DEPARTMENT OF GENERAL PLANNING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

BENJAMIN B. LEE
CHIEF PLANNING OFFICER

ROLAND D. LIBBY, JR.
DEPUTY CHIEF PLANNING OFFICER

MM/DGP 3/90-954

April 20, 1990

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

Dear Dr. Miura:

Final Environmental Impact Statement (FEIS) for the
Malulani Sports Complex - Nanatomi Hawaii, Inc.
Tax Map Keys 4-6-06: 1, 7, 9, 11, 13, 15, 22-44, 48-51;
and 4-6-16: 32

We are notifying you of our acceptance of the Final EIS for the Malulani Sports Complex, as adequate fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes, and the EIS Rules. The EIS adequately examines and discloses the potential impact that could result from the proposal.

Unresolved issues which should be addressed prior to or along with the subsequent zoning activities for the entire sports complex include:

1. Provide grading plans and details, slope analysis map, and quantify the amount of grading and excavation (cut and fill) required by the proposed project. Based on this additional information, identify the resultant impacts on drainage, soil erosion, etc. A grading plan and a detailed drainage plan should be submitted to the Department of Public Works for its review and approval.

2. Approval of a Conservation District Use Application to utilize the 117 acres on the mauka portion of the site for two water wells, golf holes, clubhouse, quality dining facilities, gym, parking, tennis courts, etc.

3. Approval of the necessary water wells.

4. Highway improvement plans and programs as required by the City Department of Transportation Services and the State Department of Transportation, along with the suggested realignment of Kamehameha Highway.

5. Approval of a groundwater monitoring plan and golf course maintenance plan.

6. Additional conditions that may be imposed by the Department of Health or other governmental agencies.

These issues are discussed in the attached Acceptance Report. If there are any questions, please contact Mel Murakami of my staff at 527-6020.

Sincerely,

Benjamin Lee

BENJAMIN B. LEE
Chief Planning Officer

BBL:ft

Attachment

cc: Nanatomi Hawaii, Inc.
Helber, Hastert and Kimura

1990 - Oahu - FEIS
Malulani Sports

FILE COPY

Malulani Sports Complex

Koolaupoko, Oahu

FINAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for: Nanatomi Hawaii, Inc.
Prepared & Submitted by: Helber Hastert & Kimura, Planners

MARCH 1990

FILE COPY

Malulani Sports Complex

Koolaupoko, Oahu

FINAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for: Nanatomi Hawaii, Inc.
Prepared & Submitted by: Helber Hastert & Kimura, Planners

Glenn T. Kimura, Partner-in Charge

MARCH 1990

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

Nanatomi Hawaii, Inc. (hereinafter referred to "Nanatomi Hawaii") has applied to the City and County of Honolulu Department of General Planning (the "Accepting Agency") for an amendment to the Koolaupoko Development Plan (DP) to permit the development of a sport complex in Heeia Kea Valley, Koolaupoko, Oahu.*

Specifically, the application requested the redesignation of 103 acres of the project area (henceforth referred to as "the area of application") from the present Residential, Public and Quasi-Public, and Agriculture DP designations to Parks and Recreation, and Residential.

By letter dated September 27, 1989, the Department of General Planning (DGP) notified both the applicant and the Office of Environmental Quality Control (OEQC) of its determination that an Environmental Impact Statement (EIS) would be required for the application.

1.2 INTENDED USES OF THIS DOCUMENT

This EIS has been prepared to support the applicant's DP amendment request. Pursuant to DGP's determination, an environmental impact statement preparation notice (EISPN) was published in the October 8, 1989 issue of the OEQC Bulletin. In addition, a more detailed version of the EISPN was sent directly to 130 agencies, organizations, individuals and surrounding landowners and lessees thought to have an interest in providing input into the preparation of the EIS. A total of 25 agencies or individuals responded by letter and these letters are reproduced in Chapter IX. Concerns raised in these letters have been addressed in relevant chapters of this report.

The Draft EIS was filed on 20 December 1989 with the accepting agency and with OEQC for public distribution. Notice of the Draft was published in the 23 December 1989 issue of the OEQC Bulletin. A total of 26 agencies or individuals responded by letter by the 6 February 1990 deadline date. As of 28 February 1990, a total of 8 letters were postmarked and received after the deadline. All comments were responded to and are reproduced in Chapter XI.

The report is intended to comply with Chapter 343, HRS and the EIS regulations promulgated by Chapter 200 of Title 11, Department of Health. The purpose of the report is to provide information about the nature of the subject action to public agencies and interested members of the community; to assess the existing environmental conditions of the property and surrounding areas; to evaluate and disclose probable impacts of the action; to propose mitigative measures to minimize adverse project impacts; and to consider alternatives to the proposed action.

---

* Application for Development Plan Amendment and Environmental Assessment, Malulani Sports Complex, Koolaupoko, Oath. (Department of General Planning Reference No. 90/KP-1). Prepared for Nanatomi Hawaii, Inc. by Helber Hastert and Kimura, Planners, 15 September 1989.

1.3 PROJECT SUMMARY

Nanatomi Hawaii proposes the development of a sports complex on the property, including an 18-hole golf course, a golf clubhouse with a restaurant, tennis courts, a health spa and aerobics facility, as well as approximately 30 to 35 single-family homes.

Applicant: Nanatomi Hawaii.

Landowner: Nanatomi Hawaii.

Request: Residential, Public and Quasi-Public, and Agriculture to Parks and Recreation (approximately 86.8 acres), and Residential (16.2 acres).

Area of Application: 103 acres.

Location: The area of application is located in Heeia Kea Valley, mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor (Figure 1).

TMK: 4-6-06: 1, 7, 9, 11, 13, 15, 22-44, 48-51; and 4-6-16: 32.

Existing Use: Vacant, undeveloped, small portion used for interim construction yard storage.

State Land Use: Urban District.

Development Plan Land Use Map Designation: Residential, Public and Quasi-Public, and Agriculture.

Development Plan Public Facilities Map Designation: Kamehameha Highway improvements programmed beyond the next 6 years.

Zoning: R-5 Residential, AG-2 Agricultural.

1.4 SUMMARY OF PROBABLE IMPACT AND MITIGATIVE MEASURES

Nearshore Marine Environment. Altering the present land usage by constructing the planned development is estimated to cause an increase in total runoff from a 100-year, 24 hour duration design storm of about 13 percent. Project plans, however, include construction of retention basins and water features that should decrease potential runoff to Kaneohe Bay relative to current conditions. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts to runoff.

Operation of golf courses has the potential to add nutrients (nitrate nitrogen) to coastal waters as a result of leaching fertilizer chemicals to groundwater, or by surface runoff following storm events. Such processes can be mitigated by ensuring that the golf course soil is porous and on the order of a foot in depth, and fertilization and irrigation schedules are designed so that application rates do not greatly exceed uptake rates. Downslope from the planned Malulani golf course,

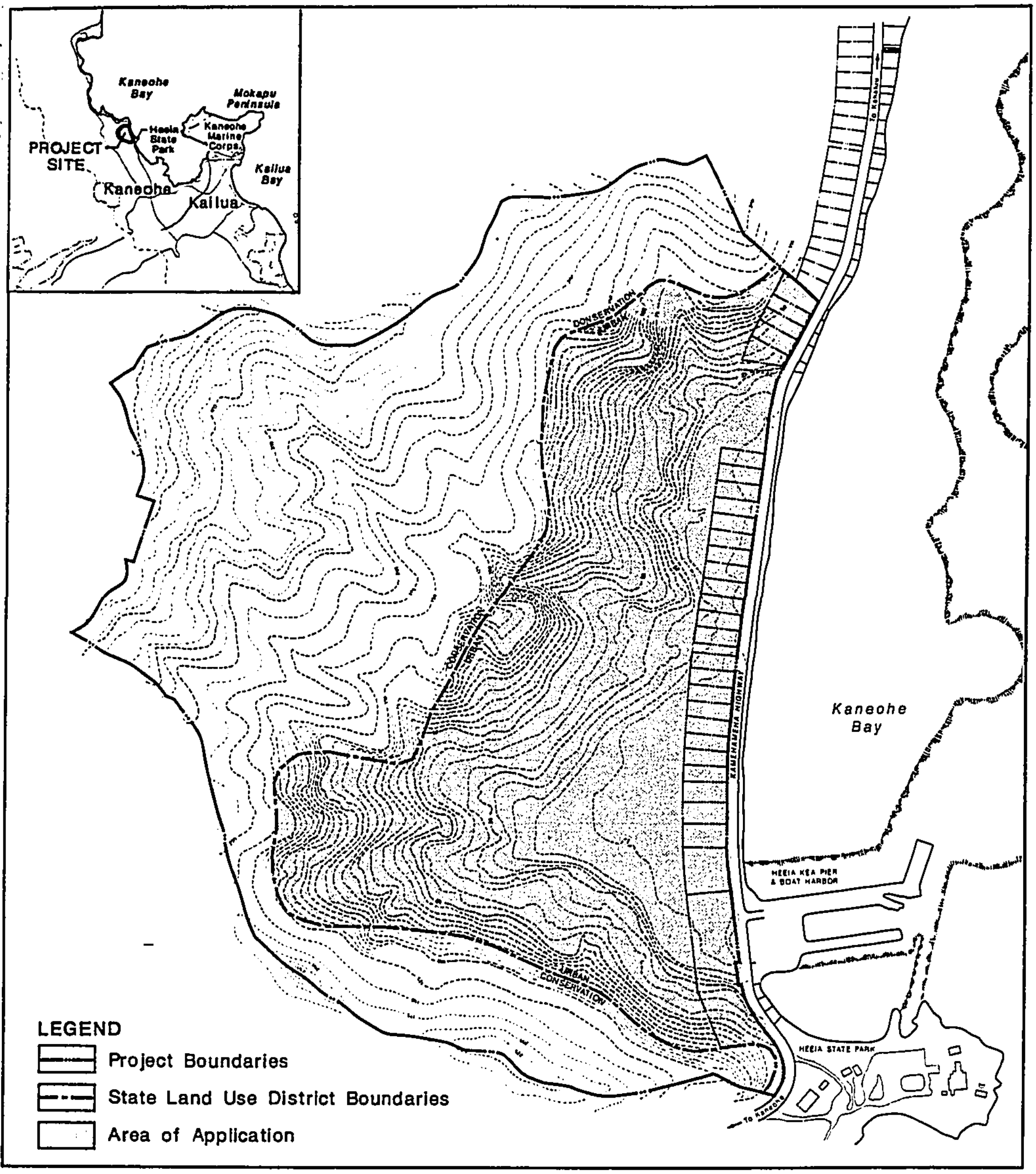


Figure 1: Location Map

0 600
Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

chemical measurements in Kaneohe Bay indicate that there is negligible influence of groundwater on the composition of the water column. With proper management strategies, there is little chance that materials from the golf course, would reach Kaneohe Bay in quantities sufficient to change the chemical characteristics of the region. While all indications are that the planned golf course will have no impacts to Kaneohe Bay, a monitoring program will be implemented.

Flora and Fauna. No endangered flora or fauna were found to inhabit the project site. In areas where vegetation is removed, there will be a temporary loss of soil retention values and exotic fauna species habitat provided by the existing vegetation. Soil erosion will be controlled by wetting down loose soil areas, good housekeeping on the job site and the prompt landscaping of bare soil areas. The existing fauna is expected to relocate elsewhere on neighboring properties which provide similar habitats. Ultimately, the project will result in the replacement of the mostly exotic vegetation with native and exotic vegetation. The new vegetation is expected to provide habitat for fauna species similar to those presently found on the property.

The chemicals applied in golf course management (fertilizers, herbicides and pesticides) pose little hazard for birds or wildlife.

Historic and Archaeological Resources. Ten sites and three isolated artifacts were identified during a archaeological inventory survey prepared for the project. Of the total ten sites, six are assessed as significant solely for information content. For four of the six sites, no further work is recommended. For the remaining four sites, further data collection is recommended. In addition to the site and feature recommendations, it is further recommended that the areas of two of the three identified isolated artifacts undergo further investigation. The remaining isolated find is assessed as significant for information content, but requires no further work.

No impacts to archaeological or historical resources are expected if the above recommended mitigative work is implemented. In the event that any previously unidentified sites or remains are encountered during construction and site work phases, work in the immediate area will cease until the State Historic Preservation Officer has been notified and is able to assess the impact and make further recommendations for mitigative actions, if warranted.

Population. Based on an average household size of 3.5 persons, it is estimated that the average daily population should ultimately range from 105 persons to 123 persons depending upon the number of units constructed (30 to 35 proposed).

Economy/Employment. The operation of the Malulani Sports Complex is estimated to create employment for 54 persons.

Traffic. Future traffic levels along Kamehameha Highway without the project are expected to remain about the same as existing levels. According to the traffic impact analysis report which was prepared for the proposed project, traffic attracted by the project would be relatively minimal. According to the report, the level-of-service along Kamehameha Highway will be unchanged even after the establishment of a new intersection for the project entry road. The project-generated traffic will have a minimal impact on the regional traffic system, since it is a facility that will attract a relatively minimal amount of traffic, distributed evenly throughout the day, going in the opposite direction from the Primary Urban Center.

Air Quality. The major short-term air quality impact of the project will be project construction and the potential emissions of fugitive dust. State of Hawaii Department of Health regulations stipulate control measures that are to be employed to reduce this type of emission. Primary control consists of wetting down loose soil areas, good housekeeping on the job site and the prompt landscaping of bare soil areas.

The primary potential long-term air pollution impact from the project will arise from carbon monoxide emissions from the increased motor vehicle traffic associated with the project. Concentrations predicted by air quality modeling for the project at full completion, either with or without the project, are about the same as present levels.

There will be no significant adverse effects on air quality from application of pesticides in golf course management provided that appropriate application techniques are used.

1.5 RELATIONSHIP TO LAND USE PLANS AND POLICIES

Chapter III contains a detailed discussion of the relationship between government plans and policies and the proposed action. The proposed action is generally consistent with all relevant public goals, objectives, policies, plans and controls.

1.6 ALTERNATIVES CONSIDERED

A number of alternatives were analyzed for the present site including: no-action; more residential development than the proposed action; an alternative prepared by Hui Malama and Waiahole-Waikane Community Association in response to proposals for extensive residential development; and development given current Koolaupoko Development Plan Land Use designations.

In summary, the applicant has evaluated alternative proposals and finds that the proposed sports complex and limited residential development represents the most feasible use of the site.

1.7 NECESSARY PERMITS AND APPROVALS

A number of permits and approvals must be secured by the applicant before development of the site can begin. Major permits and approvals still outstanding are listed in Table 1. The information provided in this table is subject to change.

TABLE 1: NECESSARY PERMITS AND APPROVALS*

Authority	Approval Required
Honolulu City Council	Koolaupoko DP Land Use Amendment Zone Change Special Management Area Use Permit
Department of Land and Natural Resources	Conservation District Use Application
Department of Land Utilization	Subdivision Approval
Building Department	Building Permits Grading Permits
Board of Water Supply	Water Commitment
Commission on Water Resource Management	Well Construction

* Subject to change

Shoreline Setback Variance probably not required. At the present time, no structures and earth-moving activities are proposed within 40 feet of the vegetation line (which is makai of Kamehameha Highway fronting the property).

CHAPTER II

PROJECT DESCRIPTION

This chapter describes the proposed Malulani Sports Complex. The project location is first described. The recent history of Heeia Kea Valley is then reviewed leading into a description of existing uses, Nanatomi Hawaii's involvement with the community, a description of the concept plan and the infrastructure improvements required by the project. The preliminary market and economic feasibility of the project is then reviewed ending with a brief discussion of project phasing and costs.

2.1 LOCATION

The proposed project is located in Heeia Kea Valley mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor (Figure 1). The property is adjacent to existing residences that stretch along Kamehameha Highway from the Kahaluu Pond, and is makai of the Valley of Temples and Ahuimanu residential and commercial development (Figure 2). The area for which the Koolaupoko Development Plan Land Use Map Amendment is being made is shown as the shaded area in Figure 1. This area of application consists of approximately 103 acres out of a total project area of approximately 220 acres.

2.2 RECENT HISTORY OF HEEIA KEA VALLEY

In 1965, Hawaiian Electric Company, Inc. (hereafter referred to as "Hawaiian Electric") signed a 30-year lease with Kamehameha Schools/B.P. Bishop Estate for the use of Heeia Kea Valley as a potential future site for an electrical power generation plant. At that time, governmental agencies were planning for population growth and development of the windward coast of Oahu, and Hawaiian Electric's acquisition of the property was in anticipation of meeting future electrical power demand.

In the mid-1970's the City and County of Honolulu enacted a General Plan and proposed a series of Development Plan Land Use maps for Oahu. A major change resulting from these plans was a shift of designated areas for population growth away from the windward coast, which essentially eliminated the need for an additional electrical power generation plant on the windward coast of Oahu.

As a consequence, the Development Plan Land Use Map designations for the portion of Heeia Kea Valley within the State Land Use Urban District boundary was changed from Residential to the current Agricultural designation.

Given the decision not to build an electrical power generation plant in Heeia Kea Valley and its obligation to ultimately purchase the property, Hawaiian Electric began exploring alternative development proposals for the valley.

In January 1983, Hawaiian Electric requested that the proposed Koolaupoko Development Plan (DP) Land Use Map be amended to allow the development of 418 residential units. The Honolulu City Council denied this application in June 1984.

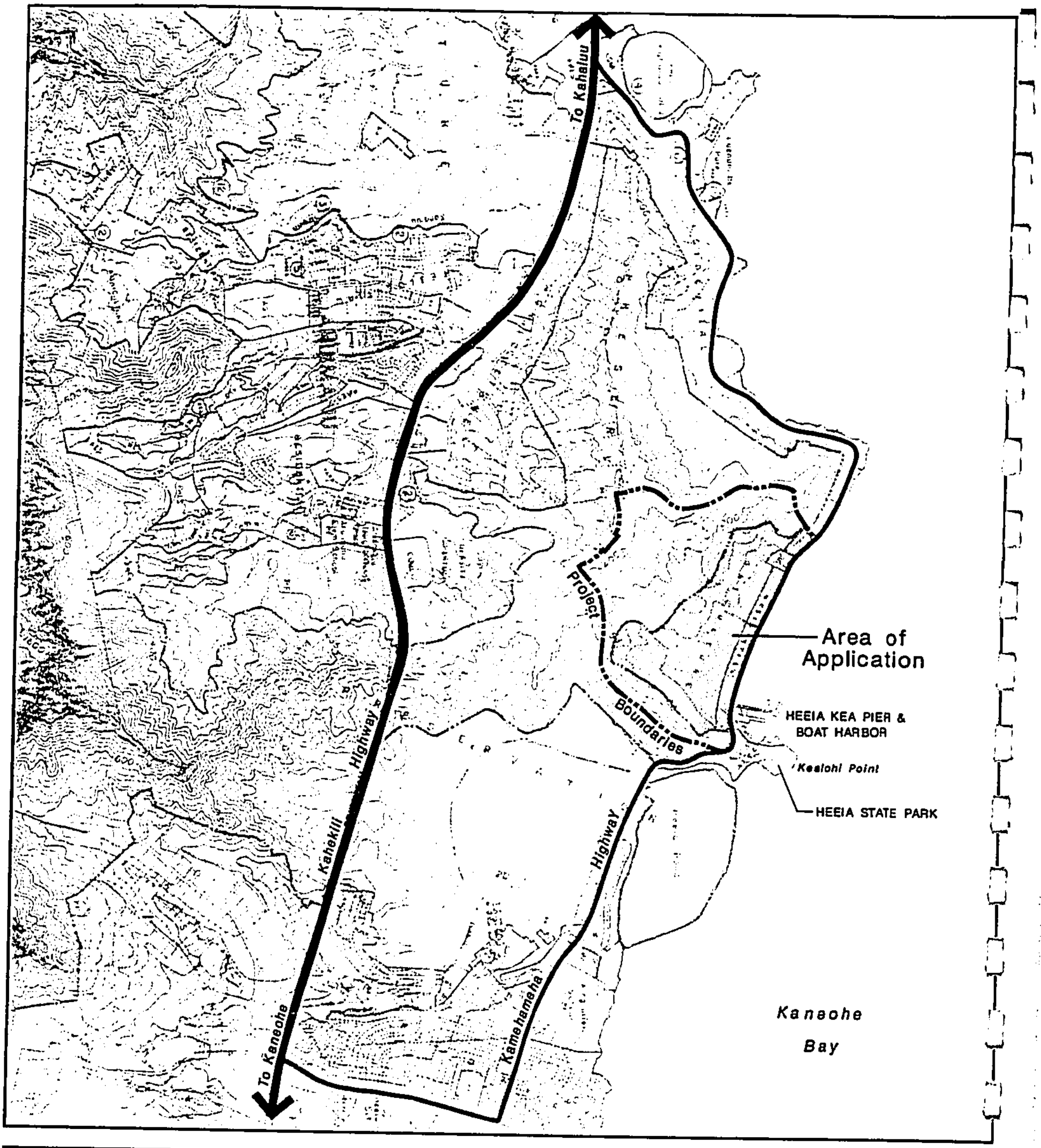


Figure 2: Vicinity Map

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

In February 1985, Hawaiian Electric submitted another proposal to amend the Koolaupoko DP Land Use Map to allow the development of 500 residential units, and Park, Industrial and Commercial uses. This proposed DP Land Use Map amendment was denied by the Honolulu City Council in June 1985.

In December 1985, Hawaiian Electric's parent company, HEI, Inc., formed Malama Pacific Corp. as its property development subsidiary, which was responsible for planning the future of Heeia Kea Valley. In the following month, Malama Pacific Corp. joined Gentry Investments to form Malama-Gentry Joint Venture and sold the lease to the joint venture. Later in 1986, Malama-Gentry Joint Venture submitted another (the third) application to amend the Koolaupoko DP Land Use Map to allow residential (360 units), commercial, industrial and park development in Heeia Kea Valley. The application was denied by the Honolulu City Council in June 1987. Among the reasons cited for the three previous DP Amendment application denials were: the lack of community support for the previous land use proposals; and concerns about the traffic that would be generated by large residential development.

In September 1987, Malama-Gentry Joint Venture decided to sell the property rather than make a fourth attempt to reclassify the valley to allow extensive residential development. Nanatomi Hawaii purchased the property in February 1989.

2.3 EXISTING USES

The property is mostly vacant except for the structure of the former Hawaiian Electric Company, Inc. baseyard. The baseyard is currently being leased to a construction company for the storage of equipment and supplies. Another portion of the property is presently being used by a trucking company for the storage of vehicles. The property is not cultivated and there are no existing residences.

2.4 COMMUNITY INVOLVEMENT

Since acquiring the property in February 1989, Nanatomi Hawaii has been engaged in an active community involvement program. The purpose of the program has been to initiate, coordinate and maintain a reciprocal flow of information exchange between project team members and the affected community-at-large.

Nanatomi Hawaii has publicly committed to this ongoing process in an effort to keep interested residents and community leaders informed about the progress of Nanatomi Hawaii's proposed plans and more importantly, to obtain their ideas and concerns regarding such plans.

The implementation of this community involvement program has and will continue to include meetings with organized community organizations, such as the Kahaluu and Kaneohe Neighborhood Boards, various community associations, business groups, youth athletic groups, Friends of Heeia State Park, area fishermen, Hawaiian cultural leaders, public officials, and other interested residents throughout the community. A widely announced community meeting was held on October 3, 1987.

In addition, periodic newsletters, releases to news media, and fact sheets describing details of the project and its proposed use have been actively distributed through community mailing lists and community interviews conducted to date.

A concept plan for the Malulani Sports Complex has been prepared and is presented in Figure 3. This plan is for illustrative purposes only and is subject to change based on community feedback, market influence, environmental impacts, and cost considerations. The plan will be refined as more information is generated.

Many of the ideas incorporated in the Concept Plan have come about as a result of community meetings and individual discussions held prior to submittal of this Draft EIS. For example, the configuration of proposed residential areas shown in the Notice of Preparation was revised (inland away from Kamehameha Highway) in response to community concerns about residences adjacent to Kamehameha Highway.

2.5 OBJECTIVES OF THE ACTION

The subject property was acquired to allow the development of a sports complex, including a par 72, 18-hole golf course. Previous proposals for the property (primarily large-scale residential) have been unsuccessful because of the impact of between 360 to 500 units on traffic, concerns regarding open space, and other environmental considerations.

2.6 APPLICANT'S PROPOSED USE OF THE PROPERTY

Nanatomi Hawaii proposes the development of a sports complex on the property, including an 18-hole golf course, golf clubhouse with quality dining facilities, meeting and function rooms, 3 tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. Refer to Figure 3.

A par 72, 18-hole golf course will be designed to use as much of the existing terrain and vegetation for challenging play allowing for proper orientations and distances for safe play. Particular attention will be paid to fairways 7 and 13 to increase safety and minimize potential hazards to users of Kamehameha Highway. Maintaining safe distances and planting shrubs and trees at appropriate areas (tees and landing areas) will minimize hazards along Kamehameha Highway. Water features will be distributed throughout the site to function as fairway amenities as well as irrigation reservoirs and siltation basins.

The golf course will be a private course open for public play for a daily fee. The projected fee schedule is unknown at this time because of the uncertainties in estimating the cost of development and the cost of operating the golf course, once completed. However, unlike other golf courses premised upon private memberships, this golf course will be dependent on public play for operating revenue, consequently the fee would need to be competitive with other courses catering to public play that will be in operation at the same time. While the daily fee structure is still being studied, Nanatomi Hawaii is committed to offering certain discounts preferably to Kahaluu and Kaneohe residents. No international memberships will be sold.

The clubhouse will contain the requisite players facilities such as administrative office, bag handling area, lockers, pro shop, food and beverage facilities, golf cart storage area and back-of-house facilities. In addition, Nanatomi Hawaii intends to provide quality dining facilities, and meeting and function rooms as part of the clubhouse. In addition to the golf facilities, health and fitness facilities are also planned as part of the clubhouse. Facilities such as 3 lighted tennis courts,

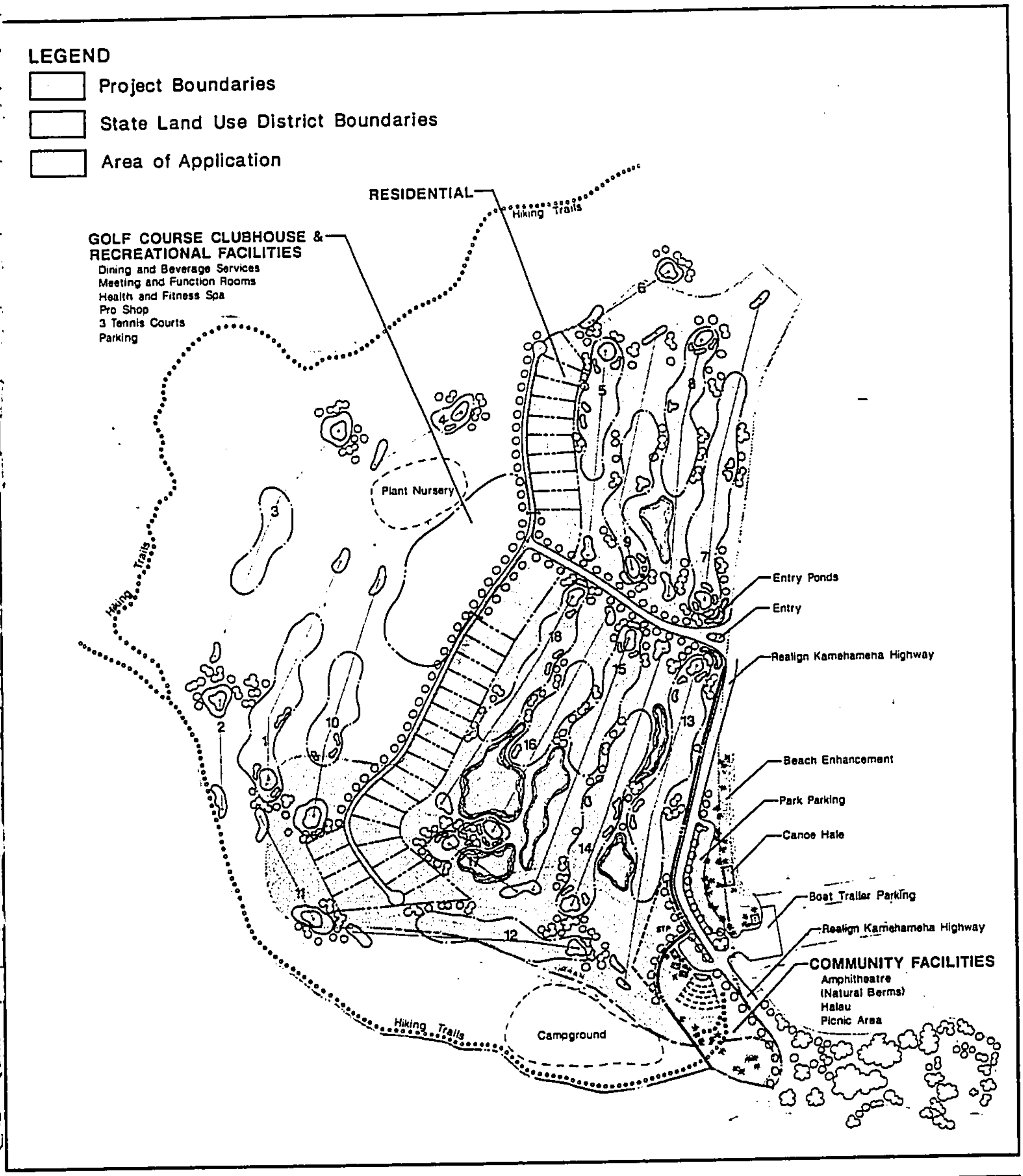


Figure 3: Concept Plan

Malulani Sports Complex

0 600
Feet

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

swimming pool, gym and weight rooms, aerobics studio, sauna, jacuzzi, and shower facilities are currently contemplated.

The clubhouse will be sited on a knoll overlooking the golf course, Heeia Kea Pier and Boat Harbor and Kaneohe Bay beyond.

Adequate parking to service the golf course and clubhouse will be provided adjacent to the clubhouse.

Nanatomi Hawaii will operate the golf course, and clubhouse and recreational facilities.

Nanatomi Hawaii will dedicate approximately 9 acres of the property for community-oriented facilities. Approximately 1 acre will be dedicated for the possible realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. If a short section of Kamehameha Highway is realigned, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park (desirable according to preliminary consultation with some segments of the community) and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. The proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area.

Preliminary discussions have been held with the State Departments of Transportation (Harbors Division), and Land and Natural Resources, and the City and County of Honolulu Departments of Transportation Services, and Parks and Recreation regarding the area proposed to be dedicated for community facilities. Only the City and County of Honolulu Department of Parks and Recreation has clearly indicated that accepting the land being offered would not be directly beneficial to them because they have no nearby facilities. Without reviewing detailed drawings, the Deparment of Transportation Services indicated that they would probably accept the road realignment when completed (if built to County standards). The State Department of Transportation, Harbors Division, is currently studying the possible opportunities of the land dedication.

Hiking trails and a 4 acre campground accessible to the windward community with a permit from Nanatomi Hawaii are also planned.

TABLE 2: PRELIMINARY LAND USE SUMMARY

Land Use	Acres
18-hole Golf Course	138.3
Vacant	40.0
30-35 Residences	16.2
Golf Clubhouse	10.0
Community Facilities	9.0
Campground	4.0
Plant Nursery	2.5
Total	220

2.7 SUPPORTING INFRASTRUCTURE

This section provides a discussion of the on-site infrastructure improvements required to support the concept plan for the property. Information for this section has been summarized from the water master plan (Appendix H), the wastewater management report (Appendix I), the drainage report (Appendix D) and the traffic report (Appendix J). Regional and off-site improvements are discussed in Chapter VI.

2.7.1 Water

The water supply for the proposed project will be separated into two different systems: the potable water system and the non-potable water system. The potable water system includes domestic supply and fire protection for the residences and the golf maintenance facility, and domestic supply for the golf clubhouse and recreational facilities. The proposed potable water system will be connected to the 30-inch BWS low service transmission line (Appendix H). A new 12-inch line will be installed along Kamehameha Highway up to the proposed project entry road (Appendix H). From the entry, a new 8-inch line will be installed along the project roadways (Appendix H).

Fire hydrants will be installed at appropriate locations. Construction of the necessary transmission/distribution system will be at the applicant's expense. All facilities will be designed to BWS standards and are intended to be dedicated to the BWS upon completion.

The non-potable water system includes irrigation for the golf course and landscaped areas. The primary sources of irrigation water will be storm runoff catchment and treated sewage effluent from the project. To supplement these sources during dry weather conditions, it is proposed that two wells be drilled on the mauka portion of the site, between the 250-foot and 275-foot elevations. The wells are expected to deliver 0.2 MGD per well. A gravity line from the well sites will supply non-potable water to an irrigation storage pond/golf course water feature south east of the clubhouse area.

2.7.2 Wastewater

Wastewater generated by the project will be collected and treated on-site. The treated effluent will be used for irrigating the golf course (Appendix I) The proposed wastewater collection system is proposed to be located on the makai side of the residential lots. A gravity sewer will collect the wastewater from the residential lots, clubhouse, and plant nursery/golf maintenance facility and convey the wastewater to the proposed wastewater treatment plant (WWTP). The proposed WWTP will be located underground near the makai, Kaneohe-side corner of the property (Figure 3). The solids (sludge) removed by the treatment process will be disinfected, dewatered, and applied to the golf course and landscaped areas as a soil conditioner. Any surplus sludge will be hauled to an approved City and County of Honolulu sanitary landfill for final disposal in compliance with State of Hawaii Department of Health regulations. The treatment wastewater effluent will be chlorinated and conveyed to an aerated blending pond. The pond will be used for mixing effluent with non-potable irrigation water from storm runoff and/or brackish groundwater. The pond will be lined to prevent direct infiltration of irrigation water. Approximately 16 percent of the estimated golf course irrigation water requirement can be supplied by the treated effluent (Appendix I).

2.7.3 Drainage

All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadway servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined.

The proposed drainage system will be designed and built to City and County of Honolulu standards. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation. Since the drainage will be designed to retain storm runoff on-site (for golf course irrigation), the existing drainage structures at Kamehameha Highway appear to have sufficient capacity to handle the storm runoff from the proposed development (Appendix D).

2.7.4 Access

Current plans for the proposed Malulani Sports Complex call for the creation of a single entry with a new "T" intersection at Kamehameha Highway. Plans for the new entry road into the project site will submitted to the Department of Transportation Services for review and approval prior to the application for a grading permit. The plans for the proposed entry will reflect the City's current design standards. The entry will be located and designed to have adequate site distance. As shown on Figure 3, roadways will be built to provide access to the clubhouse and the residences. All roadways within the property will be privately owned and maintained. Exclusive turn lanes from the entry road onto Kamehameha Highway and the construction of left and right turn lanes on Kamehameha Highway will be built by the applicant prior to occupancy or official opening of the project to the public.

All of the proposed golf clubhouse and recreational facilities will be designed and constructed to be accessible to disabled persons (1985 Uniform Building Code, as amended). Parking stalls solely for persons with disabilities will be provided in the clubhouse parking area.

2.8 PROJECT RATIONALE

The market potential for the Malulani Sports Complex development program has been analyzed by Natelson Levandar Whitney, Inc., is summarized below, and attached to the EIS as Appendix M.

Market Potential for Recreational Facilities Development. Based upon nationally-derived participation rates and actual tourist rounds played, there is currently a demand for golf on the Island of Oahu approaching 3.1 million rounds annually; by the Year 2010 this demand should approach 5.1 million rounds annually.

In comparison to the potential demand, in 1988, a total of 2.3 million rounds of golf were played on the Island of Oahu, thus indicating a current undersupply of facilities. Of this number, a total of 420,000 rounds of golf were played in the Koolaupoko District. The supply of golf facilities in the Koolaupoko District is very limited in that there are currently only two 18-hole regulation golf courses open for public use in the area, Pali Golf Course and Olomana Golf Links. In 1988, a total of 175,000 rounds of golf were played at the Pali Golf Course, *perhaps triple what most* courses typically accommodate in terms of play.

Given the shortage of courses in the immediate market area and the probable significant growth in demand for golf facilities on the Island of Oahu, an 18-hole championship course with a par 70 should achieve market success on the Malulani site. There are several constraints, however, that must be addressed prior to the development of a golf course. There is a growing concern on Oahu over conversion of agricultural land to golf courses, as evidenced by the recent moratorium on new course development. In addition, there are 10 golf courses planned for the primary market area. Of these, six courses are significantly ahead of the proposed Heeia Kea course in the approval process. In order to position itself with respect to gaining necessary entitlements, the Malulani course will be planned as a course open for public play. Also, the course should be affordable to local residents who have demonstrated an unwillingness to pay the high fees charged at the resort courses.

In order to maximize the market potentials for a championship golf course, a better-quality clubhouse facility should be provided, which offers a number of recreational and retail/service activities, including the following: a pro shop; a small health spa with aerobics facilities; a restaurant with a seating capacity of 100 to 150 seats; and a tennis complex with three lighted courts.

Market Potential for Residential Development. The demand for higher-value single family housing on the Island of Oahu has increased substantially over the past several years. The demand for this type of housing, particularly housing that offers ocean frontage and/or ocean views, can be seen in the increase in the prices of homes located in the Hawaii Kai and Kahala neighborhoods.

The subject property is located in the Koolaupoko District, an area which has historically been characterized as a moderate income residential environment, However, during the past several years the area has seen significant changes in the character of its housing market, particularly in the growth of a market for homes priced in excess of $300,000. There is currently a strong demand for oceanfront and oceanview homes, as the availability of these sites is shrinking with the urbanization of greater Honolulu. The strength of this demand can be seen in such neighborhoods as Lanikai and Kailua Beach in Kailua and Haiku Plantation and Alii Landing in Kaneohe, where prices for oceanview units currently range from $500,000 to $750,000 and oceanfront lots can exceed $1 million in price.

The major advantages of the property as a better-quality residential environment are as follows:

- The site can be effectively designed as an exclusive community around an 18-hole championship golf course;
- The 30 to 35 units proposed for the site can be designed to offer golf course frontage locations with unobstructed ocean views;
- The site is in a location which should witness significant appreciation in the future following the completion of the H-3 connector to the Primary Urban Center; and
- In addition to the golf course, the site would allow development of a recreation complex, centered around the golf clubhouse, and featuring a pro shop, health spa/aerobics center, and restaurant.

Given these considerations, the Mālulani property should be able to market 30 to 35 better quality units offering ocean views and golf course frontage locations over a two-year development period. The development should provide units offering from 3,000 to 5,000 square feet of living space on lots ranging from 10,000 to 20,000 square feet.

2.9 PROJECT PHASING AND COSTS

Upon approval of the necessary governmental approvals, approximately 9 acres will be dedicated for community-oriented facilities. Construction will commence immediately upon obtaining the necessary permits and it is anticipated that the proposed 30 to 35 single-family homes would probably be completed within 1 year. It is estimated that the golf course, golf clubhouse, and recreational facilities will be in operation approximately 2 years after commencement of the project.

Total infrastructure construction costs have been estimated at about $26 million in 1989 dollars.

CHAPTER III

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

This chapter analyzes the relationship of the proposed Malulani Sports Complex with existing public plans, policies and controls as required by Section 11-200-17(h) of the Department of Health Chapter 200 Environmental Impact Statement Rules.

3.1 FEDERAL

Presently, no federal plans or programs directly affect the proposed sports complex and residential development and no federal permits are required. However, portions of the property (isolated wetlands which result from internal drainage that ponds on the property before flowing through culverts into Kaneohe Bay; total approximately 1.74 acres) are subject to U.S. Army Corps of Engineers jurisdiction. Permits would be required for the discharge of any fill into the wetlands. Current plans for the proposed Malulani Sports Complex do not require filling any of these man-made, environmentally insignificant wetlands. The community-oriented facilities (shown on the Concept Plan for the property, Figure 3) which are intended to be dedicated to the appropriate State/County agency(ies) may affect the identified wetlands by their adjoining use. If the area to be dedicated is developed as shown on Figure 3, then, the applicable governmental agency(ies) may be required to obtain a Department of Army permit(s). Figure 11 (Wetlands Map) shows a composite of the Concept Plan with the location of the wetlands.

3.2 STATE

3.2.1 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 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).

The following section analyzes the impacts of the project with respect to at least four substantive areas of the Hawaii State Plan: economy, agriculture, housing, and leisure.

Economy. An objective of the economy element of the Hawaii State Plan is to increase and diversify employment opportunities. The proposed sports complex facilities (golf course, clubhouse/banquet facilities, pro shop, and health spa/aerobics facilities) will provide a broad range of employment opportunities in sports, landscaping, and food and beverage.

Agriculture. As one of the objectives of the economy, the agriculture element of the State Plan supports is the continued growth and development of diversified agriculture. The golf course component of the proposed action represents a major landscaping effort, which is an integral part of the greater diversified agricultural industry. The agricultural feasibility of the property was analyzed and the results (Appendix L) show that the project area is unsuitable for commercial diversified agricultural production because of the limited acreage of arable land and the poor configuration of the parcels that are adaptable to "traditional" crop production. In some respects, the use of most of the property for golf course would represent an economically viable form of agricultural use which has been determined to be unfeasible for traditional agricultural production.

Recently, the Department of Agricultural and Resource Economics, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa completed a draft report that was titled, "An Economic Profile of Hawaii's Landscape Services in 1987" (Linda J. Cox, James R. Hollyer and Donald M. Schug, August 1989). This study was funded through the Governor's Agriculture Coordination Committee. The report surveyed the gross sales of those involved in the landscape industry. The estimated gross sales of landscaping activities in Hawaii, extrapolated from the surveys, was approximately $349.9 million in 1987, this included an estimated $94.2 million from golf courses. The study stated that: "To give an idea of how the value of landscape services presented here compares to the value of other **agricultural activities** (emphasis added) in Hawaii, the gross sales of the State's fresh and processed pineapple industry was $251 million in 1987 (Hawaii Agricultural Statistics Service)."

Housing. An objective for socio-cultural advancement, the housing element of the State Plan supports "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." Due to the extremely limited size of the residential component of the project, "reasonably priced" housing opportunities for persons and families of all income ranges is not economically possible. A more intensive scale of residential development, which could provide for "a range of housing opportunities for persons and families of all income levels", will likely encounter significant community opposition, as it has in the past.

The housing element of the State Plan also supports the "orderly development of residential areas sensitive to community needs and other land uses." Although the current Development Plan and zoning designations allow the development of residences along the makai edge of the property of Kamehameha Highway, concerns of area residents (in meetings with residents of the surrounding communities), suggests that the requested redesignation of residential land inland away from Kamehameha Highway is appropriate.

Leisure. An objective for socio-cultural advancement, the leisure element of the State Plan supports the adequate provision of resources to accommodate diverse cultural, artistic and recreational needs for present and future generations. Presently, the property is not accessible and/or dangerous to the public because of trash left behind by previous tenants. The proposed sports complex will promote the recreational potential of the property while ensuring that its open space value is preserved and enhanced. The facilities of the sports complex will be open to the public on a fee/reservations basis.

Nanatomi Hawaii will dedicate approximately 9 acres of the property for community-oriented recreational facilities. Approximately 1 acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area.

Hiking trails and a 4 acre campground accessible to the windward community with a permit from Nanatomi Hawaii are also planned.

3.2.2 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. The State Functional Plans serve as the primary implementing vehicle for the goals, objectives and policies of the Hawaii State Plan.

The plans set forth "...the policies, programs, and projects designed to implement the objectives of a specified field of activity when such activity is proposed, administered, or funded by an agency of the State" (Section 226-2 [10] Hawaii Revised Statutes). Each Functional Plan contains objectives to be achieved and policies to be pursued within the specified areas. "...[S]uch policies shall address major programs and the location of major facilities" (Section 226-57 (b) HRS).

All twelve State Functional Plans have been adopted by the Hawaii State Legislature. These plans "...[S]hall be taken into consideration in amending the county general plans (Section 226-52 (a) (3) HRS)." It is important to note that the policies, objectives and implementing actions within the Functional Plans are mandates for County or private actions. Rather, they should be viewed as a guide, fully recognizing the inherent competing policy interests between the twelve plans. The applicable functional plans have been reviewed and are discussed below.

<u>State Agriculture Functional Plan</u>. The State Agriculture Functional Plan (prepared by the State Department of Agriculture) applies to lands "suitable and used (or potentially useable) for agriculture 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." The project area is located within the State Land Use Urban District boundaries.

A study on the feasibility and need of the project area for agriculture has been prepared (Appendix L) and the findings of the study indicate that the property has limited potential for "traditional" crops (bananas; papayas; truck crops; floriculture and nursery products; and beef cattle and grazing). The lands within the property which are ecologically adaptable for the crops listed above, consist of isolated parcels separated by or contiguous to inferior soil types. The use of most of the property for golf course would represent an economically viable form of agricultural use for an area which has been determined to be unfeasible for "traditional" agricultural production. The study on the feasibility and need of the project area for agriculture is reproduced in its entirety in Appendix L of this Environmental Impact Statement (EIS).

State Recreation Functional Plan. The first objective of this Functional Plan is to "Achieve a pattern of land, water and shoreline resources usage which is compatible with community values, physical resources, recreation potential, and recreational uses which support comprehensive public land use policies." Another objective of the State Recreation Functional Plan is to "Assure the provision of adequate public access to lands, waters and shorelines with public recreational value."

Based on input received from the community, the Malulani master plan reserves space for facilities which will benefit the local community. Nanatomi Hawaii will dedicate approximately 9 acres of the property for community-oriented recreational facilities. Approximately 1 acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area. This component of the conceptual plan for the property will ensure that the intended uses of the site respect community values and are compatible with the area's physical resources and recreation potential.

Hiking trails and a 4 acre campground accessible to the windward community with a permit from Nanatomi Hawaii are also planned.

The proposed golf course will enhance the scenic and open space qualities of the property.

3.2.3 State Land Use Law

All lands in the State have been classified in one of four land use districts, Urban, Rural, Agricultural and Conservation, by the State Land Use Commission, pursuant to Chapter 205, HRS. Approximately 103 acres of the property is designated Urban (Figure 1) and the proposed action will not require a State Land Use District boundary amendment. Proposed uses for the portion of the property not within the State Land Use Urban District (approximately 117 acres) will require a Conservation District Use Application (CDUA).

3.2.4 Environmental Impact Statements (Chapter 343, HRS)

Section 343-5 (a)(6), HRS notes that the provisions of Chapter 343 apply to "any amendment to existing county general plans where the amendment would result in designations other than agriculture, conservation, or preservation...."

A State Attorney General opinion (Opinion N. 85-30) has broadened the scope of the definition of county general plans to include "...non-county initiated actions which propose amendment or change to a county's planning documents, however denominated, as development plans or otherwise, and which would result in a designation other than agriculture, conservation or preservation." Thus, because the proposed Malulani Sports Complex will require a change in development plan designation from Agricultural, Residential, Public and Quasi-Public to Parks and Recreation, and Residential, it is subject to the Chapter 343 requirements. This EIS was prepared pursuant to Chapter 343.

3.3 CITY AND COUNTY OF HONOLULU

3.3.1 General Plan

The General Plan for the City and County of Honolulu (adopted 1977) was amended by the City Council in 1987. The Plan is a statement of the long-range social, economic, environmental and design objectives for the general welfare and prosperity of the people of Oahu. A major policy of the General Plan is to manage physical growth and development in the urban-fringe and rural areas so that their population densities are consistent with the character of development and environmental qualities desired for such areas (Policy C3).

By the year 1993 (the earliest expected completion date for all of the proposed single-family residences), the homes are anticipated to add 105 to 123 residents (Appendix M) to the Kaneohe population. The City and County of Honolulu Department of General Planning (DGP) estimates that in 1993, the Koolaupoko population will be approximately 119,959. The residents associated with the proposed single-family residences, then would represent 0.1 percent of the Koolaupoko population in 1993.

3.3.2 Development Plan

The City and County of Honolulu's Development Plan (DP) program provides a relatively detailed framework for implementing General Plan objectives and policies on an area-wide basis. A total of eight DP regions have been established on Oahu. The Koolaupoko DP area encompasses the area from Waimanalo to Kualoa.

The DP Ordinances consist of four elements: Common Provisions (applicable for all DP regions), and Special Provisions, DP Land Use Maps and DP Public Facilities Maps (for each DP region).

3.3.2.1 Land Use Map

The property is designated Preservation, Agricultural, Residential, and Public and Quasi-Public on the DP Land Use Map for Koolaupoko (Figure 4).

The application to amend the Koolaupoko DP Land Use Map requests that the area of application (Figure 4) be designated Residential and Parks and Recreation (Figure 5). The request to amend the Koolaupoko DP Land Use Map to include Residential designation involves the reconfiguration of the existing Residential-designated land along Kamehameha Highway to inland of the subject property. The existing Public and Quasi-Public designation was for the former Hawaiian Electric Company, Inc. baseyard site; no uses are proposed which require a Public and Quasi-Public designation. The proposed sports facilities and community facilities areas require a Parks and Recreation designation.

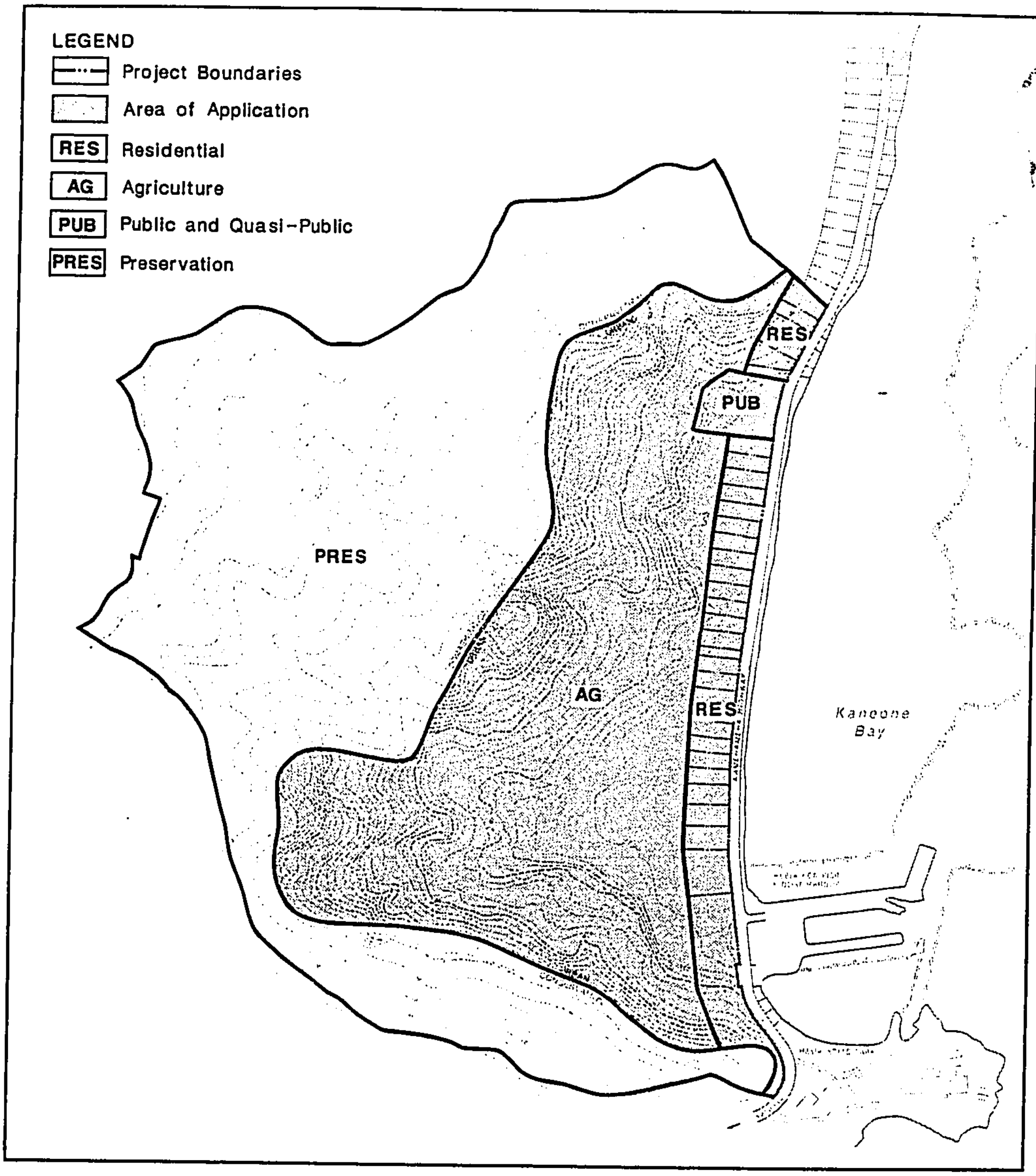


Figure 4: Current DP Land Use Map

0 600
Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

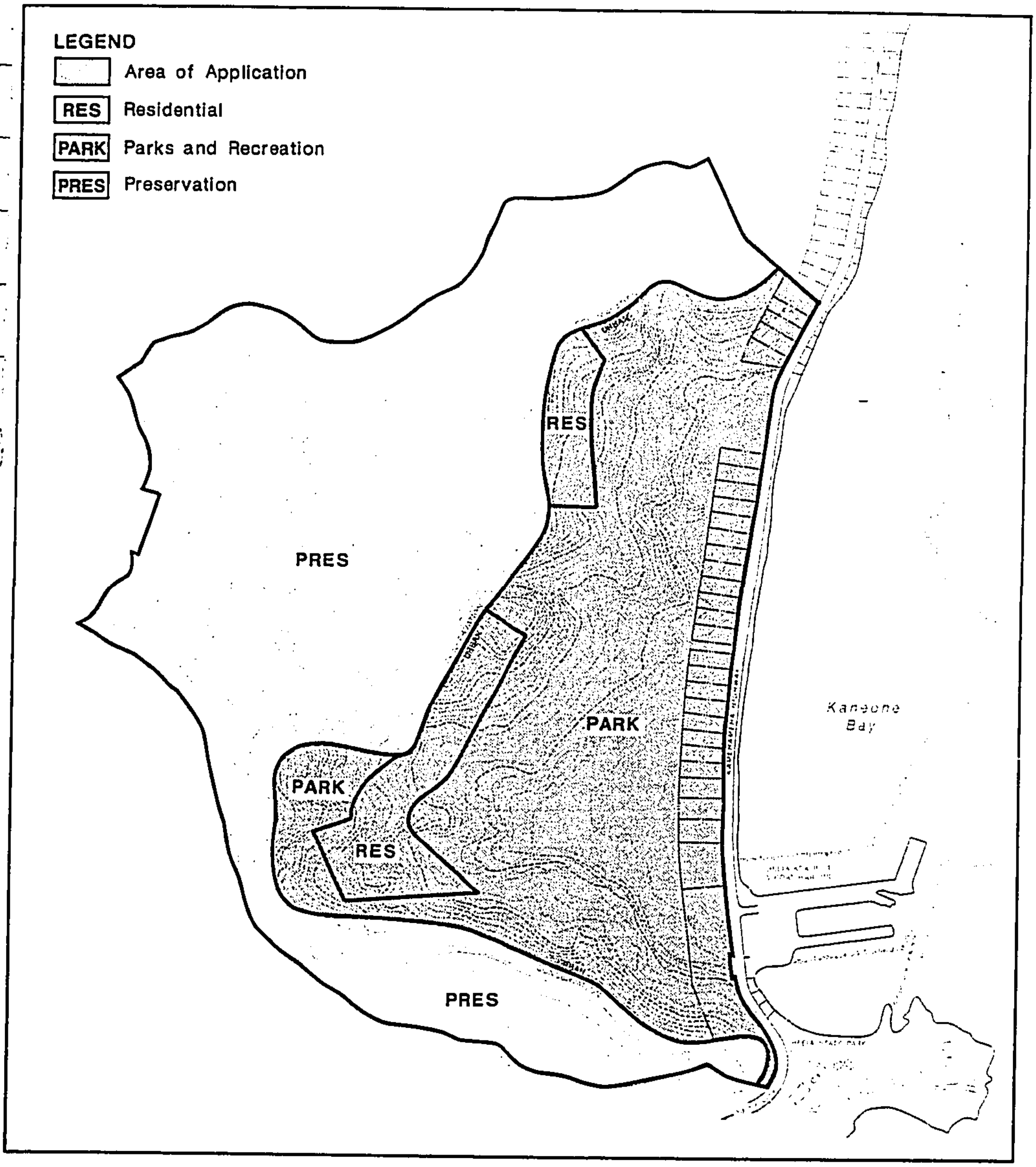


Figure 5: Proposed DP Land Use Map

0 600 Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

3.3.2.2 Common Provisions

Section 3 of the DP Common Provisions describes the various land use categories found within each of the eight DP regions. The Parks and Recreation, and Residential designations requested for the site are described as follows:

> "Parks and recreation areas include all public parks and recreational facilities, including beach parks, playgrounds, playfields, district parks, botanical gardens, zoos, golf courses, and pedestrian malls as well as privately owned and/or operated park and recreations facilities which are provided as integral parts of developments."
>
> "Residential areas are for single-family detached residences, duplexes, and other types of low-density cluster or common wall housing apartments."

The proposed project is compatible with the DP land use designations requested.

3.3.2.3. Special Provisions

The DP Special Provisions for Koolaupoko includes an area description which states:

> "Suburban single-family development is to be the predominant residential use surrounded by substantial amount of open space and agricultural land. Limited apartment uses will be permitted close to regional commercial and industrial centers, but future apartments will be low-rise in keeping with the overall open space setting of Koolaupoko.
>
> It is intended that communities of Kailua and Kaneohe will remain stable, predominantly single-family suburban "bedroom communities" and that Waimanalo will remain a rural community having extensive acreage devoted to diversified agricultural pursuits surrounding a small low-density residential area. The communities of Kahaluu, Waiahole-Waikane, and Kualoa are to remain relatively lightly settled, rural areas with the exception of limited areas in Heeia Kea and Ahuimanu Valley, where residential development of a low-density suburban character already exists."

The proposed action is compatible with the description of Koolaupoko. The project involves a small residential development (maximum density of 2.4 units per acre) surrounded by substantial open space (golf course).

3.3.2.4 Public Facilities Map

The DP Public Facilities Map for Koolaupoko (Figure 6) indicates improvements to Kamehameha Highway programmed beyond the next 6 years. The improvements would consist of 60 feet of right-of-way, with 48 feet of pavement. The Koolaupoko DP Public Facilities Map also shows improvements at Heeia Kea Pier and Boat Harbor (which are ongoing), and identification of the adjoining residential area along Kamehameha Highway as programmed for a Sewer Improvement District within the next 6 years. The proposed use of the property includes realignment of a short section of Kamehameha Highway near the Heeia Kea Pier and Boat Harbor in order to allow the construction of car and trailer parking for the pier and boat harbor.

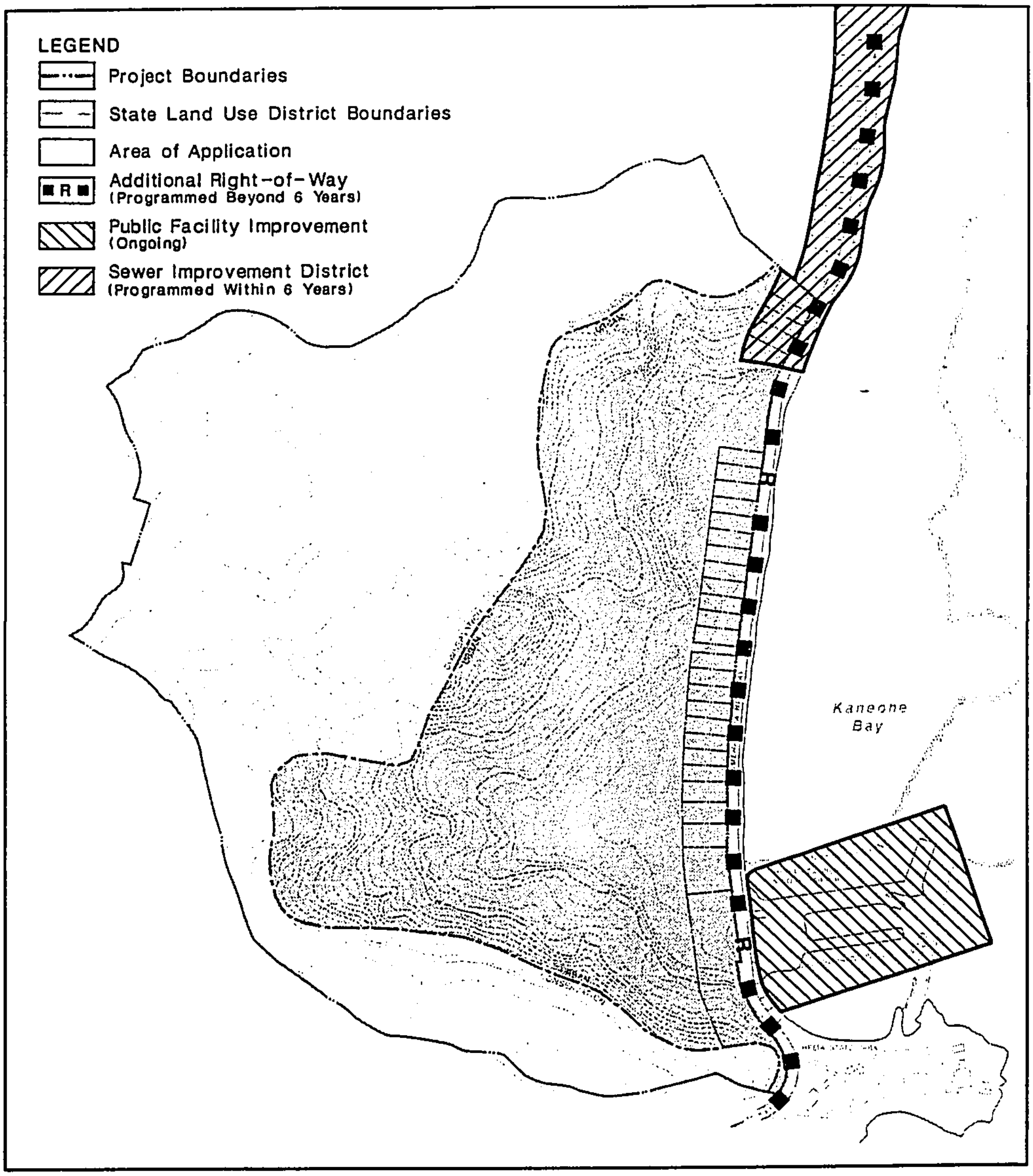


Figure 6: DP Public Facilities Map

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

3.3.3 Land Use Ordinance

Under the City and County of Honolulu Land Use Ordinance, the property is zoned P-1 Restricted Preservation, AG-2 General Agricultural and R-5 Residential (Figure 7). Upon approval of the application to amend the Koolaupoko Development Plan Land Use Map, rezoning of the area consistent with the requested Koolaupoko DP Land Use Map amendment will be sought.

3.3.4 Special Management Area

A portion of the property (approximately 23 acres), within 300 feet of the centerline of Kamehameha Highway (Figure 7), lies within the Special Management Area (SMA) and therefore the proposed action will require a Special Management Area Use Permit (SMP) from the City and County of Honolulu after approval of a zone change request.

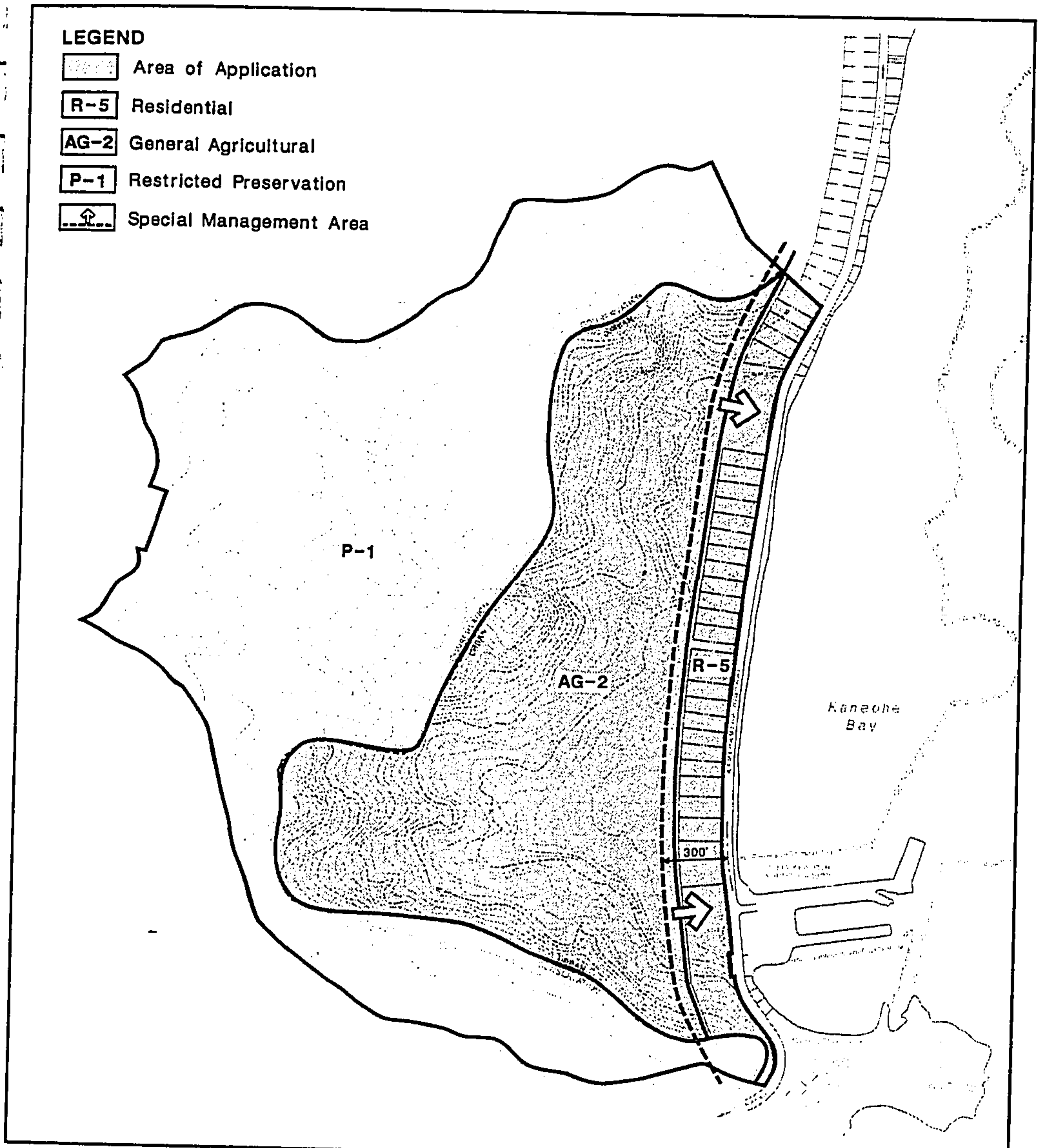


Figure 7: Current Zoning/SMA

0 600 Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

CHAPTER IV

ASSESSMENT OF EXISTING CONDITIONS AND PROBABLE IMPACTS: PHYSICAL ENVIRONMENT

This section describes the physical environment in which the project will be situated. After a brief description of the existing conditions, probable impacts (where appropriate) both to and from the proposed action are analyzed. Where appropriate, measures are proposed to mitigate adverse impacts.

4.1 CLIMATE

The approximate mean annual daily average temperature at the project site, using temperature recordings for the Kaneohe Mauka Station, is 74.1 degrees (in Fahrenheit), range from 70.9 degrees in February to 77.1 degrees in August. Rainfall for the project area can be estimated based on historical records of the nearby Heeia Station, where rainfall was recorded for a 66-year period. The median annual rainfall for this station is 59.1 inches and the mean annual rainfall is 59.8 inches. The maximum annual rainfall recorded was 94.1 inches and the minimum was 31.1 inches. Annual recordings did not exceed 71.2 inches 75 percent of the time and were not less than 45.8 inches 25 percent of the time.

4.2 GEOLOGY, PHYSIOGRAPHY AND TOPOGRAPHY

The Koolau Range is an erosional remnant of a deeply dissected large-volume volcanic lava shield. The shield remnant is an asymmetrical elongated dome extending northwest-southeast along a major rift zone 30 miles long (Appendix C).

The site is located just outside the northern boundary of the eroded Kailua caldera, and near the center of the northwest rift zone of the Koolau volcano. The regional rock types include gently-dipping, thin-bedded a'a and pahoehoe flows cut by numerous narrow, near vertical dikes of similar basaltic material. The rift zone axis is marked by closely-spaced multiple dikes (Appendix C).

Active Hawaiian shield volcanoes typically have well-defined (linear) rift zones within which most of their eruptions are concentrated. Extinct and eroded shield volcanoes like the Koolau typically have dike complexes, these being regarded as the subsurface equivalent of the active rift zones. Owing to deep erosion along windward Oahu, the crest of the Koolau Range is southwest of the main northwest dike complex. The site occupies an area approximately 0.25 miles northwest of Heeia State Park, where some of the highest intensities of dikes encountered for the Koolau dike complex have been mapped. Along an outcrop in a coastal exposure at Kealohi Point, the dike intensity was measured at 85 percent, which is the percentage of outcrop width occupied by dikes. Within the project site, the dike intensities are much lower, in the 20-30 percent range. Individual dikes in this region are spaced tens or hundreds of feet apart. Hence, the main northwest rift axis of the Koolau lava dome is located slightly to the west of the site (Appendix C).

The site contains a number of vertical basaltic dikes, parallel or nearly parallel to the rift zone, and striking between 320^{o} and 310^{o} NW, dipping 72^{o} NE. The denser dike rocks are less permeable than the rocks they intrude. Each pair of parallel dikes appear to form two walls of an elongated groundwater reservoir (Appendix C). Groundwater impounded by dikes in the Koolau Range is a major source of water for the Island of Oahu (Appendix C).

At this locality, the high degree of weathering has degraded the rocks so as to obscure the original nature of all but the most resistant, denser dike rocks. Fluvial (stream) deposits and small-scale debris flows have infilled the low-lying areas adjacent to the upper slopes of Puu Maelieli Ridge (Appendix C).

The elevations at the site range from sea level to approximately 625 feet above sea level. Slopes at the site range from level terrain (approximately 0 to 10 percent) to steeply sloping terrain (approximately 40 to 70 percent).

4.3 SOILS AND AGRICULTURAL POTENTIAL

4.3.1 Existing Conditions

According to the U.S. Department of Agriculture Soil Conservation Service (SCS) soils in the project area consist of: Ewa Silty Clay Loam (EmA); Mokuleia Clay Loam (Mt); Kokokahi Clay (KtC); Lahaina Silty Clay (LaC); Alaeloa Silty Clay (AeE); and Alaeloa Silty Clay (ALF). Refer to Figure 8. A brief description of these various soils types follows:

Ewa Silty Clay Loam, Moderately Shallow, 0 to 2 Percent Slopes (EmA). The Ewa series consists of well-drained soils in basins and on alluvial fans. The soils developed in alluvium derived from basic igneous rock. This subseries of the Ewa series occupies about 7 acres on a narrow strip of land bordering Kamehameha Highway (Figure 8). Runoff is very slow and erosion hazard is not more than slight.

Mokuleia Clay Loam, Moderately Shallow, 0 to 2 Percent Slopes (Mt). The Mokuleia series consists of well-drained soils on coastal planes. These soils formed in recent alluvium deposited over coral sand. This subseries of the Mokuleia series occupies about 4 acres on a narrow strip of land bordering Kamehameha Highway (Figure 8). Runoff is slow and erosion hazard is not more than slight.

Kokokahi Clay, 6 to 12 Percent Slopes (KtC). The Kokokahi series consists of moderately well-drained soils on talus slopes and alluvial fans. The soils developed in colluvium and alluvium derived from basic igneous rock. This subseries occupies a small pocket of land (approximately 3 acres) bordering Kamehameha Highway in the makai-Kahuku corner of the project (Figure 8). Runoff is medium and the erosion hazard is slight to moderate.

Lahaina Silty Clay, 7 to 15 Percent Slopes (LaC). The Lahaina series consists of well-drained soils on uplands. The soils developed in material weathered from basic igneous rock. About 27 acres of the Lahaina series is located in the makai-Kaneohe section of the property (Figure 8). Permeability is moderate, runoff is medium and erosion hazard is moderate.

Alaeloa Silty Clay, 15 to 35 Percent Slopes (AeE). The Alaeloa series consists of well-drained soils on uplands. The soils developed in material weathered from basic igneous rock. This subseries (approximately 75 acres) is located mostly mauka of the LaC soils. It divides fairly level lowlands from the steep mauka ridge areas (Figure

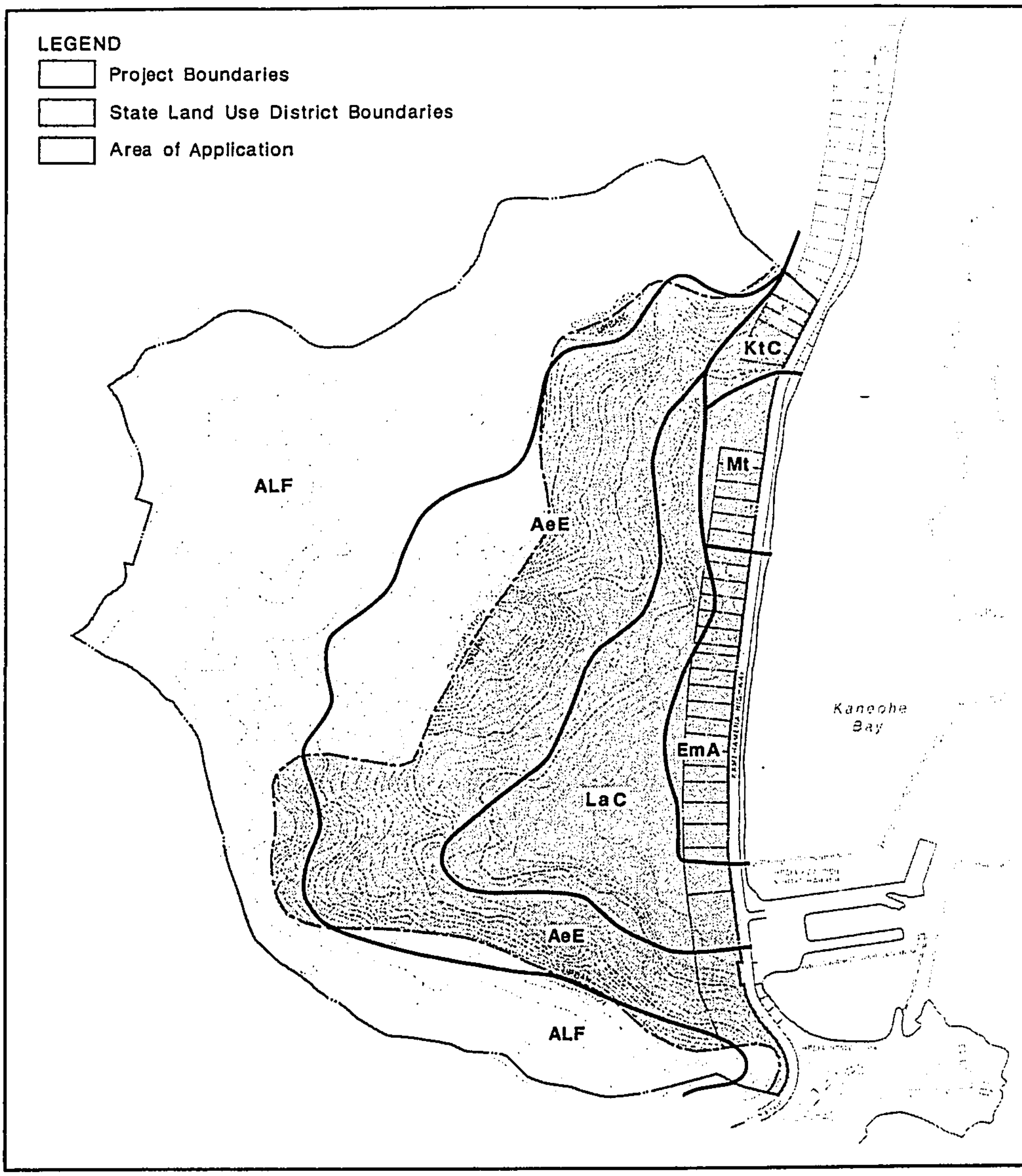


Figure 8: SCS Soil Survey

0 600
Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

8). Permeability is moderately rapid, runoff is medium and the erosion hazard is moderate.

Alaeloa Silty Clay, 40 to 70 Percent Slopes (ALF). This subseries is located on the upper slopes in the mauka section of the project (about 103 acres). The soil is the same as AeE of lesser slopes, except that runoff is rapid to very rapid, the erosion hazard is severe and the workability is extremely limited.

The feasibility and need of Malulani project lands for agriculture has been studied by agricultural economist Frank S. Scott, Jr., Ph.D. This report is reproduced in its entirety in Appendix L and is summarized below.

To date, three soil suitability studies for Hawaii have described 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 has moderate limitations, Class III is marginal and classes IV to VIII are unsuitable for crop production, with Class VIII having the most severe limitations. Soil types are shown on Figure 8 and capability classifications within the property are shown on Table 3:

Table 3

SCS LAND CAPABILITY CLASSIFICATIONS

Soil Type	Acreage	Capability Classification Nonirrigated	Irrigated
AeE	75	VIe	VIe (1)
EmA	7	IVs	IIs
KtC	3	VIe	VIe (1)
LaC	27	IIIe	IIIe
ALF	103	VIIe	VIIe
Mt	4	VIs	IIs
Total	219		
Class II		0	11
Class III		27	27
Class IV to VIII		192	181

(1) Nonirrigated rating used when no rating is given for irrigation

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. Soil types are shown on Figure 9 and capability classifications within the property are shown on Table 4:

Table 4

LSB LAND CAPABILITY CLASSIFICATIONS

Soil Type	Acreage	Capability Classification Nonirrigated	Irrigated
C1	16	C	B
C54	9	C	C
C56	27	C	B
C57	32	C	C
D2	29	D	D
D8	9	D	C
E106	19	E	E (1)
E107	73	E	E (1)
U	5	U	U
Total	103		
Class B		0	43
Class C		84	50
Class D, E and U		135	126

(1) Nonirrigated rating used when no rating is given for irrigation

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 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 the ALISH are "Unique Agricultural Land" and "Other Important Agricultural Land". Both describe successively less productive soils. The State Department of Agriculture classifies approximately 48 acres in the central part of the project area as Other Important Agricultural Land, about 64 acres bordering Kamehameha Highway as Urban, and the remainder of the site as Conservation (Figure 10).

4.3.2 Probable Impacts and Mitigative Measures

Based on SCS soil capability classifications, only 11 acres of the property are Class II lands which are well adapted to cultivated crop production, and 27 acres are Class III (marginal). LSB classifications are somewhat less restrictive and designate 43 acres

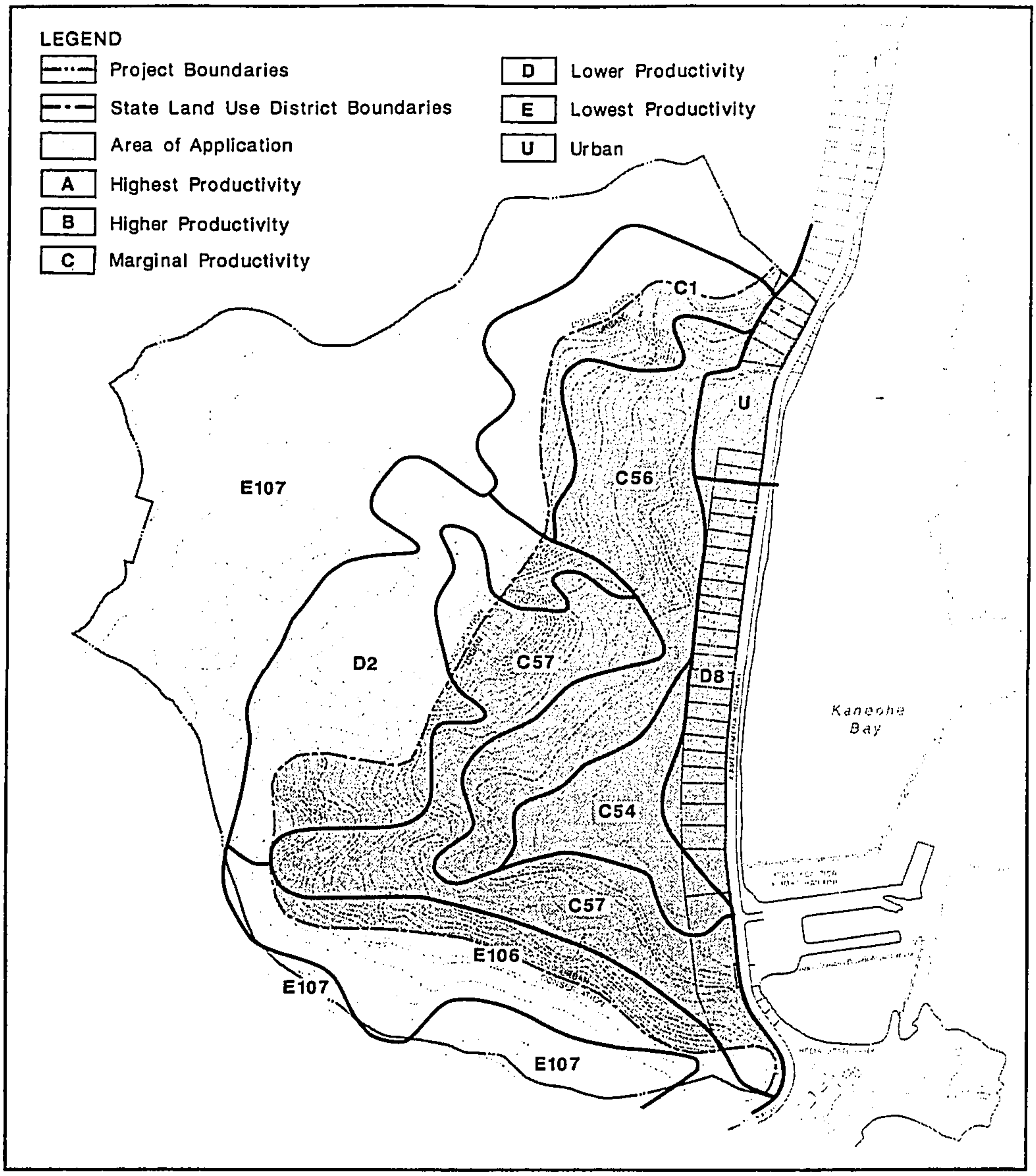


Figure 9: LSB Detailed Classification Map

0 600 Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

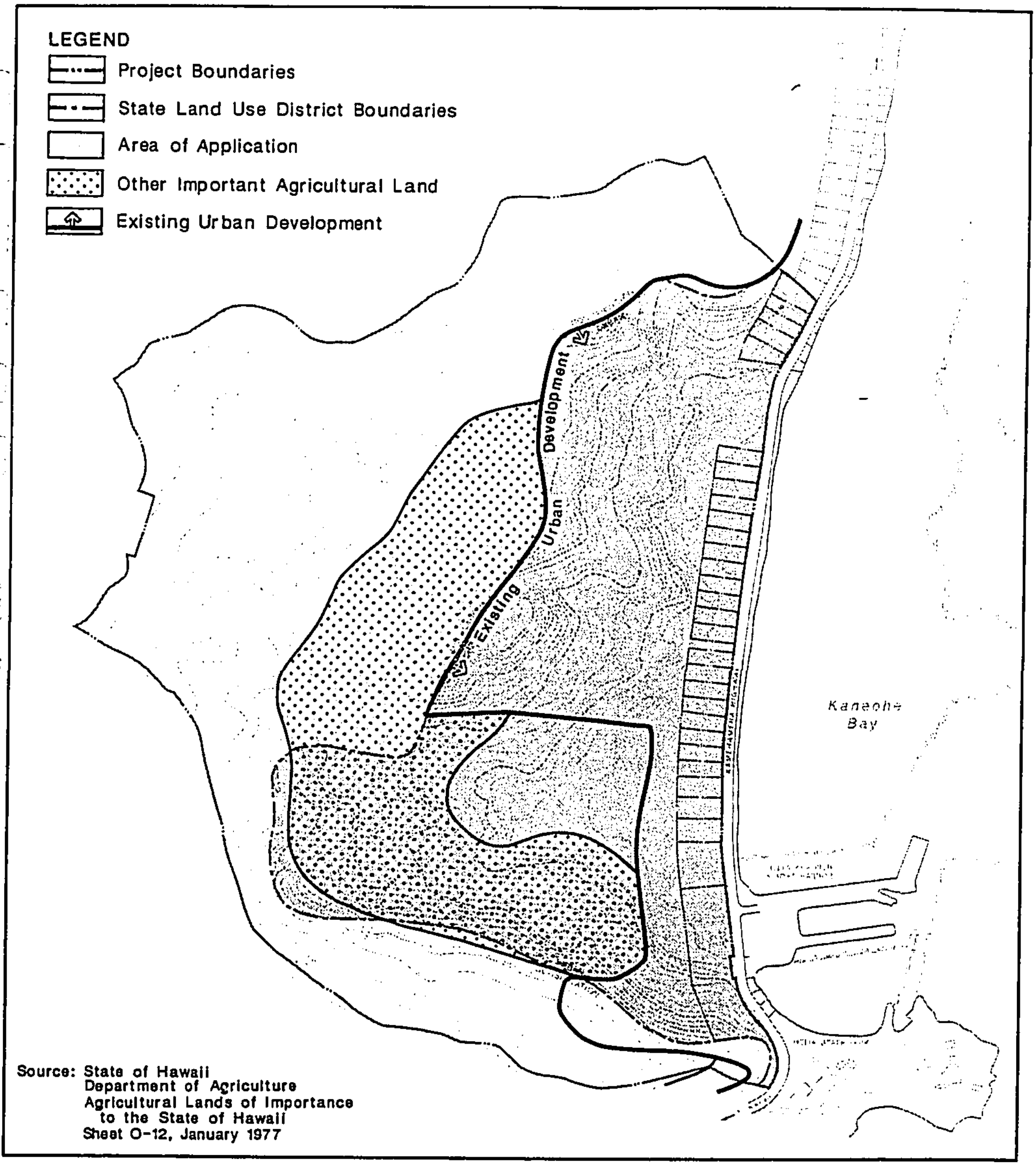


Figure 10: ALISH Map

0 600 Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

as Class B (good) and 50 acres as Class C (marginal). In summary, Dr. Scott concluded that while the above lands are ecologically well adapted to crop production, cultivated crop production would be at a serious disadvantage because of the dispersion of parcels of good land and because better locations for production of the crops considered ecologically adaptable to the soils on site can be found elsewhere on Oahu and on the neighboring islands (Appendix L).

It is expected that the proposed project will have no direct impact on agricultural activities in the vicinity of the project site, since the farming that occurs in the Ahuimanu area and the very limited grazing that occurs on Heeia Uli wetlands is separated from the project site by the ridges that delineate Heeia Valley.

Due to the marginal value of the project site for most agricultural purposes, the use of the subject property for mostly open space (golf course) should not adversely affect agricultural land availability in the vicinity of the project site. Agricultural land is available at lower cost on the neighboring islands. Because of lower land cost and lower or no irrigation water cost, production centers for crops such as bananas, guava and truck crops are moving to the neighbor islands. Substantial areas of former sugarcane and pineapple fields on Oahu are fallow. Only part of these lands will be diverted to other uses, such as housing.

Due to the low agricultural potential of the soils on the subject property (Appendix L), the impact of the project on soils is limited to erosion. Clearing and grubbing activities during construction will temporarily disturb the soil retention values of the existing vegetation, and expose the soils to erosional forces. The impact of construction activities can be mitigated by conforming to strict erosion control measures, particularly those specified in the State Department of Health's Water Quality Standards, Chapter 37-A, Public Health Regulations, 1968; and the SCS's Erosion and Sediment Control Guide for Hawaii, 1968. Primary fugitive dust control methods include wetting down loose soil areas, good housekeeping on the job site, and prompt landscaping of bare soil areas.

4.4 WATER

4.4.1 Existing Conditions

Along windward Oahu, persistent, northeast tradewinds bring large quantities of moist air to the Koolau Range. This moist air condenses above the crest of the range leaving behind large quantities of precipitation that infiltrate the porous lava flows and percolate through the lava. The resulting groundwater is then either impounded by the less permeable dike rocks or percolates deeper, eventually forming a lens of freshwater which floats on sea water. Precipitation on the Koolau Range also feeds many of the streams which flow down the windward and leeward slopes (Appendix C).

Geologic features which control groundwater occurrence in windward Oahu include lava flows and dikes, valleys, and alluvium and weathered rock. As mentioned previously, the extremely low permeability dike rocks form compartments in the porous lava rock which impound groundwater. The depth and distance that the valleys have been cut into the dike rock influences the direction of water movement and the quantity of water flowing in streams. The valleys act as drains in the dike compartments, as do man-made tunnels and wells which tap the dike-held groundwater (Appendix C).

Consolidated alluvial deposits and weathered lava flows occur along the coastline and lowland areas of windward Oahu. These impermeable materials form a barrier to seaward movement of groundwater, and cause water to appear in streams or marshy areas near the shore before flowing into the sea. The alluvium and weathered rock cause artesian conditions in some areas (Appendix C).

The rocks in the site area have different water-bearing properties, and may allow for a tapable groundwater source to be present. The basalt is quite permeable, and supplies large quantities of water in other areas of the island. The extremely low permeability dikes occurring within the permeable basalt on the site may impound groundwater in quantities large enough to tap. At the site, the larger quantities of dike-held water are probably most prevalent beneath the consolidated sediments. The low permeability consolidated sediments overlying the permeable basalt probably causes groundwater to "pile up" behind the consolidated sediments, forming a useable resource. This groundwater resource may exist under artesian conditions (Appendix C). (The project site is situated above the State Department of Health's Underground Injection Control [UIC] Line. Lands above the UIC line are considered to contain underground sources of drinking water).

The northern and western site boundary is concave towards the sea, and follows either a ridge or runs below the crest of ocean-facing slopes, consequently all drainage runs toward Kaneohe Bay. Additionally, because of the concavity, run-off from a large area flows into a small area, and occasional (seasonal) flooding may be common. The southeast corner of the site in the vicinity of the Heeia Kea Boat Harbor is particularly susceptible to flooding because it is flat-lying, and at least four well-defined streams converge there. (Approximately 1.74 acres of isolated wetlands result from internal drainage that ponds on the property before flowing through culverts into Kaneohe Bay. Refer to Appendix F and Figure 11) North of this area, the streams meet the ocean more perpendicularly and there is less flat ground, so flooding is less severe (Appendix C).

During one site survey, considerable evidence of debris flow activity was noted, in addition to the poor ability of even dense vegetation to retain the surface soil. Both the basalt and alluvial sections of the site are deeply weathered and consist of mostly clay-rich material of low permeability (some standing water was found). Because of this little infiltration, significant surface runoff can be expected during rainy periods (Appendix C).

4.4.2 Probable Impact and Mitigation Measures

The project will involve the development of non-potable water sources for the irrigation of the golf course and project landscaping. In addition, the operation of the golf course will require the periodic application of fertilizers, herbicides and pesticides.

<u>Non-Potable Water Source Development</u>. The primary source of irrigation water will be storm runoff catchment. Dames & Moore used the U.S. Army Corps of Engineers Storage, Treatment, Overflow, Runoff Model to evaluate surface water runoff at the site (Appendix C). During the 10-year design dry year, 200.78 million gallons of precipitation fell on the site. Of this precipitation, surface water runoff accounted for 54 percent, or 108.55 million gallons. The remaining 46 percent of the rainfall was lost to evaporation or infiltration. The predicted surface water runoff, averaged on a daily basis throughout the 10-year design dry year, results in a runoff value of

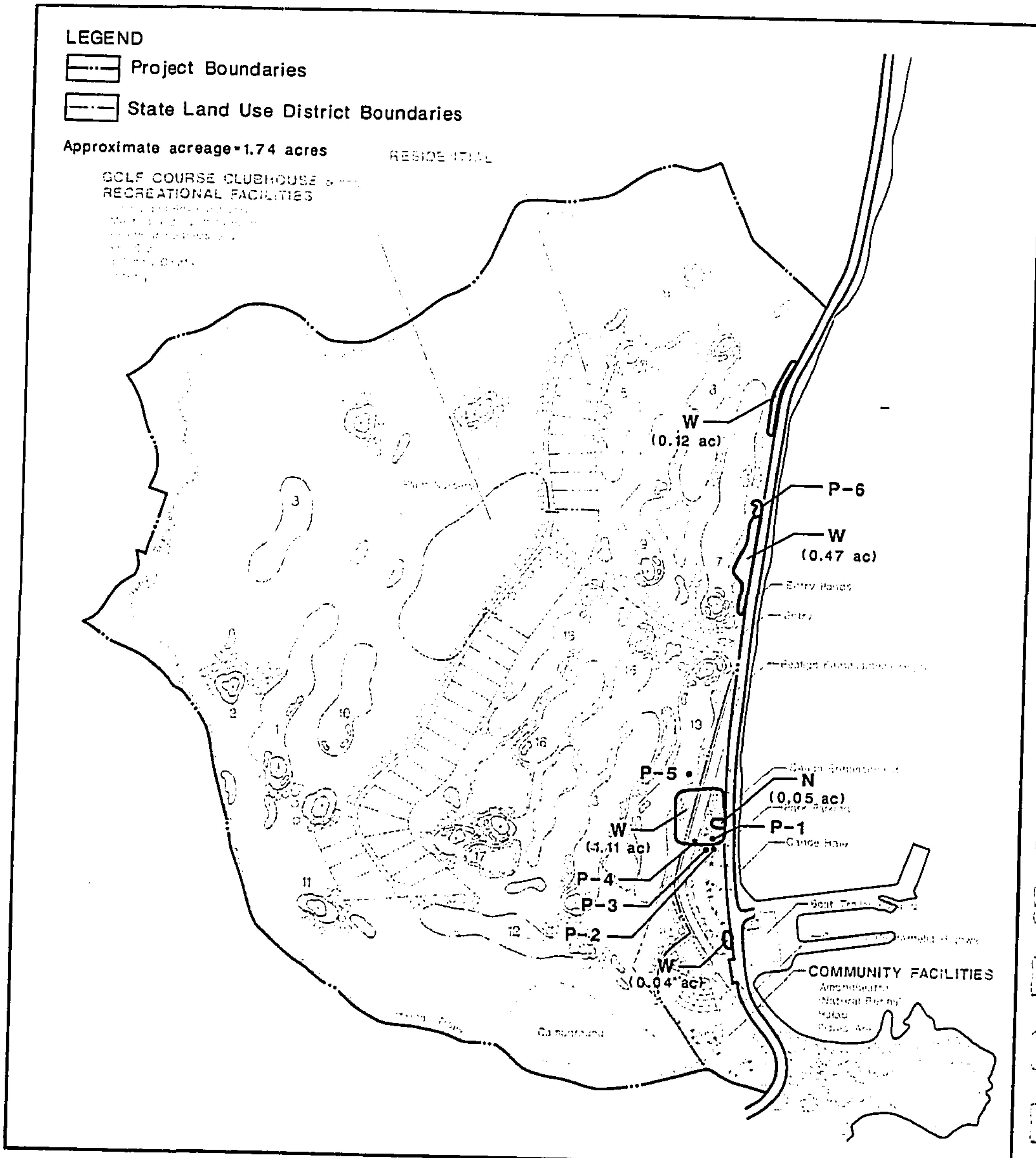


Figure 11: Wetlands Map

Malulani Sports Complex

0 600
Feet

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

297,388 gallons per day (gpd). Conservative estimated irrigation requirements are 309,750 gpd (Appendix H). These averaged daily values appear to show that there may not be enough runoff to use for irrigation during the 10-year design dry year; however, the amount of water available and the irrigation requirements depend on the spacing between, and quantity of the individual rainfall/runoff events. Dames & Moore's investigation of the site revealed that under normal conditions (during most years), rainfall and runoff collection should adequately provide for golf course irrigation requirements (Appendix C).

To supplement storm runoff catchment (and treated sewage effluent generated on site) during dry weather conditions, it is proposed that two wells be drilled on the mauka portion of the site, between the 250-foot and 275-foot elevations. The wells are expected to deliver 0.2 MGD per well.

The non-potable water system will not place an additional burden on the BWS potable water system. The proposed wells will be designed and constructed to prevent the possibility of groundwater contamination. For example, each well will have a concrete pad and full grouting to prevent seepage or floodwaters from migrating down the well shaft. The wells will be monitored to note if any changes occur to the ground water quality. In the event that significant decreases in ground water quality occur, other source alternatives will be considered.

Use of Fertilizers, Herbicides and Pesticides. Movement of chemicals in surface runoff is of some concern because of the close proximity of Kaneohe Bay to the proposed development. A high intensity rain could conceivably transport recently applied chemicals in runoff to the bay if no mitigating action were taken to retard runoff from treated areas. Satisfactory reduction of chemical transport in runoff can likely be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow released nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff.

Among the fertilizer elements, only nitrogen would likely diminish water quality, since phosphorus sorption on soils would prevent its movement from the site of application (Appendix E). Nitrogen fertilizer movement in runoff could conceivably produce undesirable nutrient enrichment of near-shore waters of Kaneohe Bay. Fertilizer nitrogen movement to Kaneohe Bay will be minimized by constructing berms adjacent to drainage ways crossing the property with associated temporary retention basins to preclude rapid runoff into the bay. Use of slow-release nitrogen fertilizer during the rainy season will also assist in reducing nitrogen movement.

Pesticide movement in runoff is much less likely than nitrate movement because of pesticide sorption on the turf thatch and underlying soil and the much lower pesticide application rates (Appendix E). Prevention of immediate runoff by retention basins will further reduce movement of pesticides from the treated area.

Where grading is necessary, topsoil will be stockpiled and replaced over the areas to which chemicals will be applied; the high-organic matter containing surface soils will retard pesticide movement. Higher elevation areas which are eroded will require importation of surface soil to enhance rapid growth of turf and reduce pesticide migration.

Judicious use of fertilizers and pesticides, especially in the early establishment of turf, is essential, since pesticides and nitrogen will be more likely to move before an extensive root system and thatch layer are developed. Use of slow-release nitrogen fertilizer during the rainy season will reduce nitrogen losses to runoff.

A system of berms and temporary water-retention basins along drainage ways crossing the site will prevent immediate runoff, thus reducing the possible movement of fertilizers and pesticides into Kaneohe Bay.

Although significant movement of applied chemicals in either leachate or runoff is not anticipated, a monitoring program for nitrogen in shoreline waters of Kaneohe Bay and in wells in the immediate vicinity will be implemented.

Other golf course activities which might contribute to groundwater contamination include the storage of small amounts of fuel for vehicles and the maintenance of vehicles and equipment. Every precaution will be taken to minimize pollution of groundwater sources (especially in the storage and disposal of materials) and to ensure the personal safety of employees.

Since the potential impacts described above can be mitigated with sound management practices with regard to fertilizer and pesticide application and irrigation, a qualified Golf Course Superintendent will be given the responsibility of managing the golf course (Appendix E).

4.5 NEARSHORE MARINE ENVIRONMENT

A survey of the nearshore marine environment was conducted by Marine Research Consultants. Their report is reproduced in its entirety in Appendix G and summarized below.

4.5.1 Existing Conditions

The nearshore region offshore of the planned Malulani Sports Complex is composed of a sand flat approximately 200 meters wide that terminates in a steep-sided channel leading to the outer reaches of Kaneohe Bay (Appendix G). Four existing dry gullies within the property discharge all runoff onto the sand flat following storm events.

Physical and biological characteristics of the offshore region represent 4 distinct zones: a nearshore sand zone, a benthic algal zone, a P. compressa-rubble zone, and a living P. compressa-channel slope zone (Appendix G). Acid dissolution of sandy sediments indicates that there is not a large component of terrigenous material on the sand flat, as is found off of permanent streams in Kaneohe Bay.

Water quality measurements (nitrogen, phosphorus, silica, and salinity) taken from transects extending from the shoreline out to the small boat channel (200 meters from shore) show that input from the shoreline (groundwater flow) is minimal, and is mixed rapidly with open ocean water over the sand flat (Appendix G). With several exceptions, water quality is relatively uniform over the entire width of the sand flat and channel (Appendix G).

Water quality parameters measured were generally below the most stringent State of Hawaii, Department of Health standards (Appendix G). Measured nutrient parameters were of the same magnitude as long-term averages measured in central Kaneohe Bay (Appendix G).

4.5.2 Probable Impacts and Mitigative Measures

The condition of water quality and the physical/biological structure of the nearshore environment indicates that terrigenous sedimentation into the Heeia Kea area of Kaneohe Bay is not a prevalent occurrence. All possible precautions will be taken to prevent erosion of soils into Kaneohe Bay during golf course construction. While temporary erosion during the construction phase would not likely have a permanent impact on the marine environment, it would temporarily alter the current nature of the area that is utilized for recreational pursuits.

Altering the present land usage by constructing the planned development is estimated to cause an increase in total runoff from a 100-year, 24 hour duration design storm of about 13 percent. Project plans, however, include construction of retention basins and water features that should decrease potential runoff to Kaneohe Bay relative to current conditions. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts of runoff (Appendix G).

Operation of golf courses has the potential to add nutrients (nitrate nitrogen) to coastal waters as a result of leaching of fertilizer chemicals to groundwater, or by surface runoff following storm events. Such processes can be mitigated by ensuring that the golf course soil is porous and on the order of a foot in depth, and that fertilization and irrigation schedules are designed so that application rates do not greatly exceed uptake rates. Downslope from the planned Malulani golf course, chemical measurements in Kaneohe Bay indicate that there is negligible influence of groundwater on the composition of the water column. With proper management strategies, there is little chance that materials from the golf course would reach Kaneohe Bay in quantities sufficient to change the chemical characteristics of the region (Appendix G).

While all indications are that the planned golf course will have no impacts to Kaneohe Bay, a monitoring program will be implemented. Such a monitoring program would be designed to provide a baseline set of conditions before construction, and to compare conditions to the baseline during and after completion of construction. Details of the monitoring program are found in Appendix G. In this manner, unforeseen circumstances that could result in environmental impact could be identified and mitigated at an early stage.

4.6 FLORA

A biological survey of the project area (Kenneth M. Nagata, May 1989) was conducted on 21-23 May 1989. The full Biological Survey is attached as Appendix A and the description of the existing flora is summarized below.

4.6.1 Existing Conditions

Historically, the property has been used extensively for pineapple cultivation, pasture, military and residential use (Appendix B).

The vegetation in the project site is primarily one of introduced species. No rare or endangered flora were found to inhabit the project site. Grasslands and closed canopied forests dominate the lowlands, drainages and most of the lower slopes. The uppermost slopes are dominated by Christmas Berry thickets, and communities of grasses and scrub are found on some of the ridge crests. Five vegetation types were recognized and are shown in Figure 12. These are depicted with distinct boundaries in Figure 12 but it must be noted that in nature such boundaries do not exist. Rather, vegetation exists as a continuum with one type gradually grading into another.

Mixed Forest. The dominant vegetation type on the property is the Mixed Forest (Figure 12). Occupying much of the lowlands, ravines and lower to middle slopes, it is a heterogeneous, closed canopied forest 20 to 50 feet tall. Monkeypod is generally dominant in the lowlands immediately behind the cultivated zone and is conspicuous because of its broad canopy. Java plum is also common in the lowlands where it often forms pure stands but is also dominant on portions of the lower and middle slopes.

Schinus Thicket. Portions of the steep upper slopes in the site (Figure 12) are dominated by thickets of Christmas berry 3 to 10 feet tall with occasional emergent Java plum and umbrella tree (Brassaia actinophylla).

Exposed Shrub. This vegetation type is found in certain areas generally on ridge crests (Figure 12) and often appears to be the result of grading activities. It is characterized by dwarfed vegetation less than 3 feet tall dominated by grasses such as broomsedge, Paragrass, molassasgrass and golden beardgrass and emergent but scrubby guava, Java plum, haole-koa and Christmas berry.

Lowland Grassland. The Lowland Grassland is an extension of the large grasslands which developed behind the former residential area along Kamehameha Highway (Figure 12). It consists mostly of Paragrass and Hilo grass with emergent koa-haole, Java plum and monkeypod.

Cultivated Areas. The vegetation type designated as Cultivated Areas in Figure 12 is actually an artificial classification based on land use rather than floristic composition. A great abundance of species can be found in this zone. Of the 185 plant species found in the project site, 145 occur in this zone.

Native Species. Seventeen native plant species were recorded during the survey, 5 endemics and 12 indigenous species. All are common to the lowlands and middle elevations on Oahu and most are common throughout Hawaii. The most abundant in the site is Boston fern which is occasional in three vegetation types and also present in the Cultivated Areas. Koali-'awahia (Ipomoea congesta) is found in all vegetation types but in smaller numbers. None of the native species in the site are considered rare or endangered. No native plant communities were observed.

4.6.2 Probable Impacts

In areas where vegetation is removed, there will be a temporary loss of soil retention values and fauna (all exotic species) habitat provided by the existing vegetation. Soil erosion will be controlled by wetting down loose soil areas, good housekeeping on the job site and the prompt landscaping of bare soil areas. The applicant will incorporate as much of the mature trees into the landscape design. Where appropriate, salt-tolerant plant materials, both native and exotic, will be used in

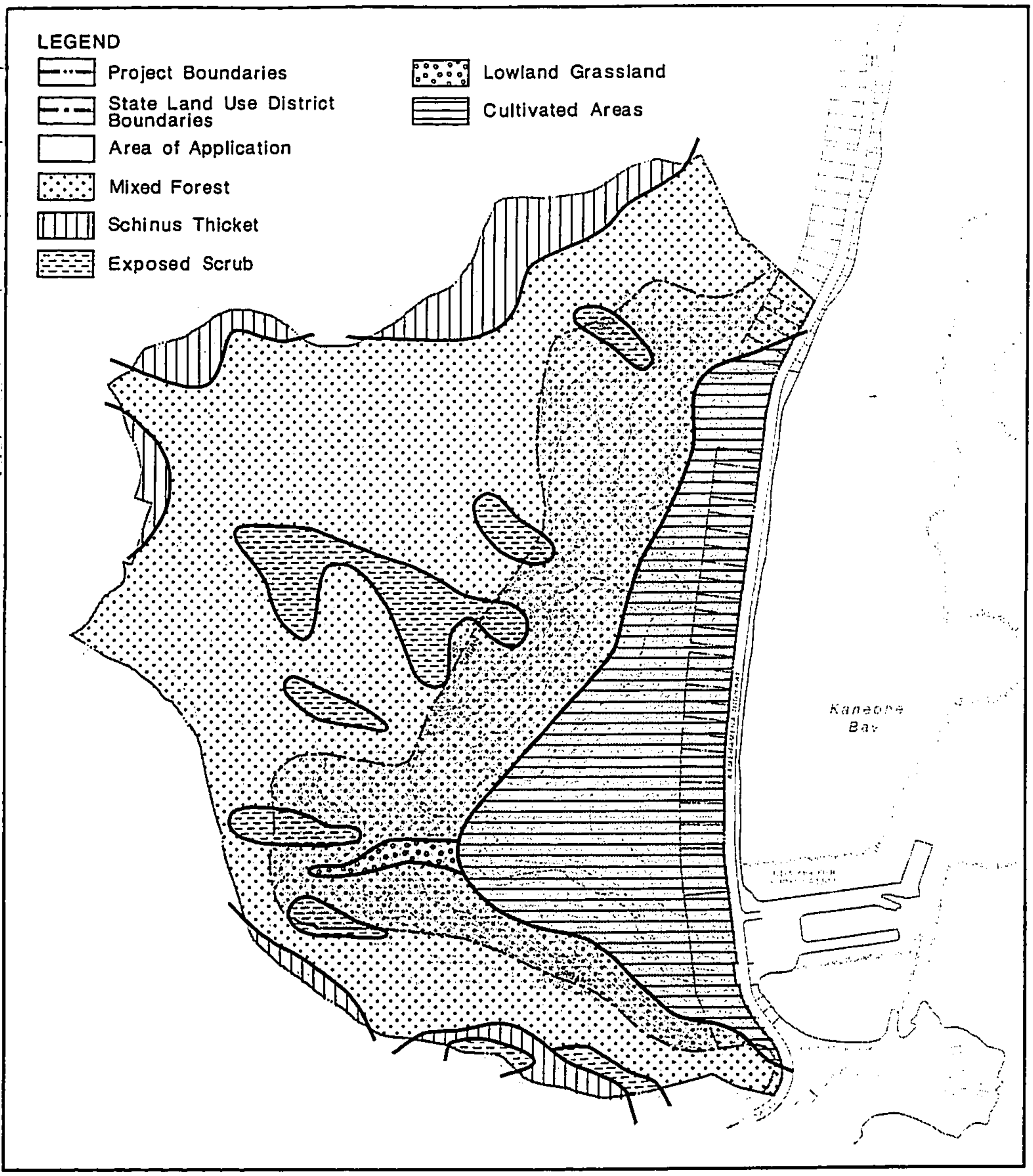


Figure 12: Vegetation Map

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

landscaping of the property. Ultimately, the project will result in the replacement of the mostly exotic vegetation with native and exotic vegetation. The new vegetation is expected to provide habitat for fauna species similar to those presently found on the property.

4.7 FAUNA

A biological survey of the project area (Kenneth M. Nagata, May 1989) was conducted on 21-23 May 1989. The full Biological Survey is attached as Appendix A and the description of the existing fauna is summarized below.

4.7.1 Existing Conditions

Nine introduced birds were observed in the project site: laceneck dove, shama thrush, barred dove, red-vented bulbul, common mynah, Japanese white-eye, ricebird, house sparrow, and cardinal. All are common to urban or field situations and most were observed in the Cultivated Areas (Figure 12).

No mammals were observed although several pig trails were found especially in the Mixed Forest in the southwest portion of the site (Figure 12). Because of their abundance in similar situations on Oahu, the small Indian mongoose is a probable resident in the site. It is probable that one or more of the following may occur in the property: roof rat, Norway rat, Polynesian rat and house mouse.

No native birds or mammals were encountered during the survey and the likelihood of any being present in the site at all is practically nil (Appendix B). According to the U.S. Fish and Wildlife Service (USFWS), there are no listed or proposed endangered species, migratory birds or anadromous fishes within USFWS jurisdiction occurring in the project area.

4.7.2 Probable Impacts

The proposed project is not expected to have a significant impact on the biological communities of the study site as it is a highly disturbed area. The proposed project will result in the loss of vegetation and some faunal habitat, but considering that all of the birds and mammals in the site are wide-ranging species common to most urban and field situations, this loss is considered negligible.

The fertilizers, herbicides, and fungicides used in golf course maintenance pose little or no hazard to birds frequenting the grassed areas or ponds associated with golf courses (Appendix E). Fertilizers are relatively non-toxic unless ingested in large amounts. All herbicides and fungicides used in golf course maintenance in Hawaii are of low to moderate toxicity (Appendix E). The only chemicals used in golf course maintenance in Hawaii which are highly toxic to birds are the organic phosphate insecticides, especially chlorpyrifos.

Although chlorpyrifos is toxic to birds it is strongly absorbed on the thatch layer of turf and moves little from the site of application. One reason for its weakness in controlling soil infesting insects is the inability to get the insecticide through the thatch layer to the depth needed to contact these insects. Recent studies (Appendix E) have shown that chlorpyrifos applied to turfgrasses does not penetrate more than 2 to 3 centimeters in the soil. In addition to resistance to movement in the soil, it has been shown that it is rapidly degraded in the soil, both by hydrolysis and microbial action (Appendix E).

Because of the absorption of organic phosphate insecticides on organic layers in turf and their rapid break down, there is little chance of their movement from grassed areas into the ponds associated with the proposed golf course. Label instructions for application of these pesticides (which turfgrass managers are required by law to follow) specifically prohibit their direct application to streams and ponds.

The likelihood of bird injury by pesticides used in maintenance of the proposed golf course can be reduced by proper application of pesticides with reduced toxicity to birds (Appendix E). Carbaryl and trichlorfon are less toxic to birds than chlorpyrifos (Appendix E). In most cases these insecticides may be substituted for chlorpyrifos with little loss of effectiveness.

Golf courses are often visited by birds. There have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management (Appendix E). Waterfowl and fish appear to thrive in ponds and water hazards on golf courses in Hawaii. Many golf courses cultivate white amur fish in the ponds to control algae. Mosquito fish are generally stocked to prevent mosquito problems. There have been no incidents of fish or waterfowl injury from chemicals applied to golf courses (Appendix E).

The labeling of herbicides and pesticides for particular uses by EPA with strict laws (enforced by the State Department of Agriculture) for their use and the cost of these chemicals are perhaps the best assurances of protection of humans and wildlife from their hazards. All pesticides must be applied in compliance with federal and state laws regulating their use. Hazards to both humans and wildlife are included in the decision to label a pesticide for specific uses, including use on golf courses, and in developing regulations on allowable application procedures of the pesticide for various uses.

The retention ponds/water features of the proposed golf course will be designed, built and maintained to discourage the breeding of mosquitoes, gnats, midges, and other aquatic pests, possibly through the use of biological control (mosquito fishes). Maintenance will include keeping these ponds and the drainage features free from uncontrolled vegetation.

4.8 NOISE

4.8.1 Existing Conditions

Depending on the location within the subject property, noise from wind and vegetation and passing vehicles on Kamehameha Highway contribute to the sound level, the majority of the time. Periodically, however, the project site is exposed to aircraft noise from the U.S. Marine Corps Air Station (MCAS) Kaneohe Bay, which is located across Kaneohe Bay from the project area. The MCAS Kaneohe Bay has studied the noise impact of its aircraft operations on surrounding areas (AICUZ Update, August 1983). The noise impact studies generated Ldn noise exposure contours as shown in Figure 13. Kealohi Point is the only civilian area other than Coconut Island within the "day/night sound level" (Ldn) 65 noise contour (approximately 8.3 acres at the tip of Kealohi Point are within the Ldn 65 contour). An Ldn of 60 to 65 "decibels on the A-weighted scale" (dBA) is "normally compatible"

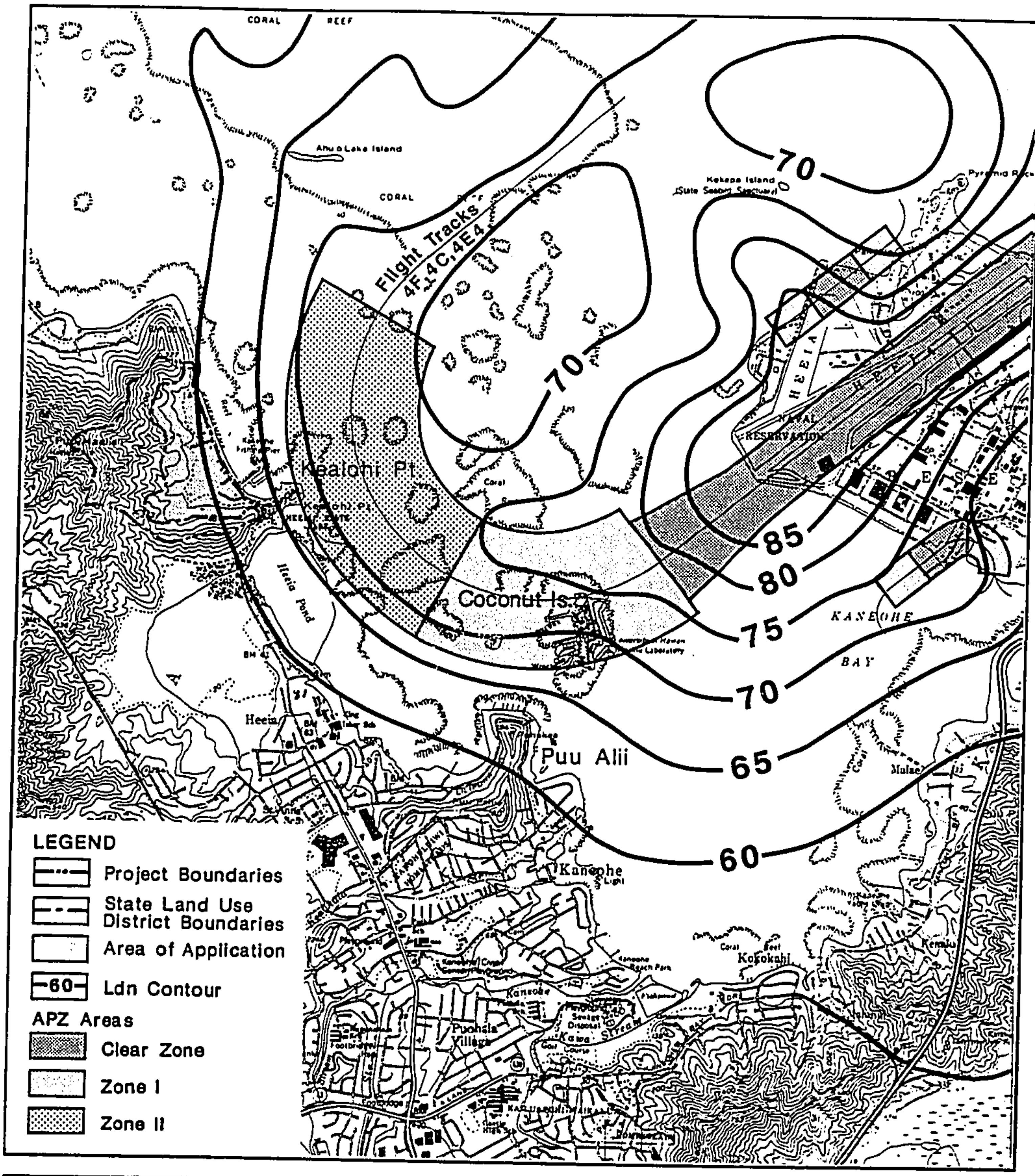


Figure 13: AICUZ Map

0
Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

for residential use. As shown on Figure 13, most of the project area is located out of the 60 Ldn contour.

4.8.2 Probable Impacts and Mitigating Measures

Short-term noise impacts from the proposed project are generally related to the initial construction period. The primary source of noise during any construction project can be broken down by activity: 1) clearing, grubbing, grading and other site preparations; 2) excavation and embankment; 3) placing foundations; 4) frame erection, floors and roofs, walls and windows; and 5) finishing work and clean-up. The most obtrusive noise will occur during the first phases of construction because of the use of heavy-duty construction equipment. Earthmoving equipment such as bulldozers and diesel-powered trucks will probably be the loudest equipment used during construction.

Since sound attenuates with distance, the farther away people are from a noise source, the less the sound will affect them. During certain phases of construction, the residences immediately north of the project area will be the most affected by noise generated during construction, which by law, will be limited to normal, daylight working hours.

Construction-period noise impacts will be mitigated through compliance with the provisions of Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu, of the State Department of Health. The hours of construction activities will be limited, and mufflers will be required of all equipment. Traffic noise from heavy vehicles travelling to and from the construction site must be minimized near existing residential areas and schools, and must comply with the provisions of Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu.

The proposed golf course, clubhouse and recreational facilities, and residences will not, by its nature, be significant contributors to the noise environment. During the day, activities that may generate noise include: golf course maintenance; deliveries of goods and services; refuse collection; and maintenance work of grounds and facilities. All of the proposed structures will be designed to minimize outdoor noise. As shown on Figure 13, most of the project area is located out of the 60 Ldn contour. Any residences within the Ldn 60 to 65 dBA contour will incorporate sound insulation in their construction. Noise generating areas will also be heavily landscaped. The proposed sports complex is expected to generate traffic which will contribute to the existing noise environment in the immediate community and on regional traffic routes.

All development will be designed and constructed to comply with the provisions of Title 11, Administrative Rules Chapter 43, Community Noise Control for Oahu. Noise from stationary equipment such as air conditioners, exhaust fans, pumps and compressors will be attenuated to meet the allowable noise levels.

4.9 AIR QUALITY

An air quality study of the project is attached as Appendix K (Barry D. Root and Barry D. Neal, November 1989) and summarized below.

4.9.1 Existing Conditions

Natural air pollutant producers, which could affect air quality in the project site, include the ocean (sea spray), plants (aero-allergens), dust, and on occasion, distant volcanic eruptions on the island of Hawaii. Concentrations of air pollutants from these kinds of sources should be fairly uniform for most of the Windward Oahu coastline.

4.9.2 Probable Impacts

The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along Kamehameha Highway as well as in the vicinity of the project area itself. Site preparation and earth moving will create particulate emissions as will building and on-site road construction.

The principal long-term air quality impact associated with the project will be automotive-related pollutants. By its inherent ability to generate and attract motor vehicle traffic the proposed sports complex constitutes an "indirect source" of air pollution. Air quality impacts can be expected to occur in the vicinity of the Kamehameha Highway/future project entry road intersection.

In order to evaluate the potential air quality impact of increased traffic from the proposed Malulani Sports Complex, a detailed modeling effort was carried out (Appendix K). Carbon monoxide was selected for modeling because it is both the most stable and the most abundant of the motor vehicle generated pollutants. It is also likely to be the pollutant with the greatest likelihood of violating present AAQS.

It is estimated that current carbon monoxide concentrations in the vicinity of the project area are well within both state and national 1-hour and 8-hour standards. Traffic projections show that future traffic levels without the project are expected to remain about the same and that traffic attracted by the project would be relatively minimal. Thus, concentrations predicted by air quality modeling for 1993 either with or without the project are about the same as present levels (Appendix K).

There will be no significant adverse effects on air quality from application of pesticides in golf course management provided that appropriate application techniques are used (Appendix E). The spray equipment used in golf course maintenance is ground-operated. Nozzle heights are typically less than 2 feet. Low spray pressures and coarse nozzle openings result in relatively large droplet sizes which are not highly subject to drift (Appendix E).

The development of the proposed Malulani Sports Complex will also result in off-site impacts as a result of: generation of electricity to meet project demand (combustion of fuels resulting in the emission of additional pollutants); and, incineration of project-generated solid waste (should solid wastes be disposed of via incineration or in the H-POWER facility).

Residents of the 30 to 35 single-family homes and the users of the golf clubhouse and recreational facilities will generate an additional demand for electrical energy. In the worst case, this demand would be met by burning additional fuel oil in existing power plants, primarily the Kahe Power Plant on the Waianae Coast. This new energy requirement could be reduced significantly by installing solar water heaters on all new homes and by incorporating solar design features into all construction plans, e.g. use of landscaping to provide afternoon shade to cut down on use of air conditioning and positioning of windows to maximize indoor light without unduly increasing indoor heat.

