon monoxide	12.0	0.03
Total hydrocarbons	4.4	0.12
Particulate matter	3.9	0.12
Sulfur oxides	3.7	0.53

8. CONCLUSIONS AND MITIGATION

8.1 Short-Term Impacts. Since as noted in Section 5, there is some potential for fugitive dust due to the fine soils, it will be important for adequate dust control measures to be employed during the construction period. At the latter stages of development there may be occupied units which will at times be downwind of construction activity. Fugitive dust, particularly during the drier, windier summer months, could be a source of complaints not to mention possible violations of State or Federal standards.

Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50%. The earliest possible landscaping of completed areas will also help.

The production of concrete and asphalt for the project will result in off-site impacts due to emissions from those processes;

however, such plants are permitted by the Department of Health and are required to be in compliance with State and Federal standards.

8.2 Mobile Source Impacts. As noted in Section 6, the project will contribute to an increase in automotive emissions in the region, but ambient carbon monoxide levels are expected to generally remain in compliance with both state and federal ambient air quality standards. Only at "hotspots" in close proximity to the Kuhio Highway - Kapule Highway intersection during peak hours might the state's 1- and 8-hour CO standards be exceeded under the worst case conditions of traffic and meteorology. The probability of such maximal events during the p.m. peak hour as predicted by the model is relatively low given the greater frequency of higher wind speeds at that time of day. Maximum CO levels are more likely in the morning when lower wind speeds are more frequent.

In the short-term, highway improvements designed to minimize queuing and keep traffic flowing reduce air quality impact. In the long-term as population and traffic grow, more efficient means of moving people must be promoted and used. Bicycles, carpooling and public transit systems are three such alternatives whose use should be increased in the future.

8.3 Electrical Generation Impact.

The proposed project will increase electrical demand which in turn will cause more fuel to be burned and more pollutants to be emitted into Kauai's air. The estimated emissions also represent increases over the 1980 Kauai County Emissions Inventory of less than 2.1% for individual regulated pollutants. Until other nonpolluting means of generating electricity are developed or higher efficiency control technologies are applied, such increases in emissions are inevitable. Emissions can be reduced to some extent by reducing electrical demand by the user, e.g., use of solar water heating, heat pumps, waste heat recovery, etc. Ambient air quality standards, however, are predicted to be met despite the increased emissions.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

at the same two receptor locations which were "hotspots" for the 1-hour CO levels at the Kapule - Kuhio intersection.

7. ELECTRICAL GENERATION

Electrical Generation Impact. The estimated annual electrical load of 3.2 million kilowatt-hours (Kwhr) will contribute to the demand on the local utility necessitating additional fuel combustion. The Kauai Electric Company provides power for Kauai from several oil and diesel-fired facilities. Emissions from these facilities would eventually increase as a result of this and other projects' electrical demand. Estimates of the annual emissions resulting from fuel combustion to meet the project's electrical demand are presented in the following table and have been compared with the county emissions inventory (see also Table 5):

Estimates of Annual Emissions Due to Electrical Generation

Pollutant	Emissions (T/yr)	Percent of 1980 County Emissions
Nitrogen oxides	55.0	2.10 %
Carbon monoxide	12.0	0.03
Total hydrocarbons	4.4	0.12
Particulate matter	3.9	0.12
Sulfur oxides	3.7	0.53

8. CONCLUSIONS AND MITIGATION

8.1 Short-Term Impacts. Since as noted in Section 5, there is some potential for fugitive dust due to the fine soils, it will be important for adequate dust control measures to be employed during the construction period. At the latter stages of development there may be occupied units which will at times be downwind of construction activity. Fugitive dust, particularly during the drier, windier summer months, could be a source of complaints not to mention possible violations of State or Federal standards.

Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50%. The earliest possible landscaping of completed areas will also help.

The production of concrete and asphalt for the project will result in off-site impacts due to emissions from those processes;

however, such plants are permitted by the Department of Health and are required to be in compliance with State and Federal standards.

8.2 Mobile Source Impacts. As noted in Section 6, the project will contribute to an increase in automotive emissions in the region, but ambient carbon monoxide levels are expected to generally remain in compliance with both state and federal ambient air quality standards. Only at "hotspots" in close proximity to the Kuhio Highway - Kapule Highway intersection during peak hours might the state's 1- and 8-hour CO standards be exceeded under the worst case conditions of traffic and meteorology. The probability of such maximal events during the p.m. peak hour as predicted by the model is relatively low given the greater frequency of higher wind speeds at that time of day. Maximum CO levels are more likely in the morning when lower wind speeds are more frequent.

In the short-term, highway improvements designed to minimize queuing and keep traffic flowing reduce air quality impact. In the long-term as population and traffic grow, more efficient means of moving people must be promoted and used. Bicycles, carpooling and public transit systems are three such alternatives whose use should be increased in the future.

8.3 Electrical Generation Impact.

The proposed project will increase electrical demand which in turn will cause more fuel to be burned and more pollutants to be emitted into Kauai's air. The estimated emissions also represent increases over the 1980 Kauai County Emissions Inventory of less than 2.1% for individual regulated pollutants. Until other nonpolluting means of generating electricity are developed or higher efficiency control technologies are applied, such increases in emissions are inevitable. Emissions can be reduced to some extent by reducing electrical demand by the user, e.g., use of solar water heating, heat pumps, waste heat recovery, etc. Ambient air quality standards, however, are predicted to be met despite the increased emissions.

REPERENCES

1. U. S. Congress. Clean Air Act Amendments of 1977 (P.L. 95-95, Section 110, Implementation Plans, August, 1977.

2. U. S. Government. Code of Federal Regulations, Title 40, Protection of Environment, Part 50, National Primary and Secondary Ambient Air Quality Standards.

3. State of Hawaii. Title 11, Administrative Rules, Chapter 59 Ambient Air Quality Standards, as amended, April, 1986.

4. Library of Congress, Congressional Research Service. A Legislative History of the Clean Air Amendments of 1970, Volume 1, p. 411, January, 1974.

5. U.S. Environmental Protection Agency. Revisions to National Ambient Air Quality Standards for Particulate Matter, Federal Register, Vol. 52, p. 2463, July 1, 1987.

6. U. S. Environmental Protection Agency. National Ambient Air Quality Standards for Hydrocarbons: Final Rulemaking, Federal Register, Volume 48, No. 3, p. 628, January, 1983.

7. U. S. Congress. Clean Air Act Amendments of 1977 (P.L. 95-95) Section 109, National Ambient Air Quality Standards, August, 1977

8. U. S. Environmental Protection Agency. National Ambient Air Quality Standards for Photochemical Oxidants: Final Rulemaking, Federal Register, Volume 44, No. 28, p. 8202, February 8, 1979

9. U. S. Environmental Protection Agency. Regulatory Agenda, Federal Register, Volume 50, No. 82, p. 17784, April 29, 1985.

10. State of Hawaii. Title 11, Administrative Rules, Chapter 60, Air Pollution Control.

11. State of Hawaii, Department of Transportation, Highway Planning Section. Traffic Count, Stations 22, 22-C, and 22-D, 9/28-29/89.

12. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, Environmental Data Service. Hawaii and Pacific Annual Summary, 1974

13. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, Environmental Data Service. Local Climatological Data, Annual Summary With Comparative Data, 1987, for Lihue, Hawaii.

14. Thornwaite, C. W. Climates of North America According to a New Classification, Geog. Rev. 21: 633-655, 1931.

REPERENCES (Continued)

15. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Fourth Edition, 1985

16. Buckman, H. O. and N. C. Brady. The Nature and Properties of Soils (6th Edition), 1966.

17. Rexworks, Inc. LO GO 5 Transit Mix Batch Plant, Bulletin No. 1017-283

18. U.S. Environmental Protection Agency. User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6, 1986.

19. U.S. Environmental Protection Agency. Guidelines for Air Quality Maintenance Planning and Analysis, Volume 10 (Revised): Procedures for Evaluating Air Quality Impact of New Stationary Sources, EPA-450/4-77-001, October 1977.

20. Kaku Associates. Traffic data received 1/16/90 and 1/18/90 from Mr. Ed Shikada.

21. U. S. Environmental Protection Agency. User's Guide to MOBILE-3 (Mobile Source Emissions Model), EPA-460/3-84-002, June, 1984.

22. City & County of Honolulu, Department of Data Systems. Age Distribution of Registered Vehicles in the City & County of Honolulu (unpublished report), August, 1988.

23. Seinfeld, John H. Air Pollution: Physical and Chemical Fundamentals, p. 69, McGraw-Hill Book Company, 1975

24. U. S. Environmental Protection Agency. Workbook of Atmospheric Dispersion Estimates, AP-26 (Sixth Edition), 1973.

25. U.S. Environmental Protection Agency. Guideline on Air Quality Models (Revised), EPA-450/2-78-027R, July, 1986.

26. California Department of Transportation. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways (Final Report), November, 1984 (Revised June, 1989).

27. U.S. Environmental Protection Agency. Guidelines for Air Quality Maintenance Planning and Analysis, Volume 9 (Revised): Indirect Sources, EPA-450/4-78-001, September, 1978.

TABLES

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	SAMPLING PERIOD	FEDERAL STANDARDS PRIMARY	FEDERAL STANDARDS SECONDARY	STATE STANDARDS
1. Total Suspended Particulate Matter (TSP)	Annual Geometric Mean	--	--	60
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	--	--	150
2. PM-10	Annual	50	50	--
(micrograms per cubic meter	Maximum Average in Any 24 Hours	150	150	--
3. Sulfur Dioxide (SO2)	Annual Arithmetic Mean	80	--	80
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	365	--	365
	Maximum Average in Any 3 Hours		1,300	1,300
4. Nitrogen Dioxide (NO2)	Annual Arithmetic Mean	100		70
(micrograms per cubic meter)				
5. Carbon Monoxide (CO)	Maximum Average in Any 8 Hours	10		5
(milligrams per cubic meter)	Maximum Average in Any 1 Hour	40		10
6. Ozone (O3)	Maximum Average in Any 1 Hour	235		100
(micrograms per cubic meter)				
7. Lead (Pb)	Maximum Average in Any Calendar Quarter	1.5		1.5
(micrograms per cubic meter)				

TABLE 2
TSP AND SO2 MONITORING DATA
LIHUE, KAUAI
1984

	TOTAL SUSPENDED PARTICULATES (TSP) 24-Hour Concentrations (ug/m3)				Sulfur Dioxide (SO2) 24-Hour Concentrations (ug/m3)			
MONTH	SAMPLES	MIN.	MAX.	MEAN	SAMPLES	MIN.	MAX.	MEAN
Jan 84	6	13	46	29	6	<5	<5	<5
Feb 84	3	19	27	24	3	<5	<5	<5
Mar 84	6	28	91	46	4	<5	<5	<5
Apr 84	5	26	63	44	5	<5	<5	<5
May 84	4	20	62	43	5	<5	<5	<5
Jun 84	5	16	39	27	5	<5	<5	<5
Jul 84	5	20	34	27	5	<5	<5	<5
Aug 84	5	24	58	35	5	<5	<5	<5
Sep 84	5	14	76	33	5	<5	<5	<5
Oct 84	4	20	71	39	2	<5	<5	<5
Nov 84	3	22	53	33	-	-	-	-
Dec 84	4	25	67	44	-	-	-	-
ANNUAL	55	13	91	35	45	<5	<5	<5

SOURCE: Department of Health

TABLE 3

AIR MONITORING DATA
LIHUE, KAUAI
1988

	Particulate Matter (10 microns) 24-Hour Concentration (ug/m3)			
MONTH	SAMPLES	MIN.	MAX.	MEAN
Jan 88	4	8	19	11
Feb 88	5	15	24	20
Mar 88	5	14	21	18
Apr 88	1	21	21	21
May 88	5	13	30	19
Jun 88	4	15	17	15
Jul 88	4	17	21	20
Aug 88	4	14	22	17
Sep 88	5	15	21	17
Oct 88	5	11	19	15
Nov 88	-	--	--	--
Dec 88	5	12	22	16
ANNUAL	47	8	30	17

SOURCE: Department of Health

TABLE 4

ANNUAL JOINT FREQUENCY DISTRIBUTION
OF WIND DATA AT LIHUE AIRPORT
1950-1967.

DIRECTION	Wind Speed (kts) 0 - 7	8 -11	12 - 18	18 - 22	All Speeds
N	0.015	0.008	0.001	0.000	0.024
NNE	0.035	0.042	0.005	0.000	0.082
NE	0.130	0.204	0.018	0.001	0.353
ENE	0.087	0.116	0.009	0.000	0.212
E	0.021	0.017	0.001	0.000	0.039
ESE	0.006	0.002	0.000	0.000	0.008
SE	0.004	0.001	0.000	0.000	0.005
SSE	0.006	0.003	0.000	0.000	0.009
S	0.008	0.006	0.001	0.000	0.015
SSW	0.005	0.003	0.000	0.000	0.008
SW	0.007	0.004	0.001	0.000	0.012
WSW	0.007	0.002	0.000	0.000	0.009
W	0.020	0.000	0.000	0.000	0.000
WNW	0.007	0.000	0.000	0.000	0.000
NW	0.002	0.000	0.000	0.000	0.000
NNW	0.007	0.002	0.000	0.000	0.000
All Directions:	0.367	0.410	0.036	0.001	0.814

Calms: 0.184

SOURCE: National Weather Service

TABLE 5

EMISSIONS INVENTORY
COUNTY OF KAUAI
1980.

SOURCE CATEGORY	EMISSIONS (Tons/Year) TSP	SOx	NOx	CO	HC
Steam Electric Power Plants	60	450	674	137	11
Gas Utilities	0	0	0	0	0
Fuel Combustion in Agricultural Industry	1,605	63	214	0	0
Refinery Industry	0	0	0	0	0
Petroleum Storage	0	0	0	0	0
Metallurgical Industries	0	0	0	0	0
Mineral Products Industry	75	3	40	0	0
Municipal Incineration	0	0	0	0	0
Motor Vehicles	122	84	1,440	19,960	1,905
Construction, Farm and Industrial Vehicles	16	13	169	513	41
Aircraft	6	10	102	1,128	102
Vessels	6	75	37	34	19
Agricultural Field Burning	1,239	0	0	12,407	1,694
TOTAL:	3,129	698	2,676	34,179	3,772

SOURCE: State of Hawaii
Department of Health

FIGURES

FIGURE 1

PROJECT LOCATION

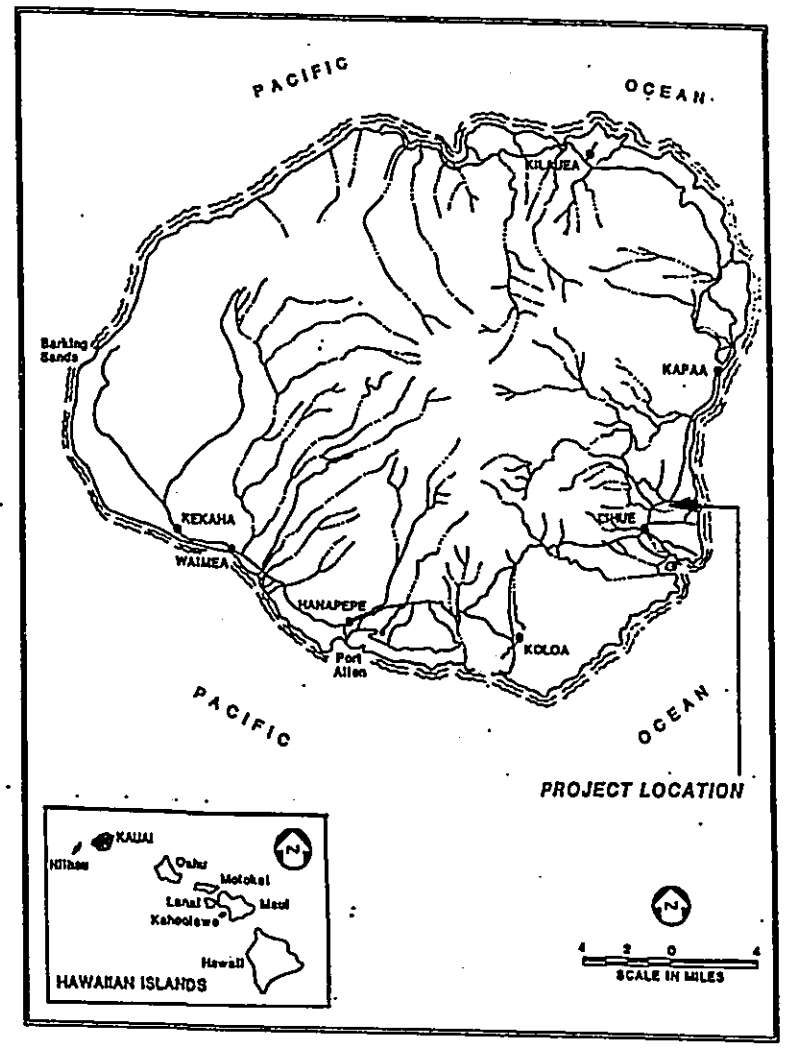


FIGURE 2

EXISTING SITE CONDITIONS

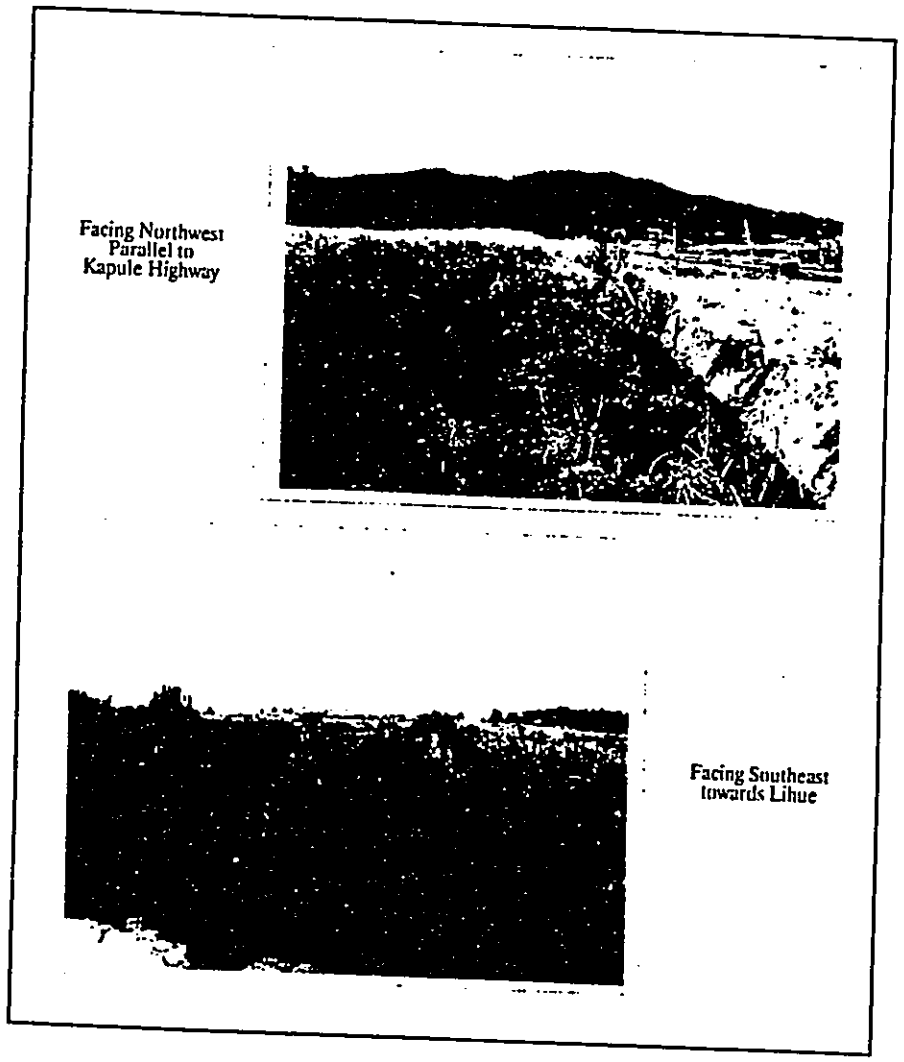


FIGURE 3

A.M. PEAK HOUR CONDITIONS
KUHIO HIGHWAY AT KAPULE HIGHWAY
JANUARY 10, 1990

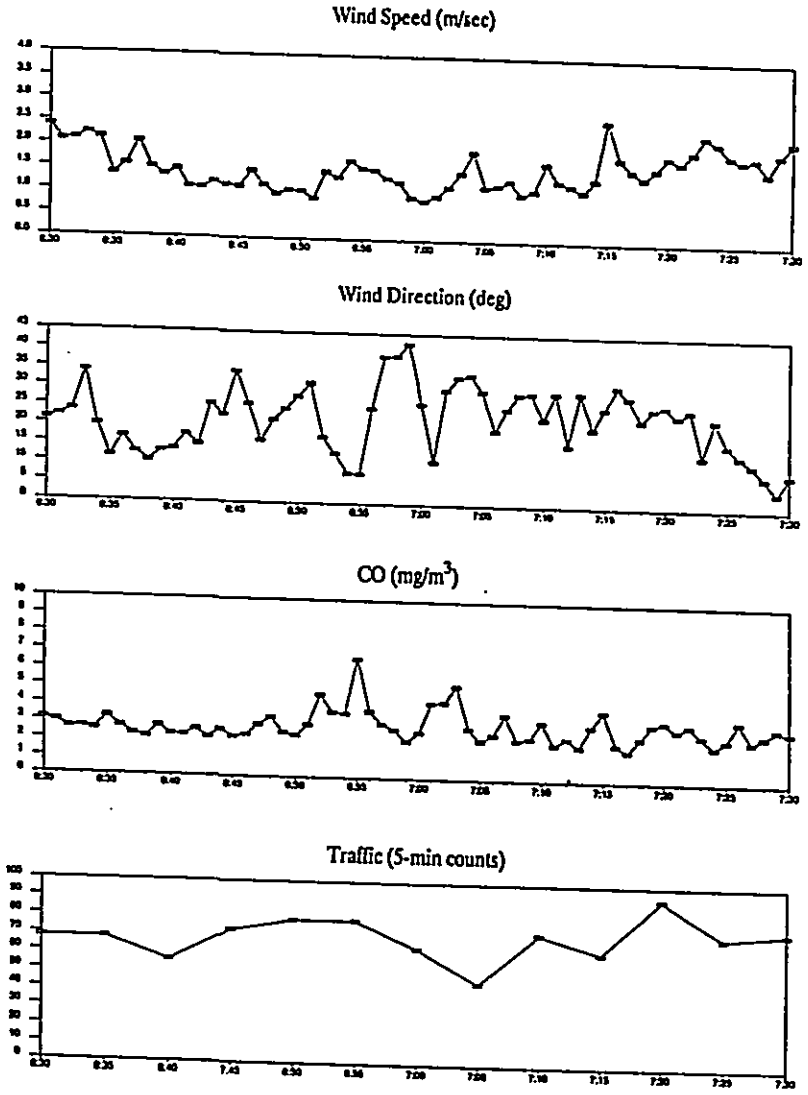


FIGURE 4

P.M. PEAK HOUR CONDITIONS
KUHIO HIGHWAY AT KAPULE HIGHWAY
JANUARY 9, 1990

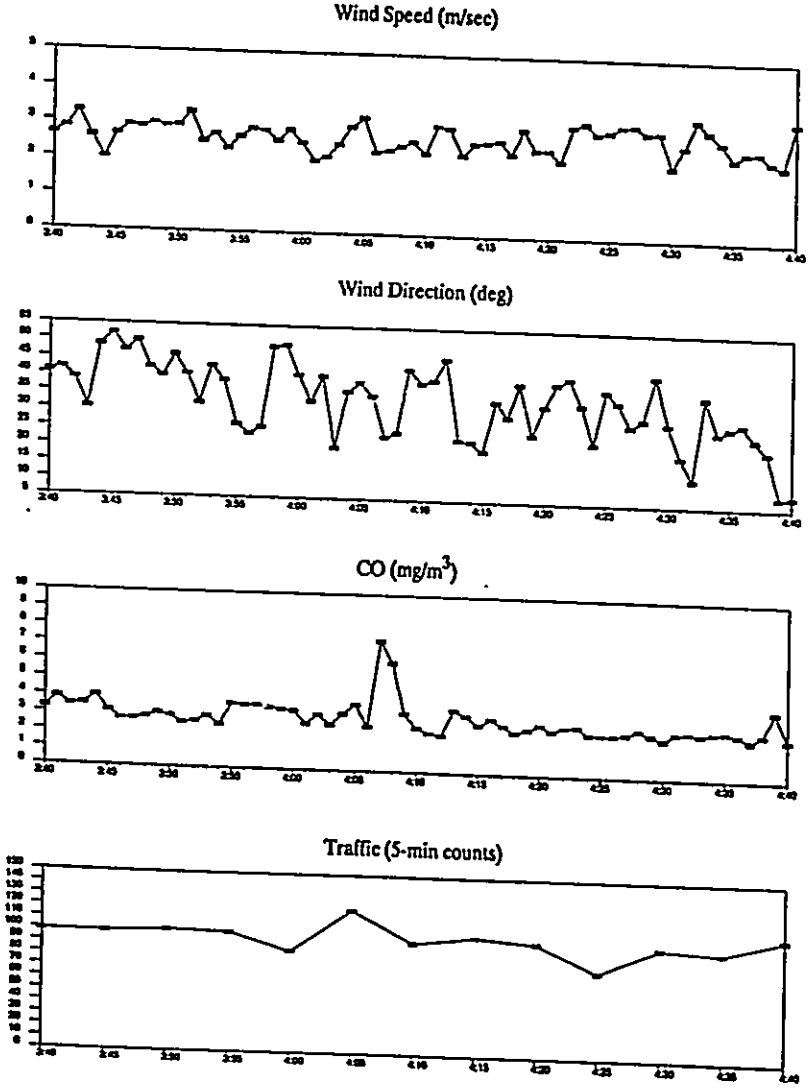


FIGURE 5

KUHIO HIGHWAY AT KAPULE HIGHWAY
JANUARY, 1990

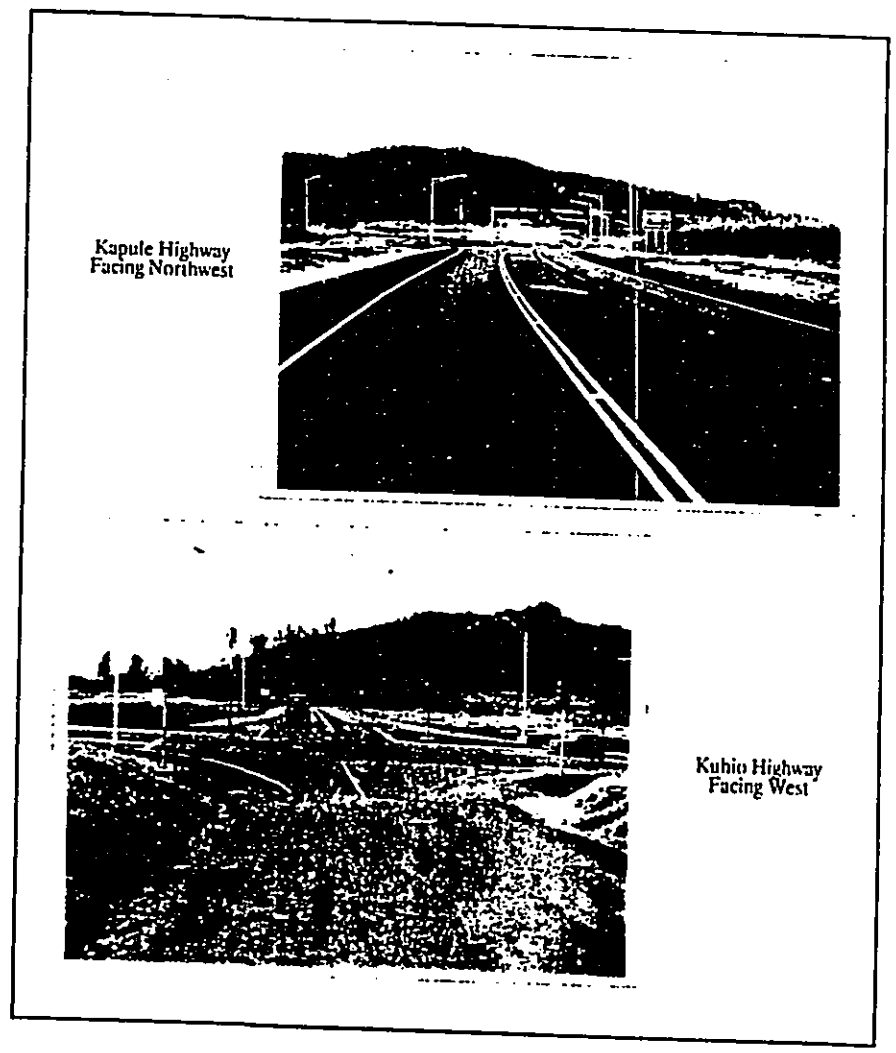
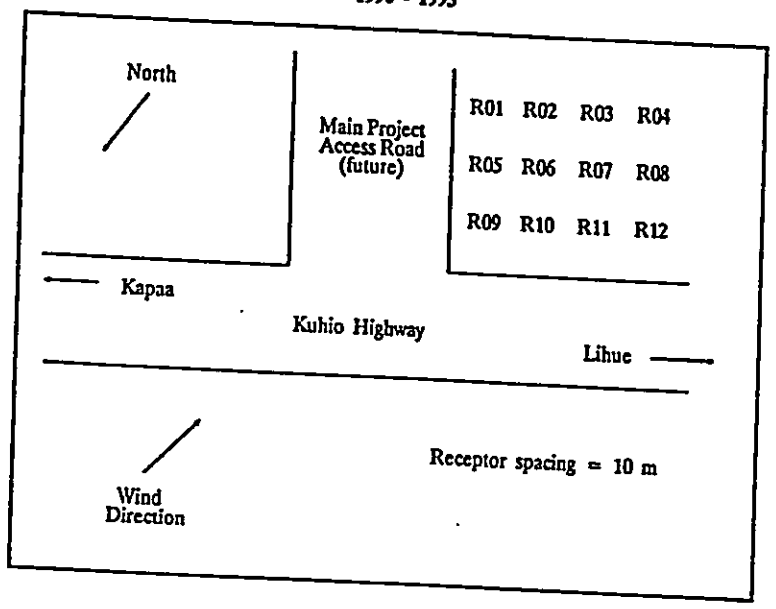


FIGURE 6

ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

Kuhio Highway at Main Project Access Road
A.M./P.M. Peak Hours
1990 - 1993

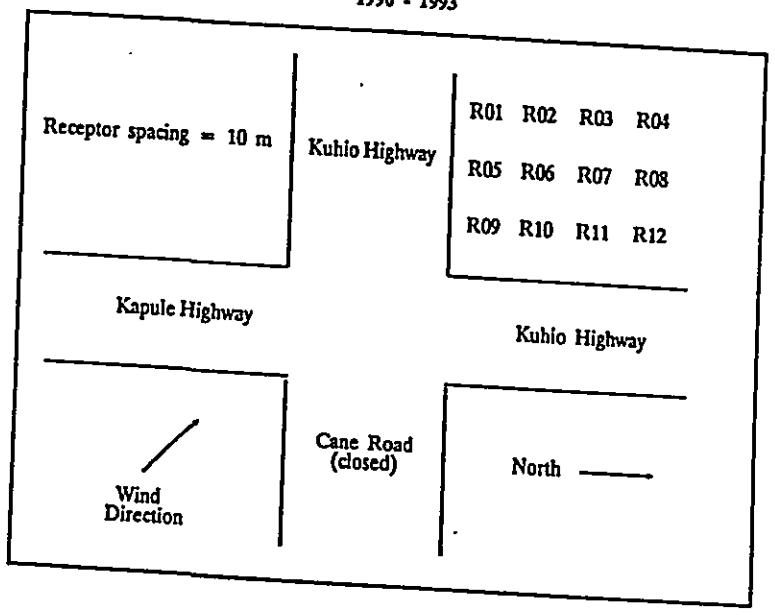


Receptor	Concentration (mg/m³) 1990 A.M.	1990 P.M.	1993 A.M.	1993 P.M.
R01	2.2	2.3	5.2	5.8
R02	2.2	2.3	4.0	4.4
R03	2.2	2.3	3.6	4.0
R04	2.2	2.3	3.5	3.8
R05	1.9	1.9	6.5	6.2
R06	1.9	1.9	4.7	4.8
R06	1.9	1.9	3.6	3.9
R08	1.9	1.9	3.2	3.4
R09	1.8	1.8	4.7	4.4
R10	1.8	1.8	4.6	4.4
R11	1.8	1.8	3.9	4.0
R12	1.8	1.8	3.3	3.4

FIGURE 7

ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

Kuhio Highway at Kapule Highway
A.M./P.M. Peak Hours
1990 - 1993



Receptor	Concentration (mg/m³) 1990 A.M.	1990 P.M.	1993 A.M.	1993 P.M.
R01	7.0	7.3	7.8	7.5
R02	7.0	7.1	7.5	7.2
R03	6.5	6.2	6.7	6.3
R04	5.9	5.1	6.0	5.4
R05	9.3	9.9	10.4	10.1
R06	7.8	7.9	8.1	7.9
R07	6.8	6.3	7.0	6.5
R08	6.3	4.9	6.4	5.2
R09	9.3	9.9	9.8	9.9
R10	8.3	8.2	8.3	8.2
R11	7.8	6.0	7.8	6.7
R12	6.8	4.1	7.1	4.8

Appendix F

NOISE STUDY–
Y. EBISU & ASSOCIATES

NOISE STUDY
FOR THE
HANAMAULU AFFORDABLE HOUSING PROJECT
HANAMAULU, KAUAI

Prepared for:
HELBER HASTERT & KIMURA PLANNERS

Prepared by:
Y. EBISU & ASSOCIATES
1126 12th Avenue, Room 305
Honolulu, Hawaii 96816

JANUARY 1990

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Hanamaulu Affordable Housing Project in Hanamaulu, Kauai were evaluated for their potential impact on present and future noise sensitive areas. The future traffic noise levels along the primary access roadways to the project were calculated for the Year 1993.

Along the existing Kuhio Highway, traffic noise levels are expected to increase by 0.4 to 1.4 Ldn between CY 1989 and CY 1993 as a result of both project and non-project traffic. Along Kapule Highway, traffic noise levels are predicted to increase by 1.0 Ldn. Along Kuhio Highway, traffic noise levels are predicted to increase by 0.4 to 1.4 Ldn. Traffic noise increases due to project traffic are predicted to be less than or equal to the noise increases caused by non-project traffic on these two roadways, and are not considered to be significant increases.