It is also possible that the new demand can be met by means other than burning fuel oil. In fact, an operating wind farm has been developed on the north shore of Oahu, and other low-pollution energy generating systems might be developed in coming years. The City and County of Honolulu resource recovery facility (H-POWER) has recently started its operations at Campbell Industrial Park. H-POWER is not to be air pollution free, however, and even with the use of on-site wet scrubbing and electrostatic precipitation, emissions from this source could be significant. Furthermore, the Hawaiian Electric Company has evidently decided that purchasing power from new coal-fired power plants to be constructed in Campbell Industrial Park would provide the most economical means for meeting future Oahu energy demands. Even with latest technology control devices on these new plants, air pollution emissions in the Campbell Industrial Park are likely to increase with the addition of these new facilities.

4.9.3 Mitigative Measures

Short-term construction-related impacts are principally in the form of fugitive dust emissions. Department of Health regulations stipulate control measures that are to be employed to reduce this type of emission. Primary control consists of wetting down loose soil areas, good housekeeping on the job site and the prompt pavement or landscaping of bare soil areas.

Long-term air quality impacts are related to vehicular emissions. The major control measure designed to limit lead emissions is a Federal law that requires the use of unleaded fuel in most new vehicles. As older cars are removed from the vehicle fleet, lead emissions should continue to fall. Federal control regulations also call for increased efficiency in removing carbon monoxide and nitrogen dioxide from vehicle exhausts. By 1995, carbon monoxide emissions from the vehicle fleet then operating are mandated to be little more than half the amounts emitted in 1984.

4.10 SCENIC AND VISUAL RESOURCES

4.10.1 Existing Conditions

The predominant view of the site is from Kamehameha Highway. The majority of the site is covered with vegetation consisting of grasses, close-canopied trees and Christmas berry thickets. The structure of the former Hawaiian Electric Company, Inc. baseyard represents the major man-made visual feature of the site. According to the City and County of Honolulu's Coastal View Study, the property lies within Section B, Heeia, of the Kaneohe Bay Viewshed. Figures 14 through 16 were prepared as a visual analysis of the property. Figure 14 shows the location from which the various photographs were taken, with numbers corresponding to those shown in the caption under each of the photographs.

4.10.2 Probable Impacts

The open space currently afforded by the site will be altered by the development of the proposed project. A preliminary building footprint estimate for the entire Malulani Sports Complex (upon completion) shows a total building lot coverage of

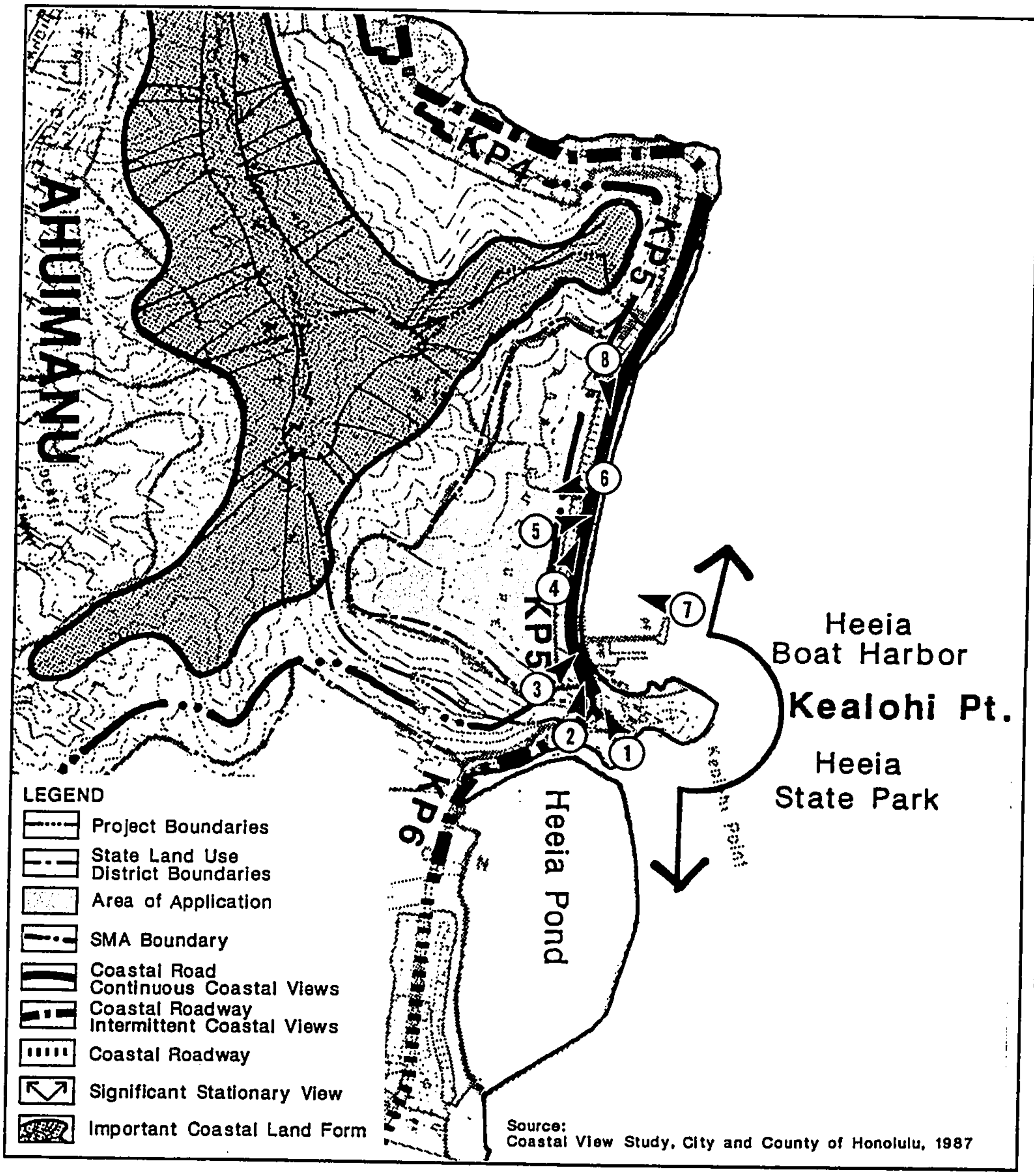


Figure 14: Visual Analysis Key Map

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

(1) View of Property From Heeia State Park

(2) Near Entry to Heeia Kea Pier and Boat Harbor

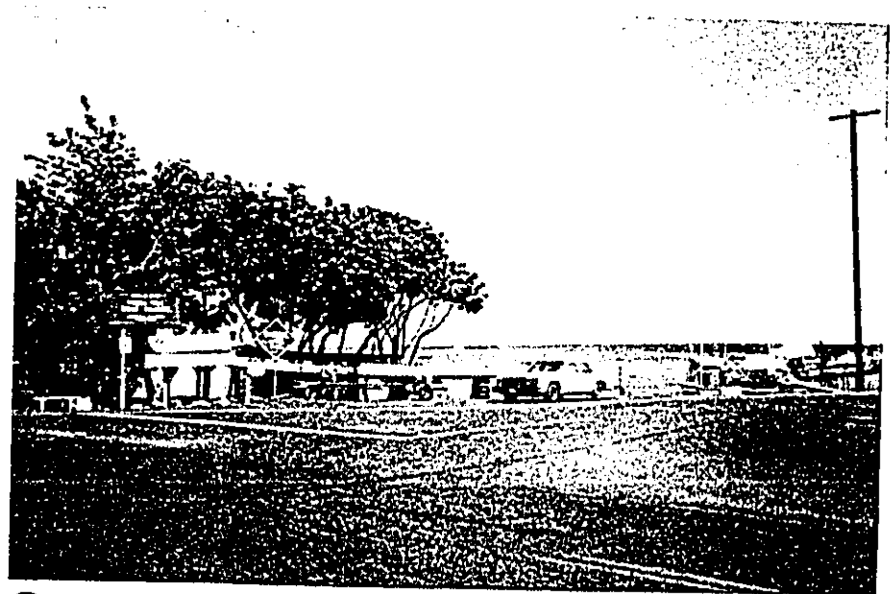
(4) Typical Kamehameha Highway View
in the Northerly Direction

(5) Opening in Vegetation at Drainage Outlet

Figure 15: Visual Analysis

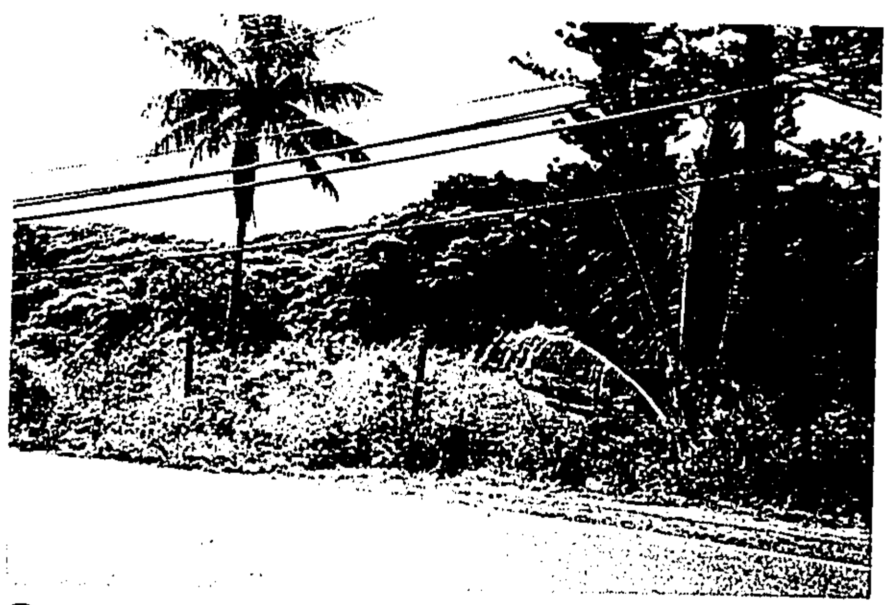
Malulani Sports Complex

Pier and Boat Harbor



③ Entry to Heeia Kea Pier and Boat Harbor

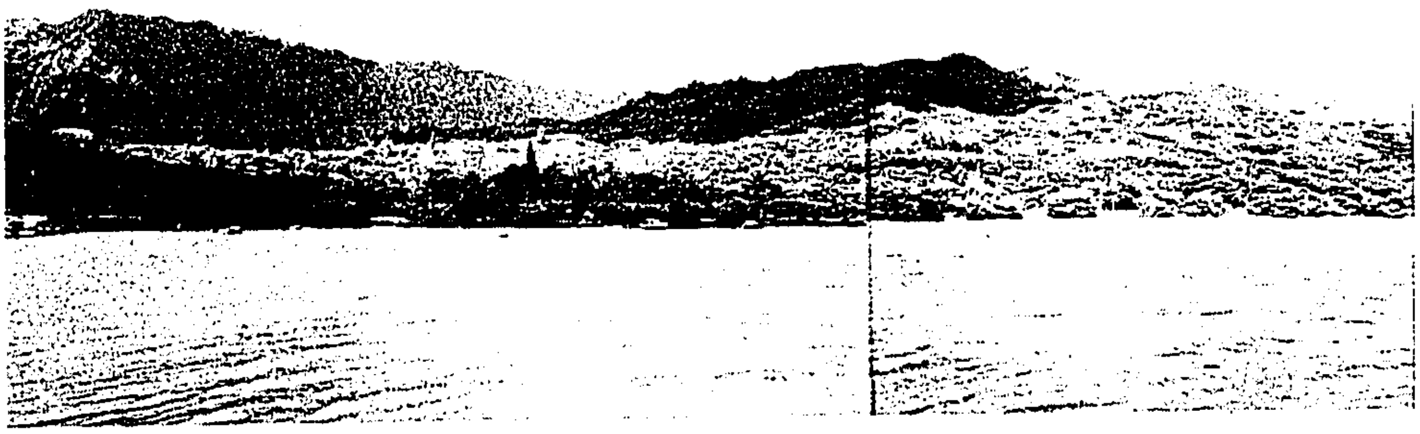
Drainage Outlet



⑥ Typical View into Property along Kamehameha Highway

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS



(7) View of Heeia Kea Valley from Heeia Kea Pier and Boat Harbor

(8) View from former Hawaiian Electric Company, Inc. baseyard

Figure 16: Visual Analysis

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

approximately 5 percent (not included in this calculation are paved surfaces such as roadways, parking lots, tennis courts, etc.). The rest of the site (approximately 95 percent) will remain in mostly landscaped open space.

No adverse effects to coastal views from the nearest inland public highway are expected (refer to Appendix O, Figures O-1 and O-2). Figure O-2 shows that trees along the highway would tend to screen most of the property from view. When views are available between the trees, the slopes of Puu Maelieli should be visible. Future landscaping will be designed to enhance the attractiveness of area and to provide necessary sound attenuation and visual separation between the various use areas. Generally the property will change from its present vacant and overgrown appearance to a heavily landscaped development.

4.11 HISTORIC AND ARCHAEOLOGICAL RESOURCES

Paul H. Rosendahl, Ph. D., Inc. conducted a 100 percent and limited surface and limited subsurface archaeological inventory survey of the property during May 1, 1989 through June 1, 1989 and between October 24, 1989 and October 26, 1989. The survey report is attached as Appendix B and is summarized below.

4.11.1 Existing Conditions

During the combined 100 percent surface and limited subsurface inventory survey of the proposed Malulani Sports Complex project area, ten sites were identified (Figure 17) and recorded, 25 backhoe trenches were excavated, subsurface deposits within backhoe trenches were examined and recorded and three isolated prehistoric artifacts were recovered. The ten sites consist of 48 components features. These features are tentatively interpreted (on the basis of the current level of investigation) to represent ten different feature types, five primary functional types, and three broad time components. Table 5 summarizes the findings by segregating prehistoric, historic, and modern components, and by displaying the distribution of the various functional feature types in terms of their frequency of occurrence within the project area.

This table is based on tentative interpretations made on the basis of the archaeological work conducted to date. The modern cultural component included in the table consists only of modern features from Site 4142. These features were recorded solely because they represent an integral aspect of that site, and a thorough level of recording could not be conducted without including them.

As can be seen in Table 5, historic agricultural features are the most common features in the project area. This may, in fact, be more true than the table indicates. Many of the sites, including 4135, 4137, 4139, 4140, 4141, and Feature 11 of 4142, have been tentatively interpreted as prehistoric. These interpretations were based on a number of attributes of the constituent features--particularly formal type. These features all exhibit construction techniques and the general aspects of prehistoric features, such as cobble and boulder construction and vertical facing of wall fronts. Therefore, these features are assumed to be prehistoric in age until proven otherwise. If the sites are historic, however, they are most likely related to the historic pineapple cultivation carried out in the project area in the early part of this century. Addressing this uncertainty as to the age and function of these sites will constitute an important aspect of any further work carried out on them, as will the collection of data to be analyzed in terms of basic archaeological research issue.

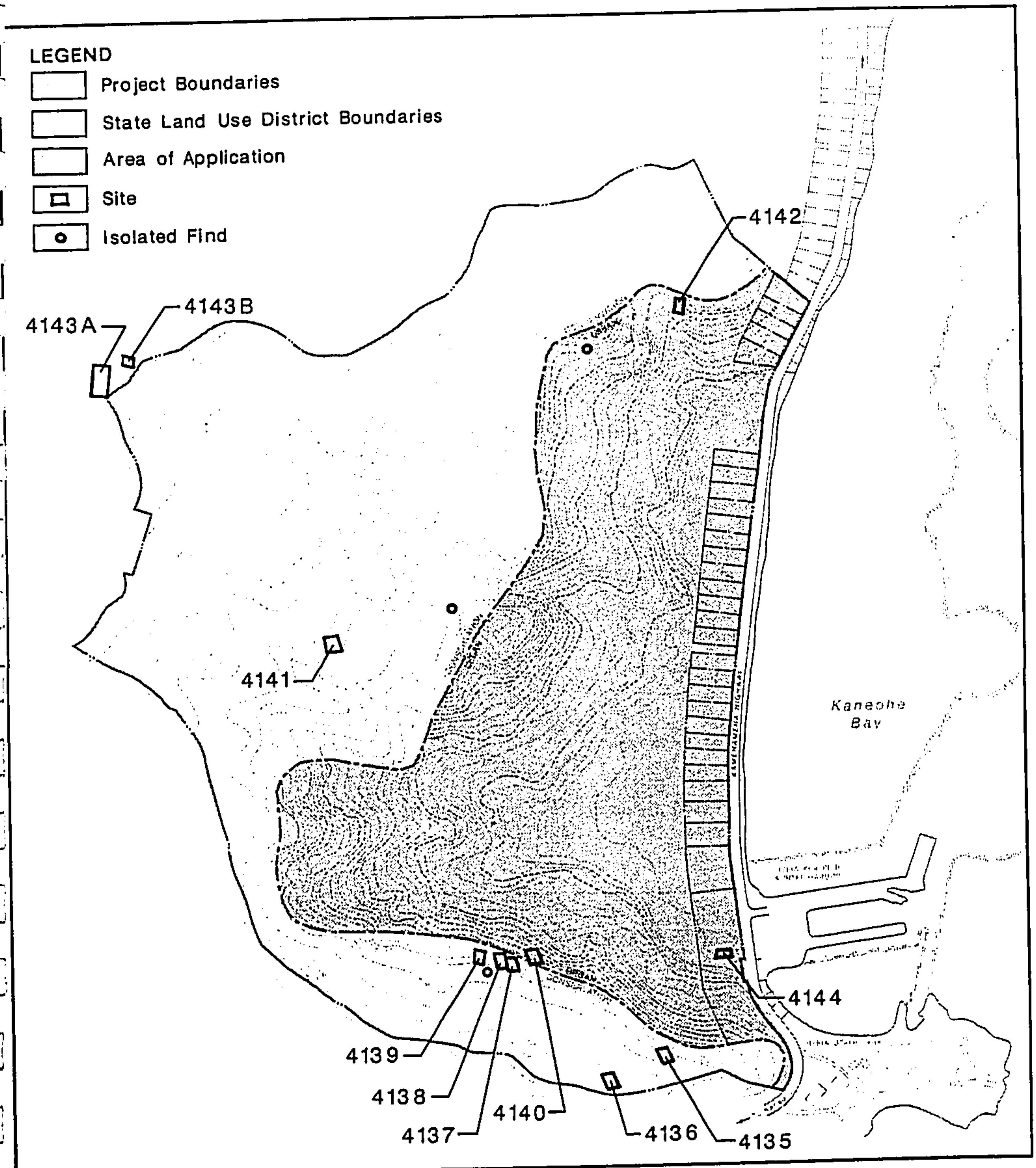


Figure 17: Archaeological/Historical Sites

Malulani Sports Complex

0 600 Feet

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

TABLE 5

DISTRIBUTION OF FEATURE FUNCTIONAL TYPES

	NUMBER	PERCENT
Single-Component Sites	9	90
Dual or Multi-Component Sites	1	10
Total # of Sites:	**10**	**100**

Distribution of Component Features		
Prehistoric Components		
Terraces (Ag.)	1	16.6
Terraces (Hab.)	3	50
Lithic Scatter	1	16.6
Activity Area	1	16.6
Sub-total Prehistoric:	**6**	**100**
Historic Components		
Military Defense	3	11
Agriculture	21	81
Road Retainment	2	8
Sub-total Historic:	**26**	**100**
Modern Components		
Agriculture	10	83
Habitation	2	17
Sub-total Modern:	**12**	**100**

----

* This table is based on tentative interpretations made on the basis of the archaeological work conducted to date.

The only unquestionably prehistoric remains located in the project area are: Site 4142, Feature 33, a lithic artifact scatter; the two flakes recovered from the vicinity of Site 4142, Feature 36, which may or may not be related to the feature; the adze preform recovered from the vicinity of Site 4142, Feature 23, which may or may not be related to the feature; and the three isolated lithic artifact finds. These prehistoric remains require additional investigation in order to determine the extent and density of the prehistoric deposits they represent, which, in turn, will allow better significance evaluations of them to be made, and will provide archaeological data for analysis in terms of basic archaeological research issues.

PHRI recently conducted subsurface testing at Site 4144. The test excavation shows that the upright stone is placed within a stratum which contained much historic trash. Obviously, the stone was placed historically, and most likely, recently (within the last 30 to 40 years; certainly after the late 1940's, after the military left the property). Site 4144 may represent a family shrine; efforts to locate prople who know of the "shrine", however, have been unsuccessful. It appears the "shrine" (if indeed it is one) has been abandoned.

While Site 4144 had been assessed earlier as significant for information content and cultural value, based on the most recent work by PHRI, the site has been reassessed by PHRI as not significant for information content and of minimal significance in terms of cultural value. The former assessment is made because the site is recent. The latter assessment is made because (a) the "shrine" was probably used by a single family, (b) other local residents are not aware of it, and (c) it is no longer in use and evidently has not been used since 1988. According to PHRI, no further archaeological work is recommended for the site; if necessary, the site can be destroyed.

The historic features tallied in Table 5 are believed to relate to three basic activities/time periods, as follows:

WWII Coastal Defenses - Site 4143, the fire control bunkers on the summit of Puu Maelieli were probably constructed during or just prior to WWII (Figure 18). The numbers stenciled on their outside walls could be military identification numbers of some kind. These numbers could be used to help document the exact period of construction and abandonment, and perhaps document who was stationed at them and when. Site 4136, which appears to be a fire control position, may have been constructed during WWII as well. It is also possible that it was constructed for military use at a later date. Although the physical remains do not warrant further data recovery and no further work has been recommended for the site, further historical documentary research could provide information interesting in terms of local history.

Early 20th Century Pineapple Cultivation - Many of the recorded sites may be related to early 20th century pineapple cultivation. Site 4138 is clearly a road retaining wall. However, it is unknown from what time period the road dates and for what activities it was used. It may be an old pineapple field road. If so, other sites, including 4137, 4139, and 4140, which are possibly directly associated with the road may simply be retaining walls or loading ramps of some kind. As stated before, addressing this uncertainty as to the age and function of these sites will constitute an important aspect of further work carried out on them.

Unknown Agricultural Practices - This activity relates solely to the majority of the features of Site 4142. The extensive fields of depressions are clearly historic, being arranged in a grid pattern, but it is not known what was cultivated in them. Sweet potato is a likely possibility given the shape and size of the depressions, and the very rocky soil in which they are located. The other historic agricultural features of the site seem to be related to the overall field layout, and they appear to have served such functions as irrigation, field boundary delineation, and slope reduction. The extent of the fields--covering 5.7 acres with a minimum of 1,000 depressions--suggests the possibility that it was a commercial operation. The physical remains do not warrant further data recovery.

Lastly the modern features recorded during the survey area are all located within Site 4142 as well. While normally modern features and remains are not recorded in detail during archaeological surveys, it was deemed appropriate in the case of Site 4142 because the modern features, representing some kind of semipermanent habitation and a small garden, have encroached and altered the earlier features in one area of the site to such an extent as to become an integral part of the site's overall aspect. To have omitted recording them would have left a void in the site area. An unidentified local person of the Heeia Kea region (an older Japanese man who said he lived in the first house north of the project area) mentioned that a

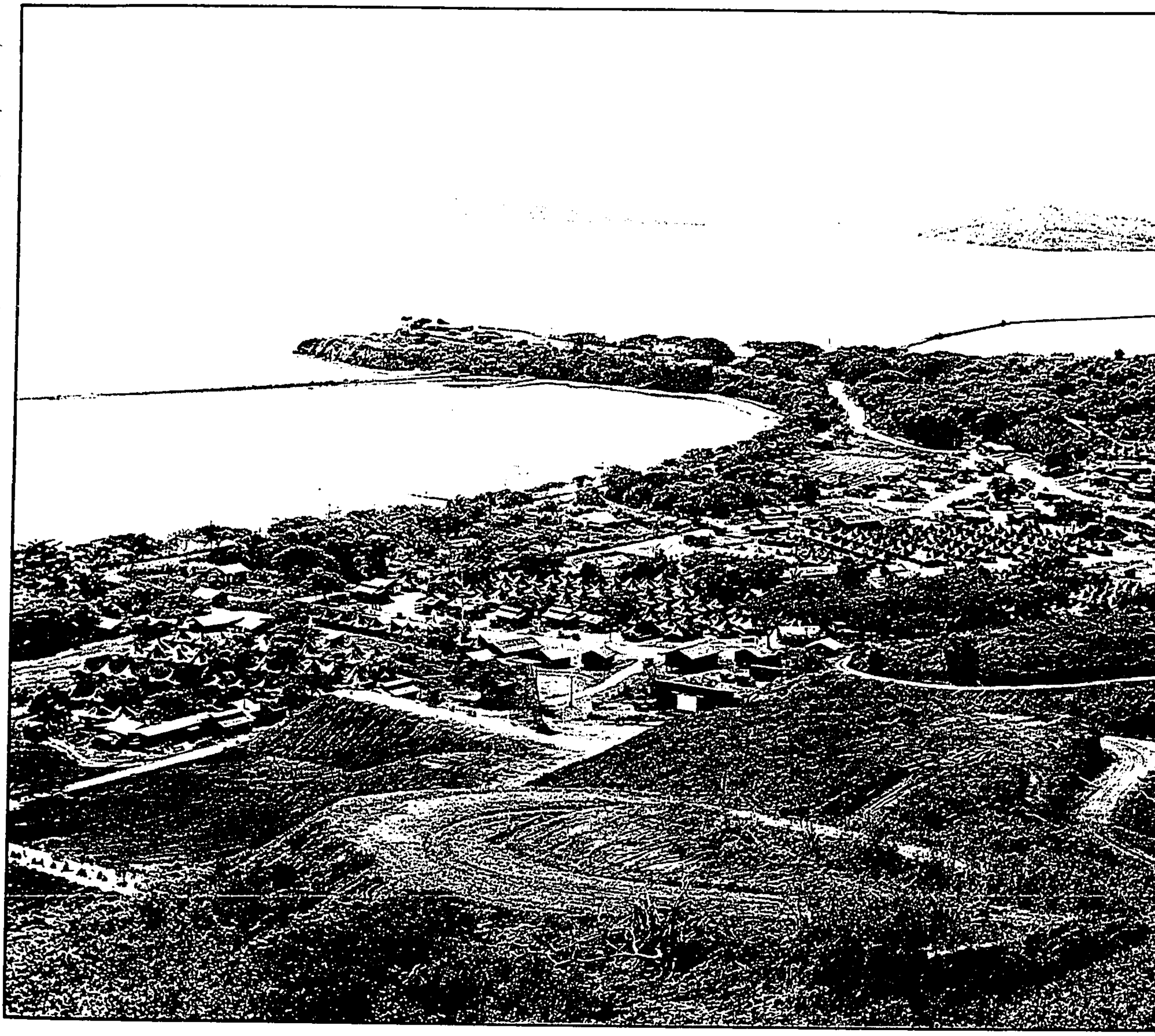
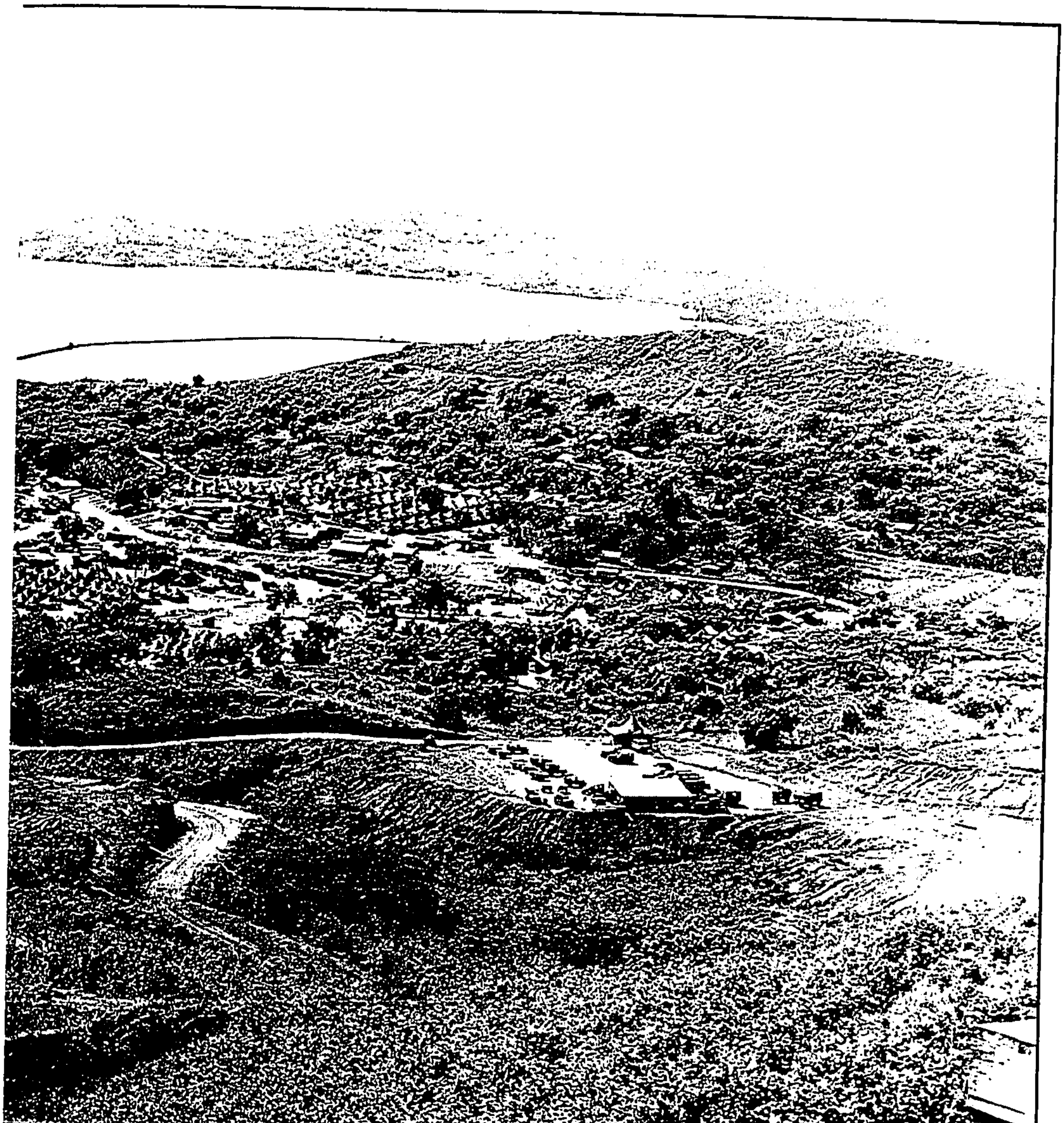


Figure 18: Camp Heeia, 1945 (19 August 1945, U.S. Army 98th Division)

Malulani Sports Complex



NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

Filipino family lived in the area of Site 4142 10 years ago. This family is probably responsible for the modern features extant today. Although the physical remains do not warrant further data recovery, further historical documentary research and local informant research could provide information interesting in terms of local history.

Significance categories used in the evaluation process for the present project area sites and isolated finds follow definitions derived from the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). The Hawaii State Historic Preservation Office also employs these criteria for evaluating cultural resources. Sites determined here to be potentially significant for information content (Category A in Table 6) are assessed under Criterion D, which defines significant resources as those which "have yielded, or may be likely to yield, information important in prehistory or history" (36 CFR Sec. 60.4). Sites determined to be potentially significant as excellent examples of site types (Category B) are assessed 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" (36 CFR Sec. 60.4).

Sites determined to be (potentially) culturally significant (Category C) are assessed under guidelines prepared by the Advisory Council on Historic Preservation, entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (Draft Report, August 1985). Cultural value is defined in the guidelines as "...the contribution made by a historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth". The guidelines specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural values". Both religious and non-religious cultural values are specified and examples include burial sites, loci of traditional economic activities, and loci that are symbolic of a group's identity or history.

To further facilitate client management decisions regarding the subsequent treatment of resources, the general significance of all identified archaeological remains was also evaluated in terms of potential scientific research, interpretive, and/or cultural values. **Scientific research value** refers to the potential of archaeological resources to produce information useful in the understanding of cultural history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. **Interpretive value** refers to the potential of archaeological resources for public education and recreation. **Cultural value**, within the framework for significance evaluation used here, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

TABLE 6

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Site Number	Signficance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
4135	+	-	-	-	+	-	-	-
4140	+	-	-	-	+	-	-	-
4141	+	-	-	-	+	-	-	-
4142#	+	-	-	-	+	-	-	-
Subtotal:	4	0	0	0	4	0	0	0
4136	-	+	-	-	-	+	-	-
4137*	-	+	-	-	-	+	-	-
4138*	-	+	-	-	-	+	-	-
4139	-	+	-	-	-	+	-	-
4143	-	+	-	-	-	+	-	-
4144*	-	+	-	-	-	-	-	-
Subtotal:	0	6	0	0	0	6	0	0
Total:	4	6	0	0	4	6	0	0
Isolated Find-1	-	+	-	-	-	+	-	-
Isolated Find-2	+	-	-	-	+	-	-	-
Isolated Find-3	+	-	-	-	+	-	-	-

General Significance Categories:

A = Important for information content, further data collection necessary (CRM value mode=research value):
X = Important for information content, no further data collection necessary (CRM value mode=research value, DLNR-HSS=not significant)
B = Excellent example of site type at local, region, island, state, or National level (CRM value mode=interpretive value; and
C = Culturally significant (CRM value mode=cultural value).

Recommended General Treatments:

FDC = Further data collection necessary (detailed recording, surface collections, and/or limited excavations, and possibly subsequent data recovery/mitigation excavations);

NFW = No further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential;

PID = Preservation with some level of interpretive development recommended (including appropriate related further collection work); and

PAI = Preservation "as is," with minimal further work (and possible inclusion into landscaping).

* General significance assessments and recommended general treatments for indicated sites have been revised based on additional inventory survey work presented in PHRI Addendum Reports 580-080189 and 691-022890.

Further data collection on Features 11, 23, 33, 35, and 36 only; no further work on other component features.

In evaluating information content (Category A - Scientific research value), all of the sites located within the project area were examined in light of several major research issues identified during background research. These issues revolve around general questions of chronology, settlement and exploitative patterns, site and assemblage variability, material culture and technology, and diet and economy.

Chronology - Determining the period of use for sites within the project area is contingent upon recovery and assay of datable materials, such as volcanic glass and charcoal. No good datable material was recovered from the sites in the project area. IF-3, a volcanic glass flake, is potentially datable. However its poor provenience and lack of meaningful context in terms of undisturbed in situ deposits would render any date obtained from the flake meaningless. Obtaining usable dating samples will be an important aspect of any further work on the sites within the project area.

Age estimates need not solely be determined through analytical assay of physical samples. Artifacts and artifact assemblages can also provide general chronological estimates of a site's age. By comparing artifacts recovered from undated or undatable sites with artifacts from other dated sites, one can make rough estimates of an undated site's age. If artifacts recovered from a site are of the same type as artifacts recovered from a site of known age, then the sites are probably close to, or are of the same age. The simplest example of this would be historic versus prehistoric artifacts. This age indicator (historic verses prehistoric artifacts) could easily resolve the present uncertainty surrounding even general age estimates of some of the sites of the project area. However, at the present level of investigation (inventory-level survey) such uncertainty cannot be resolved.

Settlement and Exploitative Patterns, Site and Assemblage Variability, Material Culture and Technology, and Diet and Economy - Inherent to the present level of archaeological investigation (inventory-level survey) is the fact that the degree of stratification, the extent, and the variability of cultural deposits and cultural remains contained within identified archaeological sites cannot be fully determined. Such information is necessary in order to thoroughly evaluate a site's significance in terms of scientific research value. Comprehensive evaluation of areal settlement and exploitative patterns, site and assemblage variability, material culture and technology, and diet and economy of past cultural groups requires intact deposits of artifacts and associated midden and features. Many of the sites located in the Malulani Sports Complex possess the potential for such intact cultural remains, and thereby may possess the data that would allow the formulation of statements and further questions regarding the nature of historic and prehistoric culture and their use of the Heeia Kea area.

In evaluating interpretive value (Category B), sites located within the project area were examined in light of their possessing qualities which would potentially make them valuable for educational or interpretive purposes. Attributes which would provide a representative example of particular kinds of behavior, activities or conditions were examined. None of the sites possess attributes which render it worthy of consideration for preservation.

Sites with cultural significance (Category C - cultural value) would include those with traditional uses and those with significant meaning in the context of a traditional way of life. None of the sites were determined to potentially possess such value.

Table 6 summarizes the general significance assessments and the recommended general treatments for sites and features located during the present project.

Based on the findings of significance and potential significance and cultural value as outlined above, the following recommendations are proposed in the event development of the project area occurs (see also Table 6). Of the total ten sites, six are assessed as significant solely for information content. For four of the six sites, no further work is recommended. For the remaining four sites, further data collection is recommended. In addition to the site and feature recommendations, it is further recommended that the areas of two of the three identified isolated artifacts undergo further investigation. The remaining isolated find is assessed as significant for information content, but requires no further work.

The general scope of recommended further work would be a data collection level of investigation as follows:

o further work on Sites 4135, 4140, 4141, and 4142, Features 11, 23, 33, 35, and 36 would involve limited excavations and detailed mapping. An emphasis would be placed on acquiring datable samples and/or diagnostic artifacts in addition to general data collection. In the case of the Site 4142 features, informant research could prove fruitful.

o further work on Isolated Finds 2 and 3 would involve a program of systematic shovel testing in the area surrounding that from which the artifacts were recovered, in an attempt at locating intact, buried cultural deposits from which the artifacts eroded. In the event that such deposits were discovered, limited testing and data collection would ensue.

Nanatomi Hawaii is committed to implementing the above recommendations prior to development.

It should be noted that the above evaluations and recommendations are based on the findings of an inventory-level surface survey and limited subsurface testing. There is always the possibility, however remote, that potentially significant unidentified cultural remains might be encountered in the course of future development activities. In such a situation archaeological consultation should be sought immediately.

4.11.2 Probable Impacts

No impacts to archaeological or historical resources are expected if the above recommended mitigative work is implemented. In the event that any previously unidentified sites or remains are encountered during construction and site work phases, work in the immediate area will cease until the State Historic Preservation Officer has been notified and is able to assess the impact and make further recommendations for mitigative actions, if warranted.

4.12 Hazardous Waste

Industrial Analytical Laboratory (INALAB, Inc.) conducted a hazardous waste assessment of the former Hawaiian Electric Company baseyard (currently being leased to a construction company for the storage of equipment and supplies). INALAB, Inc. also conducted a survey to locate and identify all above surface waste drums and containers in an area where they were found to be concentrated. Their reports are reproduced in their entirety in Appendix N of this EIS and are summarized below.

Former Hawaiian Electric Company Baseyard--INALAB, Inc. found no visual or physical indication of any potential surface contamination involving PCB fluids or other industrial chemical contaminants. INALAB, Inc. noticed no old transformers, no fluid stains, and no apparent harm to the environment from foreign substances. This is with the exception of minor waste oil spillage probably from the operations of the existing lessee.

INALAB, Inc. saw no surface evidence of any underground tanks, or holding structures of major concern during their survey.

In general, INALAB, Inc. noticed no indication of any significant environmental impact from prior year operations that may have taken place (Hawaiian Electric Company baseyard operations), and noted no real property hazards currently present. The potential property hazards (minor waste oil spillage) are of an easily correctable nature.

Nanatomi Hawaii has requested that all waste oil be stored in non-leaking 55 gallon drums. These drums will then be taken to a proper disposal organization when full.

Elsewhere on the Property--In addition, INALAB, Inc. conducted an inspection in an area elsewhere on the property where drums and containers were discovered during maintenance operations.

Of the total of 32 drums/containers located and labeled as present most were empty, a few were filled with rain water and one container, an old gasoline pump, was noted to contain a small quantity (less than 5 gallons) of gasoline at the time of inspection.

There was a considerable amount of other debris (e.g., abandoned vehicles, some small cans of what appeared to be latex, exterior paint, a jet engine, and a few abandoned buses). There were roughly 13 cans (about 13 gallons) of latex paint, all grouped together. INALAB, Inc. also noted a large stack of corrugated asbestos transite paneling also present.

The transite asbestos paneling will disposed of by first thoroughly wetting panels with water and then wrapping, either individually or in small lots (2 to 3 panels), in triple layer, 6 mil. thick plastic sheets which are prominently labeled (in accordance with OSHA regulations) as containing "ASBESTOS".

The majority of drums and containers were noted (due to the remnants of labels) to have once held paint removal and degreasing solvents. These solvents and degreasing materials even if originally present, have long ago dissipated and there was no discernable effect on surrounding and adjacent fauna and flora.

One acetylene cylinder was noted to be present but was obviously non-pressurized because it was missing (via corrosion) its entire bottom. Other cylinder-like containers were located and identified to be a combination of discarded water heaters and softeners.

On the basis of this investigation, INALAB, Inc. determined that no further action will be necessary with respect to characterization or special disposal activity of potentially toxic or hazardous drums/containers on site.

Even under ideal conditions it is possible for INALAB, Inc. to have missed either subsurface or crushed and impacted waste hidden from view. This should not represent a problem in the majority of cases. However, should significant amounts of this material be uncovered or noticed during the clearing operations, in particular, material containing liquids or solids of any type, Nanatomi Hawaii will 1) immediately suspend operations at that specific location; 2) immediately call a qualified chemist from INALAB, Inc. to quickly investigate the situation before proceeding with the demolition/clearing efforts. If necessary, INALAB, Inc. will sample and arrange for the efficient and safe removal of any potentially occupational or environmental hazard.

CHAPTER V

ASSESSMENT OF EXISTING CONDITIONS AND PROBABLE IMPACTS: SOCIO-ECONOMIC ENVIRONMENT

This chapter describes the existing socio-economic environment and probable changes due to the implementation of the proposed resort expansion.

5.1 POPULATION

5.1.1 Residential Population

5.1.1.1 Existing Conditions

DGP (September, 1988) estimated that the 1989 population of the Koolaupoko Development Plan Area is 118,382. This constituted approximately 14 percent of the island's total estimated population of 850,500 for the same time period. Presently there is no one residing on the property.

5.1.1.2 Probable Impacts

Presently, 31 subdivided lots are designated in the Koolaupoko DP Land Use Map as Residential. Based on 3.5 persons per household (Natelson Levander Whitney, Inc., Appendix M), the development of residences on the property given the current Koolaupoko DP Land Use Map designation could add 108 persons to the Koolaupoko population.

The proposed amendment to the Koolaupoko DP Land Use Map involves only the reconfiguration of the current Residential designation. If the proposed Residential configuration is approved, and subdivision is approved for 30 to 35 residential lots, then the new homes could add between 105 to 123 residents to the Koolaupoko population (Appendix M). The impact of the proposed amendment to the Koolaupoko DP area, then, is expected to be minimal.

5.1.2 Visitor Population

5.1.2.1 Existing Conditions

There is presently no visitor population at the property.

5.1.2.2 Probable Impacts

There will be visitors to the property using the facilities of the Malulani Sports Complex. The maximum visitor population can be estimated as follows:

- Golfers on the course (1 foursome per hole) = 72
- Golfers waiting to play (3 foursomes) = 12
- Golfers at the clubhouse after play (1 to 3 foursomes) = 4 to 12
- Guests at banquet facility = 150
- Tennis players on courts (doubles on each court) = 12
- Tennis players waiting to play (1 foursome at each court) = 12
- Tennis players at clubhouse after play = 12
- Health spa users (1 per exercise machine) = 20

Maximum use of the proposed facilities is estimated to generate a visitor population of approximately 300 (mostly Windward Oahu residents).

5.1.3 Character or Culture of Neighborhood

5.1.3.1 Existing Conditions

Land uses within the Koolaupoko District consist predominantly of residential uses surrounded by substantial amounts of open space and agricultural land. The communities of Kailua and Kaneohe are stable, predominantly single-family suburban "bedroom communities" and Waimanalo is a rural community having extensive acreage devoted to diversified agricultural pursuits surrounding a small low-density residential area. The communities of Kahaluu, Waiahole-Waikane, and Kualoa are relatively lightly settled, rural areas with the exception of limited areas in Heeia Kea and Ahuimanu Valley, where residential development of a low-density suburban character already exists, including residences between Heeia Uli Wetlands and Heeia Pond, single-family homes south of Heeia Uli Wetlands between Kahekili and Kamehameha Highways and homes north of the property along Kamehameha Highway to Kahaluu Pond.

5.1.3.2 Probable Impacts

The proposed Malulani Sports Complex will be compatible with the existing land uses within the Koolaupoko District since it involves mostly open space with low density residential use.

5.1.4 Displacement

5.1.4.1 Existing Conditions

There are no residents on the property.

5.1.4.2 Probable Impacts

Since no one currently resides on the property, the proposed project will not displace anyone.

5.2 ECONOMIC IMPACTS

5.2.1 Economic Growth

Construction and operation of the proposed project will provide additional employment and income in Koolaupoko and elsewhere on Oahu. Infrastructure construction will entail the expenditure of about $26 million, providing employment and income in the construction industry. Operation of the Malulani Sports Complex will add to the economic base of the Koolaupoko region by virtue of the jobs created by the project. Hiring preference will be given to Koolaupoko residents. In addition, the project will broaden the leisure and landscape industries in Koolaupoko.

The impact of the proposed project on surrounding property values is difficult to assess. In the process, the Real Property Tax Assessment Office (RPTAO) was contacted and they have stated that there is no clear answer to this question. The RPTAO stated that assessments are based upon primarily two broad factors: 1) the "neighborhood" in which the land is located; and 2) the fair market value of the land. "Neighborhoods" are determined by the usage of the land and are not determined by merely picking streets as a physical demarcation of the boundaries. RPTAO was informed that Nanatomi Hawaii plans to develop the land into a sports complex (to be known as Malulani) consisting of a golf course, golf clubhouse, healthclub facilities, tennis courts, restaurant and approximately 30 to 35 single-family residences. Based upon this information, the RPTAO stated that the project would likely be designated as a separate "neighborhood" from Kahalu'u and Kaneohe because the sports complex is an integral feature of Malulani. As a result, it is unlikely that the residential communities of Kahalu'u and Kaneohe would be assessed at the same rate as the single-family residences of Malulani.

Assessment rate is based upon fair market value of comparable vacant land. This is derived by using sales prices of land with comparable usage minus the replacement costs of any improvements on the land. In Malulani's case it is likely that the RPTAO will look to Hawaii Kai and other similar golf course residential communities for comparable sales prices. It cannot be determined whether Malulani will have a direct or indirect effect upon the fair market value of Kahalu'u and, thus, affect the real property tax assessment rate. However, when the RPTAO was asked what factors they thought would have the most impact upon the fair market value of land on the Windward side, the RPTAO responded that any improvements to the commuting time between the Windward side and Honolulu, such as H-3 and the widening of Kahekili, would likely have a more significant impact upon fair market value than the development of a golf course.

5.2.2 Employment

5.2.2.1 Existing Conditions

According to the State Department of Labor and Industrial Relations (DLIR), the estimated average unemployment rate for January through June 1989 on Oahu was 2.9 percent. In June, approximately 11,085 were unemployed on Oahu; 581 were Kaneohe residents, of which 539 were without earnings.

5.2.2.2 Probable Impacts

The proposed project will generate short-term employment during the construction of the golf course, clubhouse and recreational facilities, and 30 to 35 single-family residences. In addition, the operation of the golf course, clubhouse and recreational facilities will create long-term employment opportunities.

Direct Short-Term Construction-Related Employment. Beginning in 1991, the project will generate short-term employment for the construction of the golf course. Construction is expected to generate about 25.5 full-time equivalent person year (FTE) positions (Appendix M). The planting and landscaping phase of the golf course is estimated to create 12.5 FTE positions (Appendix M). Construction of the clubhouse and recreational facilities is anticipated to provide 39 FTE jobs (Appendix M).

Beginning in 1991, the proposed project would generate short-term employment for the construction of residential units. The construction of each residential unit would require 2.7 persons on a full-time basis, with the average construction period per unit requiring approximately one year (Appendix M). Given the small scale of the project and the relatively low anticipated rate of absorption it is assumed that the local labor market can easily supply the necessary construction work force. The project will require a maximum of 65 employees (Appendix M).

Direct Long-Term Operation-Related Employment. Based upon comparable facilities, the proposed golf course would create employment for about 20 persons and include the following positions: 1 superintendent for golf course, 1 superintendent for clubhouse grounds, 1 mechanic, 6 light equipment operators and 11 maintenance (Appendix M).

Security for the golf course and the residences will be provided by a gated entrance at the main entry. Three employees will be required to operate the entrance (Appendix M).

The clubhouse restaurant will generate employment for 18 persons, and the pro shop will create jobs for 3 employees. The health spa will require 10 employees to be distributed as follows: 1 manager, 3 weight trainers, and 6 aerobics instructors (Appendix M).

Operation of the Malulani Sports Complex, then, is estimated to create employment for a total of 54 persons. Nanatomi Hawaii is committed to giving hiring preference to Koolaupoko residents. It is expected that at full operation, the Malulani Sports Complex will provide jobs for the following categories of Koolaupoko residents: unemployed, underemployed, high school students, future high school graduates, college students, and those employed but wishing to reduce commuting time.

5.2.3 Government Revenues

5.2.3.1 Existing Conditions

Presently, revenues to the State of Hawaii and the City and County of Honolulu are non-existent.

5.2.3.2 Probable Impacts

The City and County of Honolulu would normally provide the following major services to Malulani residents and businesses: General Government; Public Safety; Sanitation; Health and Welfare; Road Maintenance and Repair; Culture and Recreation; and Retirement and Pensions. According to Natelson Levander Whitney, Inc. (Appendix M), the costs to the City and County of Honolulu are projected at approximately $10,000 and will be more than offset by the projected $161,500 in anticipated revenues.

The State of Hawaii provides the following services to residents which would be directly impacted by the proposed development: Education; Highways; Hospitals; Health; and Sanitation. According to Natelson Levander Whitney, Inc. (Appendix M), the costs to the State will also be minimal and should be more than offset by the $173,000 estimated to be generated from general excise taxes.

5.3 HOUSING

5.3.1 Existing Conditions

Current zoning allows the construction of 31 single-family homes on 16.2 acres of R-5 zoning.

5.3.2 Probable Impacts

As part of the project, the applicant proposes the development of up to 35 single-family homes on 16.2 acres, which would be a maximum of 4 more units than what is currently subdivided, but not an increase in area zoned for residential use.

Operation of the proposed Malulani Sports Complex could be expected to result in a small population increase due to the additional employment generated by the project. Most of the jobs that will be created by the sports complex will be filled by those currently residing in Koolaupoko. There will be a potential labor force available in Koolaupoko who are unemployed, underemployed, presently not in the labor force, high school students, future high school graduates, college students, and those who are employed but are tired of long commuting times (to Downtown or Waikiki). It appears that there is adequate labor supply within Koolaupoko to fill the positions created by the project without hiring in-migrants from other districts on Oahu who might decide to relocate to Koolaupoko.

To mitigate the impact of employment-generated demand for affordable housing, Nanatomi Hawaii will conduct activities that link residents of Koolaupoko with employment at the Malulani Sports Complex, these include: giving hiring preference (when all other qualifications are equal) to residents of Koolaupoko; utilizing the City and County of Honolulu Office of Human Resources' WORKHAWAII program; and providing on-the-job training for new hires.

CHAPTER VI

ASSESSMENT OF EXISTING CONDITIONS AND PROBABLE IMPACTS: PUBLIC FACILITIES AND SERVICES

This chapter describes the existing conditions of public facilities, utilities and services in the proposed development's service area and the relationship of these systems to the proposed development. Public facilities are those systems which are provided, staffed, and maintained by the government to serve the public health, safety and welfare. They include roadways, schools, fire and police protection, and refuse disposal. Public utilities are distributed services, such as electricity, water, wastewater, and communications, that are provided either by a public agency directly or by a publicly regulated utility. Project-related impacts are discussed primarily in terms of anticipated requirements generated by the development. Mitigation measures are preliminary proposals for how that demand may be satisfied.

6.1 ACCESS AND TRAFFIC

A traffic impact analysis report on the proposed Malulani Sports Complex has been prepared by Sam O. Hirota, Inc., is reproduced in its entirety in Appendix J of this EIS and is summarized below.

6.1.1 Existing Conditions

Access to the site is via Kamehameha Highway. Kamehameha Highway fronting the subject property is a 50-foot right-of-way, two-lane highway with a pavement width of 22 feet (Appendix J). Kamehameha Highway forms a three-way, signalized intersection with Kahekili Highway approximately 2 miles north of the site. Two miles south of the site, Kamehameha Highway forms another signalized intersection with Haiku Road/Lilipuna Road which is adjacent to the Windward Mall in Kaneohe. The City and County of Honolulu has jurisdiction over Kamehameha Highway between the junction of Kamehameha Highway and Kahekili Highway and "Long Bridge" (the bridge over Heeia Stream).

Presently, there are no trips being generated by the property. Traffic counts taken on Kamehameha Highway indicate existing a.m. and p.m. peak hour volumes well under the capacities typical of a two-lane rural highway (collector road) with level of service "A". Sam O. Hirota Inc. conducted traffic counts on August 12-14, 1989 at the intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor (Appendix J). The weekday peak hour was identified as occurring between 4:45 and 5:45 p.m., and the weekend peak hour from 3:30 to 4:30.

Sam O. Hirota Inc. analyzed the intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor to determine its Level-of-Service (LOS) using the field data from the traffic counts and analysis techniques for unsignalized intersections from the Highway Capacity Manual (HCM) Special Report 209 (1985 Edition). The LOS for the traffic movements in an intersection is classified into six categories ranging from little or no delay (LOS A) to very long delay (LOS F). At this intersection the results of the LOS analysis indicated little or no delay (LOS A) for all six movements (Appendix J).

6.1.2 Probable Impacts and Mitigative Measures

Local Traffic. Current plans for the proposed Malulani Sports Complex call for the creation of a single entry with a new unsignalized "T" intersection at Kamehameha Highway. As shown on Figure 3, roadways will be built within the property to provide access to the clubhouse and the residences. In addition, as part of the proposed project, the applicant is proposing to dedicate approximately 3 acres of land adjacent to the Heeia Kea Pier and Boat Harbor for a public beach park and for the expansion of boat harbor facilities. To accomplish this, approximately 1 acre will be dedicated to the City and County of Honolulu for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. Under this proposal, the entry for the Heeia Kea Pier and Boat Harbor from Kamehameha Highway would have to be relocated from its present location. In addition, the 3 acres of land to be dedicated appears to have adequate room to increase parking for Heeia Kea Pier and Boat Harbor by 89 percent.

The traffic impact analysis report (Appendix J) assessed the impact of the project-generated traffic at the proposed entry road to the Malulani Sports Complex, and secondly, at the existing access to the Heeia Kea Pier and Boat Harbor (assuming the Community Facilities improvements are implemented as shown on the Concept Plan [Figure 3]). The estimated traffic impact was calculated by adding the estimated future traffic to be generated by the project to the estimates of future traffic on this section of Kamehameha Highway.

Kamehameha Highway between Kahekili Highway and Haiku Road will remain, for the foreseeable future, a collector road serving local traffic in the Kaneohe area. In recent years the traffic volume has declined over this segment of the highway due to improvements on Kahekili Highway and this trend should continue as additional improvements are implemented to Kahekili Highway (Appendix J). In addition there are limited areas along this stretch of Kamehameha Highway with potential for development (that would generate new traffic).

In order to assess the impact of the project-generated traffic, Sam O. Hirota, Inc. conducted a LOS analysis for the following scenarios (Appendix J):

o the existing intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor, under existing conditions (during the weekday peak hour, with shared lanes [no left-turn lane or right-turn lane on Kamehameha Highway]; and with separate lanes [left-turn lane on Kamehameha Highway], and during the weekend peak hour, with shared lanes and with separate lanes);

o the existing intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor, under future conditions without the project (during the weekday peak hour, with shared lanes [no left-turn lane or right-turn lane on Kamehameha Highway]; and with separate lanes [left-turn lane on Kamehameha Highway], and during the weekend peak hour, with shared lanes and with separate lanes);

o the existing intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor, under future conditions with the project (during the weekday peak hour, with shared lanes [no left-turn lane or right-turn lane on Kamehameha Highway]; and with separate lanes [left-turn lane on Kamehameha Highway], and during the weekend peak hour, with shared lanes and with separate lanes);

- the new intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor, under future conditions with the project (during the weekday peak hour, with shared lanes [no left-turn lane or right-turn lane on Kamehameha Highway]; and with separate lanes [left-turn lane on Kamehameha Highway], and during the weekend peak hour, with shared lanes and with separate lanes); and

- the new intersection of Kamehameha Highway and the project entry road, under future conditions with the project (during the weekday peak hour, with shared lanes [no left-turn lane or right-turn lane on the entry road]; and with separate lanes [right-turn lane on the entry road], and during the weekend peak hour, with shared lanes and with separate lanes).

The analysis indicates that level-of-service for each peak hour period is an "A" indicating little or no delay for the proposed access to the Malulani Sports Complex for weekdays and weekends.

The analysis also shows that the level-of-service will be unchanged between the existing intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor, under future conditions without the project and the new intersection of Kamehameha Highway and Heeia Kea Pier and Boat Harbor, under future conditions with the project.

Although the traffic impact analysis determined that there would be minimal improvement to the level of service by the establishment of exclusive turn lanes from the entry road, and the construction of left and right turn lanes on Kamehameha Highway onto the entry road, the applicant plans to construct these improvements prior to occupancy or official opening of the project to the public.

Regional Traffic. The project-generated traffic will have a minimal impact on the regional traffic system, since it is a facility that will attract a relatively minimal amount of traffic, distributed evenly throughout the day, that will be going in the opposite direction from the Primary Urban Center. It is anticipated that traffic congestion will continue to worsen on Kahekili and Likelike Highways without the project if improvements (such as the proposed widening of Kahekili Highway and the construction of H-3) are not implemented.

Traffic has been identified as one of the major concerns in the Koolaupoko Development Plan area. To mitigate traffic congestion, the DP Public Facilities Map for Koolaupoko (Figure 8) indicates improvements to Kamehameha Highway fronting the project site programmed beyond the next 6 years. The improvements would consist of 60 feet of right-of-way, with 48 feet of pavement. One of the alternatives to the proposed widening of Kahekili Highway is the widening of this segment of Kamehameha Highway. One of the reasons that this alternative has been determined to be unacceptable was that this section of Kamehameha Highway is not linked as directly to trans-Koolau traffic routes as Kahekili Highway is, so widening of this segment of Kamehameha Highway would not do as much to improve regional peak hour traffic conditions. Therefore, the widening of this segment of Kamehameha Highway does not appear to be warranted.

6.2 WATER

6.2.1 Existing Conditions

Existing potable water service to the area consists of the 272' Punaluu transmission system within Kamehameha Highway, consisting of a 16-inch transmission main and 8-inch distribution main (Appendix H).

6.2.2 Probable Impacts

Potable water will be required for the proposed 30 to 35 single-family homes, the golf clubhouse and recreational facilities, and the golf maintenance facility. Using the City and County of Honolulu Board of Water Supply (BWS) standard water demand rate of 700 gallons per day (GPD) for a single-family residence (3.5 bedrooms), the proposed 30 to 35 homes will require approximately 21,000 GPD. The golf clubhouse and recreational facilities, and the golf maintenance facility is expected to require approximately 40,000 GPD (Appendix H). The total estimated potable water requirement, then, is approximately 61,000 GPD.

Non-potable water will be required for the irrigation of the tees, greens, fairways and, limited portions of the "roughs" of the proposed golf course. Using the City and County of Honolulu Board of Water Supply's (BWS) General Guidelines for Irrigation of Turfgrass Based on Rainfall (June 1989), the irrigation requirements for the golf course can be preliminarily estimated. Assuming an average irrigation requirement of 1,770 gallons per acre day (a conservative estimate, since according to the BWS guidelines, areas that receive 60 inches of rainfall a year will not require irrigation; SKN 839.20, Heeia, recorded an average annual rainfall of 59.8 inches), and a golf course size of 175 acres (a conservative estimate, Murdoch and Green estimate that a typical 18-hole golf course has 3 acres of green, 3 acres of tees, 50 acres of fairways and 20 acres of perimeter areas, for a total 76 acres requiring irrigation), the irrigation requirements could be approximately 309,750 gallons per day. The conservative assumptions are provided to balance the limitations of the guidelines which do not consider evapotranspiration, runoff, the amount of water draining beyond the root zone and changes in soil-water storage.

Fire protection is also required for the residences, the golf clubhouse and recreational facilities, and golf maintenance facility.

The water supply for the proposed project will be separated into two different systems: the potable water system and the non-potable water system. The potable and non-potable water systems will be carefully designed and operated to prevent cross-connections and backflow conditions. The two systems will be clearly labeled and physically separated by air gaps or reduced pressure principle backflow preventers to avoid contaminating the potable water supply.

The potable water system includes domestic supply and fire protection for the residences and the golf maintenance facility, and domestic supply for the golf clubhouse and recreational facilities. The proposed potable water system will be connected to the 30-inch BWS low service transmission line (Appendix H). A new 12-inch line will be installed along Kamehameha Highway up to the proposed project entry road (Appendix H). From the entry, a new 8-inch line will be installed along the project roadways (Appendix H).

Fire hydrants will be installed at appropriate locations. Construction of the necessary transmission/distribution system will be at the applicant's expense. All facilities will be designed to BWS standards and are intended to be dedicated to the BWS upon completion.

The availability of potable water from BWS will be determined when the building permit applications are submitted for BWS review and approval. When the applications are approved, the applicant will be required to pay BWS Water System Facilities Charges for source-transmission and daily storage.

The project will place an additional demand of 61,000 GPD on the BWS source and distribution system. However, the project system will involve the replacement of the existing 6-inch BWS line along Kamehameha Highway with a 12-inch line, and improve fire protection capabilities within the property.

The new potable water distribution system will be subject to the Department of Health's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems."

The non-potable water system includes irrigation for the golf course and landscaped areas. The primary sources of irrigation water will be storm runoff catchment and treated sewage effluent from the project. To supplement these sources during dry weather conditions, it is proposed that two wells be drilled on the mauka portion of the site, between the 250-foot and 275-foot elevations. The wells are expected to deliver 0.2 MGD per well. A gravity line from the well sites will supply non-potable water to an irrigation storage pond/golf course water feature south east of the clubhouse area.

The non-potable water system will not place an additional burden on the BWS system. The proposed wells will be designed and constructed to prevent the possibility of groundwater contamination. For example, each well will have a concrete pad and full grouting to prevent seepage or floodwaters from migrating down the well shaft. The wells will be monitored to note if any changes occur to the ground water quality. In the event that significant decreases in ground water quality occur, other source alternatives will be considered.

6.3 WASTEWATER

6.3.1 Existing Conditions

Presently, the property is not serviced by the City and County of Honolulu's wastewater collection, treatment and disposal system. The adjoining residential area between the subject property and the junction of Kamehameha Highway and Kahekili Highway is serviced by cesspools. Wastewater disposal via cesspools is a major issue within the Koolaupoko DP area. The DP Public Facilities Map for Koolaupoko identifies the adjoining residential area as a Sewer Improvement District (ID).

6.3.2 Probable Impacts and Mitigative Measures

The wastewater flows from the proposed project are anticipated to be primarily generated from two sources: the clubhouse and recreational facilities, and the residences. The clubhouse activities will include meal preparation, toilets and showers, and laundry area. The average daily wastewater generated by the clubhouse and residences is estimated to be 50,000 GPD and will be typical of domestic wastewater in composition (Appendix I).

Wastewater generated by the project will be collected and treated on-site. The treated effluent will be used for irrigating the golf course (Appendix I) The proposed wastewater collection system is proposed to be located on the makai side of the residential lots. A gravity sewer will collect the wastewater from the residential lots, clubhouse, and plant nursery/golf maintenance facility and convey the wastewater to the proposed wastewater treatment plant (WWTP). The proposed WWTP will be located near the makai, Kaneohe-side corner of the property (Figure 3). The solids (sludge) removed by the treatment process will be disinfected, dewatered, and applied to the golf course and landscaped areas as a soil conditioner. Any surplus sludge will be hauled to an approved City and County of Honolulu sanitary landfill for final disposal in compliance with State of Hawaii Department of Health regulations. The treatment wastewater effluent will be chlorinated and conveyed to an aerated blending pond. The pond will be used for mixing effluent with non-potable irrigation water from storm runoff and/or brackish groundwater (allowable per Administrative Rules Title 11, Chapter 62, Wastewater Systems). The pond will be lined to prevent direct infiltration of irrigation water.

Approximately 16 percent of the estimated golf course irrigation water requirement can be supplied by the treated effluent (Appendix I). Irrigation of the golf course with treated effluent will reduce the demand for irrigation water from non-potable sources.

With proper operation, objectionable odors will not be generated from the WWTP (Appendix I). Pumps and blowers normally associated with WWTP will be enclosed within a control building to reduce the impact of operating noises (Appendix I).

Placement of the WWTP below ground level and landscaping the perimeter fence area will reduce the visual impact of the facility.

6.4 DRAINAGE

6.4.1 Existing Conditions

There are four existing dry gullies (subbasins) within the property which discharge all storm runoff into Kaneohe Bay. There are 3 existing box culverts and one 48-inch reinforced concrete pipe drain line which pass under Kamehameha Highway and discharge into Kaneohe Bay.

According to Sam O. Hirota, Inc., the estimated total amount runoff for the site, in its existing undeveloped state, during a 100-year, 24-hour storm is approximately 136.76 acre feet (Appendix D).

The project site is located within Zone D of the Flood Insurance Rate Map and is not subject to City and County of Honolulu Ordinance 80-62 (Flood Hazard Districts). Zone D represents areas of undetermined but possible flood hazard.

6.4.2 Probable Impacts and Mitigative Measures

The proposed project would change the character of approximately 180 acres of the property (Appendix D). An open, closely cropped landscaping normally associated with a golf course would replace the present dense vegetative cover as would improvements such as buildings, roadways and parking lots. The proposed improvements are estimated to increase the total amount of runoff from 136.76 acre feet to 155.28 acre feet for the 100-year, 24-hour storm, or an increase of 13 percent (Appendix D).

All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadways servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined.

The proposed drainage system will be designed and built to City and County of Honolulu standards. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation. Since the drainage will be designed to retain storm runoff onsite (for golf course irrigation), the existing drainage structures at Kamehameha Highway appear to have sufficient capacity to handle the storm runoff from the proposed development (Appendix D). A drainage report will be submitted to the Drainage Section, Division of Engineering for review and approval prior to application for a grading permit.

The proposed ponds and water features would serve as detention silt and debris basins, reducing the peak runoff. The proposed detention basins and designed golf course rough features are expected to reduce the peak runoff discharge to below that of the existing condition (Appendix D). These mitigating measures should eliminate the potential alteration of marine communities owing to impacts of runoff (Appendix G).

6.5 SOLID WASTE

6.5.1 Existing Conditions

Presently, solid waste generated by the adjoining residential area is collected and disposed of by the City and County of Honolulu Department of Public Works, Refuse Division.

6.5.2 Probable Impacts

Solid waste is anticipated to be collected by a private collection company.

6.6 SCHOOLS

6.6.1 Existing Conditions

Public schools servicing the project area include: Heeia Elementary, King Intermediate, and Castle High. Presently, there are no school-aged children on the subject property.

6.6.2 Probable Impacts

During the EIS consultation period, the State of Hawaii Department of Education (DOE) wrote that the proposed 30 to 35 residences will have negligible impact on area schools.

6.7 PARKS

6.7.1 Existing Conditions

The closest park to the subject property is the Heeia State Park (Figures 1 and 2) at Kealohi Point (also referred to as Matson Point). This location, formerly used as a commercial restaurant, was acquired by the State of Hawaii in 1978 and dedicated as Heeia State Park as an educational and cultural center. Two pavilions in this park were extensively repaired by the State in 1981. The park facilities are available for rental by groups for luaus, weddings and parties.

The other major nearby recreational facility is the State of Hawaii Heeia Kea Pier and Boat Harbor (Figure 1) which is heavily used, especially on weekends. Presently, there are no recreational activities occurring on the subject property.

6.7.2 Probable Impacts

The City and County of Honolulu Department of Parks and Recreation has made a preliminary determination that the project, as planned, will meet the requirements of the City's Park Dedication Ordinance No. 4621.

Besides the recreational activities that will be offered on a play for fee and reservations basis (golf course, tennis and health spa), the conceptual plan (Figure 3) reserves space for public recreational uses. Approximately 1 acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, Nanatomi Hawaii will be able to dedicate approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor for the development of a public beach park and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area. It appears the proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor.

Hiking trails and a 4.2-acre campground accessible to the windward community with a permit from Nanatomi Hawaii are also planned.

6.8 POLICE

6.8.1 Existing Conditions

There is an existing police station located within Kaneohe approximately 3 miles from the subject property.

6.8.2 Probable Impacts

There will be an occasional and unavoidable demand for security services. It is planned that the Malulani Sports Complex will contract or directly hire security personnel to patrol facilities during evening hours. The proposed residences and facilities of the sports complex will be designed with adequate attention to the principles of environmental security (from crimes against property and persons). For example, adequate lighting will be installed along walkways. According to written comments received from the Police Department during the DEIS public review period, the project should have minimal impact on police operations, and the Police Department should be able to service the area with existing personnel and facilities. If, during the construction phases of the project, that a portion of one of the lanes must be temporarily closed to traffic, then safety signs and barricades will be installed at appropriate locations to assist passing.

To mitigate the potential hazards of pedestrian crossing of Kamehameha Highway between Heeia State Park and the area proposed to be dedicated for an amphitheater, it is proposed that a crosswalk be delineated near the proposed entry to Heeia Kea Pier and Boat Harbor. For special events, off-duty police could be hired for traffic control.

6.9 FIRE

6.9.1 Existing Conditions

There are 3 fire stations within the vicinity of the property: Kaneohe (Engine Co. 17), Kahaluu (Engine Co. 37), and Kailua (Ladder Co. 18). The Kaneohe and Kahaluu fire stations are located 3 miles (6 minutes) and 3.2 miles (6 minutes) away from the property, respectively.

6.9.2 Probable Impacts

There will be an occasional and unavoidable demand for fire protection. Residences and other buildings within the project will be designed with adequate attention to the principles of fire safety. As part of the proposed water transmission system, lines with adequate fire flow capacity and fire hydrants will be installed within the roadways of the subject property. Access for emergency vehicles and new construction shall conform to fire and building codes and standards.

6.10 ELECTRIC

6.10.1 Existing Conditions

Hawaiian Electric Company, Inc. provides residential electrical service to the project area via overhead powerlines located within the Kamehameha Highway right-of-way.

6.10.2 Probable Impacts

Connection to Hawaiian Electric Company, Inc. will be made at Kamehameha Highway. The existing electrical system may have to be upgraded to accommodate the new development. The applicant will work closely with Hawaiian Electric Company, Inc. 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. It is expected that the design and construction of the proposed facilities will incorporate energy saving designs and devices in order to reduce operating costs.

6.11 TELEPHONE

6.11.1 Existing Conditions

GTE Hawaiian Tel provides telephone service to the project area via overhead lines located within the Kamehameha Highway right-of-way.

6.11.2 Probable Impacts

The proposed project will be provided with underground telephone service. Connection to the GTE Hawaiian Tel system will be made at Kamehameha Highway. If Kamehameha Highway is realigned, the costs of relocating that portion of the existing Hawaiian Tel facilities will be borne by the appropriate governmental agency(ies) that would develop the land proposed to be dedicated by the applicant.

When the project enters the design phase, the appropriate governmental agency(ies) or their consultant will coordinate the facility relocation requirements with GTE Hawaiian Telephone. The applicant will consult with GTE Hawaiian Tel to assure that telecommunication services are available in a timely manner.

CHAPTER **VII**

ALTERNATIVES TO THE PROPOSED ACTION

Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of "any known alternatives...which could feasibly attain the objectives of the action." As stated in Section 2.5, the objective of the action is to develop a sports complex, including a par 72, 18-hole golf course. The rules further specify that the alternatives be explored and evaluated in light of enhancement to environmental quality or the avoidance or reduction of adverse environmental effects.

7.1 ALTERNATIVES WHICH COULD FEASIBLY ATTAIN THE OBJECTIVE OF THE ACTION

The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private limited or no public play golf course. However, provisions to enhance the opportunities for public play for Hawaii residents are important criteria in basing approval for golf courses. As stated in Section 2.6, unlike other golf courses premised upon private memberships, this golf course will be dependent on public play for operating revenue.

7.2 ALTERNATIVES WHICH WOULD NOT ATTAIN THE OBJECTIVE OF THE ACTION

Alternatives to the proposed action which would not attain the objective of the action include: no action; more residential development than the proposed action; an alternative posed by Hui Malama and the Waiahole-Waikane Community Association in response to proposals for extensive residential development; and development given current Koolaupoko Development Plan Land Use designations.

7.2.1 No Action

The no action alternative would preserve the existing situation on the property for the present time. The mostly vacant site would remain largely underutilized. The advantage of this alternative would be that no further expenditure of resources by the developer would be required, and there would be no impacts to existing infrastructure. The no action alternative would represent a loss in return of investment made in acquiring the property. In addition, the no action alternative would not include the dedication of land for the potential expansion of parking for the Heeia Kea Pier and Boat Harbor.

7.2.2 More Residential Development than the Proposed Action

Previous proposals for the property involved extensive residential development within the area of application. While this alternative would represent a greater return of investment than the proposed action, the traffic generated from extensive residential development would affect peak hour traffic significantly more than the proposed project. This latter impact would likely be the major concern expressed by area residents. Community concern regarding extensive residential development on the property is well-established; on three separate occasions, requests to amend the Koolaupoko DP Land Use Map to allow the development of 418 units, 500 units and 360 units were denied by the Honolulu City Council.

During the preparation of the Draft EIS, the State Housing Finance and Development Corporation suggested that another possible alternative to the proposed project is a more intensive scale of residential development which could provide for a range of housing opportunities for persons and families of all income levels.

The applicant feels that only from a purely financial point of view could a more intensive scale of residential development (than what is currently proposed) be feasible. There are, however, numerous other considerations in planning for the property, including, the topography of the site, the community's desires and the objectives of the applicant.

The Hui Malama and the Waiahole-Waikane Community Association plans for Heeia Kea Valley (described in the following section) reflect community concerns to lower housing densities, and to retain much of the open space character of the site. As a result, the applicant has agreed to maintain the same number of residential lots the site is currently zoned for. In response to meetings with the community, the concept plan has been revised, moving all the proposed residential areas inland away from Kamehameha Highway.

Community opposition to extensive residential development is not insignificant. There is a valid perception that more homes results in more congestion during morning peak hour traffic. Moreover, due to the community's attitude towards open space, it is unlikely that any residential development over what is currently zoned (approximately 16.2 acres of R-5 zoning) would be acceptable.

7.2.3 Hui Malama and the Waiahole-Waikane Community Association Alternative

The Hui Malama and Waiahole-Waikane Community Association jointly prepared an alternative plan for the property in response to the earlier proposals for extensive residential development. This plan proposed a major realignment of Kamehameha Highway inland (approximately 300 feet), along almost the entire length of the property, in order to create a shoreline park. The realignment would also allow the creation of light industrial and commercial areas for the expansion of the facilities of the Heeia Kea Pier and Boat Harbor. The plan also showed the expansion of residential areas and reconfiguration inland, away from Kamehameha Highway. In addition, the plan set aside land to be used for aquaculture, nurseries, "traditional" agriculture, and a golf course.

The disadvantages of the Hui Malama and Waiahole-Waikane Community Association alternative is the cost posed to the City and County of Honolulu for a major realignment of Kamehameha Highway. The City and County of Honolulu's Coastal View Study also identifies the view of Kaneohe Bay from Kamehameha Highway fronting the property as a significant roadway view. A major realignment of Kamehameha Highway to create a shoreline park would place passers by approximately 300 feet away from their existing vantage points along Kamehameha Highway. A major realignment would reduce the amount of developable land, thereby reducing the economic feasibility of the project. In addition, a major beach park, such as the one proposed by this alternative may attract many users outside of the region and create congestion and more competition for the limited parking facilities in the area. The advantages of the plan are: the reconfiguration of residential areas inland away from Kamehameha Highway and the maintenance of open space areas.

The current concept plan for the property incorporates the major components of the Hui Malama and Waiahole-Waikane Community Association alternative. The Malulani Sports Complex concept plan proposes some residential areas away from Kamehameha Highway; open space (golf course and surrounding slope areas); and a lesser realignment of Kamehameha Highway. The realignment of Kamehameha Highway is proposed in order to allow the creation of a beach park, to provide additional parking for Heeia Kea Pier and Boat Harbor commensurate with need generated by existing users, to reduce costs to the City and County of Honolulu, and to preserve at least half of the oceanviews from Kamehameha Highway fronting the property.

7.2.4 Development Given Current Devlopment Plan Land Use Map Designations

The current Koolaupoko Development Plan Land Use designations for the area of application allow residential development along Kamehameha Highway except for a portion where public and quasi-public uses are allowed, and agricultural uses inland of the residential areas. Given these DP Land Use designations and current zoning, the applicant can develop the following on the property: 31 single-family ocean-view residences; a school, college, church or major health care facility off Kamehameha Highway; and nursery and/or equestrian/horse ranch. The advantage of this alternative is the relative ease (in comparison to the proposed project) in securing governmental approvals and resulting quicker return on investment. The disadvantages of this alternative include the following: it would not meet the applicant's primary purposes in acquiring the property, which was to develop a sports complex; the proximity of homes next to Kamehameha Highway; and development within the residential-designated area along Kamehameha Highway would not allow the dedication of land to enhance the community facilities node, which existing elements include the Heeia State Park and Heeia Kea Pier and Boat Harbor.

CHAPTER VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES AND RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This Chapter summarizes information presented elsewhere in this report in terms of two requirements of the Environmental Impact Statement Rules. Applicants are required to discuss: 1) the irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented; and, 2) the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. These statements are discussed below.

8.1 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

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

The construction and long-term operation of the Malulani Sports Complex will permanently and irretrievably commit money, time and physical resources. The proposed residential and clubhouse structures will displace the open space provided by the some of the vacant portions of the property, although the proposed action will maintain a major portion of the site in golf course, landscaped open space around structures, and vacant land (portions of the property with no specified use). Only those areas which are proposed for structures will foreclose alternative land uses, such as traditional crop production. Other unavoidable impacts include the removal of some vegetation which is mostly exotic, and a relatively small increase in traffic and demand for potable water.

The loss of these resources should be evaluated in light of previous uses of the property (pineapple cultivation, pasture, military and residential) and previous proposals for the property for extensive residential development.

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

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

Short-term tradeoffs related to the proposed action are generally associated with the urbanization process. The project area consists of mostly vacant land, productive only in its ability to provide open space and its potential for alternative future uses. The proposed action will commit the site to a particular urban use (outdoor recreation, limited residential) thereby "narrowing the range of [potential] beneficial uses" and possibly foreclosing future options. (It should be noted that an analysis has been conducted to determine potential alternative uses of the site [Chapter VII]. Given the current community sentiment and the applicant's business activity [recreational facilities], the proposed use of the property appears to be the best of the alternatives considered). The construction and operational phases of development will involve greater environmental impacts than are currently generated by the site (i.e., increased water demand, and traffic). The open space currently afforded by the site will be altered by the development of the proposed project. A preliminary building footprint estimate for the entire Malulani Sports Complex (upon completion) shows a total building lot coverage of approximately 5 percent (not included in this calculation are paved surfaces such as roadways, parking lots, tennis courts, etc.). The rest of the site (approximately 95 percent) will remain in mostly landscaped open space.

The long-term tradeoffs discussed here are inherently positive and far out-weigh the short-term losses considered above. In addition, the proposed action poses no long-term risks to health or safety.

CHAPTER IX

PARTICIPANTS IN THE CONSULTATION PROCESS AND COMMENTS RECEIVED DURING PREPARATION OF THE DRAFT EIS

This chapter presents information on who participated in the preparation of the Draft EIS, who was consulted during the preparation of the Draft EIS, and all comments received and responses sent relative to the preparation of the Draft EIS.

9.1 PARTICIPANTS IN THE DRAFT EIS PREPARATION PROCESS

The Draft EIS was prepared for Nanatomi Hawaii by Helber Hastert and Kimura, Planners. The following list identifies individuals and organizations who were involved in the preparation of the report and their respective contributions.

Helber Hastert and Kimura, Planners

Glenn T. Kimura (Principal-in-charge and Project Manager)
Vincent R. Shigekuni (Project Planner and Principal Author)
Gail M. Uyetake (Planner and Associate Author)

Technical Consultants

Dames & Moore (Hydrology)
Golfscapes (Golf Course Architects)
Sam O. Hirota, Inc. (Civil Engineering and Traffic)
Marine Research Consultants (Marine Environment)
Charles L. Murdoch, Ph.D. and Richard E. Green, Ph.D. (Fertilizer, Herbicide and Pesticide Use)
Kenneth M. Nagata (Terrestrial Flora and Fauna)
Natelson Levander Whitney, Inc. (Economic and Fiscal Impacts)
Barry D. Root and Barry D. Neal (Air Quality)
Paul H. Rosendahl, Ph.D., Inc. (Archaeology)
Dana R. Sanders, Sr., Ph.D. (Wetlands)
Frank S. Scott, Jr. (Agriculture)

9.2 CONSULTED PARTIES AND COMMENTS RECEIVED DURING THE PREPARATION OF THE DRAFT EIS

By letter dated September 27, 1989, the City and County of Honolulu Department of General Planning (the Accepting Agency) determined that the proposed Malulani Sports Complex would require the preparation of an environmental impact statement pursuant to Chapter 343, HRS. The Environmental Impact Statement Preparation Notice (EISPN) for the project was published in the October 8, 1989 issue of the OEQC Bulletin which initiated a thirty-day public consultation period ending on November 6, 1989. In addition to the notice published in the OEQC Bulletin, a more detailed EISPN was mailed directly to the 130 agencies, organizations, and individuals listed below. The list contains parties believed to have an interest in the project or who requested consulted party status.

By December 18, 1989, a total of 25 agencies or individuals responded in writing. The agencies and organizations which responded are identified by an asterisk (*) and their respective comments are reproduced in this Chapter.

Federal Agencies

* Department of Agriculture, Soil Conservation Service
* Department of the Army, U.S. Army Engineer District, Honolulu
* Department of the Interior, Fish and Wildlife Service
* Department of the Interior, Geological Survey, Water Resources Division

State Agencies

* Department of Accounting and General Services
* Department of Agriculture
Department of Business and Economic Development
* Department of Defense
* Department of Education
* Department of Hawaiian Home Lands
* Department of Health
* Department of Land and Natural Resources
* Department of Transportation
* Housing Finance and Development Corporation
* Land Use Commission
Office of Environmental Quality Control
Office of State Planning
University of Hawaii
  Environmental Center
  Water Resources Research Center

County Agencies

* Board of Water Supply
* Building Department
Department of General Planning
* Department of Housing and Community Development
* Department of Land Utilization
* Department of Parks and Recreation
* Department of Public Works
* Department of Transportation Services
* Fire Department
Kaneohe Satellite City Hall
* Office of Human Resources
* Police Department

Public Utilities

Hawaiian Electric Company, Inc.
* Hawaiian Telephone Company

Private and Community Organizations

Peter Aduja, Kaneohe Neighborhood Board
Thomas T. Au, Kahaluu Neighborhood Board
Jean C. Avery, Kaneohe Neighborhood Board
Lorene Clark, Parent Partnership, Castle High School
David Michael Dunning, Kahaluu Neighborhood Board
George Fernandes, Kahaluu Neighborhood Board
Judy Fujimoto, Parent Partnership,Castle High School
Melvin Masao Goya, Kaneohe Neighborhood Board
Ronald B. Hales, Kahaluu Neighborhood Board
Bettye Jo Harris, Kaneohe Neighborhood Board
Kenneth Ito, Kaneohe Neighborhood Board
David Kauhane, Ahuimanu Homeowners Assn.
Robert R. Kenny, Kaneohe Neighborhood Board
Paul Knapp, Kahaluu Neighborhood Board
Chester Koga, Kahaluu Neighborhood Board
Keith Krueger, Kahaluu Neighborhood Board
John Manewa, Kaneohe Neighborhood Board
John Robert Medeiros Jr., Kaneohe Neighborhood Board
Lola Mench, Kahaluu Neighborhood Board
Ka'iwa Meyer, Kaneohe Neighborhood Board
Myron Macy Monte, Kahaluu Neighborhood Board
Guy Nakamoto, Kahaluu Neighborhood Board
Jo-Anna Nakata, Kahaluu Neighborhood Board
Leonard A. Peters, Kaneohe Neighborhood Board
Jan-Peter Preis, Kahaluu Neighborhood Board
E.J. Putt, Kahaluu Neighborhood Board
Linda Quon, Kahaluu Neighborhood Board
John L. Reppun, Kahaluu Neighborhood Board
Robert Reppy, Kaneohe Neighborhood Board
Donna Rewick, Kaneohe Neighborhood Board
Tomas Rosser, Kaneohe Neighborhood Board
Ray Sweeny, Kaneohe Neighborhood Board
Edwin B.G. Taylor Jr., Kaneohe Neighborhood Board
Dean Yoshida, Kaneohe Neighborhood Board
John Yu, Bayview Lions Club
Bob Kamanu, Parent Partnership, Castle High School
Frances Sawai, Parent Partnership, Castle High School
Violet Van Epps, Kaneohe Satelitte City Hall
Jan Dill, Haiku Plantation Community Assoc.
Linda Butts, Parent/Teacher Association, Heeia Elementary School
Kathy Clinton, Parent/Teacher Association, Heeia Elementary School
Cindy Dignam, Parent/Teacher Association, Heeia Elementary School
Kathleen Roskowick, Parent/Teacher Association, Heeia Elementary School
Marvis Smith, Parent/Teacher Association, Heeia Elementary School
Peter Lewis, HEI - Malama Pacific Corp.
Teney Takahashi, HEI - Malama Pacific Corp.
Harry Partika, Houlee Association
Dexter Dickson, Kahaluu Lions Club
Elise Kaneshiro, Parent/Teacher Association, Kaneohe Elementary School
Carl Kawakami, Parent/Teacher Association, Kaneohe Elementary School
June Leialoha, Parent/Teacher Association, Kaneohe Elementary School

Norene Moon Ng, Parent/Teacher Association, Kaneohe Elementary School
Annette Tashiro, Parent/Teacher Association, Kaneohe Elementary School
Mr. and Mrs. Jay Tsukayama, Parent/Teacher Association, Kaneohe Elementary School
Lenore Higa, Kaneohe Elementary School
Cyryn Biven, Kaneone Lions Club
George Hudes, Key Project/Kahaluu
Amy Entendencia, Ohana, King Intermediate School
Marge Hayes, Ohana, King Intermediate School
Leon Hiebert, Ohana, King Intermediate School
Jim Swenker, Ohana, King Intermediate School
Sua Tauala, Ohana, King Intermediate School
Jane Sugimoto, King Intermediate School
Susan Black, Pali Seniors
Reb Bellinger, Representative, State of Hawaii
Marshall K. Ige, Representative, State of Hawaii
Terrence W. H. Tom, Representative, State of Hawaii
Donna Ikeda, Senator, State of Hawaii
Stan Koki, Senator, State of Hawaii
Mike McCartney, Senator, State of Hawaii
Milton Holt, Senator, State of Hawaii
Denise Decosta, Parent/Teacher Association, Benjamin Parker Elementary
Chris Atkins, Parent Partnership, Castle High School
Robert Ginlack, Castle High School
Peter Dyer, Friends of He'eia State Park
Carole J. McLean, Friends of He'eia State Park
Susan Fristoe, Friends of Heeia State Park
John Goody, Friends of Heeia State Park
Lehman Henry, Friends of Heeia State Park
Virginia A. Kozuma, Valley View Homeowner's Association
Beatrice Krauss, Friends of Heeia State Park
Steward Wade, Windward Rotary
James Palakiko, Valley View Homeowner's Association
Tom Pellegrine, Chaney Brooks & Company
Robert Tibayan, Kaneohe Canoe Club
John Caton, Jr.
Paul Chang
Ernest Choy
Vernon Hao
Phil Helfrich
Frank Hewett
Ingeborg Hopkins
Leialoha Kaluhiwa
G. A. Morris
Bob Nakata
Peter Nottage
Jimmy Wong

The following pages contain a copy of the Agency Determination and comments received during the consultation period.

DEPARTMENT OF GENERAL PLANNING

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

DONALD A. CLEGG
CHIEF PLANNING OFFICER

GENE CONNELL
DEPUTY CHIEF PLANNING OFFICER

MH/DGP 9/89-3410

September 27, 1989

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

Dear Dr. Miura:

Chapter 343, HRS
Environmental Impact Statement (EIS) Preparation
Notice for Amendment Application from Residential,
Public Facility and Agriculture to Parks and
Recreation and Residential at Heeia, Koolaupoko
Tax Map Key 4-6-6: 1, 4, 7, 9, 11, 13, 15, 22-44,
48-51; and 4-6-16: Portion of 32, Folder No. 90/KP-1

The Department of General Planning has determined that the subject applicant action requires an EIS pursuant to Chapter 343, HRS, because the proposal, which involves an application for a Development Plan amendment, may have a significant impact on the environment. This letter, together with the enclosed environmental assessment, serves as the EIS Preparation Notice. It should be published in the OEQC Bulletin under the "Register of Chapter 343, HRS Documents."

The contact person for this EIS will be:

Mr. Vincent Shigekuni
Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

If there are any questions, please contact Mel Murakami of my staff at 527-6020.

Sincerely,

DONALD A. CLEGG
Chief Planning Officer

DAC:gmy

Encl.

cc: Vincent Shigekuni

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. BOX 50004
HONOLULU, HAWAII
96850

November 6, 1989

RECEIVED
NOV 11 1989

Mr. Vincent Shigekuni
Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice (EISPN) - Malulani Sports Complex, Koolaupoko, Oahu, HI

We have no comments to offer at this time; however, we would appreciate the opportunity to review the draft EIS.

Sincerely,

Warren M Lee

WARREN M. LEE
State Conservationist

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHVHK UW
Facsimile (808) 545-2050

December 5, 1989

Mr. Warren M. Lee
State Conservationist
United States Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 6 November 1989. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF: October 12, 1989

Planning Branch

RECEIVED OCT 14 1989 HELBER, HASTERT & KIMURA PLANNERS

Helber, Hastert & Kimura, Planners
Attn: Mr. Vincent Shigekuni
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Thank you for the opportunity to review the Environmental Impact Statement Preparation Notice (EISPN) for the Malulani Sports Complex, Koolaupoko, Oahu, Hawaii. The following comments are offered:

a. Based on the information provided in the EISPN, a Department of the Army (DA) permit will not be required for this project; however, the draft Environmental Impact Statement, including the wetlands study mentioned on page 45 of the EISPN, should be submitted to Operations Branch for verification of DA permit applicability.

b. The flood zone designation information on page 45 of the EISPN is correct.

Sincerely,

C Fy

Kisuk Cheung
Chief, Engineering Division

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

November 7, 1989

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858-5440
Attention: Planning Branch

Dear Mr. Cheung:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 12 October 1989. We have reviewed your letter and offer the following responses:

a. A copy of the Draft Environmental Impact Statement and a wetlands study will be submitted to the Operations Branch for verification of DA permit applicability.

b. We appreciate the information provided on the flood zone designation for the property.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:mcb

cc: Eddie Sase
Rick Tsujimura
Ferdinand Aranza

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P O BOX 50167
HONOLULU, HAWAII 96850

RECEIVED
SEP 27 1989
HELBER, HASTERT & KIMURA
PLANNERS

ES
Room 6307
September 26, 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber Hastert & Kimura, Planners
Grosvenor Center
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Re: Environmental Impact Statement Preparation Notice, Malulani Sports Complex, Koolaupoko, Oahu, TMK: 4-6-06:1, 4, 7, 9, 11, 13, 15, 22-44, 48-51; 4-6-16:31 and 32

Dear Mr. Shigekuni:

We have reviewed the referenced material dated September 20, 1989 and find that due to its nature, the proposed project will have no significant deleterious impact on fish and wildlife resources within our jurisdiction. Please do not hesitate to call on us if we may be of further assistance.

We appreciate this opportunity to comment.

Sincerely yours,

Ernest Kosaka
Ernest Kosaka
Field Office Supervisor
Environmental Services

cc: NMFS - WPPO
DLNR
EPA, San Francisco

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHVHV UW
Facsimile (808) 545-2050

October 3, 1989

Mr. Ernest Kosaka
Field Office Supervisor
Environmental Services
United States Department of the Interior
Fish and Wildlife Service
Pacific Islands Office
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 26 September 1989. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Vincent Shigekuni
Project Planner

VS:lf/meb

cc: Eddie Sase
Rick Tsujimura

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

November 7, 1989

Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813
Attention: Vincent Shigekuni

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii
TMK: 4-6-06:1, 4, 7, 9, 11, 13, 15
22-44, 48-51; 4-6-16:31 and 32

We have reviewed the subject environmental impact statement preparation notice for the Malulani sports Complex and have no comments.

Thank you for the opportunity to review this notice.

Sincerely,

for William Meyer

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

December 5, 1989

Mr. William Meyer
United States Department of the Interior
Geological Survey
Water Resources Division
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 7 November 1989. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:mcb

cc: Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
DIVISION OF PUBLIC WORKS
P. O. BOX 119, HONOLULU, HAWAII 96810

RECEIVED
SEP 29 1989

RUSSEL S. NAGATA
COMPTROLLER

JAMES N. YASUDA
DEPUTY COMPTROLLER

LETTER NO. (P)1957.9

SEP 28 1989

Mr. Vincent R. Shigekuni
Helber Hastert & Kimura
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Malulani Sports Complex
EIS Preparation Notice

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please contact Mr. Cedric Takamoto of the Planning Branch at 548-7192.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

CT:em

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHVHK UW
Facsimile (808) 545-2050

October 3, 1989

Mr. Teuane Tominaga
State Public Works Engineer
State of Hawaii
Department of Accounting and General Services
Division of Public Works
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Tominaga:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter (your letter no. (P)1957.9) dated 28 September 1989. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:lf

cc: Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

FAX: 548-6100

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

November 9, 1989

Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Gentlemen:

Subject: Environmental Impact Statement Preparation Notice (EISPN) -- Malulani Sports Complex
Amendment to the Koolaupoko Development Plan
Nanatomi Hawaii, Inc.
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51
4-6-16: 31, and 32
Heeia, Koolaupoko, Oahu
Area: 103 acres

The Department of Agriculture has reviewed the Environmental Impact Statement Preparation Notice for the Malulani Sports Complex and offers the following comments.

According to the EISPN, the applicant proposes the development of a sports complex on the property, including an 18-hole golf course, golf clubhouse with quality dining facilities, meeting and function rooms, a tennis club, a health spa and associated fitness facilities, and in addition, approximately 30 to 35 single-family homes.

We find that references to the Soil Conservation Service Soil Survey (SCS) and the Agricultural Lands of Importance to the State of Hawaii (ALISH) system are essentially correct. These studies (including the Land Study Bureau Detailed Land Classification Ratings) indicate that the project site has marginal value for most agricultural purposes.

As such, we do not anticipate that the project would have significant impacts on agriculture. However, we suggest that the Draft Environmental Impact Statement address potential impacts the project may have on agriculture in the vicinity of the project site.

Thank you for the opportunity to comment.

Sincerely,

Yukio Kitagawa
YUKIO KITAGAWA
Chairperson, Board of Agriculture

cc: OEQC

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2500
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

December 18, 1989

Mr. Yukio Kitagawa
Chairperson, Board of Agriculture
State of Hawaii
Department of Agriculture
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Environmental Impact Statement Notice
Maluiani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 9 November 1989. As suggested in your letter, the Draft Environmental Impact Statement (EIS) will address the potential impacts the project may have on agriculture in the vicinity of the project site. In general, it is expected that the proposed project will have no direct impact on agricultural activities in the vicinity of the project site, since the farming that occurs in the Ahuimanu area and the very limited grazing that occurs on Heeia Uli wetlands is separated from the project site by the ridges that delineate Heeia Valley.

Due to the marginal value of the project site for most agricultural purposes, the use of the subject property for mostly open space (golf course) should not adversely affect agricultural land availability in the vicinity of the project site. Agricultural land is available at lower cost on the neighboring islands. Because of lower land cost and lower or no irrigation water cost, production centers for crops such as bananas, guava and truck crops are moving to the neighbor islands. Substantial areas of former sugarcane and pineapple fields on Oahu are fallow. Only part of these lands will be diverted to other uses, such as housing.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:lf

cc: Eddie Sase
Rick Tsujimura
Frank S. Scott, Jr.

JOHN WAIHEE
GOVERNOR

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

ALEXIS T. LUM
MAJOR GENERAL
ADJUTANT GENERAL

MILES M. NAKATSU
COLONEL
DEPUTY ADJUTANT GENERAL

RECEIVED
OCT - 2 1989

September 29, 1989

Engineering Office

Mr. Vincent Shigekuni
Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

Jerry M. Matsuda

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting & Engineering Officer

NATIONAL GUARD
Americans At Their Best.

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

October 3, 1989

Lt. Col. Jerry M. Matsuda
Hawaii Air National Guard
Contracting & Engineering Officer
State of Hawaii
Department of Defense
Office of the Adjutant General
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Lt. Col. Matsuda:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 29 September 1989. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:lf/meb

cc: Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

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

OFFICE OF THE SUPERINTENDENT

CHARLES T. TOGUCHI
SUPERINTENDENT

October 13, 1989

Helber, Hastert, & Kimura, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Gentlemen:

SUBJECT: Environmental Impact Statement Preparation Notice
Halulani Sports Complex
Koolaupoko, Oahu, Hawaii
TMK: 4-6-06:1, 4, 7, 9, 11, 13, 15, 22-44, 48-51;
4-6-16:31 and 32

Our review of the proposed Halulani Sports Complex including 30 to 35 single family homes indicates that there will be negligible impact on the following schools in the area:

Heeia Elementary (K-6)
King Intermediate (7-8)
Castle High (9-12)

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:jl

cc: Mr. E. Imai
Mrs. S. Loo

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

November 7, 1989

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

Dear Mr. Toguchi:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 13 October 1989. We greatly appreciate the information provided. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

ILIMA A. PIIANAIA
CHAIRMAN
HAWAIIAN HOMES COMMISSION

NOV - 4 1989

October 25, 1989

Vincent R. Shigekuni
Helber, Hastert & Kimura Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni,

Thank you for the opportunity to comment on the Preparation Notice for an EIS regarding the proposed Malulani Sports Complex at Heeia Kea.

Hawaiian Home Lands are not directly affected by this project. Our comments are limited to available potable water supplies, since water available for Hawaiian Home Lands is drawn from the same development system. We note simply that, in addition to use of non-potable water for golf course irrigation (feasibility and decision not yet finalized), golf and tennis facilities are anticipated to consume 40,000 gpd, the equivalent of 80 households.

Sincerely,

Ilima A. Piianaia
Hawaiian Homes Commission

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634466
HHHK UW
Facsimile
(808)
545-2050

December 18, 1989

Ms. Ilima A. Piianaia
Chairman
Hawaiian Homes Commission
State of Hawaii
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

Dear Ms. Piianaia:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 25 October 1989. In response to your comments regarding available potable water supplies please note that the proposed project is subject to standard Board of Water Supply (BWS) policies regarding the provision of water. According to the BWS, the availability of water will be determined when the building permit applications are submitted for BWS review and approval. Only potable water for domestic use shall be provided by the BWS. Alternative sources of water will be developed for irrigation of the proposed golf course.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your comments.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:mb

cc: Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:
EPHSD

December 6, 1989

Mr. Vincent R. Shigekuni, Project Planner
Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement (EIS) Preparation Notice
Maluiani Sports Complex
Koolaupoko, Oahu
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-44, and 48-51;
4-6-16: 31 and 32

Thank you for the opportunity to review and comment on the subject document. We have examined the preparation notice and have the following comments to offer:

Drinking Water

1. The EIS must adequately address the issue of providing potable water for the planned project. The "Application for Development Plan Amendment and Environmental Assessment (September 1989)," indicates that the Board of Water Supply has yet to commit to serving the proposed project. The developers should be reminded that any new potable water source(s) and distribution system will be subject to the Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems."

2. Section 11-20-29 of Chapter 10 requires that all new sources of potable water serving a public water system be approved by the Director of Health prior to their use. Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements set in Section 11-20-29.

3. Section 11-20-30 of Chapter 20 requires that new or substantially modified distribution systems for public water systems be approved by the Director. However, if the water system is under the jurisdiction of the City and County of Honolulu, Board of Water Supply, they will be responsible for the review and approval of the plans.

4. The potable and non-potable water systems must carefully designed and operated to prevent cross-connections and backflow conditions. The two systems must be clearly labeled and physically separated by air gaps or reduced pressure principle backflow preventers to avoid contaminating the potable water supply.

5. The proposed development is situated above the Department's Underground Injection Control (UIC) line. Land areas located above the UIC line are considered to contain underground sources of drinking water.

6. It is essential that any proposed well in the project area be designed and constructed to prevent the possibility of groundwater contamination. For example, each well should have a concrete pad and full grouting to prevent seepage or floodwaters from migrating down the well shaft.

7. There are many golf course related activities which might contribute to groundwater contamination. Some of the activities of concern include:

   a. Application of biocides and fertilizers;
   b. Storage of fuel for vehicles;
   c. Maintenance of vehicles and equipment (cleaning, refueling, lubrication, etc.).

   If any of these activities are planned, mitigative measures to insure that groundwater contamination will not occur must be addressed.

8. As a precautionary measure, monitoring wells should be installed throughout the golf course, especially in areas downgradient of effluent irrigation and adjacent to drainage ways. The design and siting of the monitoring wells and the monitoring plan should be reviewed by the Department. The monitoring wells should be periodically sampled and tested for compounds associated with effluent irrigation, fertilizers, and biocides. If any detrimental compounds are found, the owners must be made responsible for immediate corrective actions or face the possibility of a shutdown.

9. The application of biocides should not be allowed to adversely impact nearshore coastal waters through surface runoff and/or percolation.

Wastewater Disposal

A private wastewater treatment works utilizing irrigation for effluent disposal is allowable per Administrative Rules Title 11, Chapter 62, Wastewater Systems. However, we recommend that wastewater be transported to the Kaneohe Wastewater Treatment facility. Effluent irrigation may prove unreliable due to the tight soils and high rainfall of the area.

Vector Control

The proposal to collect the estimated 50,000 gallons per day wastewater in an irrigation storage pond, including storm runoff into a series of retention ponds/water features on site within the proposed golf course should be designed, built and maintained in a manner that will not generate mosquitoes, gnats, midges and other aquatic pest insects.

Maintenance should include keeping the ponds and drainage features free from uncontrolled vegetation and ability to employ biological control of aquatic insects through the use of mosquito fishes.

Noise and Radiation

In addition to the potential noise impacts identified in the submittal, the following concerns toward the proposed development should be addressed:

1. Noise problems are anticipated due to the integration of land uses within the development. In particular, noise from activities associated with recreational facilities, including entertainment (amplified music) and people shouting, yelling or screaming, can have adverse effects, in terms of annoyances, on residents within the development.
2. The applicant states that the proposed sports complex is expected to generate traffic which will contribute to the existing noise environment. It should be noted that increased vehicular traffic, in itself, can result in adverse noise impacts on the residential areas within the project, as well as surrounding communities.
3. Those activities identified as potential noise generators, including golf course maintenance, deliveries of goods and services, refuse collection and maintenance work of grounds and facilities, can adversely impact the residential communities.
4. Mitigative measures should be incorporated into the development design in order to minimize those potential noise impacts indicated above.

Bruce S. Anderson

BRUCE S. ANDERSON, PH.D.

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHVHK Ur
Facsimile (808) 545-2050

December 18, 1989

Mr. Bruce S. Anderson, Ph.D.
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, HI 96801

Dear Mr. Anderson:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter (reference EPHSD) dated 6 December 1989. We greatly appreciate the information provided. The Draft Environmental Impact Statement (EIS) will incorporate the information provided, where appropriate. The Draft EIS will also address the provision of potable water for the proposed project and potential noise impacts.

Your letter will be reproduced in the Draft EIS in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Donna Kanemaru

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

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

DEPUTIES

LIBERT K. LANDGRAF
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

RECEIVED
OCT 18 1989

October 12, 1989

Vincent R. Shigekuni
Helber Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

SUBJECT: EISPN for Malulani Sports Complex
Heeia, Koolaupoko, Oahu
TMK: 4-6-06 and 4-6-16

Thank you for forwarding this document for our review and comment.

Our State Parks planner has several concerns related to Heeia State Park. These are:

1. Our park has a serious highway ingress-egress problem because of its location at the top of a hill where the road curves. Your proposed realignment of Kamehameha Highway may alleviate this problem to some extent but there may be other alternatives which would be more beneficial to us. We are also interested in improved pedestrian access between our park and Heeia Kea Pier.

2. Because of the hazardous highway fronting the park, we are also concerned about pedestrian crossings and/or jay walking between the proposed community facilities and our park. Considering the topography and the hazards, a pedestrian overpass may be required.

3. As part of our interpretive/outdoor education programs planned for the park, we would like to have the opportunity to hike along the ridge as indicated on your plan. We would urge you to consider providing a public easement for this trail.

4. It has been our experience that rain shelter is needed for park facilities at Heeia.

5. There is no existing or proposed beach access or fishing pier at Heeia State Park. Please correct Figure 5.

Our Historic Sites Section has reviewed the archaeological inventory survey report and responded separately. We do not forsee any problems arising from historic preservation considerations, as the historic preservation review process is currently ongoing.

Sincerely,

RALSTON H. NAGATA
State Parks Administrator and Deputy
State Historic Preservation Officer

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

October 23, 1989

Mr. Ralston H. Nagata
State Parks Administrator and Deputy
State Historic Preservation Officer
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Nagata:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 12 October 1989. We have reviewed your letter and offer the following responses:

1. As part of the conceptual plan for the Malulani Sports Complex, it is proposed land be set aside for the realignment of Kamehameha Highway and the development of a beach park (and parking). The proximity of the proposed beach park and community facilities (across Kamehameha Highway) will be beneficial to Heeia State Park (and to Heeia Kea Pier and Boat Harbor). It appears the proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor.

2. We share your concerns regarding safety of pedestrian crossing of Kamehameha Highway between the proposed community facilities and Heeia State Park. However, the addition of a pedestrian overpass (which are often unused) is not in keeping with the character of the area. Other possible options could be as simple as establishment of a crosswalk near the proposed entry to Heeia Kea Pier and Boat Harbor (especially due to the increasing numbers of harbor users) and/or the hiring of off-duty police for traffic control.

3. As suggested, we have asked the applicant to consider providing a public easement for the proposed hiking trails along the perimeter (the ridgeline) of the property.

4. We appreciate the information provided on rainfall conditions and will consider same as we proceed with the project.

5. While Heeia State Park is not part of the proposed project, a proposal for beach access and a fishing pier was shown to reflect suggestions we have received from area residents. The Conceptual Plan also shows the impact of the proposed community-oriented facilities on Heeia State Park and Heeia Kea Pier and Boat Harbor and some preliminary ideas to improve these latter (existing) public recreational facilities.

6. We look forward to comments from the Historic Sites Section on their review of the archaeological inventory survey report.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your comments.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:mb

cc: Eddie Sase
Rick Tsujimura
Glenn Kimura
Herb Lee
Patti Cook

JOHN WAIHEE
GOVERNOR

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

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO
HWY-PS
2.9494

DEC 13

DEC 11 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber Hastert & Kimura, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Environmental Impact Statement Preparation Notice (EISPN)
Malulani Sports Complex, Koolaupoko, Oahu, Hawaii
TMK: 4-6-06 and 4-6-16

Thank you for your letter of September 20, 1989, requesting our review of the subject EISPN.

We have the following comments:

1. The traffic impact analysis report (TIAR) that is being prepared for the proposed sports complex should evaluate traffic beyond the project site. Regional traffic impact should be addressed in the report.

2. Improvements to Kamehameha Highway fronting the project site should be provided by the developer prior to occupancy or official opening of the project to the public.

3. The TIAR and Drainage Report should be included in the EIS. We will furnish you with additional comments after reviewing the EIS and TIAR.

Very truly yours,

Edward Y. Hirata
Edward Y. Hirata
Director of Transportation

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

December 18, 1989

Mr. Edward Y. Hirata
Director of Transportation
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Hirata:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter (your reference number HWY-PS 2.9494) dated 11 December 1989. We have reviewed your letter and offer the following responses to your comments:

1. The traffic impact analysis report provides the following information on traffic beyond the project site. Kamehameha Highway between Kahekili Highway and Haiku Road will remain, for the foreseeable future, a collector road serving local traffic in the Kaneohe area. In recent years the traffic volume has declined over this segment of the highway due to improvements on Kahekili Highway and this trend should continue as additional improvements are implemented to Kahekili Highway. Traffic counts taken on Kamehameha Highway indicate existing a.m. and p.m. peak hour volumes well under the capacities typical of a two-lane rural highway (collector road) with level of service "A". There are limited areas along this stretch of Kamehameha Highway with potential for development (that would generate new traffic). It is anticipated that traffic congestion will continue to worsen on Kahekili and Likelike Highways if improvements (such as the proposed widening of Kahekili Highway and the construction of H-3) are not implemented.

2. Current plans for the proposed Malulani Sports Complex call for the creation of a single entry with a new "T" intersection at Kamehameha Highway. Although the traffic impact analysis report which was prepared for the project determined that there would be minimal improvement to the level of service by the establishment of exclusive turn lanes from the entry road, and the construction of left and right turn lanes on Kamehameha Highway, the applicant plans to construct these improvements prior to occupancy or official opening of the project to the public.

3. A copy of the traffic impact analysis report and the drainage report that was prepared for the proposed project will be appended to the Draft Environmental Impact Statement (EIS).

Your letter will be reproduced in the Draft EIS in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Dennis Hirota
Donna Kanemaru

JOHN WAIHEE
GOVERNOR

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) 543-6441

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:

89:PLNG/4562 jt

November 13, 1989

Mr. Vincent R. Shigekuni,
Project Planner
Helber Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Re: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Malulani Sports Complex, Koolaupoko, Oahu, Hawaii

We have reviewed the subject EISPN and offer the following comment for your consideration.

The applicant is proposing to develop up to 35 single-family homes in the project. It appears that these homes will be targeted to the higher end of the housing market, with prices ranging from $500,000 to $1,000,000. We understand that the community is concerned with "extensive" residential development on the property (e.g., between 360 and 500 units). However, has a less intensive scale of residential development which could possibly provide for a range of housing opportunities for persons and families of all income levels been explored?

Thank you for the opportunity to comment.

Sincerely,

JOSEPH K. CONANT
Executive Director

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

December 18, 1989

Mr. 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

Dear Mr. Conant:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter (your reference number 89:PLNG/4562 jt) dated 13 November 1989. We have reviewed your letter and offer the following response to your comments. The applicant feels that only from a purely financial point of view could a more intensive scale of residential development (than what is currently proposed) which could provide for a range of housing opportunities for persons and families of all income levels be feasible. There are, however, numerous other considerations in planning for the property, including, the topography of the site, the community's desires, and the objectives of the applicant.

We have reviewed the earlier Hui Malama and the Waiahole-Waikane Community Association plans for Heeia Valley. These plans echoed community concerns to lower housing densities, and to retain much of the open space character of the site. As a result we have agreed to maintain approximately the same number of residential lots the site is currently zoned for. In response to recent meetings with the community, the concept plan has been revised, moving all the proposed residential areas inland away from Kamehameha Highway.

Community opposition to extensive residential development is not insignificant. There is a valid perception that more homes results in more congestion during morning peak hour traffic. Moreover, due to the community's attitude toward open space, it is unlikely that any residential development over what is currently zoned (approximately 16 acres of R-5 zoning) would be acceptable. Given the community's desires and the applicant's type of business (recreational facilities), the proposed use of the property appears to be the best of the alternatives considered.

Mr. Joseph K. Conant
Executive Director
State of Hawaii
Department of Budget and Finance
December 18, 1989
Page 2

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Donna Kanemaru

STATE OF HAWAII

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT

LAND USE COMMISSION

Room 104, Old Federal Building, 335 Merchant Street
Honolulu, Hawaii 96813 Telephone: 548-4611

RECEIVED SEP 28 1989 HELBER H...

September 26, 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber Hastert & Kimura
Grosvenor Center
PRI Tower, Suite 2590
733 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: EISPN Malulani Sports Complex, Koolaupoko, Oahu, Hawaii, Development Plan Amendment

We have no comments to offer except that figures in the "Application For Development Plan Amendment and Environmental Assessment" approximate the location of the State Land Use Urban/Conservation District Boundary and that a more precise delineation is available at the State Land Use Commission Office.

We suggest you coordinate mapping of the State Land Use District Boundaries with our staff to assure no discrepancies in the boundary lines.

Thank you for the opportunity to comment.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:to

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634469 HHHK UW
Facsimile (808) 545-2050

October 9, 1989

Ms. Esther Ueda
Executive Officer
State of Hawaii
Department of Business and Economic Development
Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 26 September 1989.

Thank you for the information provided. We would like to take this opportunity to request a formal interpretation of the delineation of the Urban/Conservation District Boundary within the subject property. As requested, we are enclosing 5 blackline prints at 1" = 200'.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:lf/meb

cc: Eddie Sase
Rick Tsujimura

Enclosure

STATE OF HAWAII
DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

LAND USE COMMISSION

Room 104, Old Federal Building, 335 Merchant Street
Honolulu, Hawaii 96813 Telephone: 548-4611

OCT 20 1989

October 19, 1989

Mr. Vincent Shigekuni
Helber, Hastert, & Kimura
Grosvenor Center-PRI Tower
733 Bishop Street, Suite 2590
Honolulu, HI 96813

Dear Mr. Shigekuni:

SUBJECT: Boundary Interpretation 89-73

Tax Map Key: 4-6-16: 32

Location: Heeia, Koolaupoko, Oahu

Requested By: Vincent Shigekuni

Pursuant to your request of October 9, 1989, we have delineated the State's Land Use District boundaries on the enclosed map.

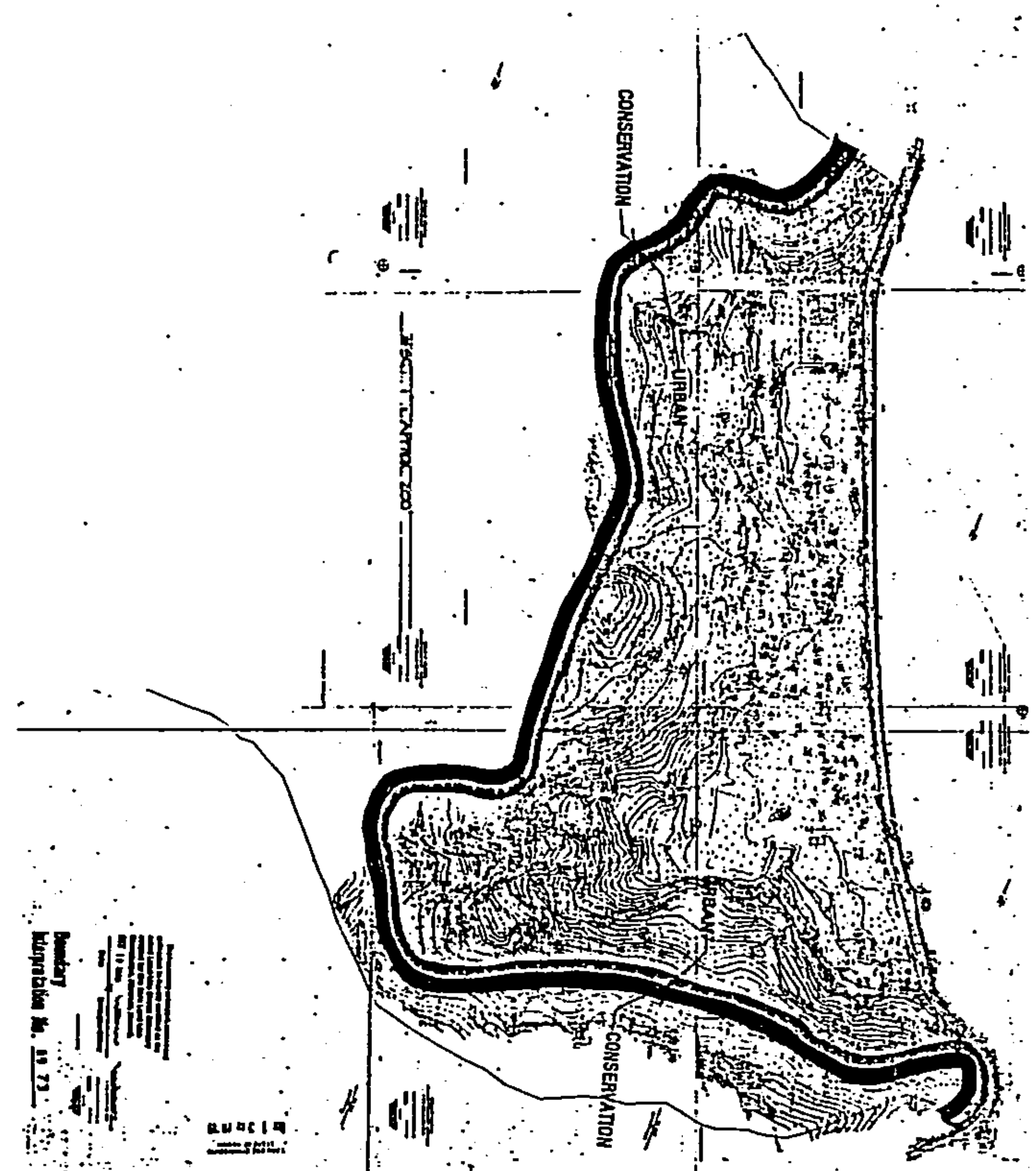
Very truly yours,

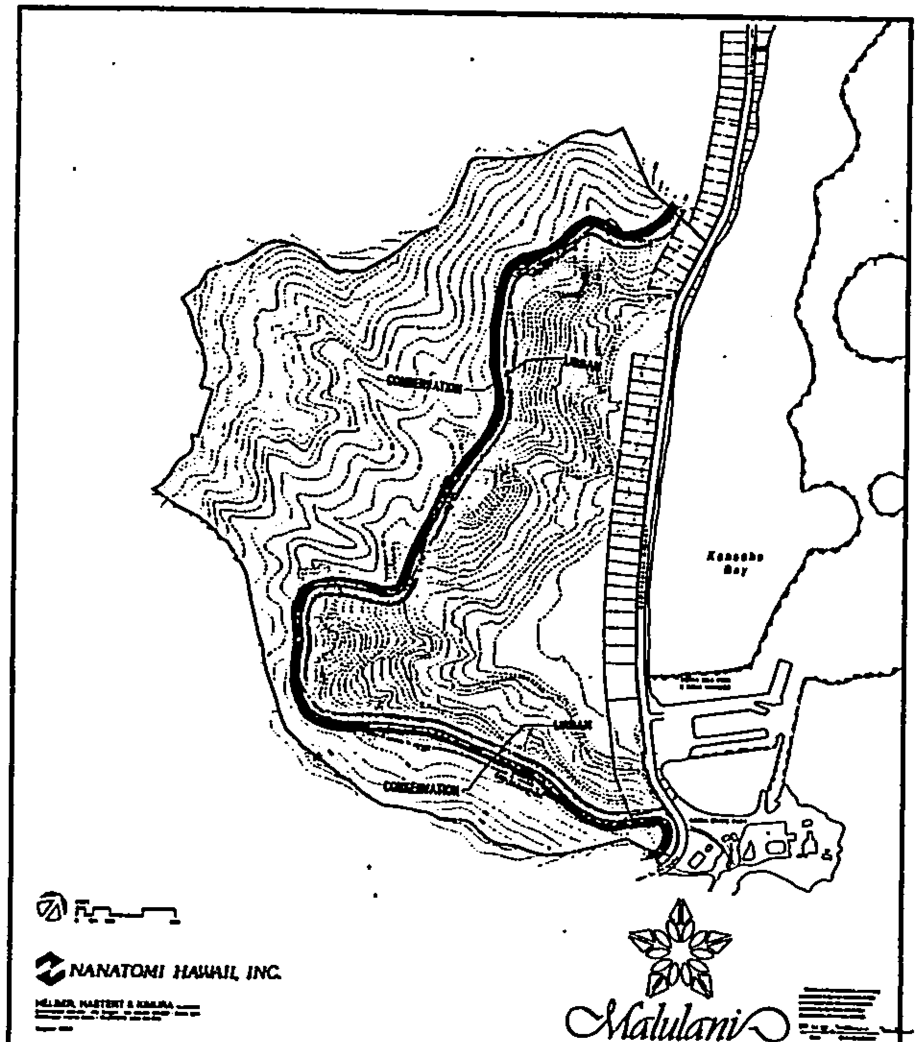
Esther Ueda

ESTHER UEDA
Executive Officer

Enclosure: Boundary Interpretation Map dated October 19, 1989.

cc: William Paty, BLNR Chairman, Attn: Conservation Affairs Office
John P. Whalen, C&C of Honolulu, DLU Director
Glenn Y. Sato, Tax Maps & Records Supervisor
C&C of Honolulu, Department of Finance





HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634463 HHVHK UW
Facsimile (808) 545-2050

October 23, 1989

Ms. Esther Ueda
Executive Officer
State of Hawaii
Department of Business and Economic Development
Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your letter dated 19 October 1989 and the accompanying Boundary Interpretation Map. We greatly appreciate the information provided and will revise the State Land Use District boundary shown on our figures accordingly.

Thanks again.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Ben Kudo

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU HAWAII 96843

October 11, 1989

RECEIVED OCT 1 2 1989 HELBER, HASTERT & KIMURA PLANNERS

Mr. Vincent R. Shigekuni
Helber, Hastert and Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Your Letter of September 20, 1989 Regarding the Environmental Impact Statement Preparation Notice for Malulani Sports Complex, Koolaupoko, Oahu, Hawaii

We have the following comments on the proposed project:

1. The developer shall be required to replace approximately 4,500 lineal feet of the existing 6-inch water main along Kamehameha Highway with a new 12-inch water main to provide adequate fire protection for the homes and sports complex.

2. The availability of water will be determined when the building permit applications are submitted for our review and approval. When the applications are approved, the applicant will be required to pay our Water System Facilities Charges for source-transmission and daily storage. As stated in the assessment, only potable water for domestic use shall be provided by the Board of Water Supply. Alternative sources of water should be developed for irrigation of the sports complex.

If you have any questions, please contact Lawrence Whang at 527-6138.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Pure Water . . . man's greatest need – use it wisely

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634458 HHVHK UW
Facsimile (808) 545-2050

December 18, 1989

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 11 October 1989. We have reviewed your letter and offer the following responses:

1. A Water Master Plan is being prepared to address providing fire protection for the proposed homes and sports complex by alternative sources. Domestic water facilities will be coordinated with the Board of Water Supply.

2. We appreciate the information provided on water availability and Water System Facilities Charges. This information will be included in the Draft Environmental Impact Statement (EIS).

Your letter will be reproduced in the Draft EIS in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Dennis Hirota

BUILDING DEPARTMENT

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

RECEIVED
SEP 29 1989

HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

PB 89-868

September 27, 1989

Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Gentlemen:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii
TMK: 4-6-06:1, 4, 7, 9, 11, 13, 15, 22-44, 48-51; 4-6-16:31 and 32

We have reviewed the subject project and have no comments to offer.

Should you have any questions, please contact Douglas Collinson at 527-6375.

Very truly yours,

HERBERT K. MURAOKA
Director and Building Superintendent

cc: J. Harada

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634455 HHWKLW
Facsimile (808) 545-2050

October 3, 1989

Mr. Herbert K. Muraoka
Director and Building Superintendent
Building Department
City and County of Honolulu
Honolulu Municipal Building
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Muraoka:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter (your reference number PB 89-868) dated 27 September 1989. Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:lf/mcb

cc: Eddie Sase
Rick Tsujimura

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5TH FLOOR
HONOLULU, HAWAII 96813
PHONE 523-4427 • FAX 527-5498

FRANK F. FASI
MAYOR

MICHAEL N. SCARFONE
DIRECTOR

RONALD B. MUN
DEPUTY DIRECTOR

November 1, 1989

NOV - 4 1989

Helber, Hastert and Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Vincent Shigekuni

Gentlemen:

Subject: Environmental Impact Statement Preparation Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-24, 44, 48-51 and
4-6-16: 31 and 32

We appreciate the opportunity to review the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Malulani Sports Complex.

We note that a zone change is required for this project. The Department's current policy is to request that ten percent of the residential units in a proposed project be set aside for low- and moderate-income households, or that the developer contribute in-kind toward the development of such housing. We intend to make this recommendation when the zone change application is circulated to our Department for our review and comment.

Thank you for the opportunity to comment.

Sincerely,

M. Scarfone

MICHAEL N. SCARFONE
Director

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center

PRI
Tower

733
Bishop
Street

Suite
2590

Honolulu
Hawaii
96813

Telephone
(808)
545-2055

Telex
634458
HHHK UW

Facsimile
(808)
545-2050

December 18, 1989

Mr. Michael N. Scarfone
Director
Department of Housing and Community Development
City and County of Honolulu
650 South King Street, 5th Floor
Honolulu, Hawaii 96813

Dear Mr. Scarfone:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 1 November 1989. We appreciate the information provided on the zone change application. Please note that the property presently contains approximately 16 acres that are zoned R-5. The applicant is only requesting the reconfiguration of the R-5 zoning inland, away from Kamehameha Highway. No additional R-5 zoning is being sought.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:mcb

cc: Eddie Sase
Rick Tsujimura
Donna Kanemaru

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

JOHN P. WHALEN
DIRECTOR

BENJAMIN B. LEE
DEPUTY DIRECTOR

OCT 26 1989

LU9/89-6088(ASK)

October 25, 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber, Hastert and Kimura
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Environmental Impact Statement Preparation Notice (EISPN)
Malulani Sports Complex--Koolaupoko, Oahu, Hawaii

Thank you for the opportunity to comment on the EISPN for the subject project. We have reviewed the document and offer the following comments:

1. The archaeological report should include recommendations for disposition of resources that are found on the site.

2. The Department of Transportation Services should be contacted regarding the proposed realignment of Kamehameha Highway.

3. The State Department of Transportation should be contacted regarding realignment of the Heeia Kea Boat Harbor entrance and other impacts that the proposed development may have on the harbor facility.

4. The City Department of Pubic Works should be consulted regarding disposal of waste activated sludge at their facilities.

5. The impacts of extracting brackish ground water on water resources should be addressed.

6. Structures and earth-moving activities within the shoreline setback area require a shoreline setback variance.

7. Alterations to drainage patterns should be addressed. Constituents of runoff and their potential effects on-site and off-site should be discussed, with special attention to potential impacts on Kaneohe Bay water quality.

8. Construction impacts should be reported. The potential impacts of grubbing and grading activities must be specifically addressed. Mitigative measures and alternatives to prevent adverse effects of soil erosion and runoff should be discussed.

9. A view analysis identifying impacts to coastal views should be provided.

You should be aware that the City Council is currently reviewing a proposed LUD amendment relative to golf course development.

Should you have any questions regarding the above, you may call Ardis Shaw-Kim of our staff at 523-4648.

Very truly yours,

John P. Whalen
JOHN P. WHALEN
Director of Land Utilization

JPW:sl
0231H/5-6

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHHK UW
Facsimile
(808)
545-2050

November 7, 1989

Mr. John P. Whalen
Director of Land Utilization
Department of Land Utilization
City and County of Honolulu
Honolulu Municipal Building
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Whalen:

<u>Environmental Impact Statement Preparation Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 25 October 1989. We have reviewed your letter and offer the following responses:

1. Based on discussions with the Hawaii State Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office, the archaeological inventory survey report which is being prepared for the property will include specific recommendations for any further archaeological work that might be appropriate and/or required for the historic sites identified.

2. A copy of the Environmental Impact Statement (EIS) Preparation Notice for the project was sent to the Department of Transportation Services (DTS). DTS reviewed the document and provided written comments which will be included in the Draft EIS.

3. The State Department of Transportation was sent a copy of the EIS Preparation Notice.

4. The City Department of Public Works (DPW) has reviewed a copy of the EIS Preparation Notice and provided information regarding the disposal of sludge from privately-operated treatment plants. A copy of the DPW review letter will be included in the Draft EIS.

5. A geologic, hydrogeologic and hydrological study of the project area is in the process of being prepared. In the event that groundwater development is proposed to supplement irrigation requirements, the impacts on water resources will be addressed.

6. We appreciate the information provided on shoreline setback requirements. At the present time, no structures and earth-moving activities are proposed within 40 feet of the vegetation line (which is makai of Kamehameha Highway fronting the property).

7. The proposed drainage improvements will be described in the Draft EIS. Technical consultants have been retained to assess the potential impacts of runoff and the use fertilizers, herbicides and pesticides on the golf course. In addition, a marine biologist will assess the impact of runoff on the marine environment makai of the property.

8. The potential impacts of grubbing and grading activities will be addressed in Draft EIS. Any mitigative measures and alternatives to prevent adverse effects of soil erosion and runoff will also be discussed.

9. A view analysis identifying impacts to coastal views will be included in the Draft EIS.

10. We appreciate the information provided on the status of the proposed LUO amendment relative to golf development. We would greatly appreciate being informed of any changes in the LUO that would affect the proposed Malulani Sports Complex.

Your letter will be reproduced in the Draft EIS in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni, Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Donna Kanemaru
Paul Rosendahl
Dennis Hirota

DEPARTMENT OF PARKS AND RECREATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

HIROAKI MORITA
DEPUTY DIRECTOR

RECEIVED
OCT 14 1989

October 11, 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber Hastert & Kimura, Planners
Grosvenor Center
PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement
Preparation Notice (EISPN)
Malulani Sports Complex - Heeia
Tax Map Key: 4-6-06 and 4-6-16

We have reviewed the EISPN for the proposed Malulani Sports Complex in Heeia and offer the following comments and recommendation.

The information in the report is inadequate to assess the concept of providing and utilizing the private, public and community-oriented facilities as proposed by the applicant. We have, however, determined that since residential development is being proposed, the project will be subject to compliance with the City's Park Dedication Ordinance No. 4621.

Please call Mr. Jason Yuen at 527-6315 to review the park dedication requirements and to discuss the conceptual plan of the project in more detail.

Thank you for the opportunity to review the EISPN.

Sincerely,

WALTER M. OZAWA, Director

WMO:js

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634488 HHVHK UW
Facsimile (808) 545-2050

December 18, 1989

Mr. Walter M. Ozawa
Director
Department of Parks and Recreation
City and County of Honolulu
Honolulu Municipal Building
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Ozawa:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 11 October 1989. As requested in your letter, we met with Messrs. Steve Salis and Jason Yuen to review the park dedication requirements and to discuss the concept plan of the project in more detail. We received a preliminary determination that the project, as presently planned, will meet the requirements of City's Park Dedication Ordinance No. 4621.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Donna Kanemaru

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

In reply refer to:
ENV 89-177(449)

October 6, 1989

OCT 11 1989
HELBER, HASTERT & KIMURA
PLANNERS

Mr. Vincent R. Shigekuni
Project Planner
Helber Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: EIS Preparation Notice (EISPN)
Malulani Sports Complex
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-24, 48-51
4-6-16: 31 and 32

We have reviewed the subject EISPN and have the following comments:

1. We have no objection to the proposed sports complex and residential homes.

2. Before the sludge from the privately-operated treatment plant is accepted by the City, the attached form has to be submitted.

3. A drainage report has to be submitted to the Drainage Section, Division of Engineering, for review and approval.

Very truly yours,

SAM CALLEJO
Director and Chief Engineer

Attach.

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WASTEWATER MANAGEMENT

PRIVATE SEWAGE TREATMENT PLANT (STP) SLUDGE DISPOSAL SYSTEM

APPLICATION NUMBER ____________ (To be completed by City)

NAME OF STP ____________

LOCATION:
Street ____________
Area and Zip Code ____________
Telephone ____________

RESPONSIBLE INDIVIDUAL:
Name ____________
Title ____________
Telephone ____________

TYPE OF SERVICE AREA:
☐ Residential
☐ Commercial
☐ Industrial

TYPE OF SEWAGE TREATMENT PROCESS:
☐ Activated Sludge
☐ Mixed Media
☐ Other ____________

SUBMIT FLOW SCHEMATIC DIAGRAM INCLUDING UNIT PROCESSES UTILIZED AND ACTUAL STP AND SERVICE AREA LAYOUT.

TREATMENT CAPACITY:
Design Average Flow ____________ GPD
Design Peak Flow ____________ GPD
Actual Average Flow ____________ GPD

EFFLUENT DISPOSAL SYSTEM: Quantity / Flow
Injection Wells ____________
Seepage Pits ____________
Leaching Fields ____________
Other ____________

FREQUENCY OF SLUDGE WASTING: ____________ TIMES PER YEAR

continued on next page

QUANTITY OF SLUDGE WASTED PER PUMPING : ______ Gallons Per Load

ESTIMATED SOLIDS CONCENTRATION OF SLUDGE ______ %

SLUDGE PUMPING AND HAULING SERVICE (PLEASE CHECK)

☐ Private Contractor

Name of Company ______

Telephone ______

☐ Self

If self, you are required to request (by letter) for permission to discharge into the public sewer system to :

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

QUALITY OF SLUDGE :

BOD_5 = ______ mg/l

Suspended Solids = ______ mg/l

Volatile Solids = ______ mg/l

CONDITIONS OF DISPOSAL APPLICATION

Application is solely for the disposal of Stabilized Activated Sludge (SAS) and forbids the disposal of screenings, grit, grease or scum into any of the City's sewerage systems. Failure to comply with these restrictions will mean forfeiture of the above stated STP's "SAS" disposal privilege into our sewerage works.

A logbook of "SAS" disposal must be maintained at each treatment facility and be made available to city personnel upon request. The records must show date, time, quantity of "SAS" for disposal, name of STP operator, and name of "SAS" collection and disposal firm for each wasting period.

CERTIFICATION

I hereby certify that the above was performed by me or under my supervision or the pertinent data provided are based on my past experience and judgement.

______ Signature ______ Date ______ Telephone

______ Print Name and Title ______ Name of Company

APPROVAL : (To be completed by City)

Date ______

Approved by ______

Remarks ______

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

October 11, 1989

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
Honolulu Municipal Building
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter (your reference number ENV 89-177(449)) dated 6 October 1989. We appreciate the information provided regarding wastewater disposal.

A preliminary drainage report is presently in the process of being prepared and upon its completion, a copy(ies) will be submitted to the Drainage Section, Division of Engineering for review and approval.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Dennis Hirota

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

OCT 10 1989

ALFRED J. THIEDE
DIRECTOR

JOSEPH M. MAGALDI, JR.
DEPUTY DIRECTOR

TE-6105
PL1.1782

October 5, 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber Hastert & Kimura Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Malulani Sports Complex
EIS Preparation Notice
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51; 4-6-16: 31 & 32

This is in response to your letter of September 21, 1989 requesting our review and comments on the subject project.

We have reviewed your EIS Preparation Notice and offer the following comments:

1. A 60-foot right-of-way street should have a pavement width of 44 feet.

2. The applicant will widen and improve the portion of Kamehameha Highway fronting their property at their own expense under Ordinance 2412.

3. We will provide additional comments on the traffic impact analysis when it is submitted as part of the EIS.

Should you have any further questions, please contact Mike Oshiro at 527-5031.

Very truly yours,

for ALFRED J. THIEDE
Director

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHHK UW
Facsimile
(808)
545-2050

December 18, 1989

Mr. Alfred J. Thiede
Director
Department of Transportation Services
City and County of Honolulu
Honolulu Municipal Building
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Thiede:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter (your reference number TE-6105, PL1.1782) dated 5 October 1989. We have reviewed your letter and offer the following responses to your comments:

1. We appreciate the information provided on County standards for pavement within 60-foot rights-of-way.

2. According to a traffic impact analysis prepared by Sam O. Hirota, Inc., Kamehameha Highway between Kahekili Highway and Haiku Road serves as a collector road. Traffic counts taken on Kamehameha Highway indicate existing a.m. and p.m. peak hour volumes well under the capacities typical of a two-lane rural highway (collector road) with level of service "A". There are limited areas along this stretch of Kamehameha Highway with potential for development (that would generate new traffic).

   One of the alternatives to the proposed widening of Kahekili Highway is the widening of Kamehameha Highway between Kahekili Highway and Haiku Road. One of the reasons that this alternative has been determined to be unacceptable was that this section of Kamehameha Highway is not linked as directly to trans-Koolau traffic routes as Kahekili Highway is, so widening of this segment of Kamehameha Highway would not do as much to improve regional peak hour traffic conditions. Therefore, the widening of Kamehameha Highway does not appear to be warranted.

3. A copy of the traffic impact analysis that will be appended to the Draft Environmental Impact Statement (EIS) has been submitted to your department directly by Sam O. Hirota, Inc.

Your letter will be reproduced in the Draft EIS in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Dennis Hirota
Ben Kudo

FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

1455 S. BERETANIA STREET, ROOM 305
HONOLULU, HAWAII 96814

FRANK F. FASI
MAYOR

FRANK K. KAHOOHANOHANO
FIRE CHIEF

LIONEL E. CAMARA
DEPUTY FIRE CHIEF

October 25, 1989

Helbert, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

ATTENTION: VINCENT R. SHIGEKUNI, PROJECT PLANNER

Gentlemen:

We have reviewed the subject material provided and foresee no adverse impact in Fire Department facilities or services, planned or now provided, existing fire protection is considered adequate.

Should you have any questions, please contact Battalion Chief Michael Zablan of our Administrative Services Bureau at 943-3838.

Sincerely,

FRANK K. KAHOOHANOHANO
Fire Chief

MZ:ny

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

November 7, 1989

Mr. Frank K. Kahoohanohano
Fire Chief
Fire Department
City and County of Honolulu
1455 South Beretania Street, Room 305
Honolulu, Hawaii 96814

Dear Mr. Kahoohanohano:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 25 October 1989. We greatly appreciate the information provided.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:mcb

cc: Eddie Sase
Rick Tsujimura
Dennis Hirota

OFFICE OF HUMAN RESOURCES
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING, 6TH FLOOR
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 527-5311

FRANK F. FASI
MAYOR

MARIA VICTORIA R. BUNYE
DIRECTOR

VICTOR D. GUILLERMO, JR.
DEPUTY DIRECTOR

OCT 2 1 1989

October 18, 1989

Mr. Vincent R. Shigekuni, Project Planner
Helbert Hastert and Kimura Planners
Grovesnor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

The Office of Human Resources has reviewed your proposal for development of the Malulani Sports Complex at Koolaupoko, Oahu (TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51; 4-6-16: 31 and 32). Your document proposal does not state whether your facilities will be accessible for persons with disabilities. In order to comply with your intentions of allowing the general public accessibility to all facilities contained within the Malulani Sports Complex, accommodations for persons with disabilities need to be addressed. This involves an accessible route within the Sports Complex for travel from one facility to another; accessibility at the golf course and tennis courts with their supportive facilities; health spa, community-oriented facilities, and hiking trail. Parking stalls solely for persons with disabilities must be provided in all lots. An accessible route from the nearest public bus stop to the Malulani Sports Complex is also required.

I am pleased that you are considering utilizing the WORKHAWAII, Honolulu Job Training Program services in meeting the employment demands involved in operating a facility of this nature. Please feel free to contact Rolanse Crisafulli, WORKHAWAII Administrator, at 523-4102 at your earliest convenience to start preliminary discussions on how WORKHAWAII can be involved.

Thank you for the opportunity to comment on this matter.

Very truly yours,

MARIA VICTORIA R. BUNYE, Director
Office of Human Resources

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

December 18, 1989

Ms. Victoria R. Bunye
Director
Office of Human Resources
City and County of Honolulu
Honolulu Municipal Building, 6th Floor
650 South King Street
Honolulu, HI 96813

Dear Ms. Bunye:

<u>Environmental Impact Statement Notice</u>
<u>Malulani Sports Complex</u>
<u>Koolaupoko, Oahu, Hawaii</u>

Thank you for your review of the above document and your letter dated 18 October 1989. We have reviewed your letter and offer the following response to your comments. The Draft Environmental Impact Statement (EIS) will state that all of the proposed golf clubhouse and recreational facilities will be designed and constructed to be accessible to disabled persons (1985 Uniform Building Code, as amended). Parking stalls solely for persons with disabilities will be provided in the clubhouse parking area. The applicant is proposing to dedicate approximately 9 acres of the property for community facilities. It is expected that the government agency(ies) that accepts the land to be dedicated will construct the community-oriented facilities so that they will be accessible to disabled persons. Providing disabled access to the proposed hiking trails does not appear to be in the best interests of public safety.

Providing an accessible route from the nearest public bus stop along Kamehameha Highway to the clubhouse and recreational facilities (distances from the highway to the makai boundary of the clubhouse area alone would be approximately 1,000 feet) does not appear to be the safest way to provide access to the latter facilities. Due to the high probability of rainfall during certain times of the year, it is felt that the use of Handi Van-type vehicles would be a safer and more convenient means of access.

Your letter will be reproduced in the Draft EIS in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Donna Kanemaru

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

1455 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96814 - AREA CODE (808) 943-3111

FRANK F. FASI
MAYOR

DOUGLAS G. GIBB
CHIEF

WARREN FERREIRA
DEPUTY CHIEF

OUR REFERENCE SS-LK

OCT 24 1989

October 23, 1989

Mr. Vincent R. Shigekuni
Project Planner
Helber, Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice (EISPN), Malulani Sports Complex, Koolaupoko, Oahu, Hawaii, TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51; 4-6-16: 31 and 32

We have reviewed the EISPN for the proposed Malulani Sports Complex in Heeia Kea and have no comments to provide at this time.

However, we would like to be consulted on matters relating to traffic and public safety as the project develops.

Thank you for allowing us the opportunity to provide comments.

Sincerely,

DOUGLAS G. GIBB
Chief of Police

By
JOSEPH AVEIRO
Assistant Chief of Police
Support Services Bureau

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu
Hawaii
96813
Telephone (808) 545-2055
Telex 634468 HHVHK UW
Facsimile (808) 545-2050

October 24, 1989

Mr. Douglas G. Gibb
Chief of Police
Police Department
City and County of Honolulu
1455 South Beretania Street
Honolulu, Hawaii 96814

Dear Mr. Gibb:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 23 October 1989 (your reference number SS-LK). Please be assured that your department will be consulted on matters relating to traffic and public safety as the project develops.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:meb

cc: Eddie Sase
Rick Tsujimura
Dennis Hirota

GTE Hawaiian Tel — Interoffice Correspondence

Beyond the call

October 23, 1989

RECEIVED OCT 24 1989

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

Dear Mr. Shigekuni:

Environmental Impact Statement Preparation Notice (EISPN)
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

GTE Hawaiian Tel (in reviewing the EISPN) foresees no adverse environmental impact on existing telephone facilities. However, the developer must be made aware of the following requirements:

1. The cost of relocating aerial and buried cable facilities along Kamehameha Highway because of the proposed Malulani Sports Complex must be borne by the developer.

2. The developer will need to consult with GTE Hawaiian Tel representative to assure that necessary telecommunication services are available in a timely manner.

If you have questions, please contact Les Kodama at 834-6262 or Francis Mau at 834-6350.

Walter M. Matsumoto
Operations Manager
OSP Engineering

FM/st(0719)
cc: M. Taosaka

G 0004 (Rev. 10/86)

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634488 HHHK UW
Facsimile (808) 545-2050

November 7, 1989

Mr. Walter M. Matsumoto
Operations Manager
OSP Engineering
GTE Hawaiian Tel
P.O. Box 2200
Honolulu, Hawaii 96841

Dear Mr. Matsumoto:

Environmental Impact Statement Notice
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 23 October 1989. We have reviewed your letter and offer the following responses:

1. Since the applicant is only proposing to dedicate land for community-oriented facilities, the cost of relocating aerial and buried cable facilities along Kamehameha Highway would be borne by the appropriate governmental agency(ies) that would develop the land dedicated.

2. The project's civil engineering consultant, Sam O. Hirota, Inc., will consult with GTE Hawaiian Tel to assure that necessary telecommunication services are available in a timely manner.

Your letter will be reproduced in the Draft Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER, HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

VS:mcb

cc: Eddie Sase
Rick Tsujimura
Ben Kudo
Dennis Hirota

CHAPTER X

REFERENCES

Cox, Linda J., James R. Hollyer and Donald M. Schug. Draft Report - An Economic Profile of Hawaii's Landscape Services in 1987. Department of Agricultural and Resource Economics, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa. August 1989.

Dames & Moore. Report Geologic, Hydrogeologic, and Hydrologic Services Proposed Malulani Sports Complex, Heeia Kea, Oahu, Hawaii for Nanatomi Hawaii, Inc. December 8, 1989.

Gray, Hong & Associates, Inc. Revised Environmental Impact Statement for Heeia Kea Subdivision, Heeia, Koolaupoko, Oahu. Prepared for Hawaiian Electric Company, Inc. Honolulu. 1983.

Gray, Hong & Associates, Inc. and Robert B. Jones, AICP. Draft Supplemental Environmental Impact Statement for Heeia Kea Valley, Heeia, Koolaupoko, Oahu. Prepared for Malama-Gentry Joint Venture. Honolulu. September 1986.

Hawaii, State of, Department of Health. "Title 11, Administrative Rules, Chapter 59, Ambient Air Quality Standards". (n.d.).

____________. "Title 11, Administrative Rules, Chapter 343, Environmental Impact Statement Rules. December 1985.

____________. "Title 11, Administrative Rules, Chapter 60, Air Pollution Control". (n.d.).

____________. "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu". November 6, 1981.

____________. "Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu". October 27, 1981.

Hawaii, State of, Department of Planning and Economic Development. The State of Hawaii Data Book. Honolulu. 1987.

____________. Title 15. Administrative Rules, Chapter 15. "Hawaii Land Use Commission Rules." October 1986.

Hawaii, State of, Land Evaluation and Site Assessment Commission. A Report on the State of Hawaii Land Evaluation and Site Assessment System. Honolulu. February 1986.

Helber Hastert & Kimura, Planners. Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review, Malulani Sports Complex, Koolaupoko, Oahu. For submittal to the City and County of Honolulu Department of General Planning (Reference No. 90/KP-1). Prepared for Nanatomi Hawaii, Inc. Honolulu. September 1989.

Sam O. Hirota, Inc. Drainage Report Proposed Malulani Sports Complex. Prepared for Nanatomi Hawaii, Inc. Honolulu. November 15, 1989.

Sam O. Hirota, Inc. Traffic Report for Malulani Sports Complex. Prepared for Nanatomi Hawaii, Inc. Honolulu. October 30, 1989.

Sam O. Hirota, Inc. Wastewater Management Report Proposed Malulani Sports Complex. Prepared for Nanatomi Hawaii, Inc. Honolulu. December 5, 1989.

Sam O. Hirota, Inc. Water Supply Report Proposed Malulani Sports Complex. Prepared for Nanatomi Hawaii, Inc. Honolulu. December 5, 1989.

Industrial Analytical Laboratory. Report of a Hazard Assessment Survey Conducted on Property Located in Heeia Kea, Koolaupoko on O'ahu, Hawaii. Prepared for Kobayashi, Watanabe, Sugita, Kawashima and Goda, Attorneys at Law. Honolulu. February 12, 1990.

Industrial Analytical Laboratory. Report of a Hazard Assessment Survey of 3.64 Acres on Property Located in Heeia Kea on O'ahu, Hawaii, TMK 4-6-06:62, Presently Occupied by South Pacific Construction Company. Prepared for Kobayashi, Watanabe, Sugita, Kawashima and Goda, Attorneys at Law. Honolulu. March 10, 1990.

Marine Research Consultants. Marine Environmental Survey to Assess Potential *Impacts from the Proposed Malulani Sports Complex.* Prepared for Helber Hastert & Kimura, Planners. Honolulu. December 15, 1989.

Murdoch, Charles L. and Green, Richard E. Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Malulani Golf Course. Prepared for Helber Hastert & Kimura, Planners. Honolulu. December 15, 1989.

Nagata, Kenneth M. Malulani Biological Survey. Prepared for Helber Hastert and Kimura. Honolulu. May 28, 1989.

Natelson Levander Whitney, Inc. Analysis of Economic and Fiscal Impacts Malulani Development Program. Prepared for Nanatomi Hawaii, Inc. Los Angeles, California. November, 1989.

Root, Barry D. and Barry D. Neal. Air Quality Study for the Proposed Malulani Sports Complex. Prepared for Helber Hastert and Kimura Planners. Honolulu. November 1989.

Paul H. Rosendahl, Ph.D., Inc. Archaeological Inventory Survey Malulani Sports Complex, Land of Heeia, Koolaupoko District, Island of Oahu. Prepared for Nanatomi Hawaii, Inc. Hilo, Hawaii. December 1989.

D.R. Sanders and Associates, Inc. Survey of Waters of the United States on the Nanatomi Hawaii, Inc. Property at Kaneohe Bay, Oahu, Hawaii. Prepared for Kobayashi, Watanabe, Sugita, Kawashima, & Goda. November 20, 1989.

Scott, Frank S., Jr. Feasibility and Need of Malulani Project Lands for Agriculture. Prepared for Helber Hastert & Kimura, Planners. Honolulu. June 1989.

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

University of Hawaii, Land Study Bureau. Detailed Land Classification - Island of Oahu. Honolulu. December 1972.

CHAPTER XI

COMMENTS AND RESPONSES RECEIVED DURING THE PREPARATION OF THE FINAL EIS

This chapter presents information on who participated in the preparation of the Final EIS, who sent written comments during and after the public review period of the Draft EIS, and all comments received and responses sent relative to the preparation of the Final EIS.

11.1 PARTICIPANTS IN THE FINAL EIS PREPARATION PROCESS

This report was prepared for Nanatomi Hawaii by Helber Hastert and Kimura, Planners. The following list identifies individuals and organizations who were involved in the preparation of the report and their respective contributions.

Helber Hastert and Kimura, Planners

Glenn T. Kimura (Principal-in-charge and Project Manager)
Vincent R. Shigekuni (Project Planner and Principal Author)
Gail M. Uyetake (Planner and Associate Author)
Michelle Masuda (Planner)
Toshiko Matsushita (Graphics)

Technical Consultants

Dames & Moore (Hydrology)
Golfscapes (Golf Course Architects)
Sam O. Hirota, Inc. (Civil Engineering and Traffic)
Industrial Analytical Laboratory (Hazardous Waste)
Marine Research Consultants (Marine Environment)
Charles L. Murdoch, Ph.D. and Richard E. Green, Ph.D. (Fertilizer, Herbicide and Pesticide Use)
Kenneth M. Nagata (Terrestrial Flora and Fauna)
Natelson Levander Whitney, Inc. (Economic and Fiscal Impacts)
Barry D. Root and Barry D. Neal (Air Quality)
Paul H. Rosendahl, Ph.D., Inc. (Archaeology)
Dana R. Sanders, Sr., Ph.D. (Wetlands)
Frank S. Scott, Jr. (Agriculture)

11.2 CONSULTED PARTIES AND COMMENTS RECEIVED DURING THE PREPARATION OF THE DRAFT EIS

Sixty (60) copies of the Malulani Sports Complex Draft Environmental Impact Statement (DEIS) were officially received by the Office of Environmental Quality Control (OEQC) on 20 December 1989. Notice of the DEIS was published in the 23 December 1989 issue of the OEQC Bulletin and 57 copies of the report were distributed to public agencies, organizations and libraries. The deadline for comments was 6 February 1990. Copies of the DEIS (including an original, signed copy) were delivered to the accepting agency, the City and County of Honolulu

Department of General Planning. Copies of the DEIS were sent to the following libraries: the State Department of Business and Economic Development Library; the State Archives; the Honolulu Star Bulletin; the Honolulu Advertiser; the Sun Press; the Municipal Reference and Records Center; the University of Hawaii Hamilton Library, Hawaiian Collection; the Legislative Reference Bureau; the State Main Library; the Kaimuki, Kaneohe, Pearl City, Hilo, Wailuku, and Lihue Regional Libraries; and the Kailua Library. In addition to distribution by OEQC, other copies were sent to: the State Departments of Education, Hawaiian Home Lands and Transportation, Harbors Division, the Land Use Commission, the U.S. Geological Survey, the U.S. National Marine Fisheries Service, the Office of Human Resources, Hawaiian Telephone Company, Kaneohe Satellite City Hall, Kahaluu Neighborhood Board, City Councilman David Kahanu, Senator Mike McCartney, Representative Terrence Tom, Senator Stan Koki, Representative Reb Bellinger, Representative Marshall K. Ige, Mr. and Mrs. Bob Nakata, Mrs. Janine Tulley (Windward Sun Press), Mrs. Susan Fristoe (Friends of He'eia State Park), Mr. John Reppun (Kahalu'u Neighborhood Board #29), Dr. Ronald Hales (Kahalu'u Neighborhood Board #29), Mr. John Manewa (Kaneohe Neighborhood Board #30), and Mr. Ray Sweeny (Kaneohe Neighborhood Board #30).

A total of 26 written comments were received by the 6 February 1990 deadline date. As of 28 February 1990, a total of 8 letters were postmarked and received after the deadline. The agencies and organizations which responded are identified below. All comments were responded to, and both comments and responses are reprinted on the following pages. At the request of one reviewer, a hazardous waste assessment was prepared. The reports prepared by Industrial Analytical Laboratory are attached to the Final Environmental Impact Statement as Appendix N. In addition to another reviewer request, additional visual analysis was prepared and is attached to this Final EIS as Appendix O.

Federal Agencies

Department of Agriculture, Soil Conservation Services
Department of Army, U.S. Army Engineer District, Honolulu
Department of the Interior, Fish and Wildlife Service
Department of the Navy

State Agencies

Department of Accounting and General Services
Department of Agriculture
Department of Business and Economic Development, Energy Division
Department of Defense
Department of Education
Department of Land and Natural Resources
Department of Land and Natural Resources, Historic Preservation Program
Department of Transportation, Harbors Division
Housing Finance and Development Corporation
Land Use Commission
Office of Environmental Quality Control
Office of State Planning

County Agencies

Board of Water Supply
Building Department
Department of General Planning
Department of Housing and Community Development
Department of Land Utilization
Department of Parks and Recreation
Department of Public Works
Department of Transportation Services
Fire Department
Office of Human Resources
Police Department

Public Utilities

Hawaiian Electric Company, Inc.
Hawaiian Telephone Company

Other Agencies and Organizations

Kahaluu Neighborhood Board
Kaneohe Outdoor Circle
Charles Reppun
Sierra Club

465 SOUTH KING STREET · KEKUANAOA BUILDING #104 · HONOLULU, HAWAII 96813 · TELEPHONE (808) 548-6915

OEQC BULLETIN

OFFICE OF ENVIRONMENTAL QUALITY CONTROL

JOHN WAIHEE
GOVERNOR

MARVIN T. MIURA, Ph.D.
DIRECTOR

Volume VI   December 23, 1989   No. 24

REGISTER OF CHAPTER 343, HRS DOCUMENTS

The OEQC Bulletin is a semi-monthly publication. The publication dates of the bulletin are the eighth and twenty-third of each month. Applicants should deliver an appropriate number of Draft and Final EISs to the accepting authority before submitting copies to OEQC for distribution and publication. Environmental Assessments should be submitted to the accepting authority directly. Based on the assessment, the accepting authority will submit to OEQC a determination of a Negative Declaration or a Preparation Notice for publication in the bulletin. Draft and Final Environmental Impact Statements must be received by the fifth and twentieth days of the month for publication in the respective issue. Negative Declarations and Preparation Notices must be received at least five working days prior to the publication date. All documents submitted for publication in the OEQC Bulletin should be delivered to the Office of Environmental Quality Control, 465 South King Street, Room 104, Honolulu, Hawaii 96813. To ensure proper processing of documents, please attach OEQC Form 89-1 with all submittals. These forms can be obtained by calling OEQC at 548-6915.

OEQC WISHES EVERYONE
A MERRY CHRISTMAS AND A HAPPY NEW YEAR

CONTENTS

650 South King Street
Honolulu, Hawaii 96813

with a copy of your comments to:

Applicant: James Campbell Estate
c/o William E. Wanket
Pacific Tower 660
1001 Bishop Street
Honolulu, Hawaii 96813

Deadline: February 6, 1990

Campbell Estate is proposing a Development Plan Amendment primarily from Agriculture to Industrial Use. Approximately 19 acres will be converted from Agriculture to Commercial Use. A total of approximately 552 acres are being proposed for redesignation.

Of this, 109 acres are being proposed for Maritime Industrial Use, 56 acres of which are destined to be used by the state for the expansion of Barber's Point Harbor. Approximately 423 acres will be for Intensive Industrial Use as an expansion to the existing James Campbell Industrial Park.

The land is adjacent to Campbell Industrial Park and is within the general vicinity of Barber's Point Harbor. The site also lies close to the City of Kapolei.

MAULANI SPORTS COMPLEX
Location: Koolaupoko, Oahu
TMK: 4-6-06:01, 04, 07, 09, 11, 13, 15, 22-44, 48-51
4-6-16:31 & 32

Please send your comments to:

Accepting Authority: City and County of Honolulu
Department of General Planning
650 South King Street
Honolulu, Hawaii 96813

with a copy of your comments to:

Applicant: Nanatomi Hawaii, Inc.
c/o Vincent Shigekuni
Helber, Hastert and Kimura Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Deadline: February 6, 1990

The proposed project is located in Heeia Kea Valley, in the vicinity of the Heeia Kea Pier and Boat Harbor. The total project area is approximately 220 acres.

Nanatomi Hawaii proposes the development of a sports complex on the property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tenis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes.

A par 70, 18-hole golf course will be designed to use as much of the existing area, terrain and vegetation for challenging play. Water features will be distributed throughout the site to function as fairway amenities as well as irrigation reservoirs and siltation basins. The golf course will be open for public play for a fee.

Nanatomi Hawaii will dedicate approximately nine acres of the property for community-oriented facilities. Approximately one acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short segment of Kamehameha Highway, a three-acre area will be available for a public beach park and the expansion of boat harbor facilities. Approximately five acres of land mauka of the realigned highway could be used as a site for an amphitheater, hula halau and picnic area.

Hiking trails and a four acre campground accessible to the windward community with a permit from Nanatomi Hawaii are also planned.

HONBUSHIN MISSION INTERNATIONAL OF HAWAII
Location: Mililani, Oahu
TMK: 9-5-01:65

Please send your comments to:

Accepting Authority: City and County of Honolulu
Department of General Planning
650 South King Street
Honolulu, Hawaii 96813

with a copy of your comments to:

( ) E.A.
( ) APPLICANT ACTION
( ) AGENCY ACTION

(x) EIS
(x) APPLICANT A
( ) AGENCY ACTI

DEC 2 6 1989

Title: Waiulani Sports Complex

Location : Koolaupoko, Oahu THK: 4-6-06: 1,4,7,9,11,13,15,22-44,4

Proposing Agency/Applicant: Nanatomi Hawaii

Accepting Authority/Approving Agency: C&C of Honolulu, Department of General Planning

Deadline for Comments: February 6, 1990

Date Sent/By: December 23, 1989

STATE AGENCIES	NO. COPIES	REMARKS
OEQC Director	1	
Dept. of Agriculture	1	
Dept. of Accounting and General Services	1	
Dept. of Defense	1	
Dept. of Education (a)*		
Dept. of Hawaiian Home Lands (a)*		
Dept. of Health	1	
Dept. of Land and Natural Resources	3	
DLNR State Historic Preservation Officer	1	
Dept. of Business and Economic Development	1	
DBED Library	1	
Housing Finance & Development Corporation	1	
Dept. of Transportation	3	
State Archives	1	
State Energy Office	1	
UNIVERSITY OF HAWAII		
Environmental Center	4	
Marine Programs (a)*		
Water Resources Research Center	1	
FEDERAL		
Regional Div. USEPA Region IX	1	
Army-DAFE (Facilities Eng.-USASCH)	1	
Environmental Protection Agency (a)*		
Navy	1	
Soil Conservation Service	1	
U.S. Army Corps of Engineers	1	
U.S. Coast Guard	1	
U.S. Fish and Wildlife Service	1	
U.S. Geological Survey (a)*		

Library Copy: 1
Total Received: 60
Total Distributed: 57
File Copy: 2
Planner ____

Copy of Distribution List Sent to: Nanatomi Hawaii
c/o Helber Hastert & Kimura
Vincent Shigekuni
733 Bishop St.Suite 2590
Honolulu, HI 96813
Date: 12/21/89

(a)* Copy desired only if project involves the agency's responsibilities.

NEWS MEDIA		
Honolulu Star-Bulletin	1	
Honolulu Advertiser	1	
Sun Press	1	
Hawaii Tribune Herald (b)**		
West Hawaii Today - Kona (b)**		
The Garden Island Newspaper - Kauai (b)**		
Maui News (b)**		
Ka Molokai (b)**		
CITY AND COUNTY OF HONOLULU (b)**		
Board of Water Supply	1	
Building Dept.	1	
Dept. of Housing and Community Development	1	
Dept. of General Planning	1	
Dept. of Land Utilization	1	
Dept. of Parks and Recreation	1	
Dept. of Public Works	1	
Dept. of Transportation Services	1	
Fire Dept.	1	
Municipal Reference and Records Center (Oahu only)	1	
Police Dept.	1	
COUNTY OF HAWAII (b)**		
Planning Dept.		
Dept. of Parks and Recreation		
Dept. of Public Works		
Dept. of Research and Development		
Dept. of Water Supply		
University of Hawaii - Hilo Campus Library		
COUNTY OF MAUI (b)**		
Planning Dept.		
Dept. of Parks and Recreation		
Dept. of Public Works		
Dept. of Water Supply		
Economic Development Agency		
Maui Community College Library		
COUNTY OF KAUAI (b)**		
Planning Dept.		
Dept. of Public Works		
Dept. of Water Supply		
Kauai Community College Library		
NON-GOVERNMENTAL AGENCIES		
American Lung Association	1	
Hawaiian Electric Company	1	
Office of Hawaiian Affairs	1	
LIBRARIES		
U.H. Hamilton Library, Hawaiian Collection	1	
Legislative Reference Bureau	1	

(b)** Copy desired only if project is in respective county.

LIBRARIES	NO. COPIES	REMARKS
State Main Library	2	
REGIONALS:		
Kaimuki Regional Library	1	
Kaneohe Regional Library	1	
Pearl City Regional Library	1	
Hilo Regional Library	1	
Wailuku Regional Library	1	
Lihue Regional Library	1	
OAHU:		
Aiea Library		
Aina Haina Library		
Ewa Beach Community-School Library		
Hawaii Kai Library		
Kahuku Community-School Library		
Kailua Library	1	
Kalihi-Palama Library		
Liliha Library		
Manoa Library		
McCully-Moiliili Library		
Mililani Library		
Wahiawa Library		
Waialua Library		
Waianae Library		
Waikiki-Kapahulu Library		
Waimanalo Community-School Library		
Waipahu Library		
HAWAII		
Bond Memorial (Kohala) Library		
Holualoa Library		
Honokaa Library		
Kailua-Kona Library		
Keaau Community-School Library		
Kealakekua Library		
Laupahoehoe Community-School Library		
Mountain View Community-School Library		
Pahala Community-School Library		
Pahoa Community-School Library		
Thelma Parker Memorial Library/Waimea Area Library		
MAUI		
Kahului Library		
Lahaina Library		
Makawao Library		
MOLOKAI		
Molokai Library		
LANAI		
Lanai Community-School Library		
KAUAI		
Hanapepe Library		
Kapaa Library		
Koloa Community-School Library		
Waimea Library		

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. BOX 50004
HONOLULU, HAWAII 96850

RECEIVED JAN 24 1990 HELBER HASTERT & KIMURA PLANNERS

January 22, 1990

Director
Department of General Planning
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Sir:

Subject: Draft Environmental Impact Statement (DEIS) - Malulani Sports Complex, Koolaupoko, Oahu

The above-mentioned document has been reviewed as requested by the Office of Environmental Quality Control, State of Hawaii.

We concur that there is a high risk of fertilizer and pesticide contamination into Kaneohe Bay from uncontrolled runoff. We recommend that a diversion be constructed to channel runoff into a settling basin just before entering the bay.

The impact statement should also address what erosion control measures will be utilized to prevent sedimentation into the bay during the grading operation.

Sincerely,

Warren M Lee

WARREN M. LEE
State Conservationist

cc:
Nanatomi Hawaii, c/o Helber, Hastert & Kimura, Planners, ATTN: Vincent Shigekuni, 733 Bishop Street, Suite 2590, Honolulu, Hawaii 96813
Marvin T. Miura, PhD., Director, Office of Environmental Quality Control, 465 South King Street, Room 104, Honolulu, Hawaii 96813

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

7 February 1990

Mr. Warren M. Lee
State Conservationist
United States Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter addressed to the City and County of Honolulu Department of General Planning (DGP) dated 22 January 1990 and offer the following responses.

Runoff - Satisfactory reduction of chemical transport in runoff can likely be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadways servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation.

Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow released nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff.

All of the above information was provided in Section 4.4.2 (page IV-11 of the Draft Environmental Impact Statement [EIS]) and Section 6.4.2 (page VI-6 of the Draft EIS) of the EIS.

Erosion Control Measures - Section 6.4.2 of the Draft EIS stated that the proposed ponds and water features would serve as detention silt and debris basins, reducing the peak runoff. The proposed detention basins and designed golf course rough features are expected to reduce the peak runoff discharge to below that of the existing condition. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts of runoff.

In addition, the Draft EIS (Section 4.3.2, page IV-8) stated that the impacts of construction on soil erosion can be mitigated by conforming to strict erosion control measures, particularly those specified in the State Department of Health's Water Quality Standards, Chapter 37-A, Public Health Regulations, 1968; and the Soil Conservation Services' Erosion and Sediment Control Guide for Hawaii, 1968. Primary fugitive dust control methods include wetting down loose soil areas, good housekeeping on the job site, and prompt landscaping of bare soil areas.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:
Planning Branch

January 24, 1990

Mr. Ben Lee
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Lee:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the proposed Malulani Sports Complex, Koolaupoko, Oahu. Our previous comments in response to the Preparation Notice (letter dated October 12, 1989) have been included in the DEIS. The following additional comments are offered:

a. Figures 3 and 11 of the DEIS indicate that there may be construction activity in wetlands and on the shoreline which would require Department of the Army (DA) permits. For your information, enclosed is a copy of a December 15, 1989 letter which was sent to the project consultants, explaining DA permit requirements for this project. For more information on DA permit requirements, please contact Operations Branch at 438-9258.

b. In the summary of probable impact and mitigative measures (page I-4), the DEIS notes that the existing "exotic" vegetation (which actually includes 17 native plant species, as documented elsewhere in the DEIS) will be replaced by new exotic vegetation. As a mitigative measure, the developer may wish to consider incorporating some of the native trees, shrubs, or other plants into the landscape design or, alternatively, offering them to parks or botanical gardens for possible transplantation.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure

RECEIVED
JAN 25 1990
HELBER, HASTERT & KIMURA PLANNERS

Copy Furnished:

Hanatomi Hawaii
c/o Helber Hastert & Kimura, Planners
Vincent Shigekuni
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

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

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

DEC 18 1989

December 15, 1989

REPLY TO ATTENTION OF
Operations Branch

SUBJECT: Wetland Determination, Nanatomi Property, Heeia Kea, Kaneohe, Oahu

Mr. Vincent Shigekuni
Helber, Hastert and Kimura
Grosvenor Center
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

We have reviewed the report by Mr. Dana Sanders, Survey of Waters of the United States on the Nanatomi Hawaii, Inc. property at Kaneohe Bay, Oahu, Hawaii. Based on his report, the wetlands result from internal drainage that ponds on the property before flowing through culverts into Kaneohe Bay. The description indicates that the wetlands are isolated wetlands under the Corps jurisdiction.

With regard to your inquiry whether or not a Department of the Army permit is required, we find that permits would be required for the discharge of any fill into the wetlands. A nationwide permit could be applied to these isolated wetlands. While we recognize the site limitations with regard to road alignments, we recommend that you avoid filling any wetlands on the property or consider "no net loss" of wetlands in your site plans.

Thank you for consulting with us early in your planning process.

Sincerely,

Stanley T. Arakaki

Stanley T. Arakaki
Chief, Operations Branch
Construction-Operations Division

HELBER HASTERT & KIMURA Planners
HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634458 HHHK UW
Facsimile (808) 545-2050

7 February 1990

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

**Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii**

Thank you for your review of the above document. We have reviewed your letter addressed to the City and County of Honolulu Department of General Planning dated 24 January 1990, and offer the following responses.

Department of Army Permit - Nanatomi Hawaii proposes the development of a sports complex on the property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. None of the aforementioned facilities will require fill within the identified wetlands. In addition, the concept plan for the property provides an area for community-oriented facilities, which are intended to be dedicated to the appropriate State/County agency(ies). If the area to be dedicated is developed as shown on the attached map, then, the applicable governmental agency(ies) may be required to obtain Department of Army permits.

Vegetation - The sentence referred to will be revised to read, "Ultimately, the project will result in the replacement of the mostly exotic vegetation with native and exotic vegetation.

While 17 native plant species were recorded during the survey (5 endemic and 12 indigenous species), as noted in the Draft EIS all are common to the lowlands and middle elevations on Oahu, and most are common throughout Hawaii. None of the native species in the site are considered rare or endangered and no native plant communities were observed. However, as a mitigative measure, the developer will incorporate, where possible, some of the existing native vegetation (especially trees), into the landscape design. Native vegetation, along with exotic plant materials, will be used in landscaping of the property.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

enclosure

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning) w/encl.
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control) w/encl.
Eddie Sase w/encl.
Rick Tsujimura w/encl.
Danny Aranza/Dana Sanders w/encl.

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

January 8, 1990

City & County
Department of General Planning
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Re: Malulani Sports Complex, Koolaupoko, Oahu

Gentlemen:

This responds to your letter of December, 1989. To the best of our knowledge, no listed or proposed endangered species, migratory birds, or anadromous fishes within our jurisdiction occur in the proposed project area(s). However, due to current manpower and budget restrictions, the Pacific Islands Office cannot devote the time necessary to conduct a thorough review of fish and wildlife concerns associated with the referenced action at this time. We strongly recommend that you consult directly with the National Marine Fisheries Service.

Please be advised that this notification does not represent Service approval of, or support for, the proposed activity. The Service may review future actions related to this proposal should administrative constraints be alleviated or if adverse impacts to significant fish and wildlife resources are identified. Please continue to keep our office apprised of the project's status.

Sincerely,

for Ernest Kosaka
Field Office Supervisor
Pacific Islands Office

cc: Manatomi Hawaii
c/o Helber Hastert & Kimura, Planners
Mr. Marvin T. Miura, Ph.D., Director
Office of Environmental Quality Control

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634486
HHVHK UW
Facsimile
(808)
545-2050

23 January 1990

Mr. Ernest Kosaka
Field Office Supervisor
Pacific Islands Office
United States Department of the Interior
Fish and Wildlife Service
Pacific Islands Office
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the City and County of Honolulu Department of General Planning (DGP) dated 8 January 1990. We contacted DGP, and they requested that, as recommended, we consult with the National Marine Fisheries Service (NMFS). NMFS indicated that they have no comments at this time, but if the project requires a Section 10 and/or Section 404, Department of Army Permit, NMFS will be a consulted party during the processing of the Department of Army Permit application. NMFS concurs that a program to monitor the nearshore environment should be implemented.

We understand that your letter does not represent U.S. Fish and Wildlife Service (USFWS) approval or support of the project and that the USFWS may review future actions related to this proposal. We will continue to keep the USFWS apprised of the project's status.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
John Naughton (National Marine Fisheries Service)
Eddie Sase
Rick Tsujimura
Danny Aranza/Dana Sanders

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:

5090 (1968)
Ser 032/3250
3 Jan 1990

Department of General Planning
City and County of Honolulu
650 S. King St.
Honolulu, HI 96813

Gentlemen:

MALULANI SPORTS COMPLEX

The Draft Environmental Impact Statement for Malulani Sports Complex, Koolaupoko, Oahu, has been reviewed, and we have no comments to offer. Since we have no further use for the document, it is being returned to the Office of Environmental Quality Control.

Thank you for the opportunity to review the draft.

Sincerely,

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
Manatomi Hawaii
OEQC (w/DEIS)

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

5 January 1990

Mr. W.K. Liu
Assistant Base Civil Engineer
Department of the Navy
Commander
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Liu:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the City and County of Honolulu Department of General Planning dated 3 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Eddie Sase
Rick Tsujimura

JAN 19 1990

JAN 18 1990

(P)1023.0

Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: Malulani Sports Complex
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please contact Mr. Cedric Takamoto of the Planning Branch at 548-7192.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

CT:em
cc: Nanatomi Hawaii
Dr. Marvin Miura

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 834468 HHHK UW
Facsimile (808) 545-2050

19 January 1990

Mr. Teuane Tominaga
State Public Works Engineer
State of Hawaii
Department of Accounting and General Services
Division of Public Works
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Tominaga:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the Department of General Planning dated 18 January 1990 (your letter no. [p]1023.0). Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

FAX: 548-6100

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

RECEIVED
FEB - 6 1990
HELBER, HASTERT & KIMURA PLANNERS

February 5, 1990

Mr. Benjamin B. Lee
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Lee:

Subject: Draft Environmental Impact Statement (DEIS) for Malulani Sports Complex
Proposed Amendment to the Koolaupoko Development Plan - Residential, Public-Quasi Public, Agriculture to Parks and Recreation, Residential
Nanatomi Hawaii
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51
4-6-16: por. 32 Heeia, Oahu
Area: 103 acres (total of 220)

The Department of Agriculture has reviewed the subject document and finds that it addresses the concerns expressed in our letter of November 11, 1989, regarding the Environmental Impact Statement Preparation Notice for the same project.

Thank you for the opportunity to comment.

Sincerely,

Yukio Kitagawa

YUKIO KITAGAWA
Chairperson, Board of Agriculture

cc: Helber Hastert and Kimura, Planners
OEQC

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHMK UW
Facsimile (808) 545-2050

6 February 1990

Mr. Yukio Kitagawa
Chairperson
Board of Agriculture
State of Hawaii
Department of Agriculture
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the Department of General Planning, dated 5 February 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 FAX (808) 531-5243

JOHN WAIHEE
GOVERNOR
ROGER A. ULVELING
DIRECTOR
BARBARA KIM STANTON
DEPUTY DIRECTOR
LESLIE S. MATSUBARA
DEPUTY DIRECTOR

January 10, 1990

Department of General Planning
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Sir:

Subject: Malulani Sports Complex, Koolaupoko, Oahu

We wish to inform you that we have no comments to offer on the subject environmental impact statement.

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:lf

cc: Hanatomi Hawaii
Dr. Marvin T. Miura, OEQC

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHHK UW
Facsimile
(808)
545-2050

15 January 1990

Mr. Maurice H. Kaya
Energy Program Administrator
State of Hawaii
Department of Business and Economic Development
Energy Division
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Kaya:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the Department of General Planning, dated 10 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

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

ALEXIS T. LUM
MAJOR GENERAL
ADJUTANT GENERAL

MILES M. NAKATSU
COLONEL
DEPUTY ADJUTANT GENERAL

JAN 6

January 5, 1990

Engineering Office

Dr. Marvin T. Miura, Director
Officer of Environmental Quality Control
465 South King Street, #104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Malulani Sports Complex
Koolaupoko, Oahu

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting & Engineering Officer

cc: C&C of Honolulu
Dept of General Planning
650 South King St.,
Honolulu HI 96813

Hanatomi Hawaii
c/o Helber Hastert & Kimura, Planners
Vincent Shigekuni
733 Bishop St, Ste 2590
Honolulu, HI 96813

NATIONAL GUARD
Americans At Their Best.

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634438
HHHK UW
Facsimile
(808)
545-2050

8 January 1990

Lt. Col. Jerry M. Matsuda
Hawaii Air National Guard
Contracting & Engineering Officer
State of Hawaii
Department of Defense
Office of the Adjutant General
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Lt. Col. Matsuda:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the State of Hawaii Office of Environmental Quality Control dated 5 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

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

OFFICE OF THE SUPERINTENDENT

CHARLES T. TOGUCHI
SUPERINTENDENT

January 11, 1990

Mr. Vincent Shigekuni
Helbert, Hastert & Kimura Planners
Grosvenor Center
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

SUBJECT: Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu
TMK: 4-6-06:1, 4, 7, 9, 11, 13, 15, 22-44, 48-51, 4-6-16: Por 32

We have reviewed the subject draft Environmental Impact Statement and have no further comments to make at this time regarding the project.

Thank you for the opportunity to review the draft.

Sincerely,

for Kenzo Dakato
Charles T. Toguchi
Superintendent

CTT:jl

cc: Mr. E. Imai
Mrs. S. Loo

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

19 January 1990

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

Dear Mr. Toguchi:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 11 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

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

DEPUTIES
Keith W. Ahue
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

REF:OCEA-VIN

File: 90-374
Doc.: 7436E

FEB 16 1990

RECEIVED
FEB 17 1990
HELBER, HASTERT & KIMURA PLANNERS

MEMORANDUM

TO: Honorable Marvin T. Miura, Director
Office of Environmental Quality Control

FROM: William W. Paty, Chairperson
Board of Land and Natural Resources

SUBJECT: Draft EIS
Malulani Sports Complex
Koolaupoko, Oahu

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Approximately 116 acres of the project site is within the Conservation District. As indicated on page III-4, a Conservation District Use Application (CDUA) will be required prior to the initiation of any new, change in existing, or expansion of land use within the Conservation District (Administrative Rules, Title 13, Chapter 2).

In addition, Heeia State Park has a serious highway ingress-egress problem because of its location at the top of a hill where the road curves. Your proposed realignment of Kamehameha Highway may alleviate this problem to some extent but there may be other alternatives which would be more beneficial to us. We are also interested in improved pedestrian access between our park and Heeia Kea Pier.

Because of the hazardous highway fronting the park, we are concerned about pedestrian crossings and/or jay walking between the proposed community facilities and our park. Considering the topography and the hazards, a pedestrian overpass may be required.

As part of our interpretive/outdoor education programs planned for the park, we would like to have the opportunity to hike along the ridge as indicated on your plan. We urge you to consider providing a public easement for this trail.

Also, it has been our experience that rain shelter is needed for park facilities at Heeia. Further, there is no existing or proposed beach access or fishing pier at Heeia State Park. Please correct Figure 5.

In addition, in Section 4.11, Historic and Archaeological Resources, no determination of significance has been made and no commitment has been made to carry out the consulting archaeologist's recommendation. If the developer agrees with the consultant's determinations of significance and plans to carry out the recommended work, then the agreement and the commitment should be clearly stated.

If these determinations and commitments are not made, the project will have an "adverse effect" on the archaeological sites on the property.

With regard to the recommendations made by the consulting archaeologist, we do not concur with the concept of relocation of Site 4144 as a preservation measure. If further research indicates that this site is a shrine with historic depth, and if it proves to be associated with a burial, then preservation in place is indicated.

Furthermore, the mitigation measures described in the Draft EIS that would prevent excessive erosion and siltation during and after construction appear to be adequate. However, we are concerned about the possibility of a build-up in the nutrient load of the Heeia Fishpond and increases in primary productivity in the adjacent stream as a result of fertilizer runoff or leaching from the golf course.

The control measures described and the monitoring program proposed by the applicant should be made mandatory to prevent excessive nutrient loading that may be attributed to golf course ground management.

Should the project be approved, we suggest that construction activities (clearing, grading, leveling, etc.), especially the clearing of riparian vegetation, be limited to the drier periods of the year to reduce erosion and excessive silt-laden runoff, and prevent adverse effects on coastal waters and the nearby Heeia Stream and Fishpond from construction contaminants.

Moreover, proposed shoreline modifications or other activities that may affect aquatic resources or their habitat during project development should be submitted to the Department for review.

Finally, the project developers should understand that although there are presently no native fauna at the project site, the development of a golf course with ponds and waterways will attract native waterbirds such as the endangered stilt, coot, gallinule and koloa, especially since this site is of close proximity to Heeia Marsh.

The judicious use of chemicals on the golf course will be essential not only as a precaution to polluting the marine environment, but the ponds and waterways of the golf course which will be used by these birds.

If you have any questions, please feel free to call me or Cathy Tilton at our Office of Conservation and Environmental Affairs at (808) 548-7837.

WILLIAM W. PATY

cc: HPP, DAR, DOFAW, State Parks
City and County of Honolulu
Department of General Planning
Manatomi Hawaii, c/o Helber Hastert & Kimura, Planners

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHKUW
Facsimile (808) 545-2050

2 March 1990

Mr. William W. Paty
Chairperson
Board of Land and Natural Resources
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum addressed to Marvin T. Miura, of the Office of Environmental Quality Control, postmarked 16 February 1990 and offer the following responses.

1. As part of the conceptual plan for the Malulani Sports Complex, it is proposed land be dedicated to the appropriate governmental agency for the possible realignment of Kamehameha Highway and the development of a beach park (and parking). The proximity of the proposed beach park and community facilities (across Kamehameha Highway) will be beneficial to Heeia State Park and to Heeia Kea Pier and Boat Harbor). It appears the proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor.

2. We share your concerns regarding safety of pedestrian crossing of Kamehameha Highway between the proposed community facilities and Heeia State Park. However, the addition of a pedestrian overpass (which are often unused is not in the keeping with the character of the area. Other possible options could be as simple as establishment of a crosswalk near the proposed entry to Heeia Kea Pier and Boat Harbor (especially due to the increasing numbers of harbor users), hiring of off-duty police for traffic control during special events, and/or signalization, if warranted.

3. The applicant has agreed to provide public easements for the proposed hiking trails along the perimeter (the ridgeline) of the property as part of the overall project concept.

4. We appreciate the information provided on rainfall conditions and will consider same as we proceed with the project.

5. While Heeia State Park is not part of the proposed project, a proposal for beach access and a fishing pier was shown to reflect suggestions we have received from area residents. The Conceptual Plan also shows the impact of the proposed community-oriented facilities on Heeia State Park and Heeia Kea Pier and Boat Harbor and some preliminary ideas to improve these latter (existing) public recreational facilities.

6. Determinations of significance for the various identified sites were made by the consulting archaeologist, Paul H. Rosendahl, Ph.D., Inc. (PHRI), however, the Draft EIS did not summarize these determinations. Section 4.11, Historic and Archaeological Resources, of the Final EIS will include a summary of PHRI's determinations of significance and will clearly state that the developer is committed to implementing PHRI's recommendations.

7. PHRI recently conducted subsurface testing at Site 4144. The test excavation shows that the upright stone is placed within a stratum which contained much historic trash. Obviously, the stone was placed historically, and most likely, recently (within the last 30 to 40 years; certainly after the late 1940's, after the military left the property). Site 4144 may represent a family shrine; efforts to locate people who know of the "shrine", however, have been unsuccessful. It appears the "shrine" (if indeed it is one) has been abandoned.

While Site 4144 had been assessed earlier as significant for information content and cultural value, based on the most recent work by PHRI, the site has been reassessed by PHRI as not significant for information content and of minimal significance in terms of cultural value. The former assessment is made because the site is recent. The latter assessment is made because (a) the "shrine" was probably used by a single family, (b) other local residents are not aware of it, and (c) it is no longer in use and evidently has not been used since 1988. According to PHRI, no further archaeological work is recommended for the site; if necessary, the site can be destroyed.

8. Satisfactory reduction of chemical transport in runoff can likely be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadways servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation.

Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow released nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff. The project is not located mauka of Heeia Kea Fishpond or Heeia Kea Stream.

9. Section 6.4.2 of the Draft EIS stated that the proposed ponds and water features would serve as detention silt and debris basins, reducing the peak runoff. The proposed detention basins and designed golf course rough features are expected to reduce the peak runoff discharge to below that of the existing condition. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts of runoff.

The Draft EIS (Section 4.3.2, page IV-8) also stated that the impacts of construction on soil erosion can be mitigated by conforming to strict erosion control measures, particularly those specified in the State Department of Health's Water Quality Standards, Chapter 37-A, Public Health Regulations, 1968; and the Soil Conservation Services' Erosion and Sediment Control Guide for Hawaii, 1968. Primary fugitive dust control methods include wetting down loose soil areas, good housekeeping on the job site, and prompt landscaping of bare soil areas. Implementation of these measures should negate the need to limit clearing, grading, leveling activities to the drier periods of the year.

In addition, the Draft EIS (Section 4.5.2, page IV-13) stated that a marine environmental monitoring program will be implemented.

10. Nanatomi Hawaii proposes the development of a sports complex on the 220-acre property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. None of the aforementioned facilities involve shoreline modifications or other activities that may affect aquatic resources or their habitat during construction. The community-oriented facilities (shown on the concept plan for the property) which are intended to be dedicated to the appropriate State/County agency(ies) may affect the identified wetlands by their adjoining use. If the area to be dedicated is developed as shown on the attached map, then, the applicable governmental agency(ies) may be required to obtain Department of Army permits.

11. The applicant concurs that the ponds and waterways of the proposed golf course may attract native waterbirds. An environmental assessment of the application of fertilizer, herbicide and pesticide use in golf course maintenance has been prepared (Murdoch, Charles L. and Richard E. Green, "Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Malulani Golf Course." 15 December 1989). According to Murdoch and Green, there have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Eddie Sase
Rick Tsujimura
Paul Rosendahl

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

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

DEPUTIES
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

January 12, 1990

MEMORANDUM

TO: Marvin T. Miura, Director, OEQC

FROM: Don Hibbard, Director, Historic Preservation Program

SUBJECT: Malulani Sports Complex
Heeia, Koolaupoko, O'ahu
TMK: 4-6-06: various and 4-6-16: por 32

In Section 4.11, Historic and Archaeological Resources, no determination of significance has been made and no commitment has been made to carry out the consulting archaeologist's recommendations. If the developer agrees with the consultant's determinations of significance and plans to carry out the recommended work, then the agreement and the commitment should be clearly stated.

If these determinations and commitments are not made, the project will have an "adverse effect" on the archaeological sites on the property.

With regard to the recommendations made by the consulting archaeologist, we do not concur with the concept of relocation of Site 4144 as a preservation measure. If further research indicates that this site is a shrine with historic depth, and if it proves to be associated with a burial, then preservation in place is indicated.

Don Hibbard

DON HIBBARD

cc: Vincent Shigekuni, Helber Hastert & Kimura, Planners

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634483 HHK UW
Facsimile (808) 545-2350

5 February 1990

Mr. Don Hibbard
Director
Historic Preservation Program
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Hibbard:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter addressed to Marvin T. Miura, of the Office of Environmental Quality Control, dated 12 January 1990 and offer the following responses.

Determinations of significance for the various identified sites were made by the consulting archaeologist, Paul H. Rosendahl, Ph.D., Inc. (PHRI), however, the Draft EIS did not summarize these determinations. Section 4.11, Historic and Archaeological Resources, of the Final EIS will include a summary of PHRI's determinations of significance and will clearly state that the developer is committed to implementing PHRI's recommendations.

PHRI contacted the State Historic Preservation Office and described the preliminary findings of the inventory survey at Site 4144. After learning about the site, it was agreed that if Site 4144 is a burial, than relocation will be an alternative mitigative measure. PHRI will be conducting field work immediately to determine whether or not Site 4144 is indeed a burial. In addition, PHRI has begun further historical research to verify if Site 4144 is a shrine. If Site 4144 is not a shrine, than it is our understanding that relocation of the site is possible.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Eddie Sase
Rick Tsujimura
Alan Haun/Paul Rosendahl

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
79 SO. NIMITZ HWY. • HONOLULU, HAWAII 96813-4898

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
RONALD N. HIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO
HAR-EP 2360

February 26, 1990

FEB 28 1990
HELBER, HASTERT & KIMURA PLANNERS

Nanatomi Hawaii, Inc.
c/o Mr. Vincent Shigekuni
Helber Hastert & Kimura Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Malulani Sports Complex
Draft Environmental Impact
Statement (DEIS)

Thank you for meeting with my staff on February 16, 1990 and presenting the background of the subject development.

We have reviewed the DEIS and the proposed community facilities as they impact our Heeia Kea Small Boat Harbor. As discussed, we are concerned about our access road, parking area and other operational matters. We will be available to work with you in resolving these concerns.

If you have any questions please call Mr. Harry Murakami at 548-2535.

Very truly yours,

Calvin M. Tsuda
Deputy Director for Harbors

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHHK UW
Facsimile
(808)
545-2050

1 March 1990

Mr. Calvin M. Tsuda
Deputy Director for Harbors
State of Hawaii
Department of Transportation
Harbors Division
79 South Nimitz Highway
Honolulu, Hawaii 96813-4898

Dear Mr. Tsuda:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 26 February 1990 (your reference no. HAR-EP 2360). We greatly appreciated your meeting with us and we look forward to continuing working with your Department and the Department of Land and Natural Resources towards resolving your concerns.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Donna Kanemaru

JOHN WAIHEE
GOVERNOR

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) 543-4641

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

RECEIVED
FEB - 8 1990

IN REPLY REFER TO:
90:PLNG/564 jt

February 6, 1990

MEMORANDUM

TO: Mr. Benjamin B. Lee, Director
Department of General Planning

FROM: Joseph K. Conant

SUBJECT: Draft Environmental Impact Statement for the Proposed Malulani Sports Complex

We have reviewed the subject draft EIS and offer the following comments.

The Hawaii State Plan includes two objectives with regard to housing. One objective, which is cited in the draft EIS, is the "orderly development of residential areas sensitive to community needs and other land uses."

Another objective, which has not been cited in the draft EIS, is to provide "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." As proposed, we do not believe that the residential component of the project will provide "reasonably priced" housing opportunities for persons and families of all income ranges.

Thank you for the opportunity to comment.

JOSEPH K. CONANT
Executive Director

cc: ✓Helber Haster & Kimura, Planners
Dr. Marvin T. Miura, OEQC

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHVHK UW
Facsimile
(808)
545-2050

23 February 1990

Mr. 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

Dear Mr. Conant:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter addressed to the Department of General Planning, postmarked 7 February 1990 (your reference no. 90:PLNG/564 jt). Section 3.2.1 of the Final EIS will be revised to include the following Hawaii State Plan housing objective: to provide "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." Section 3.2.1 will note that the residential component of the proposed project is not intended to provide "reasonably priced" housing opportunities for persons and families of all income ranges. This section will further note that a more intensive scale of residential development, which could provide for "a range of housing opportunities for persons and families of all income levels", will likely encounter significant community opposition, as it has in the past.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Donna Kanemaru

STATE OF HAWAII
DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

LAND USE COMMISSION

Room 104, Old Federal Building, 335 Merchant Street
Honolulu, Hawaii 96813 Telephone: 548-4611

JAN 9 1990

JOHN WAIHEE
Governor

RENTON L.K. NIP
Chairman

LAWRENCE F. CHUN
Vice Chairman

January 5, 1990

Mr. Vincent Shigekuni
Helber Hastert & Kimura, Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Draft EIS for the Malulani Sports Complex

We have no comments to offer on the subject draft EIS.

Thank you for the opportunity to comment.

Sincerely,

Raymond Young
Raymond Young
Staff Planner

RY:to

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634408 HH/HK UW
Facsimile (808) 545-2050

10 January 1990

Mr. Raymond Young
Staff Planner
State of Hawaii
Department of Business and Economic Development
Land Use Commission
335 Merchant Street, Room 104
Honolulu, Hawaii 96813

Dear Mr. Young:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 5 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Ben Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 SOUTH KING STREET, ROOM 104
HONOLULU, HAWAII 96813

MARVIN T. MIURA, Ph.D.
DIRECTOR

TELEPHONE NO.
548-6915

February 6, 1990

MEMORANDUM

TO: Honorable Benjamin B. Lee
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, HI 96813

FROM: Marvin T. Miura, Ph.D., Director
Office of Environmental Quality Control

SUBJECT: Draft Environmental Impact Statement
Makulani Sports Complex

We have reviewed the subject statement and offer the following comments.

We suggest that the assessment contain an evaluation of the site for existing hazardous waste. The site has been utilized by Hawaiian Electric as a baseyard and may contain polychlorinated biphenyls (PCBs) and other toxic substances. The site is currently being used for storage of construction equipment and supplies and trucking vehicles which could also contribute to hazardous waste deposits on the site. If an evaluation determines that waste does reside on the property, the assessment should contain proposals for clean-up and disposal of the wastes.

We note that page I-4 states that the project will result in the replacement of existing exotic vegetation with new exotic vegetation. However, page 7 of the Biological Survey and page IV-14 of the assessment states that 17 native plant species were recorded although no native plant colonies were noted. The applicant might consider the use of native plants in the landscaping of the project.

Appendix E, page 8 indicates that carbaryl and trichlorfon are less toxic pesticides to birds than chlorpyrifos and in most cases may be substitute with little loss of effectiveness. This measure might be proposed in the main body of the assessment.

The final should correct the statement on page II-9 regarding the H-3 connector to downtown Honolulu since the H-3 will connect to Halawa Valley which is approximately 6 miles from downtown.

We find the contention that a golf course would represent an economically viable form of agricultural use somewhat questionable. By Chapter 205 Hawaii Revised Statutes, golf courses are permitted as open area recreational activities within the Agricultural District if they are not classified A or B by the Land Study Bureau's Detailed Land Classification.

If you have any questions regarding our comments, please contact Louise Peterson of my staff at 548-6915.

Thank you for the opportunity to comment.

cc: Nanatomi Hawaii, Inc.

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

23 February 1990

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

Dear Mr. Miura:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum addressed to the Department of General Planning, dated 6 February 1990 and offer the following responses:

Hazardous Waste - The Final EIS will contain an evaluation of the site for existing hazardous waste. If any are present, proposals for clean-up and disposal of the wastes will also be included in the Final EIS.

Vegetation - The sentence on page I-4 of the Draft EIS will be revised to read. "Ultimately, the project will result in the replacement of the mostly exotic vegetation with native and exotic vegetation.

While 17 native plant species were recorded during the survey (5 endemic and 12 indigenous species), as noted in the Draft EIS, all are common to the lowlands and middle elevations on Oahu, and most are common throughout Hawaii. None of the native species on the site are considered rare or endangered and no native plant communities were observed. The developer will incorporate, where possible, some of the existing native vegetation (especially trees), into the landscape design. Native vegetation, along with exotic plant materials, will be used in landscaping of the property.

Impacts of Pesticides on Birds - As recommended, Section 4.7.2 of the EIS will be revised to include that carbaryl and trichlorfon are less toxic pesticides to birds than chlorpyrifos and in most cases may be substituted with little loss of effectiveness.

H-3 - The statement on page II-9 of the Draft EIS will be revised to read. "The site is in a location which should witness significant appreciation in the future following the completion of the H-3 connector to the Primary Urban Center..."

Golf Course as a Form Agricultural Use - Please note that no portion of the property is located within the State Agriculture Land Use District boundaries. Recently, the Department of Agricultural and Resource Economics, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa completed a draft report that was titled, "An Economic Profile of Hawaii's Landscape Services in 1987" (Linda J. Cox, James R. Hollyer and Donald M. Schug, August 1989). This study was generously funded through the Governor's Agriculture Coordination Committee. The report surveyed the gross sales of those involved in the landscape industry. The estimated gross sales of landscaping activities in Hawaii, extrapolated from the surveys, was approximately $349.9 million in 1987, this included an estimated $94.2 million from golf courses. The study stated that: "To give an idea of how the value of landscape services presented here compares to the value of other agricultural activities (emphasis added) in Hawaii, the gross sales of the State's fresh and processed pineapple industry was $251 million in 1987 (Hawaii Agricultural Statistics Service)."

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Donna Kanemaru

OFFICE OF STATE PLANNING
Office of the Governor

February 9, 1990

RECEIVED
FEB 14 1990
HELBER, HASTERT & KIMURA
PLANNERS

The Honorable Benjamin B. Lee
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Lee:

Subject: Draft Environmental Impact Statement
Malulani Sports Complex
Heeia, Koolaupoko, Oahu

We have reviewed the Draft Environmental Impact Statement (EIS) for the proposed Malulani Sports Complex in Heeia, Koolaupoko, Oahu, and have the following comments.

Project Location

The proposed project site is located in Heeia Kea Valley, mauka of Kamehameha Highway, adjacent to the Heeia Kea Pier and Boat Harbor. Heeia Meadowlands and Heeia Pond are situated less than half a mile south of the project site. Heeia State Park is located about a quarter of a mile to the southeast.

Proposed Uses

The applicant, Nanatomi Hawaii, Inc. has applied to the City and County of Honolulu, Department of General Planning, for an amendment to the Koolaupoko Development Plan (DP), for the development of a sports complex in Heeia Kea Valley, Koolaupoko, Oahu. The proposed sports complex would include an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and related fitness facilities, as well as 30 to 35 single-family homes.

Impact on Areas of State Concern

The Office of State Planning (OSP) is concerned with the impacts of the proposed project on areas of state concern, particularly in light of the project site's proximity to the Heeia Meadowlands, Heeia Pond, Heeia Kea Pier and Boat Harbor, and Heeia State Park. The proposed project will result in the urbanization of that part of Kaneohe where there is great concern about the direction of urban growth. The State's position on Heeia Meadowlands is reflective of this concern.

In addition, the sports activities and residential uses proposed at the site may generate additional traffic, contributing to overtaxed driving conditions in the area. Fertilizer and pesticide use on golf courses may impact the quality of surface and nearby coastal waters. The proposed project may adversely impact accessibility and use of the area's recreational resources, such as hiking trails, campgrounds, and picnic areas. Wildlife habitats may be affected as well. We also know that while the application before the City is for a DP amendment, the project as proposed will impact lands classified as Conservation.

In summary we have serious concerns about the proposed project.

Thank you for the opportunity to comment.

Sincerely,

Harold S. Masumoto
Director

cc: Nanatomi Hawaii
c/o Helber Hastert & Kimura, Planners

Marvin T. Miura, Ph.D., Director
Office of Environmental Quality Control

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

12 March 1990

Mr. Harold S. Masumoto
Director
Office of State Planning
Office of the Governor
State Capitol
Honolulu, Hawaii 96813

Dear Mr. Masumoto:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter addressed to the Department of General Planning, postmarked 13 February 1990 and offer the following responses to your comments.

Impact on Areas of State Concern (Heeia Meadowlands, Heeia Pond, Heeia Kea Pier and Boat Harbor, and Heeia State Park) - The Malulani Sports Complex project site is separated from Heeia Pond and Heeia Meadowlands by the southern ridge of Puu Maelieli/Kealohi Point (Heeia State Park). The proposed project does not involve the urbanization of Heeia Pond or Heeia Meadowlands.

The Development Plan Special Provisions for Koolaupoko includes an area description which states: "Suburban single-family development is to be the predominant residential use surrounded by substantial amount of open space and agricultural land...It is intended that communities of Kailua and Kaneohe will remain stable, predominantly single-family suburban 'bedroom communities'...The communities of Kahaluu, Waiahole-Waikane, and Kualoa are to remain relatively lightly settled, rural areas with the exception of limited areas in Heeia Kea and Ahuimanu Valley, where residential development of a low-density suburban character already exists." The proposed action is compatible with the Development Plan description of Koolaupoko. The project involves a small residential development (maximum density of 2.4 units per acre) surrounded by substantial open space (golf course and undeveloped hillsides). This information was provided in Section 3.3.2.3 of the Draft EIS.

Please note that the property presently contains approximately 16.2 acres that are zoned R-5 and is subdivided for 31 lots. The applicant is only requesting the reconfiguration of the R-5 zoning inland, away from Kamehameha Highway. No additional R-5 zoning is being sought.

As part of the conceptual plan for the Malulani Sports Complex, it is proposed land be dedicated to the appropriate governmental agency(ies) for the possible realignment of Kamehameha Highway and the development of a beach park (and parking). The proximity of the proposed beach park and community facilities (across Kamehameha Highway) will be beneficial to Heeia State Park and to Heeia Kea Pier and Boat Harbor. It appears the proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor.

The Malulani Sports Complex project is in no way related to proposals for Heeia Meadowlands and involves different landform situations and conditions. The State's position on Heeia Meadowlands should be directed to the appropriate landowner and/or developer.

Traffic - A traffic impact analysis report on the proposed Malulani Sports Complex was prepared by Sam O. Hirota, Inc, copied in its entirety in the Draft EIS as Appendix J and summarized in Section 6.1. Kamehameha Highway between Kahekili Highway and Haiku Road will remain, for the foreseeable future, a collector road serving local traffic in the Kaneohe area. In recent years, the traffic volume has declined over this segment of the highway due to improvements on Kahekili Highway and this trend should continue as additional improvements are implemented to Kahekili Highway. In addition, there are limited areas along this stretch of Kamehameha Highway with potential for development that would generate new traffic (especially given the State's position on Heeia Kea Meadowlands). It is agreed that the proposed sports activities and residential uses will generate traffic, however, the project-generated traffic will have a minimal impact on the regional traffic system, since it is a facility that will attract a relatively minimal amount of traffic, distributed evenly throughout the day, that will be going in the opposite direction from the Primary Urban Center. It is anticipated that traffic congestion will continue to worsen on Kahekili and Likelike highways without the project if improvements (such as the proposed widening of Kahekili Highway and the construction of H-3) are not implemented. The above information on traffic was provided in Section 6.1.2 of the Draft EIS.

Fertilizer and Pesticide Use on Golf Course - The potential impact of fertilizer, herbicide and pesticide use on the proposed golf course was studied by Charles L. Murdoch, Ph.D. and Richard E. Green, Ph.D. Their report was copied in its entirety in the Draft EIS as Appendix E. Satisfactory reduction of chemical transport in runoff can likely be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadways servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation.

Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow released nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff.

All of the above information was provided in Section 4.4.2 (page IV-11 of the Draft EIS) and Section 6.4.2 (page VI-6 of the Draft EIS) of the EIS.

Accessibility to Area's Recreational Resources - Presently, the property has no recreational value, and is not being used for hiking, camping or picnicking. The applicant will dedicate approximately 9 acres of the property for community-oriented facilities. Approximately 1 acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park (desirable according to preliminary consultation with some segments of the community) and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. The proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area (all of the above information was described in sections 2.5, 3.2.2 and 6.7.2 of the Draft EIS). Meetings have been held with the State Departments of Transportation (Harbors Division), and Land and Natural Resources, and the City and County of Honolulu Departments of Transportation Services, and Parks and Recreation regarding the area proposed to be dedicated for community facilities. Sections 2.5, 3.2.2 and 6.7.2 of the Draft EIS also stated that hiking trails and a 4-acre campground accessible to the windward community with a permit from the applicant are also planned. The applicant has agreed to provide public easements for the proposed hiking trails along the perimeter (the ridgeline) of the property as part of the overall project concept.

Wildlife - A biological survey was prepared by Kenneth M. Nagata, was copied in its entirety in the Draft EIS as Appendix A and summarized in Sections 4.6 and 4.7. The proposed project is not expected to have a significant impact

on the biological communities of the study site as it is a highly disturbed area. According to Mr. Nagata, the proposed project will result in the loss of vegetation and some faunal habitat, but considering that all of the birds and mammals in the site are wide-ranging species common to most urban and field situations, this loss is considered negligible.

Lands within the State Conservation Land Use District - Section 3.2.3 of the Draft EIS stated that proposed uses for the portion of the property not within the State Land use Urban District will require a Conservation District Use Application.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

We greatly appreciated your meeting with us on 5 March 1990. Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Donna Kanemaru

DGP 1/90-208

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96843

January 18, 1990

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR
MALULANI SPORTS COMPLEX

We have the following comments on the proposed sports complex:

1. The proposed 12-inch water main on Kamehameha Highway should be connected to the existing 30-inch low service transmission line and not to the existing 16-inch high service line as indicated on pages II-6 and VI-4 of the EIS and page 2 of the water supply report attached to the EIS.

2. Our previous comments of October 11, 1989 on the proposed sports complex which are included in Chapter IX of the EIS are still valid and applicable to the project.

cc: Nanatomi Hawaii
c/o Helber, Hastert and Kimura, Planners

Marvin T. Miura, Ph.D., Director
Office of Environmental Quality Control

RECEIVED
'90 JAN 22 PM 2:27
DEPT. OF GENERAL PLANNING
C & C HONOLULU

Pure Water . . . man's greatest need – use it wisely

HELBER
HASTERT
& KIMURA
Planners
HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634488 HHHK UW
Facsimile (808) 545-2050

10 February 1990

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to Benjamin B. Lee of the Department of General Planning dated 18 January 1990 and offer the following responses to your comments:

1. The EIS will be revised to state that the proposed 12-inch water main on Kamehameha Highway will be connected to the existing 30-inch low service transmission line.

2. Your comments of 11 October 1989, which were incorporated in Sections 2.6.1 and 6.2.2 of the Draft EIS will remain in the Final EIS.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

RECEIVED
FEB - 7 1990
HELBER, HASTERT & KIMURA PLANNERS

PB 90-98

February 5, 1990

MEMO TO: BENJAMIN LEE, DIRECTOR
DEPARTMENT OF GENERAL PLANNING

FROM: HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
MALULANI SPORTS COMPLEX

We have reviewed the subject DEIS and have no comments to offer.

Thank you for the opportunity to review the DEIS.

HERBERT K. MURAOKA
Director and Building Superintendent

DC:jo
cc: J. Harada
Nanatomi Hawaii
Office of Env. Quality Control

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHKUW
Facsimile (808) 545-2050

7 February 1990

Mr. Herbert K. Muraoka
Director and Building Superintendent
Building Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Muraoka:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your memorandum to Benjamin B. Lee of the Department of General Planning dated 5 February 1990 (your reference no. PB 90-98). Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

DEPARTMENT OF GENERAL PLANNING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

Benjamin B. Lee
CHIEF PLANNING OFFICER

MM/DGP 12/89-4584
12/89-4623

January 29, 1990

RECEIVED JAN 31 1990 HELBER, HASTERT & KIMURA PLANNERS

Mr. Vincent Shigekuni
Helber Hastert & Kimura, Planners
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Draft Environmental Impact Statement (DEIS) for the Malulani Sports Complex at Heeia, Koolaupoko Tax Map Key 4-6-6: 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51; and 4-6-16: Portion of 32, Folder No. 90/KP-1

We have reviewed the Malulani Sports Complex DEIS and have the following comments:

1. The area in question, 103 acres, is quite small to support all the proposed uses especially an 18-hole golf course. Are you considering expanding the existing site? If so, where?

2. The document should indicate the projected fee schedule for public play and elaborate on the offering of "certain discounts to Kahaluu and Kaneohe residents." Clubhouse membership requirements should be explained.

3. The status of discussion between Nanatomi Hawaii, Inc., and affected City and State agencies vis-a-vis realignment of Kamehameha Highway, the area for boat harbor and related uses and dedication of lands for park purpose should be clarified.

4. The DEIS indicates that a Conservation District Use Application (CDUA) would be sought from the State of Hawaii, presumably for Golf Course use. The details of the CDUA should be elaborated upon.

5. The DEIS should clearly indicate the proposed use of the wetland areas.

6. The DEIS should elaborate on the potential impacts of herbicides, fertilizers, fungicides and other chemicals to be used in golf course maintenance on migratory and endangered waterbirds. Also, specify the types of chemicals which would be used.

7. Finally, the document should incorporate substantive remarks (such as from the State Departments of Health, Land and Natural Resources and Transportation and the City Departments of Housing and Community Development, Land Utilization and Parks and Recreation) within the body of the report, rather than merely generalizing concerns and reproducing comments in the response section. This would further clarify problems, impacts and mitigating measures.

If there are any questions, please call Mel Murakami of my staff at 527-6020.

Sincerely,

BENJAMIN B. LEE
Chief Planning Officer

BBL:lh

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

9 February 1990

Mr. Benjamin B. Lee
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Lee:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter dated 29 January 1990 (your reference no. MM/DGP 12/89-4584, 12/89-4623) and offer the following responses to your comments.

1. As stated in Section 2.1, on page II-1 of the Draft Environmental Impact Statement (EIS), the "area of application consists of approximately 103 acres out of a total project area of approximately 220 acres..." Nanatomi Hawaii, Inc. is not considering expansion of the golf course.

2. The projected fee schedule for public play and discounts to Kahaluu and Kaneohe residents is unknown at this time because of the uncertainties in estimating the cost of development and the cost of operating the golf course, once completed. However, unlike other golf courses premised upon private memberships, this golf course will be largely dependent on public play for revenue, consequently the fee would be competitive with other courses catering to public play that will be in operation at the same time.

Clubhouse or membership requirements have not yet been established, however, as a policy, no international memberships will be sold.

3. At the present time, the City and County of Honolulu Department of Parks and Recreation is the only public agency which has been officially contacted regarding the area proposed to be dedicated for community facilities. A letter explaining the project and the park proposal has been sent to DLNR. We are presently trying to set up meetings with the State Department of Land and Natural Resources, and the City and County of Honolulu Department of Transportation Services. We are meeting with the State Department of Transportation Harbors Division next week.

4. While the need for a CDUA was indicated in Table 1, Section 1.7 of Chapter I, Introduction and Summary of the Draft EIS, additional information was provided elsewhere in the Draft EIS. Section 3.2.3 of the Draft EIS stated that "Proposed uses for the portion of the property not within the State Land Use Urban District (approximately 116 acres) will require a Conservation District Use Application (CDUA)."

5. Nanatomi Hawaii proposes the development of a sports complex on the 220-acre property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. None of the aforementioned facilities will require the filling of the identified wetlands. The community-oriented facilities (shown on the concept plan for the property) which are intended to be dedicated to the appropriate State/County agency(ies) may affect the identified wetlands by their adjoining use. If the area to be dedicated is developed as shown on the attached map, then, the applicable governmental agency(ies) may be required to obtain Department of Army permits. Figure 11 (Wetlands Map) of the EIS will be revised to show a composite of the Concept Plan with the location of the wetlands (refer to the attached map).

6. As recommended, Section 4.7.2 of the Final EIS will elaborate the potential impacts of herbicides, fertilizers, and fungicides to be used in golf course maintenance on migratory and endangered waterbirds. This section will also list the chemicals which are used in golf course maintenance.

7. We have identified specific sections of the Final EIS which will incorporate substantive comments from the State Departments of Health, Land and Natural Resources and Transportation, and the City Departments of Housing and Community Development, Land Utilization, and Parks and Recreation received during the Draft EIS consultation period with Mr. Melvin Murakami of your staff. The appropriate sections of the EIS will be revised accordingly.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

enclosure

cc: Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Donna Kanemaru

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5TH FLOOR
HONOLULU, HAWAII 96813
PHONE: 523-4427 • FAX 527-5498

FRANK F. FASI
MAYOR

MICHAEL N. SCARFONE
DIRECTOR

RONALD S. LIM
DEPUTY DIRECTOR

FEB 21 1990
HELBER, HASTERT & KIMURA
PLANNERS

February 5, 1990

RECEIVED
'90 FEB 7 PM 4:03
GENERAL PLANNING
C & C HONOLULU

MEMORANDUM

To: Benjamin B. Lee, Chief Planning Officer
Department of General Planning

From: Michael N. Scarfone, Director

Subject: Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu

We appreciate the opportunity to review the draft Environmental Impact Statement for the proposed Malulani Sports Complex. The Department has no comments to offer at this time.

Thank you for the opportunity to comment.

Michael N. Scarfone

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634458
HHHK UW
Facsimile
(808)
545-2050

23 February 1990

Mr. Michael N. Scarfone
Director
Department of Housing and Community Development
City and County of Honolulu
650 South King Street, 5th Floor
Honolulu, Hawaii 96813

Dear Mr. Scarfone:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your memorandum to Benjamin B. Lee of the Department of General Planning dated 5 February 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

DGP 2/90-388

DEPARTMENT OF LAND UTILIZATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

LU12/89-8255(DEB)
89/EC-4

RECEIVED
'90 FEB 6 PM 2:44
DEPT. OF GENERAL PLANNING
C & C HONOLULU

February 6, 1990

MEMORANDUM

TO: BENJAMIN B. LEE
CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: DONALD A. CLEGG, DIRECTOR

SUBJECT: MALULANI SPORTS COMPLEX
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)
KANEOHE, KOOLAUPOKO, OAHU; TAX MAP KEYS: 4-6-06: 1, 4, 7, 9 11, 13, 15, 22-44, 48-51 AND 4-6-16: POR. 32

Thank you for the opportunity to comment on the Draft EIS for the above described project. We have reviewed the document and offer the following comments:

1. The applicant should state the number of acres being proposed for both Parks and Recreation and Residential Development Plan designations in Section 1.3, Page I-2.

2. Any proposed work within the shoreline setback requires a Shoreline Setback Variance. Since it appears that development is proposed within the shoreline setback area makai of Kamehameha Highway, this variance should be listed in Table 1: Necessary Permits and Approvals on Page I-5. In addition, the Draft EIS states that two wells will be drilled on the mauka portion of the site to augment irrigation water sources. As such, withdrawal and use permits from the Commission on Water Resource Management should also be added to Table 1.

3. In Section 2.5, Pages II-4 and II-8, the Draft EIS states that the "golf course will be a private course open for public play for a daily fee," and "will be affordable to local residents who have demonstrated an unwillingness to pay the high fees charged at the resort courses." How does the applicant propose to ensure that the golf course will be affordable to local residents? Does the applicant intend to offer "affordable" fees only to the Windward residents as stated in the Draft EIS? Will the golf course be open to public play at all times? If not, what are the proposed days/hours when the course would be available to local residents? Will local residents be able to utilize the sports complex facilities (dining and health/fitness facilities) for a daily fee if they are not members? What will be the approximate cost for membership in the sports complex?

4. On Page II-4, the Draft EIS states that 9 acres are proposed for dedication for community-oriented facilities. Have preliminary discussions with the appropriate City and State agencies been conducted to address whether or not these areas are actually feasible or desirable?

5. What is the estimated price range for the 30-35 proposed residential units? Is any specific group targeted for the marketing of these units?

6. What are the preliminary heights of structures being planned? What is the approximate total floor area being constructed?

7. In Section 2.5, Page II-6, the Draft EIS states that the hiking trails and 4-acre campground will be accessible to the windward community. This statement also appears on Page VI-8. How and why does the applicant propose to allow access only to windward residents and exclude other Oahu residents? In addition, information regarding the hiking trails and campground should be provided. Are these trails currently existing, and where do they lead? Would the applicant maintain and assure security for the campground?

8. Section 3.2.3, Page III-4 states that 104 acres of the project falls within the State Urban District, and 116 acres are within the Conservation District. However, on Pages I-1 and II-2, the area of application is 103 acres leaving a balance of 117 acres within the Conservation District, which would require a Conservation District Use Application (CDUA). Which are the correct acreages?

9. The Draft EIS states that a request for DP Land Use Map change (Agriculture, Residential and Public/Quasi-Public to Residential and Parks and Recreation) will be submitted followed by a request for

appropriate rezoning. Upon successful rezoning, an application for a Special Management Area Use Permit (SMP) will be submitted. When does the applicant intend to apply for a CDUA for proposed uses within the Conservation District (golf course, recreational facilities, hiking trails, campground and plant nursery)? In addition, what residential zoning does the applicant intend to apply for?

10. How many acres of the subject property fall within the Special Management Area (SMA)? This information should be included in Section 3.3.4, Page III-8.

11. Since portions of the site appear very steep, the Final EIS should provide more information about any proposed grading or filling activities. Of particular interest is the steep area where residential and clubhouse/golf course uses are being proposed.

12. What is the existing urban development indicated on Figure 10: ALISH Map, Page IV-7?

13. On Page IV-11, paragraph 3, the Draft EIS states that if significant decreases in ground water quality occur because of the proposed non-potable water system, "other source alternatives will be considered." What does the applicant determine to be "significant" decreases in ground water quality and what are the "other source alternatives" which might be implemented?

14. Section 4.5.2, Page IV-13 proposes a monitoring program to test water quality and the physical/biological structure of Kaneohe Bay, makai of the subject property. This monitoring system is a positive and responsible mitigation measure. If possible, an outline of the monitoring system and how it will be implemented should be included in the Final EIS. In addition, information should be provided to explain what action will be taken if water quality degradation does occur.

15. Section 4.9.2, Page IV-19 states that the new energy requirements from the 30-35 single-family homes and the clubhouse and facilities could be "reduced significantly by installing solar water heaters on all new homes and by incorporating solar design features into all construction plans." Will solar design features be required and installed in all of the single-family homes and the sports complex facilities?

16. A more in-depth view analysis should be included in the Final EIS analyzing how the proposed project will affect the visual character of the area, especially in relation to mauka views from Kamehameha Highway.

In addition, please be advised that the City Council is currently considering Bill 152 regarding golf course regulation, which may affect the processing and timetable for implementing the sports complex.

If you have any questions regarding the above comments, please contact Geri Ung (527-5028) or Diane E. Borchardt (527-5349) of our staff.

Donald Clegg

DONALD A. CLEGG
Director of Land Utilization

DAC:sl
0251N/19-22

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634468
HHHK UW
Facsimile
(808)
545-2050

12 March 1990

Mr. Donald A. Clegg
Chief Planning Officer
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Clegg:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to Benjamin B. Lee of the Department of General Planning dated 6 February 1990 (your reference no. LU12/89-8255[DEB], 89/EC-4) and offer the following responses to your comments.

1. Section 1.3 of the Final EIS will state that the applicant is requesting the amendment of the Koolaupoko Development Plan Land Use Map from the current Residential, Public and Quasi-Public and Agriculture designations to Parks and Recreation (86.8 acres) and Residential (16.2 acres).

2. According to consultation with one of your staff, the shoreline setback area extends 40 feet inland from the vegetation line. Kamehameha Highway fronting the subject property consists of 50 feet of right-of-way. Nanatomi Hawaii proposes the development of a sports complex on the 220-acre property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. It is our understanding that since no structures and/or earthmoving activities are proposed makai of Kamehameha Highway, no Shoreline Setback Variance is necessary for the project. If the area to be dedicated to the State and/or County for community-oriented facilities is developed as shown on Figure 3 of the Draft EIS, then, the applicable governmental agency(ies) may be required to obtain a Shoreline Setback Variance.

   Table 1: "Necessary Permits and Approvals" will be revised to include the need for a Well Construction Permit from the Commission on Water Resource Management.

3. The projected fee schedule for public play and discounts to Kahaluu and Kaneohe residents is unknown at this time because of the uncertainties in estimating the cost of development and the cost of operating the golf course, once completed. However, unlike other golf courses premised upon private memberships, this golf course will be dependent on public play for operating revenue, consequently, the fee would need to be competitive with other courses catering to public play that will be in operation at the same time. In addition to offering fees that will be competitive with other public play courses, the applicant would like to offer discounts preferably to Kahaluu and Kaneohe residents.

   The golf course will not be open to public play at all times. In order not to sell memberships to the golf course, the current marketing plan is to sell the 30 to 35 homes with an undivided interest in approximately half of the golf course. Nanatomi Hawaii would own the remaining portion and manage the golf course. Owners of the homes, then, would be able to play on the course (but must be on the course at the time). Thus, while the golf course would be private, approximately 70 to 80 percent of the total play time (approximately 200 rounds per day, comparable to Olomana Golf Course) would be available to the public for a daily fee. Exact days/hours when the course would be available to local residents are not known at this time.

   Local residents will be able to utilize the sports complex facilities (dining and health/fitness facilities) for a daily fee. Clubhouse or membership requirements (if any will be sold) have not yet been established, however, as a policy, no international memberships will be sold.

4. Preliminary discussions have been held with the State Departments of Transportation (Harbors Division), and Land and Natural Resources, and the City and County of Honolulu Departments of Transportation Services, and Parks and Recreation regarding the area proposed to be dedicated for community facilities. Only the City and County of Honolulu Department of Parks and Recreation has clearly indicated that because they have no nearby facilities, accepting the land being offered would not be directly beneficial to them. Without reviewing detailed drawings, the Department of Transportation Services indicated that they would probably accept the road realignment when completed (if built to County standards). The State Department of Transportation, Harbors Division, is currently studying the possible opportunities of the land dedication.

5. While prices for the proposed residential units have not yet been established, the analysis of economic and fiscal impacts of the project (Natelson Levander Whitney, Inc., November 1989, Draft EIS, Appendix M) indicated that units could be priced in the $600,000 to $900,000 price range. It should be noted that the Koolaupoko District 's better neighborhoods have established themselves as locations for residential units priced between $500,000 and $1,000,000. Since the price of the units will be dependent on the overall costs of the project, the final sales price cannot be estimated at this time. No specific

group is being targeted for the marketing of these units. Current plans call for selling of the units in-State.

6. No architectural studies have been initiated at this early stage of the planning process. The heights of the structures will observe the maximum height limits specified in the Land Use Ordinance for R-5 Residential Districts. The analysis of economic and fiscal impacts of the project (Natelson Levander Whitney, Inc., November 1989, Draft EIS, Appendix M) indicated that the units should offer between 3,000 to 5,000 square feet (SF) of living space on lots ranging from 10,000 to 20,000 SF.

7. It is felt that Windward residents will be directly impacted by the proposed project, therefore, they should be able to have community benefits in addition to the land proposed to be dedicated to the appropriate State or County agency (and which would be presumably be open to all Oahu and State residents). The applicant has agreed to provide limited public easements for the proposed hiking trails (the number of people allowed access to the trails will be limited by permits). Windward residents, in particular some of the adjoining landowners, wish to limit the number of people that will use the proposed hiking trails and campground.

   Apparently there were trails along the perimeter (the ridgeline) of the property (as shown on old aerial photographs and according to local informants). These are presently overgrown and not accessible to the public, and would have to be cleared and possibly improved (in the event any trails have badly eroded). In response to concerns of adjoining landowners, the hiking trail permission form will state that hikers must keep to the trails and that going off these trails will subject the hikers to charges of trespass by adjacent landowners. Signs with similar warnings will be posted along the trails.

   The applicant will maintain the campground but will not provide security. The campground is intended to provide another camp site alternative for organized groups such as the Boy Scouts. Again, access to the campground will be controlled by permit from the applicant.

8. Approximately 103 acres of the property are designated Urban and the remainder, approximately 117 acres, are located within the State Conservation Land Use District. The acreages of the property within the State Urban and Conservation Land Use Districts stated in Section 3.2.3 of the Draft EIS are incorrect and will be revised in the Final EIS.

9. An application for a CDUA will be filed while the SMP is being processed.

   Upon the successful amendment of the Koolaupoko Development Plan Land Use Map, the applicant intends to apply for the reconfiguration of the existing R-5 Residential District zoning for the proposed residential units.

10. Section 3.3.4 will be revised to read that a "portion of the property (approximately 23 acres), within 300 feet of the centerline of Kamehameha Highway (Figure 7) lies within the Special Management Area..."

11. Detailed information on grading and filling is unavailable at this time. Based on the Concept Plan, the project civil engineering consultant, Sam O. Hirota, Inc. prepared a section that was cut between the proposed clubhouse and residential areas, showing as many of the fairways as possible. The section shows the existing ground and the finished grade (based on conceptual plans). This section (and a section key map) will be attached to the Final EIS as Appendix O and will also be used to supplement the visual analysis as requested elsewhere in your letter.

12. The source for Figure 10 is the State of Hawaii Department of Agriculture's Agricultural Lands of Importance to the State of Hawaii (ALISH), Sheet O-12, January 1977. The ALISH map was prepared with the assistance of the Soil Conservation Service, United States Department of Agriculture, and the College of Tropical Agriculture, University of Hawaii. We do not know the reasons for the description of the existing urban development, but an aerial photograph taken on 29 October 1949 shows the property extensively urbanized. In addition, the Final EIS will include a photograph taken of the property in 1945 when the entire valley was an Army Camp. This photograph will be identified as Figure 18.

13. The major criteria in determining diminishing ground water quality is the increase in the percentage of salinity to the point that it is unsuitable for irrigation. It must be emphasized that the main source for irrigation of the golf course will be rainfall (which averages 60 inches of rainfall per year in this area) and the collection of storm runoff. When rainfall is lacking, the stored runoff will utilized. When the stored runoff is depleted, brackish water from the proposed wells will be utilized, along with the treated effluent from the clubhouse and residential facilities (a constant source). Alternative sources of irrigation are being studied at this time.

14. Appendix G of the Final EIS will include a scope of work for a marine environment monitoring program.

    If water quality degradation is detected during the monitoring program, then soil erosion control (during construction) and golf course management (during operation) practices will be reviewed and if required, additional retention basins will be constructed and/or the application of pesticides, herbicides, and fertilizers will be more strictly controlled. If any health hazard is detected, the appropriate governmental agencies will be notified.

15. Since the applicant will be constructing the single-family homes and the sports complex facilities, energy-saving and solar design features will be installed in these structures.

16. As noted elsewhere, a section showing how the proposed project will affect the property and mauka views from Kamehameha Highway will be shown in the Final EIS as Appendix O to supplement the visual analysis in the Draft EIS.

17. We understand that Bill 152 is now Ordinance No. 90-15 and that if the applicant does not have a current grading permit within one year of rezoning, the applicant must obtain Plan Review Use approval.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota
Donna Kanemaru

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

HIROAKI MORITA
DEPUTY DIRECTOR

JAN 12 1990

January 10, 1990

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: WALTER M. OZAWA, DIRECTOR

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT (EIS)
MALULANI SPORTS COMPLEX - HEEIA
TAX MAP KEY: 4-6-06 AND 4-6-16

We have determined that the Conceptual Plan Figure 3 for the Malulani Sports Complex is generally acceptable for now. The applicant has discussed the private, public and community facilities proposed for the complex with our department's concern in particular.

We have informed the applicant to contact our department to discuss the plan as more detail becomes available.

Should you have any questions, please contact Mr. Jason Yuen of our Advance Planning Branch at extension 6315.

Thank you for the opportunity to comment on the EIS.

WALTER M. OZAWA, Director

WMO:js

cc: Manatomi Hawaii
OEQC

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHKUW
Facsimile (808) 545-2050

12 January 1990

Mr. Walter M. Ozawa
Director
Department of Parks and Recreation
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Ozawa:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your memorandum to Benjamin B. Lee of the Department of General Planning dated 10 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Donna Kanemaru

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

RECEIVED
JAN 25 1990
HELBER, HASTERT & KIMURA PLANNERS

In reply refer to:
ENV 90-17(449)

January 22, 1990

MEMORANDUM

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
MALULANI SPORTS COMPLEX
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-24, 48-51
AND 4-6-16: PORTION OF 32

We have reviewed the subject DEIS and have the following comments:

1. A drainage report should be submitted to the Drainage Section, Division of Engineering, for review and approval.

2. We have no comments on the proposed privately-operated wastewater collection, treatment and disposal system.

SAM CALLEJO
Director and Chief Engineer

cc: OEQC
Nanatomi Hawaii
c/o Helber Hastert & Kimura Planners

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHVHK UW
Facsimile (808) 545-2050

7 February 1990

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Callejo:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your memorandum to Benjamin B. Lee of the Department of General Planning dated 22 January 1990 (your reference no. ENV 90-17 (449). A drainage report will be submitted to the Drainage Section, Division of Engineering, for review and approval prior to the application for a grading permit.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

RECEIVED FEB 16 1990

ALFRED J. THIEDE
DIRECTOR

JOSEPH M. MAGALDI, JR.
DEPUTY DIRECTOR

TE-8092
PL1.1901

February 14, 1990

MEMORANDUM

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: ALFRED J. THIEDE, DIRECTOR

SUBJECT: MALULANI SPORTS COMPLEX
DRAFT ENVIRONMENTAL IMPACT STATEMENT
TMK: 4-6-06: 1, 4, 7, 9, 11, 13 AND 15

This is in response to a letter received on December 28, 1989 from the Office of Environmental Quality Control requesting our comments on the subject project.

Based on our review, we have the following comments to offer:

1. The right-of-way width of Kamehameha Highway along the project's frontage should be verified. Our records indicate that the existing roadway width is 50 feet and not 60 feet as stated in the report.

2. Detailed conceptual plans for the proposed improvements to Kamehameha Highway should be provided to our office. The plans for the realignment of the roadway and driveway locations should reflect the City's current design standards for a fully improved roadway.

3. All improvements to Kamehameha Highway should be done by the developer prior to occupancy or official opening of the project to the public.

4. All driveways should have adequate sight distance to oncoming vehicles.

fo ALFRED J. THIEDE

cc: Office of Environmental Quality Control
Nanatomi Hawaii

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634458 HHVHCUW
Facsimile (808) 545-2050

2 March 1990

Mr. Alfred J. Thiede
Director
Department of Transportation Services
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Thiede:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to Benjamin B. Lee of the Department of General Planning dated 14 February 1990 (your reference no. TE-8092, PL1.1901) and offer the following responses to your comments.

1. We appreciate the information provided. The Final EIS will be revised to indicate that the existing Kamehameha Highway right-of-way is 50 feet wide.

2. Nanatomi Hawaii proposes the development of a sports complex on the 220-acre property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. If the area to be dedicated is developed as shown on the attached map (including the realignment of Kamehameha Highway), then, the applicable governmental agency(ies) will provide detailed plans for the realignment of the roadway. Plans for the new entry road into the project site will be submitted to your Department for review and approval prior to the application for a grading permit. The plans for the proposed entry will reflect the City's current design standards.

3. Exclusive turn lanes from the entry road onto Kamehameha Highway and the construction of left and right turn lanes on Kamehameha Highway will be built by the applicant prior to occupancy or official opening of the project to the public. This was noted in Section 2.6.4 of the Draft EIS.

4. The driveway will be located and designed to have adequate sight distance to oncoming vehicles. This information will also be provided in the Final EIS.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

We greatly appreciated meeting with your staff on 1 March 1990. We look forward to continuing working with your Department. Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

1455 SOUTH BERETANIA STREET, ROOM 305
HONOLULU, HAWAII 96814

FRANK F. FASI
MAYOR

LIONEL E. CAMARA
FIRE CHIEF

DONALD S. M. CHANG
DEPUTY FIRE CHIEF

RECEIVED
JAN 30 1990
HELBER, HASTERT & KIMURA
PLANNERS

January 26, 1990

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: LIONEL E. CAMARA, FIRE CHIEF

SUBJECT: HALULANI SPORTS COMPLEX
KOOLAUPOKO, OAHU

We have reviewed the subject material provided and have no additional comments.

Should you have any questions, please contact Battalion Chief Michael Zablan of our Administrative Services Bureau at local 3838.

Lionel E. Camara

LIONEL E. CAMARA
Fire Chief

MZ:lm

cc: Hanatomi Hawaii
c/o Helber Hastert & Kimura, Planners
Vincent Shigekuni
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

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

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

30 January 1990

Mr. Lionel E. Camara
Fire Chief
Fire Department
City and County of Honolulu
1455 South Beretania Street, Room 305
Honolulu, Hawaii 96814

Dear Mr. Camara:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your memorandum to Benjamin B. Lee of the Department of General Planning dated 26 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

OFFICE OF HUMAN RESOURCES

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING, 6TH FLOOR
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4341

FRANK F. FASI
MAYOR

MARIA VICTORIA R. BUNYE
DIRECTOR

VICTOR D. GUILLERMO, JR.
DEPUTY DIRECTOR

January 23, 1990

RECEIVED
FEB - 2 1990
HELBER, HASTERT & KIMURA
PLANNERS

Vincent R. Shigekuni, Project Planner
Helbert Hastert and Kimura, Planners
Grovesnor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni,

The Office of Human Resources has reviewed Malulani Sports Complex Draft Environmental Impact Statement (EIS). We are pleased to learn that the proposed golf clubhouse and recreational facilities will be designed and constructed (1985 Uniform Building Code, as amended) to accommodate persons with disabilities.

Thank you for the opportunity to comment on this matter.

Very truly yours,

MARIA VICTORIA R. BUNYE, Director
Office of Human Resources

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634488 HHHK UW
Facsimile (808) 545-2050

2 February 1990

Ms. Maria Victoria R. Bunye
Director
Office of Human Services
City and County of Honolulu
Honolulu Municipal Building, 6th Floor
650 South King Street
Honolulu, Hawaii 96813

Dear Ms. Bunye:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 23 January 1990.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

1455 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96814 - AREA CODE (808) 943-3111

FRANK F. FASI
MAYOR

Harold Kawasaki
XXXXXXXXXXX
CHIEF

XXXXXXXXXXX
DEPUTY CHIEF

OUR REFERENCE ES-LK

RECEIVED
JAN 23 1990
HELBER, HASTERT & KIMURA

January 22, 1990

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: HAROLD KAWASAKI, CHIEF OF POLICE
HONOLULU POLICE DEPARTMENT

SUBJECT: MAUNALANI SPORTS COMPLEX, KOOLAUPOKO, OAHU

We have reviewed the draft environmental impact statement for the Maunalani Sports Complex, which we received on December 27, 1989.

The project should have minimal impact on police operations, and we should be able to service the area with existing personnel and facilities.

We have no objections to the proposal.

HAROLD KAWASAKI
Chief of Police

By Joseph Aveiro
JOSEPH AVEIRO
Assistant Chief of Police
Support Services Bureau

cc: Nanatomi Hawaii
Office of Environmental Quality Control

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

23 January 1990

Mr. Harold Kawasaki
Chief of Police
Police Department
City and County of Honolulu
1455 South Beretania Street
Honolulu, Hawaii 96814

Dear Mr. Kawasaki:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your memorandum to Benjamin B. Lee of the Department of General Planning dated 22 January 1990. Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

William A. Bonnet
Manager
Environmental Department

ENV 2-1
JA/G

January 17, 1990

JAN 19

City and County of Honolulu
Department of General Planning
650 South King Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: Draft Environmental Impact Statement (EIS) for Maluluni Sports Complex, Koolaupoko, Oahu

We have reviewed the draft EIS and have attached a marked-up print (see Attachment) of the development area that shows the approximate location of our existing electrical overhead distribution lines. Since these lines are energized and are to remain so during the construction of the project, the following language is to be included in the Notes for Construction:

1. The Contractor shall exercise extreme caution and shall maintain adequate clearance when operating equipment within or under any overhead lines.

2. The Contractor shall comply with the State of Hawaii's Occupational Safety and Health Law (DOSH).

3. The Contractor shall obtain an excavation permit from HECO's Mapping and Records Division located at 820 Ward Avenue, Fourth Floor, two weeks prior to starting construction.

4. When trench excavation is adjacent to or beneath existing HECO structures or facilities, the Contractor is responsible for:

   a. Sheeting and bracing the excavation to prevent slides, cave-ins and settlements, and

   b. Protecting existing structures or facilities with beams, struts, or under-pinning.

5. If pole bracing is required, the Contractor shall call the HECO District Construction Superintendent at Ward Avenue at 543-7745, a minimum of 72 hours in advance.

6. Any work required to relocate HECO facilities shall be done by HECO, and the Contractor shall be responsible for all coordination and costs incurred. In addition, should it become necessary for the Contractor to temporarily relocate any HECO facilities, these temporary locations will be done by HECO or by the Contractor under HECO's Supervision, and all costs will be borne by the Contractor.

7. Any damage to HECO's facilities will be reported immediately to HECO's Trouble Dispatcher at 543-7838. The Contractor shall be liable for any damages to HECO's facilities.

Sincerely,

Will. C. Bonnet

Attachment

cc: Nanatomi Hawaii
    c/o Helber Hastert & Kimura Planners
    Mr. Vincent Shigekuni

    Marvin T. Miura, Ph.D., Director
    Office of Environmental Control

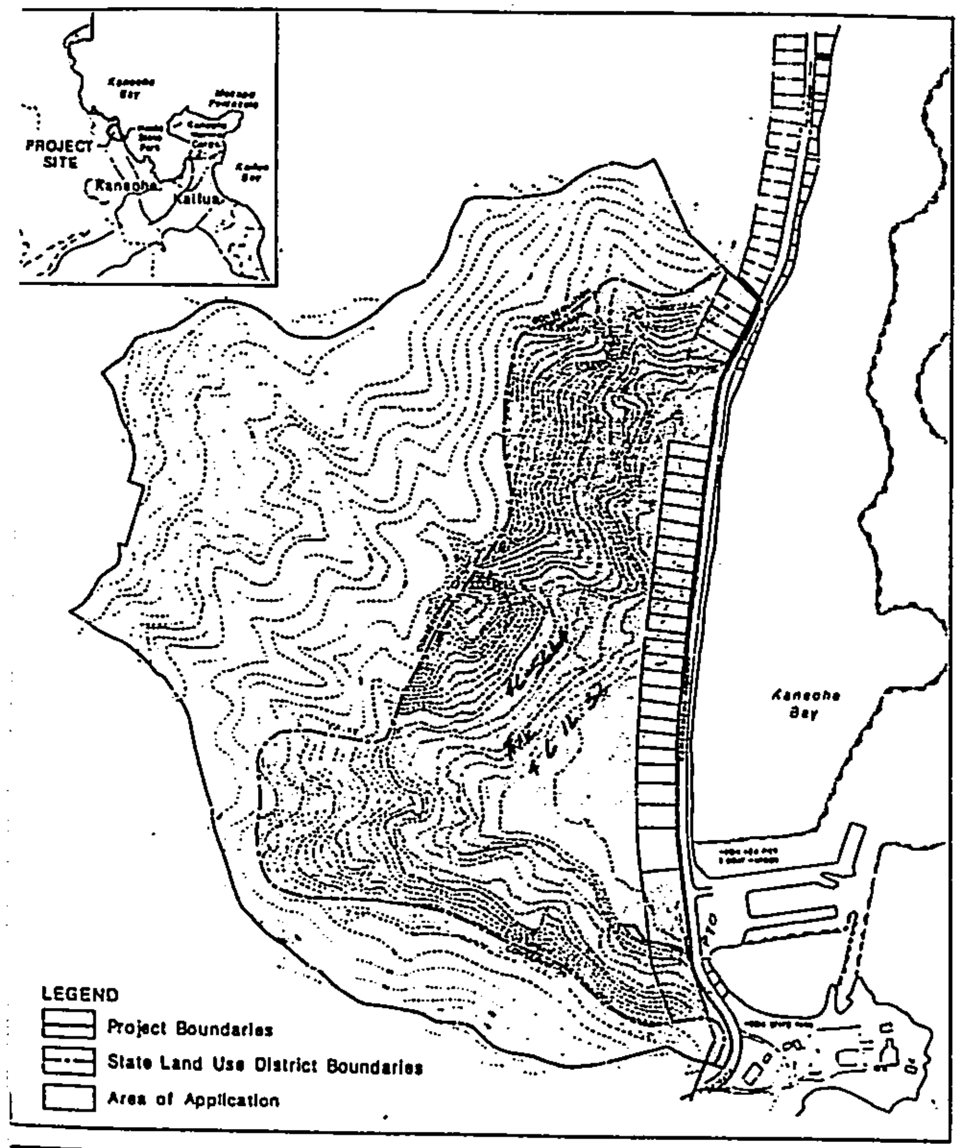


Figure 1: Location Map

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center PRI Tower 733 Bishop Street Suite 2590 Honolulu Hawaii 96813

Telephone (808) 545-2055

Telex 634488 HHHK UW

Facsimile (808) 545-2050

7 February 1990

Mr. William A. Bonnet
Manager
Environmental Department
Hawaiian Electric Company, Inc.
P.O. Box 2750
Honolulu, Hawaii 96840-0001

Dear Mr. Bonnet:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter addressed to the Department of General Planning dated 17 January 1990 (your letter no. ENV 2-1, JA/G). We have transmitted a copy of your letter, with attachment, to the consulting project civil engineer, Sam O. Hirota, Inc. The construction drawings for any work that would affect HECO's facilities will include the Notes for Construction as specified in your letter.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

GTE Hawaiian Tel
Beyond the call

GTE Hawaiian Telephone Company Incorporated
P.O. Box 2200 · Honolulu, HI 96841 · (808) 546-4511

January 18, 1990

JAN 19

Helber, Hastert & Kimura Planners
Attention: Mr. Vincent Shigekuni
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Draft Environmental Impact Statement
Halulani Sports Complex
Koolaupoko, Oahu

We have reviewed the Draft Environmental Impact Statement on Halulani Sports Complex and have no substantive comments to offer with respect to the project's impact on the environment. However, please be advised that the costs of relocating that portion of the existing Hawaiian Tel facilities along Kamehameha Highway affected by the proposed highway realignment at the entrance to the project complex must be borne by the developer.

When the project enters the design phase, the developer or its consultant should coordinate the facility relocation requirements with us. Please contact Mr. Lester Kodama of my staff at 834-6262 if there is any question.

Thank you very much for an opportunity to review and comment on the draft environmental impact statement.

Sincerely,

Walter M. Matsumoto
Operations Manager
OSP Engineering

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

7 February 1990

Mr. Walter M. Matsumoto
Operations Manager
OSP Engineering
GTE Hawaiian Telephone Company Incoporated
P.O. Box 2200
Honolulu, Hawaii 96841

Dear Mr. Matsumoto:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document and your letter dated 18 January 1990. We understand that if Kamehameha Highway is realigned, the costs of relocating that portion of the exisiting Hawaiian Tel facilities will not be borne by GTE Hawaiian Telephone, but by the appropriate governmental agency(ies) that would develop the land proposed to be dedicated by the applicant.

When the project enters the design phase, the appropriate governmental agency(ies) or their consultant will coordinate the facility relocation requirements with GTE Hawaiian Telephone.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

KAHALU'U NEIGHBORHOOD BOARD NO. 29
(He'eia Kea/'Ahulmanu, Kahalu'u, Waihe'e, Ka'a'awa, Waiahole, Waikane, Hakipu'u, Kualoa)

c/o KEY PROJECT • 47-200 WAIHE'E ROAD • KANE'OHE P.O., HAWAII 96744

"Let us not ever have an unhappy minority; rather, let us build a community consensus."

City and County of Honolulu
Department of General Planning
650 South King St.
Honolulu, HI 96813

RECEIVED
FEB - 8 1990

February 6, 1990

SUBJECT: MALULANI SPORTS COMPLEX/GOLF COURSE PROPOSAL - DRAFT EIS

To: Accepting Authority/Dept. of General Planning

Kahalu'u Neighborhood Board #29 only received copies of the subject Draft EIS just prior to its last regulary-scheduled Board meeting (Jan.9th). Copies were distrubuted to some Board members at that January 10, 1990 meeting for review. Our next regularly scheduled meeting will be on February 14, 1990. To date we have not, as a Board, been able to complete our review and comments on this document. Members of our Land Use and Planning Committee have, however, met and discussed the Draft EIS. Their comments will be forthcoming, within a day or two, for inclusion with other comments. These comments will also be presented at our next Neighborhood Board meeting for full Board review. Any additional comments that arise during the course of discussion at that meeting will also be forwarded to the accepting authority and Nanatomi, Inc. immediately thereafter.

We apologize for the delay. This proposal is substantial enough to warrant very careful consideration. Our Board has been pleased with the applicant's efforts to keep us informed throughout the process. We intend to continue to have input on proposals for the He'eia Kea area at every opportunity.

The subcommittee felt it important that we express, at the least, that the Draft EIS should not be accepted until a thorough review and comparison of alternatives is included. We are of the understanding that EIS preparation should carefully spell out the economics of every alternative (and individual components) in a dollars and cents fashion, including a description of the potential revenues associated with each proposal. All of this is necessary to allow a community to weigh the advantages of one option for land use over another. The balance of our comments will follow.

Mahalo,

John Lewis Reppun

John Lewis Reppun, Chairman
Land Use, Planning Committee
Kahalu'u NB #29

cc Nantomi Hawaii, Inc.

Oahu's Neighborhood Board System-Established 1973

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634458 HHKUW
Facsimile (808) 545-2050

12 March 1990

Mr. John Lewis Reppun, Chairman
Land Use, Planning Committee
Kahalu'u Neighborhood Board No. 29
c/o Key Project
47-200 Waihe'e Road
Kaneohe, Hawaii 96744

Dear Mr. Reppun:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to the Department of General Planning which was postmarked 7 February 1990 and offer the following responses to your comments.

Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibility attain the objectives of the action" (in this case the objective is the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

The other alternatives discussed in the Draft EIS would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course) and therefore, based on the Environmental Impact Statement Rules, do not warrant the type of economic evaluation that you requested.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook

KAHALU'U NEIGHBORHOOD BOARD NO. 29
(He'eia Kea/'Ahuimanu, Kahalu'u, Waihe'e, Ka'alaea, Waiahole, Waikane, Hakipu'u, Kualoa)
c/o KEY PROJECT • 47-200 WAIHE'E ROAD • KANE'OHE P.O., HAWAI'I 96744

"Let us not ever have an unhappy minority; rather, let us build a community consensus."

FEBRUARY 14, 1990

RECEIVED FEB 21 1990

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF GENERAL PLANNING
650 SOUTH KING STREET
HONOLULU, HI. 96813

SUBJECT: MALULANI SPORTS COMPLEX/GOLF COURSE PROPOSAL - DRAFT EIS

To: Accepting Authority/ Director,Dept. of General Planning;

The following represents the comments of the Kahalu'u Neighborhood Board # 29 with regard to the subject "draft" EIS. As stated in our letter to you, dated Feb. 6, 1990, we are of the position that this Draft EIS should not be accepted until these concerns are fully addressed.