Based on previously published aircraft noise contours for Lihue Airport, the project site is located outside of the existing and forecasted 60 Ldn noise contours, and is considered to be acceptable for the development of noise sensitive uses as planned. Based on currently available existing and forecasted aircraft noise contours over the project site and a more recent evaluation of CY 1989 aircraft noise levels, special aircraft noise attenuation measures are not considered mandatory on the project site. The implementation of the airport noise disclosure provisions of Act 208 is recommended over the entire project area because the existing and forecasted 55 Ldn noise contours are believed to encompass essentially all of the project area. Because the State Department of Transportation may be required to provide future sound attenuation for the project dwellings following project build-out if operations at Lihue Airport significantly exceed currently available forecasts, it is recommended that the State DOT be offered an opportunity to draft and ultimately negotiate the

purchase of noise or avigation easements over the noise sensitive portions of the project.

Project residents may be impacted by traffic noise from Kuhio or Kapule Highway if adequate setback distances are not provided from the highway or if other noise mitigation measures are not incorporated into the development. During preparation of the site and building plans, a reevaluation of the traffic noise levels at the proposed residential lots immediately adjacent to the Rights-of-Way may be necessary. The mitigation measures necessary to meet the FHA/HUD noise standard of 65 Ldn for combined levels of traffic plus aircraft noise should then be included within the plans of the affected dwellings of the subdivision.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed Hanamaulu Affordable Housing Project at Hanamaulu on the island of Kauai. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from noise resulting from fixed and rotary wing aircraft operations at nearby Lihue Airport, and from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the Ldn descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in APPENDIX B to this report.

TABLE 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in FIGURE 1. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. In the Hanamaulu area, noise levels at lots which front Kuhio Highway are typically above 65 Ldn. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 Ldn lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (Reference 2), including Hawaii. Because of our open-living conditions, the predominant use of nat-

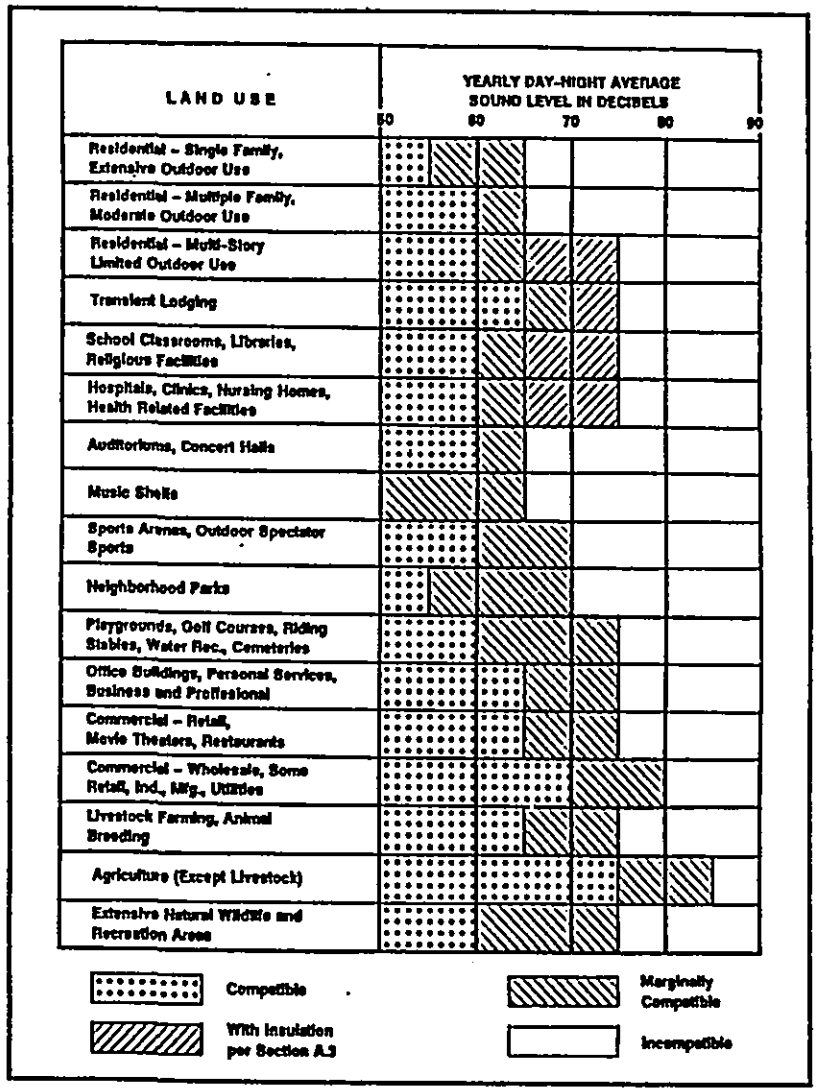
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL[1] STANDARD
Minimal Exposure	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
Moderate Exposure	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable[2]
Significant Exposure	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
Severe Exposure	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

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



LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED (Source: American National Standards Institute)

FIGURE 1

urally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 3, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

For aircraft noise, the State Department of Transportation, Airports Division, has recommended that 60 Ldn be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. In addition, for those noise sensitive land uses which are exposed to aircraft noise greater than 55 Ldn, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. Reference 4 requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150).