AGRICULTURAL POTENTIAL

In his recent State of the State address, Governor Waihee stated a sentiment that has considerable community following and one that this Board feels is prevalent amongst Kaneohe Bay area residents. He stated, "It is time to start calling a golf course a golf course." He went on to say, "Thus we will submit legislation to remove golf course development as a permitted use on Ag land." On P. III-1 it is stated that the golf course component of this proposal represents an "integral part of the diversified agricultural industry.". This statement is debatable and should be substantiated. He'eia Kea has a history of being a rural community wherein agriculture, either self-supporting or supplemental, was a source of income to the community that occupied the area. This land use dates back beyond the period of HECO's stewardship, beyond Bishop Estate leaseholds, into ancient history. That historical perspective on agricultural use should be well researched and given a value coordinate, relative to the discussion of alternative uses for the area. The potential positive impact(s), both social and economic, of re-establishing such a rural/agricultural community should be thorough and inclusive of newer forms of agriculture and aquaculture or mariculture. The latter has been given some attention and support during previous attempts to develop the area. The proximity of the bay itself and supporting research facilities such as HIMB at Coconut Island and the Mariculture Research and Training Facility are important factors related to mariculture/aquaculture potential. Discussion of State Aquaculture goals is also missing here. Consideration of ag potential must include a complete examination of the effect of land cost for this specific property

on the feasibility of such options and on the displacement over the past twenty-plus years of a community that was predominantly part-Hawaiian in ethnic background. Although provision for such opportunities may not be deemed as being the responsibility of this land owner, such a discussion is essential data for those who will assess the socio-economic impact of change - of which this proposal is a part - for the greater Kaneohe Bay region.

This Board is well aware of the "mis-match" between State "urban" designation and County "Ag" zoning. The County designation, in this case, was established through more recent reviewing efforts and is more reflective of the actual use of land.

Dr. Frank Scott's discussion of Agricultural feasibility is clinical and thorough with regard to statistics. It fails however (as with similar discussions on the Waikane Golf Course Proposal) in that his frame of reference for ag feasibility is one of searching for "economies of scale". One cannot look purely for Agri-business success opportunities in this area without consideration of the social value of encouraging small-rural family farms...in keeping with the kind of agricultural identity that now characterizes the Kaneohe Bay watershed. Large-scale agriculture (especially pineapple and sugar cane) has, on the contrary, contributed greatly to the demise of Kaneohe Bay, ranking high on the list of detrimental impacts seen in this watershed. His discussion of the potential for production in Floriculture and Nursery products is cursory, at best. He sites "destructive" Kona winds as a negative factor saying that these winds "may" be "highly" destructive to shade houses. What evidence is this statement based on for the specific project area, He'eia Kea, which lies in the lee of Maelieli ridge during such storms. In fact, this may well spell a special advantage to certain forms of agriculture here, over other windward areas. Although there are, as he states, other areas that may be more desirable, from a clinical-analysis standpoint, consideration should be given to the fact that Windward Oahu, alone, has seen a tremendous surge in floral and nursery production in the past few years. The advantageous proximity of Oahu markets, transportation connections etc. is given little attention, as is the availability of employees and farmers (from Windward Oahu) with interest and expertise in this form of agriculture. Dr. Scott also sites the disadvantage of salt-laden prevailing trades in the area for "some types of flowers and foliage", discounting the fact that much of this State is dependent on sources of salt-tolerant kinds of plants as landscaping material. Where is there a discussion of exactly what kinds of plants could be grown in this area. His discussion is incomplete.

Each potential agricultural scenario, combinations thereof, and the social value of related housing opportunities created by alternatives of this kind, should be given dollar values for the sake of further discussion.

CORRECTION

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

KAHALU'U NEIGHBORHOOD BOARD NO. 29
(He'eia Kea/'Ahuimanu, Kahalu'u, Waiha'e, Ka'alaea, Waiahole, Waikane, Hakipu'u, Kualoa)
c/o KEY PROJECT • 47-200 WAIHE'E ROAD • KANE'OHE P.O., HAWAI'I 96744

"Let us not ever have an unhappy minority; rather, let us build a community consensus."

City and County of Honolulu
Department of General Planning
650 South King St.
Honolulu, HI 96813

RECEIVED
FEB - 8 1990

February 6, 1990

SUBJECT: HALULANI SPORTS COMPLEX/GOLF COURSE PROPOSAL - DRAFT EIS

To: Accepting Authority/Dept. of General Planning

Kahalu'u Neighborhood Board #29 only received copies of the subject Draft EIS just prior to its last regulary-scheduled Board meeting (Jan.9th). Copies were distrubuted to some Board members at that January 10, 1990 meeting for review. Our next regularly scheduled meeting will be on February 14, 1990. To date we have not, as a Board, been able to complete our review and comments on this document. Members of our Land Use and Planning Committee have, however, met and discussed the Draft EIS. Their comments will be forthcoming, within a day or two, for inclusion with other comments. These comments will also be presented at our next Neighborhood Board meeting for full Board review. Any additional comments that arise during the course of discussion at that meeting will also be forwarded to the accepting authority and Nanatomi, Inc. immediately thereafter.

We apologize for the delay. This proposal is substantial enough to warrant very careful consideration. Our Board has been pleased with the applicant's efforts to keep us informed throughout the process. We intend to continue to have input on proposals for the He'eia Kea area at every opportunity.

The subcommittee felt it important that we express, at the least, that the Draft EIS should not be accepted until a thorough review and comparison of alternatives is included. We are of the understanding that EIS preparation should carefully spell out the economics of every alternative (and individual components) in a dollars and cents fashion, including a description of the potential revenues associated with each proposal. All of this is necessary to allow a community to weigh the advantages of one option for land use over another. The balance of our comments will follow.

Hahalo,

John Lewis Reppun

John Lewis Reppun, Chairman
Land Use, Planning Committee
Kahalu'u NB #29

cc Nantomi Hawaii, Inc.

Oahu's Neighborhood Board System-Established 1973

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHKUW
Facsimile (808) 545-2050

12 March 1990

Mr. John Lewis Reppun, Chairman
Land Use, Planning Committee
Kahalu'u Neighborhood Board No. 29
c/o Key Project
47-200 Waihe'e Road
Kaneohe, Hawaii 96744

Dear Mr. Reppun:

Draft Environmental Impact Statement
Halulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to the Department of General Planning which was postmarked 7 February 1990 and offer the following responses to your comments.

Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibility attain the objectives of the action" (in this case the objective is the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

The other alternatives discussed in the Draft EIS would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course) and therefore, based on the Environmental Impact Statement Rules, do not warrant the type of economic evaluation that you requested.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook

KAHALU'U NEIGHBORHOOD BOARD NO. 29
(He'eia Kea/'Ahuimanu, Kahalu'u, Waiha'e, Ka'alaea, Waiahole, Waikane, Hakipu'u, Kualoa)
c/o KEY PROJECT • 47-200 WAIHE'E ROAD • KANE'OHE P.O., HAWAI'I 96744

"Let us not ever have an unhappy minority; rather, let us build a community consensus."

FEBRUARY 14, 1990

RECEIVED
FEB 21 1990

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF GENERAL PLANNING
650 SOUTH KING STREET
HONOLULU, HI. 96813

SUBJECT: MALULANI SPORTS COMPLEX/GOLF COURSE PROPOSAL - DRAFT EIS

To: Accepting Authority/ Director,Dept. of General Planning;

The following represents the comments of the Kahalu'u Neighborhood Board # 29 with regard to the subject "draft" EIS. As stated in our letter to you, dated Feb. 6, 1990, we are of the position that this Draft EIS should not be accepted until these concerns are fully addressed.

AGRICULTURAL POTENTIAL

In his recent State of the State address, Governor Waihee stated a sentiment that has considerable community following and one that this Board feels is prevalent amongst Kaneohe Bay area residents. He stated, "It is time to start calling a golf course a golf course." He went on to say, "Thus we will submit legislation to remove golf course development as a permitted use on Ag land." On p. III-1 it is stated that the golf course component of this proposal represents an "integral part of the diversified agricultural industry.". This statement is debatable and should be substantiated. He'eia Kea has a history of being a rural community wherein agriculture, either self-supporting or supplemental, was a source of income to the community that occupied the area. This land use dates back beyond the period of HECO's stewardship, beyond Bishop Estate leaseholds, into ancient history. That historical perspective on agricultural use should be well researched and given a value coordinate, relative to the discussion of alternative uses for the area. The potential positive impact(s), both social and economic, of re-establishing such a rural/agricultural community should be thorough and inclusive of newer forms of agriculture and aquaculture or mariculture. The latter has been given some attention and support during previous attempts to develop the area. The proximity of the bay itself and supporting research facilities such as HIMB at Coconut Island and the Mariculture Research and Training Facility are important factors related to mariculture/aquaculture potential. Discussion of State Aquaculture goals is also missing here. Consideration of ag potential must include a complete examination of the effect of land cost for this specific property

on the feasibility of such options and on the displacement over the past twenty-plus years of a community that was predominantly part-Hawaiian in ethnic background. Although provision for such opportunities may not be deemed as being the responsibility of this land owner, such a discussion is essential data for those who will assess the socio-economic impact of change - of which this proposal is a part - for the greater Kaneohe Bay region.

This Board is well aware of the "mis-match" between State "urban" designation and County "Ag" zoning. The County designation, in this case, was established through more recent reviewing efforts and is more reflective of the actual use of land.

Dr. Frank Scott's discussion of Agricultural feasibility is clinical and thorough with regard to statistics. It fails however (as with similar discussions on the Waikane Golf Course Proposal) in that his frame of reference for ag feasibility is one of searching for "economies of scale". One cannot look purely for Agri-business success opportunities in this area without consideration of the social value of encouraging small-rural family farms...in keeping with the kind of agricultural identity that now characterizes the Kaneohe Bay watershed. Large-scale agriculture (especially pineapple and sugar cane) has, on the contrary, contributed greatly to the demise of Kaneohe Bay, ranking high on the list of detrimental impacts seen in this watershed. His discussion of the potential for production in Floriculture and Nursery products is cursory, at best. He sites "destructive" Kona winds as a negative factor saying that these winds "may" be "highly" destructive to shade houses. What evidence is this statement based on for the specific project area, He'eia Kea, which lies in the lee of Maelieli ridge during such storms. In fact, this may well spell a special advantage to certain forms of agriculture here, over other windward areas. Although there are, as he states, other areas that may be more desirable, from a clinical-analysis standpoint, consideration should be given to the fact that Windward Oahu, alone, has seen a tremendous surge in floral and nursery production in the past few years. The advantageous proximity of Oahu markets, transportation connections etc. is given little attention, as is the availability of employees and farmers (from Windward Oahu) with interest and expertise in this form of agriculture. Dr. Scott also sites the disadvantage of salt-laden prevailing trades in the area for "some types of flowers and foliage", discounting the fact that much of this State is dependent on sources of salt-tolerant kinds of plants as landscaping material. Where is there a discussion of exactly what kinds of plants could be grown in this area. His discussion is incomplete.

Each potential agricultural scenario, combinations thereof, and the social value of related housing opportunities created by alternatives of this kind, should be given dollar values for the sake of further discussion.

CONSERVATION DISTRICT

As stated (III-4), proposed uses for the portion of the property not within the State Land Use "Urban" District will require a CDUA. This Board is concerned with the precedent that may be set for golf course use or any other commercial use of this zone. To date no major uses have encroached upon the Conservation/Preservation district anywhere around Maelieli Ridge. Effects of the proposed action should look at cumulative impact and precedence and should be included in the final EIS. It is worth noting that a large parcel (134+ acres) was recently purchased by a Mr. Kawamoto in the Kahalu'u-Pakole area, entirely within the Conservation district and that a large number of land holdings around Maelieli Ridge include Preservation-zoned lands. The wisdom of clearing and grading of relatively-steep lands,mauka of the Conservation line should be addressed and discussion of alternatives included. One cannot assess the necessity of encroaching into these lands without adequate discussion and definition of "economic feasibility". What kind of profits/revenues are expected from the project? What is the economic feasibility of, say, a nine-hole course as opposed to the proposed eighteen-hole course? Discussion of reasonable alternatives should also include that of using land currently proposed for housing as a means of providing space for a smaller course.

HOUSING

The Board, in its informal comments and discussion, has generally reacted very positively to proposals to remove all residential zoning from within the Special Management Area, citing residential use as a "non-shoreline dependent" activity and, therefore, inappropriate for this area. Concern for "cumulative impact" of development within the SMA, given the extent of developed Kaneohe Bay shoreline, serves only to heighten this concern.

Although the County's growth policies now direct the bulk of Oahu's growth away form Windward Oahu, there remains a definite need for some "fill-in" housing designed to meet special needs and populations. Ag-related housing has already been mentioned earlier in our comments; discussion of the potential for including some or only rental housing designed to fill those needs should be included. The possibility of mixing uses of this land, including some housing of the kind mentioned, cannot be discussed without a detailed economic feasibility study.

In the City's report, GOLF COURSE DEVELOPMENT ON OAHU (July '89), the City Administration recommends against "stand alone golf courses in rural or agricultural areas" based on the fear that " such courses "may promote speculative real estate activity...resulting in displacement of small agricultural operators and higher land prices for future potential housing development sites.". Consideration of "truly affordable" rental housing component should be discussed and, perhaps, counted as a

possible public benefit.(see following section of comments)

COMMUNITY BENEFIT

Mayor Frank Fasi (preamble GOLF COURSES IN HAWAII, cited above), states that "The value of public benefit should be quantified" in golf course proposals and recommends "$20 million as minimum expected value to qualify for consideration". It is likely that this "minimum" is derived from estimates of the expected profits, speculative value of the property etc. Our Board suggests that the following public benefits be included among other benefits considered.

* **SHORELINE PARK** - The board is already on record favoring establishment of a shoreline park, the length of He'eia Kea Valley - a use that is "shoreline dependent" and an opportunity that should not be lost. This document erroneously suggests that such a park would run counter to concerns for viewplane preservation stated in the Coastal View Study. Viewplane concerns, included in that study, resulted from input from the NB and other community groups who were aware of proposals to construct a large marina fronting the entire valley (opposed by our Board!). This park would, in our opinion, enhance rather than detract from this viewplane while increasing access to the bay. Other beach parks (Kahana Bay, Punalu'u Beach Park etc.) have not damaged that viewplane - the benefits of this concept, in terms of public advantages, far outweigh any impact. At present, Kamehameha Hwy. has little or no shoulder on either side. Realignment of the Hwy. should be considered necessary from, this standpoint alone. Inclusion of a full length park may also be beneficial as an buffer between the environmental impact of the golf course (or other mauka uses) and the sensitive bay ecosystem.

* **DRAINAGE/RETENTION PONDS** - As golf courses are known to attract migratory species of birds, many of them dependent on aquatic habitats, some discussion should focus on potential for creation of nesting sites - "islands", perhaps, within the runoff retention ponds proposed. Discussion should include independent monitoring of these sites or dedication to those who would monitor for environmental hazards (pesticides, herbicides, chemicals etc) as well as consultation with appropriate Federal and/or State agencies as to design, feasibility. This concept may be included in, or relate to, creation of a substantial shoreline park.

* **ENVIRONMENTAL FUND** - Monitoring, research, and mitigation measures relating to specific and general impact on Kaneohe Bay's estuarine environment, water quality, coral reefs etc. should be addressed. Discussion of funding (based on a % of profits?) for research should go hand-in-hand with proposals for acceptance of liability and mechanisms for response to environmental hazards

and impacts to the bay. Efforts to set up such an "environmental fund" should include discussion with HIMB at Coconut Island, the State Departments of Land and Natural Resources, Health, the Coastal Zone Advisory and others. Such a fund would, ideally, receive contributions from any and all golf course developers, users of large amounts of chemicals that may impact the bay etc. This project could set a valuable precedent for conscientious care of the bay's ecosystem.

* OTHER BENEFITS TO CONSIDER:
  - Housing replacement/self help housing fund for Windward residents who meet a certain income criteria.
  - Contributions to bay area land acquisition for, or development of, areas already designated (on Dev. Plan Public Facilities Maps) for park. There are park needs in the Kaneohe-Kualoa are that have gone unmet for many years for lack of funding.

FUTURE RESORT POTENTIAL

The potential of this project to become the impetus for further resort expansion should be addressed openly. Under former Mayor Eileen Anderson's Administration, we were successful in removing Resort zoning from the Kaneohe Bay area, leaving such development for more appropriate, accepted sites. At one time the area now known as Kualoa Park was also suggested as a site for resort development. This idea was wisely thwarted by City acquisition for the present park, a benefit to the community, island-wide.

As proposed, the project would already include a number of major, resort components besides that of a golfcourse, including a clubhouse, restaurant, tennis courts, high-priced condo-style housing, spas etc. The marketability of these components potential components essential to a future resort should be discussed, economically and socially. Proximity to Kaneohe Bay and existing commercial, ocean-based recreation (albeit, controversial) as well as to other, similar resort-style proposals (Waikane Golf Course, He'eia Meadowlands, etc) should enter into this impact discussion.

EFFECTS ON HE'EIA KEA PIER/MARINA CONCERNS

Incentive for expansion of He'eia Kea Pier may well be increased by approval of this project. The project, as proposed, stands to attract many wealthy clients and home-buyers who could, in turn, press for pier expansion. Consultants do recommend that the owners/operators actively "sell" play time in Japan. Although Nanatomi is on record as being opposed to a marina and favoring a master-plan for the bay, the mere presence of this kind of operation may induce pressure for an unwanted marina expansion and/or increased tourist-style activity at the pier. Our Board is on record as supportive of only minimal expansion of the pier,

only in the direction of Lae O Kealohi/He'eia State Park.

MARINE ENVIRONMENTAL IMPACT

The "low permeability of soil" and flooding potential, due to seasonal and/or unpredictably heavy rainfall, increases concern for runoff and transporting of chemical-laden water or soil into the bay. Additionally, Kaneohe Bay is known for its reduced circulation due to the abundance and configuration of barrier, table top, shoreline reefs and submerged lands. This environmental characteristic is, at once, its greatest asset and source of vulnerability to impact from the surrounding terrestrial watershed.

Discussion of impact on the bay should look at chronic input and cumulative impact of golf courses, including those already proposed, in the Kaneohe Bay "bio-region". Episodic input should detail exact impact from each specific chemical that will or may be used, with special attention to those that are known to be highly toxic to birds and aquatic life. Hazards that may result from misapplication - a problem not to be ruled out - and the compensation for, mitigation for, or response to such hazards should be detailed at this time in the development process. These concerns are essential data that should be available for public scrutiny. Agreements, with regard to liability, should be proposed for the sake of discussion, with reference to similar situations elsewhere for comparison.

The State Dept. of Health and Dept. of Agriculture both have policies with regard to application of these chemicals What do their monitoring programs consist of; how are these programs subsidized (taxpayer, private landowner?).

GRADING

Special consideration of the potential for heavy rainfall of long duration should be given in regard to grading requirements. Controls should be spelled out in the form of potential contracts and agreements that are more stringent than existing grading requirements.

ECONOMIC FEASIBILITY / ALTERNATIVES

Again, the question of economic feasibility is of the utmost importance, especially with regard to choice of alternatives, community benefit considerations, effect on land values etc. No EIS should be considered complete or acceptable until a thorough analysis of alternatives, complete with dollars and cents values attached, has been produced. Each alternative and the component activities that comprise that alternative should be attached to costs, discussion of revenues generated (and how generated) etc. so that this community can easily compare and contrast the options.

cc: Nanatomi Hawaii, Inc.
Councilman David Kahanu
Kaneohe Neighborhood Board

HELBER HASTERT & KIMURA Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHVHK UW
Facsimile (808) 545-2050

21 March 1990

Kahalu'u Neighborhood Board No. 29
c/o Key Project
47-200 Waihe'e Road
Kaneohe, Hawaii 96744

Dear Kahaluu Neighborhood Board Members:

Draft Environmental Impact Statement
Maluluni Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to the Department of General Planning which we received 21 February 1990 and offer the following responses to your comments.

Comment: "In his recent State of the State address, Governor Waihee stated a sentiment that has considerable community following and one that this Board feels is prevalent amongst Kaneohe Bay area residents. He stated, 'It is time to start calling a golf course a golf course.' He went on to say, 'Thus we will submit legislation to remove golf course development as a permitted use on Ag land.' On p. III-1 it is stated that the golf course component of this proposal represents an 'integral part of the diversified agricultural industry.' This statement is debatable and should be substantiated."

Response: Golf courses are an integral part of the diversified agricultural industry. Recently, the Department of Agricultural and Resource Economics, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa completed a draft report that was entitled, "An Economic Profile of Hawaii's Landscape Services in 1987" (Linda J. Cox, James R. Hollyer and Donald M. Schug, August 1989). This study was funded through the Governor's Agriculture Coordination Committee. The report surveyed the gross sales of those involved in the landscape industry. The estimated gross sales of landscaping activities in Hawaii, extrapolated from the surveys, was approximately $349.9 million in 1987, including an estimated $94.2 million from golf courses (or 27 percent of the landscape industry in 1987). The study stated that:

> "To give an idea of how the value of landscape services presented here compares to the value of other agricultural activities (emphasis added) in Hawaii, the gross sales of the State's fresh and processed pineapple industry was $251 million in 1987 (Hawaii Agricultural Statistics Service)."

Comment: "He'eia Kea has a history of being a rural community wherein agriculture, either self-supporting or supplemental, was a source of income to the

community that occupied the area. This land use dates back beyond the period of HECO's stewardship, beyond Bishop Estate leaseholds, into ancient history. That historical perspective on agricultural use should be well researched and given a value coordinate, relative to the discussion of alternative uses for the area. The potential positive impact(s), both social and economic, of re-establishing such a rural/agricultural community should be thorough and inclusive of newer forms of agriculture and aquaculture or mariculture. The latter has been given some attention and support during previous attempts to develop the area. The proximity of the bay itself and supporting research facilities such as HIMB at Coconut Island and the Mariculture Research and Training Facility are important factors related to mariculture/aquaculture potential."

Response: Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory survey of the property including historical documentary background research. PHRI's report was attached to EIS as Appendix B. In addition to features that relate to WWII activities and early 1900's pineapple cultivation, features were found that relate to unknown historical agricultural activities (this information is provided in Section 4.11 of the Final EIS). Much of the property has been altered by the above activities, and therefore, only one site of clearly prehistoric remains was found. The information that has been garnered so far would not have been available without Nanatomi Hawaii's funding of these archaeological studies. Continuation of post-World War II activities on the property and more extensive agricultural use may have resulted in the destruction of the remaining prehistoric and historic sites.

While a historical analysis of agricultural use in the area might be of academic interest, the measure of agricultural feasibility is based on ecological adaptation (including soil capability, topography, climate), sales potentials, economic viability (in comparison to other areas), and intensity of production. According to an agricultural feasibility study of the property, prepared by Dr. Frank S. Scott:

> "Application of appropriate criteria for agricultural feasibility indicates that project lands have limited potentials for agriculture. None of the soil types are rated above SCS IV and LSB C without irrigation. A maximum of only 20 percent of the land area is ecologically well adapted to cultivated crop production and 23 percent is marginal if irrigated based on less restrictive LSB capability classifications. The better lands consist of isolated parcels separated by or contiguous to inferior soil types which adversely affects the potential for economies of scale and would substantially increase costs of production in relation to better land areas. The high cost of irrigation water would render the project at an economic disadvantage for most crops. This, in turn, would affect the ability to compete in the market-place. Better lands and better production conditions can be found elsewhere on Oahu."

In addition, we have reviewed the mariculture feasibility study prepared by Mark Yanagihara-Brooks "Aquaculture/Mariculture Feasibility for Land Parcel at Heeia Kea" on 3 September 1986. Among Mr. Yanagihara-Brooks' conclusions were:

> "The greater part of the subject parcel is not suitable for aquaculture or mariculture based on topographic and soil criteria. Approximately 11 acres of productive water surface acres are possible within the parcel...Economically, the project suffers the inability to expand to a more efficient economy of scale."

While we appreciate your concern for historical analysis, Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibly attain the objectives of the action" (in this case, the objective is the development of a sports complex, including an 18-hole golf course). The alternative that the Board raises (establishing a rural/agricultural community, including agriculture and aquaculture or mariculture) would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

Comment: "Discussion of State Aquaculture goals is also missing here."

Response: Among the conclusions of a mariculture feasibility study prepared by Mark Yanagihara-Brooks "Aquaculture/Mariculture Feasibility for Land Parcel at Heeia Kea" were:

> "The greater part of the subject parcel is not suitable for aquaculture or mariculture based on topographic and soil criteria. Approximately 11 acres of productive water surface acres are possible within the parcel...Economically, the project suffers the inability to expand to a more efficient economy of scale."

Since the feasibility of aquaculture activity on the property is minimal, a discussion of the State Aquaculture goal was not deemed relevant.

Comment: "Consideration of ag potential must include a complete examination of the effect of land cost for this specific property on the feasibility of such options and on the displacement over the past twenty-plus years of a community that was predominantly part-Hawaiian in ethnic background. Although provision for such opportunities may not be deemed as being the responsibility of this land owner, such a discussion is essential data for those who will assess the socio-economic impact of change - of which this proposal is a part - for the greater Kaneohe Bay region."

Response: There was no displacement of individuals by the project. When Nanatomi Hawaii acquired the property, there was no one residing on the property. The proposed project will not displace any residents. The previous landowner of the property was Kamehameha Schools/B.P. Bishop Estate and the lessee was Malama-Gentry Joint Venture. Possible reasons for the "discontinuation" of the post-WWII agricultural lifestyle that may have once existed in Heeia Kea Valley, are that the soils were not suitable for farming, a constant source of irrigation water was not present as in nearby areas (such as Waiahole), and that later generations of family members did not want to continue the farming lifestyle. While the lease rents of the previous tenants were low ($25 to $35 a month for lots averaging a

third of an acre), none of the tenants undertook any form of significant commercial agricultural activity, other than perhaps gardening, limited livestock. In fact, until recently, large portions of the site were used by tenants as a dumping ground for vehicles.

Comment: "This Board is well aware of the 'mis-match' between State 'urban' designation and County 'Ag' zoning. The County designation, in this case, was established through more recent reviewing efforts and is more reflective of the actual use of land."

Response: The State Urban classification allows for several types of uses including agricultural activities. This land has not been in agricultural use since the demise of pineapple cultivation in the 1930's. The County agricultural designation is clearly not reflective of the actual use of the property.

Comment: "Dr. Frank Scott's discussion of Agricultural feasibility is clinical and thorough with regard to statistics. It fails however (as with similar discussions on the Waikane Golf Course Proposal) in that his frame of reference for ag feasibility is one of searching for 'economies of scale'. One cannot look purely for Agri-business success opportunities in this area without consideration of the social value of encouraging small-rural family farms...in keeping with the kind of agricultural identity that now characterizes the Kaneohe Bay watershed. Large-scale agriculture (especially pineapple and sugar cane) has, on the contrary, contributed greatly to the demise of Kaneohe Bay, ranking high on the list of detrimental impacts seen in this watershed."

Response: We agree that Dr. Frank Scott objectively and thoroughly assessed the agricultural potential of the property. The scope of his studies was never intended to include the "social value of encouraging small-rural family farms". Historical trends indicate that while there used to be a larger proportion of the population who lived such a lifestyle, they certainly represent a much smaller proportion of today's population. Apparently, there have been other values and forces which have caused former farmers to no longer maintain the small-rural family farm lifestyle.

In response to your characterization of the identity of the Kaneohe Bay watershed as small-rural family farms, a review of the City and County of Honolulu Development Plan (Koolaupoko, West Sheet), shows the total area designated Agriculture (not all of which is actively cultivated), as slightly larger than the area designated Residential. However, a significantly greater proportion of the population within the Kaneohe Bay watershed lives in conventional suburban developments.

We cannot objectively prove or disprove your assessment that large-scale agriculture probably had an adverse impact on Kaneohe Bay (it would require monitoring of the nearshore marine environment prior, during and after large-scale agricultural activity). However, it should be noted that any agricultural activity that regularly exposes soil to erosional forces, without erosion control, has the potential to adversely affect downstream resources.

Comment: "His discussion of the potential for production in Floriculture and Nursery products is cursory, at best. He sites 'destructive' Kona winds as a negative factor saying that these winds 'may' be 'highly' destructive to shade houses. What evidence is this statement based on for the specific project area, He'eia Kea, which lies in the lee of Maelieli ridge during such storms. In fact, this may well spell a special advantage to certain forms of agriculture here, over other windward areas."

Response: We concur that Maelieli ridge will offer some protection to areas of the property immediately below the ridgeline from Kona winds, however, all of the more level and productive soils are farther below the ridgeline by Kamehameha Highway. Strong Kona storms (which average once every three years) may still be destructive to shadehouses that would be sited on the productive areas of the property (away from the ridgeline).

Comment: "Although there are, as he states, other areas that may be more desirable, from a clinical-analysis standpoint, consideration should be given to the fact that Windward Oahu, alone, has seen a tremendous surge in floral and nursery production in the past few years. The advantageous proximity of Oahu markets, transportation connections etc. is given little attention, as is the availability of employees and farmers (from Windward Oahu) with interest and expertise in this form of agriculture. Dr. Scott also sites the disadvantage of salt-laden prevailing trades in the area for 'some types of flowers and foliage', discounting the fact that much of this State is dependent on sources of salt-tolerant kinds of plants as landscaping material. Where is there a discussion of exactly what kinds of plants could be grown in this area. His discussion is incomplete."

Response: Scott's report clearly states that Oahu is a major producer of floraculture and nursery products and expansion has been more rapid than for the state as a whole. Scott states further that whereas the market appears to justify expansion of floriculture and nursery production on Oahu, the project site's exposure to salt air and projected high cost of irrigation water lends itself to a comparative disadvantage to other sites. Dr. Scott does not dispute the value of salt-tolerant plants; he was referring to high value plants such as orchids and potted indoor foliage plants. In fact, Nanatomi Hawaii intends to set aside a nursery on the property where existing plants can be temporarily relocated and new plants can be acclimated to the site's environmental conditions.

Comment: "Each potential agricultural scenario, combinations thereof, and the social value of related housing opportunities created by alternatives of this kind, should be given dollar values for the sake of further discussion."

Response: Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibly attain the objectives of the action" (in this case, the objective is the development of a sports complex, including an 18-hole golf course). The alternative that the Board raises (small-rural family farms) would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

Comment: "As stated (III-4), proposed uses for the portion of the property not within the State Land Use 'Urban' District will require a CDUA. This Board is

concerned with the precedent that may be set for golf course use or any other commercial use of this zone. To date no major uses have encroached upon the Conservation/Preservation district anywhere around Maelieli Ridge. Effects of the proposed action should look at cumulative impact and precedence and should be included in the final EIS. It is worth noting that a large parcel (134+ acres) was recently purchased by a Mr. Kawamoto in the Kahalu'u-Pakole area, entirely within the Conservation district and that a large number of land holdings around Maelieli Ridge include Preservation-zoned lands."

Response: It is impossible to assess the cumulative impact of development within the Conservation/Preservation district around Maelieli Ridge, when as you note, there are no other known development proposals.

Comment: "The wisdom of clearing and grading of relatively-steep lands, mauka of the Conservation line should be addressed and discussion of alternatives included."

Response: Detailed information on grading and filling is unavailable at this time. According to the project civil engineering consultant, Sam O. Hirota, Inc., the proposed golf course will be designed to avoid slopes above 25 percent (in comparison, parts of several Oahu golf courses are built on slopes over 20 percent, including Pali, Kunia, Olomana, Minami, Pearl Country Club, and Oahu Country Club). Based on the Concept Plan, Sam O. Hirota, Inc. prepared a section that was cut through the property, including the area mauka of the Conservation line. The section shows the existing ground and the finished grade (based on conceptual plans). This section (and a section key map) will be attached to the Final EIS as Appendix O.

Comment: "One cannot assess the necessity of encroaching into these lands without adequate discussion and definition of "economic feasibility". What kind of profits/revenues are expected from the project? What is the economic feasibility of, say, a nine-hole course as opposed to the proposed eighteen-hole course? Discussion of reasonable alternatives should also include that of using land currently proposed for housing as a means of providing space for a smaller course."

Response: Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibly attain the objectives of the action" (in this case, the objective is the development of a sports complex, including an 18-hole golf course). The alternative that the Board raises (a 9-hole golf course) would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

Comment: "The Board, in its informal comments and discussion, has generally reacted very positively to proposals to remove all residential zoning from within the Special Management Area citing residential use as a 'non-shoreline dependent' activity and, therefore, inappropriate for this area. Concern for "cumulative impact" of development within the SMA, given the extent of developed Kaneohe Bay Shoreline, serves only to heighten this concern."

Response: In response to the Board's and other resident's concerns, the concept plan for the property was revised so that all of the proposed residential area was moved inland (outside of the Special Management Area)

Comment: "Although the County's growth policies now direct the bulk of Oahu's growth away from Windward Oahu, there remains a definite need for some 'fill-in' housing designed to meet special needs and populations. Ag-related housing has already been mentioned earlier in our comments; discussion of the potential for including some or only rental housing designed to fill those needs should be included. The possibility of mixing uses of this land, including some housing of the kind mentioned, cannot be discussed without a detailed economic feasibility study."

Response: Given the primary purpose of constructing a sports complex with an 18-hole golf course, the amount of land available for residential housing is limited to 30 to 35 homes. Nanatomi Hawaii has agreed to such a limitation as a result of community meetings and recently defeated proposals by Malama-Gentry Joint Venture for massive residential development. All of the 30 to 35 homes will the bear the cost of the development, as no golf course memberships will be sold.

Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibly attain the objectives of the action" (in this case, the objective is the development of a sports complex, including an 18-hole golf course). The alternatives that the Board raised (small-rural family farms, rental housing) would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

Comment: "In the City's report, GOLF COURSE DEVELOPMENT ON OAHU (July '89), the City Administration recommends against 'stand alone golf courses in rural or agricultural areas' based on the fear that 'such courses' may promote speculative real estate activity...resulting in displacement of small agricultural operators and higher land prices for future potential housing development sites.'. Consideration of 'truly affordable' rental housing component should be discussed and, perhaps, counted as a possible public benefit. (see following section of comments)"

Response: There are no small agricultural operators on the property, or any known agricultural operations adjacent to the property, to displace.

Speculative real estate activity is dependent on two factors: 1) available and developable land immediately adjoining the project; and 2) a willing seller. There are no known parcels of land immediately adjoining the property which are developable for housing. All adjoining parcels are inhabited by existing residents or designated State Conservation.

There is undoubtedly a need for "truly affordable" rental housing in the community, however, given the community's desire to constrain growth, large-scale, low-cost

housing in this area is antithetical. The applicant feels that the use of a substantial portion of the property for potential housing development, will likely encounter significant opposition from certain segments of the community, as it has in the past.

Nanatomi Hawaii has no intention of adding additional housing to the perimeter of the golf course in the future.

Comment: "Mayor Frank Fasi (preamble GOLF COURSES IN HAWAII, cited above), states that 'The value of public benefit should be quantified' in golf course proposals and recommends '$20 million as minimum expected value to qualify for consideration'. It is likely that this 'minimum' is derived from estimates of the expected profits, speculative value of the property etc. Our Board suggests that the following public benefits be included among other benefits considered."

"The board is already on record favoring establishment of a shoreline park, the length of He'eia Kea Valley - a use that is 'shoreline dependent' and an opportunity that should not be lost. This document erroneously suggests that such a park would run counter to concerns for viewplane preservation stated in the Coastal View Study."

Response: In response to the Board's policy, Nanatomi Hawaii is proposing to dedicate land for the establishment of a shoreline park. The applicant will dedicate approximately 9 acres of the property for community-oriented facilities. Approximately 1 acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. The proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area (all of the above information was described in sections 2.5, 3.2.2 and 6.7.2 of the Draft EIS). The area proposed to be dedicated for a shoreline park was selected for a number of reasons: 1) the shoreline makai of the property would not be used for swimming and wading; 2) the area designated is appropriate and enhances the existing shoreline activities and resources (Heeia Kea Pier and Boat Harbor, and Heeia State Park); 3) the realignment of Kamehameha Highway for the entire length of the property would be extremely expensive; 4) the provision of shoreline park in the configuration that the Board suggests would restrict the already limited amount of flat land for use as golf course; and 5) moving Kamehameha Highway 300 feet inland from its present alignment would have an adverse impact on existing continuous views along the highway.

The Coastal View Study clearly shows that the stretch of Kamehameha Highway fronting the subject property (designated KP-5) is a coastal road with continuous coastal views (Exhibit No. 10, the base for Figure 14 of the EIS). The Coastal View Study also states on page 25 that KP-5 has

> "Continuous makai views from Heeia to Kealohi Point. Alignment of Kamehameha Highway adjacent to shoreline insures (emphasis added) preservation of continuous views."

We maintain that moving Kamehameha Highway outside of the SMA area (300 feet inland, from the centerline of the existing highway), will significantly reduce existing views.

Comment: "Viewplane concerns, included in that study, resulted from input from the NB and other community groups who were aware of proposals to construct a large marina fronting the entire valley (opposed by our Board!)."

Response: Nanatomi Hawaii does not own any portion of the shoreline necessary for the development of a shoreline park. Nanatomi Hawaii's property limit is the mauka edge of the right-of-way for Kamehameha Highway. The shoreside remnant is owned in fee by Malama-Gentry Joint Venture, who has in the past informally proposed a marina.

Comment: "This park would, in our opinion, enhance rather than detract from this viewplane while increasing access to the bay. Other beach parks (Kahana Bay, Punalu'u Beach Park etc.) have not damaged that viewplane - the benefits of this concept, in terms of public advantages, far outweigh any impact."

Response: Again, the Coastal View Study clearly shows that the stretch of Kamehameha Highway fronting the subject property (designated KP-5) is a coastal road with continuous coastal views (Exhibit No. 10, the base for Figure 14 of the EIS). The Coastal View Study also states on page 25 that KP-5 has "Continuous makai views from Heeia to Kealohi Point. Alignment of Kamehameha Highway adjacent to shoreline insures (emphasis added) preservation of continuous views." We maintain that moving Kamehameha Highway outside of the SMA area (300 feet inland, from the centerline of the existing highway), will significantly reduce existing views.

We concur that a park in the configuration you suggest would increase access to the bay by providing additional parking adjacent to the Bay and would generate increased public usage and activity of the area. Such a park could become popular although it is highly unlikely it will be used for swimming because of the mudflats fronting the shoreline. Therefore, accessibility to the shoreline is not as important as accessibility to the existing recreational resources of Heeia State Park and Heeia Kea Fishing Pier and Boat Harbor.

Kamehameha Highway appears to be only 100 to 200 feet away from the shoreline at Kahana Bay, Punalu'u beach parks. In addition, Kamehameha Highway is at a higher elevation than Kahana Bay Beach Park allowing better vantage points for views. Kamehameha Highway at Swanzy Beach Park is probably a better comparable; views from the highway of the ocean (approximately 300 feet away) are not as good as from the highway fronting the Crouching Lion Restaurant.

Comment: "At present, Kamehameha Hwy. has little or no shoulder on either side. Realignment of the Hwy. should be considered necessary from, this standpoint alone."

Response: As noted in Section 6.1.1 of the Draft EIS, Kamehameha Highway fronting the subject property is a 50-foot right-of-way, with a pavement width of only 22 feet. There is sufficient width within the right of way to accommodate additional shoulder width; however, if additional parking is not provided for the Heeia Kea Pier and Boat Harbor, any additional shoulder would likely be regularly used for overflow parking.

Comment: "Inclusion of a full length park may also be beneficial as an buffer between the environmental impact of the golf course (or other mauka uses) and the sensitive bay ecosystem."

Response: A full-length park may be beneficial as a buffer, depending on its design (including detention silt and debris basins, the preservation of the existing wetlands), the maintenance practices of the park (use of pesticides, herbicides and fertilizers), and whether the park maintenance is monitored for its possible effects on the nearshore marine environment. Section 6.4.2 of the Draft EIS stated that the proposed ponds and water features of the golf course would serve as detention silt and debris basins, reducing the peak runoff. The proposed detention basins and designed golf course rough features are expected to reduce the peak runoff discharge to below that of the existing condition. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts of runoff.

Comment: "As golf courses are known to attract migratory species of birds, many of them dependent on aquatic habitats, some discussion should focus on potential for creation of nesting sites - 'islands', perhaps, within the runoff retention ponds proposed. Discussion should include independent monitoring of these sites or dedication to those who would monitor for environmental hazards (pesticides, herbicides, chemicals etc) as well as consultation with appropriate Federal and/or State agencies as to design, feasibility. This concept may be included in, or relate to, creation of a substantial shoreline park."

Response: We concur that there will probably be some usage of the proposed golf course water hazards by waterbirds. While the golf course will create some open water areas, it is expected that Heeia Uli Wetlands will provide a significantly larger and more attractive habitats for waterbirds. There have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management. Waterbirds and fish appear to thrive in ponds and water hazards on golf courses in Hawaii.

A shoreline park of the type the Board suggests would likely not be attractive as a waterbird habitat unless human activity is significantly restricted or is buffered. Loud noises or active movement would in all likelihood scare birds away.

Comment: "Monitoring, research, and mitigation measures relating to specific and general impact on Kaneohe Bay's estuarine environment, water quality, coral reefs etc. should be addressed. Discussion of funding (based on a % of profits?) for research should go hand-in-hand with proposals for acceptance of liability and mechanisms for response to environmental hazards and impacts to the bay. Efforts to set up such an 'environmental fund' should include discussion with HIMB at

Coconut Island, the State Departments of Land and Natural Resources, Health, the Coastal Zone Advisory and others. Such a fund would, ideally, receive contributions from any and all golf course developers, users of large amounts of chemicals that may impact the bay etc. This project could set a valuable precedent for conscientious care of the bay's ecosystem."

Response: Appendix G of the Final EIS will include a scope of work for a marine environment monitoring program that Nanatomi Hawaii will fund.

Comment: - "Housing replacement/self help housing fund for Windward residents who meet a certain income criteria."

Response: We have passed this suggested community benefit to Nanatomi Hawaii.

Comment: - "Contributions to bay area land acquisition for, or development of, areas already designated (on Dev. Plan Public Facilities Maps) for park. There are park needs in the Kaneohe-Kualoa are that have gone unmet for many years for lack of funding."

Response: Nanatomi Hawaii is proposing to dedicate land for the establishment of a shoreline park. The applicant will dedicate approximately 9 acres of the property for community-oriented facilities. Approximately 1 acre will be dedicated for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, additional car and boat trailer parking, and a new canoe hale could be constructed. The proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor. Approximately 5 acres of land mauka of the realigned highway are included which could be used as a site for an amphitheater, hula halau and picnic area (all of the above information was described in sections 2.5, 3.2.2 and 6.7.2 of the Draft EIS).

Comment: "The potential of this project to become the impetus for further resort expansion should be addressed openly. Under former Mayor Eileen Anderson's Administration, we were successful in removing Resort zoning from the Kaneohe Bay area, leaving such development for more appropriate, accepted sites. At one time the area now known as Kualoa Park was also suggested as a site for resort development. This idea was wisely thwarted by City acquisition for the present park, a benefit to the community, island-wide."

"As proposed, the project would already include a number of major, resort components besides that of a golf course, including a clubhouse, restaurant, tennis courts, high priced condo-style housing, spas etc. The marketability of these components essential to a future resort should be discussed, economically and socially."

Response: Nanatomi Hawaii has no intention of developing a resort on the property. Nearly every golf course in Hawaii which is not located within a resort,

has a clubhouse with a restaurant. For instance, the Pali Golf Course has a clubhouse, but does not, in our opinion, qualify it as a resort. The proposed tennis courts and spa are part of the sports facilities proposed for the project. There are existing tennis clubs and health fitness facilities on Oahu which are marketed for and used by local residents. Resort use implies the use of residences as transient accommodations. The proposed home are being sold as single-family residences and not as transient vacation rentals. No condominiums will be sold.

Comment: "Proximity to Kaneohe Bay and existing commercial, ocean-based recreation (albeit, controversial) as well as to other, similar resort-style proposals (Waikane Golf Course, He'eia Meadowlands, etc) should enter into this impact discussion."

Response: As shown on the attached letter, Nanatomi Hawaii supports the efforts of the Board to enhance the Kaneohe Bay environment. Nanatomi Hawaii is aware of the proliferation of commercial activities in the Bay and their degrading effect on the environment of the Bay. To the extent that such activities have negatively affected the environment and aesthetics of the Bay, Nanatomi Hawaii would support the efforts of the Board to limit and control those activities, including the opposition to additional slips or moorings in the Bay, or the development of a marina in the Bay, whether it is proposed at or near the Heeia Kea Boat Harbor or anywhere else in the Bay.

We are not aware of any resorts planned at Waikane Golf Course or He'eia Meadowlands.

Comment: "Incentive for expansion of He'eia Kea Pier may well be increased by approval of this project. The project, as proposed, stands to attract many wealthy clients and home-buyers who could, in turn, press for pier expansion. Consultants do recommend that the owners/operators actively 'sell' play time in Japan. Although Nanatomi is on record as being opposed to a marina and favoring a master-plan for the bay, the mere presence of this kind of operation may induce pressure for an unwanted marina expansion and/or increased tourist-style activity at the pier. Our Board is on record as supportive of only minimal expansion of the pier, only in the direction of Lae O Kealohi/He'eia State Park."

Response: The analysis of economic and fiscal impacts of the project (Natelson Levander Whitney, Inc., November 1989, Draft EIS, Appendix M) indicated on page 47 that the golf course should be actively marketed in Japan. While this reflects the opinion of the consultant, Natelson Levander Whitney, Inc., the applicant will not implement this recommendation.

Again, Nanatomi Hawaii supports the efforts of the Board to enhance the Kaneohe Bay environment. Nanatomi Hawaii is aware of the proliferation of commercial activities in the Bay and their degrading effect on the environment of the Bay. To the extent that such activities have negatively affected the environment and aesthetics of the Bay, Nanatomi Hawaii would support the efforts of the Board to limit and control those activities, including the opposition to additional slips or moorings in the Bay, or the development of a marina in the Bay, whether it is proposed at or near the Heeia Kea Boat Harbor or anywhere else in the Bay. Aside from Nanatomi Hawaii's stated support of the Board's position (see attached letter), the State and the community have the authority to withhold expansion of the boat harbor. Nanatomi Hawaii does not have this authority.

Comment: "The 'low permeability of soil' and flooding potential, due to seasonal and/or unpredictably heavy rainfall, increases concern for runoff and transporting of chemical-laden water or soil into the bay. Additionally, Kaneohe Bay is known for its reduced circulation due to the abundance and configuration of barrier, table top, shoreline reefs and submerged lands. This environmental characteristic is, at once, its greatest asset and source of vulnerability to impact from the surrounding terrestrial watershed."

Response: Satisfactory reduction of chemical transport in runoff will be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadways servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation.

Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow released nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff.

All of the above information was provided in Section 4.4.2 (page IV-11 of the Draft Environmental Impact Statement [EIS]), and Section 6.4.2 (page VI-6 of the Draft EIS) of the EIS.

Comment: "Discussion of impact on the bay should look at chronic input and cumulative impact of golf courses, including those already proposed, in the Kaneohe Bay 'bio-region'.

Response: There will be no "chronic" impact. The main source for irrigation of the golf course will be rainfall (as noted elsewhere in your letter, a heavy rainy season can last eight months) and the collection of storm runoff. The golf course drainage system will be designed to capture as much storm runoff (up to 100-year storm events) for eventual irrigation use.

In addition, a marine environment monitoring program will be paid for by the applicant. Copies of quarterly monitoring reports will be distributed to pertinent agencies or parties, including the Department of Health and the Hawaii Institute of Marine Biology (the agency that has most studied Kaneohe Bay) both of which monitor the cumulative impacts on the Bay.

Comment: "Episodic input should detail exact impact from each specific chemical that will or may be used, with special attention to those that are known to be highly toxic to birds and aquatic life."

Response: Appendix G of the Final EIS will include a scope of work for a marine environment monitoring program that Nanatomi Hawaii will fund.

Comment: "Hazards that may result from misapplication - a problem not to be ruled out - and the compensation for, mitigation for, or response to such hazards should be detailed at this time in the development process. These concerns are essential data that should be available for public scrutiny. Agreements, with regard to liability, should be proposed for the sake of discussion, with reference to similar situations elsewhere for comparison."

"The State Dept. of Health and Dept. of Agriculture both have policies with regard to application of these chemicals What do their monitoring programs consist of; how are these programs subsidized (taxpayer, private landowner?)."

Response: Copies of quarterly monitoring reports will be distributed to pertinent agencies or parties. If adverse effects as a result of chemical runoff from the project is detected during the monitoring program, then golf course management practices will be reviewed and if required, additional retention basins will be constructed.

Comment: "Special consideration of the potential for heavy rainfall of long duration should be given in regard to grading requirements. Controls should be spelled out in the form of potential contracts and agreements that are more stringent than existing grading requirements."

Response: In addition to observing the existing grading requirements, the marine monitoring program will be conducted during the entire construction period, to monitor the effects of grading. As noted above, copies of the quarterly monitoring reports will be distributed to pertinent agencies or parties.

Comment: "Again, the question of economic feasibility is of the utmost importance, especially with regard to choice of alternatives, community benefit considerations, effect on land values etc. No EIS should be considered complete or acceptable until a thorough analysis of alternatives, complete with dollars and cents values attached, has been produced. Each alternative and the component activities that comprise that alternative should be attached to costs, discussion of revenues generated (and how generated) etc. so that this community can easily compare and contrast the options."

Response: Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibly attain the objectives of the action" (in this case, the objective is the development of a sports complex, including an 18-hole golf course). The alternatives that the Board raised would not attain the objective of the action. The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

Enclosures

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Councilman David Kahanu
Kaneohe Neighborhood Board
Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook
Donna Kanemaru

MARK YANAGIHARA-BROOKS
AQUACULTURE CONSULTANT
1555 POHAKU NO. A211
HONOLULU HAWAII 96822

SEPTEMBER 3, 1986

GRAY, HONG, AND ASSOCIATES
119 MERCHANT STREET, SUITE 607
HONOLULU, HAWAII 96813

ATTENTION : MR. DAVID B. BILLS
PROJECT ENGINEER

SUBJECT : AQUACULTURE/MARICULTURE FEASIBILITY FOR LAND PARCEL AT HEEIA KEA, TAX MAP KEY 4-6-16-32, KOOLAUPOKO DISTRICT, ISLAND OF OAHU, STATE OF HAWAII.

List of Exhibits and Tables

SCOPE OF REPORT

This report investigates the feasibility of aquaculture/mariculture on the approximately 219 acres of land constituting the subject parcel, owned by Hawaiian Electric Company, Inc. The land investigated is situated in Heeia Kea, directly mauka of Kamehameha Highway near Heeia Kea Small Boat Harbor.

Total potential mariculture land is calculated from topographic and soils characteristics of the site. Feasibility for potential mariculture acreage follows, based upon analysis of water supply and discharge constraints for the subject parcel. The potential of the project is put into perspective in a brief analysis of the criteria for and constraints to successful mariculture given current technology. A general evaluation is made for the project given historical and current economic realities of the mariculture industry in the State of Hawaii. Finally, based upon the above analysis, conclusions are presented regarding the economic soundness of mariculture activities on the subject parcel.

TOPOGRAPHY

Earthen pond construction costs become unreasonably high on slopes greater than or equal to 5 per cent. The State of Hawaii Department of Economic Development has assessed State lands for aquaculture suitability. 135,000 acres have been declared primary lands for aquaculture development and over 500,000 acres were assessed as secondary lands. The subject land parcel has been assessed as secondary land (Exhibit 1).

The property topography ranges from fairly level (makai) to gently sloping to steeply sloping upper portions (mauka) as shown in Exhibit 2. A detailed analysis of suitable lands for pond construction based on topographic characteristics of the site

shows approximately 30 of the 219 total acres to be on a slope suitable for mariculture development (Exhibit 3). The remaining 189 acres are considered too steep for economically justifiable pond development (Table 1). Mariculture ponds are generally 1 meter deep with 0.5 meter freeboard, have 2:1 - 3:1 sloped dikes, and 0.5 to 2.0 acres in water area. Ponds are built with adjacent units sharing a common levee to save on construction costs. Each pond must have a separate water inlet and outlet.

SOILS

The Hawaii State Department of Agriculture ratings under the ALISH System (Agricultural Lands of Importance to the State of Hawaii) classifies about 46 acres of land in the central part of the property as Other Important Agriculture Land (Exhibit 5).

While pond/mariculture soil productivity considerations differ from agricultural ones, there are some areas of correlation. Major differences between soil needs for mariculture and agriculture lie in soil structure. Soil fertility needs are more similar for the two food production systems and often prime soils for agriculture are most suitable for aquaculture.

The subject land parcel contains six subseries of soils as classified by the U.S.D.A. Soil Conservation Service (SCS) as shown in Exhibit 6. Descriptions of these soils are as follows.

<u>Ewa Silty Clay Loam, Moderately Shallow, 0 to 2 Percent Slopes (EmA)</u>

This subseries of the Ewa series is located in a narrow strip of land bordering Kamehameha Highway on the Kaneohe (east) side of the property. The topsoil consists of dark reddish-brown silty clay loam about 18 inches thick. The subsoil is dark reddish-brown and dark red silty clay loam, with a subangular blocky structure, moderately shallow and varying in depth. The substratum consists of coral limestone at a depth below the surface of 20 to 50 inches. Both the topsoil and subsoil have a pH of neutral.

Hokuleia Clay Loam (Mt)

This subseries of the Hokuleia series occupies a narrow strip of land bordering the mauka side of the highway on the Kahuku (west) side of the property. The topsoil consists of a very dark grayish-brown loam about 16 inches thick. The subsoil is a dark brown to light gray single grain or loamy sand of 34 to 48 inches in depth. The topsoil is neutral and the subsoil is moderately alkaline.

Kokokahi clay, 6 to 12 Percent slopes (KtC)

A small pocket of this subseries of the Kokokahi series is located along the highway in the extreme makai-Kahuku corner of the project. The topsoil consists of very dark gray and dark gray clay about 14 inches thick. The subsoil is a dark grayish brown clay with a subangular blocky structure and is about 12 inches thick. The substratum is a grayish-brown and light brownish-gray clay, 14 to 20 inches thick. The topsoil is slightly acid to neutral and the subsoil and substratum are slightly acid to mildly alkaline. The soil has a high shrink swell potential. Workability is difficult because of the sticky, plastic nature of the clay and because of the resulting narrow range of moisture content.

Alaeloa Silty Clay, 15 to 35 Percent Slopes (AeE)

This subseries of the Alaeloa series is located mostly in the makai section of the area zoned Conservation. The topsoil consists of dark reddish-brown silty clay about 10 inches thick. The subsoil is dark red and red silty clay with a subangular blocky structure and about 48 inches thick. The substratum is soft, weathered basic igneous rock. The topsoil is medium acid and the subsoil is strongly acid.

Alaeloa Silty Clay, 40 to 70 Percent Slopes (ALF)

This subseries is located entirely on land zoned as Conservation on the upper slopes of the project. This soil is the same as Alaeloa silty clay soil of the lesser slope, except that run-off is rapid to very rapid and the erosion hazard is severe.

Lahaina Silty Clay, 7 to 15 Percent Slope (LaC)

This subseries of the Lahaina series occupies the area extending mauka from the highway on the Kaneohe side and from the strips of land designated EmA at the central-makai border and Mt at the makai-Kahuku border. The topsoil consists of dark reddish brown silty clay about 15 inches thick. The subsoil is a dusky red and dark reddish brown, subangular blocky silty clay and silty clay loam about 45 inches thick. The substratum is soft, weathered basic igneous rock. The topsoil is medium acid and the subsoil is slightly acid to medium acid. This subseries includes some steep areas and areas with a few stones on the surface.

The minimum soil requirements for mariculture are (1) compactibility of the topsoil to prevent undue amounts of seepage (2) topsoil depth sufficient to prevent leakage of pond water (one meter depth) into permeable subsoil and (3) workability during pond construction. Only the part on the parcel classified Lahaina Silty Clay (LaC) meets all of the above requirements (Table 2). Preferable soil pH for mariculture use would be slightly alkaline to neutral, however production is feasible in this soil type.

POTENTIAL MARICULTURE ACREAGE

Possible mariculture acreage for the subject parcel is limited to the 30 acres of fairly level or gently sloping land out-lined in Exhibit 3 which lies within the LaC soil classification. Table 3 outlines total land available meeting criteria for both topography and soil type.

GEOLOGY

A generalized geologic map (Geological Survey water-supply paper 1894, Plate 1) of Windward Oahu shows that the subject parcel consists of Alluvium at the lower elevations and Honolulu Volcanic Series at the higher elevations. Lava flows of the Honolulu Volcanic Series are generally not very permeable and wells there have low to moderate yields. The Alluvium is composed of silt and clay, lesser amounts of sand and gravel, and some gravel and cobbles. Young Alluvium is generally more permeable than the near-surface older Alluvium. Yields of wells in Windward Oahu in Alluvium are generally low.

WATER RESOURCES

The most reliable source of ground water is the high-level water in the basaltic lava flows. High level ground water maintains the base flows of streams, water development tunnels and pumped wells. Slightly more than half the total base flow enters streams as diffused ground water effluent between altitudes of 225 and 150 feet. The most favorable area for ground water development is above an altitude of 200 feet in the major stream valleys. Water above an altitude of 500 feet is diverted by tunnels. Numerous streams drain into Kaneohe Bay relatively near the subject parcel. The Kahaluu, Ahuimanu and Waihee streams are closest to the subject parcel. The total long-term average discharge of the Kahaluu stream at its confluence with the Ahuimanu stream is 5.4 million gallons per day (mgd), and a flow (Q90) of 3.3 mgd is equaled or exceeded 90 per cent of the time. Below the confluence, the combined long-term average discharge is 9.5 mgd and the Q90 is 4.2 mgd. The Waihee stream flows northeastward and joins the Kahaluu stream after losing much of its flow to the Higa ditch. The streams are short and have steep gradients. The annual maximum discharge generally occurs in the cooler months from October through April. The minimum mean weekly rainfall around the subject parcel is about 1 inch (Exhibit 7).

WATER QUALITY

Contamination of freshwater by underlying sea water often occurs in the coastal area of Windward Oahu. Chemical analyses of water supply sources in Windward Oahu is shown in Exhibit 8 (Geological Survey water-supply paper 1894, Table 11). The pH generally ranges from 7 to 8. Ground water temperatures ranges from 65 F to 79 F in individual wells. Water from basaltic aquifers ranges in temperature from 65 F to 73 F, depending on altitude and climate. Water from limestone aquifers ranges from in temperature from 77 to 79 F, depending on ocean temperature, climate, and the amount and temperature of irrigation water recharging the aquifer.

WATER SUPPPLY FOR AQUACULTURE

Water supply is one of the more important factors in the selection of a site for an aquaculture facility. The following characteristics of the water supply are desirable :

1. Constant flow with minimal fluctuation.
2. High dissolved oxygen concentration.
3. No chemical or organic contamination.
4. Acceptable pH range.
5. Low siltation levels.
6. Does not contain predators or disease agents.
7. Acceptable temperature range.

WATER QUANTITY REQUIREMENTS

An area of less than 12 acres has been estimated to be feasible for aquaculture. Fresh water prawn is the major commercial high market value aquaculture product in Hawaii. Water requirements for freshwater prawn culture on a daily basis is about 25 gallons per minute per acre or 36,000 gallons per acre per day. A 12-acre freshwater prawn nursery and grow-out facility would require 432,000 gallons of water per day. In addition to the daily requirements, about 800 gallons per minute (gpm) should be available for filling up an acre pond with an average depth of 3.5 feet in 24 hours. The water supply for freshwater prawn culture should have a capacity of 1,100 gpm.

Shrimp is a promising aquaculture product in Hawaii. Shrimp grows well in water with salinity close to that of seawater. Freshwater is also required to prevent salinity fluctuations due to evaporation and seepage. The common water exchange rate used in intensive shrimp ponds is 20 percent of the pond volume per day. This would translate to a 160 gpm saltwater flushing rate for an acre pond or 1,920 gpm for a 12-acre farm. Evaporation and seepage rates can be as high as 2.5 cm or 27,156 gallons per acre per day. To maintain the optimal salinity for growth, freshwater would need to be added to the ponds at a rate of 18 gpm. A 12-acre shrimp farm would thus require around 216 gpm of freshwater. In addition, about 800 gpm saltwater is required to fill up an acre pond in 24 hours. The total saltwater pumping capacity required for an intensive shrimp farm would thus be 2,720 gpm.

FEASIBILITY OF DEVELOPING WATER SOURCE AND WATER DISCHARGE

Alluvium has limited importance as a source of freshwater and the development of freshwater wells where ponds can be located do not appear feasible. The streams could be a source of freshwater but are not located close enough to the parcel suitable for aquaculture. Tapping the streams and conveying the water to the parcel would be costly and technically involved because of the gradients. Alternatively, the freshwater could be obtained from municipal supplies. The agricultural rates for freshwater are $0.84 per 1,000 gallons for the first 13,000 gallons and $0.69 per 1,000 gallons thereafter, per month. Based on the daily 12-acre freshwater prawn farm water requirements of 432,000 gallons, the average monthly cost for water would be about $8945. This cost would be prohibitive for profitable operation.

Rock formations which contain ground water of high salinity near shore are basaltic lava flows and coralline limestone. An Oahu geologic map (Geologival Survey water-supply paper 1894, Plate 1) indicates that such rock formations are not present in the subject parcel and it is doubtful if substantial seawater wells can be developed at all.

Even if seawater wells could be developed, disposal of pond effluents would present problems. Ocean disposal is costly because of the need for multi-stage treatment plants and ocean outfalls to meet water quality standards of the receiving waters. The success of on-site disposal using subsurface injection wells depends on the geologic and hydrologic environments. Sub-surface disposal in low-lying areas and the coastal plain will likely lead to contamination of beaches and near-shore areas. Wastes injected into ground water bodies near the coast are likely to spread laterally and eventually discharge at the coast. This is

because ground water bodies near the coast are usually of small volume and thickness. Alluvium also has disadvantageous characteristics for sub-surface injection of waste water. Alluvium has limited distribution, quickly drains after rains and presents high danger of pollution to any underlying water bodies. Stream channels have also cut into Alluvium of low permeability, allowing discharge from the underlying confined ground water. Under such hydraulic conditions, wastes injected into the sub-surface will presumably be discharged as effluent flow in nearby stream channels which eventually drains into the ocean. Waste discharged into the stream channel will not infiltrate into the sub-surface.

HAWAIIAN AQUACULTURE IN PERSPECTIVE

OPPORTUNITIES AND CONSTRAINTS

On a worldwide basis, aquaculture continues to grow annually in economic importance, particularly in the third world. Most of the production requires significant amounts of land, feed, seedstock, quality water, and labor. Within the U.S., trout and catfish farming have grown into stable industries with the assistance of decades of public and private funding and development work. Outside of these two industries, U.S. researchers and farmers have demonstrated the technical possibility of producing many other species. Yet there is a long road between early production demonstration and eventual economic success for a new species of farm animal. It is costly, time consuming, and fairly risky process that continues to spark the imagination and entrepreneurial spirit of individuals as well as the creativity of aquatic research groups. Marine shrimp is currently drawing most popular attention and probably will continue to do so for a number of years. The production requirements, especially the need for warm water, make profitable farming (shrimp in particular) possible and challenging, yet difficult.

Hawaii is in an enviable environment for aquacultural development. The islands offer the best year-round growing temperatures in the U.S. They also have unsurpassed ocean water quality, a large group of careful and capable production technicians, and a unique local seafood market. Directly marketing fresh product to ethnic groups sophisticated in seafood demand can yield high revenues to aquafarmers.

On the other hand, there are constraints to the development of commercial aquaculture in Hawaii. High land costs, competing interests for coastal resources, and permitting obstacles make farm site aquisition difficult and expensive. Farm operation costs are also above those on the mainland. Most feedstuffs are imported at significant expense, and labor costs are high. Because there is little room to cut costs, financial viability will come basically through intensification of production. Despite all constraints, there continue to be individuals working on the cutting edge of a new industry.

BASIC CRITERIA FOR SUCCESSFUL MARICULTURE IN HAWAII

The following criteria are based on the historical failure/success rate of aquaculture in the state and the island's economic environment. Mariculture holds potential to contribute to diversification of the state's economic base. Failure to adhere to these criteria have led to several farm closures.

1. Base economic projections on existing technology, not overly optimistic levels of production.
2. Work with fairly intensive systems (high yields per unit area).
3. Produce high market value products (like prawn and shrimp).
4. Locate project in areas requiring least development costs possible.
5. Base site selection decisions on highly favorable ecological factors for productivity.
6. Avoid management top-heavy organization, wasteful operation and research costs.

PROJECT ECONOMICS

For the purpose of putting potential mariculture use of the subject land in economic perspective the following basic assumptions and costs are provided. Detailed analysis is far beyond the scope of this report. Shrimp culture would almost certainly be the species of choice for a brackishwater system on the given site. Fairly intensive levels of production would be necessary on a project of 10 acres. Only the capital costs and operating expenses of major importance are outlined. Figures are provided to be only realistic estimates of actual costs. No attempt is made to determine cost of obtaining permits or development of water supply and discharge system. The feasibility of these systems is questionable and cost determination would be a major study in itself.

CAPITAL COST OUTLINE

Pond construction (11 acres) with access road, drainage, pipes @ $10,000/acre	$110,000
Hatchery Building	$30,000
Pond equipment	$40,000
Hatchery equipment	$15,000
Truck	$ 7,000
Electrical system (for aeration system)	$10,000
Subtotal	$212,000
Water development costs	not determined
Permitting costs	unknown
Land costs	not determined

Operations Costs (Annual, first full production year)

Seedstock	$30,000
Feed	$67,500
Utilities	$15,000
Labor/management	$81,000
Estimated depreciation	$14,000
TOTAL *	$207,500

* No accounting of loan interest payments

PRODUCTION

Three crops per pond per year of <u>Penaeus vannamei</u> (white shrimp), harvest size of 30-35 count. The expected yield per acre per crop is 3,000* pounds. Thus the annual yield from 10 acres of grow-out ponds would be 58,500 pounds of tails.

The break even price would be $3.55 per pound.

* These yields are theoretically possible. They are however, approximately twice the level that a start-up venture would probably achieve in its first operating years.

CONCLUSIONS

The greater part of the subject parcel is not suitable for aquaculture or mariculture based on topographic and soil criteria. Approximately 11 acres of productive water surface acres are possible within the parcel.

The greatest constraint for development of aquaculture on the 11 possible acres is the lack of evidence of a freshwater supply. Freshwater aquaculture is basically eliminated as a possible option if agricultural water rates must be paid. This is even a serious constraint to mariculture development on the parcel as significant quantities of freshwater are required to avoid hypersalinity due to evaporation and seepage.

Geologic maps indicate that it would be difficult to obtain brackish ground water in the quantities required for intensive mariculture. Direct pumping from Kaneohe Bay presents costly engineering considerations due to the extensive, shallow reef area along the site.

There are serious problems with the site in regards to water discharge from the farm. Mariculture effluents are very turbid and carry high nutrient levels. It is difficult to assume permit approval for discharge into Class AA waters of Kaneohe Bay. The discharge alternative is an injection well. Based on the geology of the project parcel, an injection well does not appear feasible.

Economically, the project suffers the inability to expand to a more efficient economy of scale. A breakeven price of $3.55 per pound was calculated at high production levels unlikely to be achieved by a start-up organization. Interest, water development and permit costs were not considered.

Intensive shrimp culture is a relatively new agricultural industry. The industry reputation has suffered from the failure of operations which were poorly situated. Many mariculture ventures have difficult times even when sited in optimal locations which do not carry high development costs.

In summary, the foregoing analysis indicates that, based on technological and economic considerations neither aquaculture nor mariculture are appropriate potential uses for land in the project area.

TABLE 1 : Available mariculture land based on topography (see Exhibits 3 and 4)

Land Classification	Acreage for mariculture	Steep acreage (5 % slope or greater)
Preservation	0	117.0
Proposed Existing Agriculture	0	33.5
Proposed Residential	18.5	35.0
Existing Residential	7.0	0.5
Proposed Park	3.5	0
Proposed L.D. APT.	0	2.0
Proposed Commercial	1.0	0
Proposed Industrial	0	1.0
Totals	30.0	189.0

TABLE 2 : Suitability of Soils in Subject Parcel for Mariculture Use

Soil Class	Suitability	Reason
EmA	No	Coral limestone at 20 - 50 inches. Unacceptable water loss from pond.
Mt	No	Loamy sand at 16 inches . High permeability.
KtC	No	High shrink-swell, unworkability. Excessive dike cracking upon pond drain.
AeE	No	Slope, strongly acid at 10 inches.
AeF	No	Entire area in 40-70 % slope.
LaC	Yes	Meets minimum criteria.

TABLE 3 : Potential Mariculture Acreage.

Soil Type of Land meeting Topographic requirements	Approximate number of Acres.*
KtC	1
Mt	2
EmA	10
LaC	17
TOTAL	30

* From Exhibits 3 and 6

Total acreage meeting basic mariculture requirements is 17

34 per cent of land area is required for roads, land, levees, water supply and drainage.

Total productive acreage available is 11

Approximate ratio of nursing ponds to production ponds is 1:10

Approximate total mariculture potential :

1 acre nursing ponds (for rearing post-larval animals to juvenile stocking size).

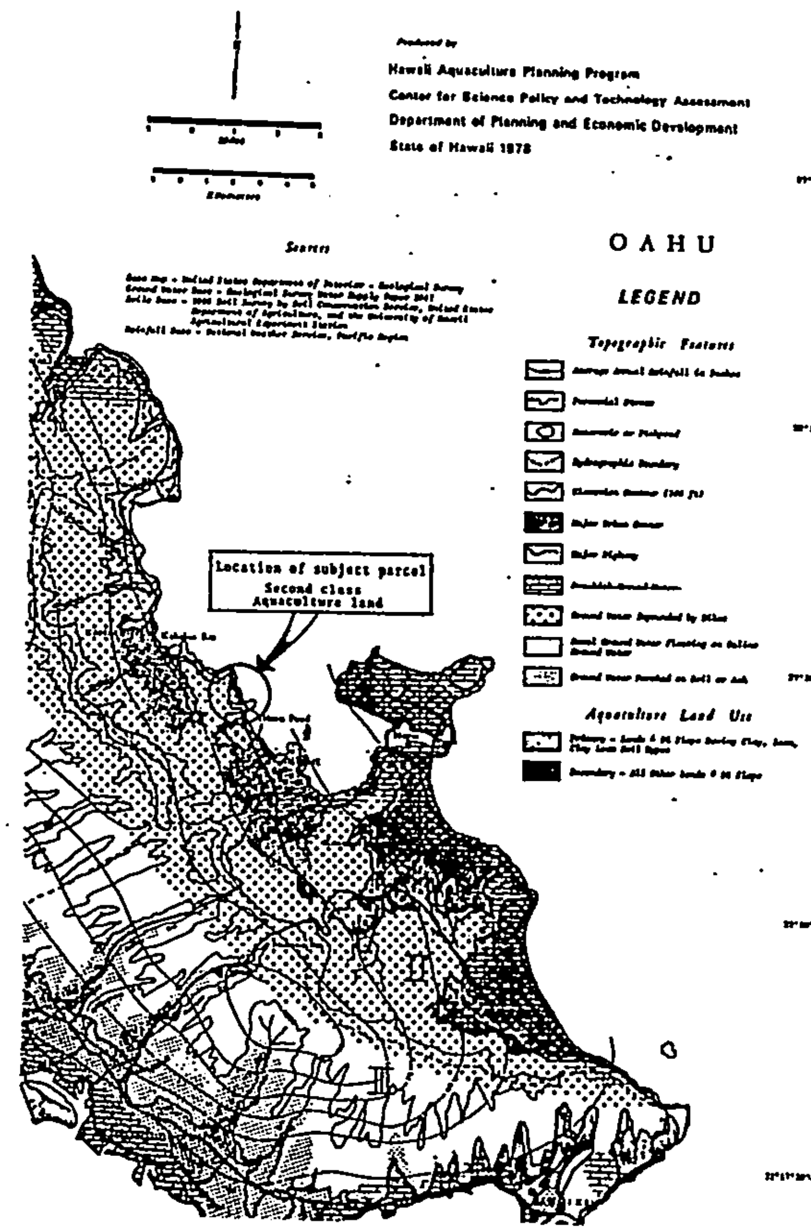
10 acres of production ponds

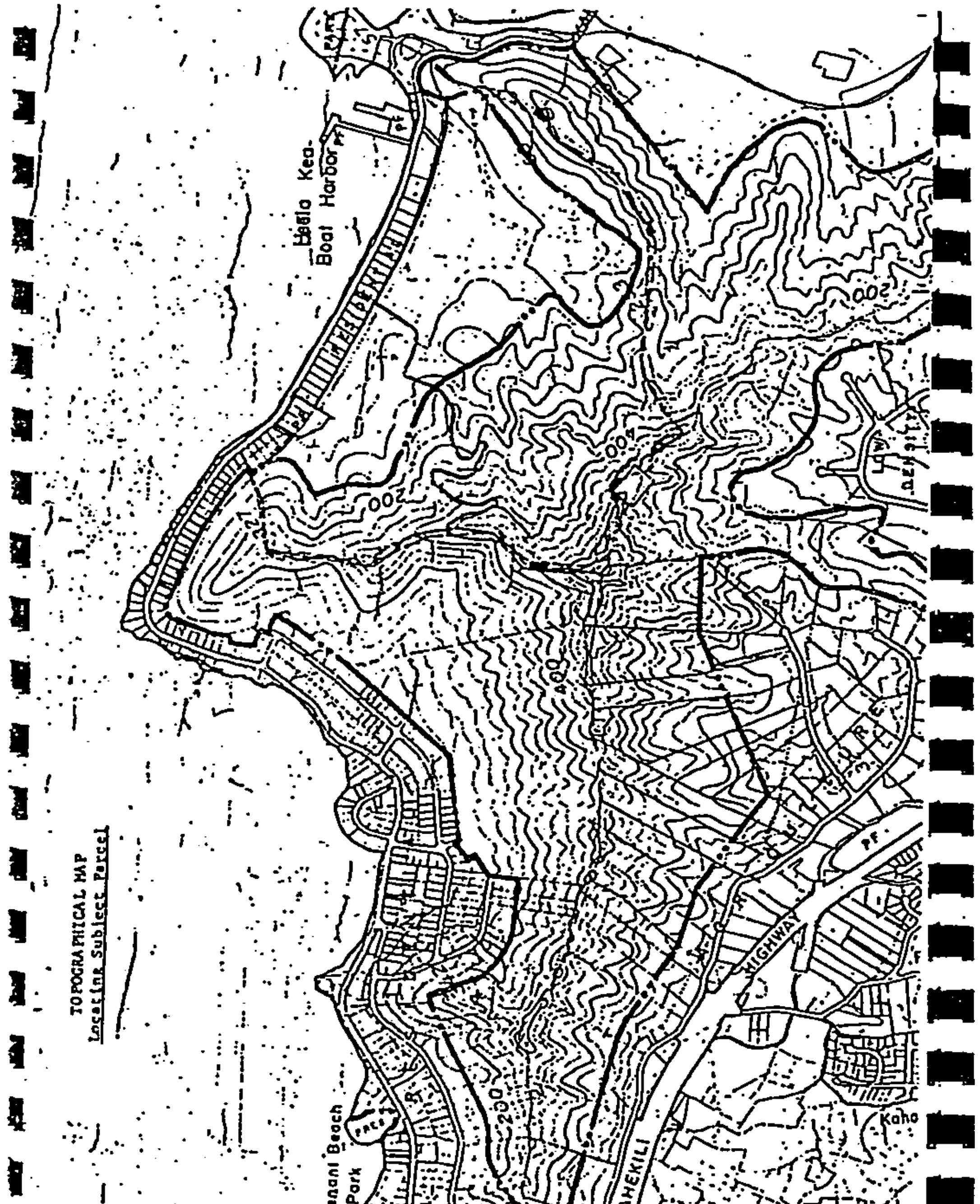
Nursery pond size : 0.25 acre.
Production pond size : 1.0 acre.

Total pond units :
4 nursery ponds @ 0.25 acre.
10 production ponds @ 1.0 acre.

EXHIBIT 1

ASSESSMENT OF LANDS FOR AQUACULTURE





TOPOGRAPHICAL MAP
Locating Subject Parcel

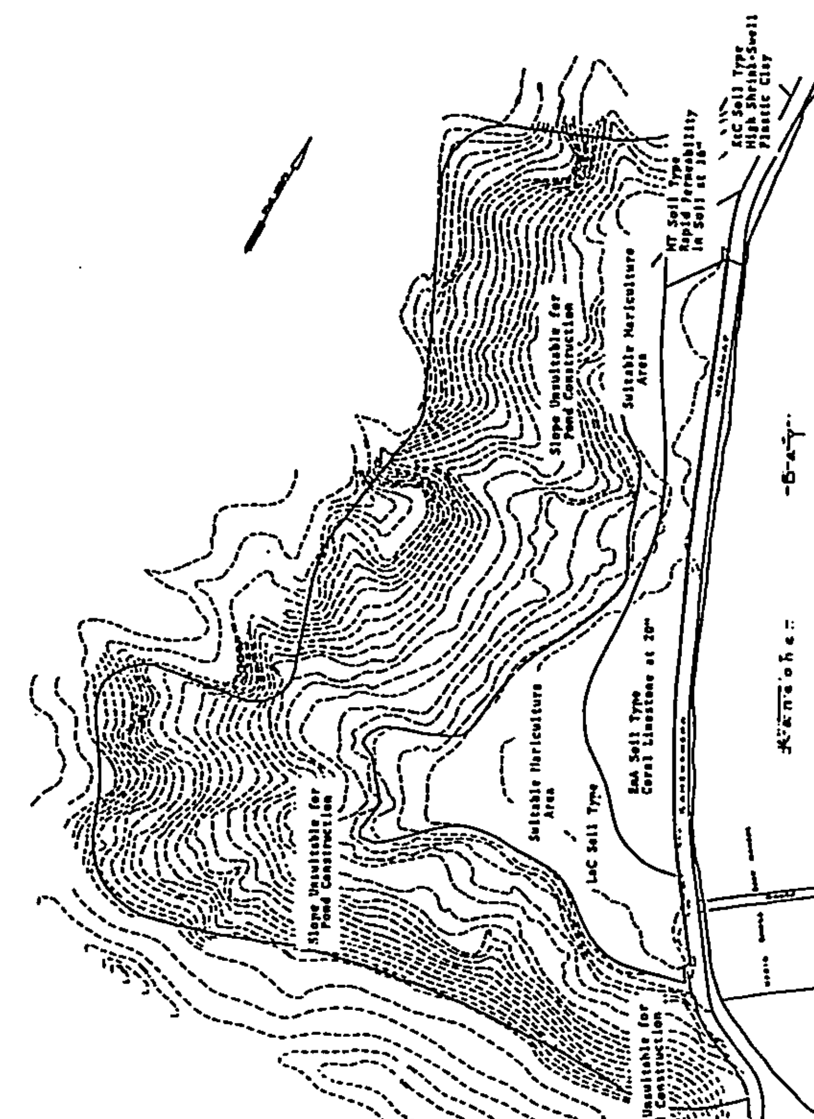
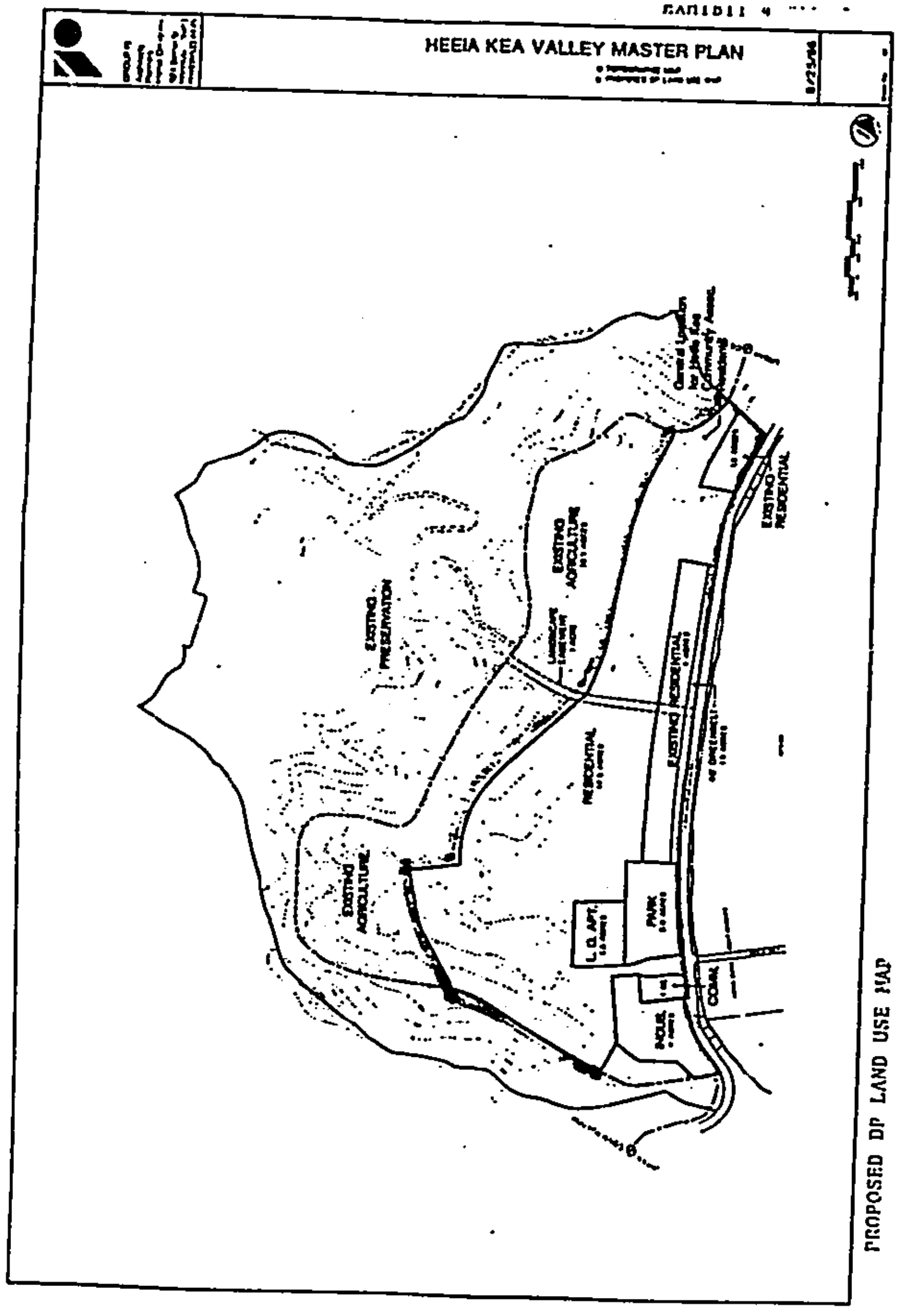


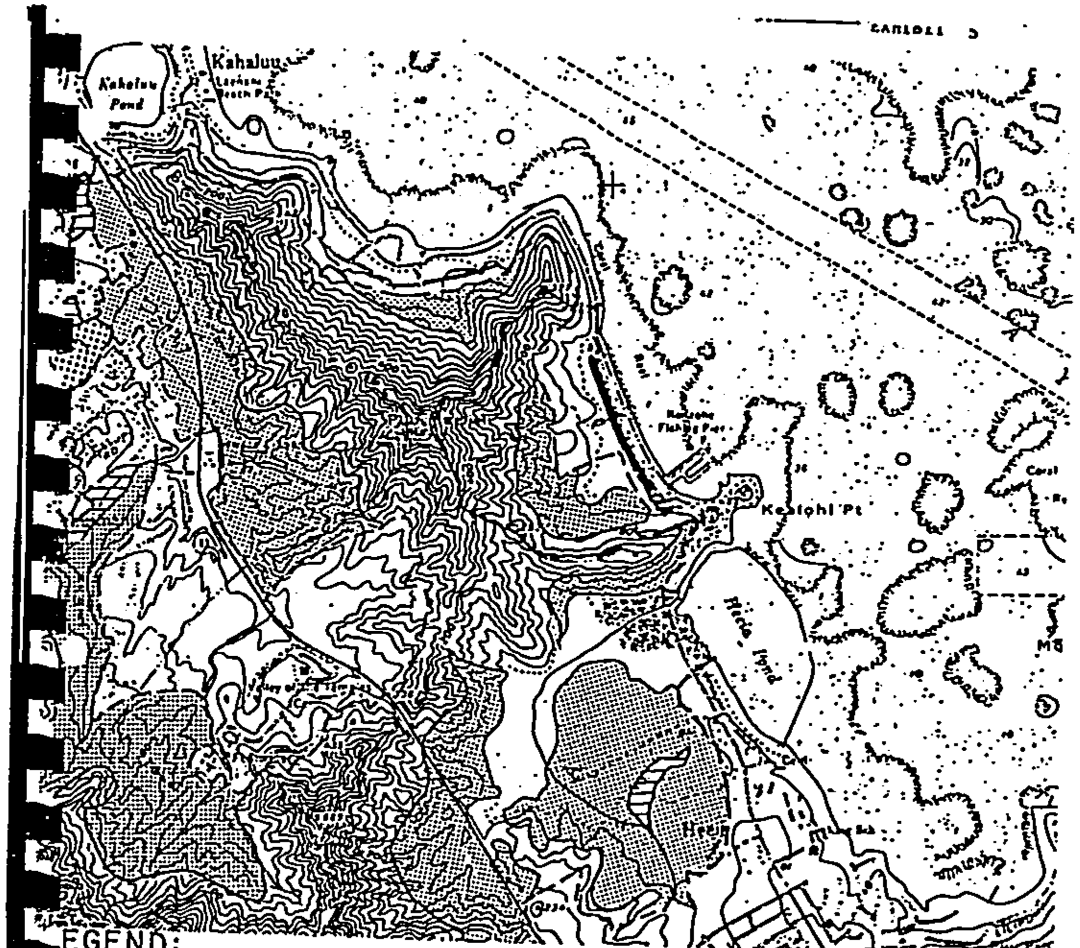
EXHIBIT 3
SOIL/SLOPE SUITABILITY FOR MARICULTURE

EXHIBIT 4



PROPOSED DP LAND USE MAP

EXHIBIT 5



LEGEND:

PRIME AGRICULTURAL LAND - Land which has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods.

UNIQUE AGRICULTURAL LAND - Land that has the special combination of soil quality, location, growing season, moisture supply, and is used to produce sustained high quality and or high yields of a specific crop when treated and managed according to modern farming methods.

OTHER IMPORTANT AGRICULTURAL LAND - Land other than Prime or Unique Agricultural Land that is also of statewide or local importance for agricultural use.

EXISTING URBAN DEVELOPMENT - Land which has been developed for urban type use.

U.S. GOVERNMENT - Land which is currently under the jurisdiction of the U.S. Government.

Ratings of Lands at Heeia-Kea, Tax Map Key 4-16-16-32, Under Agricultural Lands of Importance to the State of Hawaii, Department of Agriculture, State of Hawaii, 1977.

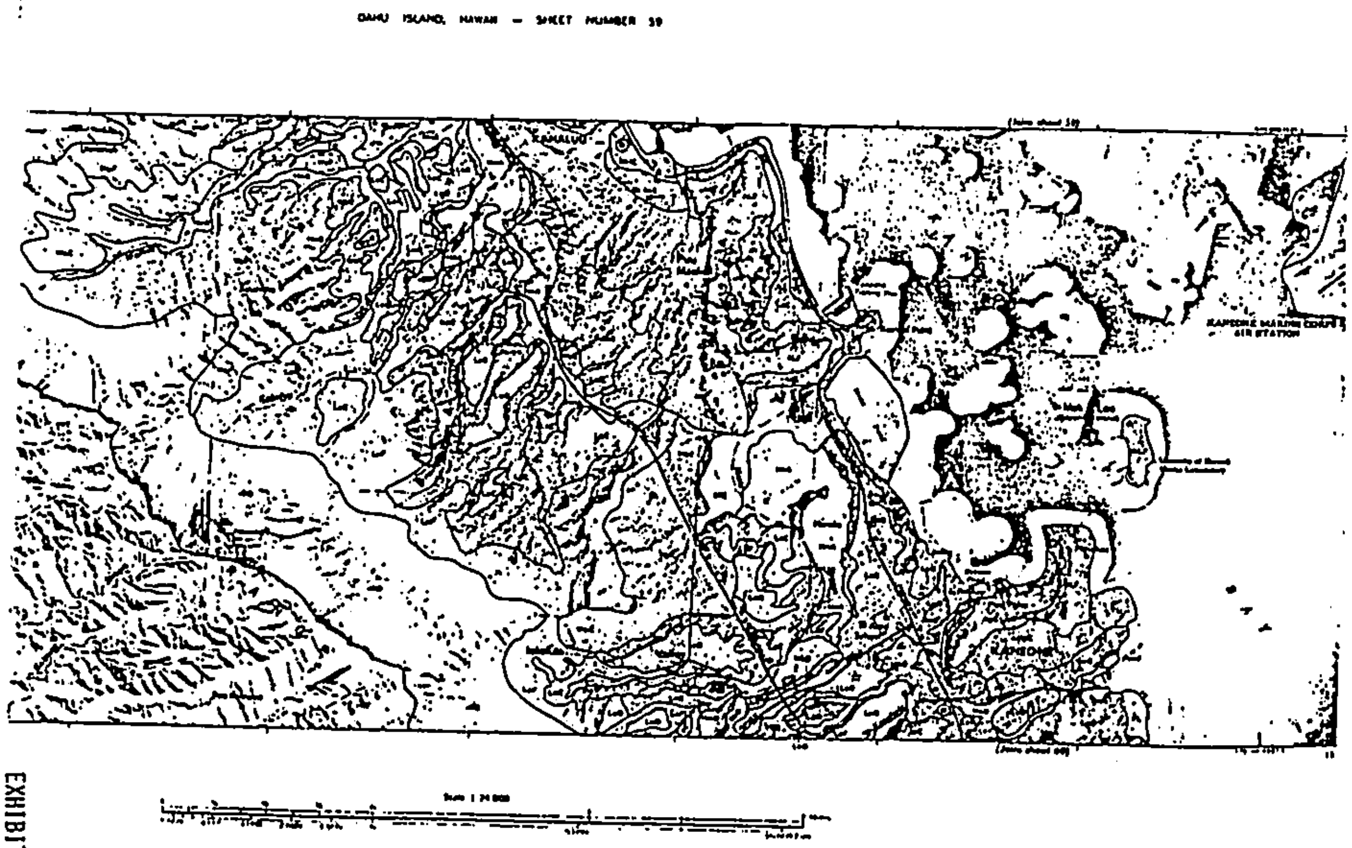


EXHIBIT 6

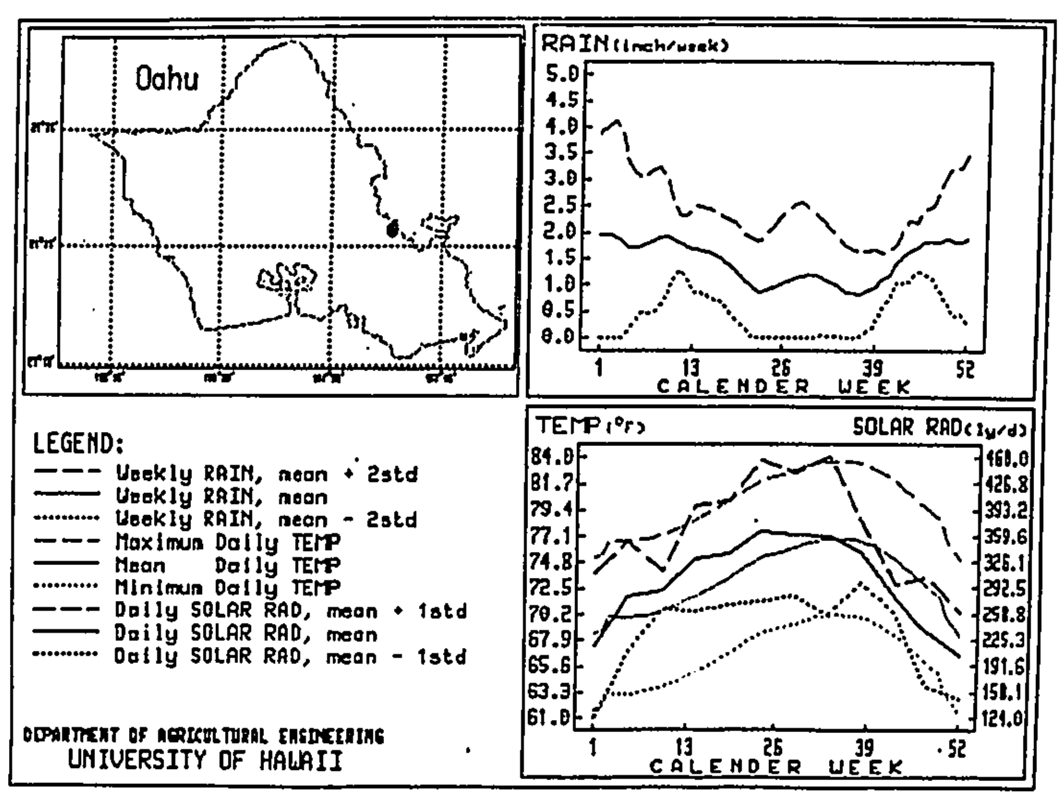


EXHIBIT 7

EXHIBIT 8

TABLE 11.—Chemical analyses of water-supply sources in windward Oahu

[Constituents in parts per million. Analytical data by Hawaii State Dept. of Health except as noted]

[illegible]

Source: Takasaki, K.J., Hirashima, G.T. and Lubke, E.R., 1969. Water Resources of Windward Oahu, Hawaii. U.S. Government Printing Office, Wa., 119pp.

nanatomi
NANATOMI HAWAII, INC. Suite 401, 735 Bishop Street, Honolulu, Hawaii 96813
Tel. (808) 521-6182. Fax. (808) 533-2127

January 9, 1990

KAHALU'U NEIGHBORHOOD BOARD NO. 29
C/O KEY PROJECT
47-200 WAIHE'E ROAD
KANE'OHE P.O., HAWAII 96744

Attention: John Reppun

RE: MALULANI SPORTS COMPLEX

Dear John,

Thank you for your letter of December 13, 1989, which requested certain clarifications of Nanatomi Hawaii's position and connection with commercial ocean recreational activities in Kane'ohe Bay.

Nanatomi Hawaii has consistently tried to be responsive and sensitive to the Kane'ohe and Kahalu'u communities' desires. As you may recall we held many meetings with both members of the Kahalu'u and Kane'ohe Neighborhood Boards, and other community organizations and residents, very early in the planning stages for this project. We have as a result of those meetings, modified our plans to reflect the comments received and to meld this with the financial objectives of Nanatomi Hawaii. As modifications have been made we have up-dated the respective community groups.

We wish to make it clear that we have no ties to the marina proposed by Malama-Gentry Joint Venture, nor are we connected in any way to commercial operations, existing or proposed in the Bay. We did retain as part of our condition of purchase of the area mauka of Kamehameha Highway, certain aesthetic conditions, which were designed to prevent an unsightly development makai of our property. We remain concerned about shoreline development along the edge of our property and would oppose anything which would be aesthetically or environmentally unsuited for the area.

In specific response to the Board's request, we would support the efforts of the Board to enhance the Kane'ohe Bay environment. We are not as close to some of the daily problems that the Board and its members are so acutely aware; however, we are aware of the proliferation of commercial activities in the Bay and its degrading effect on the environment of the Bay. To the extent that such activities have negatively affected the environment and aesthetics of the Bay, we would support the efforts of the Board to limit and control those activities, including the opposition to additional slips or moorings in the Bay, or the

development of a marina in the Bay, whether it is proposed at or near the He'eia Pier or anywhere else in the Bay.

In response to the Board's second request regarding the creation of a shoreside park along the length of the property, we have reviewed this issue several times since it was first raised at Representative Tom's community hour some months ago. There are several issues related to this question, all of which have a bearing on our response to you.

First, Nanatomi Hawaii does not own any portion of the shoreline necessary for the development of a shoreline park. Nanatomi Hawaii's property limit is the mauka edge of the right of way for Kamehameha Highway. The shoreside remnant is owned in fee by Malama-Gentry Joint Venture.

Secondly, the re-alignment of Kamehameha Highway for the entire length of the property is an extremely expensive proposition. Our estimate for the re-alignment (including the relocation of utility lines and easements, as well as demolition) is approximately $1200 @ lineal foot. At approximately 3200 lineal feet, the total cost for relocation would be $3.8 million. This is a cost which the project cannot assume. Consequently the costs for the development of any shoreline park by the community should include this as a publicly funded cost.

Thirdly, the provision of a shoreline park would restrict the already limited amount of flat land for use as our golf course facility. The result would be to force more severe cuts further into the mountains. Nanatomi Hawaii has attempted to reduce rather than increase the number of cuts into the mountain, not only for erosion control purposes, but also to maintain as much of the natural slopes and vegetation in the area. Therefore, we do not believe it is prudent to trade flat golf course land for sloping lands.

Fourth, the relocation of the highway could affect the areas designated as minimal wetlands. These areas generally occur immediately adjacent to the drainage outlets at regular intervals along that stretch of Kamehameha Highway.

Fifth, we have made a provision for a 3 acre beach park, at a scale in keeping with its use as a community rather than a regional park. In addition to the shoreside facilities we have included a sizeable mauka park for public use. This concentrates activity in and around existing facilities, such as the He'eia State Park and the He'eia Pier, and limits the possibility of cars scattered along the roadside. It also preserves the oceanview along the highway. We believe this is a compromise solution to the community's needs and goals.

nanatomi

We hope the foregoing answers the questions raised by the Board. Should you or the other members have any additional questions, please contact us.

Sincerely,

Eddie Sase
Vice President

RECEIVED
FEB -7 1990
HELBER HASTERT & KIMURA PLANNERS

February 6, 1990

Nanatomi Hawaii, Inc.
c/o Vincent Shigekuni
Helber, Hastert & Kimura Planner
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

SUBJECT: EIS Draft, Nanatomi Hawaii's Proposed Malulani Sports Complex in He'eia Kea, Kaneohe, Oahu

Page I - 4
"Ultimately the project will result in the replacement of existing exotic vegetation with new exotic vegetation." The Kaneohe Outdoor Circle is greatly concerned with the mature trees on this site, and no mention of their future is addressed in the EIS.

Also, we would like to see endemic native trees and vegetation used in all landscaping, and that the close proximity to the ocean be addressed regarding landscape materials.

Page II - 9 -.3
Kaneohe Outdoor Circle questions the term "H-3 connector to downtown Honolulu." Where does it exist?

Page IV - 20 - 4.9.3. Mitigative Measures
"Prompt pavement or landscaping of bare soil areas." No where in this EIS is a total of paved area in this development - a critical element in rain run off into Kaneohe Bay.

Page VI - 9 - 6.10 ELECTRIC
With as much open space, adjoining the open ocean, have wind power or solar power been considered or addressed?

Submitted by:

Susan Fristoe
First Vice President, Kaneohe Outdoor Circle
Board of Directors, Friends of Heeia State Park

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634489 HHVK UW
Facsimile (808) 545-2050

28 February 1990

Ms. Susan Fristoe
First Vice President, Kaneohe Outdoor Circle
44-123 Bayview Haven Place
Kaneohe, Hawaii 96744

Dear Ms. Fristoe:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter dated 6 February 1990 and offer the following responses to your comments.

Page I-4. The sentence on page I-4 of the Draft Environmental Impact Statement (EIS) will be revised to read, "Ultimately, the project will result in the replacement of the mostly exotic vegetation with native and exotic vegetation.

The Final EIS will note that the developer will incorporate, as much of the mature trees into the landscape design. Where appropriate, salt-tolerant plant materials, both native and exotic, will be used in landscaping of the property.

Page II-9. The statement on page II-9 of the Draft EIS will be revised to read, "The site is in a location which should witness significant appreciation in the future following the completion of the H-3 connector to the Primary Urban Center..."

Page IV-20. While the total area of pavement was not included in the EIS, the project civil engineer noted on page 4 of the Drainage Report (Appendix D Sam O. Hirota, Inc., "Drainage Report Proposed Malulani Sports Complex", 15 November 1989). "The proposed sports complex would change the character of approximately 180 acres of the project site. An open, close-cropped landscaping normally associated with a golf course would replace the present dense vegetative cover as would improvements such as buildings, roadways, parking lots (emphasis added)."

Altering the present land usage by constructing the planned development is estimated to cause an increase in total runoff from a 100-year, 24 hour duration design storm of about 13 percent. Project plans, however, include construction of retention basins and water features that should decrease potential runoff to Kaneohe Bay relative to current conditions. These mitigating measures should eliminate the potential alteration of marine communities owing to impacts of runoff. This information was provided in Section 4.5.2 of the Draft EIS.

Page VI-9. Both solar and wind power were addressed in Section 4.9.2 of the Draft EIS. While solar design features are applicable on-site, the potential of the site for the harnessing of wind energy is not as feasible as utilizing the HECO transmission system to which the Kahuku Wind Farm supplies energy.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook

RECEIVED
FEB - 1 1990
HELBER, HASTERT & KIMURA

5 February 1990

City & County of Honolulu
Dept. of General Planning
650 S. King St.

To: Director of General Planning,
Re.: Draft EIS for Malulani Sports Complex at Heeia kea

Hui Malama has not been on the list of consulted parties, but we would like to offer the following comments on the draft EIS.

1. The discussion of agricultural alternatives should include an in-depth discussion of subsistence agriculture as an alternative. In what ways is it consistent with land uses and lifestyles in the Heeia-Kualoa area? What is the demand for this type of agriculture?

2. How is this project consistent with the C&C General Plan concepts of urban-fringe and rural? The proposed project points to a type of resort use which can change the character of the area as surely as a change in density. Is a golf course a consistent agricultural use compared with other agricultural uses in the area?

3. There should be a more thorough analysis of the effect of a golf-course and "move-up" housing on the land and house values of surrounding communities. The demand for housing should be discussed in terms of the need for housing by those who do not own housing.

4. Who is liable if chemical run-off from this project does affect the bay?

5. What exactly does it mean to "actively market" this golf course in Japan? What is Nanatomi's definition of a "public" golf course? What percentage of play do you anticipate will be by Hawaii residents?

Thank you for the opportunity to comment.

Sincerely,

Charles Reppun

Charles Reppun
47-410 Lulani St.
Kaneohe 96744

cc. Nanatomi Hi., Inc.

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor
Center
PRI
Tower
733
Bishop
Street
Suite
2590
Honolulu
Hawaii
96813
Telephone
(808)
545-2055
Telex
634460
HHMKUW
Facsimile
(808)
545-2050

19 March 1990

Mr. Charles Reppun
47-410 Lulani Street
Kaneohe, Hawaii 96744

Dear Mr. Reppun:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum to Benjamin B. Lee of the Department of General Planning dated 5 February 1990 and offer the following responses to your comments.

1. Frank S. Scott, Jr., Ph.D. analyzed the agricultural feasibility of the property and his study was summarized in Section 4.3 of the Draft EIS and reproduced in its entirety as Appendix L. In summary, the application of appropriate criteria for agricultural feasibility indicates that the project lands have limited potentials for any form of traditional agriculture (crop production, grazing). Chapter 200 of Title 11, Environmental Impact Statement Rules (11-200-17 (f)) requires a reasonable discussion of alternatives "which could feasibly attain the objectives of the action" (in this case, the objective is the development of a sports complex, including an 18-hole golf course). The alternative that you raise (subsistence agriculture) would not attain the objective of the action (the development of a sports complex, including an 18-hole golf course). The only known reasonable alternative which could feasibly attain the objective of the action is to develop a sports complex with a private, limited or no public play golf course.

   The Development Plan Special Provisions for Koolaupoko includes an area description which states: "Suburban single-family development is to be the predominant residential use surrounded by substantial amount of open space and agricultural land...It is intended that communities of Kailua and Kaneohe will remain stable, predominantly single-family suburban 'bedroom communities'...The communities of Kahaluu, Waiahole-Waikane, and Kualoa are to remain relatively lightly settled, rural areas with the exception of limited areas in Heeia Kea and Ahuimanu Valley, where residential development of a low-density suburban character already exists." "Subsistence agriculture" and the proposed project would both be compatible with the Development Plan description of Koolaupoko. The project involves a small residential development (maximum density of 2.4 units per acre) surrounded by substantial open space (golf course and undeveloped hillsides). This information was provided in Section 3.3.2.4 of the Draft EIS.

There is no history of crop production other than subsistence grazing, in the project area since the 1930's, and according to Scott, there is no indication that the lands would be used for crop production if made available for that purpose.

2. The City and County of Honolulu's Development Plan program provides a relatively detailed framework for implementing General Plan objectives and policies on an area-wide basis. The compatibility of the project with the Development Plan Special Provisions for Koolaupoko are described above.

Resort use implies the use of residences as transient accommodations. The project is not designed or planned as a resort use. The proposed homes are being sold as single-family residences (as consistent with the Development Plan Land Use Designation and as required by the Land Use Ordinance) and not as transient vacation rentals. Again, the project involves a small residential development (maximum density of 2.4 units per acre) surrounded by substantial open space (golf course and undeveloped hillsides). This is significantly less than the residential development along Kamehameha Highway from the property to Kahekili Highway.

Golf courses are a form of agricultural activity. Recently, the Department of Agricultural and Resource Economics, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa completed a draft report that was titled, "An Economic Profile of Hawaii's Landscape Services in 1987" (Linda J. Cox, James R. Hollyer and Donald M. Schug, August 1989). This study was funded through the Governor's Agriculture Coordination Committee. The report surveyed the gross sales of those involved in the landscape industry. The estimated gross sales of landscaping activities in Hawaii, extrapolated from the surveys, was approximately $349.9 million in 1987, this included an estimated $94.2 million from golf courses. The study stated that: "To give an idea of how the value of landscape services presented here compares to the value of other agricultural activities (emphasis added) in Hawaii, the gross sales of the State's fresh and processed pineapple industry was $251 million in 1987 (Hawaii Agricultural Statistics Service)." This information will be provided in Section 3.2.1 of the Final EIS.

3. We have tried to assess the impact of the proposed project on surrounding property values. In the process, we have contacted the Real Property Tax Assessment Office (RPTAO) and they have stated that there is no clear answer to this question. The RPTAO informed us that assessment is based upon primarily two broad factors: 1) the "neighborhood" in which the land is located; and 2) the fair market value of the land. "Neighborhoods" are determined by the usage of the land and are not determined by merely picking streets as a physical demarcation of the boundaries. We informed RPTAO

that Nanatomi Hawaii plans to develop the land into a sports complex (to be known as Malulani) consisting of a golf course, golf clubhouse, healthclub facilities, tennis courts, restaurant and approximately 30 to 35 single-family residences. Based upon this information, the RPTAO stated that the project would likely be designated as a separate "neighborhood" from Kahalu'u and Kaneohe because the sports complex is an integral feature of Malulani. As a result, it is unlikely that the residential communities of Kahalu'u and Kaneohe would be assessed at the same rate as the single-family residences of Malulani.

Assessment rate is based upon fair market value of comparable vacant land. This is derived by using sales prices of land with comparable usage minus the replacement costs of any improvements on the land. In Malulani's case it is likely that the RPTAO will look to Hawaii Kai and other similar golf course residential communities for comparable sales prices We cannot determine whether Malulani will have a direct or indirect affect upon the fair market value of Kahalu'u and, thus, effect the real property tax assessment rate. However, when we asked the RPTAO what factors they thought would have the most impact upon the fair market value of land on the Windward side, the RPTAO responded that any improvements to the commuting time between the Windward side and Honolulu, such as H-3 and the widening of Kahekili, would likely have a more significant impact upon fair market value than the development of a golf course.

There is undoubtedly a need for housing in the community, however, given the community's desire to constrain growth, large-scale, low-cost housing is antithetical. Section 3.2.1 of the Final EIS will note that due to the extremely limited size of the residential component of the project, "reasonably priced" housing opportunities for persons and families of all income ranges is not possible. This section will further note that a more intensive scale of residential development, which could provide for "a range of housing opportunities for persons and families of all income levels", will likely encounter significant opposition from certain segments of the community, as it has in the past.

4. Appendix G of the Final EIS will include a scope of work for a marine environment monitoring program. Copies of quarterly monitoring reports will be distributed to pertinent agencies or parties. If adverse effects as a result of chemical runoff from the project is detected during the monitoring program, then golf course management practices will be reviewed and if required, additional retention basins will be constructed.

5. The analysis of economic and fiscal impacts of the project (Natelson Levander Whitney, Inc., November 1989, Draft EIS, Appendix M) indicated on page 47 that the golf course should be actively marketed in Japan. While this reflects the opinion of the consultant, Natelson Levander Whitney, Inc., the applicant will not implement this recommendation.

Unlike other golf courses premised upon private memberships, the Malulani Sports Complex golf course will be dependent on public play for operating revenue, consequently, the golf course will be open to public play 70 to 80 percent of the time. By precluding the sale of memberships to the golf course, the current marketing plan requires the sale of the 30 to 35 homes with an undivided interest in approximately half of the golf course. Nanatomi Hawaii would own the remaining portion and manage the golf course. Owners of the homes, then, would be able to play on the course (but must be on the course at the time). Thus, while the golf course would be private, approximately 70 to 80 percent of the total play time would be available to the public for a daily fee.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook
Donna Kanemaru

SIERRA CLUB, HAWAI'I CHAPTER
The Arcade Building, Room 201
212 Merchant Street, Honolulu, Hawai'i 96813
P.O. Box 2577, Honolulu, Hawai'i 96803
(808) 538-6616

February 6, 1990

RECEIVED
FEB -8 1990
HELBER, HASTERT & KIMURA PLANNERS

City and County of Honolulu, Department of General Planning
650 South King Street
Honolulu, Hawai'i 96813

Re: Malulani Sports Complex in He'eia Kea Draft EIS

The Hawai'i Chapter of Sierra Club has consistently commented on the various development proposals for He'eia Kea.

Our concerns are: 1. For the wise use of the coastal zone areas
2. For Kaneohe Bay as a very important Statewide natural resource.
3. For the use of precious water resources
4. Cumulative impacts of various development proposals
5. Impact on the long established semi-rural lyfe-style of the area

In this draft EIS, we do not feel that enough attention has been given to these concerns.

The plans are not definitive enough to insure prevention of further silting of Kane'ohe Bay during the construction phase. The Bay represents a sensitive eco-system that cannot survive excess water run-off, silting, sewage disposal and chemical contamination. It is already under severe stress. "Good management practices during the rainy season" will not guarantee anything. From the experience of one who has lived on the Bay for over forty years, rainy periods can happen anytime of the year. It is not uncommon to experience a heavy rainy season from September through April. Not many years ago the ground remained soggy throughout the summer. Lower He'eia Kea is essentially a marshy wetland. That portion of the land should be put into a passive park, with very little alteration of the land so that it can continue to act as a water collection basin as a natural protection of the Bay. Dr. Dunne, a National expert on land and water, said recently at the People's Water Conference, that allowing natural systems to remain is a much better and cheaper way to handle problems than to depend upon technological solutions.

While Windward Oahu does have the remaining natural water resources, there is also tremendous pressure for the use of the water. Golf courses are tremendous users of water and this concerns us. We could not approve of golf courses using water at the expense of farmers and long time residents. Is water recycling being planned? A desalination plant?

The overall cumulative impacts on the Bay, the water resources, the traffic, the local farming and life-style, the recreational use of He'eia Pier that is presently affordable, by the many proposed golf courses and high income developments, has not been adequately addressed. These are our deep concerns.

Thank you for permitting us to comment.

Lola N. Mench, Conservation Chair
Lola N. Mench
Hawai'i Chapter, Sierra Club

HELBER HASTERT & KIMURA Planners
HH&K
Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHHK UW
Facsimile (808) 545-2050

13 March 1990

Ms. Lola N. Mench
Conservation Chair
Sierra Club, Hawai'i Chapter
P.O. Box 2577
Honolulu, Hawaii 96803

Dear Ms. Mench:

Draft Environmental Impact Statement
Malulani Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your letter to the Department of General Planning postmarked 7 February 1990 and offer the following responses to your comments.

Use of the Coastal Zone Areas - As noted in Section 2.6 of the Draft Environmental Impact Statement (EIS), part of the conceptual plan for the Malulani Sports Complex includes the proposed dedication of land to the appropriate governmental agency(ies) for the possible realignment of Kamehameha Highway and the development of a beach park (and parking). The proximity of the proposed beach park and community facilities (across Kamehameha Highway) will be beneficial to Heeia State Park and to Heeia Kea Pier and Boat Harbor. It appears the proposed realignment may also create more area to allow the improvement of pedestrian access between Heeia State Park and Heeia Kea Pier and Boat Harbor. The dedication of these coastal lands will not be possible without the project.

Kaneohe Bay - Appendix G of the Final EIS will include a scope of work for a marine environment monitoring program that will be paid for by the applicant. Copies of quarterly monitoring reports will be distributed to pertinent agencies or parties. If water quality degradation is detected during the monitoring program, then soil erosion control (during construction) and golf course management (during operation) practices will be reviewed, and if required, additional retention basins will be constructed and/or the application of pesticides, herbicides, and fertilizers will be more strictly controlled.

Use of Water - It must be emphasized that the main source for irrigation of the golf course will be rainfall (as noted elsewhere in your letter, a heavy rainy season can last eight months) and the collection of storm runoff. When rainfall is lacking, the stored runoff will utilized. When the stored runoff is depleted, brackish water from the proposed wells will be utilized, along with the treated effluent from the clubhouse and residential facilities (a constant source). This information was provided in Sections 2.7.1 and 6.2.2 of the Draft EIS.

Cumulative Impacts of Various Development Proposals - Please note that presently, 31 subdivided lots are designated in the Koolaupoko DP Land Use Map as Residential. Based on 3.5 persons per household, the development of residences on the property given the current Koolaupoko DP Land Use Map designation could add 108 persons to the Koolaupoko District. The proposed amendment to the Koolaupoko DP Land Use Map involves the reconfiguration of the current Residential designation inland. If the proposed Residential configuration is approved, and subdivision is approved for 30 to 35 residential lots, then the new homes could add between 105 to 123 residents to the Koolaupoko population. The impact of the proposed amendment to the Koolaupoko DP area, then, is expected to be minimal. The above information was provided in Section 5.1.1.2 of the Draft EIS.

Lifestyle - The Development Plan Special Provisions for Koolaupoko includes an area description which states: "Suburban single-family development is to be the predominant residential use surrounded by substantial amount of open space and agricultural land...It is intended that communities of Kailua and Kaneohe will remain stable, predominantly single-family suburban 'bedroom communities'...The communities of Kahaluu, Waiahole-Waikane, and Kualoa are to remain relatively lightly settled, rural areas with the exception of limited areas in Heeia Kea and Ahuimanu Valley, where residential development of a low-density suburban character already exists." The property is adjacent to existing residences that stretch along Kamehameha Highway from the Kahaluu Pond, and is makai of the Valley of Temples and Ahuimanu residential and commercial development. The proposed action is compatible with the Development Plan description of Koolaupoko. The project involves a small residential development (maximum density of 2.4 units per acre) surrounded by substantial open space (golf course and undeveloped hillsides). This information was provided in Section 3.3.2.3 of the Draft EIS.

Siltation of Kaneohe Bay - Satisfactory reduction of chemical transport in runoff will be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay. All the runoff from the mauka lands is to be intercepted along the roadways servicing the proposed residential lots. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention. This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation.

Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow released nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff.

All of the above information was provided in Section 4.4.2 (page IV-11 of the Draft Environmental Impact Statement [EIS]), and Section 6.4.2 (page VI-6 of the Draft EIS) of the EIS.

Wetlands - Review of an aerial photograph taken on 29 October 1949 and a photograph taken of the property in 1945 when the entire valley was an Army Camp does not reflect your description of Lower He'eia Kea as a marshy wetland (the latter photograph will included in the Final EIS and identified as Figure 18).

D.R. Sanders and Associates, Inc. conducted a survey of the project site for areas that qualify as wetlands. Their report was attached to the Draft EIS as Appendix F and summarized in Section 4.4.1. Nanatomi Hawaii proposes the development of a sports complex on the property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. None of the aforementioned facilities will require fill within the identified wetlands.

The proposed golf course will provide siltation control functions similar to those provided by a wetland. Section 6.4.2 of the Draft EIS stated that the proposed ponds and water features of the golf course would serve as detention silt and debris basins, reducing the peak runoff. The proposed detention basins and designed golf course rough features are expected to reduce the peak runoff discharge to below that of the existing condition. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts of runoff.

Water Resources - The sources of water for the irrigation of the proposed golf course are described above. None of the sources are presently being used by farmers or residents.

Water Recycling - As described above, treated effluent from the proposed residences and clubhouse will also be utilized for golf course irrigation.

Desalination Plant - A desalination plant is not necessary to provide irrigation for the golf course, and is not being proposed.

Cumulative Impacts of the "Many Proposed Golf Courses and High Income Developments" on the Bay, Water Resources, Traffic, Local Farming and Life-Style, and Recreational Use of He'eia Pier - Nanatomi Hawaii has applied to the City and County of Honolulu Department of General Planning for an amendment to the Development Plan (DP) during the 1990 DP Annual Review to permit the development of a sports complex in Koolaupoko. The Annual Review process had been established to allow the public and governmental bodies and agencies the ability to assess the cumulative impacts of proposed projects on an islandwide basis.

In addition, as described above, a marine environment monitoring program will be paid for by the applicant. Copies of quarterly monitoring reports will be distributed to pertinent agencies or parties, including the Department of Health and the Hawaii Institute of Marine Biology (the agency that has most studied Kaneohe Bay).

The proposed golf course irrigation water source development has no impact on regional resources.

A traffic impact analysis report on the proposed Malulani Sports Complex was prepared by Sam O. Hirota, Inc. copied in its entirety in the Draft EIS as Appendix J and summarized in Section 6.1. Kamehameha Highway between Kahekili Highway and Haiku Road will remain, for the foreseeable future, a collector road serving local traffic in the Kaneohe area. In recent years, the traffic volume has declined over this segment of the highway due to improvements on Kahekili Highway and this trend should continue as additional improvements are implemented to Kahekili Highway. In addition, there are limited areas along this stretch of Kamehameha Highway with potential for development that would generate new traffic. It is agreed that the proposed sports activities and residential uses will generate traffic, however, the project-generated traffic will have a minimal impact on the regional traffic system, since it is a facility that will attract a relatively minimal amount of traffic, distributed evenly throughout the day, that will be going in the opposite direction from the Primary Urban Center. It is anticipated that traffic congestion will continue to worsen on Kahekili and Likelike highways without the project if improvements (such as the proposed widening of Kahekili Highway and the construction of H-3) are not implemented. The above information on traffic was provided in Section 6.1.2 of the Draft EIS.

There is no history of commercial crop production other than subsistence grazing, in the project area since the 1930's, and there is no indication that the lands would be used for crop production if made available for that purpose. Residential and commercial development does not appear to have affected local farming and lifestyles makai of Kamehameha Highway from Ahuimanu.

The State Department of Transportation (Harbors Division) has been contacted regarding the area proposed to be dedicated for community facilities. The Harbors Division is currently studying the possible opportunities of the land dedication for recreational use of He'eia Pier.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Herb Lee
Patti Cook

Addendum

As of 28 February 1990, a total of 34 letters were received in response to the public review of the Draft EIS (26 agencies or individuals responded by letter by the 6 February 1990 deadline date; 8 letters were postmarked and received after the deadline). The State Department of Health sent a letter on 9 March 1990. Their letter and a response is reproduced in its entirety here.

STATE OF HAWAII
DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH - ADMINISTRATION
P. O. BOX 3378
HONOLULU, HAWAII 96801

G011 H352

MAR-9'90 HI

U.S POSTAGE 0.25

Nanatomi Hawaii
c/o Helber Hastert & Kimura, Planners
Vincent Shigekuni
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

March 1, 1989

In reply, please refer to:
EPHSD

RECEIVED
MAR 12 1990
FEIBER HASTERT & ... PLANNERS

MEMORANDUM

To: Benjamin B. Lee
Department of General Planning
City & County of Honolulu

From: Deputy Director for Environmental Health

Subject: Maluiani Sports Complex
TMK: 4-6-06: 1, 4, 7, 9, 11, 13, 15, 22-24
4-6-16: por. 32
Owner: Nanatomi Hawaii

Thank you for allowing us to review and comment on the subject DEIS.

It appears that the subject project is part of a larger development. The DEIS proposes that wastewater be handled by a private treatment system with irrigation as a disposal means. We do not concur with the foregoing since a complete evaluation on the cost-effectiveness of connecting to the public sewers was not presented.

The use of a private wastewater system is an acceptable interim alternative. However, information on the availability of public sewers has not been made.

In addition, we have attached the Department of Health's EIGHT (8 CONDITIONS APPLICABLE TO THIS NEW GOLF COURSE DEVELOPMENT.

BRUCE S. ANDERSON, PH.D.

Attachment

cc: √Nanatomi Hawaii
Marvin T. Miura, Ph.D

RECEIVED
MAR 22 1990
FEIBER HASTERT & ... PLANNERS

April 7, 1989

EIGHT (8) CONDITIONS APPLICABLE TO THIS NEW GOLF COURSE DEVELOPMENT

Conditions:

1. The owner/developer and all subsequent owners shall establish a groundwater monitoring plan and system which shall be presented to the State Department of Health for its approval. The groundwater monitoring plan and system shall minimally describe the following components:

   a. A system of monitoring wells constructed throughout the site. These monitoring wells shall extend approximately ten (10) feet below the water table.

   b. A routine groundwater monitoring schedule of at least once every six (6) months and more frequently, as required by the State Department of Health, in the event that the monitoring data indicates a need for more frequent monitoring.

   c. A list of compounds which shall be tested for as agreed to by the State Department of Health. This list may include, but not be limited to the following: total dissolved solids; chlorides; PH; nitrogen; phosphorus; or any other compounds associated with fertilizers, biocides or effluent irrigation.

2. A baseline groundwater data shall be established as described in this paragraph. Once the test well sites and list of compounds to be monitored for have been determined and approved by the State Department of Health, the owner/developer shall contract with an independent third-party professional (approved by the State Department of Health) to have the groundwater sampled and its data reported to the State Department of Health. Testing of the groundwater shall be done by a certified laboratory.

3. If the data from the monitoring wells indicate the presence of the measured compound and/or the increased level of such compound, the State Department of Health can require the owner/developer or subsequent owner to take immediate mitigating action to stop the cause of the contamination. Subsequently, the developer/owner or subsequent owner shall mitigate any adverse effects caused by the contamination.

4. Owner/developer shall provide sewage disposal by means of connection to the public sewer system; or by means of a wastewater treatment works providing treatment to a secondary level with chlorination. Effluent from this wastewater treatment works may be used for golf course irrigation, subject to Condition #3. The entire system shall be approved by the State Department of Health in conformance with Administrative Rules Title 11, Chapter 62, Wastewater Treatment Systems, effective December 10, 1988.

5. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer and all subsequent owners shall develop and adhere to a Wastewater Reuse Plan which shall address as a minimum, the following items:

   a. Management Responsibility. The managers of the irrigation system using reclaiming wastewater shall be aware of the possible hazards and shall evaluate their system for public health, safety, and efficiency. They must recognize that contact with the reclaimed wastewater from treated domestic sewage poses potential exposure to pathogenic organisms which commonly cause infectious diseases (bacteria, viruses, protozoa, and halminths or worms).

   b. General Recommendations

      1) Irrigated areas should be no closer than 500 feet from potable water wells and reservoirs.

      2) Irrigated areas should be no closer than 100 feet from any private residence.

      3) Application rates should be controlled to minimize ponding. Excess irrigation tailwater in the reclaimed wastewater irrigation area shall be contained and properly disposed. An assessment should be made of the acceptable time and rate of application based on factors such as type of vegetation, soil, topography, climate and seasonal variations.

      4) Effluent holding/mixing ponds shall be designed to prevent the infiltration of the wastewater into the subsurface. The holding/mixing ponds shall be made impervious.

      5) Irrigation shall be scheduled such that the public is not in the vicinity and the soil is sufficiently dry to accept the irrigation water.

      6) Permanent fencing or barriers shall be erected around polishing or holding ponds to prevent public entry or stray feral and tame animals from gaining access to the ponds.

      7) Adequate irrigation records shall be maintained. Records should include dates when the fields are irrigated, rate of application, total application and climatic conditions. Records should also include any operational problems, diversions to emergency storage or safe disposal and corrective or preventive action taken.

      8) The holding/mixing ponds shall be periodically monitored for the purpose of detecting leakage into the subsuface. If leakage is detected, corrective action shall be immediately taken.

   c. Adequate Notice. Appropriate means of notification shall be provided to inform the employees and public that reclaimed wastewater is being used for irrigation on the site.

      1) Posting of conspicuous signs with sufficient letter size for clear visibility with proper wording should be distributed around the use areas.

      2) Signs shall be securely fastened. Periodic surveillance shall be conducted to assure permanent posting at all times. Immediate replacements shall be made when necessitated by deterioration, vandalism or misuse.

   d. Adequate Employee Education. Employees or users should be cautioned and warned of the potential health hazards associated with the ingestion of reclaimed wastewater being used at the site.

      1) Employees should be warned that the ingestion of reclaimed wastewater is unsafe.

      2) Employees should be protected from direct contact of the reclaimed wastewater. If necessary, protective clothing should be provided.

      3) Employees should be informed of the following:

         o The irrigation water is unsafe for drinking or washing.

         o Avoid contact of the water or soil with any open cuts or wounds.

         o Avoid touching the mouth, nose, ear or eyes with soiled hands, clothes or any other contaminated objects.

         o Be aware that inanimate objects such as clothes or tools can transport pathogenic organisms.

         o Always wear shoes or boots to protect feet from the pathogenic organisms in the soil or irrigation water.

6. Use of electrical golf carts is recommended. It is recognized that underground storage tank(s) to store gasoline for gas driven golf carts will impose potential risks to the groundwater. If gasoline-driven golf carts are to be utilized, the developer/owner must meet all federal requirements in the installation of any underground storage tank.

7. Buildings designated to house the fertilizer and biocides shall be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure for cleanup.

8. A golf course maintenance plan and program will be established based on "Best Management Practices (BMP)" in regards to utilization of fertilizers and biocides as well as the irrigation schedule. BMP's will be revised as an ongoing measure. The golf course maintenance plan will be reviewed by the State Department of Health prior to implementation.

If there are any questions regarding the eight (8) conditions mentioned here, please contact Mr. James K. Ikeda at 548-6455. We ask your cooperation in the protection of Hawaii's valuable groundwater resource.

HELBER
HASTERT
& KIMURA
Planners

HH&K

Grosvenor Center
PRI Tower
733 Bishop Street
Suite 2590
Honolulu Hawaii 96813
Telephone (808) 545-2055
Telex 634468 HHMK UW
Facsimile (808) 545-2050

22 March 1990

Mr. Bruce S. Anderson, Ph.D.
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Anderson:

Draft Environmental Impact Statement
Maluluni Sports Complex
Koolaupoko, Oahu, Hawaii

Thank you for your review of the above document. We have reviewed your memorandum addressed to the Department of General Planning, which was postmarked 9 March 1990 and offer the following responses to your comments.

Nanatomi Hawaii proposes the development of a sports complex on the property, including an 18-hole golf course, golf clubhouse with dining facilities, meeting and function rooms, three tennis courts, an aerobics facility, a health spa and associated fitness facilities, as well as approximately 30 to 35 single-family homes. No other development is being proposed.

Presently, the property is not serviced by the City and County of Honolulu's wastewater collection, treatment and disposal system. The adjoining residential area between the subject property and the junction of Kamehameha Highway and Kahekili Highway is serviced by cesspools. This information on the availability of public sewers was provided in Section 6.3.1 of the Draft EIS. The nearest public sewer system consists of a sewage pumping station and 6-inch force main on the Kaneohe side of "Long Bridge", a distance of approximately half a mile. In order to connect to the public sewer system, the applicant would have to install lift stations (approximately $250,000 to $500,000), a connecting force main ($250,000) and acquire the necessary easements (cost unknown), all for the estimated 50,000 gallons per day of effluent. In addition, connecting to the public sewer system would eliminate the possibility of water reclamation for golf course irrigation.

According to the consulting civil engineer, Sam O. Hirota, Inc., the cost of connecting to the public sewers is approximately $500,000 to $750,000 (not including the cost acquiring easements). This compares to $250,00 to $500,000 for the proposed private treatment system. Given the fact that the project will be limited to the proposed facilities described above, the proposed private treatment system is more cost effective than the alternative of connecting to the public sewers.

We have provided the applicant with a copy of the "Eight (8) Conditions Applicable to this New Golf Course Development". The applicant will work with your Department on finalizing the details of implementing these recommendations.

Your letter will be reproduced in the Final Environmental Impact Statement in its entirety.

Thanks again for your letter.

Sincerely,

HELBER HASTERT & KIMURA, Planners

Vincent Shigekuni

Vincent Shigekuni
Project Planner

cc: Benjamin B. Lee/Melvin Murakami (Department of General Planning)
Marvin T. Miura, Ph.D. (Office of Environmental Quality Control)
Eddie Sase
Rick Tsujimura
Dennis Hirota

APPENDICES

APPENDIX A

BIOLOGICAL SURVEY
Kenneth M. Nagata

HALULANI
BIOLOGICAL SURVEY

Prepared by: Kenneth H. Nagata

For: Helber Hastert & Kimura

Date: 28 May 1989

INTRODUCTION

The project site occupies 219 acres on the west side of Kamehameha Highway along Kaneohe Bay, Koolaupoko District, Oahu. Forested hills surround the site on three sides. Kamehameha Highway, Kaneohe Bay, the Heeia Kea Boat Harbor and Heeia State Park form its fourth (east) boundary. Elevation ranges from nearly sea level to approximately 600 feet.

According to Ripperton and Hosaka (1942) the vegetation in the site and the surrounding region is one of open shrubs and grasses (Zone C, Low Phase). The dominant shrubs guava (*Psidium guajava*) and koa-haole (*Leucaena leucocephala*) often form dense thickets and are best developed in gullies and in other areas where moisture is readily available. Lantana (*Lantana camara*) is also widely distributed but in smaller numbers. Other characteristic shrubs include indigo (*Indigofera suffruticosa*), partridge pea (*Cassia leschenaultiana*), false vervain (*Stachytarpheta cayennensis*) and 'uhaloa (*Waltheria americana*). Grasses proliferate in areas of diminished shrub cover. Hilo grass (*Paspalum conjugatum*) is dominant on the more fertile soils and rice grass (*Paspalum orbiculare*), yellow foxtail (*Setaria geniculata*) and golden beardgrass (*Chrysopogon aciculatus*) inhabit the poorer soils and eroded slopes.

A more recent survey (Lamoureux, n.d.) revealed the vegetation in the site to be similar to the broad patterns described by Ripperton and Hosaka. The alluvial plains and slopes below 150 feet elevation were found to be dominated by dense thickets of koa-haole 10-30 feet tall and the steeper upper slopes and ridges were dominated by grasslands consisting of broomsedge (*Andropogon virginicus*), Para-grass (*Brachiaria mutica*), molassesgrass (*Melinis minutiflora*), Guinea grass (Panicum maximum) and dallis grass (P. dilatatum). Closed canopied forests of guava, Christmas berry (Schinus terebinthifolius), Java plum (Eugenia cumini) and ironwood (Casuarina equisetifolia) were found in many of the gulches. At the time of the survey several residences were present along the mauka side of Kamehameha Highway. Numerous common ornamental and weedy species characterize this area. In areas of standing water behind the houses several patches of American mangrove (Rhizophora mangle) were found. Hala (Pandanus odoratissimus) and hau (Hibiscus tiliaceus), the only native plant species recorded during the survey were most abundant in this area.

A preliminary survey of the fauna in the site was conducted by Berger (n.d.) in about 1982. Eight introduced birds were observed - barred dove (Geopelia striata), red-vented bulbul (Pycnonotus cafer), Japanese white-eye (Zosterops japonicus), common Indian mynah (Acridotheres tristis), house sparrow (Passer domesticus), ricebird (Lonchura punctulata), cardinal (Richmondena cardinalis) and house finch (Carpodacus mexicanus) - and the probability of any native birds occurring near the site was regarded as nil since no suitable habitats were observed. The only native land mammal, the Hawaiian bat (Lasiurus cinereus semotus), was not seen and the probability of it being a permanent resident in the site was regarded as highly unlikely. The only mammals thought likely to occur on the site were the Norway rat (Rattus norvegicus), black rat (R. rattus), Polynesian rat (R. exulans), house mouse (Mus musculus) and the small Indian mongoose (Herpestes auropunctatus). No amphibians and reptiles are native to Hawaii and thus it was concluded that all of the animals in the project site are introduced.

METHODS

Walk-through surveys with approximately 75% coverage were conducted on 21-23 May 1989 to determine the floristic composition of the project site. In conjunction with the vegetation survey, a cursory survey for birds and mammals was also executed. The results of the fauna survey were not quantified and no trapping or nest investigatios were attempted.

Prior to the field survey, recent aerial photographs were studied and tentative vegetation patterns were delineated. Transects were established through these zones and their distribution and boundaries were confirmed by ground check.

RESULTS

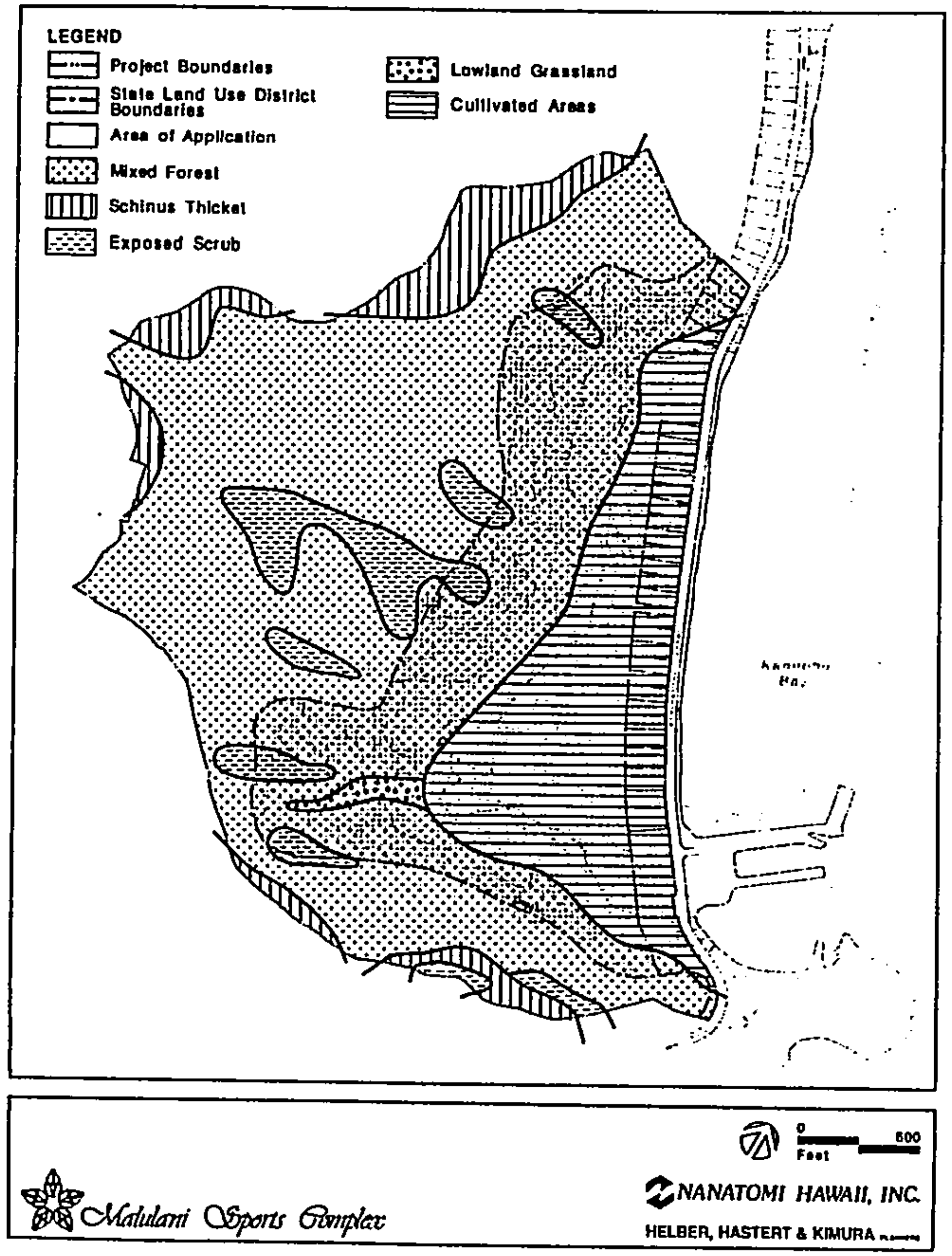
FLORA

The vegetation in the project site was found to be generally similar to that described in prior surveys. The residences present during the time of the Lamoureux survey have now been abandoned and replaced largely by wayside species and grasslands.Grasslands and closed canopied forests dominate the lowlands, drainages and most of the lower slopes. The uppermost slopes are dominated by Christmas berry thickets and communities of grasses and scrub are found on some of the ridge crests.

Five vegetation types were recognized and are described in the following paragraphs. These are depicted with distinct boundaries in the accompanying map but it must be noted that in nature such boundaries do not exist. Rather, vegetation exists as a continuum with one type gradually grading into another.

Mixed Forest (MF)

The dominant vegetation type in the project site is the Mixed



Forest. Occupying much of the lowlands, ravines and lower to middle slopes, it is a heterogeneous, closed canopied forest 20-50 feet tall. Monkeypod is generally dominant in the lowlands immediately behind the cultivated zone and is conspicuous because of its broad canopy. Java plum is also common in the lowlands where it often forms pure stands but is also dominant on portions of the lower and middle slopes. Groves of ironwood and tall dense stands of koa-haole and Christmas berry also constitute portions of the Mixed Forest. Mango (Mangifera indica), coconut (Cocos nucifera), African tulip (Spathodea campanulata), Chinese banyan (Ficus microcarpa) and hau are occasional canopy species.

The shrub and herb layers in this vegetation type varies considerably. In some portions especially where Christmas berry and koa-haole are abundant the understory is dense resulting in a depauperate herb layer consisting largely of tree seedlings, Asiatic pennywort (Centella asiatica), Hilo grass and basketgrass (Oplismenus hirtellus). Where the understory is open, basketgrass often forms a complete ground cover. Downy wood-fern (Christella dentata) and Hilo grass are also common in these situations. Paragrass is common in the lowland areas. Comb hyptis (Hyptis pectinata), burbush (Triumfetta semitriloba), Spanish clover (Desmodium canum), false vervain (Stachytarpheta jamaicensis), partridge pea and guava are common where the canopy is incomplete.

Lianes such as yellow water melon (Passiflora laurifolia), hue-hue-haole (P. suberosa), white passionflower (P. subpeltata) and maile pilau (Paederia foetida) are common in portions of the Mixed Forest. Maile pilau and yellow water melon in particular abundantly festoon the shrubs and trees throughout much of the forest. Several ornamental species have become naturalized just behind the cultivated zone. Taro vine (Scindapsus aureus) is now abundant in the lowlands and white thunbergia (Thunbergia fragrans) and Bengal trumpet (T. grandiflora) are occasionally found.

Schinus Thicket (ST)

Portions of the steep upper slopes in the site are dominated by thickets of Christmas berry 3-10 feet tall with occasional emergent Java plum and umbrella tree (Brassaia actinophylla). Guava occurs occasionally in this community. Traversing is extremely difficult in dense stands. In these situations the sparse herb layer consists mostly of Boston fern (Nephrolepis exaltata), downy wood-fern and seedlings of Christmas berry, yellow water melon and huehue-haole. Where the canopy cover is incomplete the herb layer is moderately dense and consists of molassasgrass, Spanish clover, false vervain, partridge pea and golden beardgrass. In areas where moisture is more readily available, Christmas berry begins to exceed 10 feet in height and the vegetation grades into Mixed Forest. Huehue-haole and yellow water melon are common throughout the Schinus Thicket.

Exposed Scrub (ES)

This vegetation type is found in certain areas generally on ridge crests and often appears to be the result of grading activities. It is characterized by dwarfed vegetation less than 3 feet tall dominated by grasses such as broomsedge, Paragrass, molassasgrass and golden beardgrass and emergent but scrubby guava, Java plum, koa-haole and Christmas berry. Common in the herb layer are Spanish clover, partridge pea, false vervain and sensitive plant (Mimosa pudica

var. unijuga). Vegetational cover is generally 90-100% except in erosional scars which are common in this community.

Lowland Grassland (G)

The Lowland Grassland is an extension of the large grasslands which developed behind the former residential area along Kamehameha Highway. It consists mostly of Paragrass and Hilo grass with emergent koa-haole, Java plum and monkeypod. Basketgrass, Guinea grass and honohono (Commelina diffusa) are common in certain areas. The vegetational cover provided by the herb layer is generally 100% and the upper canopy cover often exceeds 50%. Where the canopy cover approaches 100% this community grades into Mixed Forest.

Cultivated Areas (C)

The vegetation type designated as Cultivated Areas is actually an artificial classification based on land use rather than floristic composition. It is here defined as a contiguous zone which includes not only the former residential sites along the highway but those in the mauka edge of the lowlands, the numerous heaps of urban trash and junked vehicles and the distribution of certain ornamental species which indicate former habitation (eg. citrus, dieffenbachia, turk's cap, croton). Also included is the maintenance facility in the north end of the site along the highway. This zone includes the extensive Paragrass fields just behind the abandoned residences and a banana grove which presumably was once under cultivation.

Given such a broad conception of this vegetation type, a great abundance of species can be expected in this zone. Of the 185 plant species found in the project site, 145 occur in this zone. Sixty species are restricted to this zone; most of them ornamentals or urban weeds.

Native Species

Seventeen native plant species were recorded during the survey - five endemics and 12 indigenous species. All are common to the lowlands and middle elevations on Oahu and most are common throughout Hawaii. The most abundant in the site is Boston fern which is occasional in three vegetation types and also present in the Cultivated Areas. Koali-'awahia (Ipomoea congesta) is found in all vegetation types but in smaller numbers. None of the native species in the site are considered rare or endangered. No native plant communitites were observed.

FAUNA

Nine introduced birds were observed in the project site - lace-neck dove (Streptopelia chinensis), shama thrush (Copsychus malabaricus), barred dove, red-vented bulbul, common mynah, Japanese white-eye, ricebird, house sparrow and cardinal. All are common to urban or field situations and most were observed in the Cultivated Areas. The house finch recorded in Berger's earlier survey was not observed but the possibility of its presence cannot be discounted.

No mammals were observed although several pig trails were found especially in the Mixed Forest in the southwest portion of the site. Because of their abundance in similar situations on Oahu, the small Indian mongoose is a probable resident in the site. As mentioned in Berger's survey, it is also probable that one or more of the following may occur in the property: roof rat, Norway rat, Polynesian rat and house mouse.

POTENTIAL PROBLEMS AND MITIGATING MEASURES

The vegetation in the project site is primarily one of intro-

duced species. All of the 17 native species found in the site are common at least on Oahu and only two are found in any significant numbers. No native plant communities were found. In an earlier survey, Lamoureux (n.d.) remarked that "The vegetation and flora are consistent with what one would expect to find in an area long ago cleared of native plants, which has since been abandoned or at least not actively cultivated for a few decades". Concerns regarding native plant species can therefor be eliminated as potential problems.

No native birds or mammals were encountered during the survey and the likelyhood of any being present in the site at all is practically nil. The present survey substantiates the findings of Berger's survey that "There are no endemic Hawaiian animals on this site; there is no suitable habitat for them". (Berger, n.d.). The project will certainly result in the destruction of some nesting sites but considering that all of the birds and mammals in the site are wide-ranging species common to most urban and field situations, this loss is considered negiligible.

Although it is highly unlikely that the proposed development would have a direct adverse effect on native plants and animals, soil erosion and siltation in Kaneohe Bay might occur following removal of the vegetation. Appropriate mitigating measures should therefor be employed to minimize such potential problems.

LITERATURE CITED

Berger, A.J. n.d. Preliminary Vertebrate Fauna Report for TMK: 4-6-16:31 & 32. Unpublished.

__________ 1981. Hawaiian Birdlife 2nd ed. Univ. Press of Hawaii. Honolulu. 260 pp.

Lamoureux, C.H. n.d. Report on the Vegetation and Flora of the Proposed Heeia Kea Subdivision, TMK: 4-6-16:32, Heeia, Koolaupoko, Oahu. Unpublished.

Nagata, K.M. 1985. Early Plant Introductions in Hawaii. Hwn. Journ. Hist. 19:35-61.

Ripperton, J.C. & E.Y. Hosaka. 1942. Vegetation Zones of Hawaii. Haw. Agric. Exp. Sta. Bull. 89. Univ. Hawaii. 60 pp.

St. John, H. 1965. List and Summary of the Flowering Plants of the Hawaiian Islands. Pac. Trop. Bot. Gard. Memoir No. 1. Lawai. 519 pp.

Wagner, W.H., Jr. & F.S. Wagner. n.d. Revised Checklist of Hawaiian Pteridophytes. Unpublished.

SPECIES CHECKLIST

Plant families are arranged alphabetically in three groups - Pteridophytes, Gymnosperms and Angiosperms. The Angiosperms are subdivided into Monocotyledones and Dicotyledones. Genera and species are arranged alphabetically within each family. Taxonomy of the Pteridophytes follows that of Wagner's unpublished list and the common names are those which are commonly accepted. Taxonomy, common names and the status of the Gymnosperms and Angiosperms generally follow that of St. John (1973). Nagata (1985) was consulted for the native status of several species. Taxonomy of bird species follows that of Berger (1981).

EXPLANATION OF SYMBOLS

Species Status:

E - Endemic to the Hawaiian Islands, ie. occuring nowhere else in the world.

I - Indigenous, ie. native to the Hawaiian Islands but also occuring naturally elsewhere.

X - Exotic (alien), ie. plants introduced after the Western discovery of the islands.

P - Polynesian, plants introduced before the Western discovery of the islands.

Vegetation types:

- MF - Mixed Forest
- ST - Schinus Thicket
- ES - Exposed Scrub
- G - Lowland Grassland
- C - Cultivated Areas

Relative Abundance Rating:

- A - Abundant, generally the major or dominant element in an area.
- C - Common, generally distributed throughout a given area in large numbers.
- O - Occasional, generally distributed throughout a given area in small numbers.
- U - Uncommon, observed uncommonly but more than 10 times in a given area.
- R - Rare, observed 2-10 times in a given area.
- X - Indicates presence only

C H E C K   L I S T   O F   P L A N T S

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH*	MF	ST	ES	G	C
					RELATIVE ABUNDANCE				
PTERIDOPHYTES									
ADIANTACEAE									
Pityrogramma calomelanos (L.) Link	Gold fern	X			-	-	R	-	-
DAVALLIACEAE									
Nephrolepis exaltata (L.) Schott	Boston fern	I			O	O	O	-	X
GLEICHENIACEAE									
Dicranopteris linearis (Burm.) Underw.	Uluhe	I			-	-	R	-	-
LINDSAEACEAE									
Sphenomeris chusana L.	Pala'a	I			-	U	U	-	-
POLYPODIACEAE									
Microsorium scolopendrium (Burm.) Copel.	Lauae	I			-	R	-	-	-
PSILOTACEAE									
Psilotum nudum L.	Moa	I			-	R	-	-	-
THELYPTERIDACEAE									
Christella dentata (Forsk.) Brownsey & Jermy	Downy wood-fern	X			O	O	U	O	X
GYMNOSPERMS									
ARAUCARIACEAE									
Araucaria columnaris (Forst. f.) Hook.	Cook pine	X			-	-	-	-	X
ANGIOSPERMS - MONOCOTYLEDONES									
AMARYLLIDACEAE									
Crinum asiaticum L.	Grand crinum	X			-	-	-	-	X
Molineria recurvata (Ait. f.) Herb.	Molineria	X			-	-	-	-	X
ARACEAE									
Alocasia cucullata (Lour.) G. Don	Chinese taro	X			-	-	-	-	X
A. macrorrhiza (L.) Sweet	'Ape	P			U	-	-	U	X
Colocasia esculenta (L.) Schott	Taro	P			-	-	-	-	X
Dieffenbachia cv.	Dieffenbachia	X			-	-	-	-	X
Monstera deliciosa Liebm.	Monstera	X			-	-	-	-	X
Scindapsus aureus (Lind. ex Andre) Engl.	Taro vine	X			U	-	-	-	X
Syngonium auritum (L.) Schott		X			U	-	-	-	X
Xanthosoma sagittifolium (L.) Schott		X			U	-	-	-	X
X. violaceum Schott	Blue 'ape	X			-	-	-	-	X
CANNACEAE									
Canna indica L.	Ornamental canna	X			-	-	-	U	X
COMMELINACEAE									
Commelina diffusa Burm. f.	Honohono	X			-	-	-	O	X

* Category not applicable

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	H*	FH*	MF	ST	ES	G	C
CYPERACEAE									
Cyperus alternifolius L.	Umbrella plant	X			-	-	-	R	X
C. gracilis R. Br.	McCoy grass	X			U	-	-	-	X
C. hypochlorus Hbd.		E			-	-	-	-	X
C. kyllinga Endl.	Kyllinga	X			U	-	-	-	X
C. polystachyus Rottb.		I			-	-	U	-	-
C. rotundus L.	Nut grass	X			-	-	-	-	X
GRAMINEAE									
Andropogon sericeus R. Br.	Australian bluegrass	X			-	U	U	-	-
A. virginicus L.	Broomsedge	X			-	O	A	-	-
Brachiaria mutica (Forsk.) Stapf	Paragrass	X			-	-	C	A	X
Chloris inflata Link	Swollen fingergrass	X			-	-	-	-	X
C. virgata Sw.	Feather fingergrass	X			-	-	-	-	X
Chrysopogon aciculatus (Retz.) Trin.	Golden beardgrass	X			-	C	O	-	-
Cynodon dactylon (L.) Pers.	Bermuda grass	X			-	-	-	-	X
Eleusine indica (L.) Gaertn.	Goosegrass	X			-	-	-	-	X
Eragrostis tenella (L.) Beauv. ex R. & S.	Japanese lovegrass	X			-	-	-	-	X
Melinis minutiflora Beauv.	Molassesgrass	X			-	C	A	-	-
Oplismenus hirtellus (L.) Beauv.	Basketgrass	X			C	-	-	O	X
Panicum maximum Jacq.	Guinea grass	X			O	-	-	O	X
Paspalum conjugatum Berg.	Hilo grass	X			O	-	O	A	X
P. dilatatum Poir.	Dallis grass	X			U	R	-	R	X
P. orbiculare Forst. f.	Rice grass	X			O	O	O	-	X
Pennisetum purpureum Schumach.	Napiergrass	X			-	-	-	-	X
Phyllostachys sp.	Bamboo	X			-	-	-	-	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X			-	R	-	-	X
Sacciolepis indica (L.) Chase	Glenwoodgrass	X			U	-	O	-	X
Setaria geniculata (Poir.) Beauv.	Perennial foxtail	X			-	C	O	-	X
S. palmaefolia (Koen.) Stapf	Palmgrass	X			O	-	-	R	X
Sorghum halepense (L.) Pers.	Johnson grass	X			-	-	-	-	X
Sporobolus indicus (L.) R. Br.	West Indian dropseed	X			-	-	-	-	X
Tricachne insularis (L.) Nees	Sourgrass	X			U	U	-	-	X
LILIACEAE									
Asparagus densiflorus (Kunth) Jessop	Asparagus fern	X			-	U	-	-	-
A. setaceus (Kunth) Jessop	Asparagus fern	X			R	-	-	-	-
Cordyline terminalis (L.) Kunth	Ti	P			O	R	R	-	X
C. terminalis cv.	Colored ti	X			-	-	-	-	X
Pleomele fragrans (L.) Salisb.		X			-	-	-	-	X
Sansevieria trifasciata Prain	Bowstring hemp	X			-	-	-	-	X
MUSACEAE									
Heliconia humilis (Aubl.) Jacq.	Common heliconia	X			U	-	-	U	X
Musa x paradisiaca cv.	Banana	X			R	-	-	R	X
ORCHIDACEAE									
Arundina bambusaefolia (Roxb.) Lindl.		X			-	-	R	-	-
Spathoglottis plicata Bl.		X			-	O	U	-	-

* Category not applicable

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH*	RELATIVE ABUNDANCE				
					MF	ST	ES	G	C
PALMAE									
Chrysalidocarpus lutescens (Bory) H. Wendl.	Areca	X			-	-	-	-	X
Cocos nucifera L.	Coconut	P			U	-	-	-	X
Ptychosperma macarthuri (H. Wendl. in T. Moore) Nichols.	Macarthur palm	X			-	-	-	-	X
PANDANACEAE									
Pandanus odoratissimus L. f.	Hala	I?			R	-	-	-	X
ZINGIBERACEAE									
Costus speciosus (Koenig) Sm.	Spiral flag	X			-	-	-	R	X
Alpinia mutica Roxb.		X			-	-	-	-	X
A. purpurata (Vieill.) K. Schum.	Red ginger	X			-	-	-	-	X
A. zerumbet (Pers.) Burtt & Smith	Shell ginger	X			-	-	-	-	X
ANGIOSPERMS - DICOTYLEDONES									
ACANTHACEAE									
Asystasia gangetica (L.) T. Anders.	Asystasia	X			U	-	-	-	X
Dicliptera chinensis (L.) Juss.	Dicliptera	X			R	-	-	-	X
Thunbergia alata Bojer ex Sims	Black-eyed Susan	X			R	-	-	-	X
T. fragrans Roxb.	White thunbergia	X			U	-	-	-	X
T. grandiflora Roxb.	Bengal trumpet	X			U	-	-	-	X
AMARANTHACEAE									
Achyranthes indica (L.) Mill.		X			U	-	-	-	X
Amaranthus spinosus L.	Spiny amaranth	X			-	-	R	-	X
ANACARDIACEAE									
Mangifera indica L.	Mango	X			U	-	-	-	X
Schinus terebinthifolius Raddi	Christmas berry	X			O	A	C	-	-
ARALIACEAE									
Brassaia actinophylla Endl.	Umbrella tree	X			O	O	U	O	-
Polyscias guilfoylei Bull) Bailey	Panax	X			-	-	-	-	X
BALSAMINACEAE									
Impatiens sultani Hook. f.	Impatiens	X			-	-	-	-	X
BIGNONIACEAE									
Spathodea campanulata Beauv.	African tulip tree	X			O	-	-	R	X
CACTACEAE									
Hylocereus undatus (Haw.) Britt. & Rose	Night blooming cereus	X			-	-	-	-	X
CARICACEAE									
Carica papaya L.	Papaya	X			-	-	-	R	X
CASUARINACEAE									
Casuarina equisetifolia Stickm.	Common ironwood	X			O	-	-	-	X

* Category not applicable

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	I*	FII*	RELATIVE ABUNDANCE MF	ST	ES	G	C
COMBRETACEAE									
Terminalia catappa L.	False kamani	X			-	-	-	-	X
COMPOSITAE									
Ageratum conyzoides L.	Ageratum	X			U	-	-	-	X
A. houstonianum Mill.		X			-	-	-	-	X
Bidens alba var. radiata (Schz. Bip.) Ballard ex Melchert		X			U	-	U	-	X
B. pilosa L.	Spanish needle	X			-	-	-	-	X
B. sandvicensis Less.	Hawaiian Islands bidens	E			-	U	-	-	-
Calyptocarpus vialis Less.		X			-	-	-	-	X
Crassocephalum crepidioides (Benth.) Sp. Moore		X			U	-	-	U	X
Eclipta alba (L.) Hassk.	False daisy	X			-	-	-	-	X
Emilia sonchifolia (L.) DC. var. sonchifolia	Lilac pualele	X			U	-	O	-	-
E. sonchifolia var. javanica (Burm. f.) Mattfeld	Red pualele	X			-	O	O	-	-
Erigeron bonariensis L.	Hairy horseweed	X			-	U	O	-	-
Eupatorium riparium Regel	Spreading mist flower	X			-	U	U	-	-
Pluchea indica (L.) Less.	Indian pluchea	X			U	-	U	-	-
P. odorata (L.) Cass.	Pluchea	X			U	-	U	U	X
Pseudoelephantopus spicatus (Juss. ex Aubl.) Gleason	False elephants-foot	X			-	-	-	-	X
Siegesbeckia orientalis L.	Siegesbeckia	X			-	-	-	-	X
Sonchus oleraceus L.	Sow thistle	X			-	-	-	-	X
Synedrella nodiflora (L.) Gaertn.	Synedrella	X			U	-	-	-	X
Vernonia cinerea (L.) Less.	Ironweed	X			-	-	U	-	X
Wedelia trilobata (L.) Hitchc.	Wedelia	X			-	-	U	-	X
Youngia japonica (L.) DC.	Oriental hawksbeard	X			-	-	-	-	X
CONVOLVULACEAE									
Argyreia nervosa (Burm. f.) Bojer	Small wood-rose	X			U	-	-	-	X
Convolvulus arvensis L.	Field bindweed	X			-	-	-	O	X
Ipomoea congesta R. Br.	Koali-'awahia	I			U	U	R	O	X
I. obscura (L.) Ker-Gawl.		X			U	-	-	U	X
Merremia tuberosa (L.) Rendl	Wood rose	X			U	-	-	-	X
CUCURBITACEAE									
Momordica charantia var pavel Crantz	Peria	X			R	-	-	-	X
EUPHORBIACEAE									
Aleurites moluccana (L.) Willd.	Kukui	P			-	-	-	-	X
Codiaeum variegatum var. pictum (Lodd.) Muell.-Arg.	Leaf croton	X			-	-	-	-	X
Euphorbia hirta L.	Garden spurge	X			-	-	-	-	X
E. prostrata Ait.	Prostrate spurge	X			-	-	-	-	X
Phyllanthus debilis Klein ex Willd.	Phyllanthus weed	X			U	-	-	-	X
Ricinus communis L.	Castor bean	X			-	-	-	-	X
LABIATAE									
Hyptis pectinata (L.) Poir.	Comb hyptis	X			U	-	-	-	X
LAURACEAE									
Persea americana Mill	Avocado	X			-	-	-	-	X

* Category not applicable

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH*	RELATIVE ABUNDANCE MF	ST	FS	G	C
LEGUMINOSAE									
Albizia lebbeck (L.) Benth.	Siris tree	X			U	-	-	-	-
Caesalpinia sepiaria Roxb.	Wait-a-bit	X			R	-	-	-	-
Calliandra sp.		X			-	-	-	-	X
Canavalia cathartica Thouars	Mauna-loa	X			O	-	-	-	X
Cassia bicapsularis L.		X			O	-	-	-	-
C. fistula L. x javanica L.	Rainbow shower	X			-	-	-	-	X
C. leschenaultiana DC.	Partridge pea	X			O	C	C	-	X
C. surattensis Burm. f.	Kolomona	X			U	U	-	-	X
Crotalaria mucronata Desv.		X			-	-	U	-	X
Desmanthus virgatus (L.) Willd.	Virgate mimosa	X			-	-	-	-	X
Desmodium canum (Gmel.) Schinz & Thell.	Spanish clover	X			O	C	C	-	X
Erythrina variegata Stickm.	Tiger's claw	X			-	-	-	-	X
Indigofera suffruticosa Mill.	Indigo	X			U	-	-	-	-
Leucaena leucocephala (Lam.) de Wit	Koa-haole	X			C	U	U	A	X
Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb.	Sensitive plant	X			O	U	O	-	X
Mucuna gigantea (Willd.) DC.	Ka'e'e	I			O	-	-	-	-
Samanea saman (Jacq.) Merr.	Monkeypod	X			O	-	-	C	X
MALVACEAE									
Abutilon grandifolium (Willd.) Sweet	Hairy abutilon	X			-	-	-	-	X
Hibiscus rosa-sinensis L.	Chinese hibiscus	X			-	-	-	-	X
H. tiliaceus L.	Hau	I			U	-	-	-	X
Malvastrum coromandelianum (L.) Garcke	False mallow	X			U	-	-	-	X
Malvaviscus arboreus Cav.	Turk's cap	X			-	-	-	-	X
Sida rhombifolia L.	Cuba jute	X			-	-	-	-	X
Thespesia populnea (L.) Soland. ex Correa	Milo	P			-	-	-	-	X
MELASTOMATACEAE									
Clidemia hirta (L.) D. Don	Koster's curse	X			U	O	U	-	-
MORACEAE									
Cecropia obtusifolia Bertol.	Guarumo	X			U	-	-	-	-
Ficus microcarpa L. f.	Chinese banyan	X			U	-	-	-	X
MYRTACEAE									
Eugenia cumini (L.) Druce	Java plum	X			A	O	U	C	X
Metrosideros collina subsp. polymorpha (Gaud.) Rock	'Ohi'a-lehua	E			-	R	R	-	-
Psidium cattleianum Sabine	Purple strawberry guava	X			-	U	U	-	-
P. guajava L.	Guava	X			O	O	C	-	X
NYCTAGINACEAE									
Bougainvillea sp.	Bougainvillea	X			-	-	-	-	X
OCHNACEAE									
Ochna kirkii Oliver		X			-	-	-	-	X
OXALIDACEAE									
Oxalis corniculata L.	Yellow wood sorrel	P?			O	R	-	O	X
O. martiana Zucc.	Pink wood sorrel	X			U	R	-	U	X

* Category not applicable

C H E C K   L I S T   O F   P L A N T S

SCIENTIFIC NAME	COMMON NAME	STATUS	H*	FH*	RELATIVE ABUNDANCE MF	ST	FS	G	C
PASSIFLORACEAE									
Passiflora edulis f. flavicarpa Deg.	Yellow liliko'i	X			O	-	-	U	X
P. foetida L.	Pohapohā	X			U	U	C	-	C
P. laurifolia L.	Yellow water melon	X			A	C	C	O	X
P. suberosa L.	Huehue-haole	X			O	C	O	-	X
P. subpeltata Ortega	White passionflower	X			O	U	-	U	X
PHYTOLACCACEAE									
Rivina humilis L.	Rouge plant	X			U	-	-	-	X
PITTOSPORACEAE									
Pittosporum undulatum Vent.	Orange pittosporum	X			-	R	-	-	-
PLANTAGINACEAE									
Plantago major L.	Common plantain	X			-	-	-	-	X
RHIZOPHORACEAE									
Rhizophora mangle L.	American mangrove	X			-	-	-	-	X
ROSACEAE									
Osteomeles anthyllidifolia Lindl.	'Ulei	E			-	R	R	-	-
RUBIACEAE									
Coffea arabica L.	Arabian coffee	X			-	-	-	-	X
Morinda citrifolia L.	Noni	P			U	O	-	R	-
Paederia foetida L.	Maile pilau	X			A	U	O	U	X
Posoqueria latifolia (Rudge) R. & S.	Tree jasmine	X			-	-	-	-	X
RUTACEAE									
Citrus sp.		X			-	-	-	-	X
Murraya paniculata (L.) Jack	Mock orange	X			-	-	-	-	X
SAPINDACEAE									
Filicium decipiens (W. & A.) Thwaites	Fern tree	X			R	-	-	-	-
SOLANACEAE									
Capsicum annuum L.	Red pepper	X			U	-	-	-	X
Lycopersicon pimpinellifolium Mill.	Currant tomato	X			-	-	-	-	X
Solanum mauritianum Scop.	Pua-nānā-honua	X			R	-	-	-	-
S. nigrum L.	Black nightshade	I?			R	-	-	-	-
S. seaforthianum Andr.		X			U	-	-	-	-
STERCULIACEAE									
Waltheria americana L.	'Uhaloa	I			-	U	U	-	X
THYMELIACEAE									
Wikstroemia oahuensis (Gray) Rock	'Akia	E			U	O	U	-	-
TILIACEAE									
Triumfetta semitriloba (L.) Jacq.	Burbush	X			U	-	-	R	X

* Category not applicable

CHECK LIST OF PLANTS

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH*	RELATIVE ABUNDANCE									
UMBELLIFERAE														
Centella asiatica (L.) Urban	Asiatic pennywort	X			O	-	O	O	X					
VERBENACEAE														
Clerodendron buchanani var. fallax (Lindl.) Bakh.	Pagoda flower	X			-	-	-	-	X					
Citharexylum caudatum L.	Juniper berry	X			U	-	R	-	-					
Lantana camara L.	Lantana	X			O	O	O	-	-					
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain	X			U	C	C	O	X					
S. urticaefolia (Salisb.) Sims		X			-	-	-	-	X					

* Category not applicable

CHECK LIST OF ANIMALS

SCIENTIFIC NAME	COMMON NAME	STATUS	N*	FH*	RELATIVE ABUNDANCE MF	ST	ES	G	C
BIRDS									
Columbidae									
Streptopelia chinensis	Lace-necked dove	X			X	-	-	-	X
Geopelia striata	Barred dove	X			-	-	-	-	X
FRINGILLIDAE									
Richmondena cardinalis	Cardinal	X			X	-	-	-	X
PLOCEIDAE									
Lonchura punctulata	Ricebird	X			-	-	X	-	X
Passer domesticus	House sparrow	X			-	-	-	-	X
PYCNONOTIDAE									
Pycnonotus cafer	Red-vented bulbul	X			-	-	-	-	X
STURNIDAE									
Acridotheres tristis	Common mynah	X			-	-	-	-	X
TURDIDAE									
Copsychus malabaricus	Shama thrush	X			X	X	-	-	X
ZOSTEROPIDAE									
Zosterops japonica	Japanese white-eye	X			X	X	-	-	X

* Category not applicable

APPENDIX B

ARCHAEOLOGICAL SURVEY
Paul H. Rosendahl, Ph.D., Inc.

Report 580-080189

Archaeological Inventory Survey
Malulani Sports Complex

Land of Heeia
Koolaupoko District
Island of Oahu

PHRI

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

Report 580-080189

Archaeological Inventory Survey
Malulani Sports Complex

Land of Heeia
Koolaupoko District
Island of Oahu

(TMK:4-6-06:1,2,4,7-16,22-51 and 4-6-16:32)

by

Arne K. Carlson, B.A.
Supervisory Archaeologist

and

Alan E. Haun, Ph.D.
Senior Archaeologist

Prepared for

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

December 1989

PHRI

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

SUMMARY

At the request of Mr. Vincent Shigekuni of Helber, Hastert & Kimura, for their client, Nanatomi Hawaii, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted a 100% and limited subsurface archaeological inventory survey of the proposed 219-ac Malulani Sports Complex project area, situated in the Land of Heeia, Koolaupoko District, Island of Oahu. The overall objective of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Impact Statement (EIS).

Survey field work was conducted May 1, 1989 through June 1, 1989 and involved two parts: (a) a variable-coverage (partial to 100%), variable-intensity surface reconnaissance survey of the project area, and (b) limited subsurface testing of selected project area locations by means of mechanical backhoe. During the survey, ten archaeological sites consisting of 48 component features and three isolated artifacts were identified. Formal feature types present at the sites include terraces, mounds, platforms, retaining walls, alignments, a lithic scatter, an upright, and WWII gun emplacements. Functional interpretations of these features include, agriculture, religion, tool manufacture, possible habitation, possible burial, and military defense.

Most of the sites and features identified during the current project are tentatively interpreted as historic. Of the total ten sites, nine are assessed as significant solely for information content. For three of the nine sites, no further work is recommended. For the remaining six sites, further intensive data collection is recommended. The remaining one site is assessed as significant for information content and cultural value. For this site, further data collection in the form of informant research followed by preservation "as is" and/or relocation are recommended. In addition to the site and feature recommendations, it is further recommended that the areas of two of the three identified isolated artifacts (finds) undergo further investigation.

CONTENTS

ILLUSTRATIONS

TABLES

INTRODUCTION

BACKGROUND

At the request of Mr. Vincent Shigekuni of Helber, Hastert, & Kimura, for their client, Nanatomi Hawaii, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted a 100% surface and limited subsurface archaeological inventory survey of the proposed c. 219-acre Mahilani Sports Complex project area, situated in Koolaupoko District on the Island of Oahu (TMK:4-6-06:1,2,4,7-16,22-51 and 4-6-16:32). The basic objective of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Impact Statement (EIS).

The survey was conducted May 1 through June 1, 1989 under the supervision of PHRI Supervisory Archaeologist Arne K. Carlson, assisted by PHRI Field Archaeologists Jack Harris, David Dillon, Keala Kauhi, and Nick Kalipaka. The survey was conducted under the overall direction of PHRI Senior Archaeologist Dr. Alan E. Haun. Approximately 102 man-days of labor were expended conducting the survey field work.

The present report is the final report on the current project. It includes a scope of work, a detailed description of the project area, a discussion of previous archaeological investigations within the project area, a section outlining the results of historical documentary research pertaining to the project area, a section of field methods and procedures, and site descriptions. The report concludes with evaluations and recommended treatments for all sites.

SCOPE OF WORK

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

The project area inventory survey was carried out in accordance with the standards for inventory-level survey recommended by the Hawaii State Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office (DLNR-HSS/SHPO). These standards are currently being used by the City and County of Honolulu as guidelines for the review and evaluation of archaeological inventory survey reports submitted in conjunction with various development permit applications.

The specific objectives of the present inventory survey were fourfold: (a) to identify (find and locate) all sites and features present within the project area (including previously identified and as yet unidentified sites and features), (b) to evaluate the potential general 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 intensive data collection and/or other mitigation work that might be appropriate or necessary.

Based on a review of readily available background literature, basic familiarity with the general project area, extensive familiarity with the current requirements of pertinent review authorities, and discussions with Mr. Shigekuni of Helber, Hastert & Kimura and with Dr. Joyce Bath, staff archaeologist for the Island of Oahu with the Hawaii State Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office (DLNR-HSS/SHPO), the following specific tasks were determined to constitute an adequate and appropriate scope of work for the proposed inventory survey:

1. Conduct limited archaeological and historical documentary background research involving review and evaluation of readily available archaeological and historical literature, historic documents and records, and cartographic sources relevant to the immediate project area. In addition, assess the potential utility of more detailed historical research that might be appropriate in connection with any subsequent archaeological work;

2. Conduct a variable coverage (partial to 100%), variable intensity surface reconnaissance survey of the project area, with (a) relatively higher intensity coverage being given non-cultivated and otherwise minimally modified lands, and (b) relatively lower intensity coverage in areas extensively modified by historic period and/or recent cultivation;

3. Conduct limited subsurface testing of selected locations within the project area by means of mechanical backhoe to determine the presence or absence of potentially significant buried cultural features or deposits; and

4. Analyze background and field data, and prepare appropriate reports, the final report to include (a) a full descriptive account of survey findings, (b) interpretation and evaluation of the findings, and (c) specific recommendations for any further archaeological work that might be appropriate and/or required.

PROJECT AREA DESCRIPTION

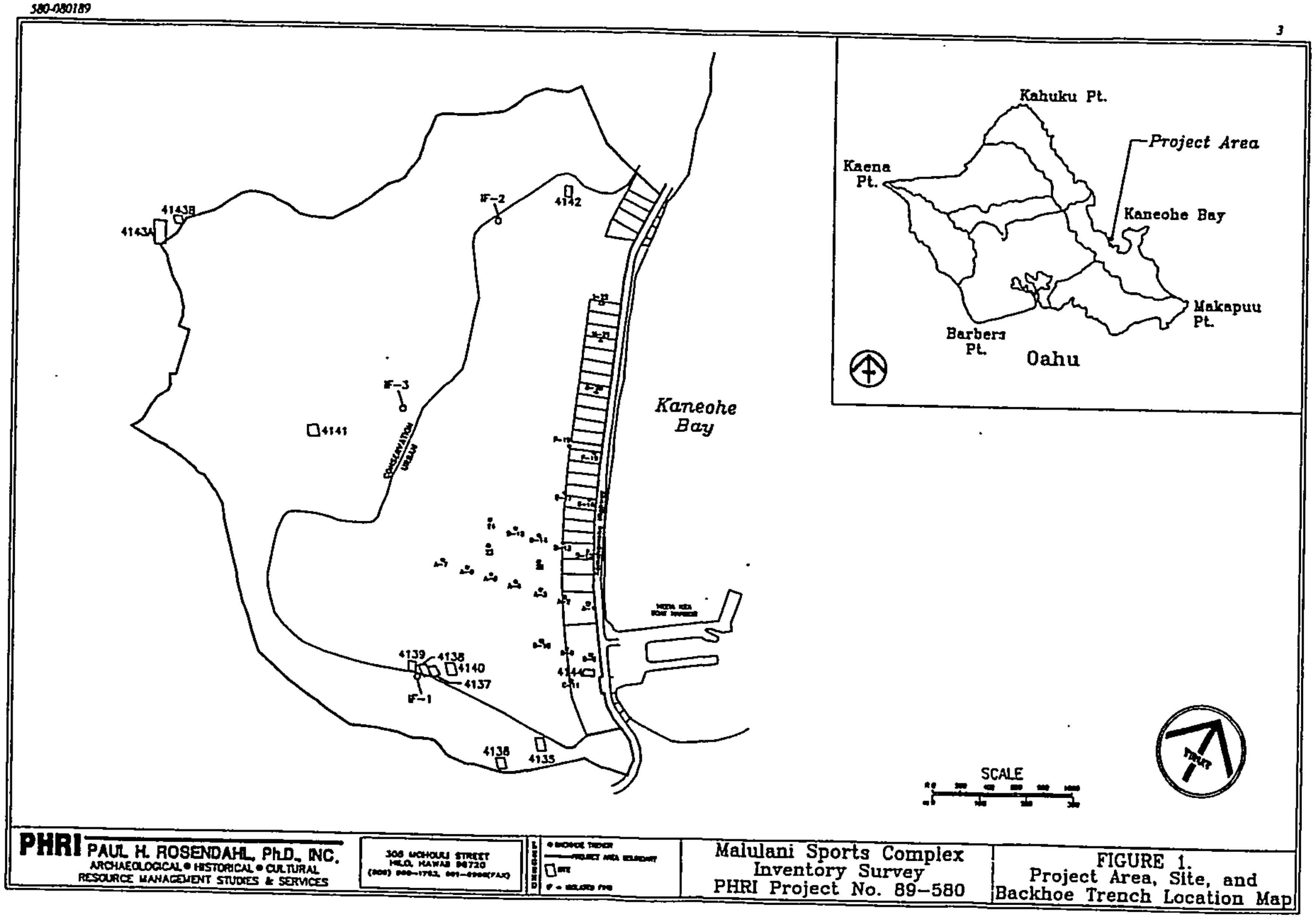
The Malulani Sports Complex project area consists of approximately 219 acres located within a small coastal valley in the Land of Heeia, District of Koolaupoko, Island of Oahu (TMK:4-6-06:1,2,4,7-16,22-51 and 4-6-16:32) (Figure 1). The eastern boundary of the project area is defined by Kamehameha Highway running along the shore of Kaneohe Bay. The Kaneohe Fishing Pier/Heeia Kea Boat Harbor is situated opposite the project area, across Kamehameha Highway. The southern and northern inland boundaries of the parcel follow ridge crests which rise to the west from the highway, and which meet and reach a maximum elevation of 718 feet at the summit of Puu Maelieli situated at the inland western side of the project area.

The topography of the project area can be divided into two general zones: low coastal plain and sloping upland. The coastal plain ranges in elevation from 5 to 25 feet AMSL (above mean sea level) and covers c. one-fifth of the project area. In the southern portion of the project area, directly across Heeia Kea Boat Harbor, the plain extends inland a maximum of 350 m from Kamehameha Highway. Its aspect is generally flat, and, depending on the amount of recent rainfall, it is often swampy, containing many ponds of standing water. The sloping uplands of the project area range from 25-718 feet AMSL and covers the greater portion of the project area. The uplands slope gently in areas of lower elevation, while in areas of higher elevation the degree of slope generally increases and often becomes 60 degrees or greater.

There are no permanent streams within the project area, although a number of intermittent streams have formed a series of ravines and ridges in the upland area. On the crests of a number of the small ridges, erosion has exposed the red, silty clay of decomposing igneous rock. Bedrock exposures are frequent within the stream channels and less frequent elsewhere.

Six soil zones have been identified within the project area: Alaeloa silty clay, 40-70% slopes; Alaeloa silty clay, 15-35% slopes; Lahaina silty clay, 7-15% slopes; Kokokahi clay, 6-12% slopes; Mokuleia clay loam; and Ewa silty clay loam, 0-2% slopes (Foote et al. 1972). Alaeloa series and Lahaina series soils, which are developed in material weathered from basic igneous rock, are found within the uplands and the higher elevations of the coastal plain. Kokokahi series, Mokuleia series, and Ewa series soils, which are developed in alluvium and colluvium derived from basic igneous rocks and which often have a substratum of coral limestone or coral sand, are found in the lower elevations of the coastal plain.

Vegetation within the project area is diverse. Nagata (1989) conducted a biological survey of the project area and recorded 185 plant species, 17 of which are native to Hawaii. He delimited five general vegetation zones: Mixed Forest, Schinus Thicket, Exposed Scrub, Lowland Grassland, and Cultivated Areas. The Cultivated Area vegetation zone encompasses essentially the low coastal plain area, and has the most varied vegetation of the five zones. Nagata comments that "of the 185 plant species found in the project area, 145 occur in [the Cultivated Area]" (1989:6). Species found in abundance within the low coastal plain include fields of Paragrass (*Brachiaria mutica* [Forsk.] Stapf), groves of banana (*Musa* sp.), umbrella plant (*Cyperus alternifolius* L.), and various vines. Other plant species found within this area include Chinese banyan (*Ficus microcarpa* L. F.), monkeypod (*Samanea saman* [Jacq] Merr.), coconut (*Cocos nucifera* L.), papaya (*Carica papaya* L.), scattered stands of koa-haole (*Leucaena leucocephala* [Lam.] de wit), Java plum (*Eugenia cuminii* [L.] Druce.), mango (*Mangifera indica* L.), octopus tree (*Brassia actinophylla* Endl.), hau (*Hibiscus tiliaceus* L.), ti (*Cordyline terminalus* [L.] Kunth), taro (*Colocasia esculenta* [L.] Schott), common heliconia (*Heliconia humilis* [Aubl.] Jacq.), as well as many ornamental species including bamboo (*Phyllostachys* sp.) and Dieffenbachia (*Dieffenbachia* cv.). The Lowland Grassland vegetation zone is basically an extension of the grasslands of the Cultivated Area zone. The Mixed Forest zone is the dominant zone within the project area. It is found within the ravines and lower to middle slopes of the upland area. Canopy species found within this area include monkeypod,



Malulani Sports Complex
Inventory Survey
PHRI Project No. 89-580

FIGURE 1.
Project Area, Site, and Backhoe Trench Location Map

Java plum, koa-haole, Christmas-berry (*Schinus terebinthifolius* Raddi.), and ironwood (*Casuarina equestifolia* L.). The shrub and herb layer within this area varies considerably and includes such species as ti, Hilograss (*Paspalum conjugatum* Berg.), basketgrass (*Oplismenus hirtellus*), and various vines. The Schinus Thicket vegetation zone is found on the steep upland slopes and is dominated by densely growing Christmas-berry and includes other species such as guava (*Psidium guajava* L.), Java plum, Boston fern (*Nephrolepis exaltata*), and various vines. Traversing this zone is very difficult. The Exposed Scrub vegetation zone is limited in extent and found predominantly on ridge crests. It is characterized by dwarfed species less than three feet tall.

PREVIOUS ARCHAEOLOGICAL WORK

A number of archaeological investigations have been conducted in the Koolaupoko District of Oahu. A brief review of a select few of these surveys and test excavations will provide a general overview of the diversity of archaeological sites and features which exist in the Kaneohe Bay region. Previous archaeological investigation within the present project area itself is limited to one reconnaissance survey.

The archaeology of Waiahole Valley within Koolaupoko District has been characterized by Tomonari-Tuggle and Tuggle (1984:1) as "Flakes and Fields." The characterization refers to the nature of the most common archaeological remains that have been located in that area, "flakes" referring to Hawaiian occupational sites and activities, and "fields" referring to Hawaiian agricultural sites and practices. This broad characterization could be considered to apply to the entire Koolaupoko District of Oahu.

In November 1982, Tomonari-Tuggle (1983) conducted an archaeological reconnaissance survey of the proposed Waiahole Valley Agricultural Park. Twenty-eight archaeological sites were located within valley areas—16 agricultural features, six habitation sites, a lithic site, two road beds, a possible railroad berm, a platform of unknown function, and the McCandless Rice Mill (1983:24). It is noted that "although most [of the sites] may have traditional Hawaiian associations, almost all show evidence of historical and/or recent modification" (1983:24). Subsequent to the 1983 survey, six of the located sites were revisited by Tomonari-Tuggle and Tuggle in 1984, and intensive data collection was carried out.

In 1988 Paul H. Rosendahl, Ph.D., Inc. carried out an archaeological reconnaissance survey of the Waikane Golf Course project area in Waikane Valley (Shapiro, Mayberry, and Haun 1988). During the survey, 29 sites consisting of 60 component features were located and recorded within the valley areas—12 agricultural sites, one habitation site, one heiau, one shrine/poss. burial, one burial/shrine, one cemetery, four tool manufacture sites, one tool manufacture/habitation site, one tool manufacture/religious site, one transportation site, and a number of indeterminate sites. Formal feature types which made up these sites included terraces, mounds, ditches, walls, lithic scatters, coral scatters, alignments, burials, sunken fields, and a midden scatter.

As compared with the present project area, Waiahole and Waikane Valleys, being larger and potentially more productive in terms of resources exploited by past cultures, would probably have had relatively large populations. The present project area is small and is limited in resources necessary to provide for a large population. However, given the proximity of the project area to these other valleys, and assuming a relatively homogenous prehistoric culture over the entire Koolaupoko District, it can be expected that feature types and site types from Waiahole and Waikane Valleys would be similar to those found in the project area. The same can be said to a certain degree about historic period sites.

The only previous archaeological investigation carried out within the current project area is one conducted by Kennedy in 1982. It consisted of a reconnaissance-level survey of the urban-zoned portion of the project area. Kennedy located and recorded five archaeological sites consisting of three terraces and two platform/mounds. During the present survey these sites were relocated, rerecorded, and were reassigned numbers as follows (SIHP numbers - refer to Table 2 for explanation of numbering system): ACH-HK1 was rerecorded as Site 4141, ACH-HK2 as Feature 23 of Site 4142, ACH-HK3 as Feature 22 of Site 4142, ACH-HK4 as Site 4140, and ACH-HK5 as Site 4137.

ACH-HK1 was interpreted by Kennedy as a terrace of traditional Hawaiian design possibly used for cultivating sweet potatoes. ACH-HK2 was interpreted as a terrace of traditional Hawaiian design possibly used for cultivating dryland taro. ACH-HK3 was assigned an indeterminate function although it was implied that it was of traditional Hawaiian design. ACH-HK4 was interpreted as a large family shrine—a kuahu, and ACH-HK5 was interpreted as a small altar. Kennedy's site descriptions are meager and do not include descriptions of the surrounding terrain—including various road beds that run directly beside some of these sites—and his interpretations must be questioned.

FIELD METHODS AND PROCEDURES

Field work was conducted May 1 through June 1, 1989 under the supervision of PHRI Supervisory Archaeologist Arne K. Carlson, assisted by PHRI Field Archaeologists Jack Harris, David Dillon, Keala Kauhi, and Nick Kailipaka. The field work was under the overall supervision of PHRI Senior Archaeologist Dr. Alan E. Haun. The field work included inventory survey and detailed recording of sites and features, and inspection and recording of subsurface deposits in selected areas of the low coastal plain by means of mechanical backhoe.

Inventory Survey and Recording

Survey transects across the entire project area involved high-intensity pedestrian sweeps, with the distance between sweeping crew members maintained at 10-20 m, depending on vegetation cover, terrain, and extent of ground disturbance encountered.

Ground surface visibility ranged from poor to fair, depending on vegetation cover. In areas of relatively low elevation, dense tall Paragrass, vines, thickets of banana and piles of automobiles created some of the greatest obstacles to ground surface visibility. In areas of higher elevation, densely growing Christmas-berry, guava, and lantana, combined with a dense blanket of understory species, made traversing these areas sometimes very difficult, and visibility in any direction was often limited.

Detailed recording was completed for all sites encountered using standard PHRI site and feature record forms. Recording included notation of site and feature dimensions; estimated limits of cultural deposits; formal type; surrounding terrain and vegetation; and preparation of scaled maps and drawings of individual features. In addition, features were photographed using 35 mm black-and-white film (PHRI Rolls 89-580:1-5).

Once identified and recorded, the approximate locations of all archaeological sites and features were determined using a combination of aerial photographs, maps, and tape and compass, and sites and features were subsequently plotted onto a master project area map. Easily identifiable landmarks close to sites were generally rare or nonexistent due to the dense vegetation canopy, and as a result the initial project site location map must be considered as indicating only approximate site locations. Currently, the survey firm Community Planning Inc., Honolulu, is precisely locating the archaeological sites using advanced survey techniques. The completed map will be available at a later date.

Each potential archaeological site encountered while conducting the pedestrian sweeps was given an initial cursory inspection, was described briefly, and was assigned a PHRI temporary site number (prefixed by "T-"). Upon completion of the pedestrian sweeps each site was revisited and recorded in detail. Each recorded site and/or the primary feature(s) within each site complex was marked with pink-and-blue surveyor's flagging tape, as well as an aluminum tag bearing the temporary site number, the feature number, the date, the letters "PHRI," and the PHRI project number (89-580).

At the time of recording a number of the identified sites were subsumed as features of adjacent recorded sites, and several of the tentatively identified sites were deleted because (a) they were assessed as noncultural, or (b) they were assessed as modern in age and/or related to modern activities. One site was reevaluated and was recategorized as an isolated find. Table 1 provides a list of *deleted* and *subsumed* sites.

Ten sites in the project area were subsequently assigned State Inventory of Historic Places (SIHP) site designations, see Table 2 for a correlation of SIHP and PHRI site numbers.

Backhoe Test Trenching

Excavation of exploratory trenches was accomplished using a mechanical backhoe. The objective of the trenching was to evaluate coastal plain deposits for evidence of buried agricultural field deposits, or other cultural features and/or deposits. Twenty-five trenches were excavated along 10 separate transect corridors. The transect corridors were established at c. 100-meter intervals along Kamehameha Highway, and each transect proceeded perpendicular to the highway so as to provide coverage of the coastal plain deposits from the highway inland (west) to the beginning of the sloping uplands. Trenches were excavated at c. 50-meter intervals along each transect corridor. Subsequently, representative profile drawings of each trench were prepared, and strata were recorded using standard PHRI stratigraphy record forms. Information recorded for each stratum included: beginning and ending depths; color (Munsell); texture; structure; consistence; and root density; as well as observations regarding degree of disturbance, presence of historic materials, and presence of floral and marine faunal remains. Soil samples were collected from each stratum of each trench; these samples were for possible use in dating and pollen analysis.

Table 1.

SUMMARY OF DELETED OR SUBSUMED SITE DESIGNATIONS

PHRI Temporary Site Designation	Status: Deleted	Status: Subsumed	Explanation
T-3	X	-	Determined noncultural
T-4	X	-	Modern ditch
T-5	X	-	Modern bottle dump
T-10	X	-	Post WWII cemented rock culvert
T-12	-	X	Now Features 25-32 of Site 4142
T-14	-	X	Now Feature 1 of Site 4142
T-15	-	X	Now Feature 23 of Site 4142
T-17	X	-	Broken fine-grained basalt cobble concentration, determined noncultural
T-18	-	X	Now Features 35 and 36 of Site 4142
T-19	-	X	Now Feature 22 of Site 4142
T-20	X	-	Basalt adze blank fragment, downgraded to status of IF-2

Table 2.

CORRELATION OF SITE NUMBERS

PHRI (1989) Site Number	Kennedy (1982) Site Number	SIHP Number
T-1	—	4135*
T-2	—	4136
T-6	ACH-HK5	4137
T-7	—	4138
T-8	—	4139
T-9	ACH-HK4	4140
T-11	ACH-HK1	4141
T-13	—	4142
Feature 23	ACH-HK2	4142
Feature 22	ACH-HK3	4142
T-16	—	4143
T-21	—	4144

*State Inventory of Historic Places (SIHP) site designation system: all four-digit site numbers prefixed by 50-80-10- (50=State of Hawaii, 80=Island of Oahu, 10=USGS 7.5 series quad map (["Kaneohe, Oahu"]).

FINDINGS

ARCHAEOLOGICAL SURVEY

During the inventory survey of the Malulani Sports Complex project area ten archaeological sites containing 48 component features were identified and recorded. Of these sites, six were newly identified, three previously identified sites were relocated, and two previously identified sites were found to be features within a single larger site containing additional, previously unrecorded features. In addition, three isolated prehistoric lithic artifacts were recovered. Figure 1 shows the locations of the 10 sites and the three isolated finds. Formal feature types present at the sites include terraces, mounds, platforms, retaining walls, alignments, a lithic scatter, an upright/shrine, and WWII gun emplacements. Functional interpretations of these features include agriculture, religion, tool manufacture, possible habitation, possible burial, and military defense. Table 3 provides a summary of the recorded sites and contains the following specific information for each site or each site feature: SIHP number assigned; feature designation (where appropriate); formal type; presumed function; presumed general age (modern=<50 yr; historic=>50 yr.); and assessments of research, interpretive, and cultural significance.

SITE DESCRIPTIONS

Site 4135 - Terrace

Site 4135 consists of a roughly crescent-shaped terrace fronted and retained by a wall consisting of stacked small cobbles and boulders of rough basalt. It is located in the southeast corner of the project area on a north facing slope at an elevation of approximately 75-100 feet AMSL. The wall measures 3.00 by 7.00 by 1.75 m high (maximum). It has collapsed somewhat, and its aspect is sloping rather than rising vertically. The lower and front section of the wall consists of a retainment formed of a single line of small boulders stacked two to three courses high (55 cm maximum height) which has been faced. The stacking is better preserved towards the east end of wall. Behind this stacked lower section, rubble consisting of small boulders and cobbles has been piled to a height of c. 70-80 cm above the top of the lower faced section of wall. At the top of this piled rubble area another stacked face of cobbles rises a maximum of 45 cm to meet the front edge of the terrace platform.

The sites appears to consist more of a retaining wall than a terrace. However, a definite platform exists behind the wall. The platform measures 1.5 by 5.0 m (maximum) and seems to consist of gravelly, silty clay loam backfilled into the area from directly behind the retaining wall. No paving is evident, and the depth of the soil deposit of the pallform was not determined. No portable cultural remains, midden, or modern trash were found in association with the terrace. Surrounding the feature on all sides, however, were a number of shallow furrows. These furrows were approximately 50 cm wide and were spaced 2 to 3 m apart, and they ran straight and directly down the slope. The furrows are probably associated with past pineapple cultivation.

The level of archaeological investigation carried out to date, and the nature of the feature allow only tentative functional and temporal interpretations of this site to be made. This site appears to be prehistoric. If it is, its most likely function would have been habitation. However, the presence of the furrows suggests it is related to historic pineapple cultivation.

Site 4136 - Levelled Slope Cut

Site 4136 consists of a roughly crescent to rectangular flat area cut into a ridgecrest. It is located on the seaward sloping ridge top which forms the southern boundary of the project area at an elevation of approximately 175 feet AMSL. It overlooks Kaneohe Bay and allows a good view of the bay and Heeia Fishpond. The site measures 7.0 by 4.5 m (maximum), and the back wall/slope-cut measures 1.03 m high at its highest point. Its condition is good, and it appears unaltered. It was constructed by excavating earth from the back, upslope side of the feature and shovelling it forward to form a level area. No portable cultural remains, midden,or modern trash were found in association with the feature.

This site is historic, and given its formal description, it may be modern. It probably functioned as a military defense lookout station or a temporary gun emplacement. The site may have also functioned as a camping spot, a storage area, or it may be somehow associated with the construction of the telephone line that runs up the ridge.

Site 4137 - Mound/Platform

Site 4137 consisus of a roughly rectangular mound constructed using small boulders and cobbles (Figure 2). Kennedy (1982) originally recorded this site as ACH-HK-5. It is located on the southern side of the project area on a

Table 3.

SUMMARY OF IDENTIFIED SITES AND FEATURES

Site/Feature Designation	Formal Type	Tentative Functional Interpretation	Tentative Age Assessment	CRM Value Mode* Assessment R	I	C
4135	Terrace	Habitation?	Prehistoric?	M	L	L
4136	Slope Cut	Military Defense?	Historic	L	L	L
4137	Mound	Burial? Shrine?	Prehistoric?	M	L	L
4138	Complex (2)#					
A	Retaining Wall	Road Retainment	Historic	L	L	L
B	Retaining Wall	Road Retainment	Historic	L	L	L
4139	Mound	Burial?	Prehistoric?	M/H	L	L
4140	Terrace	Habitation?	Prehistoric?	M	L	L
4141	Terrace	Agriculture	Prehistoric?	M	L	L
4142	Complex (37)					
1	Terrace	Agriculture	Historic	L	L	L
2	Rubble Pile	Agriculture/ Clearing	Historic	L	L	L
3	Mound, Linear	Agriculture Irrig./Bound.	Historic	L	L	L
4	Terrace/ Alignment	Agriculture?	Modern	L	L	L
5	Terrace	Agriculture	Modern	L	L	L
6	Terrace	Habitation	Modern	L	L	L

*CRM Value Mode Assessment — Nature: R = Scientific Research; I = Interpretive; C = Cultural
Degree: H = High; M = Moderate; L = Low

Number of component features within complex

Table 3. (cont.)

Site/Feature Designation	Formal Type	Tentative Functional Interpretation	Tentative Age Assessment	CRM Value Mode Assessment R	I	C
7	Terrace	Agriculture	Modern	L	L	L
8	Terrace	Agriculture	Historic	L	L	L
9	Rubble Pile	Agriculture, Clearing	Historic	L	L	L
10	Rubble Pile	Agriculture, Clearing	Historic	L	L	L
11	Mound	Burial?	Prehistoric?	M/H	L	L
12	Alignment, Semicircle	Agriculture, Planter	Modern	L	L	L
13	Alignment, Circle	Agriculture, Planter	Modern	L	L	L
14	Alignment, Semicircle	Agriculture, Planter	Modern	L	L	L
15	Alignment, Linear	Agriculture, Planter	Modern	L	L	L
16	Alignment, Linear	Agriculture?	Modern	L	L	L
17	Activity Area	Habitation	Modern	L	L	L
18	Alignment, Semicircle	Agriculture, Planter	Historic	L	L	L
19	Rubble Pile	Agriculture, Clearing	Historic	L	L	L
20	Terrace	Agriculture	Modern	L	L	L
21	Rubble Pile	Agriculture, Clearing	Historic	L	L	L
22	Retaining Wall	Agriculture	Historic	L	L	L
23	Terrace	Agriculture	Historic	M	L	L

Table 3. (cont.)

Site/Feature Designation	Formal Type	Tentative Functional Interpretation	Tentative Age Assessment	CRM Value Mode Assessment R	I	C
24	Alignment, Semicircle	Agriculture, Planter	Modern	L	L	L
25	Mound, Linear	Agriculture, Irrig./Bound.	Historic	L	L	L
26	Terrace	Agriculture	Historic	L	L	L
27	Terrace	Agriculture	Historic	L	L	L
28	Terrace	Agriculture	Historic	L	L	L
29	Terrace	Agriculture	Historic	L	L	L
30	Terrace	Agriculture	Historic	L	L	L
31	Terrace	Agriculture	Historic	L	L	L
32	Terrace	Agriculture	Historic	L	L	L
33	Lithic scatter	Tool Manufacture	Prehistoric	M	L	L
34	Mound, Linear	Agriculture, Irrigation	Historic	L	L	L
35	Terrace	Habitation?	Prehistoric?	M	L	L
36	Rubble & Lithics	Activity Area	Prehistoric	M	L	L
37	Ditch	Agriculture, Irrigation	Historic	L	L	L
4143	Complex (2)					
A	Bunker	Military Defense	WWII	L	L	L
B	Double bunker	Military Defense	WWII	L	L	L
4144	Upright	Shrine/ Possible Burial	Historic, Prehistoric?	M	M	M

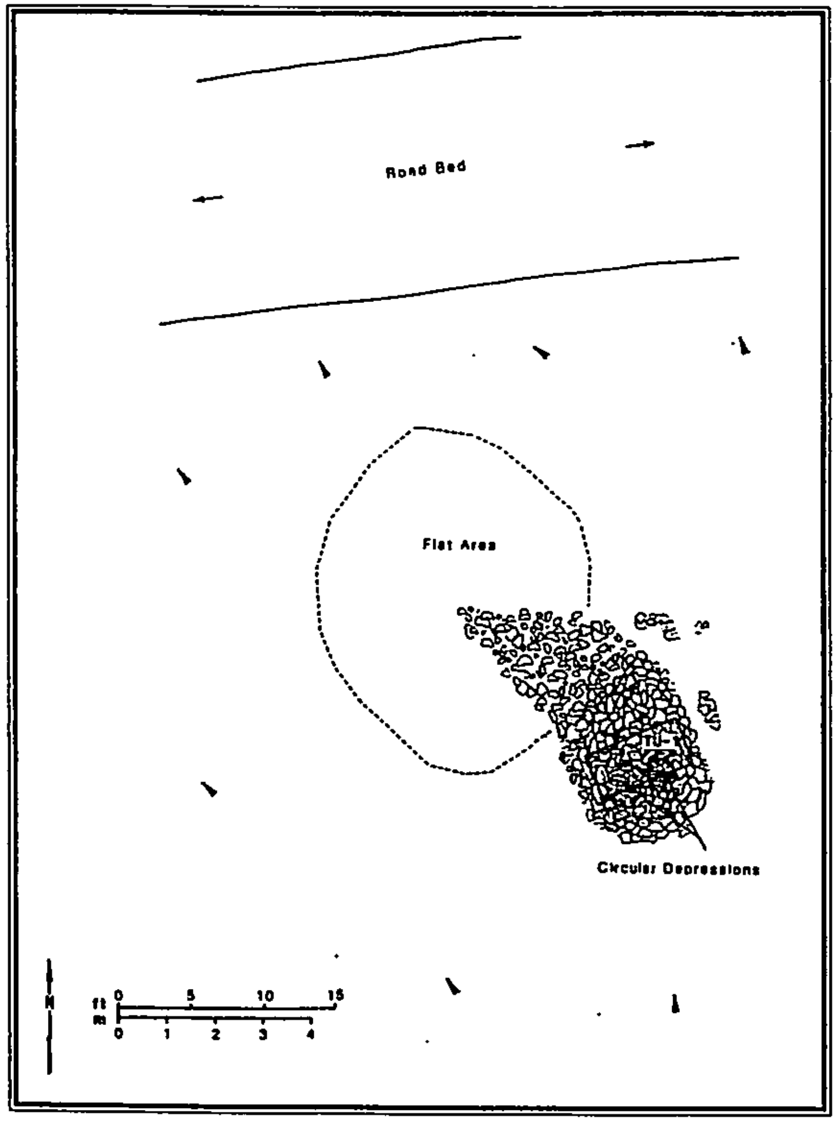


Figure 2. SITE 4137

north facing slope at an elevation of approximately 100-125 feet AMSL. It measures 3 by 4 m (maximum) and is 70 cm high at its highest point. Its long axis runs perpendicular to the direction of the slope contours, with the upslope southern side of the mound meeting the slope. Its top surface is level to mounded. Within this surface at the upslope southern end are two c. 50 by 50 cm in diameter circular depressions, c. 30 cm deep. The feature has collapsed to an unknown degree. In a few sections around its margins there is evidence of vertical cobble facing, indicating the possibility that it was originally faced on all sides and, therefore, had more the aspect of a platform at the time of construction than it has now.

No portable prehistoric cultural remains or midden were found in association with the feature. Scattered around the site area, however, is some modern trash including beer bottles and a styrofoam cooler lid. Located directly downslope of the feature is a 6.0 m in diameter flat area, below which is an old road bed running roughly east-west along the slope contours. Also, in the vicinity of the site are shallow furrows approximately 50 cm wide and spaced 2.0 to 3.0 m apart; these furrows, which run straight and directly down the slope, are probably associated with former pineapple cultivation.

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of this site to be made. Kennedy (1982) interpreted this feature as a possible small altar and possibly associated with Site 4140 (ACH-HK-4). The feature appears to be prehistoric. Given its formal type, it could be a burial; or given its formal type and the presence of two depressions on its upper surface, it may be a shrine. The depressions may have served to hold upright stones or images of some kind. On the other hand, given the presence of the furrows in its vicinity, and the old road downslope of the feature—which Kennedy failed to note—the feature may be historic, related in some way to pineapple cultivation. Perhaps the feature is a loading ramp. (See Addendum for results of subsequent excavation conducted at Site 4137.)

Site 4138 - Two Retaining Walls

Site 4138 consists of two road-cut retaining walls consisting of stacked, rough basalt small cobbles and boulders. It is located in the south side of the project area on a north facing slope at an elevation of approximately 100-125 feet AMSL. The total site area measures 10 by 25 m. The component features of the site (Features A and B) are situated 6.0 m apart. The old road bed above which the site is situated is the same one that runs below Site 4137 and above Site 4140.

Feature A. Feature A, the eastern feature, measures 4.0 by 8.5 m (maximum) and is 2.5 m high. It is situated on the upslope bank of an old road cut. The wall has collapsed somewhat, and its aspect is sloping. It has been constructed by piling small boulder and cobble rubble on and above the road cutbank. The rubble is anchored in various places by small bedrock outcrops.

Feature B. Feature B, the western feature, measures 8.0 by 9.0 m (maximum) and is 2.5 m high. It is situated on top of the upslope bank of an old road cut. The wall has collapsed somewhat and its aspect is generally sloping rather than rising vertically. A 4.0 m long faced wall, 0.4-0.6 m high and consisting of stacked cobbles, is located along its lower edge. This wall section runs parallel to and 2.0 m upslope of the top of the road cutbank. Above this faced wall section the greater part of the feature has been constructed by piling small boulder and cobble rubble. The western and upslope sides of the feature are formed by a bedrock outcrop against which the rubble has been anchored. No portable prehistoric cultural remains or midden were found in association with the feature. Scattered around the site area, however, was some modern trash, including beer bottles and old pig-wire fencing.

This site is historic, and given its formal description and obvious direct association with the old road, possibly modern. Both features appear to have been constructed at the time the road was constructed in order to stabilize the slope above the road cutbank.

Site 4139 - Mound/Platform

Site 4139 consists of a roughly rectangular small boulder and cobble mound (Figure 3). It is located on the southern side of the project area on a gentle northwest facing slope at an elevation of 75-100 ft AMSL. It measures 3 by 5 m (maximum) and is 80 cm high at its highest point. Its top surface is level to mounded, with its upslope southern side meeting the slope. The feature has collapsed. The northern downslope side of the feature is vertically faced with small boulders and cobbles. There is evidence the feature was originally faced on all sides and, therefore, had more the aspect of a platform than it has now.

No portable cultural remains or midden were found in association with the feature. Located directly upslope from the feature, however, is an old road bed running roughly east-west along the slope contours. Also, located in the area upslope of the site are shallow furrows approximately 50 cm wide, spaced 2 to 3 m apart. These furrows, which run straight and directly down the slope, are probably associated with pineapple cultivation.

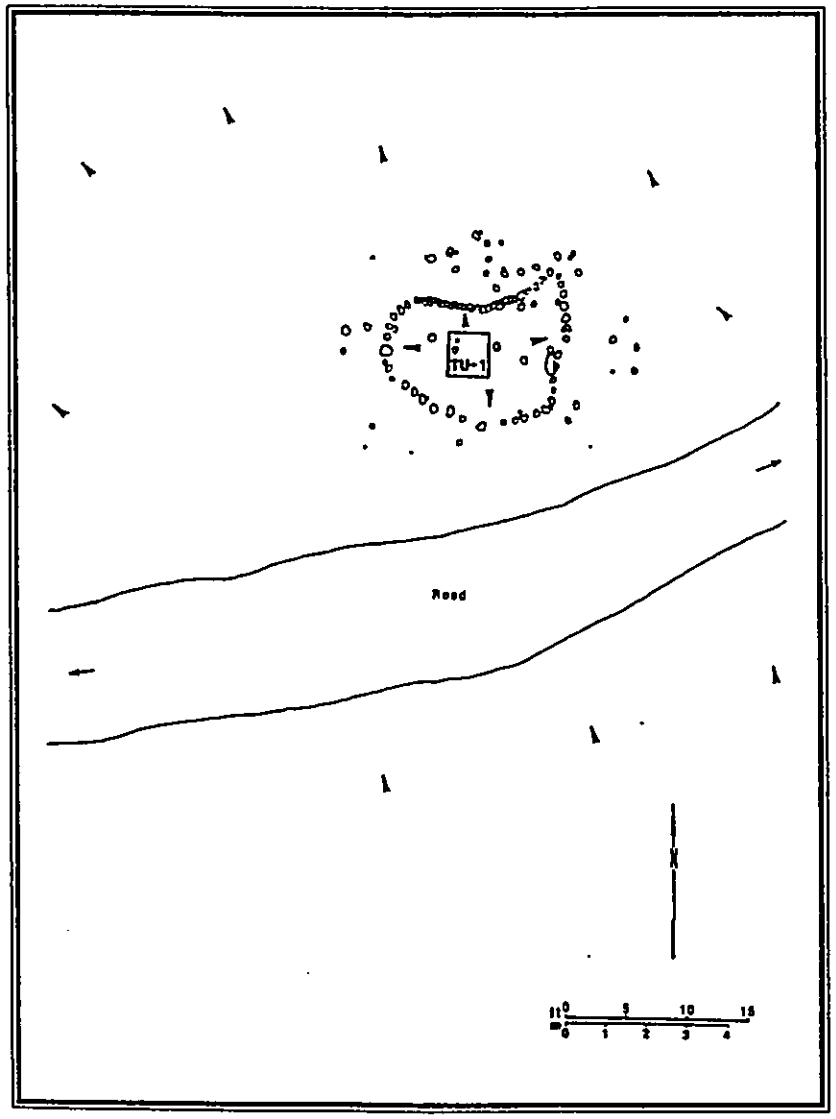


Figure 3. SITE 4139

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of this site to be made. The feature appears to be prehistoric; given its formal type, it may be a burial. The presence of the fairly obvious pineapple agriculture furrows in its vicinity, however, and the presence of the old road bed directly upslope of the feature suggest that it is possibly historic, related in some way to pineapple cultivation. Perhaps the feature functioned as a loading ramp. (See Addendum for results of subsequent excavation conducted at this site.)

Site 4140 - Terrace/Retaining Wall

Site 4140 consists of a terrace/retaining wall constructed of stacked small cobbles and boulders of rough basalt. Kennedy (1982) originally recorded this site as ACH-HK-4. It is located in the south side of the project area on a north facing slope at an elevation of approximately 75-100 feet AMSL, on the upslope side of an old road bed which runs approximately east-west along the slope contours. The wall measures 5.5 by 13 m (maximum) and is approximately 2.0 m high at its highest point. It has collapsed somewhat, and its general aspect is sloping rather than rising vertically. The bottom center section of the wall running along the upslope edge of the road bed consists of a retainment formed of a single line of small boulders stacked two to three courses high. This retainment is faced, is approximately 4.0 m long, and is a maximum 65 cm high. The rest of the wall is constructed of small boulders and cobbles which have been piled onto the slope behind and to each side of the faced section of wall.

The overall appearance of the site is more like a retaining wall than a terrace. However, a definite flat area exists behind the wall. This area measures approximately 1.5 by 9 m (maximum) and seems to have been formed by backfilling gravelly, silty clay loam into the area directly behind the retaining wall. No paving is evident, and the depth of the loam was not determined.

No portable prehistoric cultural remains or midden were found in association with the feature. Located in its vicinity, however, predominantly upslope of the feature, are shallow furrows approximately 50 cm wide and spaced 2 to 3 m apart. These furrows, which run straight and directly down the slope, are probably associated with former pineapple cultivation. Also, approximately 20 m upslope of the feature is a second old road bed running east-west along the contours. This second road is the same one that runs below Site 4138 and below Site 4137.

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of this site to be made. Kennedy (1982) interpreted this site as a shrine possibly associated with Site 4137 (ACH-HK-5). This feature may be prehistoric; if so, its most likely function would have been habitation. However, the presence of the furrows in its vicinity, and the feature's direct association with the old road bed (which Kennedy failed to note), suggest it may be historic, related in some way to pineapple cultivation. Perhaps the feature was a loading ramp, or was simply a road cut retaining wall.

Site 4141 - Terrace

Site 4141 consists of a terrace constructed of stacked rough basalt small cobbles and boulders. Kennedy (1982) originally recorded this site as ACH-HK-1. It is located in the central portion of the project area on a east facing slope at an elevation of approximately 175 feet AMSL. The feature measures 2.0 by 10.0 m (maximum), and is 40 cm high at its highest point. The terrace wall has collapsed somewhat; originally the wall may have been faced along its entire length. The platform of the terrace measures approximately 1.5 by 7.0 m (maximum) and has been constructed by filling the area behind the faced wall with rubble. Very little soil is present on the platform.

No portable cultural remains or midden were found in association with the feature. However, located in the vicinity, mainly upslope, are shallow furrows approximately 50 cm wide and spaced 2 to 3 m apart. These furrows, which run straight and directly down the slope, are probably associated with former pineapple cultivation. Also, located approximately 50 m upslope of the feature is a possible ditch or trail that runs across the slope for an indeterminate distance.

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of this site to be made. Kennedy (1982) interpreted this site as an agricultural terrace used for cultivating sweet potatoes. It may be prehistoric, and if so, it could have been used for agriculture, habitation, or religion. Given the presence of the furrows in its vicinity, however, and the possible ditch upslope, the terrace may be historic, related in some way to former pineapple cultivation.

Site 4142 - Site Complex

Site 4142 is a complex with three temporal components: (a) prehistoric use for habitation, tool manufacture, and possibly burial; (b) historic agriculture, and (c) modern habitation and agriculture. The site consists of 37 features and five feature areas (Figure 4). It is located in a small intermittent stream valley on the north side of the project area at an elevation ranging from c. 40-100 feet AMSL. The site measures c. 140 by 145 m (maximum) and covers c. 5.7 acres. Following is a brief description and discussion of the feature areas and each feature.

Feature Areas. In order to facilitate recording, the site was divided into five feature areas (Areas A-E) (Figure 4). These areas were generally delineated according to elements of the historic agricultural component of the site, and can be thought of as representing agricultural fields, although the divisions may be somewhat arbitrary. Feature Area A is situated at the northeast end of the site and covers approximately 3,500 sq m. Features 1, 2, 9, and 18 are located within Feature Area A. Feature 3 forms the boundary between Feature Areas A and B. Feature Area B is situated at the north side of the site between Feature Areas A and C, and covers approximately 3,000 sq m. Features 4-8, 10-17, 19-21, 24, and 33 are located within Feature Area B. Feature 25 forms the boundary between Feature Area B and C. Feature Area C is situated at the north side of the site between Feature Area B and Feature Area D and covers c. 3,000 sq m. Features 26-32 are located within Feature Area C. A linear rubble mound near Feature 22 forms the boundary between Feature Area C and Feature Area D. Feature Area D is situated at the northwest end of the site and covers c. 4,000 sq m. Feature 22 is located within Feature Area D. Feature 34 forms the boundary between Feature Area D and Feature Area E. Feature Area E is situated on the southwest side of the site and covers c. 9,500 sq m. Features 23, 35, and 36 are located within Feature Area D. An intermittent stream bed runs southeast through the center of the site and forms the northeast boundary of Feature Area E separating it from Feature Areas B and C. Feature 37, a ditch, runs around the upslope sides of Feature Areas B-E and forms the upslope boundary of the site.

The predominant attribute of the five feature areas is an essentially continuous, regular distribution of shallow, circular agricultural planting depressions over the site area, which reflect the principal historic function of the site—agriculture. These depressions were not given individual feature numbers, except in a few cases. An exact count of the total number of depressions over the site area was not attempted; 1,000 depressions would be a conservative estimate. The depressions range from 0.80-1.20 m in diameter and are generally 10-30 cm deep. They are spaced 2.5 to 3.2 m apart in a gridlike pattern. Figure 5 shows the typical gridlike distribution of the depressions over a small area within Feature Area A. A minimal amount of variation in the grid pattern was observed; this variation appears to be due to factors such as subsequent land use, natural relief, and the presence of other features in an area. Essentially, however, the pattern is continuous over the entire site area. The depressions themselves exhibit a number of variations depending on the nature of the soil into which they were excavated. In rocky soil the depressions are sometimes ringed or partially ringed with alignments of stones excavated from the hole; or alternatively, if the soil is very rocky the depressions are surrounded by low rubble clearing mounds. These mounds sometimes overlap and resemble alignments, linear mounds, or small terraces.

Feature 1 is an historic agricultural terrace that appears to have served to lessen the degree of slope in order to facilitate planting. It is situated on the downslope, southeastern side of Feature Area A. The wall measures 2.5 by 34 m (maximum) by 70 cm in height; it was constructed by piling cobbles and earth together. There is no definite flat area behind the wall. The wall is anchored at the east end at a bedrock outcrop and small bedrock outcrops have been incorporated into the wall in various other places. The overall condition of the wall is fair, though the wall is somewhat slumped downslope. A banyan tree grows out of the approximate center of the wall, below which is a 4.0 by 4.0 m, 80 cm deep depression containing modern trash.

Feature 2 is a small historic agricultural clearing pile consisting of cobble rubble; the rubble apparently was removed during the excavation of the planting depressions in the vicinity. Feature 2 is situated within Feature Area A, c. 5 m west of the west end of Feature 1. It measures 1.7 by 2.0 m (maximum) by 40 cm high.

Feature 3 is an historic agricultural linear mound running down the slope between Feature Areas A and B. It probably served as a field boundary or as a water diversion irrigation feature. The feature measures 1.4 by 41.0 m (maximum) by 10 to 50 cm high. It was constructed by piling together cobbles and small boulders. Its overall condition is fair, having collapsed somewhat. A ditch (Feature 37) ends at the upslope end on the eastern side of this feature. Near its lower end, the mound provides an anchor for a terrace running west (Feature 8).

Feature 4 is a small terrace/alignment located in Feature Area B near the downslope end of Feature 3. It

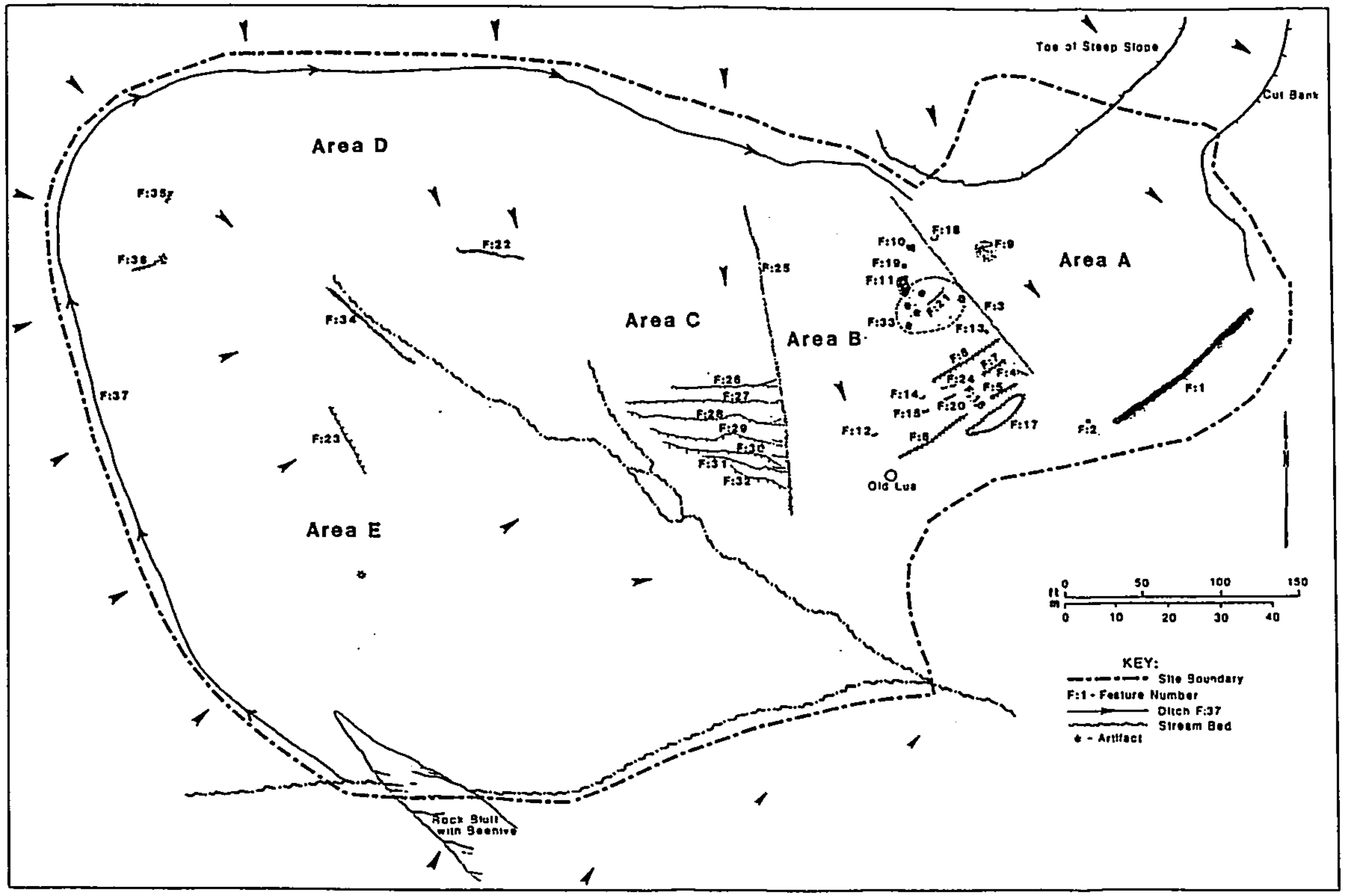


Figure 4. SITE 4142, AREAS A-E

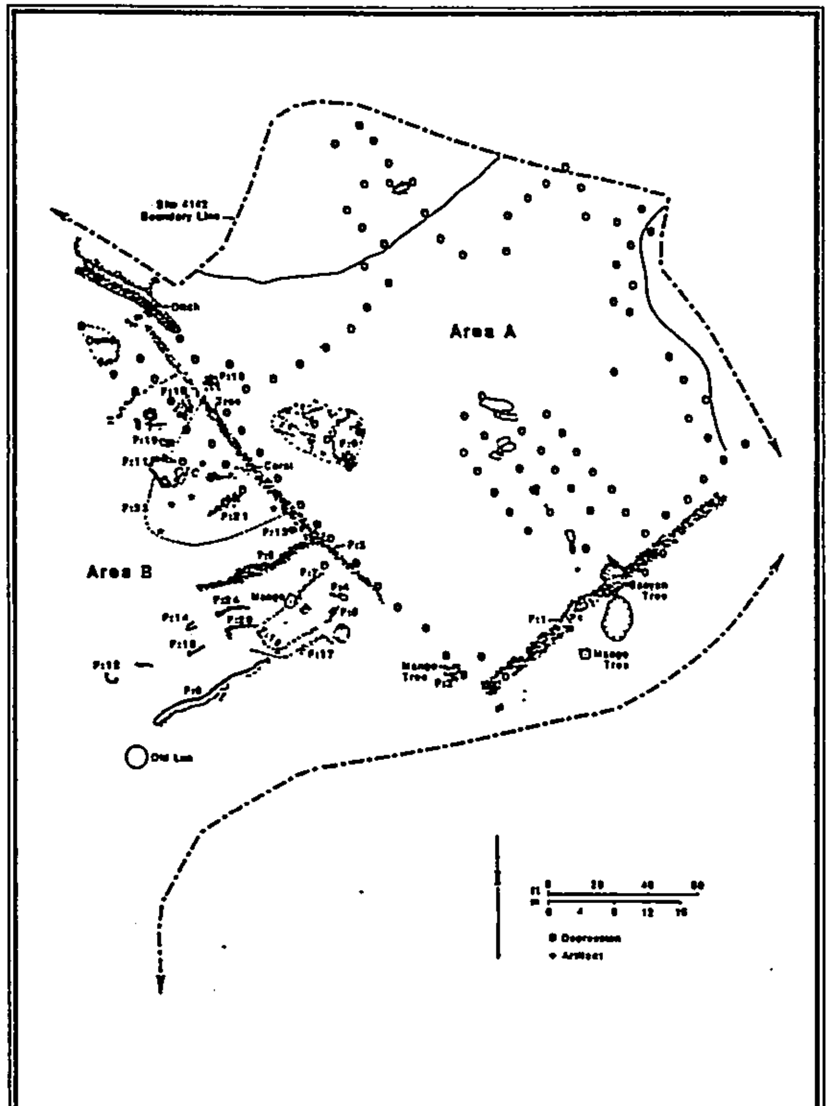


Figure 5. SITE 4142,
DISTRIBUTION PATTERN OF AGRICULTURAL DEPRESSIONS

appears to be a modern, small retainment associated with modern occupational features below it (Features 5 and 17). It measures 0.6 by 1.6 m (maximum) by 50 cm high and consists of a slightly curving linear alignment. This alignment consists of cobbles and small boulders and retains soil. The condition of the alignment is good.

Feature 5 is a modern agricultural terrace located in the downslope, southeastern portion of Feature Area B. It measures 3.5 by 10.0 m (maximum). The terrace retaining wall is 1.0 m wide and 50 cm high and consists of one course of small boulders. The wall retains rocky silty clay loam, and also acts as a retainment for the back side of a level, modern habitation area (Feature 17). On the terrace platform are faint circular depressions (planting?); the back edge of the terrace is indistinct. The overall condition of Feature 5 is fair to good.

Feature 6 is a modern terrace located in the downslope, southeastern portion of Feature Area B. It appears to have been used for habitation. Feature 6 measures 3.0 by 21.0 m (maximum areal extent). The terrace retaining wall is 0.8 m wide by 0.4 cm high and consists of piled cobble rubble; the wall retains rocky silty clay loam fill. On the front edge of the platform, running its entire length, is a single course of cinder bricks. This provides a narrow paved trail leading from the vicinity of Feature 17 to a 3.0 m in diameter, 75 cm deep depression which appears to have been an outhouse. The overall condition of Feature 6 is fair to good.

Feature 7 is a modern agricultural terrace located in the downslope southeastern portion of Feature Area B. It measures 2.5 by 6.0 m (maximum). The retaining wall of the terrace is 0.5 m wide and 0.5 m high and consists of one course of small boulders; the wall retains rocky silty clay loam fill. The overall condition of Feature 7 is good.

Feature 8 is an historic agricultural terrace that appears to have served to lessen the degree of slope in order to facilitate planting. It is located in the downslope, southeastern portion of Feature Area B. The wall measures 1.5 by 17.0 m (maximum) by 0.6 m high. It was constructed by piling together cobbles and small boulders. No definite flat area exists behind the wall. Its overall condition is fair, having slumped downslope somewhat. It is anchored at its eastern end on a low, linear rubble mound (Feature 3).

Feature 9 is an historic agricultural clearing pile consisting of cobble rubble removed during the excavation of nearby planting depressions. It is situated in the upslope, northwestern portion of Feature Area A. It measures 3.5 by 9.0 m (maximum) by 0.5 m high. In some spots rocks from the pile have fallen creating the semblance of an alignment. The overall condition of Feature 9 is good.

Feature 10 is an historic agricultural clearing pile consisting of cobble and boulder rubble removed during excavation of nearby planting depressions. It is situated in the upslope, northeastern portion of Feature Area B. It measures 2.3 by 3.3 m (maximum) by 0.5 m high. The overall condition of Feature 10 is good.

Feature 11 is a mound/platform located in the upslope, northeastern portion of Feature Area B (Figure 6). It measures 4.4 m by 3.1 m (maximum) by 1.0 m high (downslope side). It is roughly rectangular and consists of stacked boulders and cobbles anchored at the downslope side by two very large bedrock boulders. A red/brown, elongate, rounded lava boulder is lying flat on the top of the mound in the southern corner of the feature; this boulder may be a toppled upright stone; it was the only rock of that material found over the entire site. The overall condition of the feature is fair, having collapsed somewhat. The sides of the feature may have once been faced. Directly downslope of the feature is a surface lithic scatter (Feature 33).

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of the feature to be made. It may be prehistoric, and if so, it could be a shrine of some kind, or it could be a burial. Given the presence of obvious historic agricultural features in the immediate vicinity, the mound may be an historic feature related to this agriculture—perhaps it is a clearing mound. (See Addendum for results of subsequent excavation conducted at this site.)

Feature 12 is an historic or modern planter located in the downslope, southern portion of Feature Area B. It measures 1.7 by 1.0 m (maximum) by 0.3 m high and consists of one course of small boulders aligned in a crescent shape. The crescent, open on the upslope side, encloses a flat circular area of rocky, silty clay loam. The overall condition of Feature 12 is good.

Feature 13 is probably a modern decorative planter; it is located in the downslope, southeastern portion of Feature Area B. The feature measures 1.1 by 0.7 m (maximum areal extent) and consists of one course of small boulders placed directly on the surface and arranged to form an oval. The overall condition of Feature 13 is good.

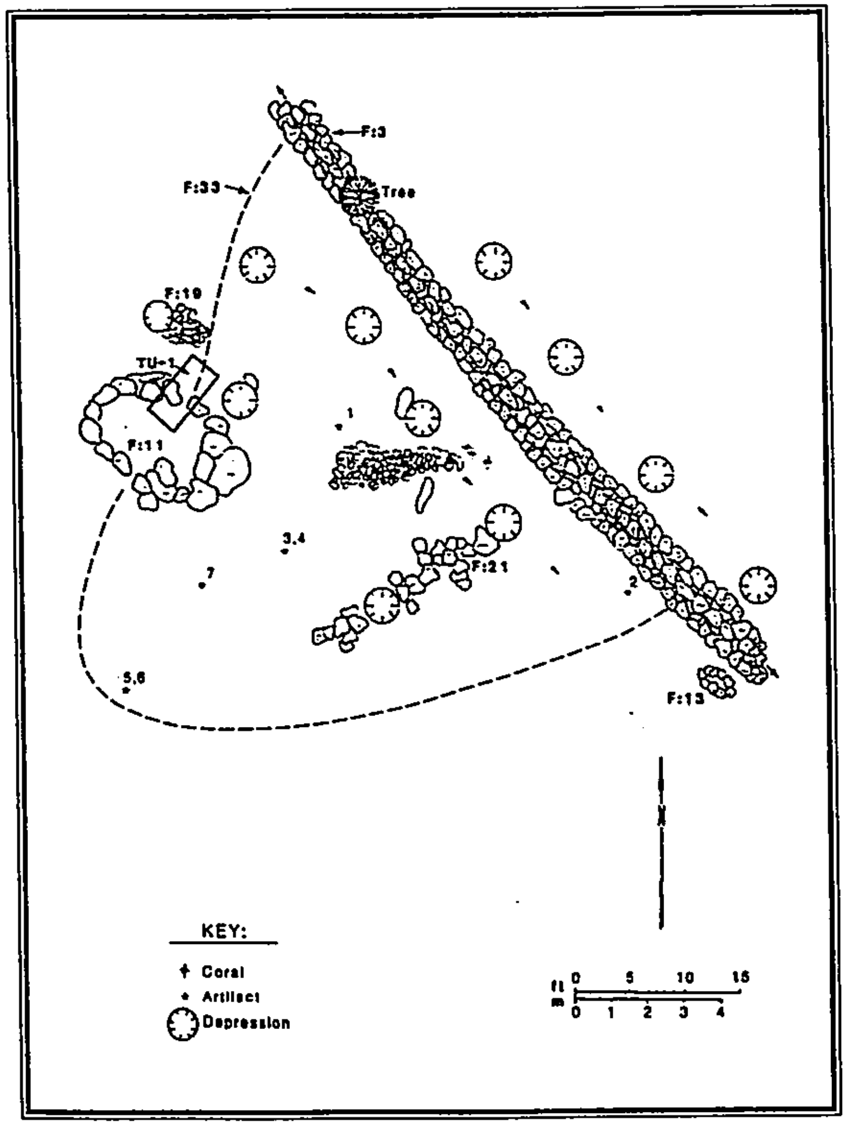


Figure 6.
SITE 4142; FEATURES 11, 33, AND ADJACENT FEATURES

Feature 14 appears to be a modern agricultural planter. It is located in the downslope southeastern portion of Feature Area B. It measures 1.2 by 0.5 m (maximum) and consists of one course of small boulders arranged in a crescent. The crescent, open on the upslope side, encloses a flat circular area of rocky, silty clay loam. Directly in the center of this area of loam sits a rusted bucket. The feature's overall condition is good.

Feature 15 appears to be a modern agricultural planter. It is located in the downslope southeastern portion of Feature Area B. It measures 1.1 by 0.3 m (maximum areal extent) and consists of a linear alignment of small boulders. A small amount of rocky silty clay loam fill is retained by the alignment. The feature's overall condition is fair to good.

Feature 16 is a linear alignment of small boulders located in the downslope southeastern portion of Feature Area B. The alignment runs upslope between Features 5 and 6. It measures 2.1 by 0.4 m (maximum areal extent). Its overall condition is fair to good. The function of Feature 16 is indeterminate, but given its direct association with modern features, it is most likely modern.

Feature 17 is a modern habitation area. It is located in the downslope southeastern portion of Feature Area B. The feature measures 15.0 by 5.0 m (maximum areal extent) and consists of a leveled area. Present on the leveled area is scattered modern trash and bricks, including four large cinder foundation blocks. Feature 17 appears to represent the principal activity area of the modern component of the site. Its overall condition is poor.

Feature 18 is an historic planter/alignment located in the upslope northwest portion of Feature Area A. It measures 1.9 by 0.3 m (maximum areal extent) and consists of a single-course, semicircular alignment of small boulders surrounding an agricultural planting depression. The feature is probably the result of excavation of the depression. The overall condition of the feature is good.

Feature 19 is an historic agricultural clearing pile consisting of cobble and boulder rubble removed during excavation of a nearby planting depression. It is situated in the upslope northeastern portion of Feature Area B. It measures 1.1 by 1.0 m (maximum) by 25 cm high. The overall condition of Feature 19 is good.

Feature 20 is a modern agricultural terrace located in the downslope southeastern portion of Feature Area B. It measures 5.0 by 3.5 m (maximum areal extent). The terrace retaining wall measures 1.0 m wide by 25 cm high and consists of stacked small boulders and cobbles; the wall retains a fill of rocky, silty clay loam. A modern washtub sits on the terrace platform. The overall condition of Feature 20 is good.

Feature 21 is an historic agricultural clearing pile consisting of cobble and small boulder rubble removed during excavation of nearby planting depressions. The rubble has fallen into the semblance of an alignment. Feature 21 is situated in the upslope northwestern portion of Feature Area B. It measures 5.0 by 1.0 m (maximum areal extent) by 0.4 cm high. The overall condition of Feature 21 is good.

Feature 22 is an historic agricultural retaining wall located on the eastern side of Feature Area D. This feature was previously recorded by Kennedy (1982) as ACH-HK-3 and was interpreted as a prehistoric agricultural terrace. Based on the present work, however, the feature appears to be associated with planting depressions in its vicinity; or perhaps the feature is the result of excavating planting depressions. It measures 13.0 by 2.0 m (maximum areal extent) by 0.5 m high and is constructed of stacked cobbles and small boulders. Its aspect is irregular, and its condition is fair to poor.

Feature 23 is a terrace (Figure 7). This feature was previously recorded by Kennedy (1982) as ACH-HK-2 and interpreted as a prehistoric agricultural terrace possibly used for growing dryland taro. The feature is located in the central portion of Feature Area E. It measures 18.0 by 4.0 m (maximum areal extent) by 60 cm high. The terrace retaining wall consists of cobbles and small boulders stacked to create a vertical face. The terrace platform is filled with rocky, silty clay loam. A number of circular planting depressions are present on the platform. The overall condition of Feature 23 is fair. A large adze blank of fine-grained grey basalt, shaped and prepared for grinding, was located 23.0 m south of this feature.

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of the feature to be made. The feature may be prehistoric, and if so, its function could be agricultural (as Kennedy suggested), or it could be a habitation feature. Given the presence of the obvious historic agricultural planting depressions in the immediate vicinity, however, the terrace may be historic and related to the depressions.

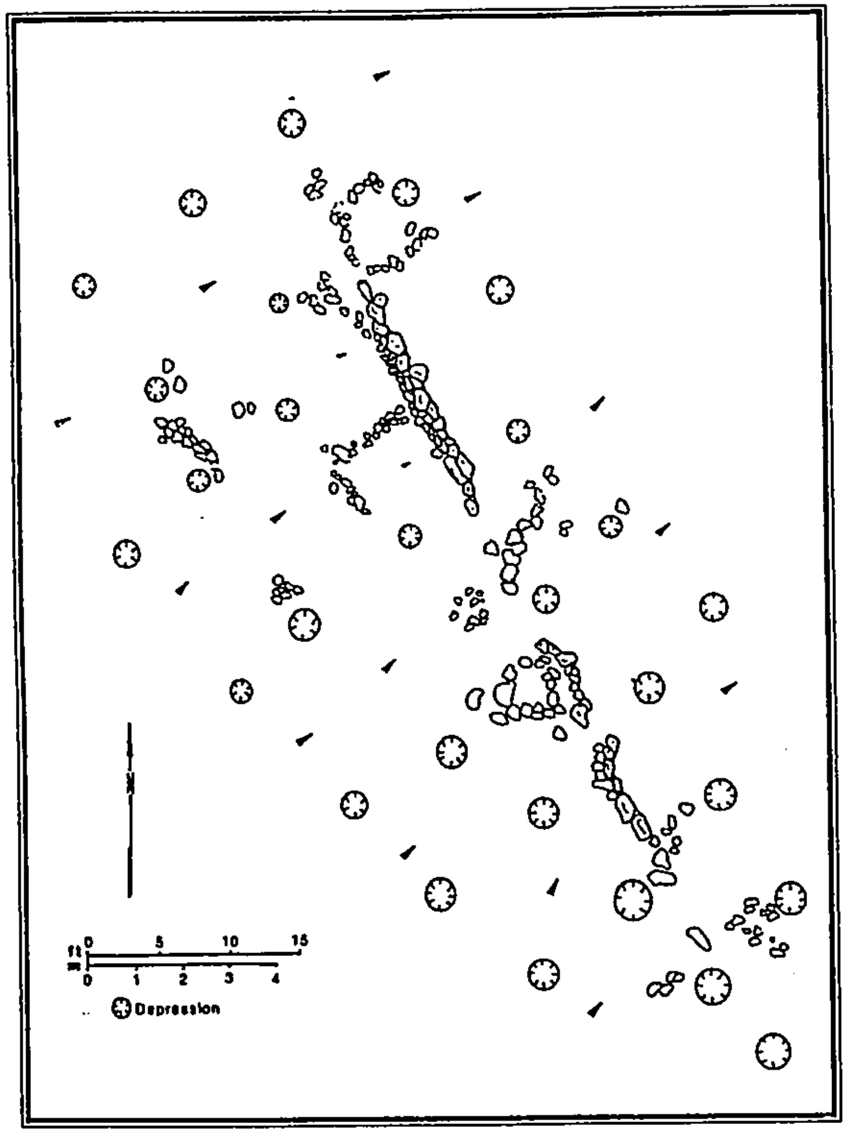


Figure 7. SITE 4142, FEATURE 23

Feature 24 is a modern agricultural planter located in the downslope, southeastern portion of Feature Area B. It measures 4.5 by 1.5 m (maximum areal extent) and consists of two side by side crescent-shaped alignments of small boulders. The alignments retain a thin layer of rocky, silty clay loam fill on its upslope side. The condition of the alignments is good.

Feature 25 is an historic agricultural linear mound running downslope between Feature Areas B and C. It probably served a boundary function or served as a water diversion feature for irrigation. Its upslope end comes within 10 m of a ditch running around the site area (Feature 37). It measures 58.0 m long by 1.0 m wide by 30 cm high. Feature 25 is constructed of piled cobbles and small boulders. Having collapsed somewhat, its overall condition is fair. The lower half of the feature provides an anchor for seven terraces running off to the west (Features 25-32, Figure 8). Present along its lower half is a row of ti plants which parallel the feature's western edge.

Feature 26 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 20.0 by 3.0 m (maximum areal extent) by 0.85 m high. This terrace is the uppermost of a series of seven terraces (Features 26-32). It is constructed of leveled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). Circular historic planting depressions are present on the terrace platform. The condition of the feature is good to fair.

Feature 27 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 30.0 by 3.0 m (maximum areal extent) by 0.85 m high. This terrace is one of a series of seven terraces (Features 26-32). It is constructed of levelled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). Circular, historic planting depressions are present on the terrace platform. The condition of the terrace is good to fair.

Feature 28 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 31 by 3.0 m (maximum areal extent) by 105 cm high. This terrace is one of a series of seven terraces (Features 26-32). It is constructed of levelled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). The terrace's condition is good to fair.

Feature 29 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 26.0 by 3.0 m (maximum areal extent) by 0.9 m high. This terrace is one of a series of seven terraces (Features 26-32). It is constructed of levelled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). The terrace's condition is good to fair.

Feature 30 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 24.0 by 3.0 m (maximum areal extent) by 1.0 m high. This terrace is one of a series of seven terraces (Features 26-32). It is constructed of levelled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). The terrace's condition is good to fair.

Feature 31 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 15.0 by 2.5 m (maximum areal extent) by 75 cm high. This terrace is one of a series of seven terraces (Features 26-32). It is constructed of levelled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). The terrace's condition is good to fair.

Feature 32 is an agricultural terrace—probably historic—located in the southeast portion of Feature Area C. It measures 10.0 by 2.5 m (maximum areal extent) by 75 cm high. This terrace is the lowermost of a series of seven terraces (Features 26-32). It is constructed of levelled, rocky, silty clay loam which is retained by a discontinuous wall of piled and aligned cobbles. The terrace is anchored at its eastern end to a low linear mound of small boulders (Feature 25). The terrace's condition is good to fair.

Feature 33 is a prehistoric lithic scatter/activity area located in the upslope northeastern portion of Feature Area B (Figure 6). Its observed extent measures 15.0 by 10.0 m (maximum areal extent). This feature may be associated with Feature 11, a possible prehistoric mound situated on the northwestern edge of the lithic scatter. The feature has been altered somewhat by subsequent activity in the area, particularly excavation of the circular, historic planting depressions. The density of artifacts over the area of the feature is low. It is unknown whether subsurface deposits are present in the area. Artifacts collected from the surface include two adze blank preforms, one core remnant, one

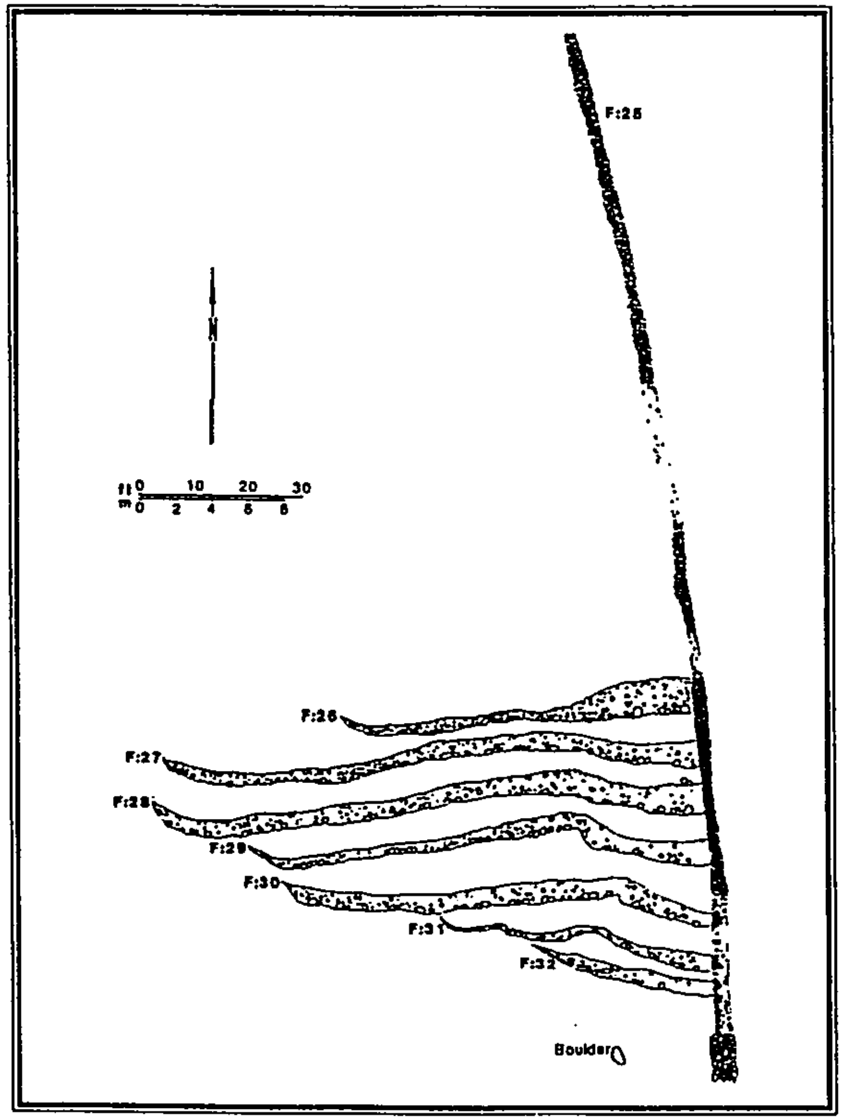


Figure 8. SITE 4142, FEATURES 25-32.

retouched flake, and three unmodified flakes, all of a fine-grained grey basalt. Table 4 provides a summary and description of the artifacts collected. Three small pieces of branch coral were also found within the feature, but they were not collected.

Feature 34 is an historic agricultural mound which appears to have served for irrigation control. It is located in a creek bed and forms part of the boundary between Feature Areas D and E. Feature 34 measures 22.0 by 1.25 m (maximum areal extent by 0.35 m high. It consists of a low linear mound of cobble and small boulder rubble piled directly alongside a stream channel. It appears that the mound was created by clearing rocks out of the stream channel in order to straighten and deepen it. The feature's condition is fair.

Table 4.

SUMMARY OF PREHISTORIC ARTIFACTS

Accession Number	Site Number	Feature/ Area	Artifact Type	Artifact Material
1	4142	F:33	Core remnant	Fine-grained gray basalt
2	4142	F:33	Adze blank preform	Fine-grained gray basalt
3	4142	F:33	Retouched flake	Fine-grained gray basalt
4	4142	F:33	Flake	Fine-grained gray basalt
5	4142	F:33	Flake	Fine-grained gray basalt
6	4142	F:33	Flake	Fine-grained gray basalt
7	4142	F:33	Adze blank preform	Fine-grained gray basalt
8	4142	F:23	Adze blank	Fine-grained gray basalt
9	4142	F:36	Flake	Fine-grained gray basalt
10	4142	F:36	Flake	Fine-grained gray basalt
11	IF-1	South side project area	Retouched flake	Fine-grained gray basalt
12	IF-2	North side project area	Adze blank preform frag.	Fine-grained gray basalt
13	IF-3	Central project area	Flake	Volcanic glass

Feature 35 is a small double terrace located in the northwestern portion of Feature Area E. Its function is indeterminate. It consists of two small terraces situated 2.5 m apart; these terraces together cover an area measuring 4.5 by 4.0 m (maximum). The terrace walls are constructed of cobbles and small boulders stacked c. 0.4 m high. The walls may have once been faced. The condition of the upper terrace is better than that of the lower.

The level of archaeological investigation carried out to date, and the nature of the feature allow only a tentative functional/temporal interpretation of the feature to be made. This feature may be prehistoric, and if so, its function could be agriculture or habitation. Given the presence of the historic agricultural features in the general vicinity, however, the terraces may be related to historic agriculture.

Feature 36 is a rubble pile located in the northwestern portion of Feature Area E. Its function is indeterminate. It measures 8.0 by 4.0 m (maximum areal dimensions) by 40 cm high. Feature 36 consists of a linear pile of cobbles and small boulders; this pile runs downslope and widens out at the downslope end. A few segments of the pile appear to have been possibly stacked. The overall condition of Feature 36 is fair to poor. Two fine-grained, grey basalt flakes were recovered from the lower end of the feature.

The level of archaeological investigation carried out to date, and the indeterminate nature of the feature allow only a tentative functional/ temporal interpretation of the feature. This feature may be prehistoric, as the flakes suggest, and if so, its function could be agriculture or habitation, or it could be an activity area of some kind. Given the presence of the historic agricultural features in the general vicinity, however, the pile may be related to historic agriculture—perhaps it is a clearing pile.

Feature 37 is an historic irrigation ditch that forms the upslope boundary of the site; the feature probably served as the principal water channel for irrigating the historic agricultural planting depressions. It is approximately 300 m in length and ranges from 1 to 2 m in width. It has slumped in and become filled over most of its length and as a result has some aspects of a trail. It runs gently downslope around the contours of the small valley in which the site is located. It starts at a point directly above a steep rock bluff in the stream bed forming the south boundary of the site and ends up at the top end of Feature 3.

Site 4143 - Two WWII Bunkers

Site 4143 consists of two WWII pillboxes situated near the summit of Puu Maelieli at an elevation of approximately 700 feet AMSL.