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and aircraft noise levels were measured at seven locations in the project environs to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development: Kuhio Highway and Kapule Highway (or the Hanamaulu-Ahukini Bypass Road); and for validating the aircraft noise contours previously developed during the FAR Part 150 Noise Compatibility Program for Lihue Airport (Reference 5).

The locations of the measurement sites are shown in FIGURE 2. Noise measurements were performed during the latter part of December 1989. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in TABLE 2. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 6). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. The traffic study for the project (Reference 7) and Hawaii State Department of Transportation counts on Kuhio and Kapule Highways (References 8 thru 11), were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were 0.5 dB less than the 24-hour Ldn along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour Ldn of traffic noise on Kuhio and Kapule Highways (see FIGURES 3 and 4).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level

TABLE 2

TRAFFIC NOISE MEASUREMENTS

Location	Time of Day (HRS)	Ave.Speed (MPH)	——Hourly Traffic Volume—— Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
C. 55 FT from the centerline of Kapule Highway (12/22/89).	1550 TO 1700	50	1,199	12	5	65.2	65.7
D. 105 FT from the centerline of Kapule Highway (12/21/89).	1420 TO 1555	45	1,151	23	20	60.0	61.4
E1 50 FT from the centerline of Kuhio Highway (12/21/89).	1630 TO 1707	45	1,040	4	4	65.7	65.7
E2 100 FT from the centerline of Kuhio Highway (12/21/89).	1607 TO 1630	45	1,220	8	4	60.5	61.9

Note:

Partial shielding of road noise was present at measurement Locations "D" and "E2".

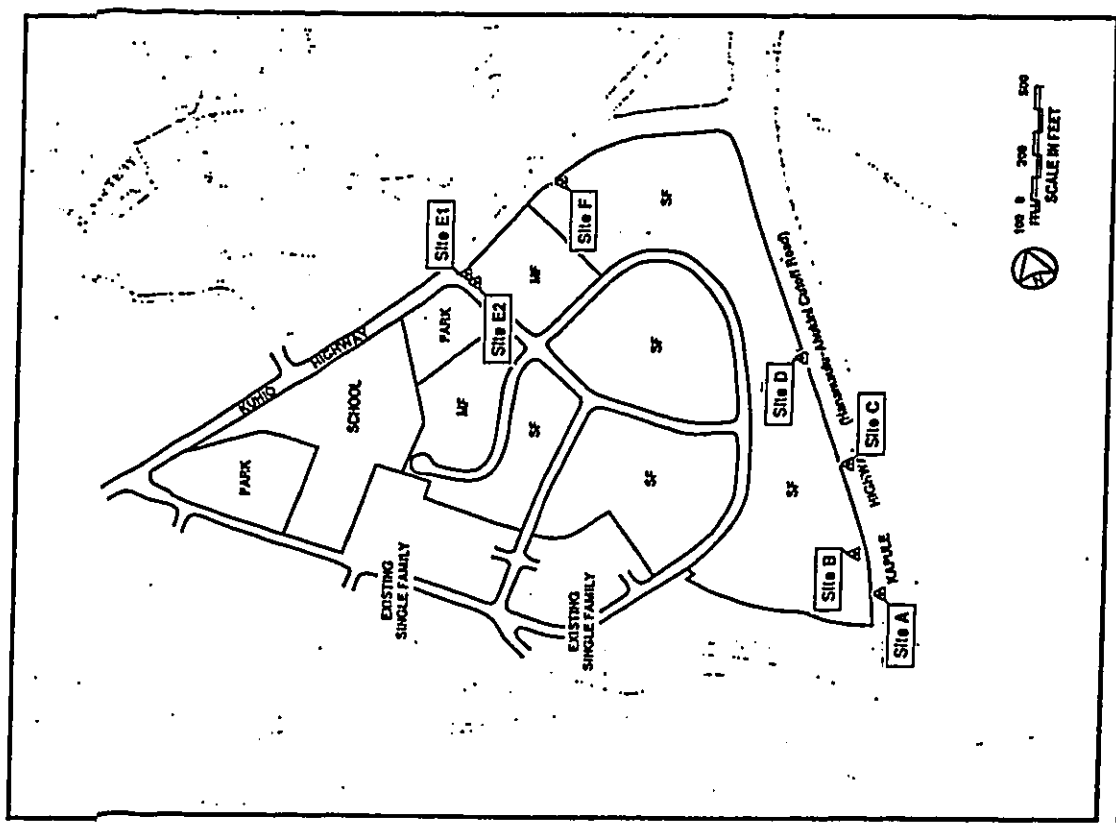


FIGURE 2

LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF

KUHIO HIGHWAY AT HANAMAULU ROAD

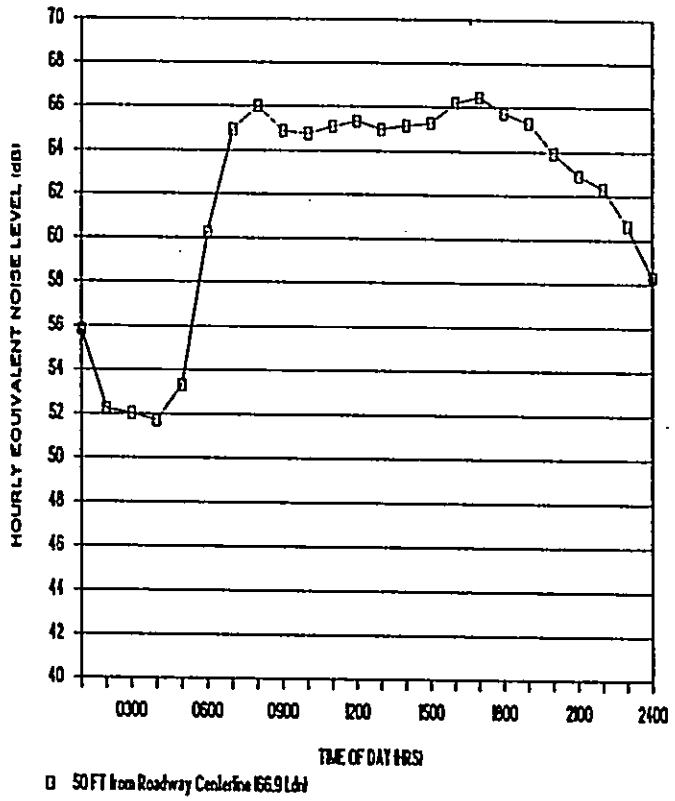
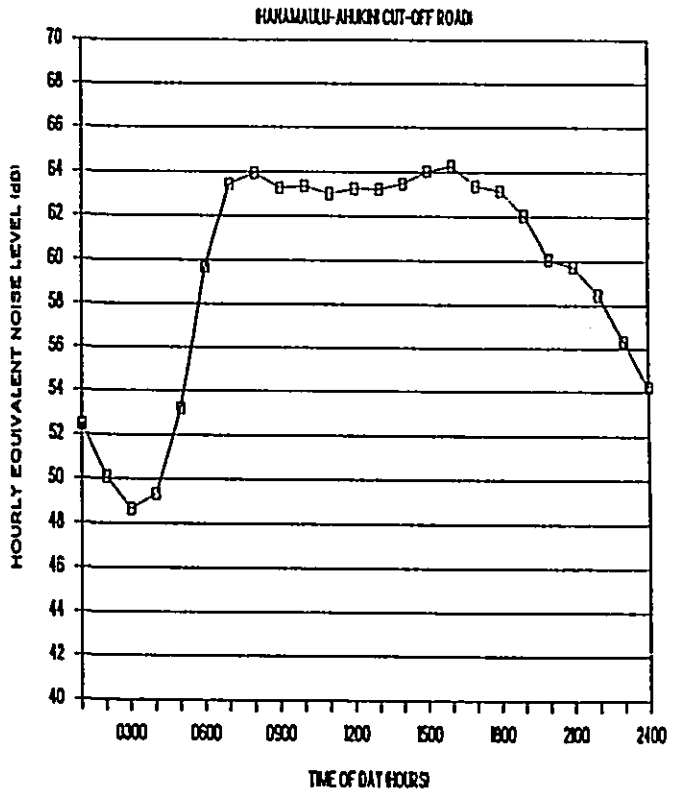


FIGURE 4

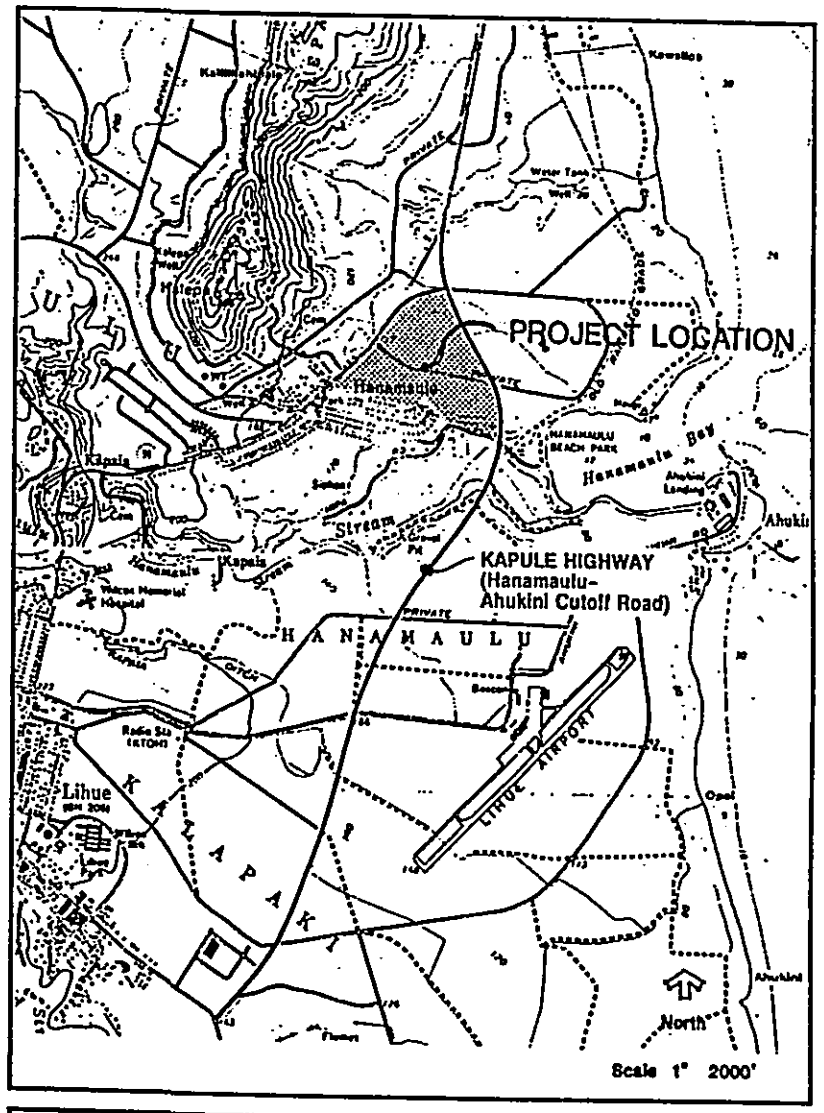
HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF

KAPULE HIGHWAY



receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic study (Reference 7). The forecasted increases in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.

Aircraft noise measurements were obtained at Sites "A" thru "D" and at Site "F" (see FIGURE 2), which were all located on or adjacent to the project site. The relationship of the project site to Lihue Airport is shown in FIGURE 5. Aircraft noise measurements were made to confirm that single event noise levels associated with aircraft operations at Lihue Airport were consistent with the noise data and contours for Lihue Airport which were developed during the FAR Part 150 Program for CY 1986, 1991, 1995, and 2005. The on-site measurements were also performed to confirm helicopter noise levels and flight tracks in the project environs, as were originally reported in Reference 12 as well as in Reference 5. In addition, 1989 airline schedules and enroute strips obtained during a ten week period from July thru October 1989 were also used to obtain the most current estimate of the existing aircraft noise contours over the project site.



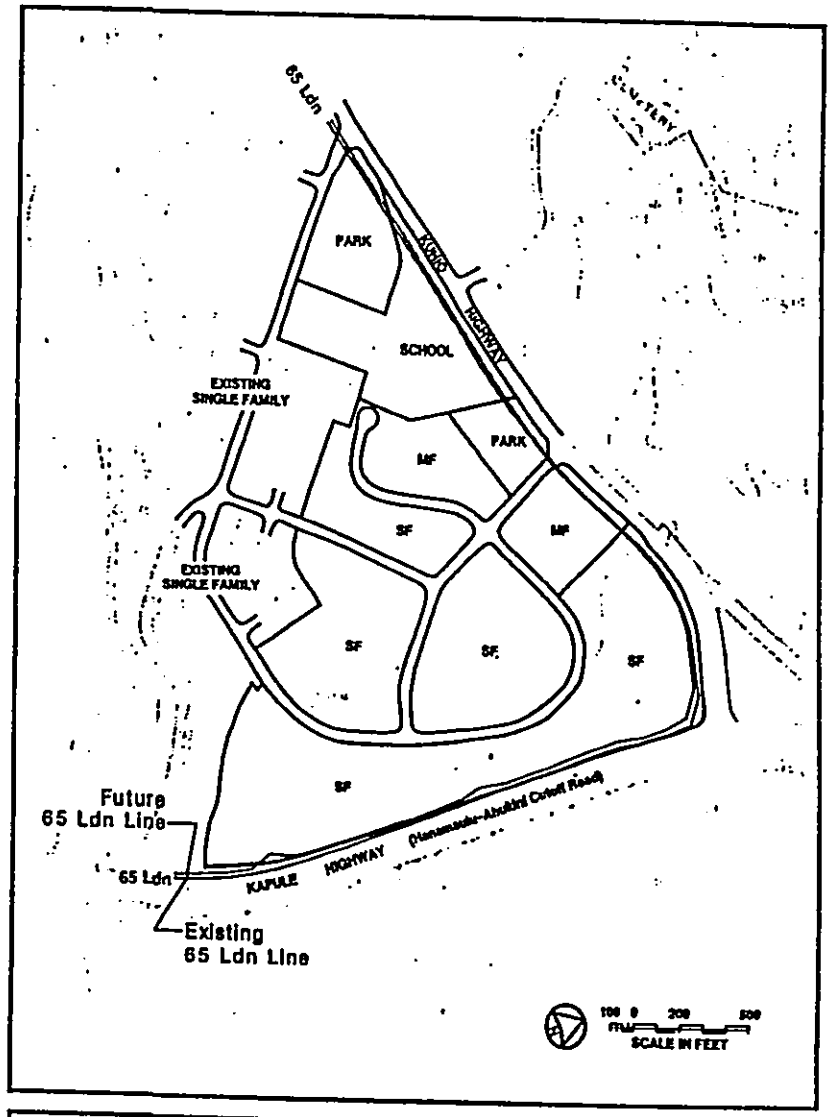
PROJECT SITE LOCATION

FIGURE 5

CHAPTER V. EXISTING NOISE ENVIRONMENT

Traffic Noise. The existing traffic noise levels in the project environs (see FIGURE 6) are in the "Significant Exposure, Normally Unacceptable" category along the Kuhio Highway Right-of-Way, with traffic noise levels between 65 to 75 Ldn. Setback distances greater than 62 to 87 FT from the centerline of Kuhio Highway are required to reduce traffic noise levels to the "Moderate Exposure, Acceptable" category, and to levels less than 65 Ldn. Along the south section of the Kapule Highway Right-of-Way, existing traffic noise levels are in the "Moderate Exposure, Acceptable" category, with traffic noise levels between 60 to 65 Ldn. Along the north section of the Kapule Highway Right-of-Way near the intersection with Kuhio Highway, existing traffic noise levels are approximately 65 Ldn. The existing Kapule Highway Right-of-Way is approximately 40 to 50 FT wider along the project's boundary line, and will accommodate the addition of future traffic lanes between the Hanamaulu Stream Bridge and the Kuhio Highway intersection. Because of the larger setback distance to the existing highway centerline from the mauka (or west) Right-of-Way, traffic noise levels are approximately 3 to 5 Ldn units lower along the mauka Right-of-Way than along the makai Right-of-Way of Kapule Highway in the vicinity of the project site.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in TABLE 3. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 60, 65, and 70 Ldn contours were also calculated as shown in TABLE 4. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of TABLE 4, it was concluded that the existing 65 Ldn traf-



LOCATIONS OF EXISTING AND FUTURE TRAFFIC NOISE CONTOURS ON PROJECT SITE

FIGURE 6

TABLE 3

COMPARISONS OF EXISTING AND CY 1993 TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(PM PEAK HOUR AND 50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING (CY 1989) PM PEAK HR. TRAFFIC:						
Kapule Hwy. Fronting Project	45	1,280	63.6	58.9	63.7	67.3
Kapule Highway at Bridge	50	1,280	65.3	60.5	64.9	68.8
Kuhio Hwy. at Hanamaulu School	45	1,175	65.3	56.6	58.4	66.6
Kuhio Hwy. at Kapule Hwy.	43	1,175	64.6	55.9	57.9	65.9
Kuhio Hwy. North of Project	40	2,205	64.0	59.6	64.8	68.1
CY 1993 PM PEAK HR. TRAFFIC WITH THE PROJECT:						
Kapule Hwy. Fronting Project	45	1,600	64.5	59.9	64.7	68.3
Kapule Highway at Bridge	50	1,600	66.3	61.5	65.8	69.8
Kuhio Hwy. at Hanamaulu School	44	1,595	66.3	57.6	59.5	67.6
Kuhio Hwy. at Kapule Hwy.	42	1,758	66.0	57.3	59.4	67.3
Kuhio Hwy. North of Project	39	2,635	64.3	60.0	65.4	68.5

Notes:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

(a) Kuhio Highway at Project: 98.5% autos, 1.0% medium trucks, and 0.5% heavy trucks and buses.

(b) Kuhio Highway North of Project: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks and buses.

(c) Kapule Highway: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks and buses.

TABLE 4

EXISTING AND CY 1993 DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	CY 1993	65 Ldn SETBACK (FT) EXISTING	CY 1993	70 Ldn SETBACK(FT) EXISTING	CY 1993
Kapule Hwy. Fronting Project	167	193	77	90	36	42
Kapule Highway at Bridge	208	242	97	112	45	52
Kuhio Hwy. at Hanamaulu School	149	173	69	80	32	37
Kuhio Hwy. at Kapule Hwy.	134	165	62	77	29	36
Kuhio Hwy. North of Project	187	200	87	93	40	43

Notes:

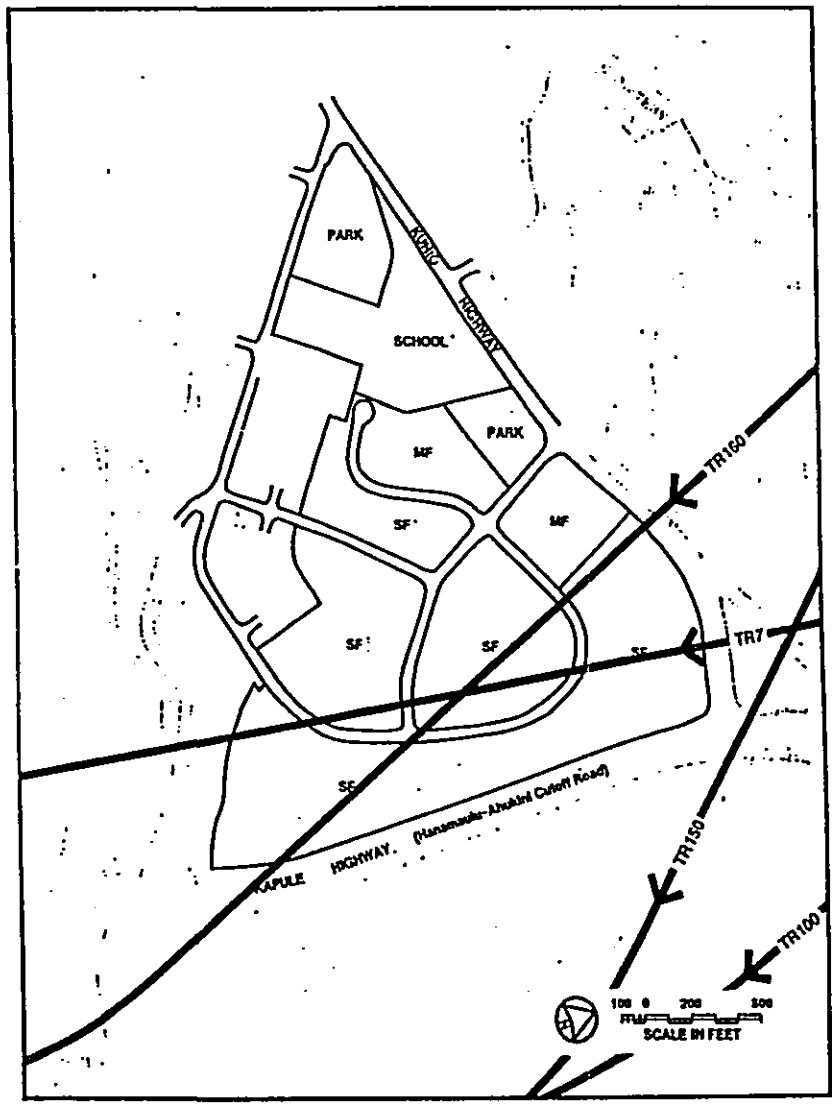
(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM Peak Hour Leq plus 0.5 dB along Kapule and Kuhio Highways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

fic noise contour extends beyond the Right-of-Way and into the project site along Kuhio Highway. Along Kapule Highway, due to the makai offset of the existing highway lanes within the Right-of-Way, the existing 65 Ldn traffic noise contour does not extend into the project site, except in the vicinity of the Kuhio Highway intersection.

Existing traffic noise levels at the interior portions of the project site are low (less than 60 Ldn) due to their larger setback distances from Kuhio and Kapule Highways. At these interior locations on the project site, aircraft noise is the dominant noise source. A discussion of existing aircraft noise levels on the project site is provided in the following section. Between aircraft noise events, background ambient noise levels drop to a range of 40 to 50 dB, and can go below 40 dB during calm periods. The steady background ambient noise levels at these interior locations are controlled by distant traffic, birds, and foliage movement with the wind.

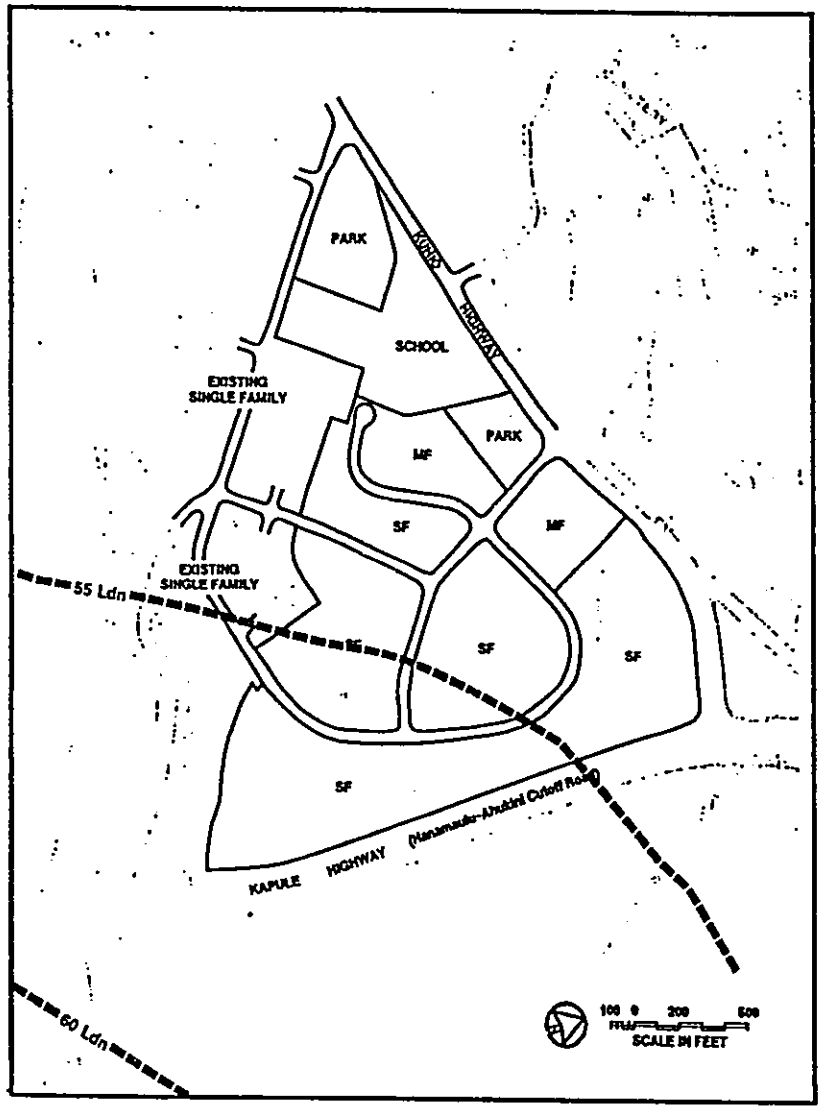
Aircraft Noise. Aircraft noise sources in the project environs are associated with fixed and rotary wing aircraft operations at Lihue Airport. FIGURE 7 depicts aircraft flight tracks in the project environs during CY 1986, which were reported in Volume I of Reference 5. Flight tracks TR100, TR150, and TR160 represent helicopter arrival tracks to Lihue Airport, the majority of which are north and east of the project site. Occasionally, however, depending on weather, visibility, or air traffic conditions, helicopter flight tracks may cross over the project site as indicated by Track TR160. Flight Track TR7 depicts the average flight track of tour aircraft which approach Lihue Airport from the northwest. Tour aircraft which approach the airport from the east or northeast generally remain south of the project site.