Feature A. Feature A is situated approximately 10.0 m north of the summit of Puu Maelieli and faces essentially east overlooking Kaneohe Bay. It consists of an 8 by 4.5 m concrete single-room structure. The interior of the structure measures 4.0 by 6.5 m by 2.2 m high. Inside the structure are two steel gun mounts (guns have been removed) placed side by side at the front of the room. The room has a narrow slit gun port 32 cm high, which runs the entire length of the front wall and approximately halfway along the side walls. Access to the room is obtained through a 1.0 m square hole in the back right hand corner of the roof. Presumably this hole would have had a cover when the structure was in use. Stencilled on the outside of the NW wall is the number "38." There is a large amount of modern trash, mostly soda cans, scattered around and inside the feature, as well as painted graffiti on the walls.

Feature B. Feature B is situated along the ridgetop which runs north from the summit of Puu Maelieli, approximately 65 m below Feature A. Feature B faces essentially east overlooking Kaneohe Bay. It consists of a two-room, two-level structure measuring 9.0 by 5.0 m (maximum). The interior of both rooms measure 3.75 by 3.75 m by 2.2 m high. The rooms are oriented east-west one behind the other, with the rear room raised approximately 1.2 m higher than the forward room. Inside each room, a single steel gun mount (guns have been removed) is situated centrally at the front of the room. Both rooms have narrow slit gun ports 32 cm in height, which run the entire length of the front wall and approximately halfway along the side walls. The window of the rear room overlooks the roof of the forward room. Access to each room is obtained through an approximately 1.0 m square hole in the back right-hand corner of the roof of each room. Presumably these holes would have had covers when the structure was in use. The rooms are not connected on the inside by any kind of doorway or opening. Stencilled on the outside NW walls of each room are the numbers "39" (lower room) and "40" (upper room). There is a large amount of modern trash, mostly soda cans, scattered around and inside the structure as well as painted graffiti on the walls.

This site obviously served for WWII military defense. The view of Kaneohe Bay and the surrounding area obtained from the summit of Puu Maelieli is excellent, and there is little wonder as to the reason this site is located where it is.

Site 4144 - Shrine/Possible Burial

Site 4144 consists of an upright stone placed upon a small earth mound (Figure 9). The site is located in the southeast corner of the project area, c. 15.0 m from Kamehameha Highway, c. 1.0 m from an old dirt road

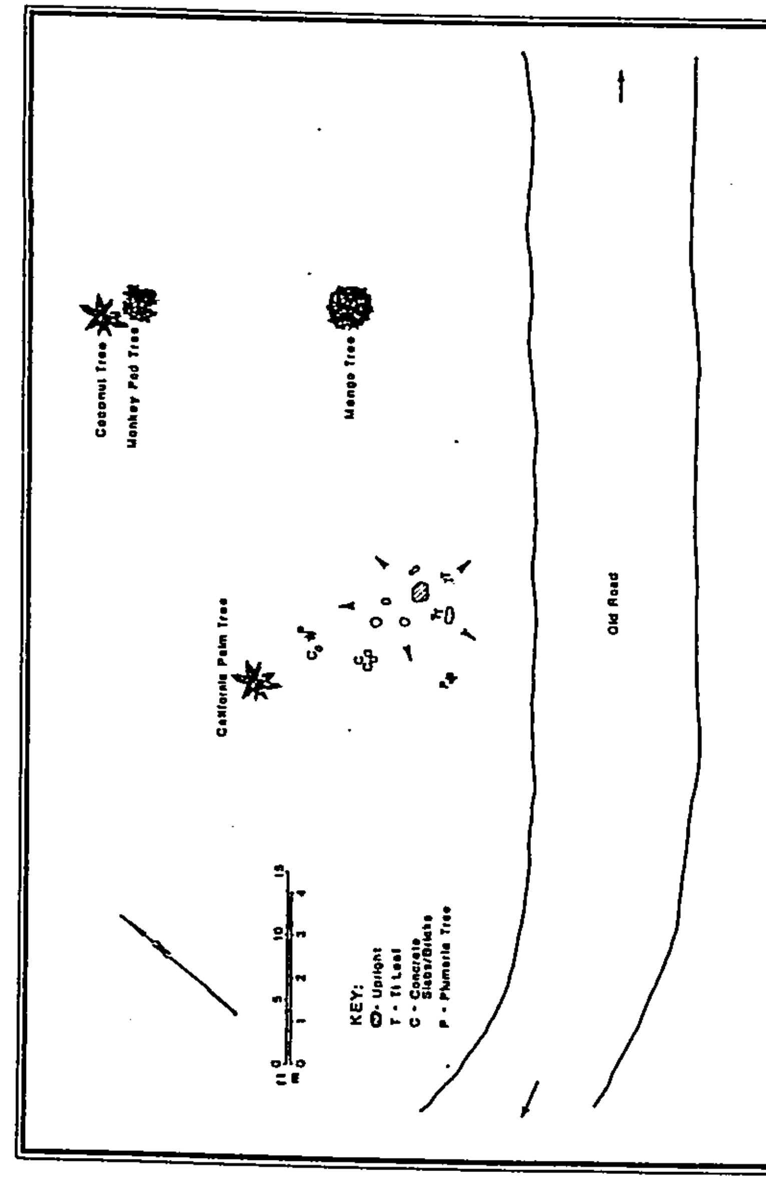


Figure 9. SITE 4144

entering the highway. It is located at an elevation of approximately 5-10 feet AMSL. The earth mound is oval and measures c. 4.0 by 3.0 m (maximum) by c. 0.4 m high. The stone upright stands in about the middle of the mound. The upright consists of a rounded oblong basalt boulder measuring c. 0.4 m in diameter at its base and c. 0.9 m high. A second stone, which could be considered a small upright, stands on the west end of the mound. It measures c. 0.2 m in diameter and c. 0.4 m high. A small ti plant is growing from the south side of the mound, and two small plumeria trees are growing within a meter of the mound.

Portable remains at the site consist of a number of modern articles, among them: plastic flowers, a small red decorated china pot containing artificial flowers made from beads, a potted aloe vera plant, a plastic toy dump-truck, and three round concrete bricks embedded with decorative rocks. Modern trash not associated with the site is present in the vicinity.

This site is a shrine or may be a burial. See Appendix: Historical Documentary Research for further discussion of this possibility.

ISOLATED FINDS (IF)

Three isolated prehistoric lithic artifacts were recovered during the survey. They were located in three widely separate areas in the upland portion of the project area (Figure 1). Table 4 provides a summary and description of the isolated artifacts.

IF-1 is a retouched/utilized flake of fine-grained, dark grey basalt. It was recovered from the surface of the north facing slope in the southern portion of the project area, c. 50.0 m upslope of Sites 4138 and 4139. Extensive historic pineapple cultivation was carried out throughout this region and the artifact was located among what were obviously remnant pineapple field furrows. As such, the artifact's provenience is obviously disturbed. It may have been dragged a great distance from its original location.

IF-2 is a fragment of an adze blank preform of fine-grained grey basalt. It was recovered from the surface in the bottom of an erosional gully located on a ridge top in the northern portion of the project area. A possible flake of the same material was recovered along with the adze preform. The provenience of this artifact, in terms of its original in situ position, is poor. The length of the gully from which it was recovered, however, is c. 25 to 30.0 m long and c. 5.0 m wide. It is possible then that an original deposit containing other cultural remains lies upslope from the artifact's recorded position within a 25 to 30 m range.

IF-3 is a small volcanic glass flake. It was recovered from the surface in an eroded area on a ridge in the central portion of the project area. The provenience of this artifact, in terms of its original in situ position, is poor. However, as in the case of IF-2, an original deposit from which this flake eroded may lie upslope from the artifact's recorded position, in this case within a 50-60.0 m range.

The primary significance of the isolated finds lies in the fact that they indicate prehistoric utilization of the Heeia Kea area. Their discovery suggests the possibility that undiscovered subsurface cultural deposits exist in the upland area. However, no confident predictions of the extent and density of such deposits can be made based on these finds.

BACKHOE TRENCHES

Excavation of exploratory trenches was accomplished using a mechanical backhoe. The objective was to inspect the coastal plain soil profiles for evidence of buried agricultural field deposits, or other cultural features and/or deposits. A total of 25 trenches was excavated along 10 transect corridors running along a bearing of 240 degrees magnetic, or perpendicular to Kamehameha Highway (Figure 1). This bearing was chosen to maximize coverage of the flat low elevation areas (5 to 15 feet above sea-level) of the low coastal plain. Transects were spaced 100 m apart with trenches excavated at 50 m intervals along the transects. In four of the ten transects only one trench was excavated, as inland of these trenches the terrain began to slope steadily. Two trenches were excavated along the tenth transect corridor, which was situated between the two longest of the original transects (A and D) in order to gain additional coverage of that area. Trenches averaged 4.0 m in length, 1.2 m in width, and ranged from 0.65 to 2.5 m in depth, depending upon the depth at which the water table or an impenetrable matrix and/or a buried beach/shoreline deposit was encountered.

Foote et al. (1972) indicates that soils in the project area consist primarily of Ewa silty clay loam (0-2% slopes) and Lahaina silty clay (7-15% slopes). This is generally true; soil in much of the project area is the dark reddish-brown that characterizes these soils. The backhoe trenches, however, as mentioned previously, were placed in the low coastal flats, which consist of different soils. The trenches were placed in these areas, as it was thought they were the most likely to have been utilized prehistorically for agriculture.

In general, soils in trenches consisted of brown and brownish-yellow clays, silty clays, and sands. The only red to reddish-brown soils were found in Trenches 3 (Layer 3), 4 (2), 5 (2), 6 (2), 7 (3), 8 (1), 9 (3,5) and 11 (2). These soils may have been present in the various sublayers as a result of disturbance; it is known that the area of the trenches were cultivated historically. Thirteen trenches (1-6, 8, 12, 13, 16, 20, 21, 23) contained gleyed or possibly gleyed soils. The gleyed layers are inconsistent across trenches, i.e., are in different layers; this may be due to disturbance.

The trenches with gleyed layers are located in the southeastern portion of the low coastal plain, where it has its maximum inland extent. Figure 10 shows a representative profile of the deposits encountered in this area (Trench A-6). Whether the gleyed soils in trenches are natural or man-induced (formed by way of agriculture) is open to question. Dicks indicates that "the difference between the two [soil types] is slight" (Dicks et al. 1987:76). Man-induced gleyed soils, however, usually have certain characteristics. Aside from having the typical coloration and consistence of gleyed soils, they usually exhibit mottles, charcoal, and subsurface structures. The trenches placed in the project area evidenced no definite indicators that gleyed soils were culturally produced. No charcoal or buried pond walls were observed in the trenches. Trenches without gleyed soils exhibited naturally weathered alluvial and colluvial soils. The following 15 different general soil types were found in the trenches:

1. Very dark brown-dark brown; 10YR 2/2, 3/3, and 4/3; clay, sand, and silt; friable to firm; slightly sticky and slightly plastic to plastic.

2. Dark yellowish-brown; 10YR 3/4, 3/6, 4/4, and 4/6; clay, sand, and silt; friable to firm; slightly sticky and slightly plastic to plastic.

3. Yellowish-brown and brownish-yellow; 10YR 6/4, 6/6, 6/8, 5/4, 5/6, 5/8; clay, sand, and silt; friable to firm; slightly sticky and slightly plastic to plastic.

4. Dark grayish-brown; 10YR 4/2; clay, sand, and silt; friable; slightly sticky and slightly plastic to plastic.

5. Very dark grayish-brown; 10YR 3/2; clay, silt, and sandy loam; very friable to friable; slightly sticky to sticky, slightly plastic to plastic.

6. Light brownish-gray; 10YR 6/2; clay, silt, sand, and coarse sand; very friable; slightly sticky to sticky, slightly plastic to plastic.

7. Very dark gray; 10YR 3/1; sandy loam; loose; non-sticky and non-plastic.

8. Black; 10YR 2/1; sand and silt; loose; non-sticky and non-plastic.

9. Light gray; 10YR 7/1, 7/2; clayey coarse sand; very friable; slightly sticky, slightly plastic.

10. Very pale brown; 10YR 7/3, 7/4, 8/3, 8/4; sand, clay, and silt; very friable; slightly sticky and slightly plastic.

11. White; 10YR 8/1; sandy clay loam; very friable; slightly sticky and slightly plastic.

12. Red; 2.5YR; 4/6, 4/8, 5/6, 5/8; clay; firm; sticky and plastic.

13. Dark red; 10R 3/6; clay; firm; sticky and plastic.

14. Dark reddish-brown; 5YR; 3/2; clay and silt; friable to firm; slightly sticky to sticky, slightly plastic to plastic.

15. Gray to dark gray and grayish-brown to very dark grayish-brown; 10YR 5/1, 4/1, 4/2, 3/1, 3/2; very fine to coarse sandy clay; friable to firm, sticky, plastic. Mottled with dark greenish-gray; 5 GY 4/1, 5/1; very fine sandy clay; friable to firm; sticky, plastic.

The trenches displayed the following sequences of soil types (based on #1-15 above; consecutively, beginning with the surface layer:

Trench	
A-1	3 (0-25 cmbs), 7 (25-50), 5 (50-80), 15 (80-140)
A-2	1 (0-35), 9 (35-50), 10 and 15 (50-75)
A-3	1 (0-5), 3 (5-10), 12 (10-20), 4 (20-60), 15 (60-65)
A-4	1 (0-10), 12 (10-40), 15 (40-150)
A-5	1 (0-10), 12 (10-20), 4 (20-52), 15 (52-82), 15 (82-150)
A-6	2 (0-35), 12 (35-55), 6 (55-68), 15 (68-160)
A-7	4 (0-30), 6 (30-60), 12 (60-80), 3 (80-85), 3 (85-109)
B-8	12 (0-40), 6 (40-48), 4 (48-80), 15 (80-100), 15 (100-110)
B-9	1 (0-10), 3 (10-20), 13 (20-40), 1 (40-55), 12 (55-80), 2 (80-110), 10 (110-140)
B-10	Historic trash and dozer disturbed

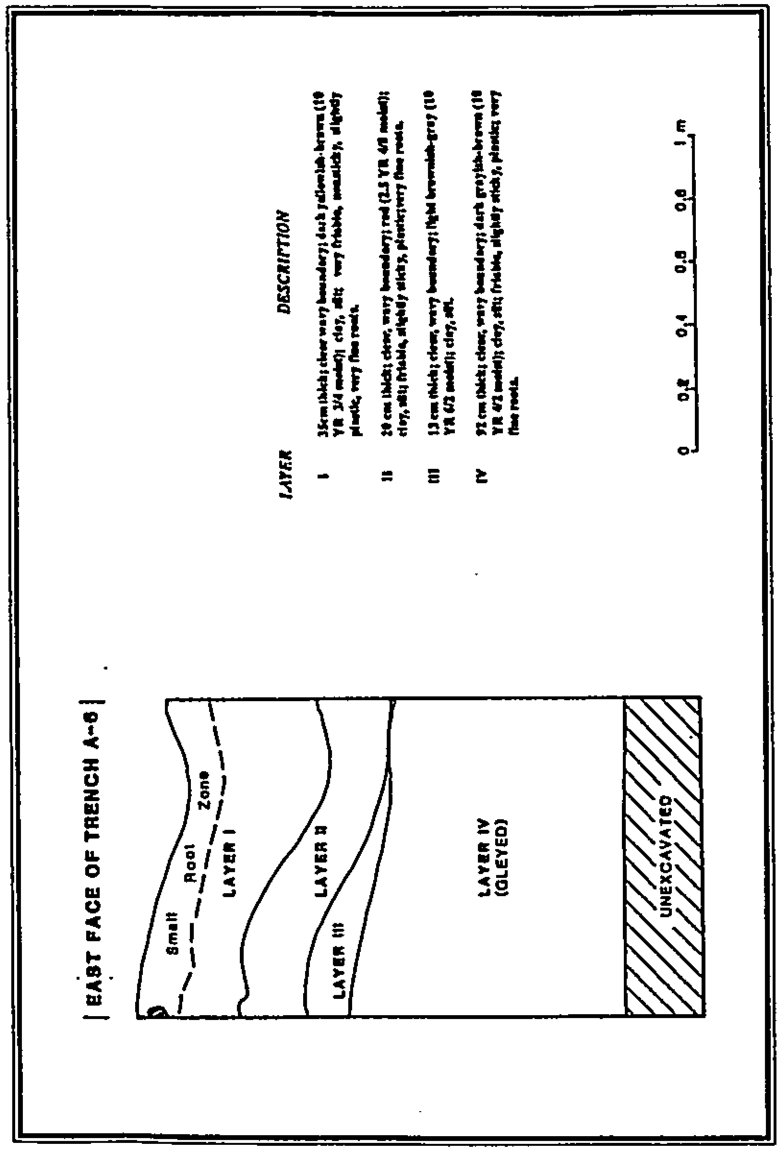


Figure 10. REPRESENTATIVE PROFILE OF NATURAL GLEYED SOILS

Trench (cont.)

C-11	Layer 1 is trash (0-19); 14 (19-100), 2 (100-190), 3 (190-240)
D-12	1 (0-15), 2 (15-39), 15 (39-70), 15 (70-103), 15(103-120)
D-13	2 (0-35), 10 (35-100) (has gleyed lens [42-48])
D-14	3 (0-10), 10 (10-25), 1 (25-65), 10 (65-115)
D-15	10 (0-2), 2 (2-43), 2 (43-70), 11 (70-100)
E-16	5 (0-22), 15 (22-50), 10 (50-70), 10 (70-90), 2 (90-130)
E-17	1 (0-5), 10 (5-28), 1 (28-32), 1 (32-70), 5 (70-80), 10 (80-156)
F-18	1 (0-15), 1 (15-45), 10 (45-55), 1 (55-65)
F-19	1 (0-148), 1 (148-150), 2 (150-210)
G-20	1 (0-20), 2 (20-50), 8 (50-65), 6 (65-75), 9 (75-85), 10 (85-130), 15 (130-150)
H-21	3 (0-30), 1 (30-45), 15 (45-60), 10 (60-100)
I-22	1 (0-30), 10 (30-50), 10 (50-95)
23	2 (0-20), 1 (20-50), 15 (50-190)
24	1 (0-30), 2 (30-70), 2 (70-130), 5 (130-210)
25	1 (0-20), 2 (20-42), 2 (42-80), 6 (80-100), 10 (100-140)

Generally, the layers did not fall into readily discernible patterns. Again, this may be due to the considerable disturbance that has taken place in the area of the trenches.

Overall, evidence suggests that the gleyed soils are probably naturally deposited and formed. Emergence of the reef and shoreline would have created a low coastal flat, probably initially tidal, upon which water would have ponded naturally. Perhaps a coastal marsh/swamp formed as sediments grew deeper. Later, alluvium and colluvium washing down from the upland regions covered the area. A general developmental scenario such as this could account for the observed soil profiles of the backhoe trenches. Another possibility is that isolated prehistoric wetland agricultural ponds were indeed present in the area, but the limited number of trenches placed did not come across definite evidence of them.

CONCLUSION

DISCUSSION

During the combined 100% surface and limited subsurface inventory survey of the proposed Maluiani Sports Complex project area, ten sites were identified and recorded, 25 backhoe trenches were excavated, subsurface deposits within backhoe trenches were examined and recorded, and three isolated prehistoric artifacts were recovered. The ten sites consist of 48 component features. These features are tentatively interpreted (on the basis of the current level of investigation) to represent ten different feature types, five primary functional types, and three broad time components. Table 5 summarizes the findings by segregating prehistoric, historic, and modern components, and by displaying the distribution of the various functional feature types in terms of their frequency of occurrence within the project area.

This table is based on tentative interpretations made on the basis of the archaeological work conducted to date. The modern cultural component included in the table consists only of modern features from Site 4142. These features were recorded solely because they represent an integral aspect of that site, and a thorough level of recording could not be conducted without including them.

As can be seen in Table 5, historic agricultural features are the most common features in the project area. This may, in fact, be more true than the table indicates. Many of the sites, including 4135, 4137, 4139, 4140, 4141, and Feature 11 of 4142, have been tentatively interpreted as prehistoric. These interpretations were based on a number of attributes of the constituent features—particularly formal type. The features all exhibit construction techniques and the general

Table 5.

DISTRIBUTION OF FEATURE FUNCTIONAL TYPES

	NUMBER	PERCENT
Single-Component Sites	9	90
Dual or Multi-Component Sites	1	10
Total # of Sites:	10	100
Distribution of Component Features		
Prehistoric Components		
Terraces (Ag.)	1	11
Terraces (Hab.)	3	34
Mound (Burial)	3	33
Lithic Scatter	1	11
Activity Area	1	11
Sub-total Prehistoric:	9	100
Historic Components		
Military Defense	3	11
Agriculture	21	78
Road Retainment	2	7
Upright(Religion)	1	4
Sub-total Historic:	27	100
Modern Components		
Agriculture	10	90
Habitation	2	10
Sub-total Modern:	12	100

* This table is based on tentative interpretations made on the basis of the archaeological work conducted to date.

aspects of prehistoric features, such as cobble and boulder construction and vertical facing of wall fronts. Therefore, these features are assumed to be prehistoric in age until proven otherwise. If the sites are historic, however, they are most likely related to the historic pineapple cultivation carried out in the project area in the early part of this century. Addressing this uncertainty as to the age and function of these sites will constitute an important aspect of any further work carried out on them, as will the collection of data to be analyzed in terms of basic archaeological research issues.

The only unquestionably prehistoric remains located in the project area are: Site 4142, Feature 33, a lithic artifact scatter; the two flakes recovered from the vicinity of Site 4142, Feature 36, which may or may not be related to the feature; the adze preform recovered from the vicinity of Site 4142, Feature 23, which may or may not be related to the feature; and the three isolated lithic artifact finds. These prehistoric remains require additional investigation in order to determine the extent and density of the prehistoric deposits they represent, which, in turn, will allow better significance evaluations of them to be made, and will provide archaeological data for analysis in terms of basic archaeological research issues.

Site 4144 may be a shrine that has been used over a long period of time. Its formal type is prehistoric, but given the presence of modern portable remains placed by it as offerings, it has clearly been used in modern times and may have been erected in modern/late historic times. In order to determine whether or not this is the case, further informant research needs to be conducted in order to locate the people or family who have recently used the shrine and question them on its origins and how they currently feel about the shrine. Site 4144 may also be a burial. The site has the potential for interpretive development in terms of incorporating it into landscape plans and/or relocating it to some suitable location within the project area or elsewhere.

The historic features tallied in Table 5 are believed to relate to three basic activities/time periods, as follows:

1. **WWII Coastal Defenses** - Site 4143, the gun emplacement bunkers on the summit of Puu Maelieli were probably constructed during or just prior to WWII. The numbers stenciled on their outside walls could be military identification numbers of some kind. These numbers could be used to help document the exact period of construction and abandonment, and perhaps document who was stationed at them and when. Site 4136, which appears to be a temporary gun position, may have been constructed during WWII as well. It is also possible that it was constructed for military use at a later date. Although the physical remains do not warrant further data recovery and no further work has been recommended for the site, further historical documentary research could provide information interesting in terms of local history.

2. **Early 20th Century Pineapple Cultivation** - As mentioned before, many of the recorded sites may be related to early 20th century pineapple cultivation. Site 4138 is clearly a road retaining wall. However, it is unknown from what time period the road dates and for what activities it was used. It may be an old pineapple field road. If so, other sites, including 4137, 4139, and 4140, which are possibly directly associated with the road may simply be retaining walls or loading ramps of some kind. As stated before, addressing this uncertainty as to the age and function of these sites will constiture an important aspect of further work carried out on them.

3. **Unknown Agricultural Practices** - This activity relates solely to the majority of the features of Site 4142. The extensive fields of depressions are clearly historic, being arranged in a grid pattern, but it is not known what was cultivated in them. Sweet potato is a likely possibility given the shape and size of the depressions, and the very rocky soil in which they are located. The other historic agricultural features of the site seem to be related to the overall field layout, and they appear to have served such functions as irrigation, field boundary delineation, and slope reduction. The extent of the fields—covering 5.7 acres with a minimum of 1,000 depressions—suggests the possibility that it was a commercial operation. Although the physical remains do not warrant further data recovery, further historical documentary research could provide information interesting in terms of local history.

Lastly, the modern features recorded during the survey are all located within Site 4142 as well. While normally modern features and remains are not recorded in detail during archaeological surveys, it was deemed appropriate in the case of Site 4142 because the modern features, representing some kind of semipermanent habitation and a small garden, have encroached and altered the earlier features in one area of the site to such an extent as to become an integral part of the site's overall aspect. To have omitted recording them would have left a void in the site area. An unidentified local person of the Hoeia Kea region (an older Japanese man who said he lived in the first house north of the project area) mentioned that a Filipino family lived in the area of Site 4142 10 years ago. This family is probably responsible for the modern features extant today. Although the physical remains do not warrant further data recovery, further historical documentary research and local informant research could provide information interesting in terms of local history.

EVALUATIONS*

Significance categories used in the evaluation process for the present project area sites and isolated finds follow definitions derived from the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). The Hawaii State Historic Preservation Office also employs these criteria for evaluating cultural resources. Sites determined here to be potentially significant for information content (Category A in Table 6) are assessed under Criterion D, which defines significant resources as those which "have yielded, or may be likely to yield, information important in prehistory or history" (36 CFR Sec. 60.4). Sites determined to be potentially significant as excellent examples of site types (Category B) are assessed 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" (36 CFR Sec. 60.4).

Sites determined to be (potentially) culturally significant (Category C) are assessed under guidelines prepared by the Advisory Council on Historic Preservation, entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (Draft Report, August 1985). Cultural value is defined in the guidelines 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" (1985:1). The guidelines specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural values" (1985:7). Both religious and non-religious cultural values are specified, and examples include burial sites, loci of traditional economic activities, and loci that are symbolic of a group's identity or history (1985:11).

To further facilitate client management decisions regarding the subsequent treatment of resources, the general significance of all identified archaeological remains was also evaluated in terms of potential scientific research, interpretive, and/or cultural values. Scientific research value refers to the potential of archaeological resources to produce information useful in the understanding of cultural history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value, within the framework for significance evaluation used here, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

In evaluating information content (Category A - Scientific research value), all of the sites located within the project area were examined in light of several major research issues identified during background research. These issues revolved around general questions of chronology, settlement and exploitative patterns, site and assemblage variability, material culture and technology, diet and economy, and socio-religious patterns.

Chronology - Determining the period of use for sites within the project area is contingent upon recovery and assay of datable materials, such as volcanic glass and charcoal. No good datable material was recovered from the sites in the project area. IF-3, a volcanic glass flake, is potentially datable. However its poor provenience and lack of meaningful context in terms of undisturbed in situ deposits would render any date obtained from the flake meaningless. Obtaining usable dating samples will be an important aspect of any further work on the sites within the project area.

Age estimates need not solely be determined through analytical assay of physical samples. Artifacts and artifact assemblages can also provide general chronological estimates of a site's age. By comparing artifacts recovered from undated or undatable sites with artifacts from other dated sites, one can make rough estimates of an undated site's age. If artifacts recovered from a site are of the same type as artifacts recovered from a site of known age, then the sites are probably close to, or are of the same age. The simplest example of this would be historic versus prehistoric artifacts. This age indicator (historic verses prehistoric artifacts) could easily resolve the present uncertainty surrounding even general age estimates of some of the sites of the project area. However, at the present level of investigation (inventory-level survey) such uncertainty cannot be resolved.

* Evaluations and recommendations for Sites 4137, 4139, and 4142 have been revised due to subsequent mitigation work at the sites. See Addendum to this report.

Table 6.

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Site Number	Significance Category A	X	B	C	Recommended Treatment FDC	NFW	PID	PAI
4135	+	-	-	-	+	-	-	-
4137*	+	-	-	-	+	-	-	-
4139*	+	-	-	-	+	-	-	-
4140	+	-	-	-	+	-	-	-
4141	+	-	-	-	+	-	-	-
4142*	+	-	-	-	+	-	-	-
IF-2	+	-	-	-	+	-	-	-
IF-3	+	-	-	-	+	-	-	-
Subtotal:	8	0	0	0	8	0	0	0
4144	+	-	-	+	+	-	-	+
Subtotal:	1	0	0	1	1	0	0	1
4136	-	+	-	-	-	+	-	-
4138	-	+	-	-	-	+	-	-
4143	-	+	-	-	-	+	-	-
IF-1	-	+	-	-	-	+	-	-
Subtotal:	0	4	0	0	0	4	0	0
Total:	9	4	0	1	9	4	0	1

General Significance Categories:

A = Important for information content, further data collection necessary (CRM value mode = research value);
X = Important for information content, no further data collection necessary (CRM value mode = research value, DLNR-HSS = not significant
B = Excellent example of site type at local, region, island, state, or National level (CRM value mode = interpretive value; and
C = Culturally significant (CRM value mode = cultural value).

Recommended General Treatments:

FDC = Further data collection necessary (intensive survey and testing, and possibly subsequent data recovery/mitigation excavations);
NFW = No further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential;
PID = Preservation with some level of interpretive development recommended (including appropriate related data recovery work); and
PAI = Preservation "as is," with minimal further work (and possible inclusion into landscaping), or appropriate data recovery/historic.

* Significance assessments and recommended treatments for this site have been revised due to subsequent mitigation work at the site. See Addendum to this report.

Settlement and Exploitative Patterns, Site and Assemblage Variability, Material Culture and Technology, and Diet and Economy — Inherent to the present level of archaeological investigation (inventory-level survey) is the fact that the degree of stratification, the extent, and the variability of cultural deposits and cultural remains contained within identified archaeological sites cannot be fully determined. Such information is necessary in order to thoroughly evaluate a site's significance in terms of scientific research value. Comprehensive evaluation of areal settlement and exploitative patterns, site and assemblage variability, material culture and technology, and diet and economy of past cultural groups requires intact deposits of artifacts and associated midden and features. Many of the sites located in the Malulani Sports Complex possess the potential for such intact cultural remains, and thereby may possess the data that would allow the formulation of statements and further questions regarding the nature of historic and prehistoric cultures and their use of the Heeia Kea area.

Socio-Religious Patterns — The possible shrines, burials, and the one historic shrine/possible burial (4144) in the Malulani Sports Complex project area possess the potential for the formulation of statements and further questions regarding the nature of historic and prehistoric religious practices in the region. These sites may contain sufficient information to provide a general picture of historic and prehistoric socio-religious patterns which could potentially be used in local or regional comparisons.

In evaluating interpretive value (Category B), sites located within the project area were examined in light of their possessing qualities which would potentially make them valuable for educational or interpretive purposes. Attributes which would provide a representative example of particular kinds of behavior, activities or conditions were examined. Only one site, Site 4144, possesses attributes which render it worthy of consideration for preservation.

Sites with cultural significance (Category C - cultural value) would include those with traditional uses and those with significant meaning in the context of a traditional way of life. The possible burials and the shrine/possible burial (4144) represent sites which potentially possess such value.

Table 6 summarizes the general significance assessments and the recommended general treatments for sites and features located during the present project.

RECOMMENDATIONS

Based on the findings of significance and potential significance and cultural value as outlined above, the following recommendations are proposed in the event development of the project area occurs (see also Table 6). Of the total ten sites, nine are assessed as significant solely for information content. For three of the nine sites, no further work is recommended. For the remaining six sites, further data collection is recommended. The remaining one site is assessed as significant for information content and cultural value. For this site, further data collection in the form of informant research followed by preservation "as is" is recommended. In addition to the site and feature recommendations, it is further recommended that the areas of two of the three identified isolated artifacts undergo further investigation. The remaining isolated find is assessed as significant for information content, but requires no further work.

The general scope of recommended further work would be a data collection level of investigation as follows:

1. Further work on Sites 4135, 4137, 4139, 4140, 4141, and 4142, Features 11, 23, 33, 35, and 36 would involve limited testing and detailed mapping. An emphasis would be placed on acquiring datable samples and/or diagnostic artifacts in addition to general data collection. In the case of the Site 4142 features, informant research could prove fruitful.

2. Because informant testimony indicates Site 4144 may be a burial, further work at the site would involve detailed mapping and subsurface testing, and the development of an appropriate mitigation plan for the shrine/burial in terms of preservation "as is" and/or relocation.

3. Further work on Isolated Finds 2 and 3 would involve a program of systematic shovel testing in the area surrounding that from which the artifacts were recovered, in an attempt at locating intact, buried cultural deposits from which the artifacts eroded. In the event that such deposits were discovered, limited testing and data collection would ensue.

It should be noted that the above evaluations and recommendations are based on the findings of an inventory-level surface survey and limited subsurface testing. There is always the possibility, however remote, that potentially significant unidentified cultural remains might be encountered in the course of future development activities. In such a situation 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)

CFR (Code of Federal Regulations)

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

Dicks, A.M., A.E. Haun, and P.H. Rosendahl

1987 Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates - Golf Course and Parks, Land of Honouliuli, Ewa District, Island of Oahu. PHRI Report 322-102887. Prepared for City and County of Honolulu.

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. of Agriculture - Soil Conservation Service and Univ. of Hawaii Agri. Experiment Station. Washington, D.C.: U.S. Government Printing Office.

Kennedy, J.

1982 An Archaeological Reconnaissance at Heeia Kea. Archaeological Consultants of Hawaii. Prepared for Cowell & Co. Inc.

Nagata, K.M.

1989 Malulani Biological Survey. Manuscript prepared for Helber, Hastert & Kimura. Dated 28 May 1989.

Shapiro, W.A., J.D. Mayberry, and A.E. Haun

1988 Archaeological Reconnaissance Survey and Limited Subsurface Testing, Waikane Golf Course Project Area, Land of Waikane, Koolaupoko District, Island of Oahu. PHRI Report 398-042188. Prepared for Mr. Norman Quon, c/o Group 70.

Tomonari-Tuggle, M.

1983 Archaeological Resources in Waiahole Valley: An Archaeological Reconnaissance Survey for Waiahole Valley Agricultural Park, Koolaupoko, Oahu. Prepared for M&E Pacific, Inc. (Honolulu).

Tomonari-Tuggle, M., and H.D. Tuggle

1984 Flakes and Fields: Archaeology in Waiahole Valley. Prepared for M&E Pacific, Inc. (Honolulu).

APPENDIX

HISTORICAL DOCUMENTARY RESEARCH
HEEIA KEA GOLF COURSE PROJECT AREA

by Helen Wong Smith, B.A.

A search through available historical documents yielded relatively little information on Heeia ahupua'a. A few references were found concerning the origin of the name "Heeia." One is in Pilahi Paki's Legends of Hawaii: Oahu's Yesterday (1972), from which the following is quoted:

> The figurative interpretation of the name He'eia is the Envious Challenge. The He'eia coastline...is famous for He'e, or Octopus, which swarm in these waters at a certain time each year. When the Wiliwili tree crimsons with its claw-like blossoms, fishermen know the He'e are running. Once there were two brothers, both chiefs...champions in the art of He'e-nalu, or Wave surfing, and both were handsome figures. However, the older brother was shorter, and for this reason envied his younger relative...Finally, the envious brother challenged the younger favorite to a contest in surfing. As usual, the wager was large and included full title to all the family possessions and the loser's very life. Surfing at that particular time was very dangerous. Often the monster octopus of the deep ocean depths swarmed with their smaller cousins. But the challenge made had to be accepted...[h]ad the younger man refused to accept the duel, the people would have judged him to be cowardly. A chief's Mana or Power, should protect him even from any huge, man-devouring He'e of the depths. The Kana-wai, or Law, teaches that mortals should be content with their lot in life and make the best of it and feel truly thankful. Therefore, when the older brother broke this law he had to receive just punishment from the Akua, or Deity. In punishment, the older brother was caught in the rip tide and taken down among the He'e-nui, the huge devils of the deep sea. Today, at the swarming time of the He'e, each year, during the season of Fall-into-Winter, you should listen carefully. You can hear, on the stillness of the night, the muffled voice of the older brother calling to his younger brother, his tones lamenting, "He e i a! He...e...i...a!" in the late October to December and January when the surf rides high upon the shores of He'eia.

Another explanation is that Heeia ahupua'a was named after Heeia, the handsome foster son of the goddess Haumea and the grandson of the demigod, Olopana, who was an uncle of Kamapua'a (Pukui 1928; Pukui et al. 1974:44). Heeia, Haumea's son, was named in commemoration of a tsunami-type wave that washed Haumea and others into the sea; they swam until they were exhausted and were finally washed ashore at Kapapa Island in Kaneohe Bay (Pukui 1928). It was the handsome Heeia who fell in love with Kaohelo, a younger sister of Pele and Hiiaka, whom he met in Koolau, Oahu (Beckwith 1940:188).

The present research indicated there are a few minor legendary/mythological references to Heeia. These can be found in Sterling and Summers (1976:197-204).

A search through archaeological records yielded a few interesting items regarding Heeia. The records indicate that the ahupua'a at one time boasted no fewer than six heiau, five of which were destroyed by commercial sugar and pineapple cultivation (McAllister 1933:173-177). One heiau still exists—Leleahina Heiau, believed to be outside the present project area. There were once two unusual sites connected with Heeia. One was a famous off-shore reef called Koamano (McAllister 1933:173). It is said that this reef had many caves where numerous sharks lived. Their keeper, Makanui, used to feed them the bodies of deceased people. When this was discovered people took revenge on Makanui and fed him to his own sharks (ibid). The other unusual site was Luamo'o, a land that was the home of Meheanu, the mo'o guardian spirit of Heeia Fishpond (ibid.: 173). Other important archaeological sites in Heeia include springs and agricultural terraces.

There are a few references to Heeia in the Land Files at the State Archives. One concerns Heeia Pier, TMK 4-6-06-63. The entry is dated 8/19/46 and reads:

> **United States vs Kahaloa Land Trust** (LCA 10613:1). For construction & operation of a Marine Fueling Station. Site situated on the fishing wharf constructed by and under the control and management of the Board of Harbor Commission and located on Kaneohe Bay at Heeia Kea. For the term by Jan. 1, 1951 and ending Dec. 21, 1955. 1 acre.

The following are other minor Land File references:

> Privy Council vol. 2p.573
> re. application of Paki and L. Koknia for a preference to purchase the Govt. share of heeia. Res. Re. granting the said appli.
>
> Int. Dept. Jan. 24, 1854
> In notice by A. Paki. that he is the owner of heeia and that Hee is the tabu fish.
>
> Int. Dept. Jan. 14, 1852
> same as above but in letter to MMin of Int.
>
> Bishop Estate Ed (revised) 1927 p.31
> Charles R. Bishop to Trustee est. B.P. Bishop Deed No. 1 Quit Claim Deed to all tracts & parcels of land.
>
> 10. - The above ahupuaa, Koolaupoko, described in R.P. 1664, &c.
>
> Int. Dept. Bk. 15 pg. 107
> In table of Konohiki lands, showing that the above land was awarded under Land Claim No. 10613 & that it has a sea coast frontage along the reef of 1.93 miles.

The Archives also provided testimonies for seven Land Commission Awards (LCA) awarded within Heeia. Of the seven awards, LCA 10713B to Haaloa for 1.21 acres, is the most likely to be within the project area. Its translation is presented here:

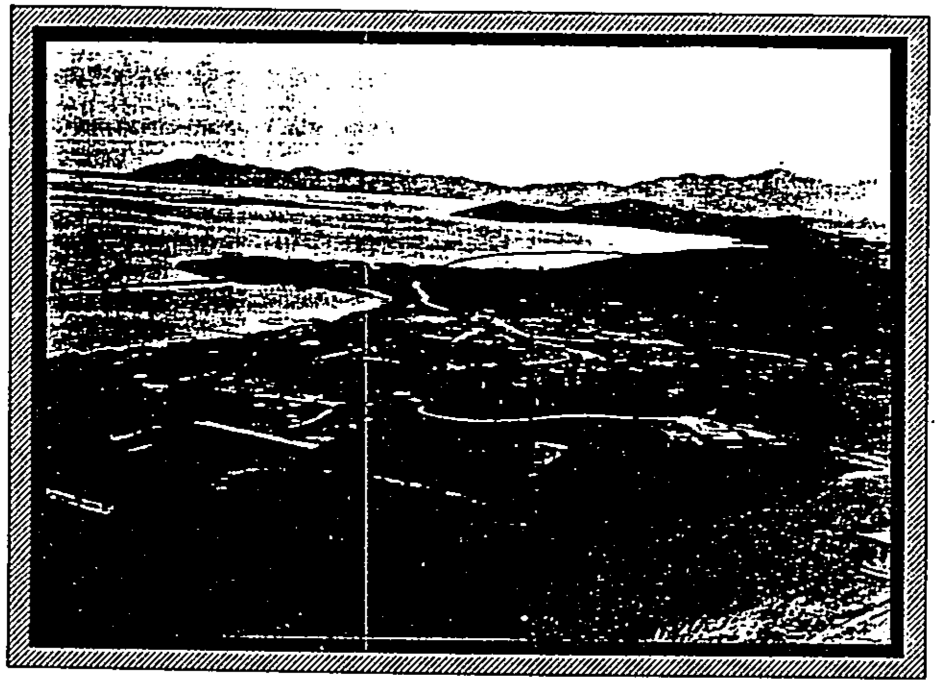
> Kamaka sworn says, I know claimants land. It is in Heeia and consists of 4 taro patches and a house lot a little upland with trees. Parcel 1 has four taro patches. Parcel 2 is the house lot. Parcel 1 is bounded by a creek, taro land of Kama and Kahaonui, upland, taro land of Hanui. Parcel 2 is bounded on all sides by the upland of Heeia. Claimant had the land from Uhuuhu in the time of Liliha and has had it in peace up to this time. Uhuuhu sworn says the above is true. (Foreign Testimony 14:386)

Other testimonies for Heeia cite taro patches as the prevailing crop in the area. Several LCAs include fish ponds as part of their claim. LCA 2608 includes in its boundary description a creek. This, plus the cultivation of taro in the area (the term lo'i, which usually refers to wetland taro, is used throughout the testimonies) indicates that at one time Heeia might have had ground and/or surface water, although it lacks such today (Gray, Hong & Associates 1983:29).

A cursory check for maps at the State Survey Office yielded Registered Map #1140 by Jackson dated 1882. This map indicates that Heeia during this period was mostly marshland. A fenceline is depicted on the map. T.G. Thrum copied Jackson's map in 1892 (Reg. Map #1848); on Thrum's map there are on features which would aid the present archaeological study. A 1913 map by Alexander & Baldwin shows the fenceline depicted in the 1882 map and reveals that a great deal of land at Heeia Kea was planted in pineapples. A 1916 map shows that the pineapple operation had expanded somewhat and occupied a majority of the land. No residential sites appear on the 1913 map and only one appears on the 1916 map. Judging by the maps, it is evident that pineapple cultivation in the project area was widespread and that if archaeological features or deposits existed in the areas in which pineapple fields were established, they would have been destroyed or at least damaged during land clearing and plowing.

The pineapple cultivation lasted through the 1930s. Evidence for the cultivation in the project area includes furrows which cover the entire upland slope on the south side of the project area. These furrows are spaced c. 2 to 3.0 meters apart and run straight downslope. The upland slopes in the central western portion of the project area also exhibit these furrows. In some areas, the vegetation, particularly koa-haole, has grown in lines paralleling the furrows. Other features in the project area possibly related to pineapple cultivation include a number of old road beds and ditches, and possibly a number of rock retaining walls/terraces/platforms.

Following the pineapple operations the area was converted to pasture land (Kennedy 1982). Then came WWII. During the early 1940s, $274,000 was spent to establish Camp Heeia for the 98th Regimental Combat Team which was sent to Japan. Work on this facility commenced October 1, 1943 and was completed three months later on the first day of 1944. Overgrown roads and concrete foundations present in the project area today are believed to be remnants of this camp. A cemented rock culvert on one of the roads that go through the central portion of the area up to the ridgetops has the date "1946" inscribed into the mortar on its top surface. Military defense bunkers located on the summit of Puu Maelieli as well as the discovery of unexploded ordnance in the central portion of the parcel are other probable remnants of the camp. A National Archives photo taken in 1945, included within this report (Figure A-1), shows the extent of the military operations in the area. These operations, combined with the former pineapple cultivation must have severely modified the land within the project area.



Courtesy of National Archives

Figure A-1. CAMP HEEIA, 1945.

After the war, small family-sized dwelling were located in the makai section of the project area near Kamehameha Highway. Mr. Chris Folger, a backhoe operator, mentioned that he plowed down the last remaining structures in this area in the fall of 1988 (pers comm.). Today, widely scattered over this area are large amounts of modern trash including household items, old lumber, overgrown small garden plots, and pieces of foundations and septic tanks. A number of roads—each with a mailbox— enter the area from Kamehameha Highway.

During the late 1960s groups of "hippies" resided in the mauka (inland) section of the project area (Kennedy 1982). In this area are various structural remains, bathtubs, washing machines and stoves, as well as various assorted other household articles and trash. Also present in the area is a very large bottle dump (c. 15 by 15 meters diameter by c. 1.5 meters deep) containing mostly stubby beer bottles and large bleach/chemical bottles.

Site 4144, an upright rock with associated plastic flowers situated near the southeast corner of the project area, may be a shrine or a burial. Mr. Vincent Shigekuni of Helber, Hastert, & Kimura, Planners, had said he had heard from Mr. Herb Lee—who had interviewed Kumu Hula Kawaikapu Frank Hewett—that the Hewitt family, some of which had resided in the general vicinity of the project area, had shrines in the area. On November 16, the author visited Site 4144 with Mr. Hewett. Mr. Hewett recalled that the area was once called Ma'eli eli (macron over the "a"), which means to overwhelm, apparently in reference to the overwhelming mana in the area—mana being attested to by the number of shrines which Hewett said were once in the area. Mr. Hewett said the ali'i, Kahahana and Kahekili spent part of their reigns in the Heeia area, and that due to their residences, there probably would have been religious structures in the area. Hewett said that in 1974-75 he located the scattered remains of a heiau on the ridge to the north of the project area. The remains were covered with dense vegetation. Hewitt does not think what is left of the heiau warrants preservation, saying this and other religious structures in the area would likely be in great disrepair or to have been obliterated during the course of land modifications by the army and former tenants of the area.

Hewett's grandmother's grandmother, Wahineali'i, who was a Kaula (macron over the a), or prophetess, resided in Ma'eli eli. Hewett has located some of the family shrines in the area of Heeia Kea State Park, across the street from the project area, and has relocated remains that were found. In regards to Site 4144, he said he had never seen or heard of it prior to our visit. He questioned several family members, and no one could recall the site. After praying at the site, Hewett felt intuitively that it is a burial, rather than a shrine. For this reason, it is recommended that the site be tested. If it is a burial, and the developer chooses to move the upright rock of the shrine and any remains, Hewett stressed that prior to moving the rock he would like to perform an appropriate ceremony.

REFERENCES CITED

Beckwith, M.

1940 Hawaiian Mythology. Folklore Foundation of Vassar College. New Haven: Yale University Press.

Gray, Hong & Associates

1983 Revised EIS for Heeia Kea Subdivision, Heeia, Koolaupoko, Oahu.

Kennedy, J.

1982 An Archaeological Reconnaissance at Heeia Kea. Archaeological Consultants of Hawaii. Prep for Cowell & Co. Inc.

McAllister, J.G.

1933 Archaeology of Oahu. B.P. Bishop Museum Bulletin 104. Honolulu.

Paki, P.

1972 Legends of Hawaii: Oahu's Yesterday.

Pukui, M.K.

1928 He Moolelo no Makalei, Ka Hoku o Hawaii, March 13, 1928. Copy of translation in Hawaiian Ethnological Notes, Oahu. B.P. Bishop Museum, Honolulu.

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

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

Sterling, E.P., and C.C. Summers

1976 Sites of Oahu. Departments of Anthropology and Education. B.P. Bishop Museum, Honolulu.

ADDENDUM

ADDITIONAL SUBSURFACE TESTING AND RADIOCARBON DATING OF RECOVERED SAMPLES

At the request of Nanatomi Hawaii, Inc., PHRI conducted additional subsurface testing for the archaeological inventory survey of the Mahulani Sports Complex. The testing was conducted October 24-26, 1989, and the purpose of the testing was to determine if burials were present or absent at Sites 4137, 4139, and 4142 (Feature 11). This determination would enable functional assessments for the features/sites to be made. The testing was conducted under the supervision of Supervisory Archaeologist Amy E. Dunn, assisted by four to five crew members. Providing overall direction for the project was Senior Archaeologist Dr. Alan E. Haun.

The test units involved excavating a total of 4.35 square meters. A 1.0 by 2.0 m unit was placed at Feature 11 of Site 4142, a one sq m unit was placed at Site 4139, and a 0.75 by 1.80 m unit was placed at Site 4137. Prior to excavating the units, a scaled map more detailed than the original was drawn of the three features which were to be excavated. All soil excavated was processed through 1/8-in mesh, and soil samples were taken of all designated stratums.

SITE 4137

A 1.80 by 0.75 m test unit (TU-1) was excavated at the single feature at Site 4137 (Figure 2, main text). The south wall of the test unit cross-sectioned the two depressions at the south end of the basalt cobble mound (see Figure 2, main text). A datum was set in the center of the south wall, at the surface of the mound between the two depressions. Stratum I (0-47 cmbd [centimeters below datum]) consisted of angular basalt cobbles, averaging 6-30 cm in diameter, stacked above the ground surface, and contained one fragment of coke bottle glass. Stratum II (47-97 cmbd) was excavated in two arbitrary levels. This stratum was designated as such when soil was encountered after removing the basalt cobbles stacked on the ground surface. Due to the steep slope on which the feature is constructed, soil was encountered specifically at 47 cmbd in the south portion of the unit, 65 cmbd in the middle of the unit, and 73 cmbd along the north wall of the unit. From 47-65 cmbd the soil consisted of: very dusty red (2.5YR 2.5/2 moist) clay with gravel; weak, fine, and crumb in structure; very hard when dry, friable when moist, nonsticky when wet, and of nonplastic consistence; many roots, and contained small fragments of Coke bottle glass and charcoal. From 65-97 cmbd the soil consisted of dark reddish-brown (5YR 3/4) clay; strong, fine, crumb structure; very hard when dry, firm when moist, sticky when wet, and of slightly plastic consistence; roots common, and contained no cultural material.

Due to the lack of any significant subsurface cultural deposit or human burial remains at Site 4137, the site is interpreted as either a shrine or an historic agricultural feature.

SITE 4139

A test unit (TU-1) measuring 1.0 m by 1.0 m was excavated in the single feature at Site 4139 (Figure 2, main text). The unit was placed on the highest point of the mound, approximately 0.5 m south of the faced portion, and a datum was set at the surface of the mound, at the center of the south wall of the test unit. Stratum I (0-66 cmbd) consisted of angular basalt cobbles, averaging 8 by 15 by 23 cm in diameter, stacked on the ground surface. Two waterworn basalt cobbles were present in the stratum; also, at c. 68-69 cmbd, a fragment of a kukui oil lamp was recovered (Figure 1, this addendum).

Stratum II (66-96 cmbd) was excavated in three arbitrary 10 cm levels and consisted of: dark reddish-brown (2.5YR 2.5/4 moist) clay; high density of basalt cobbles; strong, fine, crumb structure; very hard when dry, firm when moist, sticky when wet, of plastic consistence; roots common. Level 1 (66-76 cmbd) contained charcoal, possible lithic debitage, two small pieces of chill glass, and one piece of historic bottle glass. Level 2 (76-86 cmbd) contained two pieces of historic bottle glass, charcoal, and possible lithic debitage. Level 3 (86-96 cmbd) contained one piece of green bottle glass recovered at c. 93 cmbd. At approximately 90 cmbd the soil became devoid of angular basalt cobbles, and consisted of the dark reddish-brown clay.

The single feature comprising Site 4139 is constructed near and at the end of a small drainage which originates from the south and southeast. The excavation indicates that the ground surface at the time of original construction of the feature was much lower, and over time, the alluvial activity from the small drainage caused 24 cm of soil to wash in around the feature, raising the ground surface to the present level and giving the bases of the original construction the appearance of a subsurface deposit of angular basalt cobbles.

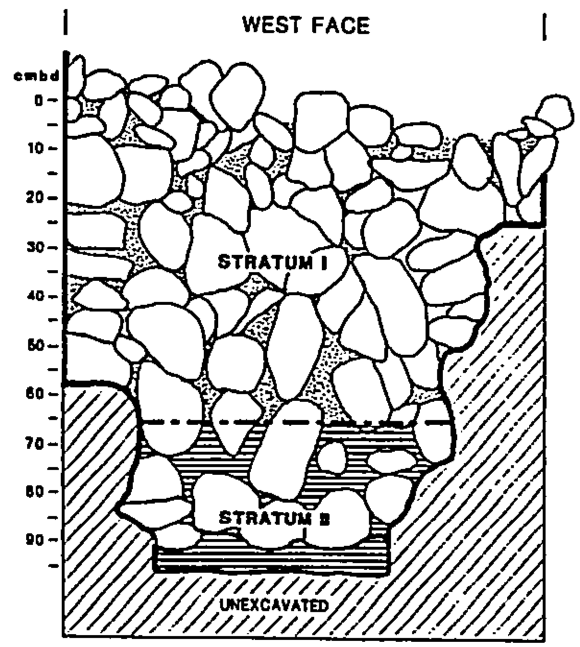


Figure 1. SITE 4139, TU-1

There was no evidence of a cultural deposit from the time of construction in the excavation. Based on the excavation, Site 4139 appears to have functioned as a marker, or as previously noted during the inventory survey, a loading ramp associated with the road.

SITE 4142

A 1.0 by 2.0 m test unit (TU-1) was excavated at Feature 11 of Site 4142 (Figure 6, main text). The unit was placed to cross-section the platform and the ground surface at the north boundary, and a datum was set on the surface of the platform at the northwest boundary. Stratum I (13-55 cmbd) consisted of angular basalt cobbles stacked above the present ground surface, and was present in the southwest half of the unit only. Due to the slope from the northwest this stratum measured 39 cm thick at the northwest end, and 13 cm thick at the southwest end. Other than basalt cobble, the stratum contained no cultural materials.

Stratum II (30-60 cmbd) was excavated in three arbitrary 10 cm levels. The stratum consisted of dark reddish-brown (5YR 2.5/1 moist) soil; silty clay with loam and gravel; moderate, fine to medium, and crumb in structure; very hard when wet, friable when moist, slightly sticky when wet, and slightly plastic in consistence; many roots. Due to the slope, the northeast corner measured 20 cm higher before excavation began; therefore, the first two levels of Stratum II did not encompass the entire unit floor. Many small (fist-sized) angular basalt cobbles existed throughout the unit in all levels. Level 1 (30-40 cmbd) contained possible lithic debitage, a small volcanic glass core, and charcoal. Level 2 (40-50 cmbd) contained a small piece of red ochre, charcoal, a deteriorated coral fragment, and possible lithic debitage. Level 3 (50-60 cmbd) contained a small amount of charcoal and possible lithic debitage.

The excavation unit contained no substantial cultural deposit. The charcoal in the unit appeared randomly and could be remnants of surface burning. The possible lithic debitage also was randomly scattered throughout the unit. The small angular pieces of basalt appeared to occur naturally; also, there was no difference in soil deposition between the platform and the surrounding area. Based on the lack of cultural deposition and absence of human burial remains, Feature 11 is interpreted to have an agricultural or indeterminate function.

RADIOCARBON DATING OF SAMPLES FROM TEST UNITS

Radiometric dating of carbon samples was conducted in conjunction with the above subsurface testing. Three samples (one from Site 4142 and two from Site 4139) were submitted to Beta Analytic, Inc. for dating analysis. One sample from Site 4139 was found to have insufficient carbon for analysis. The other two samples yielded calibrated date ranges spanning AD 900-1954. A complete summary of the radiocarbon samples and the dates they yielded is presented in Table 1.

The sample from Feature 11 at Site 4142 yielded three calibrated ranges spanning AD 1519-1954. It should be kept in mind that the sample consists of pieces of charcoal randomly scattered throughout the unit, and that the charcoal may represent remnants of surface burning. The sample from Site 4139 yielded a calibrated range of AD 900-1250. This indicates that the site is prehistoric. It should be noted, however, that the level from which the sample was taken also contained a piece of green bottle glass.

CONCLUSION

In the text to which this is an addendum, Sites 4137, 4139, and 4142 (Feature 11) are assessed as significant for information content and are recommended for further data collection (Table 6, page 35). The recommendations for the further work were made primarily due to the possible presence of burials at the sites/features. During the present work, however, no burials or any other significant cultural materials were encountered. Therefore, the mitigation work for Sites 4137, and 4139 is considered complete, and no further work is recommended. Further work is still recommended for Site 4142 because the site includes features (other than Feature 11) that require further mitigation.

Table 1.

SUMMARY OF RADIOCARBON AGE DETERMINATIONS

PHRI Lab.No. RC-	Lab. No. BETA-	Provenience	C-14 Age Yrs. B.P. (one sigma)	C-13/ C-12 Ratio	C-13 Adjusted C-14 Age Yrs. B.P.	*Calendric Range Yrs. AD
Site 4142						
639	34211	Fea. 11 TU-1, Layer II, Level 2	300±60	-30.3	210±60	1519-1588 1620-1890 1907-1954
Site 4139						
640	34212	TU-1, Layer IV, 30-40 cmbs	1000±80	-27.7	960±80	900-1250

*Calibrated according to Stuiver and Pearson (1989). Range at two sigmas.

PHRI
Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services
305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 • FAX (808) 961-4998
P.O. Box 12335 • Tamuning, Guam 96911 • (671) 649-3045 • FAX (671) 649-2611

Report 691-022890

February 28,1990

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

Subject: *Addendum to Archaeological Inventory Survey*
Malulani Sports Complex
Land of Heeia, Koolaupoko District, Island of Oahu
(TMK:4-6-06:1,2,4,7-16,22-51&4-6-16:32)

Dear Sirs:

At the request of Vincent Shigekuni of Helber, Hastert & Kimura, for their client, Nanatomi Hawaii, Inc., Paul H. Rosendahl Ph.D., Inc. (PHRI) recently conducted subsurface testing at Site 4144*, situated within the above subject project area (Figure 1, at end). The objective of the testing was to determine if the site contained a human burial. A burial had been suspected based on previous inventory-level survey work at the site, and historical documentary and informant research conducted in conjunction with the survey (Carlson and Haun 1989).

During the Carlson and Haun (1989) survey, Site 4144 was recorded in detail. The survey report includes the following description of the site:

> Site 4144 consists of an upright stone placed upon a small earth mound....The site is located...c. 15.0 m from Kamehameha Highway, [and] c. 1.0 m from an old dirt road entering the highway. It is located at an elevation of approximately 5-10 feet AMSL. The earth mound is oval and measures c. 4.0 by 3.0 m (maximum) by c. 0.4 m high. The stone upright stands in about the middle of the mound. The upright consists of a rounded oblong basalt boulder measuring c. 0.4 m in diameter at its base and c. 0.9 m high. A second stone, which could be considered a small upright, stands on the west end of the mound. It measures c. 0.2 m in diameter and c. 0.4 m high.... Portable remains at the site [include] plastic flowers, a small red decorated china pot containing artificial flowers made from beads, a potted aloe vera plant, a plastic toy dump-truck, and three round concrete bricks embedded with decorative rocks.

In the Recommendations section of the report, the site is assessed as significant for information content and cultural value, and it is recommended the site undergo further data collection (detailed mapping and subsurface testing) and be preserved "as is" (1989:35). This recommendation was based primarily on the structural form of the site, portable artifacts present at the site, and informant research. The form of the site and the portable artifacts suggested the site was a shrine. During the informant research, one person interviewed, Kumu Hula Frank Hewitt, mentioned there were once numerous shrines in the general area of the project area and that he intuitively felt there was a burial at Site 4144, although he had never seen or heard of Site 4144 prior to that time.

*State Inventory of Historic Places (SIHP) site designation system: four-digit site numbers prefixed by 50-80-10- (50=State of Hawaii, 80=Island of Oahu, 10=USGS 7.5 series quad map ["Kaneohe, Oahu"]).

On Feb. 15, 1990, Supervisory Archaeologist Amy E. Dunn, assisted by Field Archaeologist Jenny O'Cleary, conducted a test excavation at Site 4144. A 2.0 m by 0.5 m test unit (TU-1) was placed across the site, on the NNW side of and up against the upright stone at the site (Figure 2, at end). Stratum I of the excavation (0-31 cmbd [centimeters below datum]) consisted of dark red (10R 3/6 when moist), silty clay, with a weak, fine, crumb structure; soft when dry, friable when moist, sticky when wet, and of plastic consistence; with many rootlets. The stratum contained much historic trash (broken glass, rusty metal fragments, plastic, pieces of composition roofing, etc.). Also present in the stratum were a very small sample of charcoal and two marine shell fragments. Stratum II (31-48 cmbd) consisted of dark yellowish-brown (10YR 3/4 when moist) silty clay with a high density (50-70%) of small angular basalt cobbles and gravels; strong, fine to medium, crumb structure; slightly hard when wet, firm when moist, sticky when wet, and of plastic consistence; with many rootlets. Stratum II contained trash similar to that in Stratum I. TU-1 was terminated at c. 48 cmbd, when it became obvious the unit did not contain a burial. Photos were taken of the excavation, and a profile of the excavation was drawn.

The profile of TU-1 shows the upright stone placed within Stratum I (Figure 2), which contained much historic trash. Obviously, the stone was placed historically, and most likely, recently (within the last 30-40 years; certainly after the late 1940s, after the military left). The site may represent a family shrine; efforts to locate people who know of the shrine, however, have been unsuccessful. It appears the shrine has been abandoned. The portable artifacts associated with it show considerable wear, and vegetation around the shrine is overgrown.

As mentioned previously, Site 4144 had been assessed earlier as significant for information content and cultural value (Carlson and Haun 1989:35). Based on the present work, however, the site is reassessed here as not significant for information content and of minimal significance in terms of cultural value. The former assessment is made because the site is recent. The latter assessment is made because (a) the shrine was probably used by a single family, (b) other local residents are not aware of it, and (c) it is no longer in use and evidently has not been used since 1988 (the year in which houses in the vicinity were destroyed [Carlson and Haun 1989:Appendix A,p.4]). No further archaeological work is recommended for the site. If necessary, the site can be destroyed.

If you have any questions concerning this report, please feel free to contact me at our Hilo office (808) 969-1763.

Sincerely yours,

Alan E. Haun, Ph.D.
Senior Archaeologist

AD/LK:lk

Reference Cited

Carlson, A.K., and A.E. Haun

1989 Archaeological Inventory Survey, Malulani Sports Complex, Land of Heeia, Koolaupoko District, Island of Oahu (TMK:4-6-06:1,2,4, 7-16,22-51&4-6-16:32). PHRI Report 580-080189. Prepared for Nanatomi Hawaii, Inc.

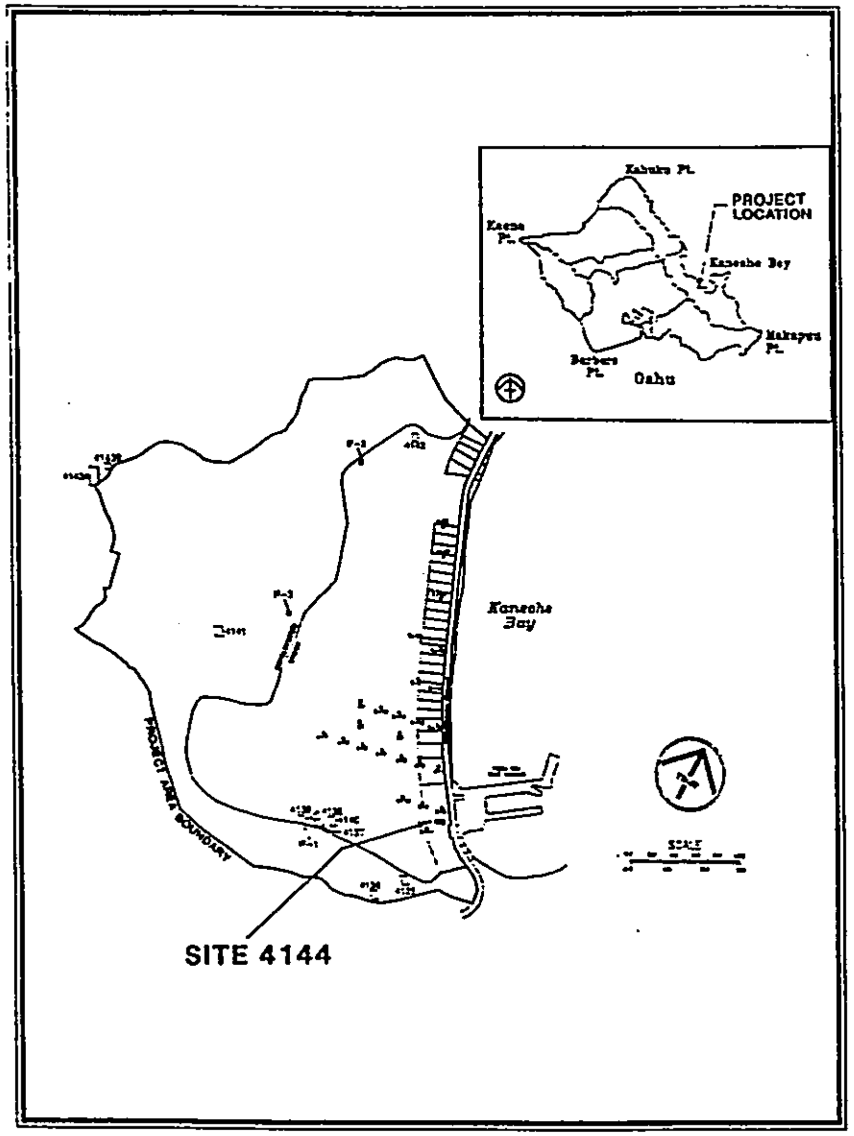


Figure 1. PROJECT AREA AND SITE LOCATION MAP

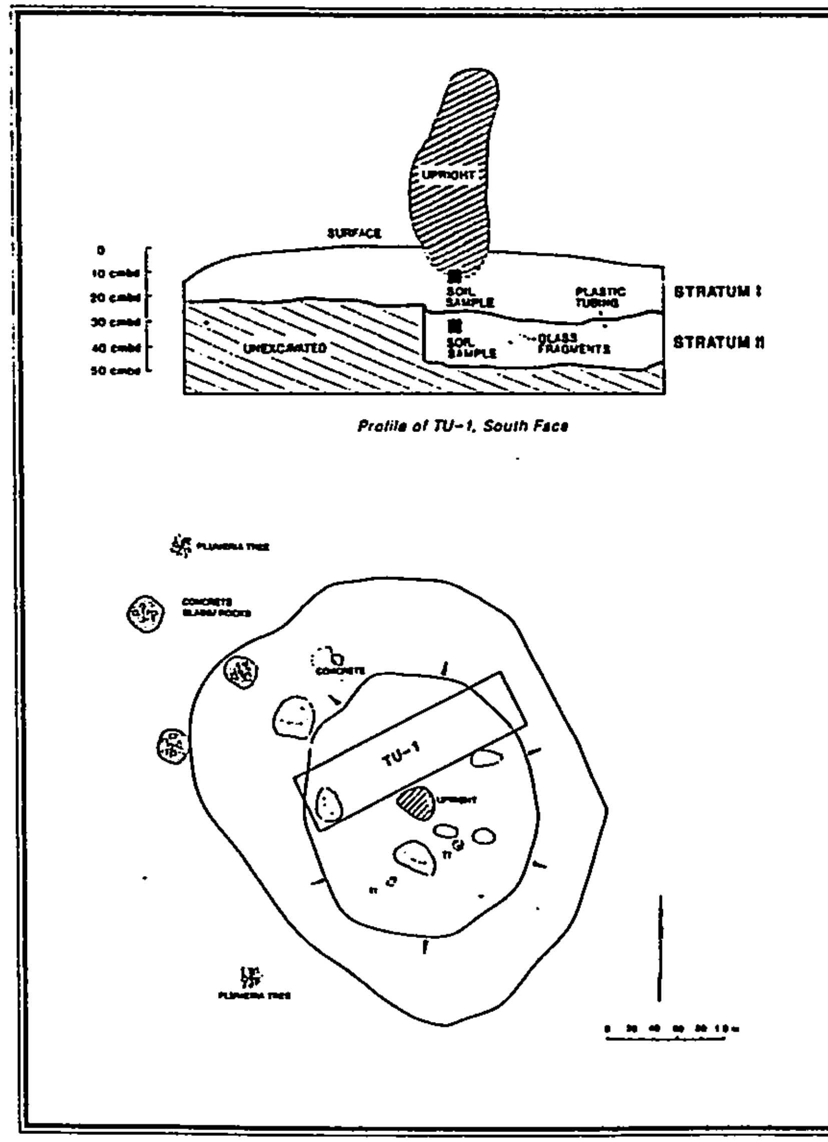


Figure 2. SITE 4144, TU-1 PLAN AND PROFILE

APPENDIX C

HYDROLOGICAL STUDY
Dames & Moore

REPORT
GEOLOGIC, HYDROGEOLOGIC, AND HYDROLOGIC SERVICES
PROPOSED HALULANI SPORTS COMPLEX
HEEIA KEA, OAHU, HAWAII
FOR
NANATOMI HAWAII, INC

DAMES & MOORE JOB NO. 18874-001-11

DAMES & MOORE

DAMES & MOORE
1144 10TH AVENUE, SUITE 200, HONOLULU, HAWAII 96816-2497 (808) 735-3585

D&M Facsimile Number: (808) 732-6077

December 8, 1989
18874-001-11

Helber Hastert Kimura Planners
Grosvenor Center, PRI Tower
733 Bishop Street, Suite 2590
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Gentlemen:

Submitted with this transmittal letter are two bound and one unbound copies of our report entitled "Geologic, Hydrogeologic, and Hydrologic Services, Proposed Halulani Sports Complex, Heeia Kea, Oahu, Hawaii for Nanatomi Hawaii, Inc." Our work was performed in accordance with our proposal dated March 16, 1989.

It has been a pleasure conducting the investigations and preparing this report for you. Please call us if we can be of further assistance to you.

Respectfully submitted,

DAMES & MOORE
A Professional Limited Partnership

Masanobu R. Fujioka, P.E.
Consultant

MRF/JJK:ob(6401A/428A:18874-001-11)
(Two copies submitted)

REPORT

GEOLOGIC, HYDROGEOLOGIC, AND HYDROLOGIC SERVICES

PROPOSED MALULANI SPORTS COMPLEX

HEEIA KEA, OAHU, HAWAII

FOR

NANATOMI HAWAII, INC

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF WORK

The purpose of this investigation was to assess the availability of sufficient groundwater or surface water for golf course and landscaping irrigation.

The scope of work, as outlined in our proposal dated March 16, 1989, consisted of the following tasks:

Geologic Reconnaissance

1. A literature search for available geological and engineering data.
2. A site reconnaissance.

Hydrogeologic Study

1. A review of available hydrogeological literature to assess the potential for groundwater availability.
2. A visual site reconnaissance concurrent with the geologic reconnaissance.

Hydrologic Study

Estimation of the quantity of surface water available for irrigation during the 10-year and 20-year design dry years.

1.2 PHYSIOGRAPHIC SETTING

The proposed golf course and residential development is located mauka of Kanehoe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Fishing Pier and Boat Harbor, as shown on Plate 1. The proposed site occupies Tax Map Key 4-6-06: parcels 1, 4, 7, 9, 11, 13, 15, 22-44, 48-51 and Tax Map Key 4-6-16: parcel 32. The total site area is approximately 220 acres, encompassing the land from Kamehameha Highway to approximately the ridge crest. Plate 2 shows a plot plan of the site.

The elevations at the site range from sea level to approximately 625 feet above sea level. Slopes at the site range from level terrain (approximately 0 to 10 percent) to steeply sloping terrain (approximately 40 to 70 percent).

Rainfall at the site averages 60 inches a year (Giambelluca et al., 1986) and pan evaporation is approximately 50 to 60 inches per year (Ekern and Chang, 1985). The site in general is heavily vegetated and undeveloped except for a small construction yard storage area.

2.0 METHODOLOGY

2.1 GEOLOGIC RECONNAISSANCE

A geologist and a hydrogeologist from Dames & Moore conducted a reconnaissance of the site on June 8, 1989. Based on data collected in the field, data from our files, and data from the literature, we assessed the site geology. Information on the site geology was used to determine the potential for groundwater occurrence and to gather information necessary to assess the surface water hydrology of the site.

2.2 HYDROGEOLOGIC STUDY

The hydrogeologic study was conducted in conjuction with the geologic reconnaissance. Using information gathered during the site visit and water resource/hydrogeological information available in the literature and our files, we assessed the potential for groundwater occurrence at the site.

2.3 HYDROLOGIC STUDY

2.3.1 The Model, STORM

To assess the surface water hydrology of the site, we employed a computer model created by the U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC). The model entitled "Storage, Treatment, Overflow, Runoff Model (STORM)," provides a means for analysis of the quantity and quality of runoff from urban or nonurban watersheds (HEC, 1977). In our analysis, we computed only the quantity of runoff from the watershed encompassing the site. The program is designed for a period of record analysis using continuous hourly precipitation data and is, therefore, a continuous simulation model. STORM has the capability to recognize not only the duration and intensity of rainfall/runoff events, but also the spacing between events.

Based on rainfall records, we calculated the 10-year and 20-year design dry years, and then used the equivalent hourly rainfall of the design dry year as input to STORM (see Appendix A).

In our application, STORM computed the quantity of runoff using the coefficient method. The coefficient method computes the runoff during each hourly time interval by the following equation:

$$r = C(P-f)$$

where,

r = runoff in inches
C = composite runoff coefficient
P = rainfall in inches over the area
f = available depression storage in inches

The composite runoff coefficient, C, incorporates average annual runoff coefficients for the pervious and impervious areas of the watershed, weighted according to the total fraction of imperviousness. The runoff coefficient accounts for losses due to infiltration and is computed by the following equation:

$$C = C_p + (C_I - C_p) \sum_{i=1}^{L} X_i F_i$$

where,

C_p = runoff coefficient for pervious surfaces
C_I = runoff coefficient for impervious surfaces
X_i = area in land use i as a fraction of total urban watershed area
F_i = fraction of land use i that is impervious
L = total number of land uses

Additional information on the technical aspects of the model can be found in the Users Manual (HEC, 1977).

2.3.2 Required Input

Input data required for our application of STORM included the following:

- Area of Watershed (220 acres)
- Hourly Precipitation (available on diskette from the National Weather Service, Ahuimanu Loop Station, factored for site location as shown in Appendix A)

- Monthly Pan Evaporation Rates (taken from Ekern and Chang (1985) as summarized in Appendix A)
- Land Use (entire watershed classified as preservation - no significant development)
- Percent Imperviousness of Land Use (81%, calculated during calibration runs)
- Washoff decay coefficient (2.0, program default)
- Runoff Coefficients (0.15 for pervious areas, 0.90 for impervious areas, both are program defaults)
- Available depression storage (0.10 inch, based on previous applications of STORM in similar watersheds)

2.3.3 Calibration of the Model

Before applying the model for runoff prediction during the 10-year and 20-year design dry years, we calibrated the model using water resources data from the U.S. Geological Survey (USGS) publication entitled "USGS Water Resources Data - Hawaii and Other Pacific Areas, Volume 1, Water Year 1986". Since there is no data available for the site itself, we selected a watershed that has stream flow data and is representative of the site. We then used this stream flow data as calibration for surface runoff at the site.

Out of the windward Oahu watersheds with stream flow data, we selected a watershed that is located close to the project site, has similar acreage as the project site, similar soil types, similar slopes, and similar land use. Plate 3 shows the calibration watershed and Table 1 compares the calibration watershed to the project site.

The main parameter used in calibration of the model was the percent imperviousness of the watershed (This parameter is actually the percent imperviousness of the land use; however, both watersheds have only one land use). By altering the percent imperviousness of the calibration watershed, we obtained surface water runoff close to that of the measured stream flow data.

This percent imperviousness was then used as input to the surface water runoff prediction simulations at the site. Table 2 presents the results of the calibration runs.

2.3.4 Limitations

Models are only representations of reality. The results of this investigation are not absolute but only approximations of what may actually occur.

The coefficient method, used for calculating runoff, computes runoff for every rainfall event in the rainfall record, regardless of rainfall characterisitics or antecedent moisture conditions. This method, therefore, performs better on watersheds of relatively high percent imperviousness, where infiltration is small (HEC, 1977). The geologic characterisitics of the site (i.e. rock outcrops, steep slopes, stiff clays) probably cause small amounts of water to infiltrate and large amounts to runoff, which is compatible to the coefficient method.

The rainfall records provided by the National Weather Service often have several days or even months of missing or unusable data. The design dry years calculated for this study may, therefore, represent less rainfall than actually occurred. In addition, the simulations assumed no significant development at the site, which is the present condition. With the construction of structures and roads, the percent imperviousness of the site will increase, resulting in slightly more runoff. These two considerations make the results of our investigation conservative: there will likely be more rainfall and runoff in the 10-year and 20-year design dry years at the site than indicated in this investigation.

CORRECTION

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

2.2 HYDROGEOLOGIC STUDY

The hydrogeologic study was conducted in conjuction with the geologic reconnaissance. Using information gathered during the site visit and water resource/hydrogeological information available in the literature and our files, we assessed the potential for groundwater occurrence at the site.

2.3 HYDROLOGIC STUDY

2.3.1 The Model, STORM

To assess the surface water hydrology of the site, we employed a computer model created by the U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC). The model entitled "Storage, Treatment, Overflow, Runoff Model (STORM)," provides a means for analysis of the quantity and quality of runoff from urban or nunurban watersheds (HEC, 1977). In our analysis, we computed only the quantity of runoff from the watershed encompassing the site. The program is designed for a period of record analysis using continuous hourly precipitation data and is, therefore, a continuous simulation model. STORM has the capability to recognize not only the duration and intensity of rainfall/runoff events, but also the spacing between events.

Based on rainfall records, we calculated the 10-year and 20-year design dry years, and then used the equivalent hourly rainfall of the design dry year as input to STORM (see Appendix A).

In our application, STORM computed the quantity of runoff using the coefficient method. The coefficient method computes the runoff during each hourly time interval by the following equation:

$$r = C(P-f)$$

where,

r = runoff in inches
C = composite runoff coefficient
P = rainfall in inches over the area
f = available depression storage in inches

The composite runoff coefficient, C, incorporates average annual runoff coefficients for the pervious and impervious areas of the watershed, weighted according to the total fraction of imperviousness. The runoff coefficient accounts for losses due to infiltration and is computed by the following equation:

$$C = C_p + (C_I - C_p) \sum_{i=1}^{L} X_i F_i$$

where,

C_p = runoff coefficient for pervious surfaces
C_I = runoff coefficient for impervious surfaces
X_i = area in land use i as a fraction of total urban watershed area
F_i = fraction of land use i that is impervious
L = total number of land uses

Additional information on the technical aspects of the model can be found in the Users Manual (HEC, 1977).

2.3.2 Required Input

Input data required for our application of STORM included the following:

- Area of Watershed (220 acres)
- Hourly Precipitation (available on diskette from the National Weather Service, Ahuimanu Loop Station, factored for site location as shown in Appendix A)

- Monthly Pan Evaporation Rates (taken from Ekern and Chang (1985) as summarized in Appendix A)
- Land Use (entire watershed classified as preservation - no significant development)
- Percent Imperviousness of Land Use (81%, calculated during calibration runs)
- Washoff decay coefficient (2.0, program default)
- Runoff Coefficients (0.15 for pervious areas, 0.90 for impervious areas, both are program defaults)
- Available depression storage (0.10 inch, based on previous applications of STORM in similar watersheds)

2.3.3 Calibration of the Model

Before applying the model for runoff prediction during the 10-year and 20-year design dry years, we calibrated the model using water resources data from the U.S. Geological Survey (USGS) publication entitled "USGS Water Resources Data - Hawaii and Other Pacific Areas, Volume 1, Water Year 1986". Since there is no data available for the site itself, we selected a watershed that has stream flow data and is representative of the site. We then used this stream flow data as calibration for surface runoff at the site.

Out of the windward Oahu watersheds with stream flow data, we selected a watershed that is located close to the project site, has similar acreage as the project site, similar soil types, similar slopes, and similar land use. Plate 3 shows the calibration watershed and Table 1 compares the calibration watershed to the project site.

The main parameter used in calibration of the model was the percent imperviousness of the watershed (This parameter is actually the percent imperviousness of the land use; however, both watersheds have only one land use). By altering the percent imperviousness of the calibration watershed, we obtained surface water runoff close to that of the measured stream flow data.

This percent imperviousness was then used as input to the surface water runoff prediction simulations at the site. Table 2 presents the results of the calibration runs.

2.3.4 Limitations

Models are only representations of reality. The results of this investigation are not absolute but only approximations of what may actually occur.

The coefficient method, used for calculating runoff, computes runoff for every rainfall event in the rainfall record, regardless of rainfall characterisitics or antecedent moisture conditions. This method, therefore, performs better on watersheds of relatively high percent imperviousness, where infiltration is small (HEC, 1977). The geologic characterisitics of the site (i.e. rock outcrops, steep slopes, stiff clays) probably cause small amounts of water to infiltrate and large amounts to runoff, which is compatible to the coefficient method.

The rainfall records provided by the National Weather Service often have several days or even months of missing or unusable data. The design dry years calculated for this study may, therefore, represent less rainfall than actually occurred. In addition, the simulations assumed no significant development at the site, which is the present condition. With the construction of structures and roads, the percent imperviousness of the site will increase, resulting in slightly more runoff. These two considerations make the results of our investigation conservative: there will likely be more rainfall and runoff in the 10-year and 20-year design dry years at the site than indicated in this investigation.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 REGIONAL GEOLOGY

The Koolau Range is an erosional remnant of a deeply dissected large-volume volcanic lava shield. The shield remnant is an assymmetrical elongate dome extending northwest-southeast along a major rift zone 30 miles long.

The site is located just outside the mapped northern boundary of the eroded Kailua caldera, and near the center of the northwest rift zone of the Koolau volcano. The regional rock types include gently-dipping, thin-bedded a'a and pahoehoe flows cut by numerous narrow, near vertical dikes of similar basaltic material. The rift zone axis is marked by closely-spaced multiple dikes.

Active Hawaiian shield volcanoes typically have well-defined (linear) rift zones within which most of their eruptions are concentrated. Extinct and eroded shield volcanoes like the Koolau typically have dike complexes, these being regarded as the subsurface equivalent of the active rift zones. Owing to deep erosion along windward Oahu, the crest of the Koolau Range is southwest of the main northwest dike complex. The site occupies an area approximately 0.25 miles northwest of Heeia State Park, where Walker (1987) has mapped some of the highest intensities of dikes encountered for the Koolau dike complex. Along an outcrop in a coastal exposure at Kealohi Point, Walker measured the dike intensity at 85 percent, which is the percentage of outcrop width occupied by dikes. Within the project site, the dike intensities are much lower, in the 20-30 percent range, similar to the marginal dike zone as described by Hirashima (1971). Individual dikes in this region are spaced tens or hundreds of feet apart. Hence, the main northwest rift axis of the Koolau lava dome is located slightly to the west of the site.

The site contains a number of vertical basaltic dikes, parallel or nearly parallel to the rift zone, and striking between 320° and 310° NW, dipping 72° NE. The denser dike rocks are less permeable than the rocks they intrude. Hence, Hirashima (1971) suggests that each pair of parallel dikes form two walls of an elgonated groundwater reservoir. Others (Stearns and Vaksvik, 1935; Takasaki et al., 1969) have noted that groundwater impounded by dikes in the Koolau Range can be a major source of water for the Island of Oahu.

At this locality, the high degree of weathering has degraded the rocks so as to obscure the original nature of all but the most resistant, denser dike rocks. Fluvial (stream) deposits and small-scale debris flows have infilled the low-lying areas adjacent to the upper slopes of Puu Maelieli Ridge.

3.2 SITE GEOLOGY

In general, rock exposures at the site are poor due to extensive plant overgrowth; however, a number of outcrops (generally at higher elevations and within narrow stream gullies) were found.

The eastern approximately one-third of the site consists of two younger overlying sedimentary rock units mapped as unconsolidated and consolidated noncalcareous deposits, Ra and Pa, respectively (Refer to Site Geologic Map, Plate 4). The boundaries of these lithologic units are relatively horizontal, and roughly parallel to the 25-foot and 50-foot elevation contours. The older underlying volcanic rocks outcrop along the western two-thirds of the site, along the upper slopes and within many of the narrow stream channels and gullies. These deposits represent the denudated portions of the Koolau volcanic series (Koolau dike complex) and are referred to as Tkdc after Stearns and Vaksvik (1938) on the Site Geologic Map (Plate 4). The Tkdc deposits consist of moderately to slightly weathered, gray to black, nearly vertical, single and multiple basaltic dikes a few inches to several feet thick, usually microcrystalline to massive with a few olivine phenocrysts. The dikes tend to be very dense, and locally are highly cross-jointed, and brecciated. They intrude the Koolau anygdaloidal tholeiitic lava flows which in many places, below an altitude of 800 feet, have been weathered in-situ to a brilliant orange-red color (Stearns and Vaksvik, 1938).

Weathered vesicular basaltic lava flows cross-cut by less-weathered, denser, less-vesicular dikes of similar volcanic material occur at localities 1 and 3 (refer to site map).

Within the narrow stream gullies, slightly-weathered, narrow (less than 3 feet wide), near-vertical basaltic dikes commonly occur in sets of 3 to 5. These dikes are often spaced closely together.

Individual dike sets, however, may be widely spaced up to several hundred feet apart. Due to differential weathering of the denser dike rock, their occurence and trend has influenced the erosional pattern and to some degree the extent of gullying and drainage along the upper slopes of the site. These dikes tend to parallel the main northwest trend of the Koolau dike complex (Stearns and Vaksvik, 1935; Walker, 1987).

Directly overlying the Koolau basalt is an older unit of consolidated, non-calcareous alluvium intercalated with deeply weathered conglomerates and finer-grained sediments. This unit forms a band approximately between Elevations +25 feet and +50 feet on the eastern (ocean-facing) portion of the site. Below Elevation +25 feet, and on the same eastern side of the site are younger unconsolidated alluvial (fluviatile) deposits consisting mostly of slope wash, talus, as well as clays and clayey silts.

Unconsolidated alluvium (both fluviatile and debris-flow) deposits occur along the lower elevations, and locally are found in isolated areas at higher elevations between the 100-foot and 75-foot contours (localities 2 and 4). Where exposed on steep slopes, the alluvium often shows evidence of (mass-wasting) debris-flow characteristics (e.g. locality 2).

3.3 REGIONAL HYDROGEOLOGY

Along windward Oahu, persistent, northeast tradewinds bring large quantities of moist air to the Koolau Range. This moist air condenses above the crest of the range leaving behind large quantities of precipitation that infiltrate the porous lava flows and percolate through the lava. The resulting groundwater is then either impounded by the less permeable dike rocks or percolates deeper, eventually forming a lens of freshwater which floats on sea water. Precipitation on the Koolau Range also feeds many of the streams which flow down the windward and leeward slopes.

Geologic features which control groundwater occurrence in windward Oahu include lava flows and dikes, valleys, and alluvium and weathered rock (Takasaki et al., 1962). As mentioned previously, the extremely low permeability dike rocks form compartments in the porous lava rock which impound groundwater. The depth and distance that the valleys have been cut into the dike rock influences the direction of water movement and the quantity of water flowing in streams. The valleys act as drains in the dike compartments, as do man-made tunnels and wells which tap the dike-held groundwater.

Consolidated alluvial deposits and weathered lava flows occur along the coastline and lowland areas of windward Oahu. These impermeable materials form a barrier to seaward movement of groundwater, and cause water to appear in streams or marshy areas near the shore before flowing into the sea. The alluvium and weatherd rock cause artesian conditions in some areas. Several wells have been developed north of the site which tap the artesian water. Most of these wells were drilled in the early to mid nineteen hundreds and are presently unused or serve as domestic water supplies (USGS Groundwater Data).

3.4 SITE HYDROGEOLOGY

The three rock units mapped in the site area have different water-bearing properties, and may allow for a tapable groundwater source to be present. The basalt is quite permeable, and supplies large quantities of water in other areas of the island. The extremely low permeability dikes occurring within the permeable basalt on the site may impound groundwater in quantities large enough to tap. At the site, the larger quantities of dike-held water are probably most prevalent beneath the consolidated sediments. The low permeability consolidated sediments overlying the permeable basalt probably causes groundwater to "pile up" behind the consolidated sediments, forming a useable resource. This groundwater resource may exist under artesian conditions.

There are no wells on the site or immediately adjacent to the site. The closest wells are approximately 1 and 1/2 miles north of the site, in the vicinity of Kahaluu Pond. These wells tap dike-held water within the Koolau basalts at depths of approximately 60 to 135 feet below mean sea level (USGS Groundwater Data).

The unconsolidated sediments found in the coastal and low-lying areas of the site range from highly permeable to highly impermeable. However, because of the limited extent of these sediments and the underlying impermeable

sediment, the water-bearing properties of the unconsolidated sediments are probably negligible.

The northern and western site boundary is concave towards the sea, and follows either a ridge or runs below the crest of ocean-facing slopes, consequently all drainage runs towards Kaneohe Bay. Additionally, because of the concavity, run-off from a large area flows into a small area, and occasional (seasonal) flooding may be common. The southeast corner of the site in the vicinity of the Heeia Kea Boat Harbor is particularly susceptible to flooding because it is flat-lying, and at least four well-defined streams converge there. North of this area, the streams meet the ocean more perpendicularly and there is less flat ground, so flooding is less severe.

During the site survey, considerable evidence of debris flow activity was noted, in addition to the poor ability of even dense vegetation to retain the surface soil. Both the basalt and alluvial sections of the site are deeply weathered and consist of mostly clay-rich material of low permeability (some standing water was found). Because of this little infiltration, significant surface runoff can be expected during rainy periods.

4.0 RESULTS OF THE HYDROLOGIC INVESTIGATION

To evaluate surface water runoff at the site, we employed STORM as outlined in section 2.3 and in Appendix A. Table 3 presents the average annual statistics for the 10-year and 20-year design dry years.

During the 10-year design dry year, 200.78 million gallons of precipitation fell on the site. Of this precipitation, surface water runoff accounted for 54%, or 108.55 million gallons. The remaining 46% of the rainfall was lost to evaporation or infiltration. The predicted surface water runoff, averaged on a daily basis throughout the 10-year design dry year, results in a runoff value of 297,388 gallons per day (gpd). Estimated irrigation requirements are 309,750 gpd (HH&K, 1989). These averaged daily values appear to show that there may not be enough runoff to use for irrigation during the 10-year design dry year; however, the amount of water available and the irrigation requirements depend on the spacing between, and quantity of the individual rainfall/runoff events. Table 4 presents the individual event summaries for the 10-year design dry year.

During the 20-year design dry year, 123.84 million gallons of precipitation fell on the site, and surface water runoff accounted for 40% (49.40 million gallons) of the total annual precipitation. Average daily runoff for the 20-year design dry year is 135,355 gpd. Table 5 presents the individual event summaries for the 20-year design dry year.

Tables 4 and 5 summarize the individual storm events that took place throughout the 10-year and 20-year design dry years, respectively. The data presented on these tables include the number of events throughout the year, the date and time of the event, the elapsed time since the previous event, the quantity of rainfall occurring during the event, the quantity of runoff occurring during the event, and the length of the event. This information can be used to determine the storage capacity required to assure that enough water is available for golf course irrigation during periods of low rainfall.

5.0 CONCLUSIONS

Our investigation of the site revealed that under normal conditions (during most years), rainfall and runoff collection should adequately provide for golf course irrigation requirements. Subsequent engineering studies by the civil engineer will determine if sufficient storage can be constructed so

that rainfall and runoff collection will be adequate for irrigation requirements in drier years.

Groundwater development may be feasible to supplement irrigation requirements; however, further investigation, such as exploratory wells and test pumping, would be required. Due to high rainfall in the area (approximately 60 inches per year) and limited groundwater supplies, it is probably not desirable to rely solely on groundwater resources for irrigation requirements, although groundwater development to augment surface water supplies during dry periods may be feasible.

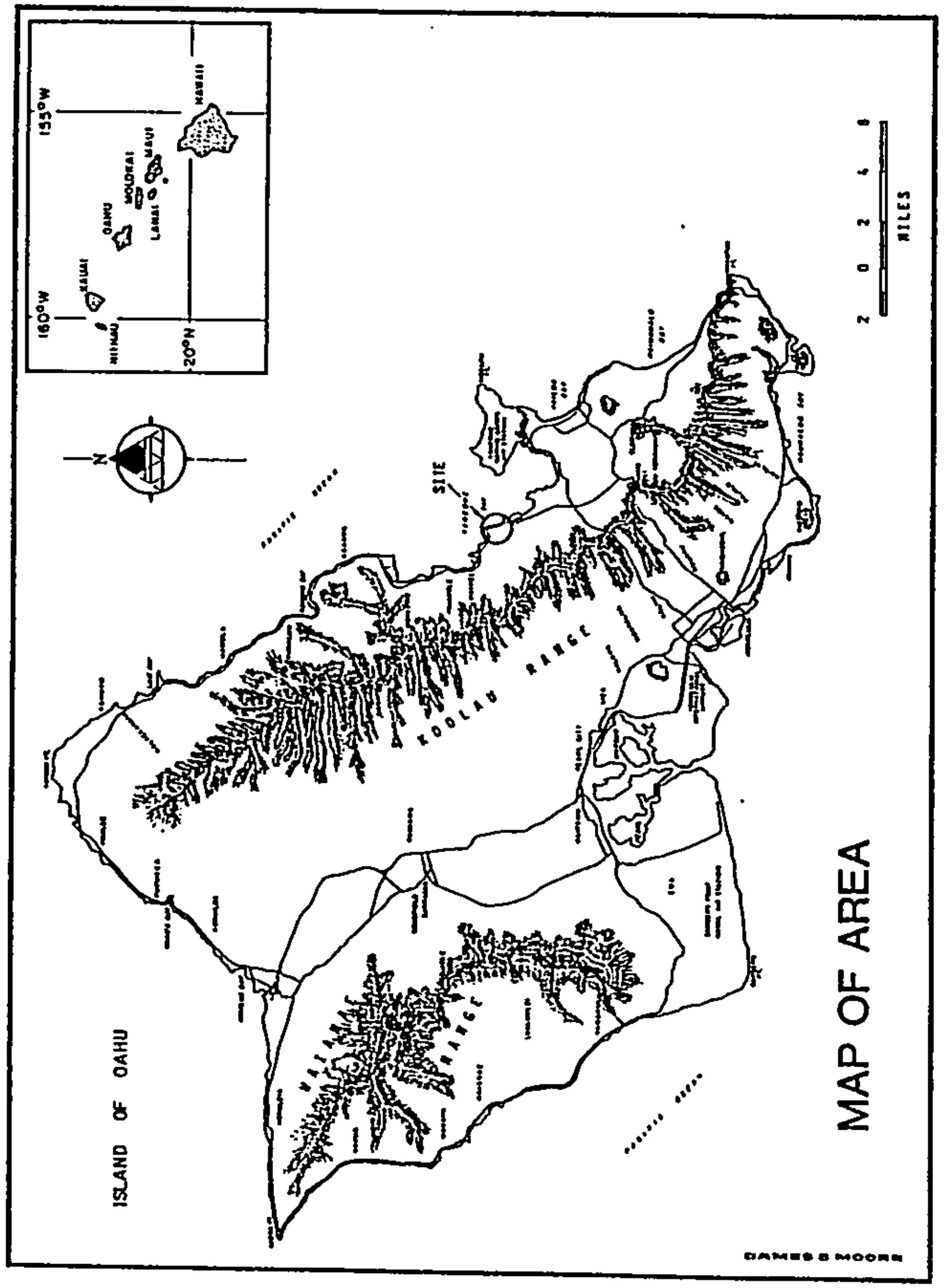


PLATE 1

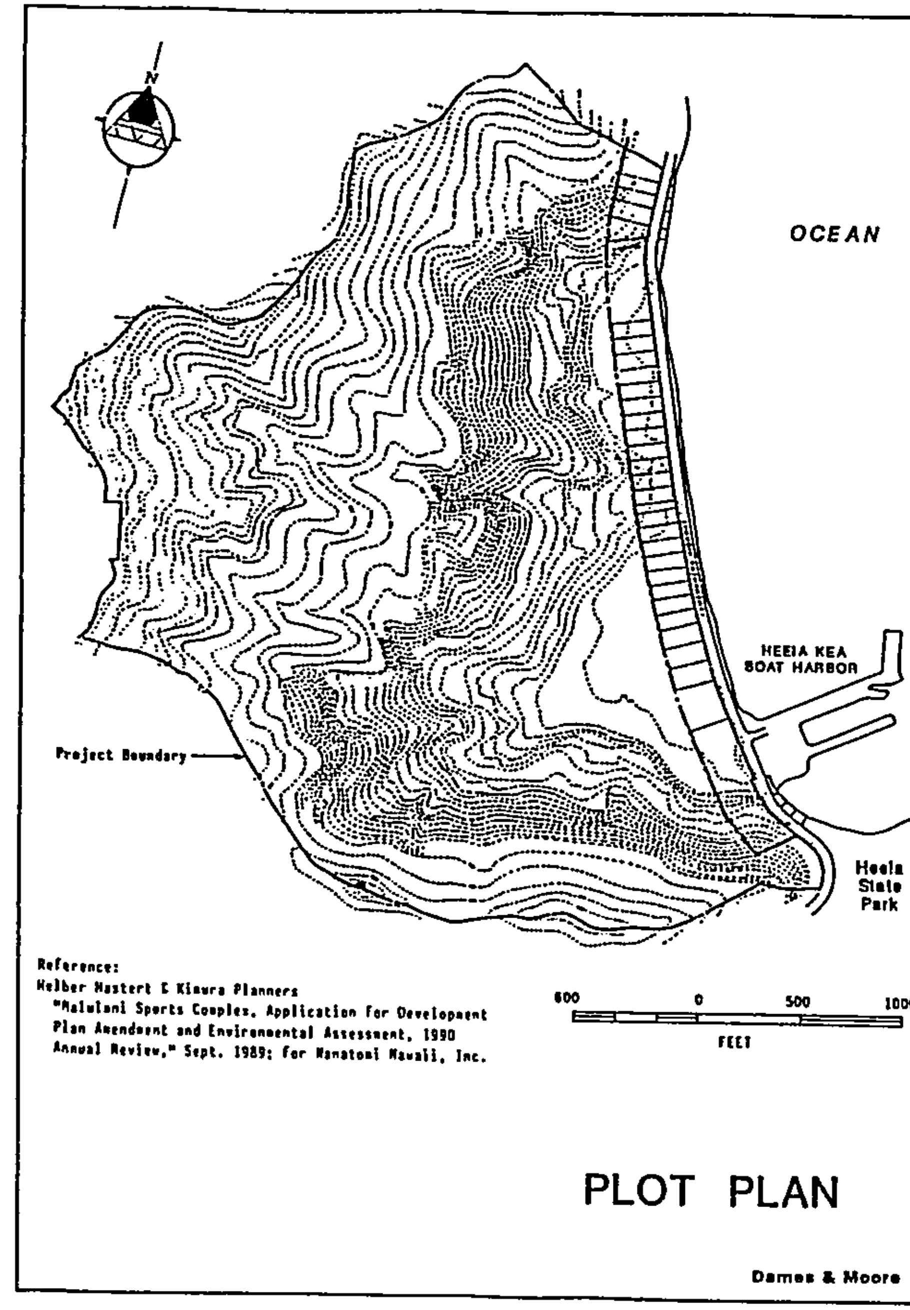
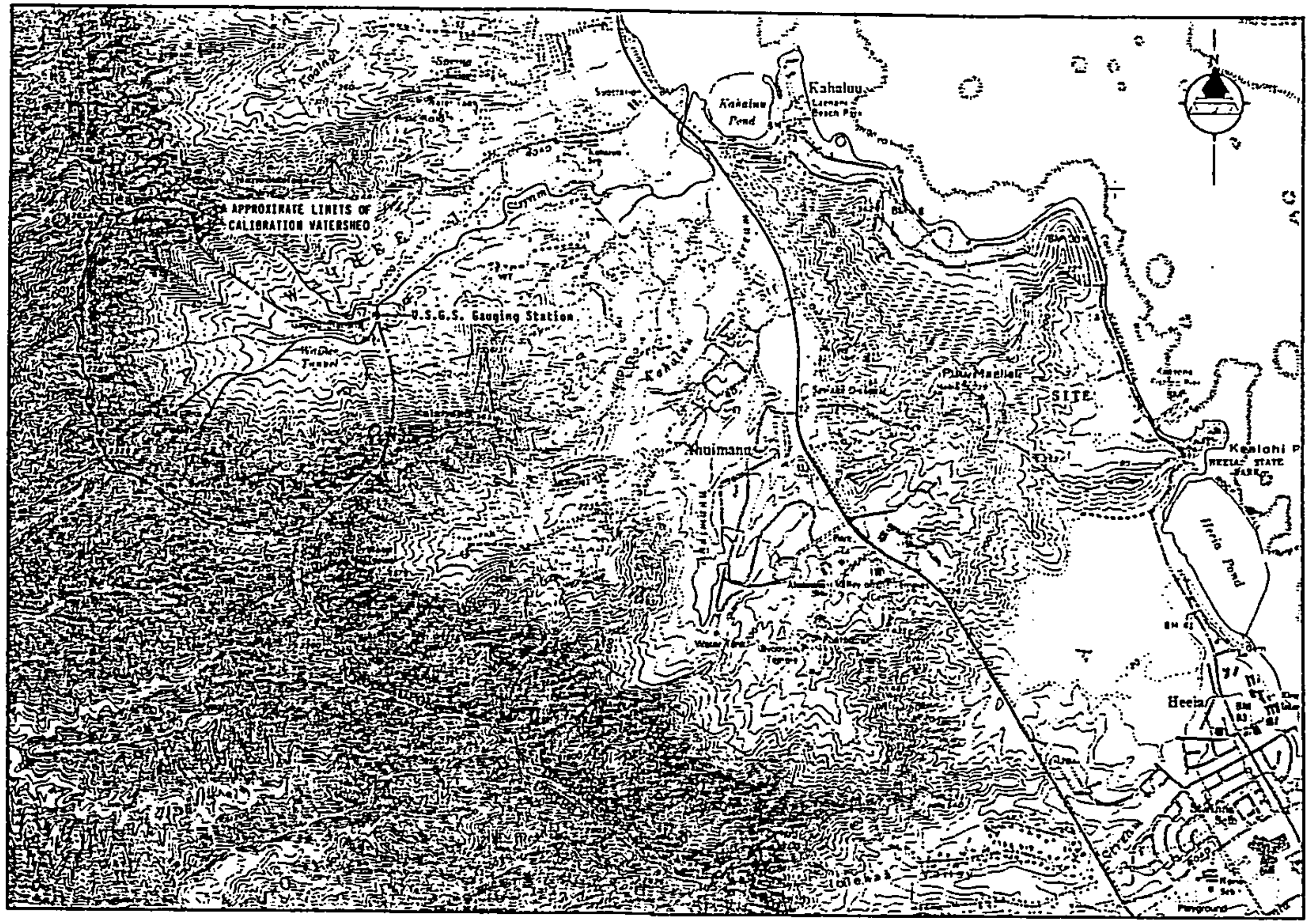


PLATE 2



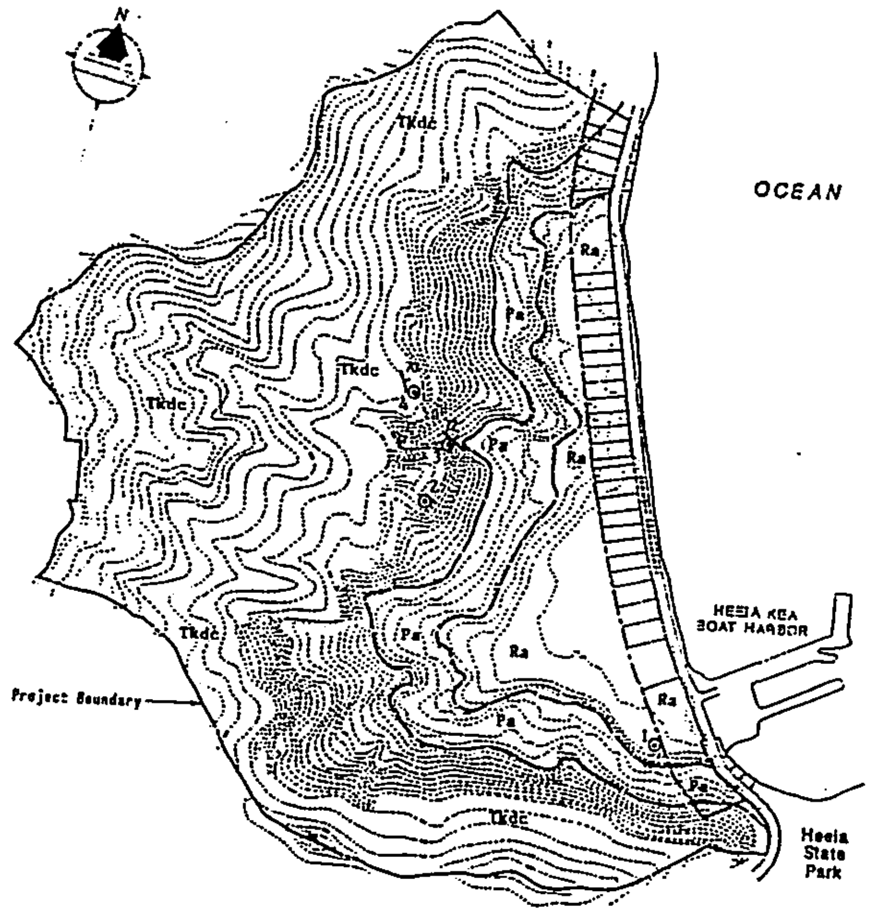
Reference:
U.S.G.S. Topographic Map
Kaneohe, Oahu, Hawaii (1983)

CALIBRATION WATERSHED

2000 0 1000 2000 3000
FEET

Dames & Moore

PLATE 3



Legend:

Ra	Unconsolidated non-calcareous deposits of younger alluvium; consisting of brown to dark brown silty clay and interstitial talus and soil.
Pa	Consolidated non-calcareous deposits of older alluvium; consisting of mottled brown to reddish brown deeply weathered, poorly sorted conglomerates that locally grade into coarse angular talus and debris slide deposits.
Tkdc	Koolau volcanic series (dike complex); consisting of gray to black nearly vertical single and multiple basalt dikes, a few inches to several feet thick, mostly non-vesicular and massive, which intrude into Koolau amygdaloidal lava flows of both pahoehoe and a'a-type.
	Approximate contact between different lithologic units mapped.
70	Trend of intrusive dikes showing strike and dip direction, (in degrees).
⊕1	Localities

Reference:

Helber, Hastert & Kimura Planners (topographic base map) "Malulani Sports Complex, Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review," Sept. 1959; for Hanatomi Hawaii, Inc.

Stearns, Harold T. & Knute N. Vaksvik; 1938; "Geologic and Topographic Map of the Island of Oahu, Hawaii"; U. S. Geological Survey, Division of Hydrography, Bulletin 2, Plate 2.

GEOLOGIC MAP

Dames & Moore

PLATE 4

REVISIONS
BY ____ DATE ____ TO EO ____
BY ____ DATE ____ TO EO ____

18874-001-011

BY *lml* DATE *10/26/89*
CHECKED BY ____
COPY TO EO ____

466.12 (4-64)

MALULANI SPORTS COMPLEX
COMPARISON OF PROJECT SITE AND CALIBRATION SITE
18874-001-11

TABLE 1

	PROJECT SITE	CALIBRATION SITE
AREA OF WATERSHED	220 acres	621 acres
LANDUSE	preservation (no significant development)	preservation
SOIL TYPES AND SLOPES (U.S. Department of Agriculture Soil Conservation Service, 1972)	silty clay (ALF) 40% - 70% slopes	silty clay (VpF) 40% - 70% slopes
	silty clay (AeE) 15% - 35% slopes	silty clay (WpE) 25% - 40% slopes
	silty clay (LaC) 7% - 15% slopes	silty clay (HnB) 2% - 6% slopes
	clay (KtC) 6% - 12% slopes	
	silty clay loam (EmA) 0% - 2% slopes	
	clay loam (Mt) nearly level	
AVERAGE ANNUAL RAINFALL (Giambelluca et al., 1986)	60 inches	157 inches
TOTAL STREAM DISCHARGE CALENDAR YEAR 1985 (USGS, 1988)	not applicable	1976.7 cfs
BASE STREAM FLOW (USGS, 1988)	not applicable	150 cfs
STREAM DISCHARGE DUE TO RAINFALL/RUNOFF CALENDAR YEAR 1985 (USGS, 1988)	not applicable	1826.7 cfs (70.04 inches)

MALULANI SPORTS COMPLEX
MODEL CALIBRATION DATA
18874-001-11

TABLE 2

CALIBRATION RUN NO.	PERCENT IMPERVIOUSNESS	SURFACE WATER RUNOFF (inches)
1	50	48.51
2	90	76.23
3	80	69.30
4	81	69.99 *
5	82	70.69

* Closest to stream flow value of 70.04 inches

MALULANI SPORTS COMPLEX
RUNOFF MODELLING
AVERAGE ANNUAL STATISTICS
18874-001-11

TABLE 3

	UNITS	10-YEAR DRY YEAR	20-YEAR DRY YEAR
AREA OF WATERSHED	acres	220	220
PRECIPITATION ON WATERSHED	inches	33.61	20.73
PRECIPITATION ON WATERSHED	million gallons	200.78	123.84
AVERAGE DAILY PRECIPITATION	gal/day	550,094	339,287
SURFACE RUNOFF FROM WATERSHED	inches	18.17	8.27
SURFACE RUNOFF FROM WATERSHED	million gallons	108.55	49.40
AVERAGE DAILY RUNOFF	gal/day	297,388	135,355

MALULANI SPORTS COMPLEX
RUNOFF MODELLING
10-YEAR DRY YEAR
EVENT SUMMARIES
18874-001-11

TABLE 4

EVENT	DATE	TIME	TIME SINCE LAST EVENT (hrs)	QUANTITY OF RAINFALL (in)	QUANTITY OF RAINFALL (mil gal)	QUANTITY OF RUNOFF (in)	QUANTITY OF RUNOFF (mil gal)	LENGTH OF EVENT (hrs)
1	1 9 85	1100	153	0.48	2.87	0.29	1.73	2
2	1 15 85	1600	147	0.91	5.44	0.65	3.88	12
3	1 16 85	700	3	0.06	0.36	0.03	0.18	2
4	1 16 85	1400	5	0.06	0.36	0.03	0.18	2
5	1 18 85	2300	55	0.06	0.36	0.02	0.12	2
6	1 22 85	1200	83	0.79	4.72	0.52	3.11	2
7	1 31 85	900	211	1.22	7.29	0.85	5.08	2
8	2 4 85	200	87	0.06	0.36	0.03	0.18	2
9	2 4 85	600	2	0.91	5.44	0.68	4.06	8
10	2 4 85	1800	4	0.30	1.79	0.21	1.25	5
11	2 8 85	500	78	0.06	0.36	0.01	0.06	2
12	2 10 85	300	44	0.12	0.72	0.06	0.36	2
13	2 12 85	200	45	0.42	2.51	0.25	1.49	4
14	2 12 85	1000	4	0.12	0.72	0.07	0.42	4
15	2 12 85	1500	1	0.06	0.36	0.04	0.24	2
16	2 12 85	2000	3	0.42	2.51	0.30	1.79	4
17	2 13 85	700	7	0.06	0.36	0.01	0.06	2
18	2 13 85	1100	2	0.12	0.72	0.08	0.48	3
19	2 14 85	400	14	3.96	23.66	2.99	17.86	17
20	2 22 85	2000	191	0.18	1.08	0.11	0.66	3
21	2 26 85	300	76	0.85	5.08	0.56	3.35	8
22	2 26 85	1800	7	0.24	1.43	0.15	0.90	4
23	2 26 85	2400	2	0.12	0.72	0.08	0.48	2
24	2 27 85	300	1	0.06	0.36	0.04	0.24	2
25	2 27 85	600	1	0.06	0.36	0.04	0.24	2
26	3 5 85	600	142	0.18	1.08	0.10	0.60	4
27	3 5 85	1300	3	0.06	0.36	0.03	0.18	2
28	3 10 85	500	110	0.06	0.36	0.01	0.06	2
29	3 11 85	300	20	0.18	1.08	0.10	0.60	3
30	3 22 85	1100	269	0.67	4.00	0.45	2.69	7
31	3 30 85	700	181	0.61	3.64	0.39	2.33	3
32	3 30 85	1100	1	0.06	0.36	0.04	0.24	2
33	3 30 85	1700	4	0.06	0.36	0.02	0.12	2
34	4 30 85	2400	749	1.46	8.72	1.03	6.15	2
35	7 8 85	600	1636	0.06	0.36	0.00	0.00	2
36	7 14 85	2000	156	0.06	0.36	0.01	0.06	2
37	7 16 85	600	32	0.18	1.08	0.11	0.66	3
38	7 16 85	2400	15	0.12	0.72	0.02	0.12	2
39	7 17 85	300	1	0.12	0.72	0.08	0.48	2
40	7 20 85	1500	82	0.12	0.72	0.02	0.12	2
41	7 20 85	1900	2	0.06	0.36	0.03	0.18	2
42	7 22 85	500	32	0.06	0.36	0.02	0.12	2
43	7 24 85	300	44	0.12	0.72	0.06	0.36	3
44	7 24 85	2400	18	0.18	1.08	0.10	0.60	2
45	7 25 85	300	1	0.30	1.79	0.22	1.31	2

MALULANI SPORTS COMPLEX
RUNOFF MODELLING
10-YEAR DRY YEAR
EVENT SUMMARIES
18874-001-11

TABLE 4

EVENT	DATE	TIME	TIME SINCE LAST EVENT (hrs)	QUANTITY OF RAINFALL (in)	QUANTITY OF RAINFALL (mil gal)	QUANTITY OF RUNOFF (in)	QUANTITY OF RUNOFF (mil gal)	LENGTH OF EVENT (hrs)
46	7 31 85	400	143	0.24	1.43	0.12	0.72	5
47	7 31 85	1000	1	0.18	1.08	0.13	0.78	3
48	8 1 85	1100	22	0.06	0.36	0.01	0.06	2
49	8 1 85	2100	8	0.06	0.36	0.01	0.06	2
50	8 4 85	600	55	0.06	0.36	0.01	0.06	2
51	8 4 85	1100	3	0.12	0.72	0.07	0.42	2
52	8 7 85	2200	81	0.12	0.72	0.06	0.36	2
53	8 19 85	1300	277	0.06	0.36	0.00	0.00	2
54	8 25 85	2000	149	0.06	0.36	0.01	0.06	2
55	8 26 85	2100	23	0.06	0.36	0.01	0.06	2
56	8 28 85	2100	46	0.12	0.72	0.02	0.12	2
57	8 30 85	100	26	0.12	0.72	0.02	0.12	2
58	9 9 85	1700	254	0.24	1.43	0.16	0.96	2
59	9 10 85	1400	19	0.30	1.79	0.19	1.14	4
60	9 12 85	1700	47	0.30	1.79	0.16	0.96	3
61	9 12 85	2300	3	0.06	0.36	0.03	0.18	2
62	9 19 85	500	148	0.18	1.08	0.10	0.60	5
63	9 19 85	1100	1	0.06	0.36	0.04	0.24	2
64	9 19 85	1500	2	0.06	0.36	0.03	0.18	2
65	9 22 85	400	59	0.12	0.72	0.02	0.12	2
66	9 22 85	1100	5	0.06	0.36	0.02	0.12	2
67	9 22 85	1500	2	0.06	0.36	0.03	0.18	2
68	9 23 85	600	13	0.12	0.72	0.07	0.42	4
69	9 23 85	1100	1	0.06	0.36	0.04	0.24	2
70	9 23 85	1600	3	0.73	4.36	0.53	3.17	4
71	9 24 85	100	5	0.12	0.72	0.06	0.36	4
72	9 24 85	900	4	0.06	0.36	0.02	0.12	2
73	9 24 85	2400	13	0.48	2.87	0.30	1.79	3
74	9 25 85	800	5	0.06	0.36	0.02	0.12	2
75	9 26 85	1400	28	0.73	4.36	0.52	3.11	3
76	9 27 85	1500	22	0.12	0.72	0.02	0.12	2
77	10 1 85	100	80	0.12	0.72	0.02	0.12	2
78	10 1 85	600	3	0.18	1.08	0.12	0.72	2
79	11 4 85	2200	830	0.24	1.43	0.11	0.66	5
80	11 5 85	1200	9	0.06	0.36	0.01	0.06	2
81	11 8 85	2100	79	0.12	0.72	0.02	0.12	2
82	11 9 85	800	9	0.18	1.08	0.10	0.60	4
83	11 10 85	300	15	0.48	2.87	0.31	1.85	7
84	11 11 85	500	19	0.06	0.36	0.03	0.18	2
85	11 11 85	800	1	0.18	1.08	0.13	0.78	4
86	11 11 85	2000	8	0.12	0.72	0.06	0.36	2
87	11 11 85	2300	1	0.73	4.36	0.54	3.23	13
88	11 12 85	1700	5	0.12	0.72	0.07	0.42	2
89	11 12 85	2200	3	0.79	4.72	0.59	3.52	3
90	11 15 85	900	56	0.12	0.72	0.06	0.36	2

MALULANI SPORTS COMPLEX
RUNOFF MODELLING
10-YEAR DRY YEAR
EVENT SUMMARIES
18874-001-11

TABLE 4

EVENT	DATE	TIME	TIME SINCE LAST EVENT (hrs)	QUANTITY OF RAINFALL (in)	QUANTITY OF RAINFALL (mil gal)	QUANTITY OF RUNOFF (in)	QUANTITY OF RUNOFF (mil gal)	LENGTH OF EVENT (hrs)
91	11 15 85	1300	2	0.06	0.36	0.04	0.24	2
92	11 18 85	1800	75	0.36	2.15	0.24	1.43	3
93	11 23 85	1000	109	0.91	5.44	0.62	3.70	7
94	11 25 85	700	38	0.24	1.43	0.15	0.90	6
95	11 26 85	1700	28	0.30	1.79	0.20	1.19	3
96	11 27 85	1400	18	0.73	4.36	0.49	2.93	8
97	11 28 85	300	5	0.06	0.36	0.03	0.18	2
98	11 28 85	700	2	0.06	0.36	0.04	0.24	2
99	11 28 85	1000	1	0.36	2.15	0.27	1.61	3
100	12 15 85	1800	413	0.24	1.43	0.15	0.90	4
101	12 24 85	700	201	0.12	0.72	0.06	0.36	2

MALULANI SPORTS COMPLEX
RUNOFF MODELLING
20-YEAR DRY YEAR
EVENT SUMMARIES
18874-001-11

TABLE 5

EVENT	DATE	TIME	TIME SINCE LAST EVENT (hrs)	QUANTITY OF RAINFALL (in)	QUANTITY OF RAINFALL (mil gal)	QUANTITY OF RUNOFF (in)	QUANTITY OF RUNOFF (mil gal)	LENGTH OF EVENT (hrs)
1	3 23 83	500	2091	0.14	0.84	0.03	0.18	2
2	4 3 83	1400	271	0.71	4.24	0.46	2.75	4
3	4 3 83	1900	1	0.07	0.42	0.05	0.30	2
4	4 7 83	2200	97	0.28	1.67	0.14	0.84	4
5	4 12 83	900	103	0.07	0.42	0.01	0.06	2
6	4 16 83	1500	100	0.07	0.42	0.01	0.06	2
7	4 16 83	1800	1	0.14	0.84	0.10	0.60	3
8	4 16 83	2200	1	0.07	0.42	0.05	0.30	2
9	4 17 83	700	7	0.07	0.42	0.02	0.12	2
10	4 22 83	1800	129	0.21	1.25	0.11	0.66	6
11	4 24 83	1400	38	0.42	2.51	0.28	1.67	5
12	4 24 83	2100	2	0.14	0.84	0.09	0.54	3
13	5 2 83	300	171	0.21	1.25	0.08	0.48	4
14	5 3 83	2000	37	0.07	0.42	0.03	0.18	2
15	5 4 83	2300	25	0.14	0.84	0.07	0.42	2
16	5 5 83	300	2	0.14	0.84	0.09	0.54	4
17	5 5 83	800	1	0.07	0.42	0.04	0.24	2
18	5 5 83	1100	1	0.07	0.42	0.04	0.24	2
19	5 5 83	2000	7	0.07	0.42	0.02	0.12	2
20	5 7 83	1000	36	0.21	1.25	0.13	0.78	3
21	5 17 83	2200	249	0.14	0.84	0.03	0.18	2
22	5 18 83	1200	12	0.07	0.42	0.05	0.30	2
23	5 20 83	1900	53	1.13	6.75	0.78	4.66	12
24	5 21 83	900	2	0.07	0.42	0.04	0.24	2
25	5 31 83	900	238	0.07	0.42	0.03	0.18	2
26	5 31 83	1400	3	0.14	0.84	0.08	0.48	4
27	5 31 83	2400	6	0.07	0.42	0.02	0.12	2
28	6 9 83	600	196	0.07	0.42	0.02	0.12	2
29	6 10 83	600	22	0.07	0.42	0.03	0.18	2
30	6 10 83	900	1	0.07	0.42	0.04	0.24	2
31	6 21 83	2000	273	0.07	0.42	0.01	0.06	2
32	6 26 83	500	103	0.14	0.84	0.06	0.36	4
33	7 2 83	1200	147	0.07	0.42	0.01	0.06	2
34	7 5 83	1200	70	0.07	0.42	0.03	0.18	2
35	7 5 83	1600	2	0.07	0.42	0.04	0.24	2
36	7 7 83	900	39	0.07	0.42	0.02	0.12	2
37	7 8 83	700	20	0.35	2.09	0.23	1.37	6
38	7 10 83	1000	45	0.07	0.42	0.01	0.06	2
39	7 12 83	300	39	0.07	0.42	0.03	0.18	2
40	7 12 83	1100	6	0.07	0.42	0.02	0.12	2
41	7 13 83	600	17	0.07	0.42	0.03	0.18	2
42	7 13 83	1300	5	0.07	0.42	0.02	0.12	2
43	7 13 83	1900	4	0.14	0.84	0.08	0.48	4
44	7 14 83	800	9	0.28	1.67	0.17	1.02	4
45	7 18 83	600	90	0.21	1.25	0.12	0.72	4

MALULANI SPORTS COMPLEX
RUNOFF MODELLING
20-YEAR DRY YEAR
EVENT SUMMARIES
18874-001-11

TABLE 5

EVENT	DATE	TIME	TIME SINCE LAST EVENT (hrs)	QUANTITY OF RAINFALL (in)	QUANTITY OF RAINFALL (mil gal)	QUANTITY OF RUNOFF (in)	QUANTITY OF RUNOFF (mil gal)	LENGTH OF EVENT (hrs)
46	7 18 83	1200	2	0.42	2.51	0.30	1.79	7
47	8 2 83	1000	351	0.07	0.42	0.03	0.18	2
48	8 2 83	1400	2	0.35	2.09	0.25	1.49	5
49	8 2 83	2200	3	0.56	3.35	0.40	2.39	10
50	8 3 83	1500	7	0.07	0.42	0.02	0.12	2
51	8 4 83	300	10	0.21	1.25	0.10	0.60	6
52	8 5 83	2100	36	0.07	0.42	0.03	0.18	2
53	8 12 83	200	147	0.07	0.42	0.03	0.18	2
54	8 12 83	500	1	0.14	0.84	0.10	0.60	2
55	8 16 83	800	97	0.14	0.84	0.09	0.54	3
56	8 16 83	1300	2	0.07	0.42	0.04	0.24	2
57	8 16 83	1800	3	0.07	0.42	0.04	0.24	2
58	8 24 83	1000	182	0.21	1.25	0.08	0.48	4
59	11 4 83	300	1717	0.07	0.42	0.02	0.12	2
60	11 4 83	1200	7	0.07	0.42	0.03	0.18	2
61	11 5 83	400	14	0.07	0.42	0.00	0.00	2
62	11 5 83	700	1	0.07	0.42	0.05	0.30	2
63	11 6 83	400	19	0.07	0.42	0.04	0.24	2
64	11 11 83	1200	126	0.07	0.42	0.02	0.12	2
65	11 11 83	1900	5	0.28	1.67	0.19	1.14	7
66	11 12 83	500	3	0.07	0.42	0.04	0.24	2
67	11 12 83	1100	4	0.07	0.42	0.04	0.24	2
68	11 12 83	2200	9	0.14	0.84	0.07	0.42	4
69	11 16 83	200	72	0.07	0.42	0.02	0.12	2
70	11 19 83	1600	84	0.07	0.42	0.02	0.12	2
71	11 19 83	2100	3	0.07	0.42	0.04	0.24	2
72	11 20 83	700	8	0.07	0.42	0.02	0.12	2
73	11 20 83	1600	7	0.07	0.42	0.03	0.18	2
74	11 21 83	400	10	0.14	0.84	0.07	0.42	3
75	11 21 83	800	1	0.07	0.42	0.05	0.30	2
76	11 29 83	500	187	0.14	0.84	0.06	0.36	3
77	12 3 83	1600	104	0.56	3.35	0.35	2.09	4
78	12 9 83	1700	141	0.21	1.25	0.12	0.72	4
79	12 13 83	1300	88	0.07	0.42	0.03	0.18	2
80	12 24 83	2100	270	1.20	7.17	0.84	5.02	3
81	12 25 83	1100	11	0.28	1.67	0.17	1.02	5
82	12 25 83	2000	4	0.78	4.66	0.58	3.46	6

REFERENCES

Chinn, Salwyn S., Grace A. Tateishi, and Johnson J.S. Yee, 1988. "Water Resources Data Hawaii and other Pacific Areas, Water Year 1986, Vol. 1, Hawaii," U.S. Geological Survey Water-Data Report HI-86-1, prepared in cooperation with the State of Hawaii Department of Land and Natural Resources, Division of Water and Land Development and with other agencies.

Ekern, Paul. C. and Jen-Hu Chang, 1985. "Pan Evaporation: State of Hawai'i, 1894-1983." Report R74, University of Hawaii at Manoa, Water Resources Research Center, in cooperation with Hawaiian Sugar Planters' Association. Published by the State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development, Honolulu, Hawaii.

Giambelluca, Thomas W., Michael A. Nullet, and Thomas A. Schroeder, 1986. "Rainfall Atlas of Hawaii," Report R76, Water Resources Research Center, University of Hawaii at Manoa, with the cooperation of the Department of Meteorology, University of Hawaii at Manoa. Published by the State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development, Honolulu, Hawaii.

Helber Hastert & Kimura Planners, September 1989. "Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review, Malulani Sports Complex, Koolaupoko, Oahu," prepared for Nanatomi, Hawaii, Inc., for Submittal to: Department of General Planning, City and County of Honolulu.

Stearns, H.T. and K.N. Vaksvik, 1935. "Geology and Groundwater Resources of the Island of Oahu, Hawaii", U.S. Geological Survey, Maui Publishing Co., 478p.

Stearns, H.T. and K.N. Vaksvik, 1938. "Geologic and Topographic Map of the Island of Oahu, Hawaii", U.S. Geological Survey, Division of Hydrography, Bulletin 2, Plate 2.

Takasaki, K.J, George Yamanaga, and E. R. Lubke, 1962. "Preliminary Summary of Findings in Water Resources Studies of Windward Oahu, Hawaii," Water Resources Circular No. 10, prepared by the U.S. Geological Survey in cooperation with the State of Hawaii, Division of Water and Land Development, Department of Land and Natural Resources, Honolulu, Hawaii.

U.S. Department of Agriculture Soil Conservation Service in cooperation with the University of Hawaii, Agricultural Experiment Station, 1972. "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii".

U.S. Army Corps of Engineers, Hydrologic Engineering Center, Water Resources Support Center, 1977. "Storage, Treatment, Overflow, Runoff Model 'STORM'", Generalized Computer Program, Users Manual 723-S8-L7520.

Walker, G.P.L., 1987. "The Dike Complex of Koolau Volcano, Oahu: Internal Structure of a Hawaiian Rift Zone", in Volcanism in Hawaii, 2, U.S. Geological Survey Professional Paper 1350, 961-993.

(6401A/430A)

APPENDIX A

COMPUTATION OF THE 10-YEAR AND 20-YEAR DESIGN DRY YEARS

APPENDIX A

A.1 ANNUAL RAINFALL CALCULATIONS

Plate A-1 shows a rainfall map of windward Oahu outlining the project site, the site of the Ahuimanu Loop rainfall station, and the site of the calibration watershed.

Because the median annual rainfall varies for these three locations, a factor is needed to have the rainfall at the Ahuimanu Loop station represent the site and the calibration watershed. The following paragraphs demonstrate how we calculated the rainfall factors.

We obtained hourly rainfall data at the Ahuimanu Loop station from the National Weather Service. From this hourly data, we calculated an average annual rainfall value from the 20 years of record. Table A-1 shows the rainfall values. One year, 1984, was not considered as part of the record because it had over five months of missing or unusable data. The average annual rainfall at the Ahuimanu Loop Station was calculated at 84.1 inches.

From Plate A-1, rainfall at the site was estimated at 60 inches per year, and rainfall at the calibration watershed was estimated at 157 inches per year. Annual rainfall varies within the sites themselves; however, we used the larger rainfall values because stream flow and/or surface water runoff starts in these areas.

To have the Ahuimanu Loop station represent the calibration watershed, the following factor was calculated:

$$\frac{157 \text{ inches/yr}}{84.1 \text{ inches/yr}} = 1.87$$

where,

157 inches/yr = average annual rainfall at the calibration watershed, and
84.1 inches/yr = average annual rainfall at the Ahuimanu Loop station.

To have the Ahuimanu Loop station represent the project site, a factor of 0.71 was used (60 inches/yr / 84.1 inches/yr).

A.2 CALCULATION OF DESIGN DRY YEARS

The Ahuimanu Loop station data shown on Table A-1 was used to calculate the 10-year and 20-year design dry years. Using this data, annual rainfall was plotted against return time, as shown on Plate A-2. The return time is equal to (n+1)/m, where n = the number of years of record, and m = the rank of the event. A best fit line was plotted on the graph (Plate A-2) and then annual rainfall for the 10-year and 20-year return times was read off the graph. The annual rainfall values are:

10-year design dry year = 47 inches
20-year design dry year = 29.2 inches

The 20-year design dry year at Ahuimanu Loop was 1983 (see Table A-1). The closest year at the Ahuimanu Loop station to the 10-year design dry year was 1985, which had 55.1 inches of rain.

To have 1985 represent the 10-year design dry year, a rainfall factor of 0.85 is required (47 inches/yr / 55.1 inches/yr). Therefore, the rainfall factor used to have 1985 from the Ahuimanu Loop station represent the 10-year design dry year at the site is:

$$\frac{47 \text{ inches/yr}}{55.1 \text{ inches/yr}} \times \frac{60 \text{ inches/yr}}{84.1 \text{ inches/yr}} = 0.85 \times 0.71 = 0.61$$

For the computer simulations at the site, this factor, 0.61, was then multiplied by the hourly rainfall data at Ahuimanu Loop.

A.3 PAN EVAPORATION DATA

Pan evaporation data for the site was obtained from Ekern and Chang (1985). Plate A-3 shows annual pan evaporation for Oahu. Annual pan evaporation at the site, as shown on Plate A-3, is between 50 and 60 inches. We selected monthly pan evaporation data from a station that was close to the site and had good quality data. The station we selected is located in Maunawili, southeast of the site, as shown on Plate A-3.

The pan evaporation at this station is slightly lower than at the site; however, there are not many stations to choose from in windward Oahu. The monthly mean pan evaporation values (in inches) at the Maunawili station over a period of record of 8 or 9 years are presented below:

January	3.35
February	3.47
March	4.40
April	4.05
May	4.44
June	4.53
July	4.70
August	4.51
September	4.67
October	4.12
November	3.26
December	3.26
Sum of Monthly Means	48.76

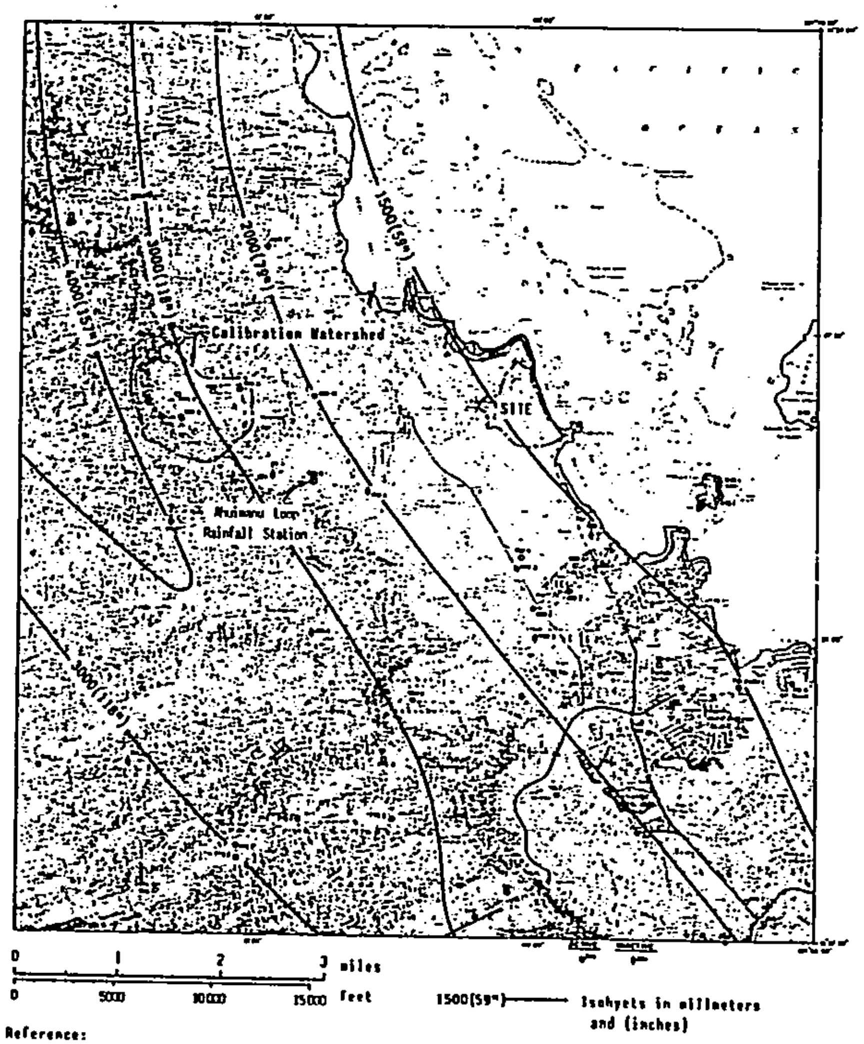
\- o0o -

(6401A/430A)

MALULANI SPORTS COMPLEX
AHUIMANU LOOP YEARLY RAINFALL DATA
18874-001-11

TABLE A-1

YEAR	TOTAL RAINFALL (inches)	
1969	86.7	
1970	82.5	
1971	87.7	
1972	78.1	
1973	75.6	
1974	101.5	
1975	71.3	
1976	65.1	
1977	61.1	
1978	87.7	
1979	89.1	
1980	101.2	
1981	92.9	
1982	150.0	
1983	29.2	
1984	32.8	incomplete record
1985	55.1	
1986	86.0	
1987	108.4	
1988	88.4	
AVERAGE	84.1	excluding 1984



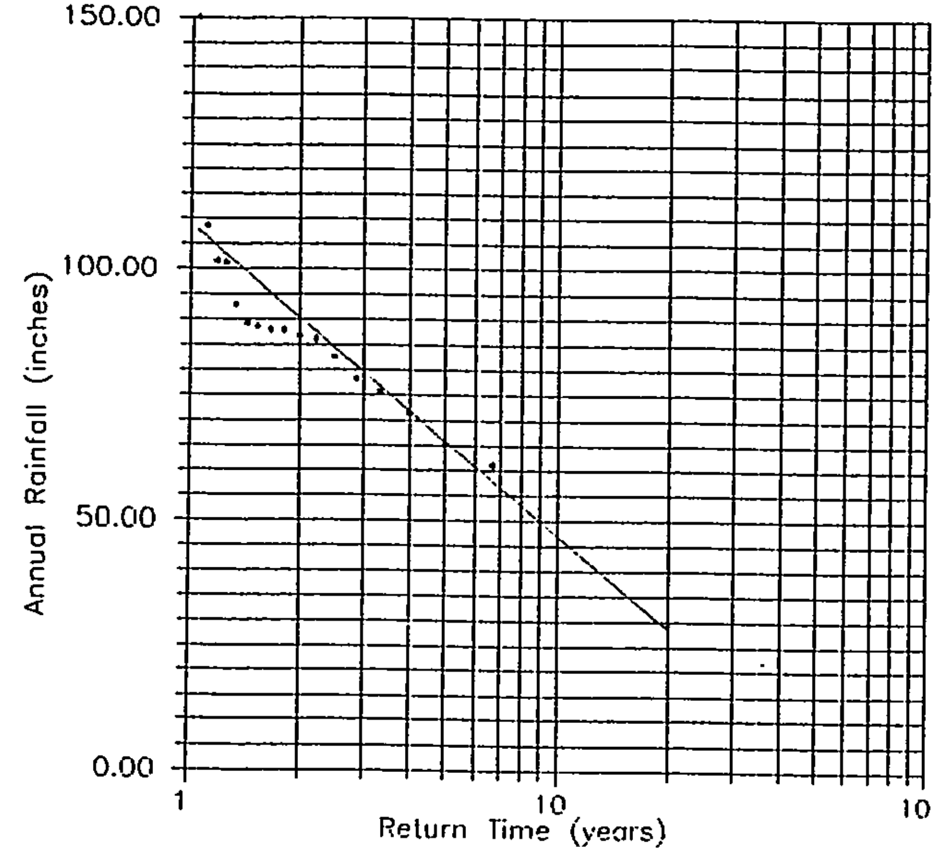
Reference:
Hawaii Department of Land & Natural Resources, Climatologic Station in Hawaii, Report R42, January 1973; p.39.
Hawaii Department of Land & Natural Resources, Rainfall Atlas of Hawaii, Report R76, June 1986;

MEDIAN ANNUAL RAINFALL

Dames & Moore

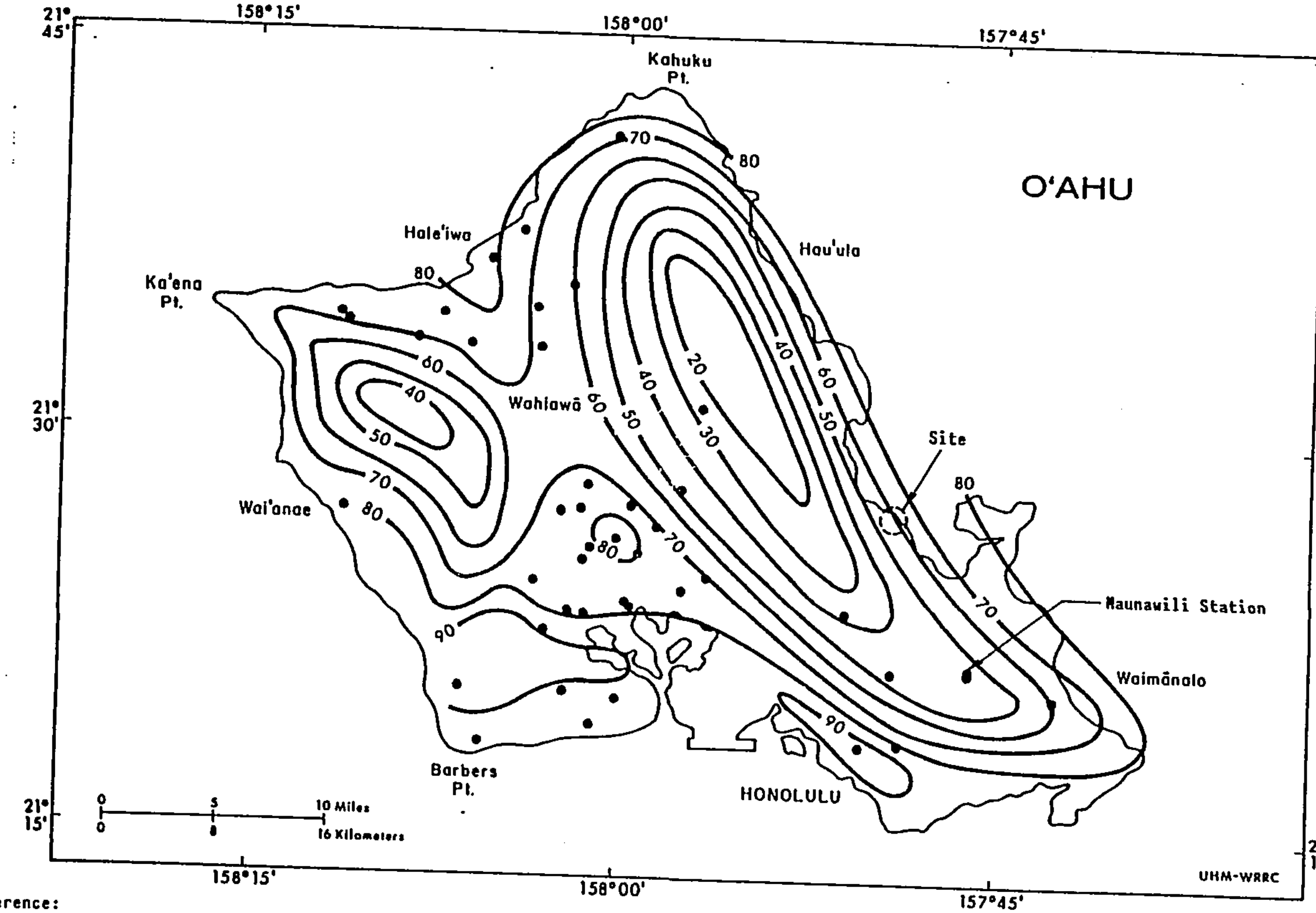
PLATE A-1

ANNUAL RAINFALL VS. RETURN PERIOD
AHUIMANU LOOP
18874-001-11



Dames & Moore

PLATE A-2



Reference:
Hawaii Dept. of Land & Natural Resources
Pan Evaporation: State of Hawaii, 1894-1983; Report R74; August 1985.

PAN EVAPORATION FOR SITE: 50-60

Dames & Moore

PLATE A-3

APPENDIX D

DRAINAGE REPORT
Sam O. Hirota, Inc.

DRAINAGE REPORT

PROPOSED MALULANI SPORTS COMPLEX

HEEIA KEA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY:

4-6-06:1,4,7,9,11,13,15,22-44,48-51; 4-6-16:portion 32

Prepared By:

SAM O. HIROTA, INC.
Engineers and Surveyors
864 South Beretania Street
Honolulu, Hawaii 96813

November 15, 1989

TABLE OF CONTENTS

PROJECT LOCATION AND DESCRIPTION:

The proposed project is located in Heeia Kea Valley mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor (see Figure 1). The project site is approximately 220 acres and is owned by Hanatomi Hawaii, Inc.

Hanatomi Hawaii, Inc. proposes to develop a sports complex on the property (see Figure 2). This proposal includes the construction on an 18 hole golf course, a golf clubhouse (which includes dining and beverage services, meeting and function rooms, health and fitness spa), a tennis club (tennis stadium, and 4 to 6 additional tennis courts), a paved parking lot, a maintenance/storage building, an amphitheatre, and approximately 30 to 35 single family houses.

LANDUSE AND ZONING DESIGNATION:

The property is presently designated conservation and urban in approximately equal areas by the State Land Use Commission. Current zoning allows for 31 residential R-5 lots with the remainder in AG-2 agricultural.

EXISTING CONDITIONS:

Existing Drainage Patterns:

The site's topography consists of varying terrain, with elevations ranging from about mean sea level along Kamehameha Highway to approximately 500 feet at the mauka boundary. Slopes ranging from 15 to 25 percent exists along all boundaries except the makai boundary. Lesser slopes of 0 to 10 percent are found in the center of the property and along Kamehameha Highway.

The property is vacant except for the structure of the former Hawaiian Electric Company, Inc. baseyard. The baseyard is currently being leased to a construction company for the storage of equipment and supplies. Another portion of the property is presently being used by a trucking company for the storage of vehicles. They property is not cultivated and there are no existing residences. The site is covered with mature trees, shrubs, and grasses.

According to the United States Department of Agriculture Soil Conservation Service (USDA SCS), soils in the area of application consists of: Ewa Silty Clay Loam (EmA);

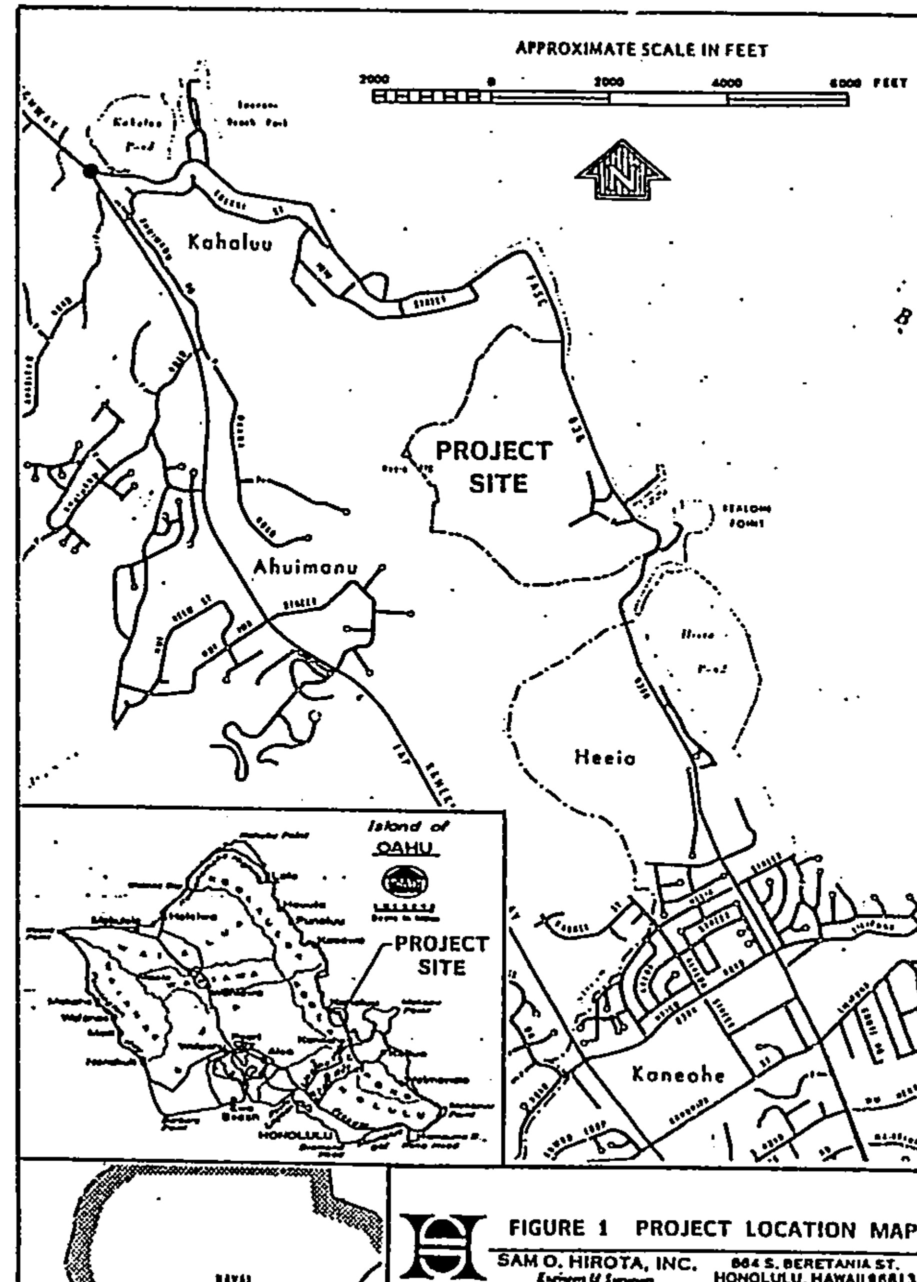


FIGURE 1 PROJECT LOCATION MAP

SAM O. HIROTA, INC. Engineers & Surveyors 864 S. BERETANIA ST. HONOLULU, HAWAII 96813

Mokuleia Clay Loam (Mt); Kokokahi Clay (KtC); Lahaina Silty Clay (LaC); and Alaeloa Silty Clays (AeE and ALF).

There are four existing dry gullies (subbasins) within the property which discharge all storm runoff through 3 existing box culverts and one 48 inch reinforced concrete pipe drain line passing under Kamehameha Highway and discharge into kaneohe Bay (see Figure 3).

The project site is located within Zone D of the Flood Insurance Rate Map and is not subject to City and County of Honolulu Ordinance 80-62 (Flood Hazard Districts). Zone D represents areas of undetermined but possible flood hazard (see Figure 4).

Existing Condition Hydrology:

Since the parcels are greater than 100 Ac, the Rational Method, in accordance with Reference 2, was not applicable. Therefore, a series of analyses was conducted using various methods and recurrence interval of 100 years to establish an acceptable level of on-site storage without disrupting play on the course, and to determine ponding levels across the course for major storm events. The analyses conducted were as shown listed below:

METHOD	RECURRENCE INTERVAL(S) YEARS	REFERENCE NUMBER
"Design Curves for Peak Discharge vs. Drainage Area"	100	2.
SCS - Hawaii	100	3.

The analyses are described in Appendices A and B. The City and County of Honolulu Storm Drainage Standards (Ref 2), provide curves for determining the peak discharge for stream channels and drainage structures. The drainage area of 220 acres results in a peak discharge of 1,500 cubic feet per second (cfs). Estimating existing condition runoff by the SCS method as described in Appendix B, provides a quantity of 439 cfs for the 100 year 24 hour storm.

Although a detailed evaluation of the City culverts mentioned above have not been completed at this time, it seems reasonable that the 100 year storm under the existing conditions would pass through the drainage system without

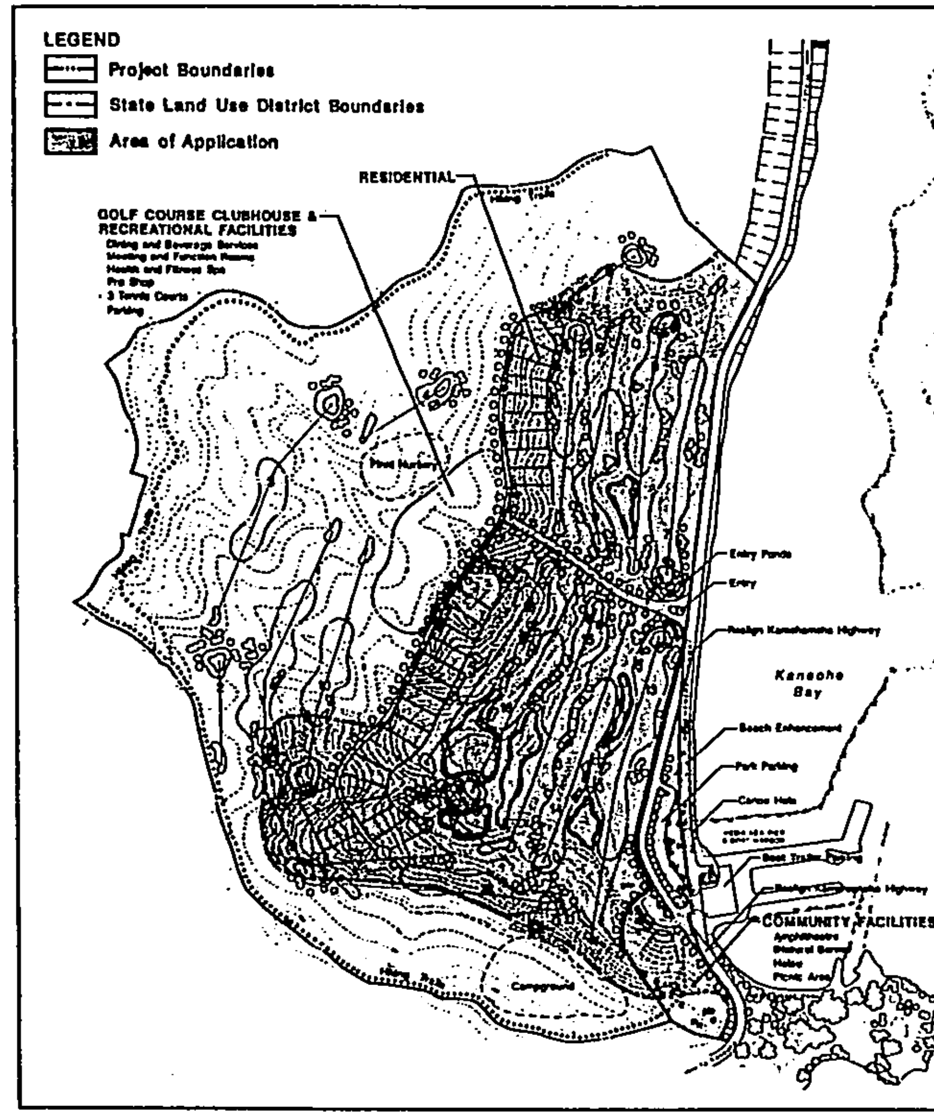
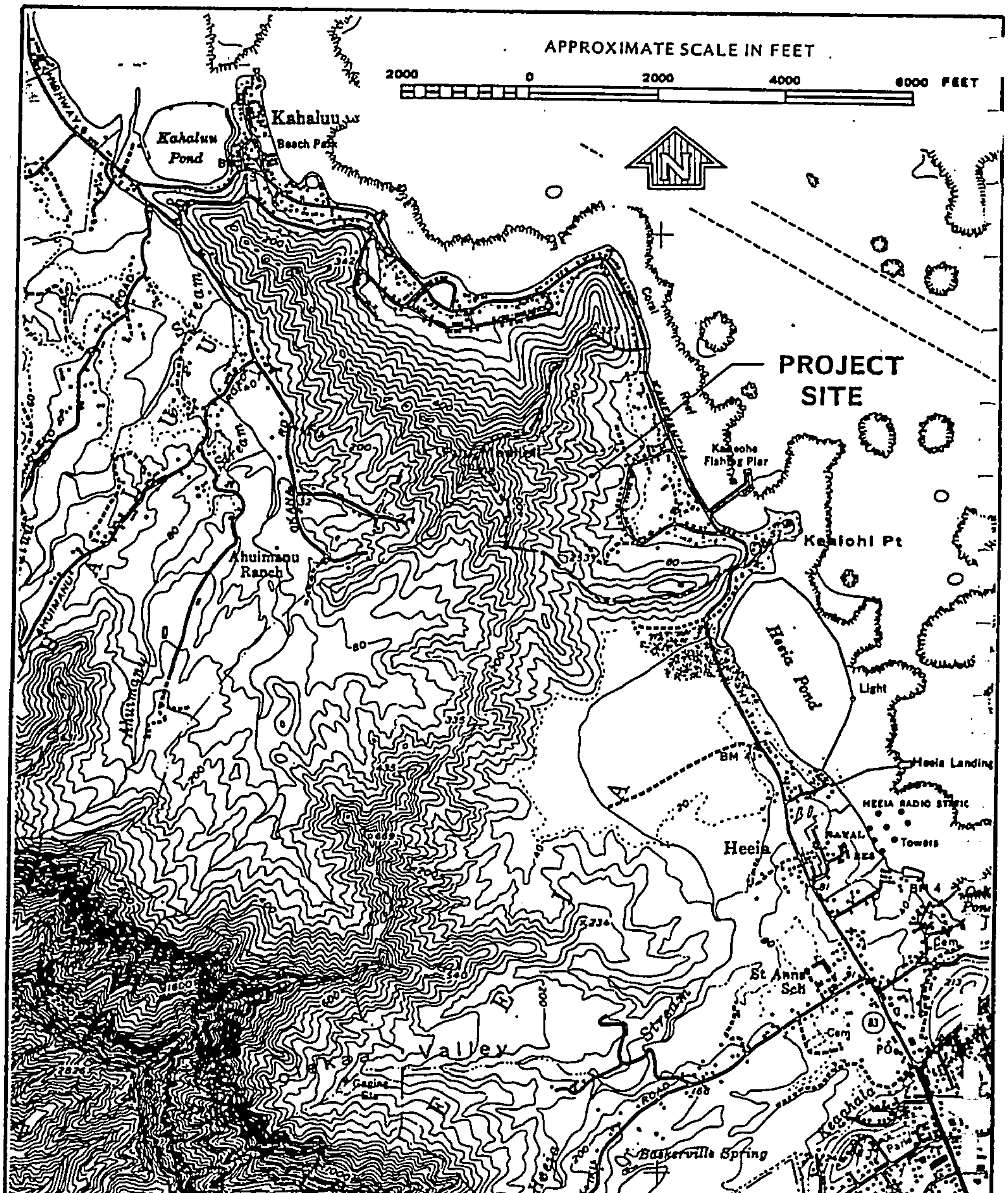


FIGURE 2 SPORTS COMPLEX PLAN

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA



SOURCE:
U.S. Geological Survey
Topographic Map

FIGURE 3 DRAINAGE AREA

SAM O. HIROTA, INC.
Engineers & Surveyors
864 S. BERETANIA ST.
HONOLULU, HAWAII 96813

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X	Areas determined to be outside 500-year flood plain.
ZONE D	Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

(D)——(D) Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

RM7 X Elevation Reference Mark

*Referenced to the National Geodetic Vertical Datum of 1929

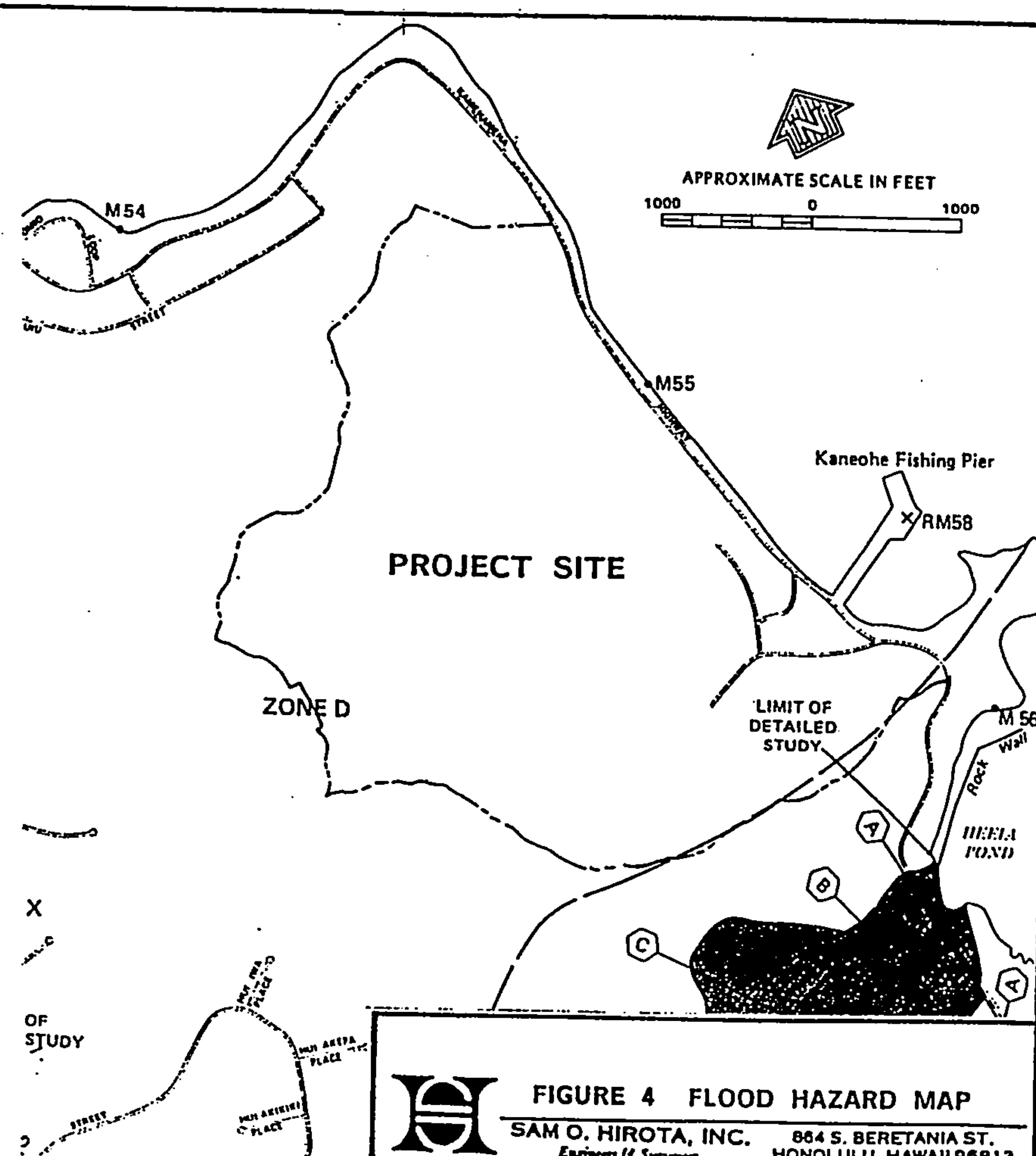


FIGURE 4 FLOOD HAZARD MAP

SAM O. HIROTA, INC. Engineers & Surveyors — 864 S. BERETANIA ST. HONOLULU, HAWAII 96813 damaging Kamehameha Highway. This reasoning is based on the design of the Kamehameha Highway drainage system to accept the 1,500 cfs as described in the City design manual.

DEVELOPED CONDITIONS:

Developed Area Drainage Patterns:

All of the runoff from the proposed project is to be disposed of by a combination of retention for irrigation, detention for sediment control and final overflow into Kaneohe Bay.

All the runoff from the mauka lands is to be intercepted along the roadway bordering the residential lots within the golf course. The intercepted runoff will be channeled to low depressions throughout the golf course for temporary detention.

This swale will be graded to divide the runoff flows into channels which will convey water to the various storage depressions. The swales are proposed to be unlined.

Under the proposed developed conditions, two separate area land uses will exist, tabulated as follows:

LAND USE	AREA
Future residential	16.2 Ac
Golf Course	148.2 Ac

All of these areas will generally drain towards the east. Runoff from the future residential areas will be collected in the swales to be constructed along the boundary of the golf course and directed into collection ponds. Runoff from the golf course itself will to flow into storage depressions.

The proposed drainage system will be designed to City and County of Honolulu standards. Storm runoff will be directed into a series of retention ponds and water features within the proposed golf course and used for golf course irrigation.

Since the drainage and golf course irrigation will be designed to retain storm runoff on-site, the existing drainage structures at Kamehameha Highway appear to have sufficient capacity to handle the storm runoff from the proposed development. The potential decrease of runoff into

Kaneohe Bay would result in decreased volumes of freshwater and suspended sediment discharge, which in turn should have a positive impact on marine biota.

The runoff for a 100 year, 24 hour storm for the 220 acre sports complex was calculated using SCS methodology. This program generates the peak discharge rate and runoff volume.

The proposed sports complex would change the character of approximately 180 acres of the project site. An open, close-cropped landscaping normally associated with a golf course would replace the present dense vegetative cover as would improvements such as buildings, roadways, parking lots.

The proposed improvements would increase the peak runoff from 439 cubic feet per second (cfs) to 556 cfs for the 100 year 24 hour storm. The computations are found in Appendix B using the SCS Runoff Guide. The total amount of runoff is expected to increase slightly from 136.76 acre-ft to 155.28 acre-ft for the 100 year 24 hour storm after development.

The drainage patterns will be slightly altered to divert some of the runoff to proposed irrigation ponds and golf course depressions for temporary storage. Much of the perimeter boundary areas, slopes and vegetation will not be affected by construction activities.

IMPACT AND MITIGATION:

The sports complex improvements will potentially increase the 100 year 24 hour storm runoff by 13.5 percent. Without any mitigation, the increased storm flow would carry additional quantities of silt and debris into Kaneohe Bay.

The proposed ponds and water features would serve as detention silt and debris basins, reducing the peak runoff. The proposed detention basins and designed golf course rough features are expected to reduce the peak runoff discharge to below that of the existing condition.

REFERENCES:

1. "Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review, Malulani Sports Complex." Helber , Hastert and Kimura Planners, September 1989.
2. "Storm Drainage Standards", Department of Public Works, City and County of Honolulu, May 1988.
3. "Erosion and Sediment Control Guide for Hawaii", U.S. Department of Agriculture, Soil Conservation Service (USDA SCS), Honolulu, Hawaii, March 1981.
4. "Computer Program for Project Formulation-Hydrology, Technical Release Number 20", (TR-20), USDA SCS, Washington D.C., Draft May 1982.
5. "Hydrology", SCS National Engineers Handbook, USDA SCS, Washington D.C., Revision August 1972.
6. "Proposed Twenty-Seven Hole Golf Course, Honolulu, Ewa, Oahu, Hawaii", Department of Land Utilization Zone Change Application, August 1987.

DRAINAGE REPORT

PROPOSED MALULANI SPORTS COMPLEX

HEEIA KEA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY:

4-6-06:1,4,7,9,11,13,15,22-44,48-51; 4-6-16:portion 32

APPENDIX A

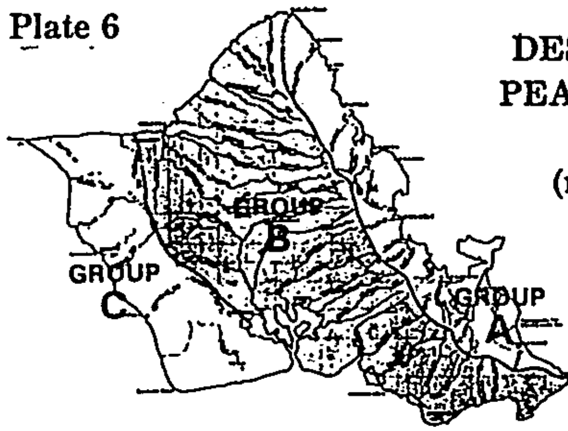
CITY AND COUNTY OF HONOLULU

STORM DRAINAGE DESIGN CURVES

DEPARTMENT OF PUBLIC WORKS - CITY AND COUNTY OF HONOLULU
STORM DRAINAGE STANDARD, MAY 1988

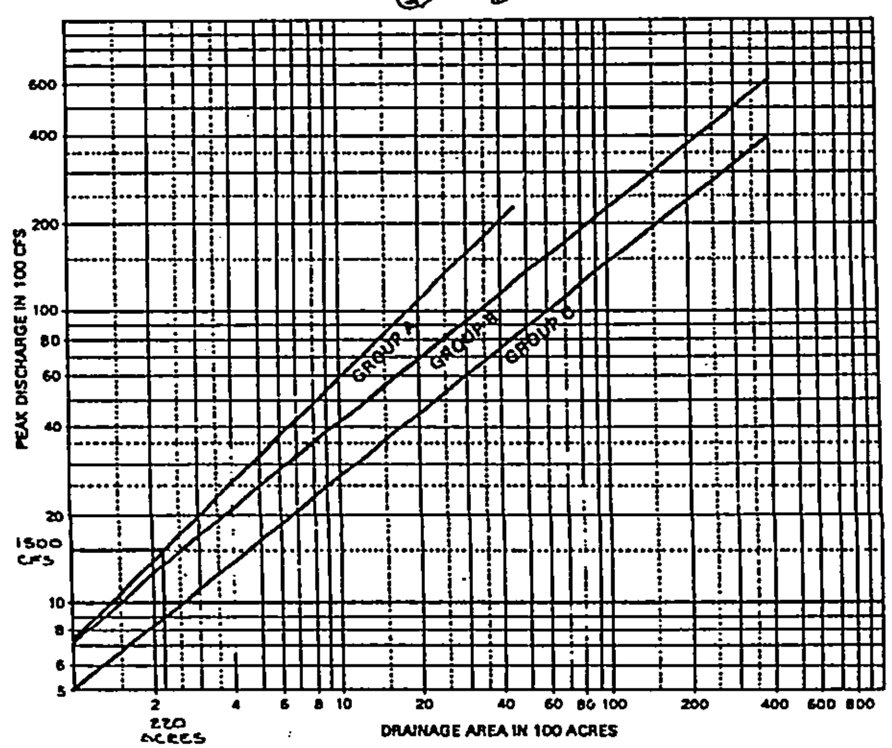
Plate 6

DESIGN CURVES FOR PEAK DISCHARGE VS. DRAINAGE AREA (more than 100 acres)



- CURVES ARE FOR STREAM CHANNELS AND DRAINAGE STRUCTURES.

GROUP A
DRAINAGE AREA 220 ACRES
PEAK DISCHARGE 1500 CFS



SOURCE DATA FROM U.S. GEOLOGICAL SURVEY
REV. MAY 1988

DRAINAGE REPORT

PROPOSED MALULANI SPORTS COMPLEX

HEEIA KEA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY:

4-6-06:1,4,7,9,11,13,15,22-44,48-51; 4-6-16:portion 32

APPENDIX B

SOIL CONSERVATION SERVICE - HAWAII

ESTIMATING RUNOFF

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
EROSION AND SEDIMENT CONTROL - GUIDE FOR HAWAII
MARCH 1981

APPENDIX B

ESTIMATING RUNOFF

SECTION I

Estimating runoff is the process of determining the volume or peak rate of runoff, from a given watershed for the design storm, or the safe yield expected from the watershed. This section establishes procedures for estimating depth and peak rates of runoff and annual and seasonal yield from small watersheds for use in designing soil and water conservation measures.

The procedures for determining yield and peak rates are applicable to drainage areas of 5 to 2,000 acres.

Tables and charts are included for a quick and reliable way to estimate peak rates of discharge and associated runoff volumes for a range of rainfall amounts, soil types, land use, cover conditions and average watershed slope.

Rainfall is the principal source of water that may run off the surface of small watersheds. The kind of soil and type of vegetation growing in it have a major effect on the amount of water that runs off. Mechanical treatment on a watershed, along with its topography and shape, affect the rate at which water runs off. The combined effect of soil, vegetative cover and conservation practices on the amount of rainfall that runs off the watershed are represented by "runoff-curve numbers" (CN's).

TABLE 24. Runoff depth in inches for selected CN's and rainfall amounts

Rainfall (inches)	Curve Number (CN)[1] 60	65	70	75	80	85	90	95	98	55	61
1.0	0	0	0	0.03	0.08	0.17	0.32	.56	.79		
1.2	0	0	0.03	0.07	0.15	0.28	0.46	.74	.99		
1.4	0	0.02	0.06	0.13	0.24	0.39	0.61	.92	1.18		
1.6	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11	1.38		
1.8	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.29	1.58		
2.0	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48	1.77		
2.5	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27		
3.0	0.33	0.51	0.72	0.96	1.25	1.59	1.98	2.45	2.78		
4.0	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77		
5.0	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76		
6.0	1.92	2.35	2.80	3.28	3.78	4.31	4.85	5.41	5.76		
7.0	2.60	3.10	3.62	4.15	4.69	5.26	5.82	6.41	6.76		
8.0	3.33	3.90	4.47	5.04	5.62	6.22	6.81	7.40	7.76		
9.0	4.10	4.72	5.34	5.95	6.57	7.19	7.79	8.40	8.76	3.48	4.22
10.0	4.90	5.57	6.23	6.88	7.52	8.16	8.78	9.40	9.76	4.22	5.05
11.0	5.72	6.44	7.13	7.82	8.48	9.14	9.77	10.39	10.76	5.00	5.86
12.0	6.56	7.32	8.05	8.76	9.45	10.12	10.76	11.39	11.76	5.80	6.71

1. To obtain runoff depths for CN's and other rainfall amounts not shown in this table, use an arithmetic interpolation.

RAINFALL 14 INCHES
CURVE NUMBER 55 (EXIST.) 61 (PROPOSED)
RUNOFF DEPTH 7.46 INCHES (EXIST) 8.47 INCHES (PROPOSED)

TABLE 25. Runoff curve numbers for selected agricultural, suburban, and urban land use

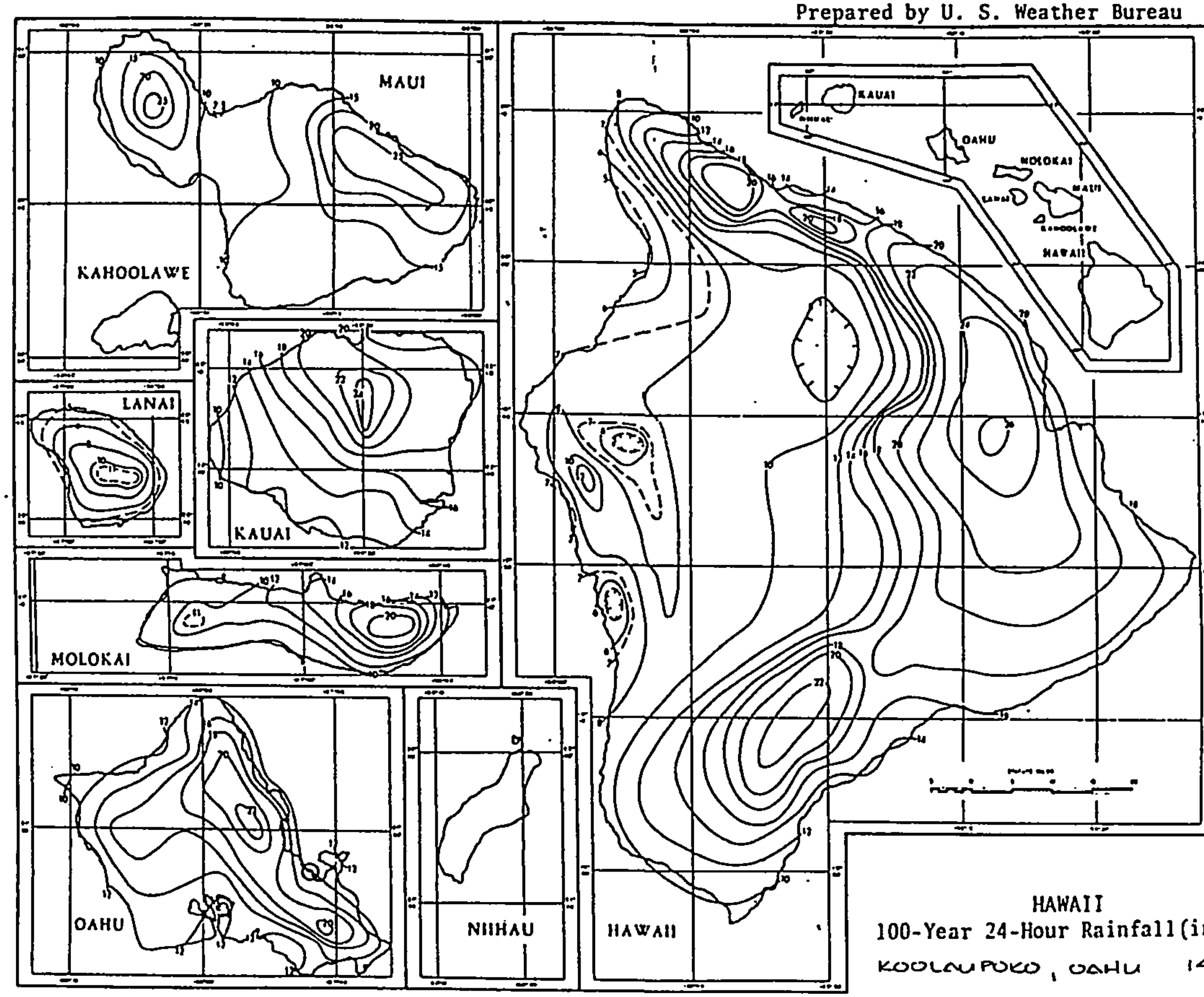
Land use description		Hydrologic soil group A	B	C	D
Cultivated land[1]					
without conservation treatment		72	81	88	91
with conservation treatment		62	71	78	81
Pasture or range land					
poor condition		68	79	86	89
good condition		39	61	74	80
Meadow					
good condition		30	58	71	78
Wood or Forest land					
thin stand, poor cover, no mulch		45	66	77	83
good cover[2]		25	$\boxed{55}$	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.					
good condition					
grass cover on 75% or more of the area		39	$\boxed{61}$	74	80
fair condition					
grass cover on 50% to 75% of the area		49	69	79	84
Commercial and business areas (85% impervious)		89	92	94	95
Industrial districts (72% impervious).		81	88	91	93
Residential[3]					
Average lot size	Average % Impervious[4]				
⅛ acre or less	65	77	85	90	92
¼ acre	38	61	75	83	87
⅓ acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
Paved parking lots, roofs, driveways[5] etc.		95	95	95	95
Streets and roads					
paved with curbs and storm sewers		95	95	95	95
gravel		76	85	89	91
dirt		72	82	87	89

1. For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.
2. Good cover is protected from grazing and litter and brush cover soil.
3. Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.
4. The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

SOIL SYMBOL	SOIL SERIES	HYDROLOGIC CLASSIFICATION
AcE	Alaeloa	B
ALF	Alaeloa	B
EmA	Ewa	B
KtC	Kokokahi	D
LaC	Lahaina	B
Mt	Mokuleia	B

RUNOFF CURVE NUMBER = 55 (EXISTING CONDITIONS)
= 61 (PROPOSED CONDITIONS)

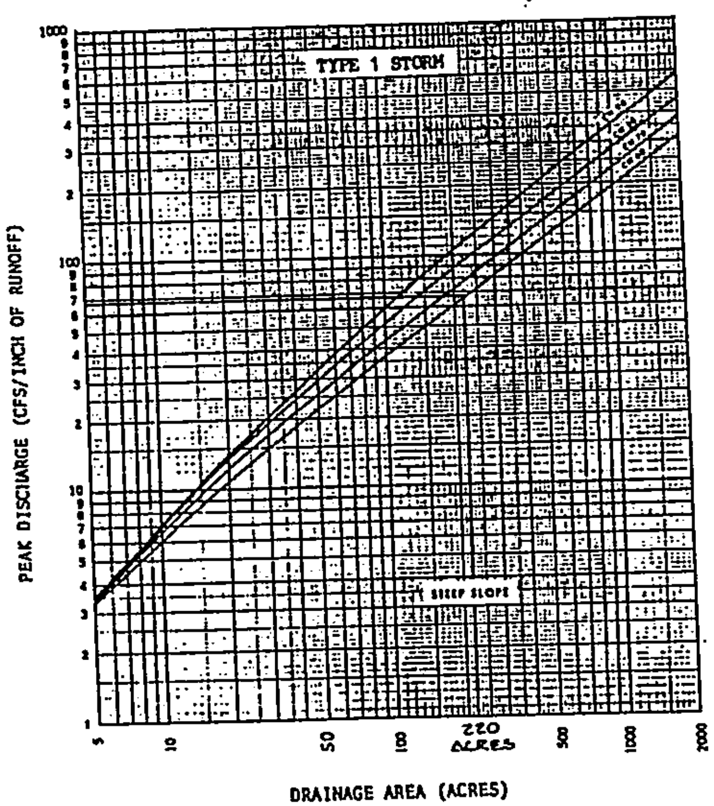
Prepared by U. S. Weather Bureau



HAWAII
100-Year 24-Hour Rainfall (inches)

KOOLAUPOKO, OAHU 14 INCHES

AREA = 220 ACRES
CURVE NUMBER = 55 (EXIST.) 61 (PROPOSED)
PEAK DISCHARGE = 60 CFS/INCH OF RUNOFF (EXIST.)
67 CFS/INCH OF RUNOFF (PROPOSED)



Peak rates of discharge for small watersheds
(24-hour type I storm distribution).
16 % SLOPE

TABLE 28. Slope adjustment factors by drainage areas

Slope %	10 acres	20 acres	50 acres	100 acres	200 acres	500 acres	1,000 acres	2,000 acres
				Flat slopes				
0.1	0.49	0.47	0.44	0.43	0.42	0.41	0.41	0.40
0.2	.61	.59	.56	.55	.54	.53	.53	.52
0.3	.69	.67	.65	.64	.63	.62	.62	.61
0.4	.76	.74	.72	.71	.70	.69	.69	.69
0.5	.82	.80	.78	.77	.77	.76	.76	.76
0.7	.90	.89	.88	.87	.87	.87	.87	.87
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.13	1.14	1.14	1.15	1.16	1.17	1.17	1.17
2.0	1.21	1.24	1.26	1.28	1.29	1.30	1.31	1.31
				Moderate slopes				
3	.93	.92	.91	.90	.90	.90	.89	.89
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.04	1.05	1.07	1.08	1.08	1.08	1.09	1.09
6	1.07	1.10	1.12	1.14	1.15	1.16	1.17	1.17
7	1.09	1.13	1.18	1.21	1.22	1.23	1.23	1.24
				Steep slopes				
8	.92	.88	.84	.81	.80	.78	.78	.77
9	.94	.90	.86	.84	.83	.82	.81	.81
10	.96	.92	.88	.87	.86	.85	.84	.84
11	.96	.94	.91	.90	.89	.88	.87	.87
12	.97	.95	.93	.92	.91	.90	.90	.90
13	.97	.97	.95	.94	.94	.93	.93	.92
14	.98	.98	.97	.96	.96	.96	.95	.93
15	.99	.99	.99	.98	.98	.98	.98	.98
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10
25	1.06	1.08	1.12	1.14	1.15	1.16	1.17	1.19
30	1.09	1.11	1.14	1.17	1.20	1.22	1.23	1.24
40	1.12	1.16	1.20	1.24	1.29	1.31	1.33	1.35
50	1.17	1.21	1.25	1.29	1.34	1.37	1.40	1.43

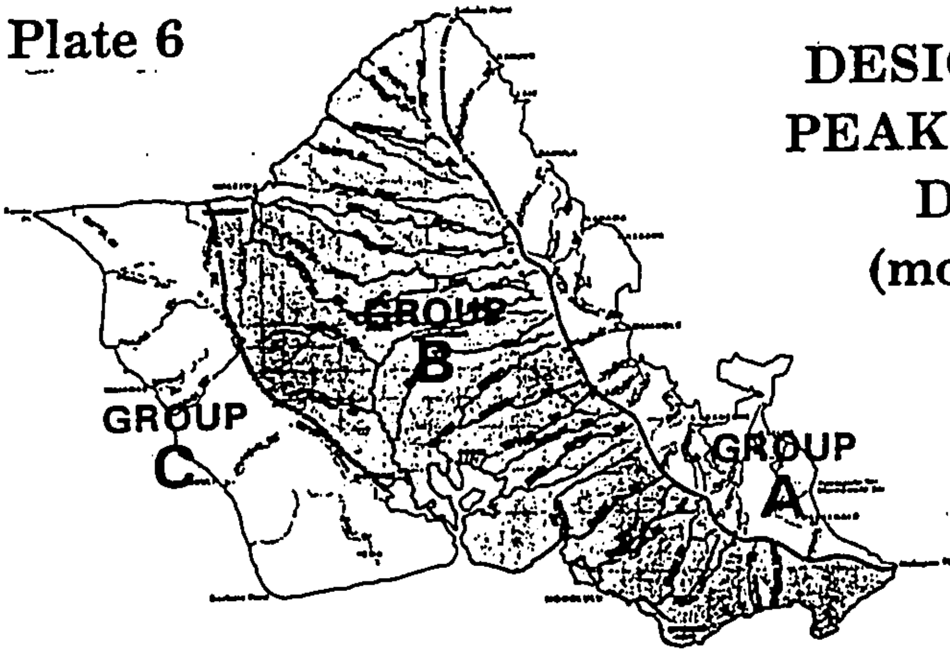
AVERAGE SLOPE = 15 %
SLOPE ADJUSTMENT FACTOR = 0.98

PEAK DISCHARGE FOR 15%

(60 CFS/IN)(7.46 IN)(0.98) = 439 CFS (EXIST.)
(67 CFS/IN)(8.47 IN)(0.98) = 556 CFS (PROPOSED)

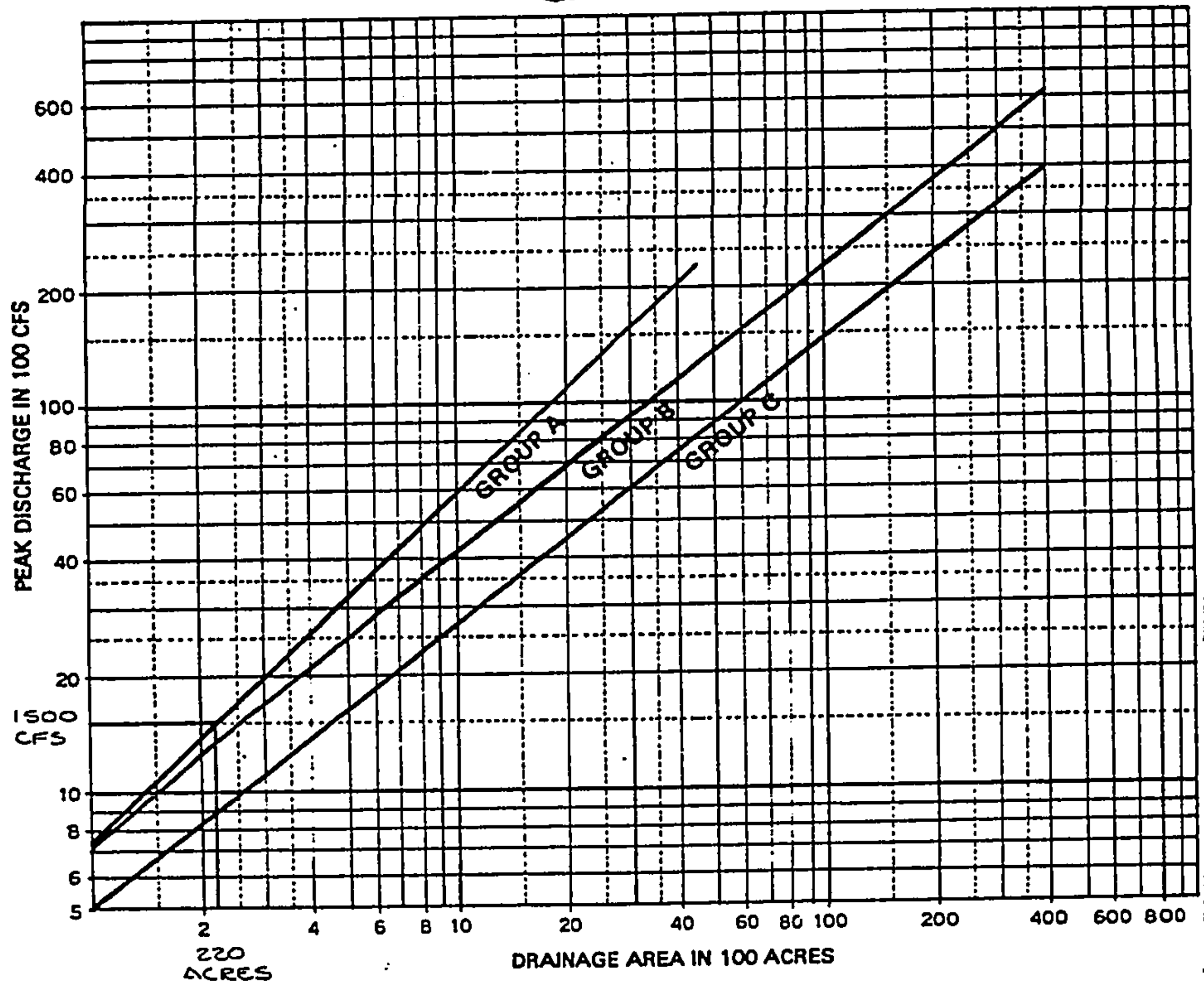
Plate 6

DESIGN CURVES FOR PEAK DISCHARGE VS. DRAINAGE AREA (more than 100 acres)



- CURVES ARE FOR STREAM CHANNELS AND DRAINAGE STRUCTURES.

GROUP A
DRAINAGE AREA 220 ACRES
PEAK DISCHARGE 1500 CFS



SOURCE: DATA FROM U.S. GEOLOGICAL SURVEY, REV. MAY 1988

APPENDIX E

ASSESSMENT OF FERTILIZER,
HERBICIDE AND PESTICIDE USE
ON GOLF COURSE

Charles L. Murdoch, Ph.D. and
Richard E. Green, Ph.D.

ENVIRONMENTAL ASSESSMENT

OF

FERTILIZER, HERBICIDE AND PESTICIDE USE

ON THE PROPOSED

MALULANI GOLF COURSE

A REPORT TO

Helber, Hastert and Kimura, Planners

Draft: June 8, 1989
Revision: December 15, 1989

PREPARED BY

Charles L. Murdoch, Ph. D

Richard E. Green, Ph. D.

I. INTRODUCTION

The Malulani Golf Course will require application of fertilizers to supply essential nutrients to turfgrasses and ornamental plants, and herbicides, fungicides and insecticides to control their associated weed, disease, and insect pests. In this report the generic term "pesticide" will include all chemicals which are used to control pests. These chemicals, although approved by EPA for use in golf course management, could conceivably be subject to movement from the site of application, either by runoff during high intensity storms, or by leaching when water infiltration exceeds evapotranspiration (ET). The proposed site is a moderately high rainfall, low ET area. Additionally, high-intensity storms occur occasionally, resulting in runoff through drainage ways to Kaneohe Bay. Rainfall or irrigation in excess of ET may contribute water recharge to shallow groundwater or runoff, thus irrigation management is an important determinant in the control of chemical movement.

This report provides an environmental assessment for chemicals applied to a eighteen-hole golf course at this site, based on an analysis of site factors and recommended management practices.

II. APPROACH AND INFORMATION RESOURCES

The analysis which follows is based on (1) published reports on rainfall, hydrology and soils of the location and on pesticide properties, toxicology and behavior in soils, (2) a drainage report by Sam O. Hirota, Inc., (3) our own knowledge and experience with golf course management and the reaction and movement of agricultural chemicals in soils, and (4) a site visit on April 21, 1989.

III. ANALYSIS OF RELEVANT FACTORS WHICH MAY IMPACT ON CHEMICAL MOVEMENT

A. Site Factors

1. Topography and soils

A location map, provided by Helber, Hastert and Kimura, Planners, is in the Appendix of this report. The elevation contours on this map show the level topography along Kamehameha Highway, with a rapid increase in elevation as one moves inland. After an initial steep incline at the boundary between the P-1 and AG-2 land use areas, the slope diminishes somewhat, but the elevation continues to rise as one moves west toward the summit of Pu'u Ma'eli'eli (elevation 718 feet). The low lying coastal area is only a few feet above sea level, and appears to be flooded during periods of intense rainfall in the nearby foothills. Surface drainage to Kaneohe Bay appears to be impeded somewhat by mudflats near the shore in the bay. Drainage of this area is probably quite sensitive to tidal levels.

The tentative plan calls for development of an eighteen-hole golf course with thirteen holes to be located in the areas labelled AG-2 and R-5 in the appendix map, and five holes, a practice green and the clubhouse to be located in the central portion of the area labelled P-1 (Sam O. Hirota, Inc., 1989). House lots will occupy a strip at the west boundary of the AG-2 area.

Four soil series occupy the area to be developed (Foote et al., 1972). The level strip along Kamehameha Highway consists principally of Ewa silty clay loam, 0-2% slope, with some Mokuleia clay loam at the north end. The Ewa soil (Aridic Haplustoll, fine, kaolinitic, isohyperthermic) is formed on alluvium from weathering of basic igneous rock. This soil is generally well drained, though found in basins and on alluvial fans. The Mokuleia soil (Entic Haplustolls, sandy, carbonic, isothermic) generally consists of small areas of well drained soils in drainage ways, but can also include small areas of poorly drained clay soils underlain by reef limestone. Both of these soils have slow runoff and no erosion hazard.

Moving inland, there is a strip (300-600 feet wide) of Lahaina silty clay, 7-15% slope, which occupies lower elevation slopes. Classified Typic Torrox, clayey, kaolinitic, isohyperthermic, this soil is a common agricultural soil on Oahu. It is formed from alluvium from weathered basalt, has moderate permeability, medium runoff and moderate erosion hazard.

The higher elevation areas of the AG-2 zone on the Appendix map are occupied by Alaeloa silty clay (Orthoxic Tropohumult, clayey, oxidic, isohyperthermic). The slopes in this area are 15-35%, consequently the soil is subject to moderate runoff and erosion even though the permeability is moderately rapid. The P-1 lands to the west consist principally of the Alaeloa soil also, although the soils in this area were not surveyed in as much detail as the other areas. Slopes in steeper areas are 40-70% and subject to severe erosion.

2. Rainfall and potential recharge

Median annual rainfall for the area is approximately 1500 to 2000 mm (59-79 inches). Monthly median rainfall varies from a low of about 50 to 75 mm for the months of May and June, to a high of about 150 to 200 mm in December. (Giambelluca et al., 1986). Mean annual pan evaporation for the area is approximately 1525 mm (60 inches) (Ekern and Chang, 1985). Thus, on an annual basis, ET is approximately equal to rainfall. However, months with lowest ET are those with highest rainfall, therefore there will be recharge to groundwater and runoff without irrigation during periods of high rainfall and low ET. Actual measured ET data are not available for the Heeia area, but ET for a climatically similar area combined with rainfall data for the Heeia area suggest that about 5 inches of natural recharge could occur during November to January.

3. Groundwater and surface hydrology

The development site is located in the Koolaupoko aquifer system of the Windward sector (Mink and Lau, 1987). The upland areas (elevations exceeding about 50 feet) overlie a high level, unconfined dike aquifer which is currently developed as a drinking water source. It is considered to be highly vulnerable to contamination. Lower elevation areas are associated with two aquifers, one of which overlies the other. Both are in the Koolaupoko aquifer system. The deeper one is a confined, basal, dike aquifer. It is overlain by a basal, unconfined sedimentary aquifer of sufficient salinity (250-1000 mg/L) that it is not used for drinking water. The deeper aquifer has high quality water but is less vulnerable to contamination.

The surface hydrology has been described in a report by Sam O. Hirota, Inc. (1989). The relatively short distance between the shoreline and nearby foothills suggests that lowland areas may be readily flooded when sustained high rainfall occurs. Runoff from the area drains directly into Kaneohe Bay northwest of Heeia Kea Boat Harbor.

B. Management Factors

1. Fertilizers

Fertilizers are applied to golf courses to supply those essential nutrients which are used in large amounts and which are deficient in most soils. In typical soils, the elements which are normally applied in a turfgrass fertilization program are nitrogen (N), phosphorus (P), and potassium (K). Fertilizers are normally applied to only the greens, tees, fairways, and part of the roughs of a golf course. Typical areas in each of these types of turf are estimated in the discussion below.

Turfgrasses use much more N than other elements. Based on turfgrass clipping composition, it has been shown that the turfgrasses grown in Hawaii use about twice as much N as K and about 4 times as much N as P.

The primary fertilizer elements of concern for contamination of ground and surface waters are nitrogen and phosphorus. Phosphorus is attached very tightly to soil clays and moves little if any from the site of application. Phosphorus, therefore will not cause any problem with contamination of drainage water. Ammonium nitrogen (NH_4) likewise moves little in soils. Nitrogen applied in the ammonium form, however, is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. Because of high nitrogen use rates by turfgrasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss by surface runoff or by leaching below the root zone. Thus nitrogen movement can be mitigated by applying a slow-release nitrogen fertilizer in which the nitrogen is in an insoluble form when applied and is released at a rate similar to the nitrogen uptake rate of turfgrasses.

Fertilizer use rates for the different golf course areas are shown in Table 1. Complete fertilizers (ones containing N, P, and K) are usually applied. Because nitrogen is applied in larger quantities and also because it is the only fertilizer element likely to cause contamination of ground or surface waters, only nitrogen application rates are given.

Table 1. Approximate fertilizer use rates for different areas of a typical 18-hole golf course in Hawaii.

Type of turf	Area (acres)	Fertilizer amount (lb. N/1000 sq. ft.)	Application frequency	Total annual application (tons N)
Greens	3	0.5	2 weeks	0.85
Tees	3	1.0	3 weeks	1.15
Fairways	50	1.5	8 weeks	10.00
Roughs	30	1.0	3 months	2.60
Total	86			14.60

2. Pesticides

There are a number of weed, insect and disease pests of turfgrasses in Hawaii which sometimes require application of chemical pesticides. Pesticides are normally applied only in response to outbreaks of pests. There are few instances in which pesticides are applied in a regularly scheduled, preventative program. A typical pesticide program for golf courses in Hawaii is given in Table 2 below. There are several chemicals which may be substituted for certain ones in this suggested program. Properties of the chemicals listed in Table 2, as well as those of most chemicals used in turf in Hawaii, are given in Appendix Table 1.

Table 2. A typical pesticide program for an 18-hole golf course in Hawaii.

Turfgrass area	Area (acres)	Chemical	Frequency	Rate/application	Annual total
I. Herbicides					
A. Greens	3	MSMA bensulide	6 times/year 2 times/year	2 lb. ai/acre 12 lb ai/acre	36 lb. ai 72 lb. ai
B. Tees	3	MSMA Trimec® bensulide	6 times/year 3 times/year 2 times/year	2 lb. ai./acre 1 pint/acre 12 lb. ai./acre	36 lb. ai 9 pints 72 lb. ai
C. Fairways	50	MSMA Trimec® metribuzin	6 times/year 3 times/year 2 times/year	2 lb. ai./acre 1 pint/acre 0.75 lb. ai./acre	600 lb. ai 19 gallons 75 lb. ai.
D. Perimeter areas	20	glyphosate	3 times/year	1.5 lb ai./acre	90 lb. ai.
II. Insecticides					
A. Greens	3	chlorpyrifos	As needed	1 lb. ai./acre	Approx. 18 lb. ai.
B. Tees	3	chlorpyrifos	As needed	1 lb. ai. acre	Approx. 18 lb. ai.
C. Fairways	Spot treatments	chlorpyrifos	As needed	1 lb. ai./acre	Approx. 50 lb. ai.
III. Fungicides					
A. Greens	3	metalaxyl chlorothalonil	As needed As needed	1.3 lb. ai./acre 8 lb. ai./acre	Approx. 25 lb. ai. Approx. 72 lb. ai.
B. Tees	3	metalaxyl chlorothalonil	As needed As needed	1.3 lb. ai./acre 8 lb. ai./acre	Approx. 25 lb. ai. Approx. 72 lb. ai.
C. Fairways	Spot treatments	chlorothalonil	As needed	8 lb. ai./acre	Approx. 250 lb.ai.

3. Irrigation

Because rainfall is not uniformly distributed throughout the year, all golf courses are irrigated to supplement rainfall. Golf courses usually have permanent sprinkler irrigation systems with sophisticated control systems. Many are computer controlled, so that each sprinkler head on the golf course can be adjusted to apply a selected amount of water on each cycle.

Because golf greens are constructed of sand (or primarily sand), the water holding capacity is less than for other areas containing soil. For this reason, golf greens must be watered more frequently than other areas.

Typical evapotranspiration rates for well-watered turf in Hawaii range from 0.1 to 0.3 inches per day, depending on temperature, the amount of sunlight, relative humidity, wind speed, the amount of available water in the soil, etc. Soils store approximately 0.5 to 2.5 inches of available water per foot of depth, depending on soil texture. Sands hold less, clays hold more. Irrigation should be applied when about one-half the available water has been used. The effective rooting depth for mown turf is approximately one foot. Therefore, turfgrasses will need to be watered every day to about once a week depending upon the type of soil and the water use rate.

Irrigation practices may have a large influence on the movement of soluble nitrogen fertilizers in soils. If excessive irrigation water is applied soon after application of soluble nitrogen sources, the chances for runoff or leaching of nitrogen below the root zone is increased. Because of the high cost of irrigation water, there is little incentive to over-water golf courses.

IV. ENVIRONMENTAL IMPACT OF CHEMICALS APPLIED TO THE PROPOSED GOLF COURSE

A. Groundwater and Runoff

The higher elevation dike aquifer is the water body of greatest concern in regard to potential for contamination by fertilizers and pesticides. The portion of the project area which overlies this aquifer is comprised of steeply undulating land, much of which is severely eroded. The lack of a well developed surface horizon enriched with organic matter increases the likelihood that pesticides will leach below the root zone. Also, it will be difficult to establish good turf in these soils initially. Groundwater protection will require that an organic matter barrier be provided in the root zone to retard pesticide movement. This can be done by importing soil with an organic carbon content exceeding 1.5% or by stockpiling good topsoil in the area during grading and subsequently recovering the graded area.The tentative development plan for the area indicates that only five of the 18 holes will be located in the higher elevation area, thus the nitrogen fertilizer and pesticide input to the recharge area will be minimal. Location of more chemically treated areas in the parcel designated P-1 should be avoided.

The lower elevation portion of the project probably contributes recharge to the sedimentary aquifer (Section III-A3) which is less sensitive to low-level contamination because of the elevated chloride levels (250 to 1000 mg/L) which preclude its use for drinking water. The deeper confined basal aquifer would not likely receive recharge from this area due to the sedimentary caprock.

Rainfall and evaporation data (Section III-A2) suggest that natural recharge from rainfall will occur in the winter months, November through January. Given the vulnerability of the high-level aquifer to contamination, fertilizer and pesticide use during this period should be restricted, and only slow release

nitrogen fertilizers used when N application is necessary. Such precautions would be appropriate for lower lying areas also, although the relatively shallow sedimentary aquifer is less sensitive.

Movement of chemicals in surface runoff is of some concern because of the close proximity of Kaneohe Bay to the proposed development. A high intensity rain could conceivably transport recently applied chemicals in runoff to the bay if no mitigating action were taken to retard runoff from treated areas. Satisfactory reduction of chemical transport in runoff can likely be achieved by construction of low berms along natural drainage ways and associated retention basins to capture the early runoff from storms, providing an opportunity for dilution and degradation of pesticides in runoff. Also, careful timing of fertilizer and pesticide applications during normally high-rainfall periods will generally prevent the movement of chemicals into Kaneohe Bay. Use of slow release nitrogen fertilizers and careful irrigation management during periods of high rainfall will also reduce the potential for chemical movement in runoff.

Given the potential for movement of nitrate to both groundwaters and shoreline surface waters during the high rainfall period, a modest monitoring program before, during and after development would be appropriate. Serious negative impacts are not anticipated, but caution should be exercised and sound management is essential.

B. Impact on Migratory Birds and Endangered Hawaiian Waterbirds.

The fertilizers, herbicides, and fungicides used in golf course maintenance pose little or no hazard to birds frequenting the grassed areas or ponds associated with golf courses. Fertilizers are relatively non-toxic unless ingested in large amounts. All herbicides and fungicides used in golf course maintenance in Hawaii are of low to moderate toxicity (Appendix Table 1). The only chemicals used in golf course maintenance in Hawaii which are highly toxic to birds are the organic phosphate insecticides, especially chlorpyrifos.

Although chlorpyrifos is toxic to birds, it is strongly adsorbed on the thatch layer of turf and moves little from the site of application. One reason for its weakness in controlling soil infesting insects is the inability to get the insecticide through the thatch layer to the depth needed to contact these insects. Recent studies (Sears and Chapman, 1980; Tashiro, 1980) have shown that chlorpyrifos applied to turfgrasses does not penetrate more than 2 to 3 centimeters in the soil. In addition to resistance to movement in the soil, it has been shown that it is rapidly degraded in the soil, both by hydrolysis and microbial action (Miles et al. 1979).

Because of the adsorption of organic phosphate insecticides on organic layers in turf and their rapid break down, there is little chance of their movement from grassed areas into the ponds associated with the proposed golf course. Label instructions for application of these pesticides (which turfgrass managers are required by law to follow) specifically prohibit their direct application to streams and ponds.

The likelihood of bird injury by pesticides used in maintenance of the proposed golf course can be reduced by proper application of pesticides with reduced toxicity to birds. The attached table shows that carbaryl and trichlorfon are less toxic to birds than chlorpyrifos. In most cases these insecticides may be substituted for chlorpyrifos with little loss of effectiveness.

Golf courses are often visited by birds. As far as we are aware, there have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management. Waterfowl and fish appear to thrive in ponds and water hazards on golf courses in Hawaii. Many golf courses cultivate white amur fish in the ponds to control algae. Mosquito fish are generally stocked to prevent mosquito problems. We are aware of no incidents of fish or waterfowl injury from chemicals applied to golf courses.

The labeling of herbicides and pesticides for particular uses by EPA with strict laws (enforced by the Hawaii Department of Agriculture) for their use are perhaps the best assurance of protection of humans and wildlife from their hazards. All pesticides must be applied in compliance with federal and state laws regulating their use. Hazards to both humans and wildlife are included in the decision to label a pesticide for specific uses, including use on golf courses, and in developing regulations on allowable application procedures of the pesticide for various uses.

C. Impact on Air Quality.

Most herbicides and pesticides used on golf courses are of relatively low mammalian toxicity, ranging from hundreds to several thousand mg/kg body weight (Appendix Table 1). Because they are not highly volatile and are applied in dilute sprays (50 to 100 gallons of spray solution per acre) to open areas, there is little likelihood of volatility once the pesticides are applied. The greatest danger of significant airborne concentrations of pesticides is from aerial application. Golf course pesticides are applied with ground spray equipment. Boom height of spray equipment is less than one meter. Low spray pressures (20 to 40 psi) and coarse spray droplets further reduce the hazard of airborne fine droplets. Droplets larger than 100 micrometers diameter are not highly subject to drift. Most of the spray volume from typical flat-fan nozzles used in agricultural spray equipment is from droplets larger than 100 micrometers. Table 3 below shows a typical distribution of droplet sizes for a flat-fan nozzle (the type used in most golf course spray equipment).

Table 3. Droplet size range for a typical flat-fan nozzle at 20 and 40 psi. (from Hofman et al., 1986)

Droplet size range (microns)	Percent of spray volume 20 psi	40 psi
0-21	0.1	0.4
21-63	3.0	10.4
63-105	10.7	20.1
105-147	16.2	25.4
147-210	36.7	35.3
210-294	27.5	7.7
>294	5.8	0.7

At the low concentrations used in pesticide application, this would not result in significant quantities of pesticides being carried downwind. High wind speed would increase the likelihood of drift of fine spray droplets, however, because high wind speed distorts spray patterns and results in poor pesticide coverage; spraying in periods of high wind is not common practice. Table 4 below shows the percent of spray application volume deposited at 4 and 8 feet downwind and the distance downwind for the volume to drop to 1% or below for flat-fan nozzles under different conditions. Even under high wind conditions (almost 10 mph) and spraying at 40 psi, the distance downwind at which 1% or less of the total spray volume was deposited was only 17 feet.

Table 4. Percent of spray volume deposited at 4 and 8 feet downwind and the distance in feet for the volume of spray solution to drop to 1% of the total spray volume (from Hofman et al., 1986).

Nozzle ht. (in.)	Pressure (psi)	Wind speed (mph)	Percent deposited 4 ft.	8 ft.	Distance to drop to 1% of volume
14	40	3.5	3.1	0.6	7.0
27	40	3.5	5.9	1.5	13.0
18	30	5.3	9.3	2.2	14.0
18	25	9.9	10.3	3.1	15.5
18	40	9.9	9.1	3.6	17.0

To facilitate spray operations and to comply with label instructions of some pesticides, spray applications are only made in late afternoon or early morning hours when golfers are not on the golf course. This reduces the risk of exposure of people to airborne spray particles. Sufficient buffer space with tall vegetation between the golf course and housing sites and facilities (such as the clubhouse) which will be used by people will further reduce the chance of exposure to airborne pesticide particles.

The greatest danger of airborne pesticides is to the applicators of pesticides themselves. Mixing of wettable powder formulations and being in close proximity to airborne spray particles, particularly when operating spray equipment in a downwind position, places spray operators in particularly vulnerable positions. EPA and OSHA have strict standards which specify that spray operators wear appropriate protective clothing and breathing apparatuses.

V. SUMMARY AND CONCLUSIONS

This study consists of an analysis of factors which contribute to the movement of applied fertilizers and pesticides by water and wind from the proposed Malulani Golf Course near Heeia, Oahu. Relevant published reports were consulted and the site was visited. The normal use of approved chemicals on the golf course should not have an adverse environmental effect, providing some mitigating measures are taken in the construction of the golf course and adequate attention is given to good management of chemicals and irrigation. The following items support our conclusions:

1. Among the fertilizer elements, only nitrogen would likely diminish water quality, since phosphorus sorption on soils would prevent its movement from the site of application. Nitrogen fertilizer movement in runoff could conceivably produce undesirable nutrient enrichment of near-shore waters of Kaneohe Bay. Fertilizer nitrogen movement to Kaneohe Bay can be minimized by constructing berms adjacent to drainage ways crossing the property with associated temporary retention basins to preclude rapid runoff into the bay. Use of slow-release nitrogen fertilizer during the rainy season will also assist in reducing nitrogen movement.

2. Pesticide movement in runoff is much less likely than nitrate movement because of pesticide sorption on the turf thatch and underlying soil and the much lower pesticide application rates. Prevention of immediate runoff by retention basins will further reduce movement of pesticides from the treated area.

3. In regard to groundwater quality, the small treated area currently planned for the mauka portion of the development is not expected to contribute significant chemical movement to the high-level dike aquifer. Even so, careful management of chemicals is warranted. The sedimentary aquifer which is probably recharged by the lower portion of the golf course is more likely to be contaminated because of higher chemical application quantities in this area and the shallowness of the aquifer. However, this aquifer is not as sensitive to low-level contamination because it is not a potential potable water source.

4. The chemicals applied in golf course management pose little hazard for birds or wildlife. Fertilizers are relatively non-toxic unless ingested in large amounts. With the exception of chlorpyrifos, the pesticides are of low toxicity to birds.

5. There will be no significant adverse effects on air quality from application of pesticides in golf course management provided that appropriate application techniques are used. The spray equipment used in golf course maintenance is ground-operated. Nozzle heights are typically less than 2 feet. Low spray pressures and coarse nozzle openings result in relatively large droplet sizes which are not highly subject to drift.

VI. RECOMMENDATIONS

- Irrigation management is critical to the conclusions reached above. For this reason we recommend that a U. S. Weather Bureau class A evaporation pan be used to measure evaporation and schedule irrigation application in the management of the proposed golf course. Excellent discussion of irrigation scheduling can be found in the book Golf Course and Grounds Irrigation and Drainage (Jarret, 1985).

- Where grading is necessary, topsoil should be stockpiled and replaced over the areas to which chemicals will be applied; the high-organic matter containing surface soils will retard pesticide movement. Higher elevation areas which are eroded will require importation of surface soil to enhance rapid growth of turf and reduce pesticide migration.

- Judicious use of fertilizers and pesticides, especially in the early establishment of turf, is essential, since pesticides and nitrogen will be more likely to move before an extensive root system and thatch layer are developed. Use of slow-release nitrogen fertilizer during the rainy season will reduce nitrogen losses to runoff.

- A system of berms and temporary water-retention basins along drainage ways crossing the site will prevent immediate runoff, thus reducing the possible movement of fertilizers and pesticides into Kaneohe Bay.

- Although we do not anticipate significant movement of applied chemicals in either leachate or runoff, a modest monitoring program (perhaps quarterly) for nitrogen in shoreline waters of Kaneohe Bay and in wells in the immediate vicinity seems appropriate.

- As our conclusions are based on the assumption that sound management practices will be followed with regard to fertilizer and pesticide application and irrigation, we recommend that a qualified Golf Course Superintendent be given the responsibility of managing the golf course.

VII. LITERATURE CITED

Cox, D. C. et al. 1973. Estuarine pollution in the state of Hawaii. Vol. 2: Kaneohe Bay Study. Tech Report No. 31, Water Resources Research Center, University of Hawaii, Honolulu.

Ekern, P. C. and J. H. Chang. 1985. Pan Evaporation: State of Hawaii 1894-1983. Report R 74. State of Hawaii Dept. of Land and Natural Resources, Div. of Water and Land Development. 172 p.

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. Soil Conservation Service, U. S. Department of Agriculture, and Univ. Hawaii Agricul. Expt. Station, Honolulu.

Giambelluca, T. W., M. A. Nullet, and T. A. Schroeder. 1986. Rainfall Atlas of Hawaii. Report R76. Department of Land and Natural Resources, Division of Water and Land Development, State of Hawaii. 276 pp.

Hartley, Douglas and Hamish Kidd (Eds.). 1983. The Agrochemicals Handbook. Unwin Brothers, Ltd. Old Working, Surrey, England.

Hirota, Sam O. 1989. Drainage report, proposed Malulani Sports Complex, Heeia Kea, Koolaupoko, Ohau, Hawaii. Unpublished Report.

Hawaii Water Resources Regional Study Team. 1979. Hawaii Water Resources Plan. p. 37. Hawaii Department of Land and Natural Resources, Honolulu.

Hofman, Vern, Henry Kucera and Mark Berge. 1986. Spray Equipment and Calibration. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota 58105. 13 AEng-5-3. 31 pp.

Jarrett, Albert. 1985. Golf Course and Grounds Irrigation and Drainage. Reston Publishing Co. Inc. Reston, VA 22090.

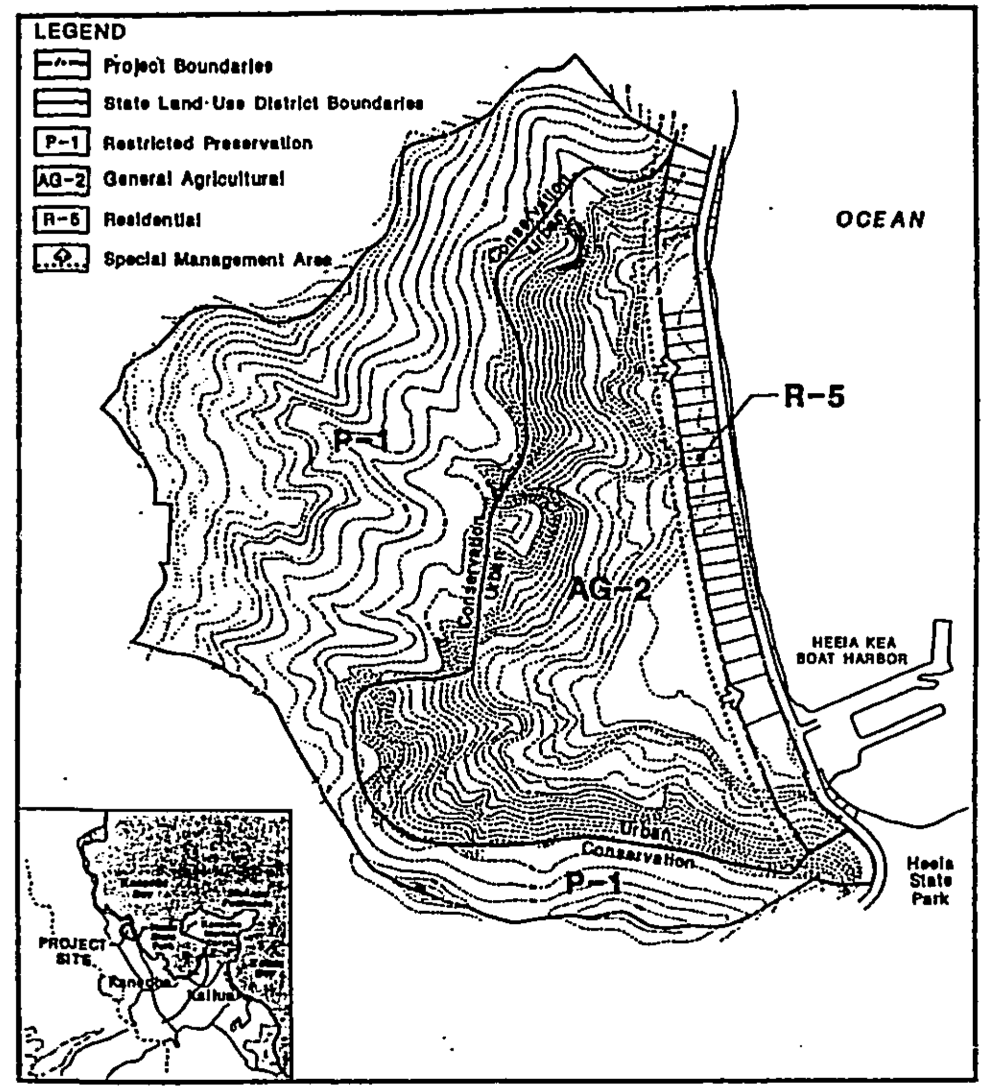
Miles, J. R. W., C. M. Tu, and C. R. Harris. 1979. Persistence of eight organophosphorus insecticides in sterile and non-sterile organic and mineral soils. Bull. Environ. Contam. Toxicol. 22: 312-318.

Mink, J. F. and L. S. Lau. 1987. Aquifer identification and classification for O'ahu: Groundwater protection strategy for Hawai'i. Water Resources Research Center Technical Report No. 179. 28 p.

Sears, M. K., and R. A. Chapman. 1980. Persistence and movement of four insecticides applied to turfgrasses. In: H. D. Niemcyzk and B. G. Joyner (eds.) Advances in Turfgrass Entomology. pp. 57-50.

Tashiro, H. 1980. Distribution and persistence of chlorpyrifos and diazinon in soil when applied to turfgrass. In: H. D. Niemcyzk and B. G. Joyner (eds.) Advances in Turfgrass Entomology. pp. 53-56.

APPENDIX



MALULANI
- State Land Use Districts
- City and County of Honolulu Zoning
- Special Management Area

Appendix Table 1. Properties of pesticides used on turf in Hawaii.

Pesticide common name	Trade name (s)	Oral LD-50 (mg/kg body wt)*	Toxicity to fish and wildlife*	Soil sorption index (Koc)**	Water solubility (mg/l)**	Half-life in soil (days)**	Leaching potential**
I. Herbicides							
MSMA	WeedHoe etc.	1800	Low	10000	1000000	100	Small
glyphosate	Roundup, Kleenup	150	Mod. to birds, none to fish	10000	1000000	30	Small
metribuzin	Sencor	2200	Moderate	41	1220	30	Large
2,4-D	part of mixtures	370-700	High to fish	109	300000	10	Medium
mecoprop	ditto	700-1500	Low	3	660000	21	Large
dicamba	ditto	1000-2000	Non toxic to fish	2	800000	14	Large
oryzalin	Surflan	10000	Mod. to birds, toxic to fish	2700	2.5	60	Small
oxadiazon	Ronstar	8000	Toxic to fish		0.7		
propyzamide	Kerb	5620-8350	Low	990	15	30	Small
simazine	Princep	>5000	Low	138	3.5	75	Large
chlorthal-dimethyl	Dacthal	>3000	Low	5000	0.5	30	Small
bensulide	Betasan, Betamec	770	Mod. to fish	10000	25	60	Small
paraquat dichloride	Ortho Paraquat CL	150	Mod. to birds, none to fish	100000	1000000	3600	Small
benfluralin	Balan	10000	Low to birds, high to fish	11000	0.1	30	Small
II. Insecticides							
chloropyrifos	Dursban	135-163	High	6070	2	30	Small
bendiocarb	Ficam	40-156	High				
carbaryl	Sevin	400-850	Moderate	229	40	7	Small
trichlorfon	Dylox	450-630	Moderate	2	154000	27	Large
III. Fungicides							
anilazine	Dyrene	<5000	Low	3000	10	1	Small
benomyl	Benlate	9590	Low	2100	2	100	Small
chlorothalonil	Daconil 2787	>10000	Low to birds, mod. to fish	1380	0.6	20	Small
iprodione	Chipco 26019 RP	3500	Low	500	13	20	Small
mancozeb	Dithane M-45	>8000	Low	1000	0.5	35	Small
quintozene	PCNB, Terrachlor	12000	Non-toxic	1000	0.44	21	Small
thiram	Tersan	7500	Low	383	30	20	Medium
triadimefon	Bayleton	568	Low	273	260	21	Medium
metalaxyl	Subdue	669	Non-toxic	16	7100	7	Medium
thiophanate-methyl	Cleary 3336	7500	Low	1000	3.5	0	Small

*From: Hartley, Douglas and Hamish Kidd (Eds.) 1983. The Agrochemicals Handbook. Unwin Bros., Ltd. Old Working., Surrey, England.

**From: Wauchope, R. D. 1988. U. S. D. A.-ARS Interim Pesticide Properties Database, Version 1.0. Unpublished

Appendix Table 2. Toxicity classes of pesticides.

Class	Description	Warning Statement	Oral LD50
1	Highly Toxic Skull & Crossbones	Poison,	1-50
2	Moderately Toxic	Danger	51-500
3	Low Toxicity	Warning	500-5,000
4	Very Low Toxicity	Caution	>5,000

APPENDIX F

SURVEY OF WATERS OF THE UNITED STATES

Dana R. Sanders, Sr., Ph.D.

SURVEY OF WATERS OF THE UNITED STATES
ON THE NANATOMI HAWAII, INC. PROPERTY
AT KANEOHE BAY, OAHU, HAWAII

PREPARED FOR

KOBAYASHI, WATANABE, SUGITA, KAWASHIMA, & GODA
HAWAII TOWER, 8TH FLOOR
745 FORT STREET
HONOLULU, HI 96813-3889

BY

DANA R. SANDERS, SR., PHD.
D. R. SANDERS AND ASSOCIATES, INC.
RT. 2, BOX 142
UTICA, MS 39175

20 NOVEMBER 1989

CONTENTS

EXECUTIVE SUMMARY

Background

1. During the planning of a recreational development (Malulani Sports Complex) on a 219-acre site west of Kamehameha Highway at Kaneohe Bay, Oahu, Hawaii, Nanatomi Hawaii, Inc. encountered questions as to whether or not any portion(s) of the project site are subject to federal regulation as "waters of the United States." Subsequently, D. R. SANDERS AND ASSOCIATES, INC. was engaged to conduct a survey of Malulani for areas that technically qualify as wetlands or other categories of "waters of the United States" potentially subject to federal jurisdiction under Section 404 of the Clean Water Act of 1977 and/or Section 10 of the Rivers and Harbors Act of 1899.

Purpose

2. The purpose of this study was to determine the extent to which the Malulani Sports Complex site contains "waters of the United States" potentially subject to federal jurisdiction.

Approach

3. After a general survey was conducted on the project site for areas that might qualify as a category of "waters of the United States," the routine wetland delineation procedures described in Federal Interagency Committee for Wetland Delineation (1989) were applied to the areas of potential "waters of the United States." Portions of the project site qualifying

as wetlands or another category of "waters of the United States" were mapped on a base map.

Results

4. Two types of wetlands were found on the project site: mangrove forest, dominated by *Rhizophora mangle*; and paragrass grassland, dominated by *Brachiaria mutica*. These had wetland indicators of vegetation (dominated by OBL, FACW, and/or FAC plant species), soils (matrix chroma of 1), and hydrology (standing water or saturated soils present at the time of the on-site study). The total area of wetlands on the project site is approximately 1.74 acres.

5. Nonwetlands comprise the remaining 217.26 acres of Malulani. Nonwetland vegetation is diverse, but largely dominated by FACU and UPL species. Some portions of the nonwetlands have *Brachiaria mutica* (FACW) as a dominant species, but lack wetland indicators of soil (chromas typically of 3 or sometimes 2 and unmottled) and hydrology (no evidence of long duration of inundation or soil saturation).

Recommendation

6. I recommend that attempts be made to incorporate the wetlands into the project design without filling them. The vegetation of the wetlands could be altered without a Section 404 permit as long as no fill material is placed in the wetlands. Likewise, it might be possible to excavate a lake in an existing

wetland without a Section 404 permit, as long as all excavated material is deposited in nonwetlands. However, because some portions of the wetlands area could be subject to Section 10 jurisdiction, I strongly recommend that no excavation be conducted in wetlands areas without notifying the local Corps of Engineers regulatory office of the intent to alter the area.

SURVEY OF WATERS OF THE UNITED STATES ON THE NANATOMI HAWAII, INC. PROPERTY AT KANEOHE BAY, OAHU, HAWAII

INTRODUCTION

Background

1. Nanatomi Hawaii, Inc. is planning a recreational development called Halulani Sports Complex on a 219-acre site west of Kamehameha Highway at Kaneohe Bay, Oahu, Hawaii (Figure 1). During the planning process, a question arose as to whether or not the site contains wetlands or other categories of "waters of the United States" subject to federal jurisdiction under Section 404 of the Clean Water Act of 1977 and/or Section 10 of the Rivers and Harbors Act of 1899. These statutes and their associated regulations require an applicant to obtain a permit prior to depositing dredged or fill material in areas subject to federal jurisdication. D. R. SANDERS AND ASSOCIATES, INC. was engaged to conduct a survey of the project site for areas that technically qualify as wetlands or other categories of "waters of the United States" potentially subject to federal jurisdiction.

Purpose and Objectives

2. Purpose. The purpose of this study was to determine the extent to which the Halulani Sports Complex site contains "waters of the United States" potentially subject to federal jurisdication.

3. Objectives. Objectives of this study were:

a. To identify, delineate, and map all portions of the project site that technically qualify as wetlands for purposes of Section 404 of the Clean Water Act.

b. To identify, delineate, and map all portions of the project site that technically qualify as other categories of "waters of the United States" for purposes of either Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.

c. To prepare a report describing methods, results, and conclusions of this study.

Approach

4. A general survey was conducted on the project site for areas that might qualify as wetlands or other categories of "waters of the United States." Then, standard procedures for identifying and delineating wetlands or other categories of "waters of the United States" were applied in areas potentially subject to federal jurisdiction. Areas found to qualify as wetlands or other categories of "waters of the United States" were mapped on a base map (1 inch = 200 feet) .

WATERS OF THE UNITED STATES

5. The term "waters of the United States" refers to all types of waterbodies and special aquatic sites that collectively are subject to federal jurisdiction under Section 404 of the Clean Water Act of 1977 and/or Section 10 of the Rivers and Harbors Act of 1899. The term "waters of the United States" was originally considered to be synonymous with navigable waters, but has been expanded through judicial interpretation to include all navigable waters, their tributaries, adjacent wetlands, and most isolated wetlands (33 U.S.C. 328).

6. Navigable waters. The term "navigable waters" refers to those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Navigable waters may be included under both Section 10 and Section 404 regulations, depending on factors such as type of activity and whether the area to be filled was historically a navigable waterway. Any portion of Malulani that receives tidal influx on a frequent basis would be considered to be navigable waters.

7. Wetlands. Wetlands represent one of six categories of "special aquatic sites" described in the Environmental Protection Agency's Section 404b.(1) guidelines [33 U.S.C. 1344(b)1]. As defined by regulations (33 CFR 328.3), wetlands are:

> "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

The definition of wetlands clearly indicates that such areas are periodically wet long enough to produce saturated soils, and as a result, hydrophytic vegetation. Hydrophytic vegetation refers to any type of vegetation in which the component species have some type(s) of adaptations that allow them to occur in saturated soils. The presence of saturated soils for long duration produces certain distinctive characteristics reflecting soil development under wet conditions. Under normal circumstances, wetland indicators of all three parameters identified in the definition must be present for an area to be considered a wetland. Rooted emergent vegetation distinguishes wetlands from most other types of "waters of the United States."

METHODS

Standard

8. The multiparameter approach, as described in the Federal Manual for the Identification and Delineation of Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation, 1989), was the standard employed to identify and delineate wetlands on the Malulani project site.* Under this approach, an area must exhibit wetland indicators of three parameters -- vegetation, soil, and hydrology -- to qualify as a wetland. However, because many wetlands characteristically lack saturated soils during portions of the year, it is not necessary that an indicator of wetland hydrology actually be present at the time of the on-site inspection.

Field Sampling

9. After reviewing topographic maps and aerial photographs and preliminarily examining the area, it became obvious that the only potential wetlands on the project site were located immediately adjacent to and inland of Kamehameha Highway. Therefore, on-site sampling was limited to these areas. Dr. Evangeline J. Funk assisted in the identification of plant species at sampling locations. The routine wetland delineation procedures contained in Federal Interagency Committee for Wetland Delineation (1989) were applied on-site on 8 November 1989.

* - The project site contains no other categories of "waters of the United States" other than wetlands.

10. Vegetation. Plant community types and their general locations were identified. Dominant plant species occurring in each vegetation layer (i. e., trees, saplings, shrubs, herbaceous, and woody vines) were subjectively determined at representative sampling locations in each community type. The dominant plant species were those having the greatest percent areal cover and/or basal area (tree stratum). All dominant species of all vegetation layers at each sampling station were recorded on data sheets (see Appendix A). The wetland indicator status category of each dominant plant species (see Table 1) was entered on the data sheets. [NOTE: The wetland indicator status category of each species that occurs in wetlands has been assigned by a federal interagency panel for the Hawaii region (Reed, 1988). A copy of the list was obtained from the U. S. Army Corps of Engineers- Pacific Ocean Division.] Any sampling location in which more than 50 percent of the dominant plant species have a wetland indicator status of OBL, FACW, and/or FAC (see Table 1) was considered to have hydrophytic vegetation. Hydrophytic vegetation refers to vegetation that may occur in wetlands.

11. Soil. The soil at each sampling station was examined for indicators of hydric soils. A soil pit was dug to a depth of 15 inches and the various indicators of hydric soils listed in Federal Interagency Committee for Wetland Delineation (1989) were sought. The most important of the indicators is soil color. The

TABLE 1

WETLAND INDICATOR STATUS CATEGORIES USED IN THE NATIONAL LIST OF PLANT SPECIES THAT OCCUR IN WETLANDS (REED, 1988)

Category*	Definition
OBLIGATE PLANTS (OBL)	Plant species whose estimated probability of occurring in wetlands is >99%.
FACULTATIVE WETLAND PLANTS (FACW)	Plant species whose estimated probability of occurring in wetlands is >66%-99%.
FACULTATIVE PLANTS (FAC)	Plant species whose estimated probability of occurring in wetlands is >33%-66%.
FACULTATIVE UPLAND PLANTS (FACU)	Plant species whose estimated probability of occurring in wetlands is 1%-33%.

* - Species whose estimated probability of occurring in wetlands is <1% are considered to be UPLAND PLANTS (UPL).

presence of soils having a matrix chroma of 1 or of 2 with mottles is considered to be indicative of hydric soils.* Soil matrix colors were determined using Munsell Color (1975). In addition, the Honolulu County Soil Conservation Service Soil Survey (U. S. Soil Conservation Service, 1972) was examined to determine the soil series occurring on-site. Any sampling location having a soil series listed in the Hydric Soils of the United States: 1988 (U. S. Soil Conservation Service, 1988) was considered to have hydric soil if the soil characteristics on-

* - The soil matrix is the portion of a soil sample having the predominant color. "Mottles" refers to splotches of contrasting color scattered within the soil matrix. Soil colors are identified using an alpha-numeric system (e. g., 10YR3/1, in which 10YR represents the hue, 3 represents the value of the color, and 1 represents the chroma).

site matched those described in the county soil survey.

12. Hydrology. Indicators of wetland hydrology listed in Federal Interagency Committee for Wetland Delineation (1989) were sought at each sampling location. Wetland hydrology was considered to be present at a sampling location when evidence indicated exposure of the area to long duration of inundation and/or soil saturation in the upper portion of the soil profile. Long duration refers to a period of 7 continuous days or longer. [NOTE: Wetland hydrology was assumed to be present in areas dominated by OBL plant species and having hydric soils (Federal Interagency Committee for Wetland Delineation, 1989).]

13. Wetlands Identification. Wetlands were concluded to be present at sampling locations where wetland indicators of vegetation, soil, and hydrology were found. In addition, areas dominated by OBL plant species and having hydric soils were concluded to be wetlands (wetlands hydrology was assumed to be present).

14. After sampling in both wetlands and nonwetlands, the wetland boundary was established based on vegetation, soil, and topographic position. This required additional analyses of vegetation and examination of soil along the wetland boundary.

Wetlands Mapping

15. Delineated wetland areas were mapped on a 1 inch = 200 feet map. Wetland boundary locations were measured from fixed landmarks, and the locations of wetland boundaries between known boundary locations were estimated.

RESULTS AND DISCUSSION

16. Portions of Malulani qualifying as wetlands are shown on Figure 1, and field data sheets are provided in Appendix A. Two types of wetlands are present at Malulani -- mangrove (*Rhizophora mangle*) forest at the lowest elevations and portions of a paragrass (*Brachiaria mutica*) grassland at slightly higher elevations. All portions of Malulani not specifically shown on Figure 1 as wetlands are nonwetlands.

Mangrove Forest

17. Vegetation. The areas of mangrove forest are dominated by *Rhizophora mangle* (OBL), *Thespesia populnea* (FAC+), and *Cyperus alternifolius* (FACW). Other commonly-occurring species observed in these areas include *Hibiscus tiliaceus* (FACW), with *Pluchea odorata* (FAC) and *Commelina diffusa* (FACW) growing along the forest margins. Therefore, the vegetation clearly qualifies as hydrophytic.

18. Soils. All soils of these areas have a matrix chroma of 1, which is clearly indicative of hydric soil. Since neither of the two soil series (i. e., Ewa and Mokuleia) identified on the county soil survey as occurring in these areas is listed as a hydric soil (U. S. Soil Conservation Service, 1988), the soils in areas dominated by *Rhizophora mangle* are either small inclusions of hydric soils or are man-induced features.

19. Hydrology. Areas dominated by *Rhizophora mangle* represent the lowest elevations on the project site, and are

generally confined to drains and/or ditches having abrupt topographic boundaries. Thus, surface water runoff accumulates and remains in these areas until it flows out of the areas through large box culverts under Kamehameha Highway. Because the soils are moderately well-drained to well-drained, the standing water percolates quite rapidly into the soil and soils become saturated for long duration. All areas dominated by Rhizophora mangle had standing water in some portions at the time of the on-site visit. Prominent oxidized root channels are present, which are strongly indicative of a reducing soil environment resulting from anaerobic soil conditions induced by soil saturation. Oxidized root channels form during periods of long duration of soil saturation. Under such conditions, reduced iron is converted to the oxidized form as oxygen diffuses out of the plant roots into the rhizosphere. Thus, oxidized root channels are strongly indicative of wetland hydrology.

20. Wetlands Identification and Delineation. All portions of the mangrove forest community type were delineated as wetlands based on the presence of OBL plant species, hydric soils, and wetland hydrology.

Paragrass Grassland

21. Vegetation. The vegetation of the portion of the paragrass grassland qualifying as wetlands is dominated by Brachiaria mutica (FACW), Pluchea odorata (FAC), Commelina diffusa (FACW), and Cyperus alternifolius (FACW). Such areas are

located at slightly higher elevations than and adjacent to the mangrove forests. Virtually all areas of the paragrass grassland community type qualify as having hydrophytic vegetation, although not all of the areas dominated by paragrass have the same complement of associated dominant species (see paragraph 28).

22. Soils. The paragrass grassland occurs on the Ewa and Mokuleia soil series. Although neither soil series is listed as a hydric soil, soils in portions of the paragrass grassland community type have matrix chromas of 1, which is clearly indicative of hydric soil. Such areas represent small inclusions of a hydric soil series within the nonhydric series.

23. Hydrology. Soils in portions of the paragrass community type were saturated at the time of the on-site visit. Their location adjacent to the drainage pattern containing the mangrove forest is also suggestive of wetland hydrology.

24. Wetlands Identification and Delineation. Portions of the paragrass community type having hydrophytic vegetation, hydric soil, and wetland hydrology were delineated as wetlands.

Wetlands Summary

25. The total portion of Halulani shown as wetlands on Figure 1 is approximately 1.74 acres. Wetlands are confined to depressions and drainages.

Nonwetlands

26. All portions of Halulani other than those depicted as wetlands on Figure 1 are nonwetlands (217.26 acres). All sloped

portions of the project site lack wetland hydrology, and thus do not qualify as wetlands. Conditions in nonwetlands of the more gently sloping coastal terrace are described in paragraphs 27-29.

27. Vegetation. The vegetation of nonwetlands on the highly disturbed coastal terrace is extremely diverse. Most plants encountered in the area are introduced species, many of which are common ornamental, cultivated, or greenhouse plants. Some formerly cultivated areas are dominated by banana (*Musa* X *paradisiaca*). Large portions of the area are dominated by *Panicum maximum* (FACU) and/or *Brachiaria mutica* (FACW), with scattered *Leucaena leucocephala* (UPL), *Cocos nucifera* (FACU), and *Desmanthus virgatus* (FACU). *Ficus microcarpa* (UPL) occurs in groves on the upper portion of the coastal terrace. Except for *Brachiaria mutica*, all of the above species seldom, rarely, or never occur in wetlands. *Brachiaria mutica*, a FACW species, may occur as much as 33 percent of the time in nonwetlands. It is a highly aggressive, broadly adapted species that can become dominant in virtually any open environment in Hawaii.

28. Soil. None of the soils series (i. e., Alaeloa, Lahaina, Hokuleia, Kokokahi, and Ewa) occurring on Halulani are listed as hydric soils in U. S. Soil Conservation Service (1988). All of these soil series are either well-drained or moderately well-drained. Soils in nonwetland portions of the paragrass grasslands have matrix chromas of either 3 or 2, but without the requisite mottling. No other indicators of hydric soils,

including exposure to long duration of inundation or soil saturation, are present in nonwetland portions of Halulani.

29. Hydrology. Due to the sloping surface and well-drained soils, nonwetlands portions of Halulani lack wetland hydrology. Located at higher elevations than the wetland areas, these areas exhibit no indication of long duration of inundation or saturated soils. The lowest portions of the nonwetlands might occasionally have standing water after major storm events, but only temporarily (not for 7 continuous days or longer).

CONCLUSIONS

30. The total area of wetlands on the Halulani project site (Figure 1) is approximately 1.74 acres. Wetland areas are confined to drainages and depressions. No other categories of "waters of the United States" occur on the project site. The total area of nonwetlands on the project site is 217.26 acres (all portions of Figure 1 other than areas shown as wetlands).

RECOMMENDATION

31. Considering that small portions of Halulani are wetlands potentially subject to Section 404 of the Clean Water Act, I recommend that attempts be made to incorporate these natural features into the project design without filling them. Removal or alteration of the vegetation in wetlands would not require a Section 404 permit if none of the wetland areas are filled. As another possibility, wetland areas could be converted to open water areas without a Section 404 permit if all excavated material is removed and placed in nonwaters. Section 404 only pertains to the filling of wetlands, not excavation in them. However, this activity should not be undertaken without notifying the local Corps District because some portions of the wetlands could be subject to Section 10 jurisdiction.

LITERATURE CITED

Federal Interagency Committee for Wetland Delineation. 1989. "Federal Interagency Manual for Identifying and Delineating Jurisdictional Wetlands," U. S. Army Corps of Engineers, U. S. Environmental Protection Agency, U. S. Fish and Wildlife Service, and U. S. D. A. Soil Conservation Service, Washington, D.C. Cooperative technical publication.

Munsell Color. 1975. "Munsell Soil Color Charts," Kollmorgen Corporation, Baltimore, MD.

Reed, Porter B., Jr. 1988. "National List of Plant Species That Occur in Wetlands, Region H: Hawaii (Draft)," U. S. Fish and Wildlife Service, National Wetland Inventory, Washington, D.C.

U. S. Soil Conservation Service. 1972. "Honolulu County, Hawaii Soil Survey," U. S. Soil Conservation Service, Washington, D.C.

U. S. Soil Conservation Service. 1988. "Hydric Soils of the United States: 1988," U. S. D. A. Soil Conservation Service, Washington, D.C.

APPENDIX A

FIELD DATA SHEETS FOR HALULANI PROJECT SITE

P-1

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Dana R. Sanders Sr. Date: 11/8/89
Project/Site: Malulani State: HI County: Honolulu
Applicant/Owner: Nanatomi Hawaii, Inc. Plant Community #/Name:
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes ✓ No ____ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ____ No ✓ (If yes, explain on back)

VEGETATION

Dominant Plant Species	Indicator Status	Stratum	Dominant Plant Species	Indicator Status	Stratum
1. Rhizophora mangle	OBL	T	11.		
2. Thespesia populnea	FAC+	T	12.		
3. Rhizophora mangle	OBL	H	13.		
4. Cyperus alternifolius	FACW	H	14.		
5.			15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 100 %
Is the hydrophytic vegetation criterion met? Yes ✓ No ____
Rationale: ≥ 50 % of dominant plant species ≥ FAC.

SOILS

Series/phase: Ewa Subgroup:[2] —
Is the soil on the hydric soils list? Yes ____ No ✓ Undetermined ____
Is the soil a Histosol? Yes ____ No ✓ Histic epipedon present? Yes ____ No ✓
Is the soil: Mottled? Yes ____ No ✓ Gleyed? Yes ____ No ✓
Matrix Color: 10YR 4/4 Mottle Colors:
Other hydric soil indicators: saturated soil for long duration
Is the hydric soil criterion met? Yes ✓ No ____
Rationale: chroma 1

HYDROLOGY

Is the ground surface inundated? Yes ____ No ✓ Surface water depth: —
Is the soil saturated? Yes ✓ No ____
Depth to free-standing water in pit/soil probe hole: 13"
List other field evidence of surface inundation or soil saturation.
Prominent oxidized root channels
Is the wetland hydrology criterion met? Yes ✓ No ____
Rationale: Saturated soils, plus oxidized root channels which indicate saturated soil for long duration.

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ____
Rationale for jurisdictional decision: Wetland indicators of all three parameters are present.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] Classification according to "Soil Taxonomy."

260' From ~~South~~ north edge of area 225' south to north across area

P-2

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Dana R. Sanders Sr. Date: 11/8/89
Project/Site: Malulani State: HI County: Honolulu
Applicant/Owner: Nanatomi Hawaii Plant Community #/Name:
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes ✓ No ____ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ____ No ✓ (If yes, explain on back)

VEGETATION

Dominant Plant Species	Indicator Status	Stratum	Dominant Plant Species	Indicator Status	Stratum
1. Panicum maximum	FACU	H	11.		
2. Pluchea odorata	FAC	H	12.		
3. Leucaena leucocephala	UPL	SH	13.		
4. Commelina diffusa	FACW	H	14.		
5. Cocos nucifera	FACU	T	15.		
6. Desmanthus virgatus	FACU	SH	16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 33 %
Is the hydrophytic vegetation criterion met? Yes ____ No ✓
Rationale: < 50 % of dominant species ≥ FAC.

SOILS

Series/phase: Ewa Subgroup:[2]
Is the soil on the hydric soils list? Yes ____ No ✓ Undetermined ____
Is the soil a Histosol? Yes ____ No ✓ Histic epipedon present? Yes ____ No ✓
Is the soil: Mottled? Yes ____ No ✓ Gleyed? Yes ____ No ✓
Matrix Color: 10YR 3/3 Mottle Colors: —
Other hydric soil indicators: None
Is the hydric soil criterion met? Yes ____ No ✓
Rationale: No indicators, chroma > 2.

HYDROLOGY

Is the ground surface inundated? Yes ____ No ✓ Surface water depth: —
Is the soil saturated? Yes ____ No ✓
Depth to free-standing water in pit/soil probe hole: —
List other field evidence of surface inundation or soil saturation.
None; soil friable, not even moist.
Is the wetland hydrology criterion met? Yes ____ No ✓
Rationale: No indicators; soil well-drained.

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ____ No ✓
Rationale for jurisdictional decision: Wetland indicators are lacking for each of the three parameters.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] Classification according to "Soil Taxonomy."

P-3

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Dana R. Sanders, Sr. Date: 11/08/89
Project/Site: Malulani State: HI County: Honolulu
Applicant/Owner: Nanatomi Hawaii Plant Community #/Name:
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

VEGETATION

	Dominant Plant Species	Indicator Status	Stratum		Dominant Plant Species	Indicator Status	Stratum
1.	Panicum maximum	FACU	H	11.			
2.	Leucaena leucocephala	UPL	H	12.			
3.	Brachiaria mutica	FACW	H	13.			
4.				14.			
5.				15.			
6.				16.			
7.				17.			
8.				18.			
9.				19.			
10.				20.			

Percent of dominant species that are OBL, FACW, and/or FAC 33%
Is the hydrophytic vegetation criterion met? Yes ___ No ✓
Rationale: ≤50% of dominant species ≥FAC.

SOILS

Series/phase: Ewa Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ___ No ✓ Gleyed? Yes ___ No ✓
Matrix Color: 10YR3/3 Mottle Colors: —
Other hydric soil indicators: None
Is the hydric soil criterion met? Yes ___ No ✓
Rationale: chroma 2, but no mottles.

HYDROLOGY

Is the ground surface inundated? Yes ___ No ✓ Surface water depth:
Is the soil saturated? Yes ___ No ✓
Depth to free-standing water in pit/soil probe hole: —
List other field evidence of surface inundation or soil saturation.
None
Is the wetland hydrology criterion met? Yes ___ No ✓
Rationale: No indicators

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ___ No ✓
Rationale for jurisdictional decision: Wetland indicators of each of the three parameters are lacking.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] Classification according to "Soil Taxonomy."

P-4

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Dana R. Sanders, Sr. Date: 11/8/89
Project/Site: Malulani State: HI County: Honolulu
Applicant/Owner: Nanatomi Hawaii Plant Community #/Name:
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes ✓ No ___ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ___ No ✓ (If yes, explain on back)

VEGETATION

	Dominant Plant Species	Indicator Status	Stratum		Dominant Plant Species	Indicator Status	Stratum
1.	Commelina diffusa	FACW	H	11.			
2.	Brachiaria mutica	FACW	H	12.			
3.	Cyperus polystachyos	FAC	H	13.			
4.	Leucaena leucocephala	UPL	SH	14.			
5.	Rhizophora mangle	OBL	T	15.			
6.				16.			
7.				17.			
8.				18.			
9.				19.			
10.				20.			