FIGURE 8 depicts the locations of the 55 and 60 Ldn aircraft noise contours during the CY 1986 period. The previously developed and published aircraft noise levels over the project site were less than 60 Ldn, and as such, are considered to be in the



LOCATIONS OF EXISTING AVERAGE AIRCRAFT FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 7



LOCATIONS OF CY 1986
AIRCRAFT NOISE CONTOURS ON PROJECT SITE

FIGURE 8

"Moderate Exposure, Acceptable" category for the planned land uses on the project site. The CY 1986 noise contours shown in FIGURE 8 are probably underestimating the current aircraft noise levels over the project site, because of the approximately 61 percent increase in nighttime and early morning departures of the nosier B-737(200), DC-9(15), and DC-9(50) aircraft.

TABLE 5 summarizes the results of the aircraft noise measurements obtained at sites on or adjacent to the project site. Maximum helicopter noise levels were typically less than 75 dB. During one flyover by a helicopter over Site F, a maximum noise level of 80 dB was recorded. In general, however, helicopter flight tracks were observed to be normally north and east of the project site, with maximum noise levels below 75 dB.

Maximum noise levels of jet aircraft departures from Runway 03 and military jet training flights on Runway 35 were typically greater than 75 dBA. The measured noise levels from KC-135 and EC-135 military aircraft performing touch and go operations on Runway 35 were the loudest aircraft events recorded on the project site. Measured noise levels from approximately 50 percent of these military flybys exceeded 85 dBA at Site A. Reduced levels of 70 to 75 dBA from the KC-135 aircraft were recorded at Site A during flights which turned seaward south of Hanamaulu Bay. Maximum noise levels from departing B-737(200), DC-9(15), and DC-9(50) aircraft typically ranged from 77 to 82 dB.

Based on the most recently available information on aircraft operations at Lihue Airport during CY 1989, the location of the existing 60 Ldn contour is estimated to be approximately 600 to 800 FT northwest of its CY 1986 location shown in FIGURE 8. The location of the existing 55 Ldn contour is estimated to be approximately 800 to 1,000 FT northwest of its CY 1986 location shown in FIGURE 8, and more similar to the previously forecasted CY 1991 noise contours (see FIGURE 10). Based on these updated estimates of the Lihue Airport aircraft noise contours in the vicinity of the project site, it was concluded that the 60 Ldn aircraft noise

TABLE 5

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS

MEASUREMENT SITE	AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)
A	B-737(200)	78; 77; 79
A	DC-9(50)	81; 78; 81
A	KC-135	75; 71; 74; 84; 85; 83; 85; 86; 86; 88; 86; 86
A	EC-135	85; 84; 86; 85; 86; 81; 86
A	Helicopters	68; 71; 65; 69; 68; 69; 69; 76
B	B-737(200)	77; 80
B	B-737(300)	65
B	DC-9(50)	81
B	Helicopters	67; 67; 66; 75; 64
C	B-737(200)	78; 82; 76
C	DC-9(50)	86; 80
C	Helicopters	68; 63; 68; 69; 68; 72; 66; 68; 70; 65; 66; 67; 67; 72
D	B-737(200)	79; 79; 76
D	DC-9(15)	74; 81
D	Helicopters	73; 62; 67; 68; 64; 69; 63; 69; 66; 72
F	B-737(200)	80; 81
F	DC-9(50)	82; 80
F	Helicopters	66; 72; 69; 73; 69; 80

contour is located outside but very close to the southeast corner of the project site. The 55 Ldn aircraft noise contour continues to cross through the project site, but is probably located just east of the Hanamaulu Elementary School property. Based on these updated estimates of aircraft noise over the project site, it was concluded that special aircraft noise mitigation measures are not required, but that disclosure of aircraft noise under Act 208 for the entire project site is warranted.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7 for CY 1993 with and without the proposed project. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in TABLE 3 for the PM peak hour of traffic. As indicated in TABLE 3, by CY 1993 and following complete project build-out, traffic noise levels on Kapule Highway are predicted to increase by 1.0 dB, which is considered to be a moderate increase. Along Kuhio Highway and south of the Kapule Highway intersection, traffic noise levels are predicted to increase by 1.0 to 1.4 dB. North of the intersection, traffic noise levels are predicted to increase by 0.4 dB. The predicted increases in traffic noise levels along Kuhio Highway range from insignificant to moderate increases. TABLE 4 summarizes the predicted increases in the future setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways servicing the project and attributable to both project plus non-project traffic in CY 1993. The setback distances in TABLE 4 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in TABLE 4, the setback distances to the 65 Ldn contour are predicted to range from 77 to 112 FT from the centerlines of Kapule and Kuhio Highways following project build-out in CY 1993. FIGURE 6 depicts the predicted locations of the 65 Ldn traffic noise contour following project build-out.

TABLE 6 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 1993, and as measured by the Ldn descriptor system. As indicated in TABLE 6, the increases in traffic noise along Kuhio Highway due to project traffic are equal to or less than those due to non-project traffic, and will be difficult to measure due to their relatively

TABLE 6

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 1993)

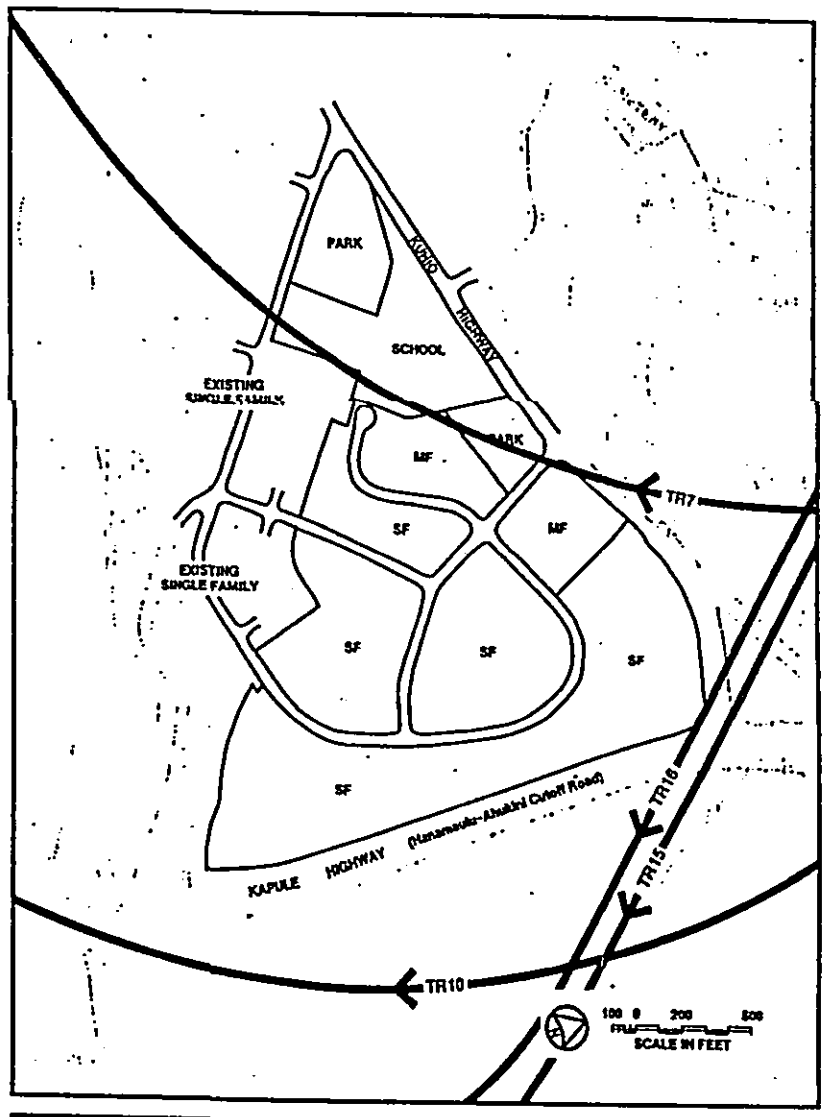
STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Kapule Hwy. Fronting Project	0.6	0.4
Kapule Highway at Bridge	0.6	0.4
Kuhio Hwy. at Hanamaulu School	0.7	0.3
Kuhio Hwy. at Kapule Hwy.	0.7	0.7
Kuhio Hwy. North of Project	0.2	0.2

low levels. Along Kapule Highway, the increases in traffic noise due to project traffic are predicted to be less than those due to non-project traffic. The largest increases in traffic noise levels attributable to project traffic are expected to occur along the section of Kuhio Highway which fronts the project and is near the Kapule Highway intersection. Overall, the increases in noise levels associated with project traffic are expected to be very low along both roadways and range between 0.2 to 0.7 Ldn.

Aircraft Noise. Predictions of future aircraft flight tracks and noise levels in the project environs were prepared during the recently completed FAR Part 150 study for Lihue Airport (Volume II, Reference 5). The aircraft flight tracks near the project site are reproduced as FIGURE 9, in which Tracks TR10, TR15, and TR16 represent helicopter approach tracks to the interim helicopter facility at Lihue Airport, and Track TR7 represents the average track of fixed wing tour aircraft which approach the airport from the northwest. As indicated in FIGURE 9, the project site should continue to be clear of the primary helicopter approach corridors to Lihue Airport, while the fixed wing corridor depicted by Track TR7 is expected to shift mauka to provide lateral separation from the helicopter tracks to the interim helicopter facility which is currently under construction.

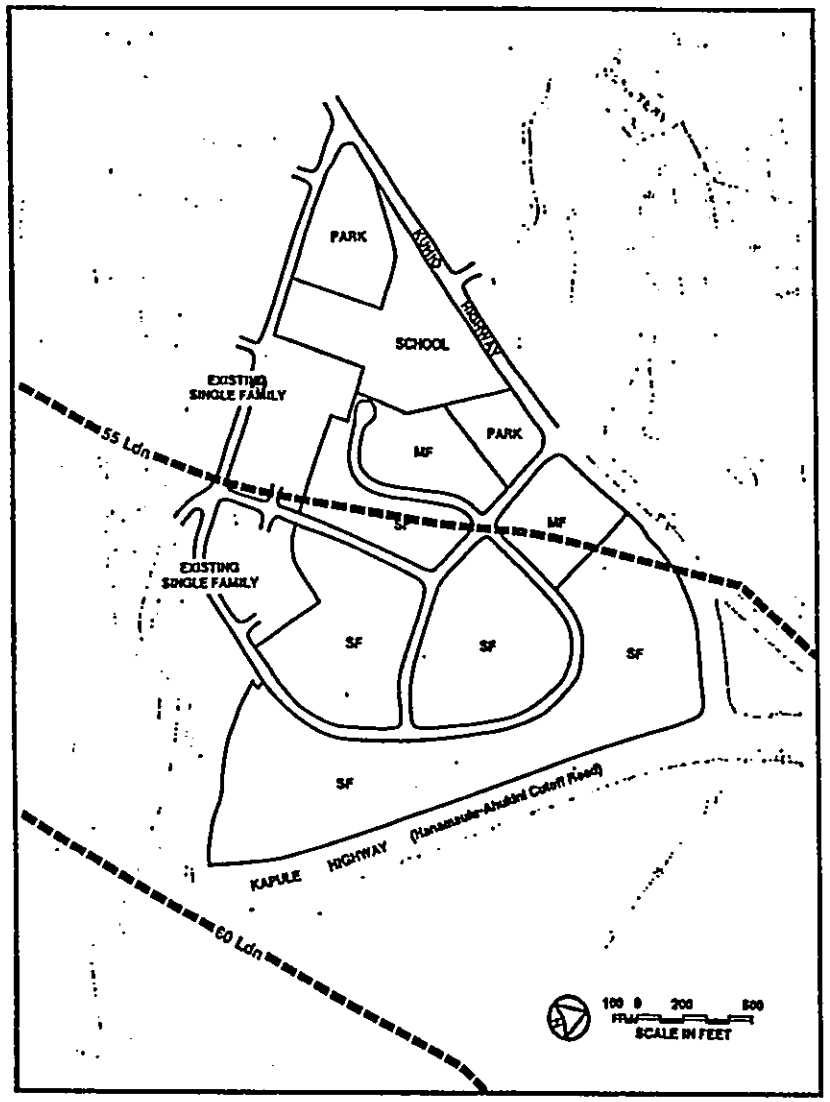
The forecasted CY 1991 and 1995 aircraft noise contours over the project site, which were developed during the FAR Part 150 study, are reproduced as FIGURES 10 and 11. As indicated previously in Chapter V, the CY 1991 noise contours over the project site are believed to be representative of the existing conditions, and for this reason, they may be underestimating the forecasts for CY 1991 if growth in military or Stage 2 jet aircraft operations at Lihue Airport continues. The CY 1995 noise contour forecast shown in FIGURE 11 includes an extension of RWY 35/17 by 2,000 FT as well as continued operation of the interim helicopter facility at Lihue Airport prior to construction of the inland heliport.

Both the CY 1991 and 1995 aircraft operational forecasts pre-



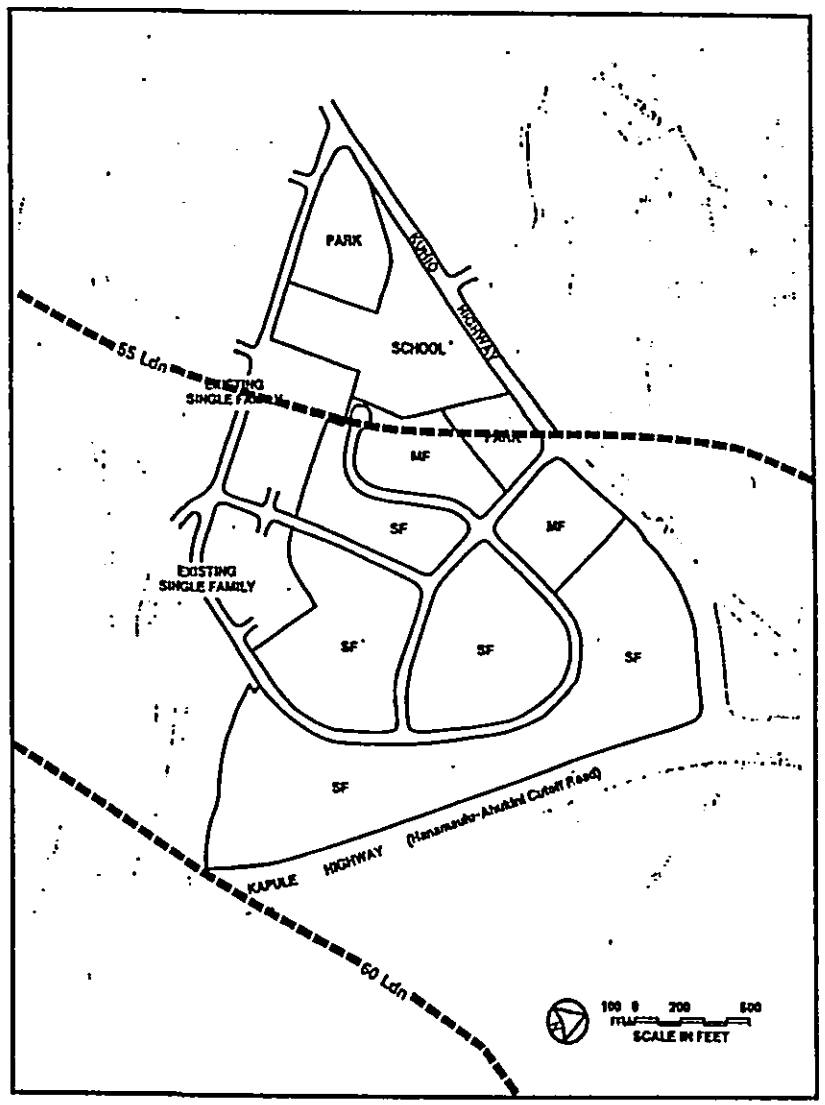
LOCATIONS OF FUTURE AVERAGE AIRCRAFT FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 9



LOCATIONS OF CY 1991
AIRCRAFT NOISE CONTOURS ON PROJECT SITE

FIGURE 10



LOCATIONS OF CY 1995
AIRCRAFT NOISE CONTOURS ON PROJECT SITE

FIGURE 11

viously developed by the State Department of Transportation Airports Division may change in light of the introduction of a third air carrier to interisland service, the possible extension of RWY 35/17 to 10,000 rather than 8,500 FT, and the probable relocation of tour helicopter operations to a new inland heliport on Kauai. These potential changes to the Lihue Airport operations forecasts are not expected to occur before CY 1991, but may affect the CY 1995 noise contours at the project site (see FIGURE 11) as follows:

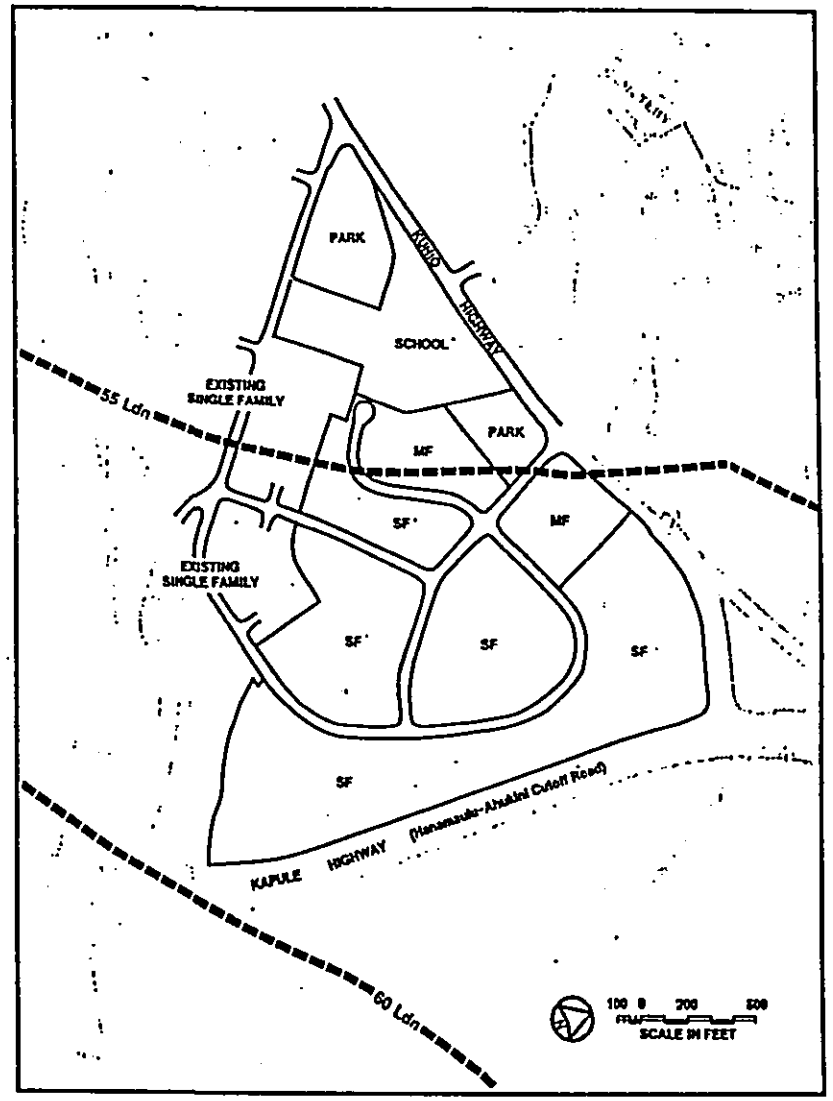
- The announced February, 1990 inauguration of flights by Discovery Airways to Kauai is expected to be beneficial by not contributing to the significant expansion of the noise contours at Lihue Airport, while adding additional air passenger seats in and out of Lihue Airport. This is due to their use of quieter BAE 146(200) aircraft, which are not expected to make significant contributions to the existing and forecasted noise contours at Lihue Airport.

- The possible additional extension of RWY 35/17 to 10,000 FT would tend to increase the potential for expansion of the airport noise contours in the area from Hanamaulu to the Kauai Hilton Hotel toward the north, and in the area of the Kauai Lagoons Hotel toward the south. The amount of expansion of the noise contours shown in FIGURE 11 will depend upon the type, number, and departure times of the additional aircraft which are forecast to use RWY 35 for departures or local training operations. However, until updated forecasts are available for Lihue Airport it is not possible to determine the final form of the future noise contours in the project area. As soon as updated forecasts are available from the State DOT Airports Division, new contours applicable to the future forecasts can then be developed.

- A possible secondary effect from the extension of RWY 35/17 is an increase in military and civil jet aircraft training operations on the extended runway. An increase in these jet aircraft training operations at Lihue Airport over the previously forecasted levels would tend to expand the noise contours in the project area. At the present time, the State DOT forecasts for military operations at Lihue Airport indicate a constant level of 12,000 operations per year between CY 1990 and 2005. There are no forecasts indicating increased levels of training activity by civil aircraft at Lihue Airport, although Aloha Airlines temporarily increased its nighttime jet training operations at Lihue Airport in CY 1988 due to an increase in new pilot hires during that year. In CY 1989, the level of nighttime jet training operations by Aloha Airlines were reduced to their normal quarterly activities, with training flights routed to Kahului or Lihue Airports whenever weather or congested conditions did not permit training at Honolulu International Airport. In the future years, if aircraft traffic congestion worsens at Honolulu International Airport, increased levels of training operations at Lihue and other state airports may occur. Updated forecasts of future training operations are not available at this time, but new CY 1995 contours can also be developed when these new forecasts become available.

- If tour helicopter operations are relocated from Lihue Airport to a new inland heliport as is presently being planned, a contraction of the 55 and 60 Ldn noise contours by 0.5 to 1 Ldn is expected to occur. This level of reduction is not considered to be significant and is well within the accuracy limits of the noise contour modeling process. Of greater significance is the reduction in the number of audible tour helicopter flyby events from the forecasted daily volumes of 110 flights per day in CY 1995.

The available forecasts for aircraft noise over the project site indicate that the 60 Ldn contour will not extend into the project site by CY 1995. Similar statements can be made regarding the noise contours for CY 2005 (see FIGURE 12) which were developed from currently available forecasts for the CY 2005 period, with RWY 35/17 extended to 8,500 FT, and without the transfer of tour helicopters to a new inland helicopter facility. Therefore, unless significant changes occur in the operational activity and forecasts for Lihue Airport, the project site is expected to remain outside the 60 Ldn aircraft noise contour through the CY 2005 time period.



LOCATIONS OF CY 2005
AIRCRAFT NOISE CONTOURS ON PROJECT SITE

FIGURE 12

CHAPTER VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise. The increases in traffic noise levels attributable to the project from the present to CY 1993 are predicted to range from 0.2 to 0.7 Ldn along Kuhio Highway, where traffic noise levels are expected to remain above 65 Ldn along the highway Right-of-Way. This degree of increase in traffic noise levels attributable to the project is not considered to be significant, and is comparable to or less than the traffic noise increases expected as a result of non-project traffic. For these reasons, traffic noise impacts along Kuhio Highway and resulting from project traffic are not considered to be serious. However, maximum setback distances to the 65 Ldn contour are expected to increase as a result of both project and non-project traffic.

Relatively small increases in traffic noise levels along the Kapule Highway are expected to occur as a result of the proposed project. By CY 1993, project traffic is expected to increase traffic noise levels along the Kapule Highway by approximately 0.4 Ldn. This level of increase is not considered significant, and traffic noise impacts resulting from project traffic on Kapule Highway are not expected to occur.

Potential noise impacts along Kuhio and Kapule Highways are possible, both in respect to existing and planned noise sensitive receptors along these roadways. Existing and future residences which are located along the Kuhio Highway may be impacted by the added traffic noise along the existing highway if their setback distances to the 65 Ldn contours are less than those indicated in TABLE 4 and FIGURE 6. Because traffic noise along public roadways are generated by non-project as well as project traffic, mitigation of off-site traffic noise impacts are generally performed by individual property owners fronting the roadways' Right-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks,

sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Where adequate setbacks beyond the 65 Ldn noise contour are not available, the construction of 6 FT high sound walls is generally effective for attenuating traffic noise at single story structures, or at the ground floors of multistory structures. Whenever mitigation of traffic noise at the upper floors are required, the use of closure and air conditioning, or the use of sound attenuating windows are the more appropriate sound attenuation measures.

Aircraft Noise. Based on currently available existing and forecasted aircraft noise contours over the project site, special aircraft noise attenuation measures are not considered mandatory on the project site. The implementation of the airport noise disclosure provisions of Act 208 is recommended over the entire project area because the existing and forecasted 55 Ldn noise contours encompass essentially all of the project area.

Because the existing and forecasted 60 Ldn contours are very close to the southeast corner of the project site, and because of the recent difficulty experienced in accurately forecasting future operations at Lihue Airport, there is some risk that future noise mitigation measures will be required following development of the project if operations increase significantly above the currently available forecasts. The State Department of Transportation may not be able to claim immunity from future airport noise litigation if the 60 Ldn airport noise contour expands into the project site following project construction and build-out. In addition, it may be required to add sound attenuation measures to the affected dwellings of the project in the form of closure and air conditioning. Therefore, the development of the proposed project could create potential additional costs to the State Department of Transportation if the future operations at Lihue Airport significantly exceed the presently available forecasts.

If the proposed project (or portions of the project) were located within the existing 60 Ldn airport noise contour, denial

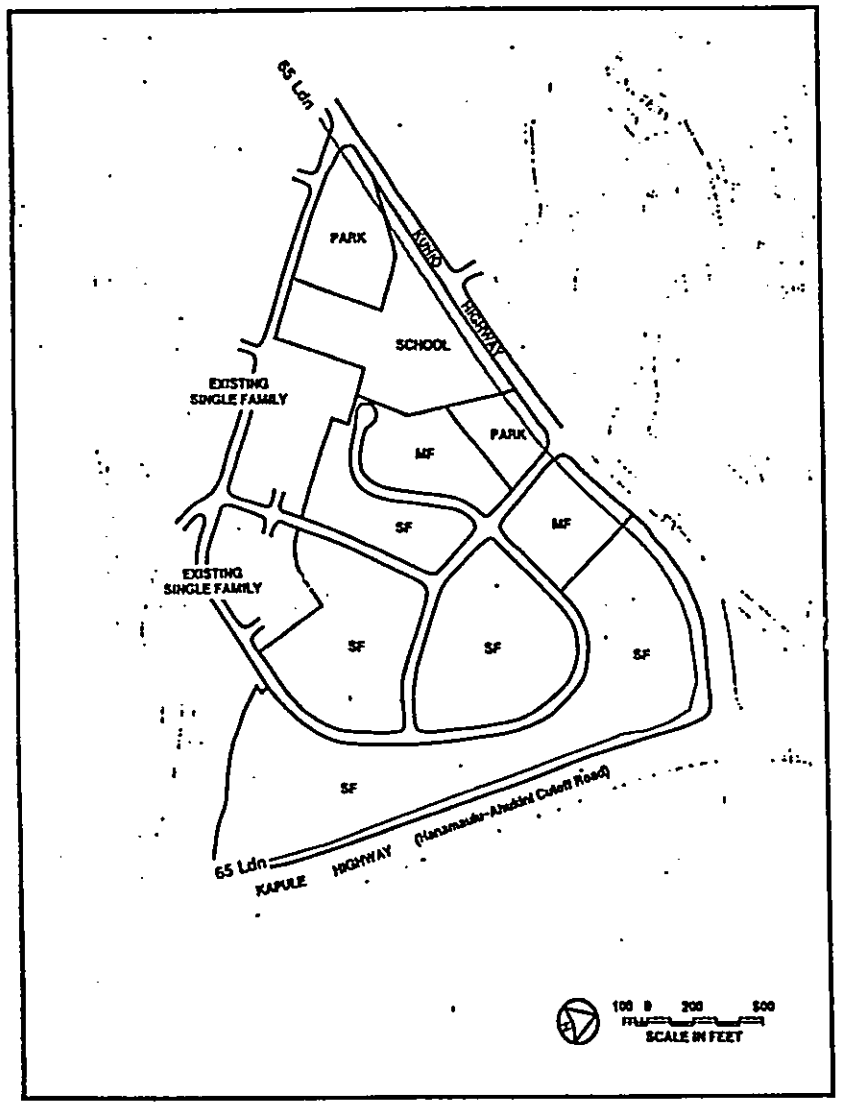
of the noise sensitive portions of the development would probably be recommended under the planning and Part 150 Noise Compatibility Program guidelines used by the State DOT at all of its airports. Under the existing circumstances of the proposed Hanamaulu Affordable Housing Project, where the project is located outside the existing and forecasted 60 Ldn contours, but inside the existing and forecasted 55 Ldn contours, noise disclosure under Act 208 is a minimum requirement. In situations such as this, where the State DOT will continue to be vulnerable to unexpected increases in airport operations, the purchase of noise and/or avigation easements for aircraft noise levels as high as 75 Ldn and which run with the land may also be appropriate. In exchange for the granting of these easements, the State DOT could assist the developer by contributing to the added costs of including minimum built-in construction features to allow for the future addition of sound attenuation measures at lower futura cost impact to the owner or the State DOT. These features are those which would provide for a minimum sound attenuation of 30 dB if the dwelling needed to be closed and air conditioned in the future due to unexpected increases in aircraft noise levels. A maximum exterior noise level of 75 Ldn is considered to be the upper limit of acceptability for exterior noise in residential areas. Since an interior level of 45 Ldn is considered to be a reasonable design goal when treating residences, a minimum sound attenuation of 30 dB (75 Ldn minus 45 Ldn) is the recommended design target for the ultimate sound attenuation treatment of the project dwellings. Examples of these sound attenuation features which may be built into the project's dwellings are: insulated, double exterior wall construction; heavy roof construction with gypboard ceilings and attic insulation; solid core, wood exterior doors with gasketing; 1/4" thick, laminated, casement or plate glass windows with gasketing; and electrical wiring to accommodate the addition of future central air conditioning units by the owner.

In summary, it is recommended that the State DOT be offered

an opportunity to draft and ultimately negotiate the purchase of noise or avigation easements over the noise sensitive portions of the project. Disclosure of the airport noise levels over the project site should also be performed as required under Act 208.

Combined Traffic and Aircraft Noise. FIGURE 13 depicts the combined aircraft plus traffic noise contours over the project site. These contours were developed by combining the CY 1995 aircraft noise contours of FIGURE 11 with the CY 1993 traffic noise contours of FIGURE 6. The combined 65 Ldn noise contours are useful for determining if sound attenuation measures are required under federal program standards, and would normally be developed using data from a common forecast year. When applying for FHA/HUD financial assistance on residential developments, sound attenuation measures are normally required if total exterior noise levels exceed 65 Ldn. If the traffic noise level equals 65 Ldn and the aircraft noise level equals 60 Ldn at a project dwelling, the total noise level will be 66 Ldn, which exceeds the FHA/HUD standard of 65 Ldn. Whenever the total noise level exceeds 65 Ldn as a result of aircraft plus roadway traffic noise, it is usually more practical to attempt to attenuate the traffic noise component rather than the aircraft noise component so as to reduce the total noise level to 65 Ldn or less.

Use of the sound attenuation methods described above under the Traffic Noise section apply when attempting to reduce total noise levels to comply with FHA/HUD standards. Use of the sound attenuation methods described above under the Aircraft Noise section also apply, but tend to be more expensive because they are structured toward achieving higher levels of exterior-to-interior noise reductions, and generally require total closure and air conditioning. A third method is to insure that all rooms of affected dwellings, which face the traffic noise source and marginally (by 1 to 3 Ldn) exceed the FHA/HUD standard due to combined levels of traffic and aircraft noise, have at least one ventilation opening per room which is restricted to a 90 degree field-of-view toward



LOCATION OF COMBINED (AIRCRAFT PLUS TRAFFIC) 65 Ldn NOISE CONTOUR ON PROJECT SITE

FIGURE 13

the traffic noise source. An example of this is occurs in a corner room of a dwelling which has one exterior wall parallel to the roadway and the second exterior wall perpendicular to the roadway. A window on the wall parallel to the roadway would probably have greater than 90 degree field-of-view to the roadway and would probably not be acoustically acceptable when opened. However, a window on the wall perpendicular to the roadway would probably not have a field-of-view to the roadway which exceeds 90 degrees, and would probably be acoustically acceptable when opened.

CHAPTER VIII. OTHER NOISE IMPACT CONSIDERATIONS

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in FIGURE 14. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing Hanamaulu residences and school southwest and west of the project site. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (Reference 13), is another noise mitigation measure which can be applied to this project. TABLE 7 depicts the allowed hours of construction for normal construction noise (levels which do not exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Noisy

construction activities are not allowed on holidays under the DOH permit procedures.

FIGURE 14

CONSTRUCTION NOISE LEVELS VS. DISTANCE

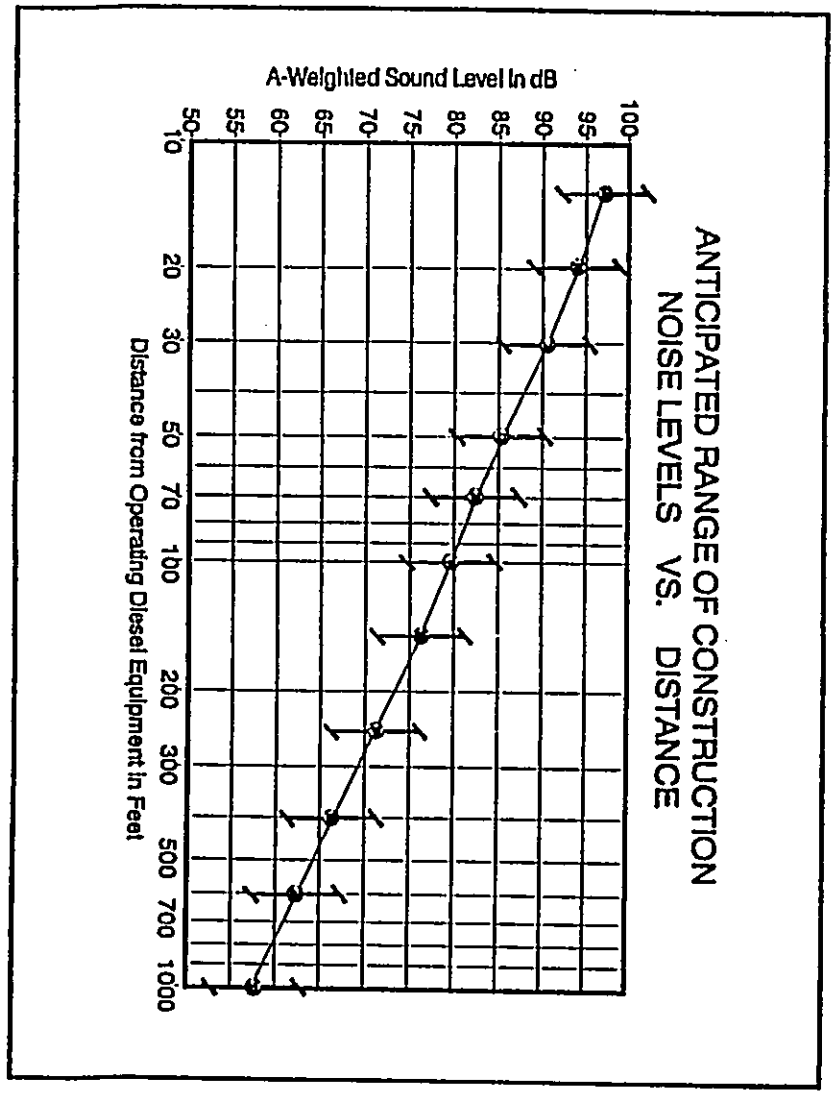
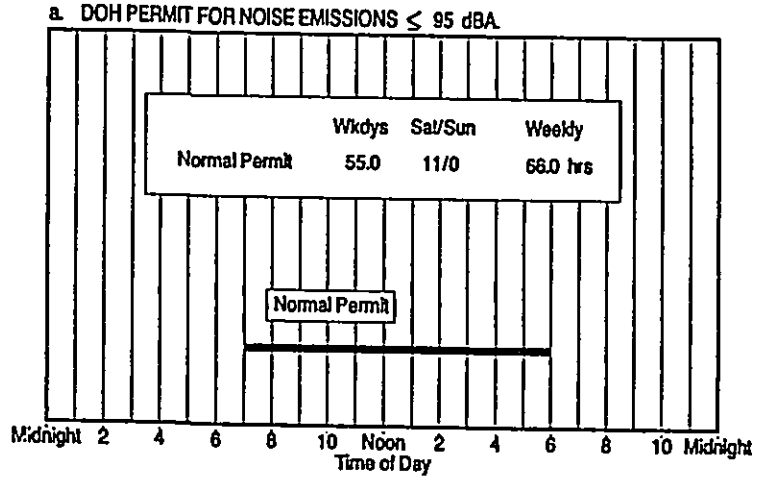


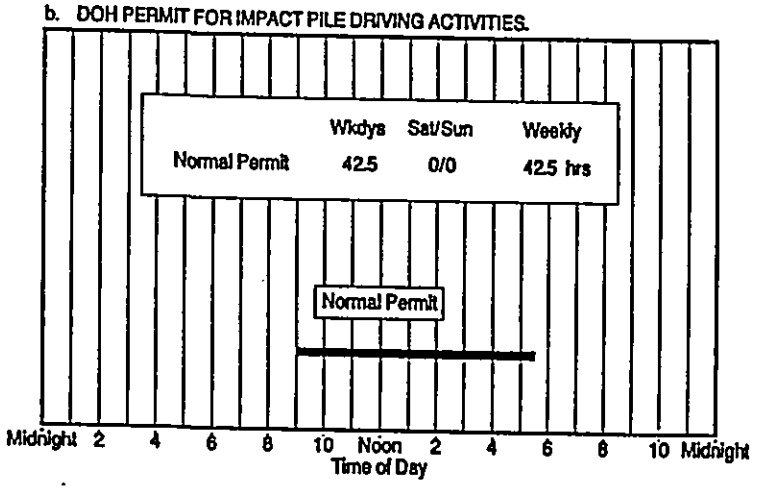
TABLE 7

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤ 95 dBA.



b. DOH PERMIT FOR IMPACT PILE DRIVING ACTIVITIES.



APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control"; Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B"; U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety"; Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) Act 208, Session Laws of Hawaii 1987; Fourteenth Legislature, State of Hawaii; June 7, 1987.

(5) "Lihue Airport - FAR Part 150 Noise Compatibility Program; Lihue, County of Kauai; Volumes I and II"; Hawaii State Department of Transportation, Airports Division; September, 1989.

(6) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model"; FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(7) Draft of traffic study for the Hanamaulu Affordable Housing Project; Kaku Associates; January 19, 1990.

(8) September 28-29, 1989 24-Hour Traffic Counts; Station 22, Kuhio Highway at Hanamaulu Road; Hawaii State Department of Transportation.

(9) September 28-29, 1989 24-Hour Traffic Counts; Station 22-D, Kuhio Highway at Kapule Highway; Hawaii State Department of Transportation.

(10) October 3-4, 1989 24-Hour Traffic Counts; Station 22-C, Ahukini Road at Kapule Highway; Hawaii State Department of Transportation.

(11) September 27-28, 1989 Vehicle Type Classification; Station 22-D, Kuhio Highway at Kapule Highway; Hawaii State Department of Transportation.

(12) "Acoustic Study of Potential Noise Impacts Associated with the Interim Helicopter Facility at Lihue Airport; Lihue, Kauai;" Y. Ebisu & Associates; May 1988.

(13) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu"; Hawaii State Department of Health; November 6, 1981.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "Lepn" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNDB, and EPNDB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., decl).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PWL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_d	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,...weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.