Percent of dominant species that are OBL, FACW, and/or FAC 80%
Is the hydrophytic vegetation criterion met? Yes ✓ No ___
Rationale: ≥50% of dominant species ≥FAC.

SOILS

Series/phase: Ewa Subgroup:[2]
Is the soil on the hydric soils list? Yes ___ No ✓ Undetermined ___
Is the soil a Histosol? Yes ___ No ✓ Histic epipedon present? Yes ___ No ✓
Is the soil: Mottled? Yes ___ No ✓ Gleyed? Yes ___ No ✓
Matrix Color: 10YR4/1 Mottle Colors: —
Other hydric soil indicators: —
Is the hydric soil criterion met? Yes ✓ No ___
Rationale:

HYDROLOGY

Is the ground surface inundated? Yes ___ No ✓ Surface water depth: —
Is the soil saturated? Yes ✓ No ___
Depth to free-standing water in pit/soil probe hole: 3"
List other field evidence of surface inundation or soil saturation.
drainage pattern
Is the wetland hydrology criterion met? Yes ✓ No ___
Rationale:

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ___
Rationale for jurisdictional decision: Wetland indicators of all three parameters are present.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] Classification according to "Soil Taxonomy."

P-5

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Dana R. Sanders Sr. Date: 11/8/89
Project/Site: Malu land State: HI County: Honolulu
Applicant/Owner: Nanatomi Hawaii Plant Community #/Name:
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes ✓ No ____ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ____ No ✓ (If yes, explain on back)

VEGETATION

Dominant Plant Species	Indicator Status	Stratum	Dominant Plant Species	Indicator Status	Stratum
1. Cocos nucifera	FACU	T	11.		
2. Leucaena leucocephala	UPL	T	12.		
3. Ficus microcarpa	UPL	T	13.		
4. Brachiaria mutica	FACW	H	14.		
5.			15.		
6.			16.		
7.			17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 33%
Is the hydrophytic vegetation criterion met? Yes ____ No ✓
Rationale: <50% of dominant species ≥ FAC.

SOILS

Series/phase: Ewa Subgroup:[2]
Is the soil on the hydric soils list? Yes ____ No ✓ Undetermined ____
Is the soil a Histosol? Yes ____ No ✓ Histic epipedon present? Yes ____ No ✓
Is the soil: Mottled? Yes ____ No ✓ Gleyed? Yes ____ No ✓
Matrix Color: 10YR3/2 Mottle Colors: —
Other hydric soil indicators: none
Is the hydric soil criterion met? Yes ____ No ✓
Rationale: chroma 2, no mottles.

HYDROLOGY

Is the ground surface inundated? Yes ____ No ✓ Surface water depth: —
Is the soil saturated? Yes ____ No ✓
Depth to free-standing water in pit/soil probe hole: —
List other field evidence of surface inundation or soil saturation.
None
Is the wetland hydrology criterion met? Yes ____ No ✓
Rationale: No indicator

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ____ No ✓
Rationale for jurisdictional decision: Wetland indicators of each of the three parameters is lacking.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] Classification according to "Soil Taxonomy."

P-6

DATA FORM
ROUTINE ONSITE DETERMINATION METHOD[1]

Field Investigator(s): Dana R. Sanders Sr. Date: 11/8/89
Project/Site: Malu land State: HI County: Honolulu
Applicant/Owner: Nanatomi Hawaii Inc Plant Community #/Name:
Note: If a more detailed site description is necessary, use the back of data form or a field notebook.

Do normal environmental conditions exist at the plant community?
Yes ✓ No ____ (If no, explain on back)
Has the vegetation, soils, and/or hydrology been significantly disturbed?
Yes ____ No ✓ (If yes, explain on back)

VEGETATION

Dominant Plant Species	Indicator Status	Stratum	Dominant Plant Species	Indicator Status	Stratum
1. Cyperus alternifolius	FACW	H	11.		
2. Rhizophora mangle	OBL	SH	12.		
3. Pluchea odorata	FAC	SH	13.		
4. Pluchea indica	FAC	H	14.		
5. Commelina diffusa	FACW	H	15.		
6. Terminalia catappa	UPL	T	16.		
7. Thespesia populnea	FAC	SH	17.		
8.			18.		
9.			19.		
10.			20.		

Percent of dominant species that are OBL, FACW, and/or FAC 85.7%
Is the hydrophytic vegetation criterion met? Yes ✓ No ____
Rationale: >50% of dominant species ≥ FAC.

SOILS

Series/phase: MOKULEIA Subgroup:[2]
Is the soil on the hydric soils list? Yes ____ No ✓ Undetermined ____
Is the soil a Histosol? Yes ____ No ✓ Histic epipedon present? Yes ____ No ✓
Is the soil: Mottled? Yes ____ No ✓ Gleyed? Yes ____ No ✓
Matrix Color: 10YR3/1 Mottle Colors: —
Other hydric soil indicators: None
Is the hydric soil criterion met? Yes ✓ No ____
Rationale: chroma 1.

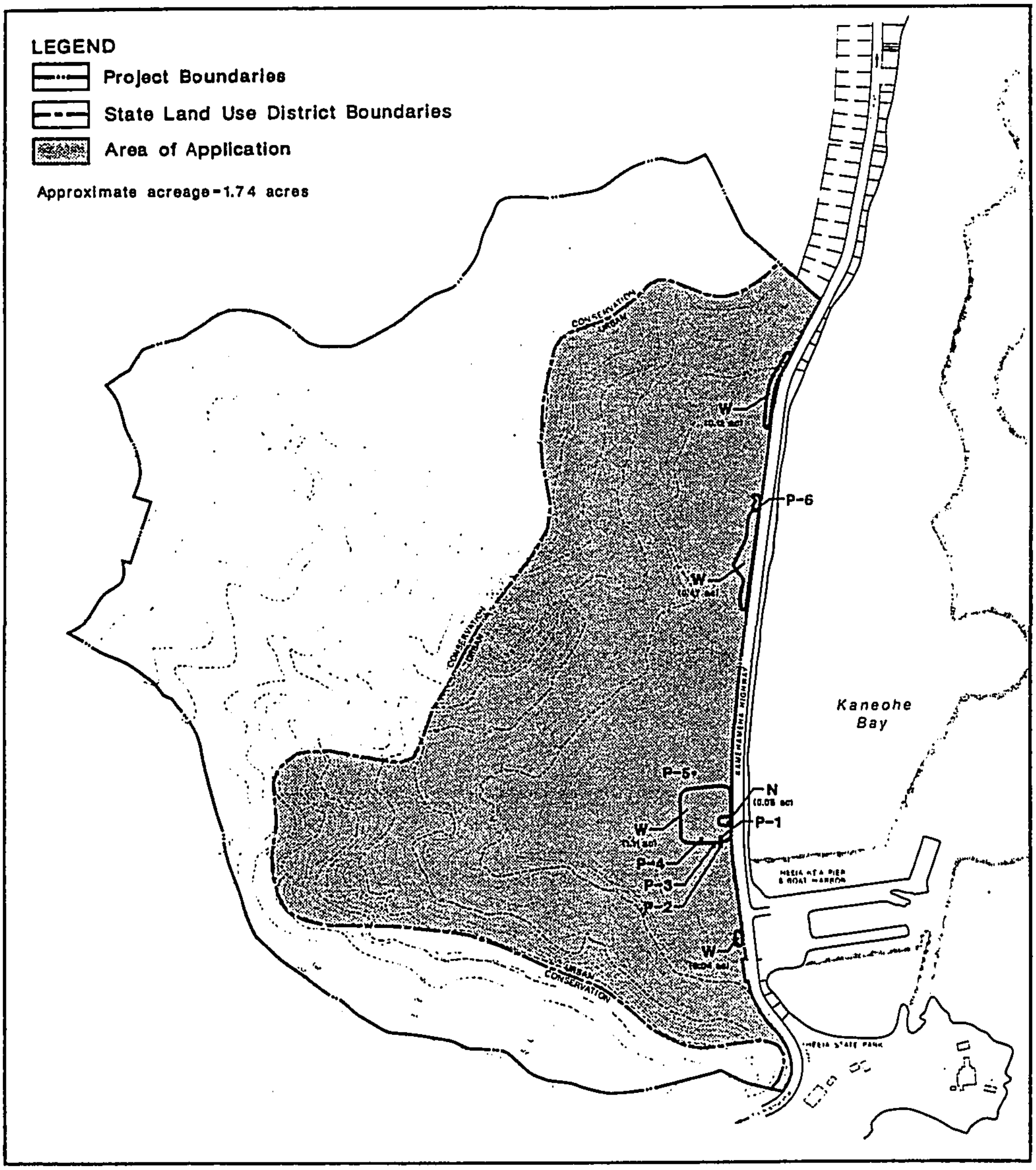
HYDROLOGY

Is the ground surface inundated? Yes ____ No ✓ Surface water depth: —
Is the soil saturated? Yes ✓ No ____
Depth to free-standing water in pit/soil probe hole: 14"
List other field evidence of surface inundation or soil saturation.
drift deposited; tidal influence
Is the wetland hydrology criterion met? Yes ✓ No ____
Rationale: Saturated soil

JURISDICTIONAL DETERMINATION AND RATIONALE

Is the plant community a wetland? Yes ✓ No ____
Rationale for jurisdictional decision: Wetland indicators of all three parameters are present.

[1] This data form can be used for the Hydric Soil Assessment Procedure and the Plant Community Assessment Procedure.
[2] Classification according to "Soil Taxonomy."



0 600
Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

APPENDIX **G**

MARINE ENVIRONMENTAL
SURVEY
Marine Research Consultants

MARINE ENVIRONMENTAL SURVEY

TO ASSESS POTENTIAL IMPACTS FROM THE

PROPOSED MALULANI SPORTS COMPLEX,

HEEIA KEA, OAHU, HAWAII

Prepared for

Helber Hastert & Kimura, Planners
733 Bishop St., Suite 2590
Honolulu, HI 96813

by

Marine Research Consultants
1720-A Paula Dr.
Honolulu, Hawaii 96816

December 15, 1989

INTRODUCTION

Purpose

Nanatomi Hawaii, Inc. is planning a recreational development called Malulani Sports Complex on a 219-acre site in Heeia Kea Valley, Kaneohe, Oahu. The proposed project includes construction of an 18-hole golf course, a golf clubhouse, a tennis club, a paved parking lot, a maintenance/storage building, an amphitheater, and approximately 30 single family homes. The proposed development is mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Kaneohe Fishing Pier/Heeia Kea Boat Harbor. None of the development plans call for alteration of the shoreline or nearshore marine environment.

A possible concern regarding construction and operation of the golf course from the local community as well as various regulating agencies is likely to center on the potential for environmental degradation of Kaneohe Bay resulting from the project. Of particular importance is the potential for runoff of soil, fertilizers, and other chemicals which may be used on the golf course, to cause alterations to water quality and marine life in Kaneohe Bay. The concerns are likely to be particularly acute owing to the status of Kaneohe Bay, and especially the Heeia Kea area, as a prime recreational area for residents.

In the interest of addressing these concerns and assuring maintenance of environmental quality, it has been deemed appropriate to conduct a baseline marine survey and potential impact analysis. The purpose of the following report is to present the results of an initial baseline survey designed to evaluate the potential effects of construction and subsequent operation of the planned golf course development on the marine environment. The survey includes evaluation of water quality and marine community structure in the nearshore areas of Kaneohe Bay, offshore of the planned golf course. Based on these data, as well as review of the existing literature pertaining to estimated changes in drainage from the planned golf course, effects to the marine environment from existing golf courses in Hawaii, and the historical record of human-induced impacts to Kaneohe Bay, evaluations are rendered regarding the potential for impacts from the proposed Sports Complex. The design of the survey is such that the data can also serve as a baseline preliminary phase for any monitoring programs that may be required as a contingency for permit approval by government agencies, including those of the City and County of Honolulu, the State of Hawaii, and the U.S. Army Corps of Engineers.

Objectives

1) to establish a baseline set of water chemistry parameters that characterize the presently occurring environmental conditions of the nearshore ocean directly downslope of the site planned for golf course development. Chemical composition of the environment will be evaluated by analysis of pertinent parameters specified by State of Hawaii, Department of Health water quality standards (Chapter 11-54 S11-54-06 (3)), as well as several other parameters that are not listed by DOH, but provide important information. This range of parameters includes materials that are potentially sensitive to alteration by the effects of golf course construction and operation, particularly sediment and fertilizer input. Particular attention will be given to evaluating the influence of groundwater entering the marine environment downslope of the golf course site. As leaching of irrigation/fertilization materials to groundwater will be the major source of potential impacts from the golf course, characterization of the input of groundwater will be important.

2) to establish a descriptive baseline of biotic communities in Kaneohe Bay in the vicinity of the probable drainage of the proposed golf course. Such a characterization of biotic assemblages will provide a basis for estimating any potential for alteration of community structure as a result of altered drainage patterns.

3) to evaluate the degree of natural stresses (sedimentation, wave scour, freshwater input, etc.) that influence the nearshore marine environment in the area that could be potentially influenced by the proposed project. Typically, the composition of nearshore marine communities is intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed project may either be mitigated in large part, or amplified by natural environmental factors. Therefore, evaluating the range of natural stress is a prerequisite for assessing the potential for additional change to the marine environment owing to shoreline modification.

4) to offer recommendations on scheduling and construction procedures to minimize impacts, based on the characteristics of the environment determined by the baseline.

Overview of Kaneohe Bay

Kaneohe Bay is a semi-enclosed embayment located on the northeast coast of Oahu (see Figure 1). The landward boundary of the Kaneohe watershed is sharply delineated by a nearly vertical mountain range (Koolaus); the seaward boundary of the bay is a barrier reef that extends across the bay mouth. The bay includes components of both estuaries and coral reefs, two quite different kinds of ecosystems. Coral reefs develop best in environments free of terrestrial influence, while estuaries are characterized by input from land, principally by river and stream discharge. Kaneohe Bay is a weakly developed estuary, but is influenced by input from land in the form of freshwater, sediment, and nutrients. In addition, the shape of the bay, as well as submarine topography and relatively weak tidal exchange give the bay a rather poor circulatory pattern. As a result, impacts from shoreline activities may be more acute than along areas of open coastline.

Kaneohe Bay is also one of the most-studied marine ecosystems in the world, as the Hawaii Institute of Marine Biology is located on Coconut Island in the center of Bay. HIMB has served as a field station for investigations with the objectives of documenting impacts to the Bay associated with man-induced activities, such as sewage discharge and episodes of intense flooding and sedimentation from run-off. A brief review of these impacts provides a useful background for the present investigation.

Banner (1974) reviewed the impacts of urbanization associated with the dredging of ship channels to provide access to Kaneohe Marine Corps Air Station, and a ten-fold increase in population in the watershed of the Bay in the decades following WWII. Banner reports that dredging activity prior to World War II caused the removal of about 29% of the living reef, but that the remaining reefs were not permanently damaged by sediment created by dredging. Removal of vegetative cover, exposing soil during the urbanization process, resulted in substantial increases in siltation to the Bay floor. In 1965, torrential rains falling on newly bulldozed lands caused run-off of fine, red silt that caused alteration of normal coral community structure. In addition, the lowering of salinity by flood run-off contributed to reef organism mortality. Torrential rains and floods from a storm in January of 1988 were similar in magnitude to the 1965 event. The 1988 flood also resulted in substantial mortality to corals in the south sector of the bay (P. Jokiel, personal communication).

The effects of sewage discharge in Kaneohe Bay, as well as relaxation of the discharge , have been thoroughly documented by Smith et al. (1981). A major response of biota to the nutrient subsidy supplied by sewage effluent was internal water-column cycling between dissolved nutrients,

phytoplankton, zooplankton, microheterotrophs, and detritus, at rates of productivity far exceeding the rate of nutrient loading. The primary benthic response to effluent discharge was a build-up of detritovorous heterotrophic biomass. During peak sewage discharge, available evidence suggested that no major taxa were totally eliminated, even in the vicinity of the sewer outfall structures. However, the structure of benthic communities was severely altered owing to increased biomass and productivity. This response was most pronounced in the central and northern bay, where nutrient subsidy from sewage supported dense growths of "green bubble algae" (Dictyosphaeria cavernosa). These aggregations of algae outcompeted corals for space, and in some cases smothered living colonies (Maragos 1972). Much of the observed taxonomic alteration apparently represented synergistic effects of biotic "kills" from freshwater run-off and siltation, combined with biotic succession in response to altered nutritional status from sewage. Smith (personal communication), however, feels that without the stresses associated with flooding and siltation caused by shoreline development, coral communities could have probably endured the nutrient subsidies from sewage without alteration in community structure.

After diversion of sewage effluent to an open ocean outfall off Mokapu Peninsula, biomass of both plankton and benthos in Kaneohe Bay decreased rapidly. Five years after diversion, total coral coverage increased, and small colonies were noted in the south Bay. Algal cover (primarily D. cavernosa) decreased by about 75% overall, with the greatest reduction in areas where the alga had previously exhibited peak abundance (Maragos et al. 1985). These studies indicate that while Kaneohe Bay has been subjected to severe environmental insult in the past decades, much of the detrimental changes appear to be reversible when the perturbations are removed.

ANALYTICAL METHODS

Water Quality

All field work was conducted on May 21 and 22, 1989. Figure 1 is a map showing the shoreline and topographical features of the Heela Kea area of Kaneohe Bay, and the location of the proposed development. Survey site locations are identified as transects perpendicular to the shoreline extending across the sand flats and across the channel leading from Heela Kea Small Boat Harbor to the outer Bay. Survey site 1 is off of the drainage culvert located near the northern boundary of the project site; survey sites 2 and 3 bisect the area off culverts in the central region, while site 4 is off the most southern drainage near the southern end of the project.

At each of the survey sites, samples were collected at low tide at 6 distances from the shoreline, ranging from the highest wash of waves to the open water in the channel approximately 200 meters (m) offshore. Water quality parameters evaluated included specific criteria designated for embayments in Chapter 11-54, Section 06 of the Water Quality Standards, Department of Health, State of Hawaii. These criteria include: total nitrogen, nitrate + nitrite nitrogen ($NO_3^- + NO_2^-$), ammonia (NH_4^+), total phosphorus, Chlorophyll a (Chl a), turbidity, and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}), dissolved organic phosphorus (DOP), dissolved inorganic nitrogen (DON) and silica (Si) were also reported because these parameters are relevant indicators of water quality.

Water samples were collected in 1-liter polyethylene bottles. Subsamples for nutrient analyses were filtered in the field through glass-fiber filters into 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and immediately placed on ice. Analysis for Si, NH_4^+, PO_4^{3-}, and $NO_3^- + NO_2^-$ were performed using manual spectrophotometric techniques on a fiber-optic colorimeter. Total nitrogen and total phosphorus were analyzed in a similar fashion following ultra-violet digestion. Dissolved inorganic nitrogen (DON) and dissolved inorganic phosphorus (DOP) were calculated as the difference between total dissolved N and P, and dissolved inorganic N and P. Chemical analytical procedures were performed according to standard methods for seawater analysis (Strickland and Parsons 1968).

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with HgCl to terminate biological activity. Fixed samples were kept refrigerated until turbidity was measured on a Monitek Model 21 nephelometer, and reported in nephelometric turbidity units (NTU). Chl. a was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted and assessed fluorometrically. Salinity was determined using a hand-held refractometer with readability of 1 $^{o}/oo$.

Calcium carbonate content of sediments was determined by drying sediment samples to constant weight, followed by serial dissolution with dilute HCl. After subsequent drying, weight loss revealed proportion of sample composed of $CaCO_3$.

Biological Community Structure

Several methods were employed in the collection of qualitative and quantitative data. Qualitative reconnaissance surveys covering the width of the shoreline fronting the project were conducted by walking and swimming from the shoreline over the sand flat out to the limits of coral reef formation (approximately the 50 foot depth contour). These reconnaissance surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region of study.

Following the preliminary survey, 4 quantitative transect sites were selected along the 4 offshore stations sampled for water chemistry. Each transect site was selected to represent the typical zonation pattern of the particular station. Transects were 165 feet (50 m) long, and were oriented parallel to the shoreline so that they bisected a cross-section of a physical/biological zone. Quantitative benthic surveys were conducted by stretching a surveying tape over the reef surface; An aluminum quadrat frame, with dimensions of 1 m by 0.66 m, was sequentially placed over 10 random marks on the transect tape so that the tape bisected the long axis of the frame. At each quadrat location a color photograph recorded the segment of reef area enclosed by the quadrat frame. In addition, a diver knowledgeable in the taxonomy of resident species visually estimated the percent cover and occurrence of organisms and substratum types within the quadrat frame. Only macrofaunal species greater than approximately 2 cm were noted; no attempt was made to identify and enumerate cryptic species dwelling within the reef framework. Following the period of field work, quadrat photographs were projected onto a grid and units of bottom cover for each benthic faunal species and bottom type were calculated. The photo-quadrat transect method is a modification of the technique described in Kinzie and Snider (1978), and has been employed in numerous field studies of Hawaiian reef communities (e.g. Dollar 1979, Grigg and Maragos 1974, Grigg 1983).

RESULTS AND DISCUSSION

Physical Environment

The nearshore area of Kaneohe Bay north off of Heeia Kea Valley is relatively uniform along the entire length of the proposed project site. A sand flat approximately 200 to 275 m wide fronts the development. The sand flat terminates to the south in the Heeia Kea Small Boat Harbor. The seaward edge of the flat terminates in a sharply sloping wall that delineates the channel leading from the

Harbor to the outer Bay.

The offshore area including the sand flat and channel is characterized by four distinct zones, each with a characteristic substratum and associated biota (see Table 1). Nearest to shore, the flat is composed almost totally of coarse sand. As this area is within the range of tidal fluctuation, attached benthic organisms that require constant immersion in seawater are not present. This nearshore zone is also the area that receives the most direct input of runoff from land. Along the proposed development frontage there are four existing dry gullies which discharge all storm runoff through 3 existing box culverts and one 48-inch reinforced concrete pipe drainline passing under Kamehameha Highway. During storms, drainage flows over the sand flat and mixes with oceanic Bay water.

Analysis of sand from the areas directly offshore of these drainages reveals that the composition is predominantly $CaCO_3$ (see Table 2). Following acid dissolution, residual material appeared to be predominantly black particles of basalt rather than red-brown soil material of terrigenous origin. Inspection of the nearshore area one day after a heavy rainstorm (December 10, 1989) also revealed no layer of organic terrigenous material in the nearshore region of the sand flat. This observation shows a distinctly different nature off areas of permanent streams, such as Waiahole and Waikane Streams in northern Kaneohe Bay, and Kawa and Kaneohe Streams in the southern Bay. In the vicinity of these stream mouths (especially immediately following heavy rains) bottom sediments are composed of layers of terrigenous materials that have been eroded and carried to the Bay by streamflow.

Approximately 25 m from shore, water depth is such that there is constant immersion regardless of the state of the tide. The sand flat bottom is characterized by benthic algae growing on the sandy substratum, as well as on scattered rubble fragments. This benthic algal zone extends to within approximately 25 m of the channel cut. The third sand flat zone, located between the algal zone and the channel cut is an area covered with friable rubble composed of dead coral colonies that appear to be the remains of colonies of _Porites compressa_. From the edge of the channel cut to the bottom of the channel wall bottom cover is composed almost entirely of interconnected thickets of live colonies of _P. compressa_, commonly called "finger coral". The channel floor is composed of calcium carbonate sand.

Water Chemistry

Table 1 shows results of water chemistry analyses at all of the Kaneohe Bay sampling sites shown in Figure 1. Plots of concentrations of 7 parameters as functions of distance from the shoreline are shown in Figure 2. With respect to salinity, it can be seen in that there is only a slight indication of freshwater input near the shoreline. Salinity is slightly depressed (30-31$^{o}/oo$) on transects 2 and 3. As sampling was undertaken during a period when no visible drainage from the 4 culverts was entering the Bay, the observed small variation in salinity can be considered typical of "dry" drainage conditions. During conditions of storm drainage, the pattern of salinity distribution obviously changes with substantial freshwater input at the shoreline.

Examination of nutrient concentrations (Si, PO_4^{3-}, NO_3^- and NH_4^+) as functions of the distance from shore (Figure 2) shows a slight depression at a distance of 25 m from shore at all transects. Such a depression may be the result of nutrient uptake by benthic algae, or by a circulation anomaly. PO_4^{3-} and NO_3^- show concentration spikes at transect 4 at the shoreline sampling point. The slight elevation of Si at the same locale indicates that this area may either be a site of groundwater efflux, or recent surface runoff. Samples from 50 to 200 m offshore showed little variation with respect to either distance or transect location.

Chl. a concentrations were generally highest in samples taken from stations within 25 m of the shoreline. Elevated Chl. a may be a result of either resuspended fragments of benthic algae in the water column, or phytoplankton. Turbidity decreased with distance from shore, probably as a result of sediment stirring by tidal and wind action.

Specified limits of the measured water quality parameters set forth by the Department of Health for embayments are also shown in Table 1. DOH criteria are shown for both "wet" and "dry" conditions. The wet condition are applied when the average daily fresh water inflow to the embayment is greater than 1% of the bay volume. Conversely, dry conditions are applied when freshwater inflow is less than 1% of the bay volume. Smith et al. (1981) estimate that the volume of Kaneohe Bay is 268 x 10^6 m^3, while net freshwater input is estimated at approximately 272 x 10^3 m^3 day^{-1}. These estimates indicate that there is an average daily freshwater input of about 0.1% of the Bay volume. Therefore, in comparing measured values to DOH specific parameters, it appears that "dry" criteria are most applicable.

When comparing transect water chemistry concentrations with DOH water quality standards (Table 1), it can be seen that no measured values of TP, TN and NH_4^+, exceed the most stringent DOH standard (geometric mean for dry conditions). None of the measured values exceed the "not to exceed more than 2% of the time" DOH dry criteria limits, and only 1 measurement (NO_3^- at sample 4-1) is greater than the "not to exceed more than 10% of the time" DOH criteria.

It was not possible under the time limitations of the present study to collect a comprehensive data set that characterizes the temporal variability of nutrient dynamics in the region of Kaneohe Bay adjacent to the proposed development. Several long term studies, however, have provided time-integrated estimates of nutrient dynamics in Kaneohe Bay. Smith et al. (1981) provide a complete budget of nutrient fluxes in Kaneohe Bay, and have partitioned these fluxes into various geographical sections. The region of Kaneohe Bay containing the present study site is characterized as the Central Bay. Following diversion of sewage discharge, dissolved TN concentrations in the central Bay averaged was 6.3 uM; NO_3^- was 0.27 uM, NH_4^+ was 0.38 uM, dissolved TP was 0.28 uM, PO_4^{3-} was 0.09 uM, dissolved Si was 9.1 uM, and chlorophyll concentrations averaged 0.60 ug/L (measured from 1977 to 1979). Examining the means and standard deviations of nutrient parameters measured during the present survey (Table 1) reveals that, with the exception of Si, all of the mean values from the combined data set of the present survey are less than the long-term means assembled by Smith et al. (1981).

Taguchi and Laws (unpub. manuscript) have measured particulate nitrogen and Chl a on a weekly basis over a two-year period from 1986 to 1988 at a station in southeastern Kaneohe Bay. Particulate concentrations showed considerable temporal variability both within and between years. High concentrations were associated with periods of above average rainfall. Heavy rains in January of 1988 resulted in Chl. a concentrations of almost 4 times the highest concentration measured during the period when sewage was being discharged into the south Bay. Large increases in nutrient concentrations from land runoff, as well as from the decomposition of organisms killed by salinity stress from storm runoff, were the apparent causes of the spectacular bloom. However, within 2 weeks, Chl.a and nutrient levels had returned to pre-storm conditions, indicating that while the impacts of single intense events can be significant, the duration of the impacts is short, and does not necessarily cause irreversible changes to the environment.

Benthic Community Structure

Qualitative and quantitative surveys of the region fronting the proposed development indicate that between the shoreline and the channel slope, the entire bottom is composed primarily of sand or rubble. On the sand and mud flat in the central Bay, the majority of the macrofaunal community is composed of burrowing shrimp (Alpheus mackayi), gobiid fish, and occasional portunid crabs . The shrimp appear to be the dominant member of the soft-bottom marcrofaunal community, and occur in densities of up to 10-20 individuals per square meter (Harrison 1981). The soft sediment meiofaunal and microfaunal communities remain uncharacterized.

Table 3 shows the percentage of benthic cover on transects. With the exception of the channel wall zone, dominant biota consisted of benthic algae. Nine genera of algae were encountered on transects, with the most abundant being Padina spp., Acanthophora specifera and Sargassum spp.. Most benthic plants were growing either to limestone rubble, or directly on the sandy substratum.

At the seaward edge of the sand flat, a narrow zone occurs where bottom cover is dominated by rubble fragments composed almost completely of dead segments of Porites compressa skeletal structures. These rubble fragments are extremely friable and are covered with a short algal turf.

At the juncture of the sand flat and the boat channel, bottom cover consists almost entirely of an interconnected mat of living colonies of P. compressa. These mats extend from the top of the sand flat over the nearly vertical channel wall in near continuous cover. In several areas, large blocks of the P. compressa mat have calved off of the main reef structure and are lying on the channel floor. Only three other species of corals, P. lobata, Monlipora verrucosa and Pocillopora damicornis were observed in the coral/channel wall zone, and occurrence of these species was extremely low.

CONCLUSIONS

Sediment Stress

The main objective of this baseline survey is to estimate the potential for impact to the marine environment from construction and operation of a golf course and associated recreational features landward of the shoreline of Kaneohe Bay. Because the project plans do not entail any shoreline modification, potential problems could arise only from changes in input to the marine environment from erosion of soils, or chemical subsidies from fertilizers and pest control agents.

A recent literature review compiled by the Golf Course Superintendents Association of America (GCSAA)(November 1988) summarizes the impacts of existing golf courses on environmental quality. Overall, the findings indicate that golf courses do not pose a significant pollution threat to the nation's water supplies. With respect to impacts from erosion, golf courses actually help reduce sedimentation pollution by increasing soil stability through thick layers of grass thatch. Carefully managed golf course turf grasses have been found to have 15 times less runoff than does a lower quality lawn. Studies have also shown that grasslands experience 84 to 668 times less erosion than areas planted in wheat or corn (DeBoot and Grabriels 1980). Golf courses can also greatly reduce erosion and runoff effects compared to other land uses, such as roadways, buildings, or parking lots.

However, potential for increased sedimentation (soil erosion runoff), does exist during the period of construction. During the construction process, proper planning to reduce exposed acreage at any one point in time is essential to minimize the potential for increased erosion. Temporary increases to sediment loading in the nearshore environment of Kaneohe Bay in the vicinity of Heela Kea could pose the potential for temporary negative impacts, as the sediment composition of the sand flat does not contain a sizable fraction of terrigenous material (as do areas off of permanent streams in other areas of Kaneohe Bay).

Following construction of the project, operation of the Sports Complex may result in alteration of the current drainage pattern of runoff into Kaneohe Bay. A drainage report for the Malulani Sports Complex (S. O. Hirota, Inc. 1989) provides an assessment of such alterations. The proposed project would change the character of the 180-acre site from dense vegetative cover to a close-cropped landscape normally associated with golf courses. In addition, project plans would include construction of impervious structures such as buildings, roadways, and parking lots.

According to calculations presented in the drainage report (Hirota, 1989) the proposed changes in land use would increase peak runoff about 26% from 439 cubic feet per second (cfs) to 556 cfs for a 100-year storm of 24-hour duration. The total amount of runoff following project completion is expected to increase slightly (about 13%) from 136.8 acre-feet to 155.3 acre-feet from the same 100-year storm.

Without any mitigation, these increases in runoff owing to the development would likely increase delivery of runoff water and particulate material to Kaneohe Bay. However, plans for the development include a series of retention ponds and water features within the proposed golf course. The purpose of these structures to retain storm runoff on-site for use as irrigation water. As such, there is a potential decrease of runoff into Kaneohe Bay. Such a decrease in runoff may be expected to result in lower volumes of freshwater and suspended sediment discharge than occur at present.

The single zone that has the most potential for impacts from increased sedimentation is the channel wall/P. compressa region.
While reef corals, generally considered to be the "keystone species" must deal with sediment in the environment under natural conditions, the effects of sediment stress to corals has been extensively reviewed by Johannes (1975), Dodge and Vaisnys (1977), Bak (1978), Brown and Howard (1985) and Grigg and Dollar (1989). In summary, these reviews conclude that while it is clear that increased sedimentation can have a deleterious effect on corals, especially when buried, sedimentation can also result in no negative impacts. Because sediments are suspended by natural processes in many reef environments, most corals can withstand a certain level of sediment supply to the living surface. Many species have the ability to remove sediment from their tissues by distension of the coenosarc with water, or ciliary action which can nullify lethal effects of sedimentation (Yonge 1931).

In case studies of the effects of sedimentation, the range of environmental effects varies through the entire spectrum of stress. Cases where activities of man have caused coral mortality have been generally limited to dredging of channels or harbors in areas of confined circulation such as Castle Harbor, Bermuda (Dodge and Vaisnys 1977), and Kaneohe Bay, Hawaii (Banner 1974). In areas of unrestricted circulation, however, there have been instances of increased sedimentation reported that do not appear to cause any substantial effects to reefs. Sheppard (1980) reported that following dredging and blasting for a military Harbor in Diego Garcia Lagoon, coral cover appeared to show no effects from increased siltation. While corals in Kaneohe Bay has been shown to have suffered mortality from massive dredging, areas adjacent to the dredge sites often showed no detrimental changes (Banner 1974). As the potential for the present project to increase sediment loading appears to be minimal with proper mitigation (and may even reduce sediment loading), possible impacts to corals appear to be insignificant.

It is stressed, however, that all engineering and construction considerations should aim to completely exclude the possibility of adding sediment runoff to Kaneohe Bay. While temporary increases may not result in any substantial or permanent alteration to the biotic communities, inputs of erosional sediment is not desirable, owing to the high recreational usage of the Bay.

Fertilization and Irrigation

The development and operation of the proposed golf course will require application of fertilizers to supply essential nutrients to turfgrasses, and pesticides to control weeds, diseases and insect pests. Fertilization may be accomplished either from commercial mixes, or application of treated sewage effluent. Under some conditions, these chemicals may be subject to movement from the site of application, principally by leaching to the groundwater aquifer, or by surface runoff after storm rains.

A primary concern of the present report is the potential effect of fertilizer nutrients. The primary fertilizer nutrients of concern for contamination of groundwater are nitrogen and phosphorus. Phosphorus is attached very tightly to soil colloids and moves little, if any, from the site of application. Because of the mineralogic composition, most of the highly weathered soils in Hawaii, such as those in Heela Kea, can immobilize large amounts of phosphorus. As a result there is little potential for phosphorus to leach to groundwater owing to golf course operation.

With respect to effects to the marine environment, nitrogen is the nutrient of concern for several reasons. N is used as a major component of most fertilizers, is essential soluble in the nitrate-nitrite form, and plays a potential role in the eutrophication of open bodies of water receiving high levels of infiltrate from land. Like phosphorus, ammonium nitrogen (NH_4^+) moves little in soils. NH_4^+, however, is converted to nitrate (NO_3^-) which is not bound tightly to soils, and moves readily with water. Normally, when golf course management matches evapotranspiration with irrigation, NO_3^- will be used rapidly after application in the production of new turfgrass. However, under some conditions, such as overfertilization and overirrigation, or when excessive rainfall occurs soon after application of a soluble nitrogen source, there is potential for excessive loss by surface runoff or by leaching below the root zone.

Impacts from fertilization of golf courses using treated sewage effluent has been a subject of study as both an effective alternative to ocean sewage disposal and as a means of recycling fresh water. California grass (paragrass) irrigated with effluent from secondarily treated domestic sewage showed excellent response as a means of disposal of large amounts of water, and effective removal of nitrogen. Under irrigation rates as great as 98 mm/day, the monthly effluent nitrogen content ranged from 17 to 59 mg/l with an average level of 34 mg/l. Of the applied nitrogen, an average of 69% was harvested in the grass, 3% percolated, nearly 28% was denitrified, while the soil nitrogen status remained unchanged or decreased slightly. Even with the highest effluent irrigation rates, nitrate nitrogen levels in the percolate remained less than the 10 mg/l recommended maximum for potable water (Handley and Ekern 1981).

Soil retention studies conducted on a golf course in Hawaii indicated that upwards of 90% of the applied fertilizer N and 100% of P was taken up by the thatch/soil complex (Chang and Young 1977). Data from Brown et al. (1977) and Tavares (1983) show that for soluble N sources at high rates of application and high irrigation rates, about 10% of the total N applied is leached in the first 2 to 4 days after application, after which the leaching loss dropped to about 2% of the applied N per day for about 2 to 3 weeks. Essentially all of the applied N was used by plants, leached, lost as gas (denitrified), or otherwise accounted for 2 to 3 weeks after application. Murdoch and Green (1989) suggest that relatively porous soil with a minimum depth of 12 inches is necessary to provide adequate water and nutrient storage for healthy turf, and to retard movement of nutrients and pesticides to groundwater. As the Heela Kea site is characterized by natural soil, such criteria should be easily met with the planned golf course.

A survey of the effects of existing golf course irrigation and fertilization on nearshore marine waters off the West Coast of the Island of Hawaii showed that existing courses (Mauna Lani, Waikoloa, Mauna Kea) are not causing alteration in water quality or biological community function and structure. Courses located upslope from open coastlines, showed no measureable effects whatsoever on nutrient concentrations in the nearshore ocean. These results indicated that normal fertilization does not result in any undesirable nutrient enrichment in nearshore waters. An exception, however, appeared in a semi-enclosed inlet (Keauhou Bay) located directly downslope from a 27-hole golf course. Owing to a residence time in the Bay that is substantially longer than in an equivalent area of open coastline, and to the apparent "focusing" of groundwater efflux, increases in dissolved nitrogen measured in Keauhou Bay appear to be attributable to golf course fertilization (Dollar and Smith 1988).

Nutrient subsidy to Kaneohe Bay resulting from runoff of storm waters following fertilization also is a consideration of the planned golf course development. Such impacts should be mitigated in part by the planned construction scenario which includes retention ponds and water features designed to intercept storm drainage before flow reaches Kaneohe Bay. In addition, peak operational efficiency of golf course management entails matching fertilization/irrigation rates with evapotranspiration rates. When these processes are of near equal magnitude, uptake by the plant/soil layer utilizes all applied fertilizer nutrients, and eliminates the potential for subsidies that could constitute "potential pollutants". Most golf courses in the planning stages include on-site weather stations that interact with computer controlled irrigation systems. By utilizing such strategies of matching weather conditions (i.e. evapotranspiration) with irrigation rates, management practices ensure the most efficient operation of the golf course in terms of minimizing expenditures for expensive fertilizers, as well as protecting neighboring environments.

The results of the present survey (particularly salinity, Si and NO_3^-) indicate that the area of Kaneohe Bay directly downslope from the proposed golf course receives only a negligible amount of groundwater input, and that the chemical signal owing to the groundwater is essentially absent within a few meters of the shoreline. Smith et al. (1981) report that groundwater input to Kaneohe Bay is approximately 8% of the net freshwater input. Alterations to groundwater characteristics underlying golf courses are not thought to significantly affect groundwater flow rates, but rather to provide dissolved nutrient subsidies to the existing groundwater flow. Because there is presently little effect to the marine environment from groundwater at Heeia Kea, it follows that there is little potential for impacts owing to nutrient subsidies to groundwater from the proposed golf course.

SUMMARY AND RECOMMENDATIONS

1) The nearshore region offshore of the planned Malulani Sports Complex is composed of a sand flat approximately 200 m wide that terminates in a steep-sided channel leading to the outer reaches of Kaneohe Bay. Four existing dry gullies within the property discharge all runoff onto the sand flat following storm events.

2) Physical and biological characteristics of the offshore region represent 4 distinct zones: a nearshore sand zone, a benthic algal zone, a P. compressa-rubble zone, and a living P. compressa-channel slope zone. Acid dissolution of sandy sediments indicates that there is not a large component of terrigenous material on the sand flat, as is found off of permanent streams in Kaneohe Bay.

3) Water quality measurements (nitrogen, phosphorus, silica, and salinity) taken from transects extending from the shoreline out to the small boat channel (200 meters from shore) show that input from the shoreline (groundwater flow) is minimal, and is mixed rapidly with open ocean water over the sand flat. With several exceptions, water quality is relatively uniform over the entire width of the sand flat and channel.

4) Water quality parameters measured were generally below the most stringent State of Hawaii, Department of Health standards. Measured nutrient parameters were of the same magnitude as long-term averages measured in central Kaneohe Bay.

5) The condition of water quality and the physical/biological structure of the nearshore environment indicates that terrigenous sedimentation into the Heeia Kea area of Kaneohe Bay is not a prevalent occurrence. All precautions possible should be taken to prevent erosion of soils into Kaneohe Bay during golf course construction. While temporary erosion during the construction phase would not likely have a permanent impact on the marine environment, it would temporarily alter the current nature of the area that is utilized for recreational pursuits.

6) Altering the present land usage by constructing the planned development is estimated to cause an increase in total runoff from a 100-year, 24 hour duration design storm of about 13%. Project plans, however, include construction of retention basins and water features that should decrease potential runoff to Kaneohe Bay relative to current conditions. These mitigating measures should eliminate the potential for alteration of marine communities owing to impacts of runoff.

7) Operation of golf courses has the potential to add nutrients (nitrate nitrogen) to coastal waters as a result of leaching of fertilizer chemicals to groundwater, or by surface runoff following storm events. Such processes can be mitigated by ensuring that the golf course soil is porous and on the order of a foot in depth, and that fertilization and irrigation schedules are designed so that application rates do not greatly exceed uptake rates. Downslope from the planned Malulani golf course, chemical measurements in Kaneohe Bay indicate that there is negligible influence of groundwater on composition of the water column. With proper management strategies, there is little chance that materials from the golf course, would reach Kaneohe Bay in quantities sufficient to change the chemical characteristics of the region.

8) Based on the existing body of scientific literature, golf courses appear to be excellent land uses in terms of minimizing erosion and preventing nutrient percolation to groundwater, compared to either agricultural crops or other land development scenarios. Usage of treated sewage effluent for fertilization and irrigation appears to be without potential environmental problems as long as management practices prevent severe over-irrigation.

9) Historical scientific evidence shows that Kaneohe Bay has been subjected to various forms of environmental degradation owing to the activities of man. It is also evident that such degradation is reversible, and that marine environments can recover once the stress factors are removed. It is clear that this finding should not be construed in any way as a license to implement activities on land without consideration of impacts to the Bay. However, it is important to understand that temporary, or unforeseen, alteration of environmental quality, while clearly undesirable, does not necessarily cause permanent negative changes.

10) While all indications are that the planned golf course will have no impacts to Kaneohe Bay, it is nevertheless recommended that a monitoring program be implemented. Such a monitoring program would be designed to provide a baseline set of conditions before construction, and to compare conditions to the baseline during and after completion of construction. In this manner, unforeseen circumstances that could result in environmental impact could be identified and mitigated at an early stage.

REFERENCES CITED

Banner, A. H. 1974. Kaneohe Bay, Hawaii: Urban pollution and a coral reef ecosystem. Proc. 2nd. Int. Coral Reef Symp. 2:685-702.

Bak, R. P. M. 1978. Lethal and sublethal effects of dredging on coral reef. Mar. Poll. Bull. 2:14-16.

Brown, B. E. and L. S. Howard. 1985. Assessing the effects of "stress" on reef corals. Adv. In Mar. Biol. 22:1-63.

Brown, K. W., R. L. Duble, and J. C. Thomas. 1977. Influence of Management and season on fate of N applied to golf greens. Agron. J. 69:667-761.

Chang, S. Y. K. and R. H. F. Young. 1977. An investigation into environmental effects of sewage effluent reuse at the Kaneohe Marine Corps Air Station Klipper golf course. Tech. Mem. Rep. No. 53. Water Resources Research Center, University of Hawaii.

DeBoot, M. and D. Grabiels (eds). 1980. Assessment of erosion. John Wiley and Sons, New York. pp. 219-221.

Dodge, R. E. and J. R. Vaisnys. 1977. Coral populations and growth patters: Responses to sedimentation and turbidity associated with dredging. J. of Mar. Res. 35:715-730.

Dollar, S. J. 1975. Zonation of reef corals off the Kona Coast of Hawaii. Master of Science Thesis. University of Hawaii.

Dollar, S. J. and S. V. Smith. 1988. The effects of golf course irrigation and fertilization on nearshore marine waters off West Hawaii. Prepared for Helber, Hastert & Kimura, Planners.

Grigg, R. W. and S. J. Dollar. 1989. Natural and anthropogenic disturbance on coral reefs. In: Coral Reefs, Vol. 25. Z. Dubinsky, ed. In press.

Handley, L. L. and P. C. Ekern 1981. Irrigation of California grass with domestic sewage effluent: water and nitrogen budget and crop productivity. Water Resources Research Center, University of Hawaii, Tech. Rpt. No. 141.

Hirota, S. O., Inc. 1989. Drainage report: proposed Maiulani sports Complex, Heeia Kea, Koolaupoku, Oahu, Hawaii.

Johannes, R. E. 1975. Pollution and degradation of coral reef communities. In: Tropical Marine Pollution, E. J. Ferguson Wood and R. E. Johannes (eds.) Elsevier Scientific Publishing, Amsterdam. pp. 13-50.

Murdoch, C. L. and R. E. Green. 1989. Environmental assessment of fertilizer and pesticide use on golf courses of the proposed Waikoloa Beach Resort Expansion. Prepared for Belt, Collins & Assoc.

Sheppard, C. 1980. Coral fauna of Diego Garcia lagoon following harbor construction. Mar. Poll. Bull. 11:227-230.

Smith, S. V., W. J. Kimmerer, E. A. Laws, R. E. Brock, and T. W. Walsh. 1981. Kaneohe Bay sewage diversion experiment: perspectives on ecosystem responses to natural perturbation. Pac. Sci. 35:279-402.

Strickland J. D. H. and T. R. Parsons. 1968. A practical handbook of sea-water analysis. Fisheries Research Bd. of Canada, Bull. 167. 311 p.

Tavares, W. J. 1983. The effect of N source, N rate and a vascular-arbuscular mycorrhizal fungus on nitrogen leaching and elemental composition in bermudagrass turf. M.S. Thesis, Horticulture Dept., University of Hawaii.

Yonge, C. M. 1931. The biology of reef building corals. Sci. Rept. Brit. Mus. (N. H.,) 1:353-391.

TABLE 1. Water chemistry data from transects off proposed Heeia Kea Golf Course.
For transect locations, see Figure 1.

TRANSECT SAMPLE ID	PO4 (uM)	TOT. P (uM)	DOP (uM)	NO3 (uM)	NH4 (uM)	TOT. N (uM)	DON (uM)	SI (uM)	TURBIDITY (ntu)	SALINITY (o/oo)	CHL A (ug/L)
1-1	0.10	0.24	0.14	0.07	0.27	6.98	6.64	9.95	0.61	33	0.67
1-2	0.08	0.23	0.15	0.05	0.09	6.43	6.29	8.54	0.59	33	0.74
1-3	0.11	0.35	0.24	0.19	0.19	6.23	5.85	14.59	0.52	33	0.52
1-4	0.08	0.22	0.14	0.28	0.15	6.54	6.11	14.59	0.32	33	0.43
1-5	0.08	0.26	0.18	0.28	0.19	5.99	5.52	13.38	0.26	33	0.40
1-6	0.10	0.24	0.14	0.26	0.11	5.93	5.56	13.98	0.29	34	0.44
2-1	0.08	0.29	0.21	0.28	0.15	6.74	6.31	12.37	0.51	32	1.20
2-2	0.06	0.23	0.17	0.07	0.11	6.45	6.27	9.35	0.32	30	0.75
2-3	0.08	0.25	0.17	0.12	0.13	6.27	6.02	12.37	0.53	32	0.76
2-4	0.08	0.30	0.22	0.24	0.11	6.45	6.10	12.98	0.30	33	0.44
2-5	0.08	0.25	0.17	0.30	0.21	6.63	6.12	12.98	0.20	33	0.57
2-6	0.07	0.24	0.17	0.28	0.11	5.99	5.60	13.38	0.20	33	0.48
3-1	0.07	0.25	0.18	0.26	0.07	6.94	6.61	9.55	0.73	31	0.47
3-2	0.04	0.24	0.20	0.05	0.00	5.99	5.94	7.94	0.49	31	0.33
3-3	0.07	0.27	0.20	0.17	0.09	6.24	5.98	11.37	0.21	31	0.45
3-4	0.06	0.28	0.22	0.33	0.04	6.10	5.73	12.37	0.18	32	0.45
3-5	0.07	0.22	0.15	0.33	0.15	5.94	5.46	12.37	0.33	33	0.35
3-6	0.07	0.30	0.23	0.21	0.09	5.63	5.33	12.98	0.24	33	0.70
4-1	0.24	0.33	0.09	1.22	0.09	5.63	4.32	14.19	0.35	33	0.84
4-2	0.10	0.27	0.17	0.10	0.07	5.99	5.82	10.36	0.33	32	0.72
4-3	0.10	0.21	0.11	0.10	0.04	6.01	5.87	11.16	0.26	32	0.51
4-4	0.13	0.31	0.18	0.10	0.21	6.32	6.01	12.17	0.38	32	0.45
4-5	0.10	0.28	0.18	0.07	0.07	6.24	6.10	12.17	0.26	33	0.37
4-6	0.08	0.29	0.21	0.12	0.04	6.44	6.28	12.37	0.29	33	0.52
MEAN	0.09	0.26	0.18	0.23	0.12	6.25	5.91	11.98	0.36	32	0.57
STD. DEV.	0.04	0.04	0.04	0.23	0.06	0.35	0.47	1.81	0.15	1	0.20
DOH WATER QUALITY STDS.											
GEOMETRIC MEAN		0.81* 0.64**		0.57* 0.36**	0.42* 0.25**	14.28* 10.71**			1.50* 0.40**		1.50* 0.50**
NOT TO EXCEED 10%		1.61* 1.29**		1.43* 1.00**	0.92* 0.61**	25.00* 17.80**			3.00* 1.00**		4.50* 1.50**
NOT TO EXCEED 2%		2.42* 1.93**		2.50* 1.78**	1.43* 1.07**	35.70* 24.00**			5.00* 1.50**		8.50* 3.00**

* "WET" CRITERIA APPLY WHEN THE AVERAGE DAILY FRESH WATER INFLOW FROM THE LAND EQUALS OR EXCEEDS 1% OF THE BAY VOLUME

** "DRY" CRITERIA WHEN THE AVERAGE DAILY FRESH WATER INFLOW IS LESS THAN 1% OF THE EMBAYMENT VOLUME.

TABLE 3. Percent coverage of benthic biota and bottom sustrate on transects off of the proposed Malulani Sports Complex. For transect locations, see Figure 1.

	TRANSECT															
SPECIES	1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4	3-1	3-2	3-3	3-4	4-1	4-2	4-3	4-4
Corals																
Porites compressa				71.0				63.5				82.5				72.4
Montipora verrucosa				0.2								0.1				0.1
Pocillopora damicornis				0.2												
Algae																
Dictyosphaeria cavernosa		0.4	0.2	10.5		1.2	0.2	8.4		0.2	0.1	4.2		0.4	0.1	9.7
Lyngbya majuscula						0.1								0.1		
Dictyota spp.		1.6				0.5								2.4	0.1	
Padina spp.		1.9	0.3			2.5	0.4			14.5	0.3			8.7	0.3	
Sargassum spp.		2.5	0.1			4.6				1.9				4.1	0.1	
Acanthora specifera		15.6	2.4			13.3	0.5			17.1	0.9			14.3	0.5	
Gracilaria spp.		0.1				0.1				0.1				0.1		
Hypnea spp.		1.6														
BOTTOM COVER																
Sand	100.0	71.7	27.5	18.1	100.0	70.9	15.4	24.6	100.0	57.6	14.6	11.8	100.0	60.6	16.4	17.8
Rubble		4.6	69.5			6.8	83.5	3.5		8.6	84.1	1.4		9.3	82.5	

TABLE 2. Percent weight loss of sediment samples following acid dissolution.

TRANSECT	% WT. LOSS
1-1	78
1-2	81
1-3	89
1-4	94
2-1	82
2-2	82
2-3	88
2-4	98
3-1	74
3-2	79
3-3	88
3-4	92
4-1	83
4-2	87
4-3	91
4-4	94

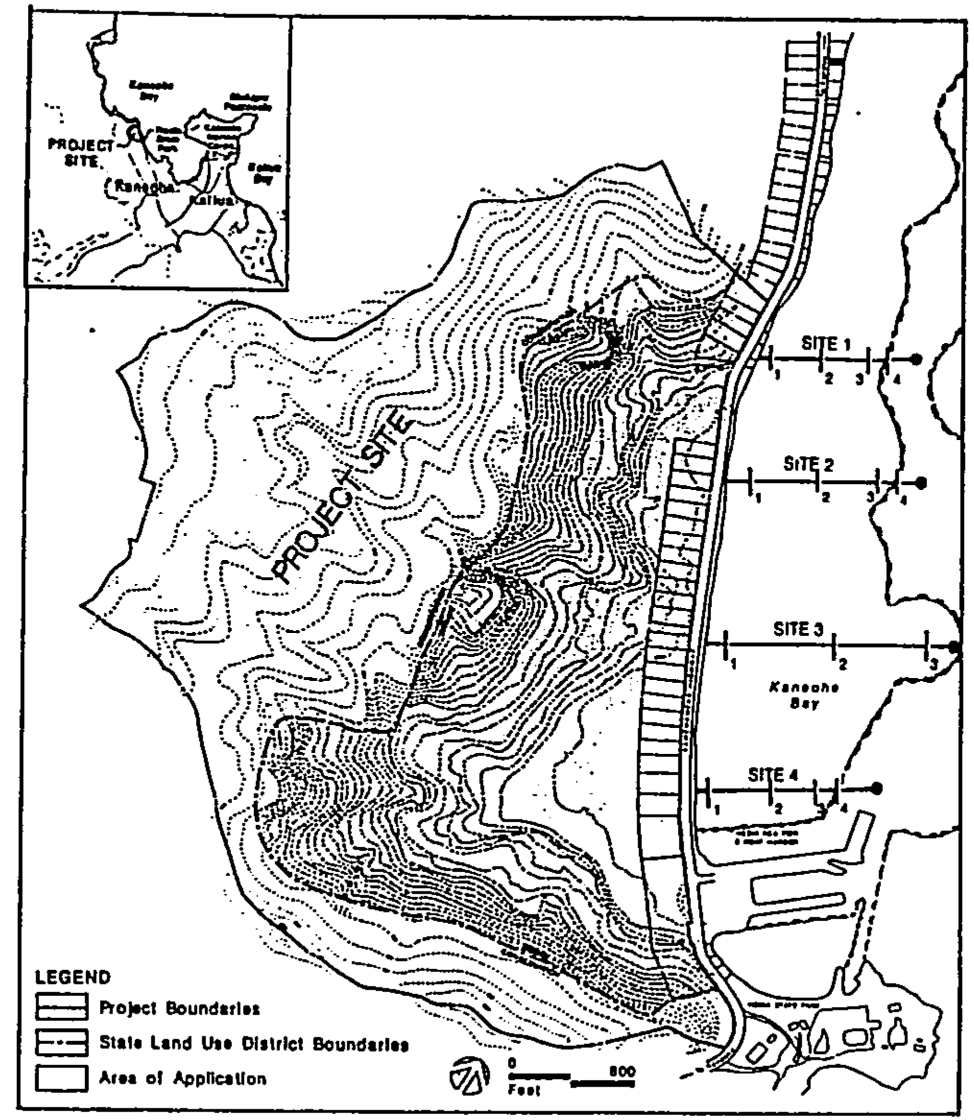


FIGURE 1. Map showing location of planned Malulani Sports Complex on the shoreline of Kaneohe Bay. Four marine environmental survey sites are also shown. Locations of numbered transects are shown at each site.

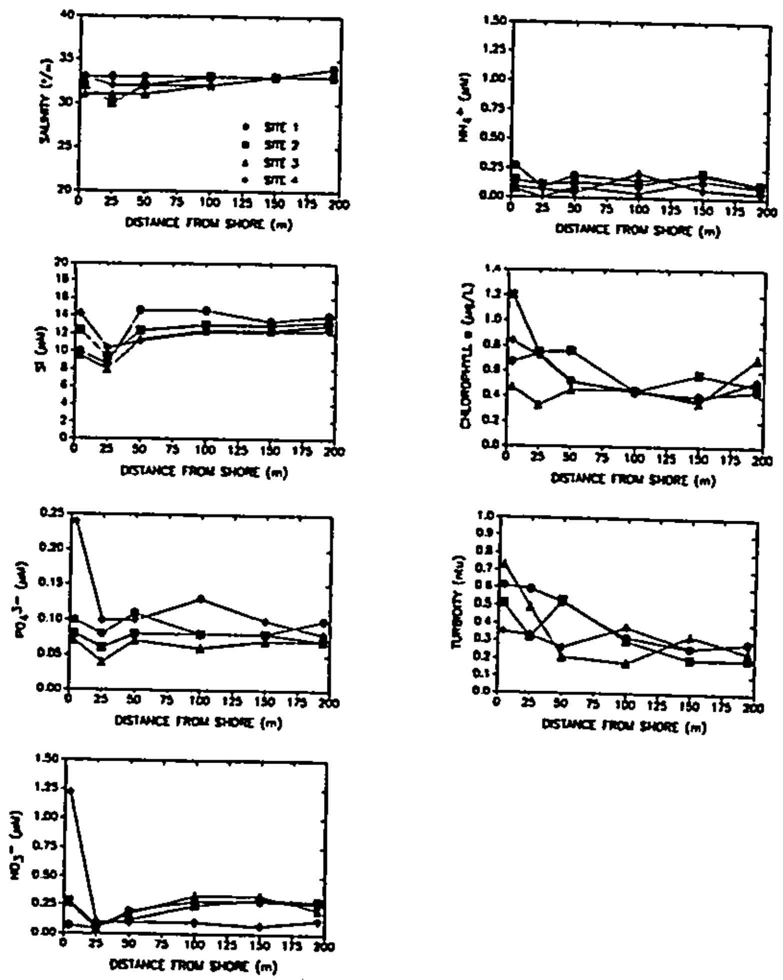


FIGURE 2. Plots of seven water chemistry parameters in Kaneohe Bay off the planned Malulani Sports Complex as functions of distance from the shoreline.

SCOPE OF WORK FOR A MARINE ENVIRONMENTAL MONITORING PROGRAM, MALULANI SPORTS COMPLEX, HEEIA KEA, OAHU, HAWAII

Prepared by

Marine Research Consultants
1720-A Paula Dr.
Honolulu, HI 96816

March 2, 1990

INTRODUCTION AND PURPOSE

Nanatomi Hawaii, Inc. is planning a recreational development called Malulani Sports Complex on a 219-acre site in Heeia Kea Valley, Kaneohe, Oahu. The proposed project includes construction of an 18-hole golf course, a golf clubhouse, a tennis club, a paved parking lot, a maintenance/storage building, an amphitheater, and approximately 30 single family homes. The proposed development is mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Kaneohe Fishing Pier/Heeia Kea Boat Harbor. None of the development plans call for alteration of the shoreline or nearshore marine environment.

A possible concern regarding construction and operation of the golf course from the local community as well as various regulating agencies is likely to center on the potential for environmental degradation of Kaneohe Bay resulting from the project. Of particular importance is the potential for runoff of soil, fertilizers, and other chemicals which may be used on the golf course, to cause alterations to water quality and marine life in Kaneohe Bay. The concerns are likely to be particularly acute owing to the status of Kaneohe Bay, and especially the Heeia Kea area, as a prime recreational area for residents.

In the interest of addressing these concerns and assuring maintenance of environmental quality, a baseline marine survey and potential impact analysis was performed in May of 1989. A purpose of the initial survey was to establish a baseline set of water quality and marine community structure parameters in the nearshore areas of Kaneohe Bay, offshore of the planned golf course. The design of the survey was such that the data could serve as a baseline preliminary phase for any monitoring programs that may be implemented to insure that irreversible environmental changes do not occur.

The purpose of this proposal is to present the methods and sampling strategies for such a monitoring program. Objectives of the monitoring program are threefold: 1) to establish the "preconstruction" character of several of the most important facets of the marine environment, including aspects of temporal (seasonal) and spatial variability, 2) to determine if construction and operation of the proposed Malulani Sports Complex causes changes to the marine environment beyond the "envelope" of natural variability, and 3) if impacts to the marine environment owing to the project are found, to offer suggestions as to measures which would mitigate the potential problem prior to permanent and irreversible alteration of the marine environment.

The monitoring program will include quantification of both water chemistry parameters that define water quality, and biotic assemblages. In addition, a goal of the program is to evaluate the degree of natural stresses (sedimentation, wave scour, freshwater input, etc.) that influence the nearshore marine environment in the area that could be potentially influenced by the proposed project. Typically, the composition of nearshore marine communities is intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed project may either be mitigated in large part, or amplified by natural environmental factors. Therefore, evaluating the range of natural stress is a prerequisite for assessing the potential for additional change to the marine environment owing to shoreline modification.

PROPOSED OUTLINE OF WORK

I. WATER CHEMISTRY

A. Parameters - Chemical composition of the marine environment will be evaluated by analysis of all parameters specified by State of Hawaii, Department of Health water quality standards (Chapter 11-54 S11-54-06 (3)), as well as several other parameters that are not listed by DOH, but provide important information. Specific parameters include total nitrogen (TN), nitrate nitrogen (NO_3^-), ammonium (NH_4^+), total phosphorus (TP), orthophosphate phosphorus (PO_4^{3-}), dissolved silica (Si), salinity, turbidity, chlorophyll a, dissolved oxygen, temperature and pH. This range of parameters includes those that are sensitive to alteration of groundwater dynamics, and sediment input. Particular attention will be given to evaluating the influence of groundwater and streamflow entering the marine environment, as chemicals from shoreline development enter the marine environment via additions to these hydraulic fluxes.

B. Sampling Sites and Protocol - Figure 1 is a map showing the shoreline and topographical features of the Heeia Kea area of Kaneohe Bay, and the location of the proposed development. Survey site locations are identified as transects perpendicular to the shoreline extending across the sand flats and across the channel leading from Heeia Kea Small Boat Harbor to the outer Bay. Survey site 1 is off of the drainage culvert located near the northern boundary of the project site; survey sites 2 and 3 bisect the area off culverts in the central region, while site 4 is off the most southern drainage near the southern end of the project. At each transect, water samples will be collected at 6 locations ranging from the highest wash of waves in the intertidal zone, to approximately 300 m offshore. Where water depths are greater than 1 m, surface and bottom samples will be collected; surface samples will be taken from within the upper 2 cm of the water column, bottom samples will be collected within 0.5 m of the seafloor. As a key interest in the investigation deals with effects to groundwater dynamics, sampling will be concentrated in the shallow nearshore areas where groundwater effects are most noticeable. Such a sampling scheme, which allows scaling of water chemistry parameters to salinity is applicable to a hydrographic mixing model that has been established as an effective method of determining changes in chemical make-up of groundwater discharge. In addition, the method allows identification of chemical sources on land that are contributing to material input to the marine environment (Smith and Atkinson 1990, Dollar and Smith 1988). This methodology also eliminates the necessity of repetitive sampling at the same tidal state in order to compare temporal variability. In addition, the sampling scheme allows for determination of spatial variability of chemical constituents within the horizontal range of the survey (across the reef), and with respect to vertical stratification.

C. Sampling Methodology - Water samples will be collected in 1-liter polyethylene bottles. Subsamples for nutrient analyses will be filtered in the field through glass-fiber filters into 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and immediately placed on ice. Analysis for NH_4^+, PO_4^{3-}, and NO_3^- + NO_2^- are performed using manual spectrophometric techniques on a fiber optic colorimeter. Total nitrogen and total phosphorus are analyzed in a similar fashion following ultra-violet digestion. Dissolved inorganic nitrogen (DON) and dissolved inorganic phosphorus (DOP) are calculated as the difference

between total dissolved and dissolved inorganic N and P. All nutrient procedures will be performed according to standard methods for seawater analysis (Strickland and Parsons 1968). Turbidity will be determined on 60-ml subsamples fixed with HgCl to terminate biological activity using a laboratory nephelometer. Chl. a is measured by filtering 300 ml of water through glass fiber filters; pigments on filters will be extracted and assessed fluorometrically. Salinity will be determined using a laboratory salinometer with a readability of 0.0001 $^o/oo$. In-situ field measurements will include dissolved oxygen and water temperature using field meters with readability of 0.01 milligrams per liter (mg/l) and 0.1^o C, respectively). pH is determined in the field millivolt meter with a readability of 0.001 pH units.

II. REEF STRUCTURE AND BIOTA

A. Parameters - Physical and benthic biotic structure of the reef environment will be evaluated by establishing a descriptive and quantitative baseline of benthic reef communities. Key components of reef communities includes hermatypic and soft corals, benthic algae, motile macroinvertebrates, reef fish, and substratum type. Such a characterization of biotic assemblages will yield a quantitative estimate of organism distribution, diversity, and abundance that can be used as a basis of comparison for sequential monitoring surveys.

B. Sampling Sites - Figure 1 is a map showing the shoreline and topographical features of the Heeia Kea area of Kaneohe Bay, and the location of the proposed development. Results of the baseline survey indicated that biological community structure is essentially uniform off the entire frontage of the proposed development. As such, two of the transect sites (Nos. 2 and 4) will constitute biological monitoring stations. Survey site 2 is off of the drainage culvert in the central region, while site 4 is off the most southern drainage near the southern end of the project. At each survey station, 4 quantitative transect surveys will be conducted. Transects will be located in each of the 4 physical/biotic zones identified in the baseline survey. These zones were described as the sand flat zone, algal-rubble zone, coral rubble zone, and coral slope zone.

C. Sampling Methodology

1. Benthos - Benthic line transects will be 50 m long, and will be oriented perpendicular to the shoreline. Quantitative benthic surveys are conducted by stretching a surveying tape over the reef surface between the marker floats. An aluminum quadrat frame, with dimensions of 1 m by 0.66 m, is sequentially placed over 10 random marks on the transect tape so that the tape bisects the long axis of the frame. At each quadrat location a color photograph records the segment of reef area enclosed by the quadrat frame. In addition, a diver knowledgeable in the taxonomy of resident species visually estimates the percent cover and occurrence of organisms and substratum type within the quadrat frame. No attempt will be made to disturb substrata to observe organisms, and no attempt will be made to identify and enumerate cryptic species dwelling within the reef framework. Only macrofaunal species greater than approximately 2 cm will be noted. Following the period of field work, quadrat photographs are projected onto a grid and units of bottom cover for each benthic faunal species and bottom type are recorded. Results of the photo-quadrats are combined with the in-situ cover estimates and community structure parameters (percent cover,

species diversity) are calculated. The photo-quadrat transect method is a modification of the technique described in Kinzie and Snider (1978), and has been employed in numerous field studies of Hawaiian reef communities (e.g. Dollar 1979, Grigg and Maragos 1974), and has proven to be particularly useful for quantifying coverage of attached benthos such as corals and macrothalloid algae, and large epifauna (e.g. sea urchins, sea cucumbers).

2. Reef Fish - Quantitative assessment of reef fish community structure will be conducted in conjunction with the benthic surveys. As the transect tape is being laid along the bottom, all fishes observed within a band approximately 2 m wide along the transect path are identified by species name and enumerated. Care is taken to conduct the fish surveys so that the minimum disturbance by divers is created, ensuring the least possible dispersal of fish. Only readily visible individuals are included in the census. No attempt is made to seek out cryptic species or individuals sheltered within coral. This transect method is an adaptation of techniques described in Hobson (1974).

MONITORING PROGRAM FREQUENCY

The outline of work described above presents the methods for one phase of investigative sampling. The true value, however, of the program lies in the ability to determine changes over time, and to identify the causal agents for such change. The monitoring program is designed to identify potentially detrimental additions to the environment at levels below that capable of causing changes in community structure. Design of the program is also such that cumulative impacts over time can also be assessed. Thus, if no deleterious effects are noted, such a monitoring program can provide assurance to the community that activities on land are not causing impacts to the marine environment. If, however, materials are identified in the marine environment that are the result of shoreline development, they will be noted at an early stage where mitigative measures can be applied prior to alterations in biological community structure.

Changes in water chemistry will likely be the causative factor for any potential pollutant situations. Water sampling will be conducted quarterly for an annual cycle prior to construction. Quarterly sampling will provide information on temporal (seasonal) variability. In order to delineate the optimum range in parameters, sampling will be biased toward "extreme" situations. Such situations will include summer periods of low rainfall, and neap tides (minimum mixing in the nearshore zone), and winter periods of heavy rainfall and runoff. For the duration of construction activity, water sampling will be conducted bimonthly (every 60 days). Increased frequency of sampling during construction is recommended as this is the phase where activities on land have the most potential to impact nearshore waters. Bimonthly sampling will allow identification of impacts on a time scale where mitigative measures can be implemented with only a minimum of lag time between the cause and the remedy.

Following completion of the project, water chemistry will be monitored quarterly for one annual cycle. If no impacts are identified owing to the Sports Complex, it is recommended that monitoring frequency be decreased to semi-annually, as a permanent preventative measure. If impacts are identified in the year following completion of the project, it is recommended that water quality analyses are continued on a quarterly basis for an annual cycle until all environmental alterations from the project are absent. At each phase of water quality monitoring, results will provide a data matrix that will be amenable to

statistical evaluation for comparison with compliance criteria outlined in Department of Health Water Quality Standards.

Prior to construction, biological community structure should be assessed twice (once in summer, once in winter) to ensure characterization of seasonal variability. During the course of construction, it is recommended that biological community structure analyses are repeated semi-annually, while frequency should drop to yearly following completion of construction.

Below is a matrix showing sampling frequency at each phase of construction and post construction for each component of marine monitoring.

CONSTRUCTION PHASE	MONITORING COMPONENT	
	WATER CHEMISTRY	REEF BIOTA
PRECONSTRUCTION (1 yr)	quarterly	semi-annually
DURING CONSTRUCTION (2 yrs)	quarterly	semi-annually
POST CONSTRUCTION		
1st Year	quarterly	annually
Following Years	semi-annually*	annually

*Annually, if no impacts are found during the first year after construction. If no impacts are detected five years after construction, then continuation of the monitoring program could be reconsidered.

MITIGATIVE MEASURES

The analytical methods proposed for the monitoring program are designed to be able to identify material added to the marine environment from extraneous sources (i.e. other than natural inputs), at levels lower than are likely to cause alterations in either water quality or marine community structure. As a result, the monitoring program functions as an "early warning" indicator of potentially stressful situations. If monitoring results indicate that material is being added to the marine environment as a consequence of construction or operation of the proposed development, mitigative actions can be undertaken. In the construction phase, the most likely cause of perturbation is erosion and runoff associated with exposure of soils during grading. As this phase is essentially a "one-time" event most mitigative measures involve the planning stages. In the operational phase, the most likely cause of impacts would be leaching of chemicals to groundwater or stream flow with subsequent discharge to Kaneohe Bay. Monitoring methods are specifically sensitive to addition of fertilizer nutrients (nitrogen and phosphorus), and excess materials can be detected at extremely low levels compared to naturally occurring concentrations in the marine environment. Any detected throughput of fertilizer nutrients indicates that the applied material is in excess of the uptake potential of the golf course. In this case, mitigative measures would involve scaling down application rates to match uptake.

DATA REPORTING

Following the commencement of the monitoring program, a written report will be prepared quarterly. Each report will contain all cumulative data collected to that point in the program presented in tabular form along with appropriate graphic representations and explanatory text. Geometric means and individual measurements of water quality will be analyzed for compliance with DOH Water Quality Standards by comparison to specific criteria for open coastal waters. During the construction and post-construction phases, water quality data will be applied to hydrographic mixing models in order to determine if there are changes to parameters in excess of the baseline conditions. If data analysis reveals that there is augmentation to chemical constituents as a result of construction, interpretation will be made as to the detrimental potential of the increased values. If the evaluation is made that there is potential for detrimental changes, mitigative measures will be suggested.

Community structure parameters including abundance and diversity of all transect results will be presented in each quarterly report. Statistical analyses will indicate if differences exist between the preconstruction baseline and subsequent construction and post-construction data.

Copies of quarterly monitoring reports will be distributed to pertinent agencies or parties.

REFERENCES CITED

Dollar, S. J. 1979. Ecological response to relaxation of sewage stress off Sand Island, Oahu, Hawaii. Water Resources Research Center Tech. Rpt. No. 124. Water Resources Research Center, University of Hawaii.

Dollar, S. J. and S. V. Smith. 1988. The effects of golf course irrigation and fertilization on nearshore marine waters off West Hawaii. Prepared for Helber, Hastert & Kimura, Planners.

Grigg, R. W. and J. E. Maragos. 1974. Recolonization of hermatypic corals on submerged lava flows in Hawaii. Ecology 55:387-395.

Hobson, E. S. 1974. Feeding relationships of teleostean fishes on coral reefs in Kona, Hawaii. Fishery Bull. 72:915-1031.

Kinzie, R. A. III and R. H. Snider. 1978. A simulation study of coral reef survey methods. In:Coral reefs: research methods. UNESCO, eds: D. R. Stoddart and R. E. Johannes.

Smith, S. V. and M. J. Atkinson. 1990. Mass balance analysis of C, N, and P fluxes in coastal water bodies, including lagoons. Submitted.

Strickland J. D. H. and T. R. Parsons. 1968. A practical handbook of sea-water analysis. Fisheries Research Bd. of Canada, Bull. 167. 311 p.

APPENDIX **H**

WATER SUPPLY REPORT
Sam O. Hirota, Inc.

WATER SUPPLY REPORT

PROPOSED MALULANI SPORTS COMPLEX

HEEIA KEA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY:

4-6-06:1,4,7,9,11,13,15,22-44,48-51; 4-6-16:portion 32

Prepared By:

SAM O. HIROTA, INC.
Engineers and Surveyors
864 South Beretania Street
Honolulu, Hawaii 96813

December 5, 1989

TABLE OF CONTENTS

PROJECT LOCATION AND DESCRIPTION:

The proposed project is located in Heeia Kea Valley mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor (see Figure 1). The project site is approximately 220 acres and is owned by Nanatomi Hawaii, Inc.

Nanatomi Hawaii, Inc. proposes to develop a sports complex on the property (see Figure 2). This proposal includes the construction on an 18 hole golf course, a golf clubhouse (which includes dining and beverage services, meeting and function rooms, health and fitness spa), 3 tennis courts, a paved parking lot, a maintenance/storage building, an amphitheatre, and approximately 30 to 35 single family houses.

LANDUSE AND ZONING DESIGNATION:

The property is presently designated conservation and urban in approximately equal areas by the State Land Use Commission. Current zoning allows for 31 residential R-5 lots with the remainder in AG-2 agricultural.

EXISTING CONDITIONS:

The site's topography consists of varying terrain, with elevations ranging from about mean sea level along Kamehameha Highway to approximately 500 feet at the mauka boundary. Slopes ranging from 15 to 25 percent exists along all boundaries except the makai boundary. Lesser slopes of 0 to 10 percent are found in the center of the property and along Kamehameha Highway.

The property is vacant except for the structure of the former Hawaiian Electric Company, Inc. baseyard. The baseyard is currently being leased to a construction company for the storage of equipment and supplies. Another portion of the property is presently being used by a trucking company for the storage of vehicles. They property is not cultivated and there are no existing residences. The site is covered with mature trees, shrubs, and grasses.

According to the United States Department of Agriculture Soil Conservation Service (USDA SCS), soils in the area of application consists of: Ewa Silty Clay Loam (EmA); Mokuleia Clay Loam (Mt); Kokokahi Clay (KtC); Lahaina Silty Clay (LaC); and Alaeloa Silty Clays (AeE and ALF).

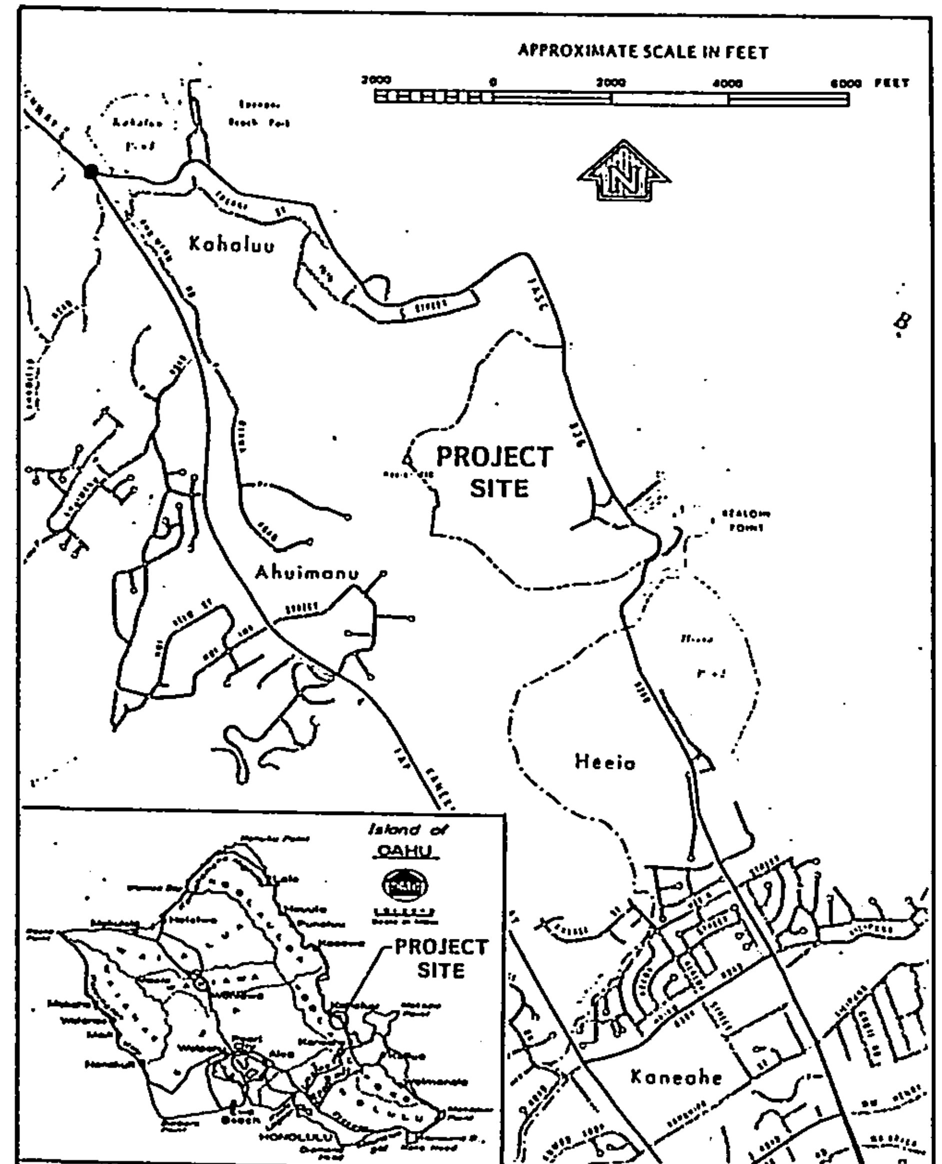


FIGURE 1 PROJECT LOCATION MAP

SAM O. HIROTA, INC. Engineers & Surveyors 864 S. BERETANIA ST. HONOLULU, HAWAII 96813

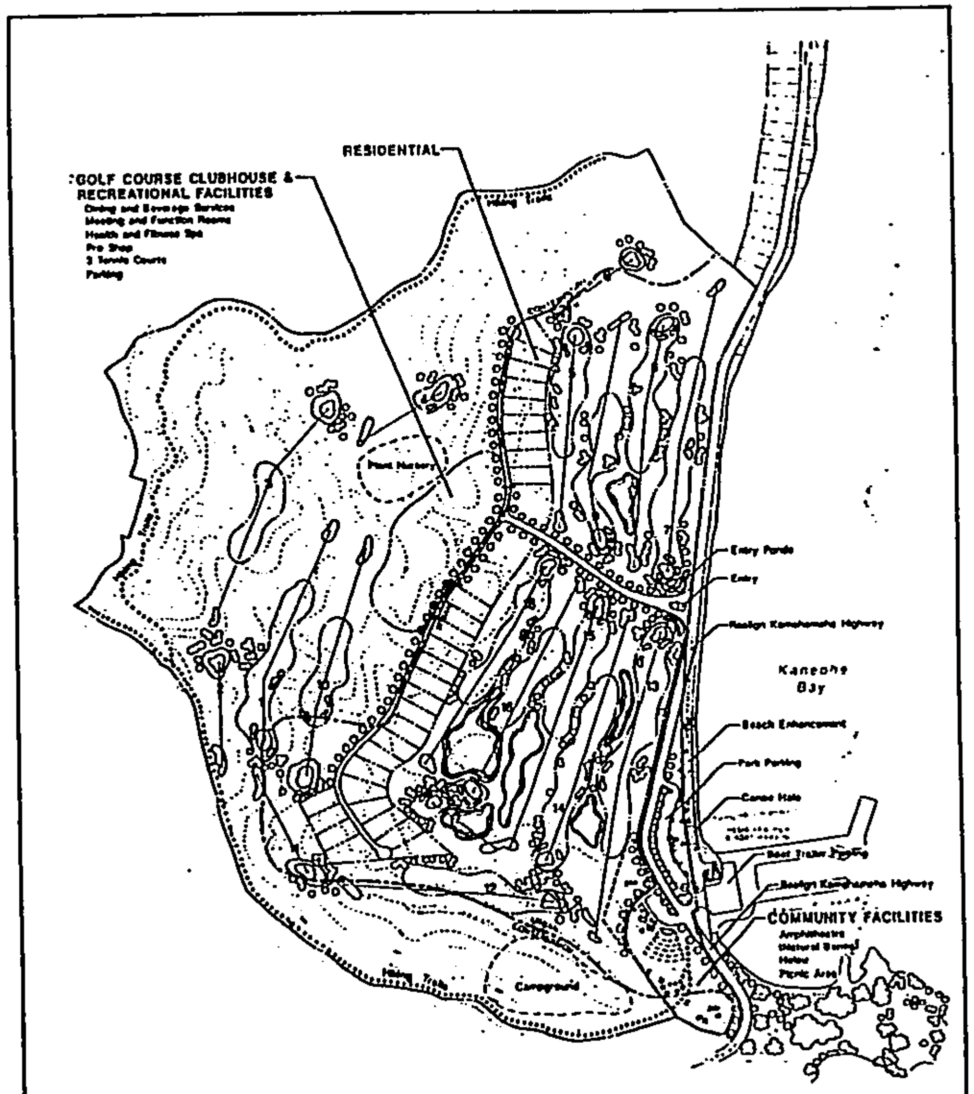


FIGURE 2 SPORTS COMPLEX PLAN

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

Existing potable water service to the area consists of the 272' Punaluu transmission system within Kamehameha Highway, consisting of a 16-inch transmission main and a 6-inch distribution main (see Figure 3).

PROJECTED WATER DEMAND:

Potable water will be required for the proposed 30 to 35 single-family homes, the golf clubhouse, golf maintenance facility, and the health spa. Using the City and County of Honolulu Board of Water Supply (BWS) standard water demand rate of 700 gallons per day (GPD) for a single-family residence (3.5 bedrooms), the 30 to 35 homes will require approximately 21,000 GPD. The golf clubhouse, golf maintenance facility, and health spa is expected to require approximately 40,000 GPD. The total estimated potable water requirement, then, is approximately 61,000 GPD.

Non-potable water will be used for the irrigation of the tees, greens, fairways, and limited portions of the "roughs" of the proposed golf course. Using the City and County of Honolulu BWS's General Guidelines for Irrigation of Turfgrass Based on Rainfall (June 1989), the irrigation requirements for the golf course can be preliminarily estimated. Assuming an average irrigation requirement of 1,770 gallons per acre day and a golf course size of 175 acres, the irrigation requirements could be approximately 309,750 gallons per day. The conservative assumptions are provided to balance the limitations of the guidelines which do not consider evapotranspiration, runoff, the amount of water draining beyond the root zone, and changes in soil-water storage.

Fire protection is also required for the residences, the golf clubhouse, and the golf maintenance facility. A projected water demand for fire protection of the clubhouse and maintenance facility is 2,000 gallons per minute (gpm) for a 2 hour duration. This demand is based on the fire flow rate for small shopping centers and neighborhood businesses.

PROPOSED DEVELOPMENT:

Potable Water System: The potable water system includes domestic supply and fire protection for the residences golf maintenance facility, and domestic supply for the golf clubhouse and health spa. The proposed potable water system will be connected to the 30 inch BWS low service transmission line (see Figure 4). A new 12 inch line will

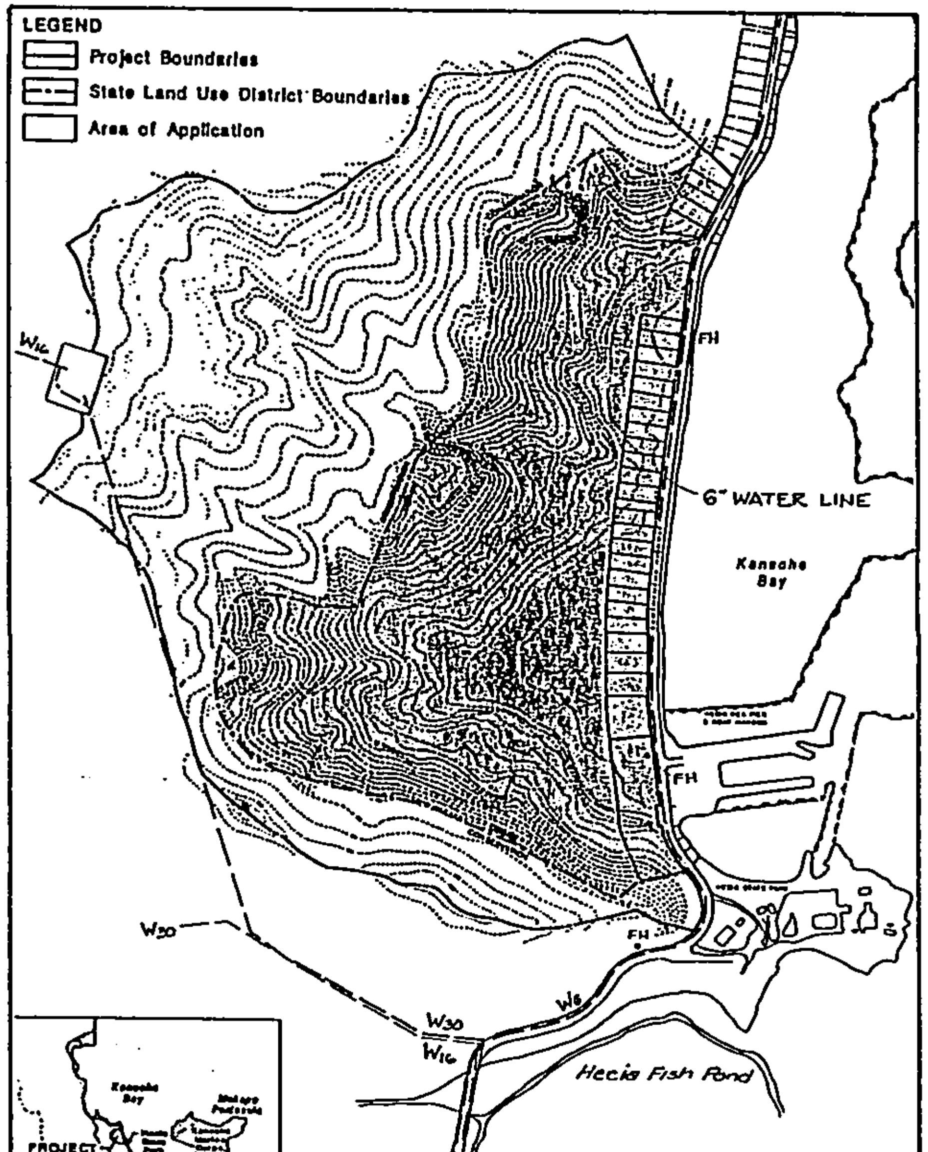


FIGURE 3
EXISTING BWS WATER SYSTEM

SAM O. HIROTA, INC. Engineers & Surveyors
864 S. BERETANIA ST. HONOLULU, HAWAII 96813

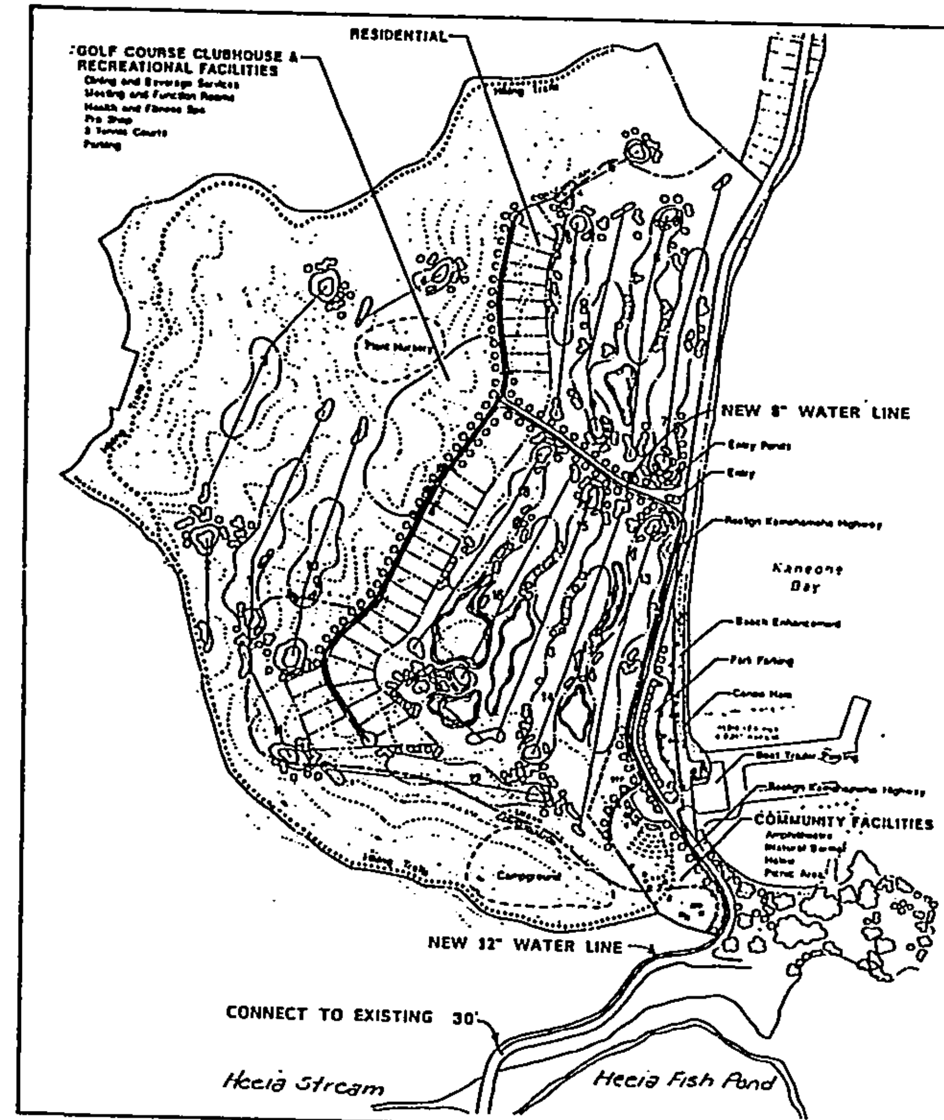


Figure 4 Potable Water System

0 Feet 600

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

be located along Kamehameha Highway north-bound and will end at the Sports Complex entry road. A new 8 inch water line will be connected to the 12 inch line and service the golf course clubhouse and residential lots.

Nonpotable Water System: The non-potable water system includes irrigation for the golf course and landscaped areas (see Figure 5). Drilling of two on-site wells is required to provide additional irrigation water during dry weather to supplement storm runoff catchment and treated sewage effluent. The proposed wells, located between 250 and 275 foot elevation at the mauka side of the site, are expected to deliver 0.2 MGD/per well. A gravity line from the well sites will supply non potable water to an irrigation storage pond south east of the clubhouse area.

IMPACT AND MITIGATION:

Positive impacts resulting from the proposed water system include: (1) Using non-potable sources for irrigation of golf course and landscaping; (2) Upgraded fire protection for the proposed residential lots and proposed clubhouse facilities; (3) Replacement of the existing 6 inch BWS line along Kamehameha Highway with a 12 inch line.

Possible negative impacts resulting from the proposed water system include: (1) Increased demands on the BWS source and distribution system due to approximately 60,000 gallons per day from the use of the golf course clubhouse and the residential lots; (2) Decreases in ground water quality due to pumping of irrigation water from the two proposed wells. In the event that significant changes in ground water quality occur during monitoring of the wells, other source alternatives will be considered.

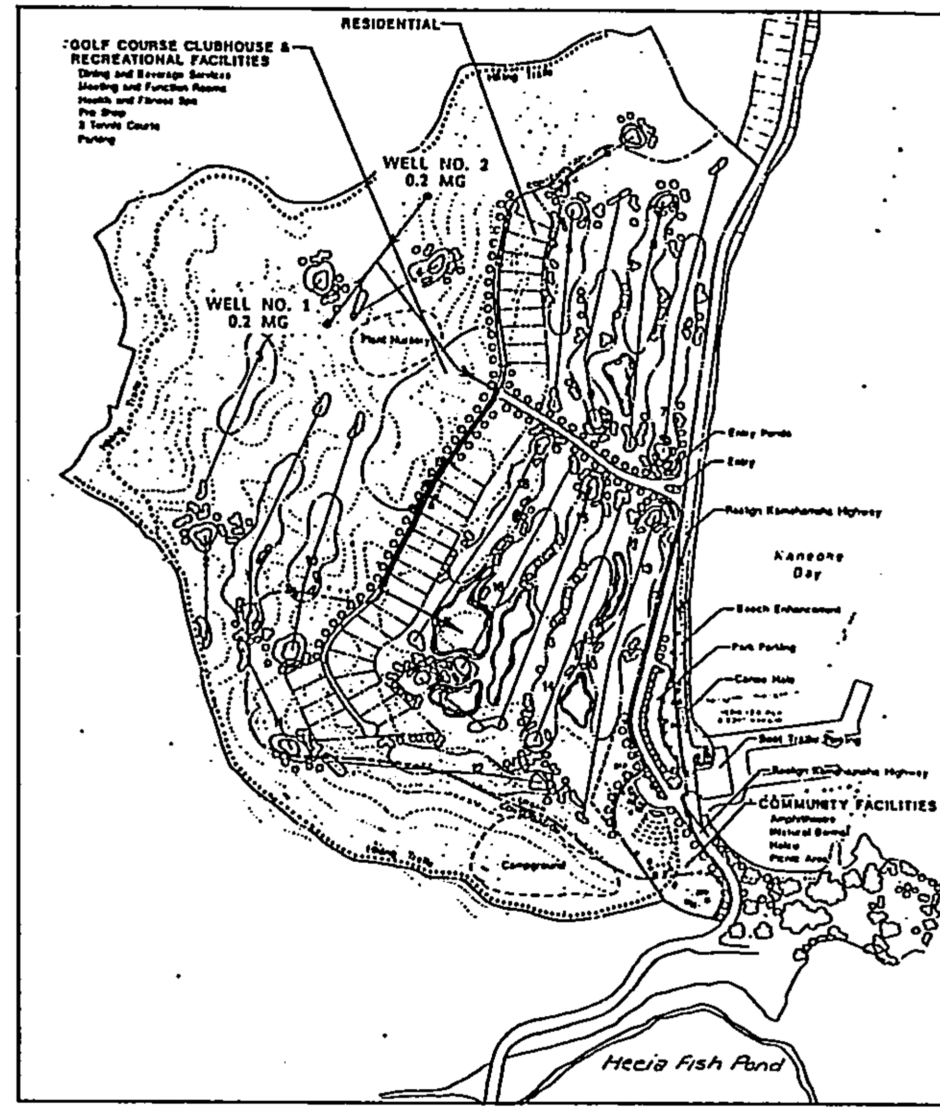


FIGURE 5 NON - POTABLE WATER SYSTEM

Malulani Sports Complex

NANATOMI HAWAII, INC.
HELBER, HASTERT & KIMURA

<u>REFERENCES:</u>

1. "Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review, Halulani Sports Complex." Helber , Hastert and Kimura Planners, September 1989.

APPENDIX I

WASTE WATER MANAGEMENT
REPORT
Sam O. Hirota, Inc.

WASTEWATER MANAGEMENT REPORT

PROPOSED MALULANI SPORTS COMPLEX

HEEIA KEA, KOOLAUPOKO, OAHU, HAWAII

TAX MAP KEY:

4-6-06:1,4,7,9,11,13,15,22-44,48-51; 4-6-16:portion 32

Prepared By:

SAM O. HIROTA, INC.
Engineers and Surveyors
864 South Beretania Street
Honolulu, Hawaii 96813

December 5, 1989

TABLE OF CONTENTS

PROJECT LOCATION AND DESCRIPTION:

The proposed project is located in Heeia Kea Valley mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor (see Figure 1). The project site is approximately 220 acres and is owned by Nanatomi Hawaii, Inc.

Nanatomi Hawaii, Inc. proposes to develop a sports complex on the property (see Figure 2). This proposal includes the construction on an 18 hole golf course, a golf clubhouse (which includes dining and beverage services, meeting and function rooms, health and fitness spa), 3 tennis courts, a paved parking lot, a maintenance/storage building, an amphitheatre, and approximately 30 to 35 single family houses.

LANDUSE AND ZONING DESIGNATION:

The property is presently designated conservation and urban in approximately equal areas by the State Land Use Commission. Current zoning allows for 31 residential R-5 lots with the remainder in AG-2 agricultural.

EXISTING WASTEWATER FACILITIES:

The site's topography consists of varying terrain, with elevations ranging from about mean sea level along Kamehameha Highway to approximately 500 feet at the mauka boundary. Slopes ranging from 15 to 25 percent exists along all boundaries except the makai boundary. Lesser slopes of 0 to 10 percent are found in the center of the property and along Kamehameha Highway.

The property is vacant except for the structure of the former Hawaiian Electric Company, Inc. baseyard. The baseyard is currently being leased to a construction company for the storage of equipment and supplies. Another portion of the property is presently being used by a trucking company for the storage of vehicles. They property is not cultivated and there are no existing residences. The site is covered with mature trees, shrubs, and grasses.

According to the United States Department of Agriculture Soil Conservation Service (USDA SCS), soils in the area of application consists of: Ewa Silty Clay Loam (EmA); Hokuleia Clay Loam (Mt); Kokokahi Clay (KtC); Lahaina Silty Clay (LaC); and Alaeloa Silty Clays (AeE and ALF).

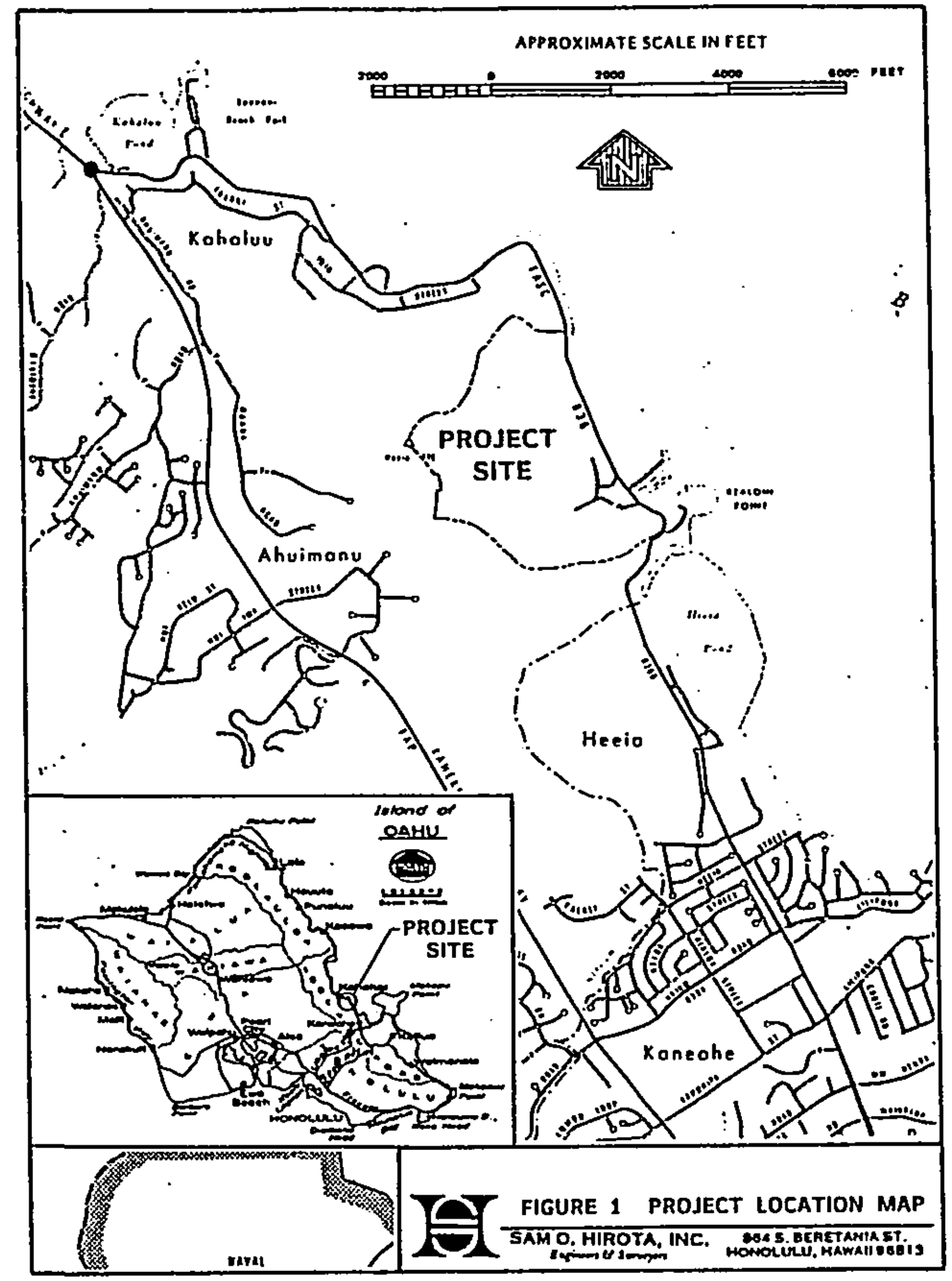


FIGURE 1 PROJECT LOCATION MAP

SAM O. HIROTA, INC. Engineers & Surveyors 864 S. BERETANIA ST. HONOLULU, HAWAII 96813

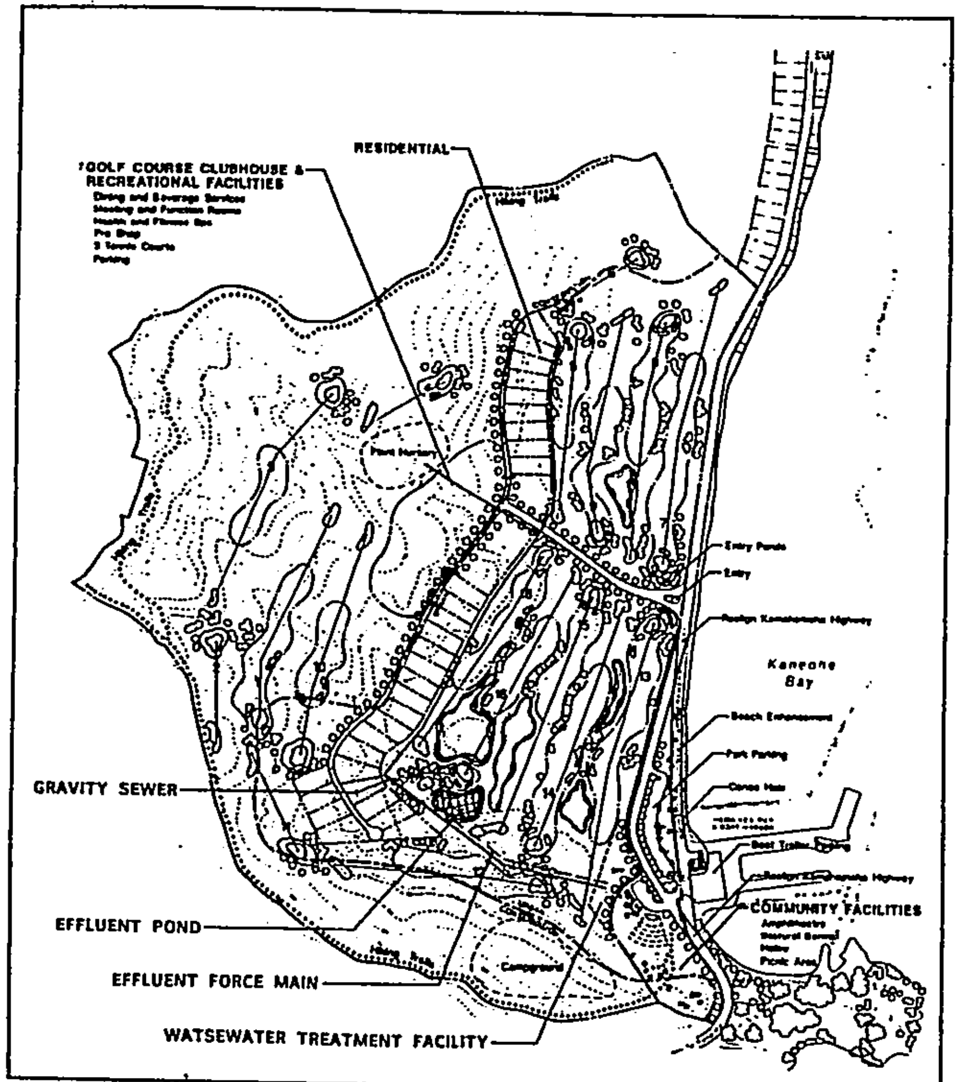


FIGURE 3 PROPOSED WASTEWATER SYSTEM AND EFFLUENT DISPOSAL SYSTEM

0 600 Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

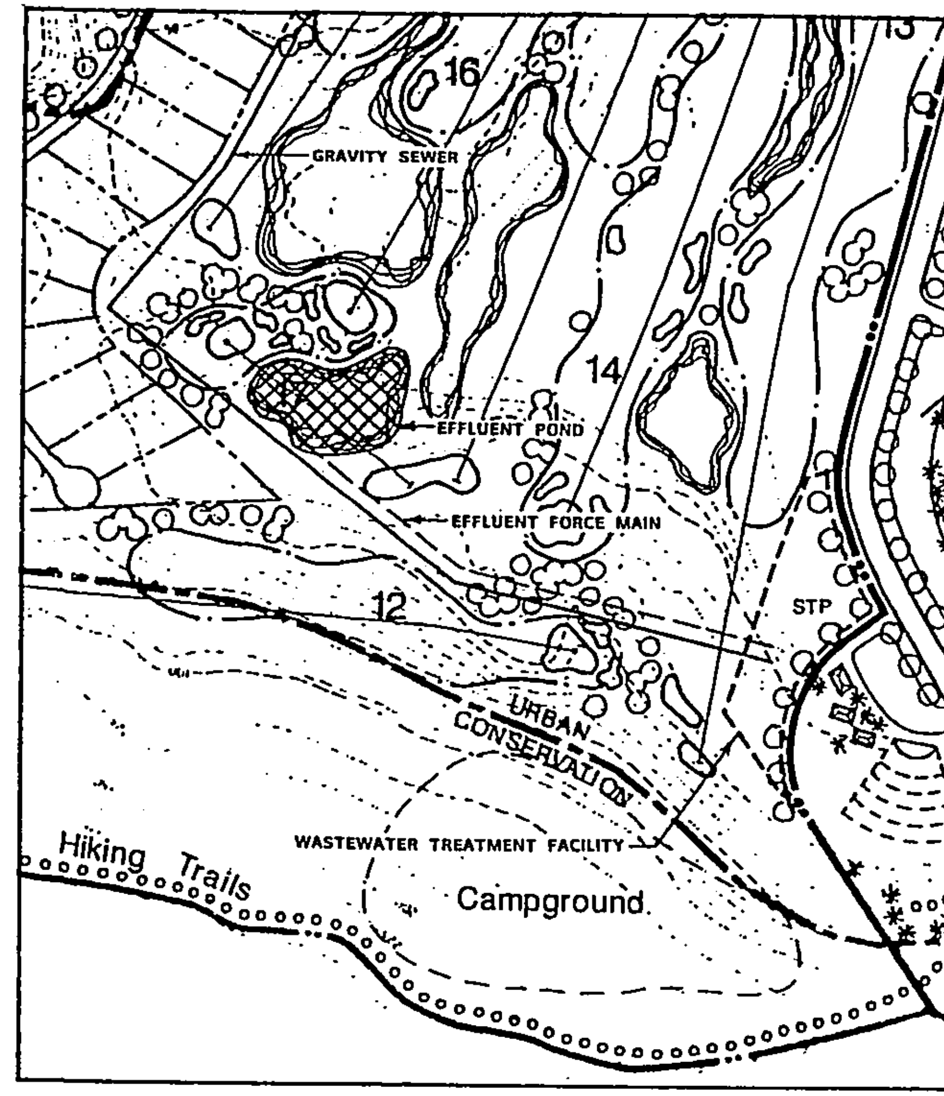


FIGURE 4 WASTEWATER TREATMENT FACILITY SITE MAP

0 200 Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

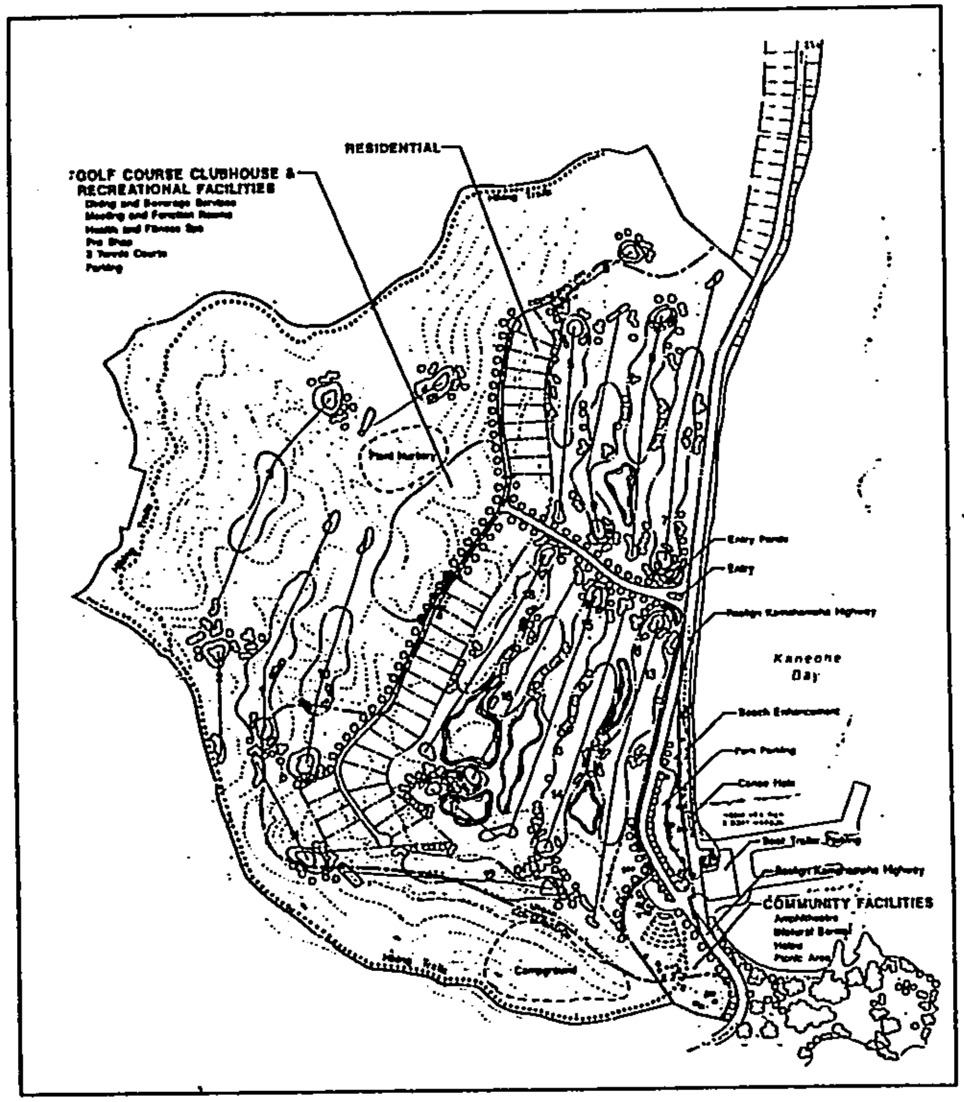


FIGURE 2 SPORTS COMPLEX PLAN

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

Presently, the property is not serviced by the City and County of Honolulu's wastewater collection, treatment, and disposal system. The adjoining residential area between the subject property and the junction of Kamehameha Highway and Kahekili Highway is serviced by cesspools. Wastewater disposal by cesspools is a major issue within the Koolaupoko Development Plan (DP) area. The DP Public Facilities Map for Koolaupoko identifies the adjoining residential area as a Sewer Improvement District.

PROPOSED WASTEWATER INFRASTRUCTURE:

The major components of the proposed wastewater infrastructure are: (1) the wastewater collection system; (2) the treatment system; and (3) the wastewater effluent disposal system. The proposed wastewater infrastructure will serve only the Malulani Sports Complex and residential lots.

Projected Wastewater Flows: The wastewater flows from the Sports Complex are anticipated to be primarily generated from two sources: (1) the clubhouse activities and (2) 30 residential units. The clubhouse activities will include meal preparation; toilets and showers; and laundry area for washing towels.

The average daily wastewater generated by the golf clubhouse and the residences is estimated to be 50,000 GPD and will be typical of domestic wastewater in composition.

Collection System: The proposed wastewater collection system is shown in Figure 3. The collection system is located on the makai side of the residential lots. A gravity sewer will collect and convey the wastewater to the treatment facility from the clubhouse; maintenance facility and plant nursery; and residential lots.

Wastewater Treatment Plant (WWTP): The proposed WWTP is shown in Figure 4 located mauka of Kamehameha Highway. The solids (sludge) removed by the treatment process will be disinfected, dewatered and applied to the golf course and landscape areas as a soil conditioner. Any surplus sludge will be hauled to an approved City Sanitary landfill for final disposal in compliance with State of Hawaii Health Department requirements.

Effluent Disposal: The treatment wastewater effluent will be chorinated and conveyed to an aerated blending pond. The pond will be used for mixing effluent with non-potable irrigation water from storm runoff and /or brackish groundwater. The pond will be lined to prevent direct infiltration of irrigation water. Approximately 16 percent of the estimated golf course irrigation water requirement can be supplied by the treated effluent.

IMPACT AND MITIGATION:

Irrigation of the golf course with treated effluent will reduce the demand for irrigation water from non-potable sources.

With proper operation, objectionable odors will not be generated from the WWTP. Pumps and blowers normally associated with WWTP will be enclosed within a control building to reduce the impact of operating noises.

Placement of the WWTP below ground level and landscaping the perimeter fence area will reduce the visual impact on users of the Sports Complex and the general public passing on Kamehameha Highway.

REFERENCES:

1. "Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review, Malulani Sports Complex." Helber , Hastert and Kimura Planners, September 1989.

CORRECTION

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

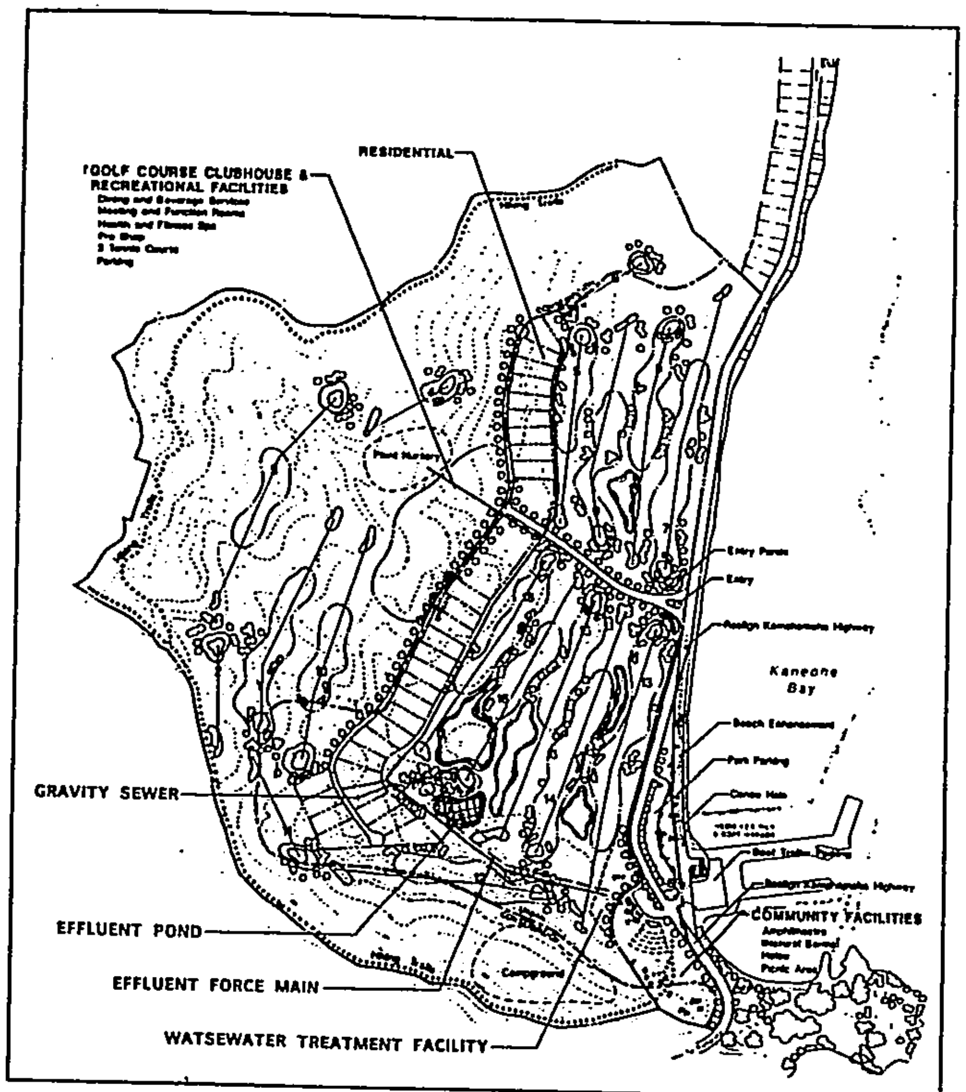


FIGURE 3 PROPOSED WASTEWATER SYSTEM AND EFFLUENT DISPOSAL SYSTEM

0 Feet 800

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

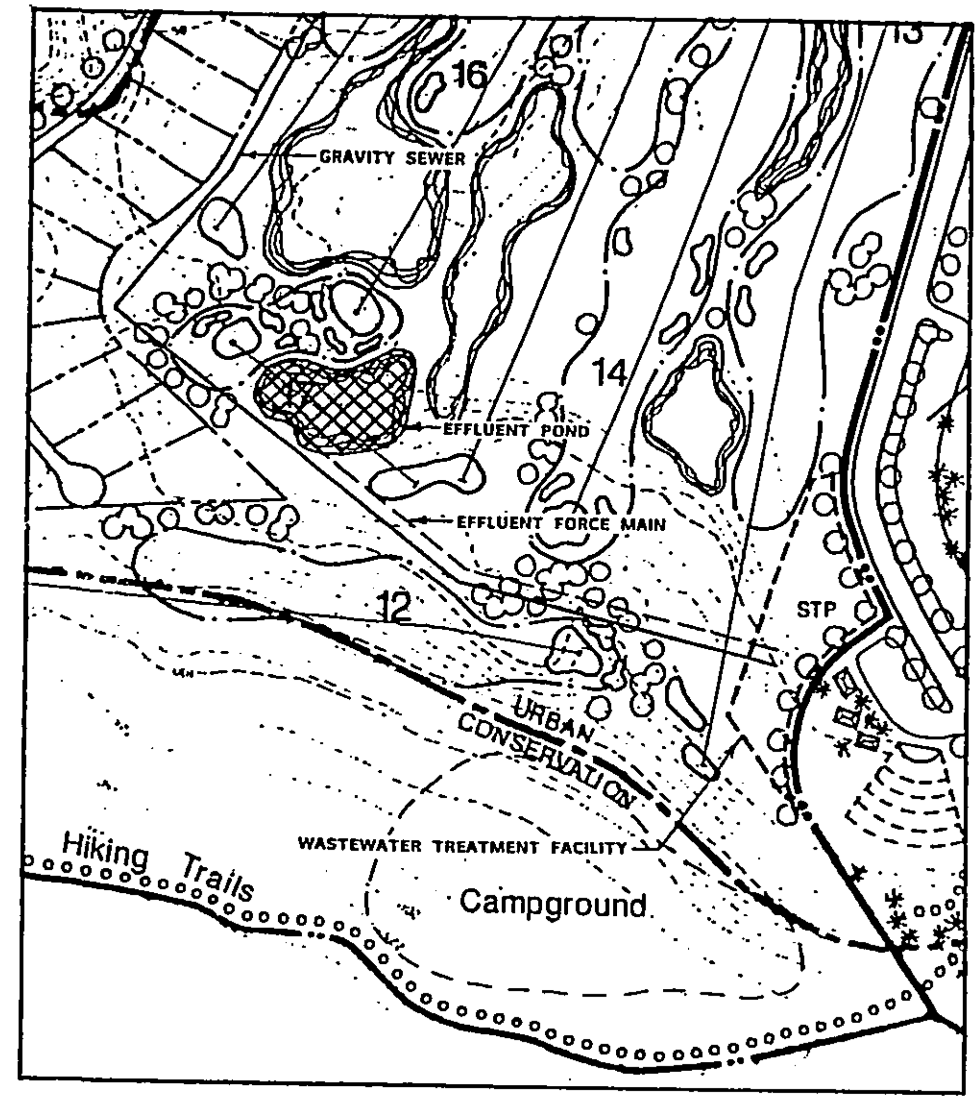


FIGURE 4 WASTEWATER TREATMENT FACILITY SITE MAP

0 Feet 200

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

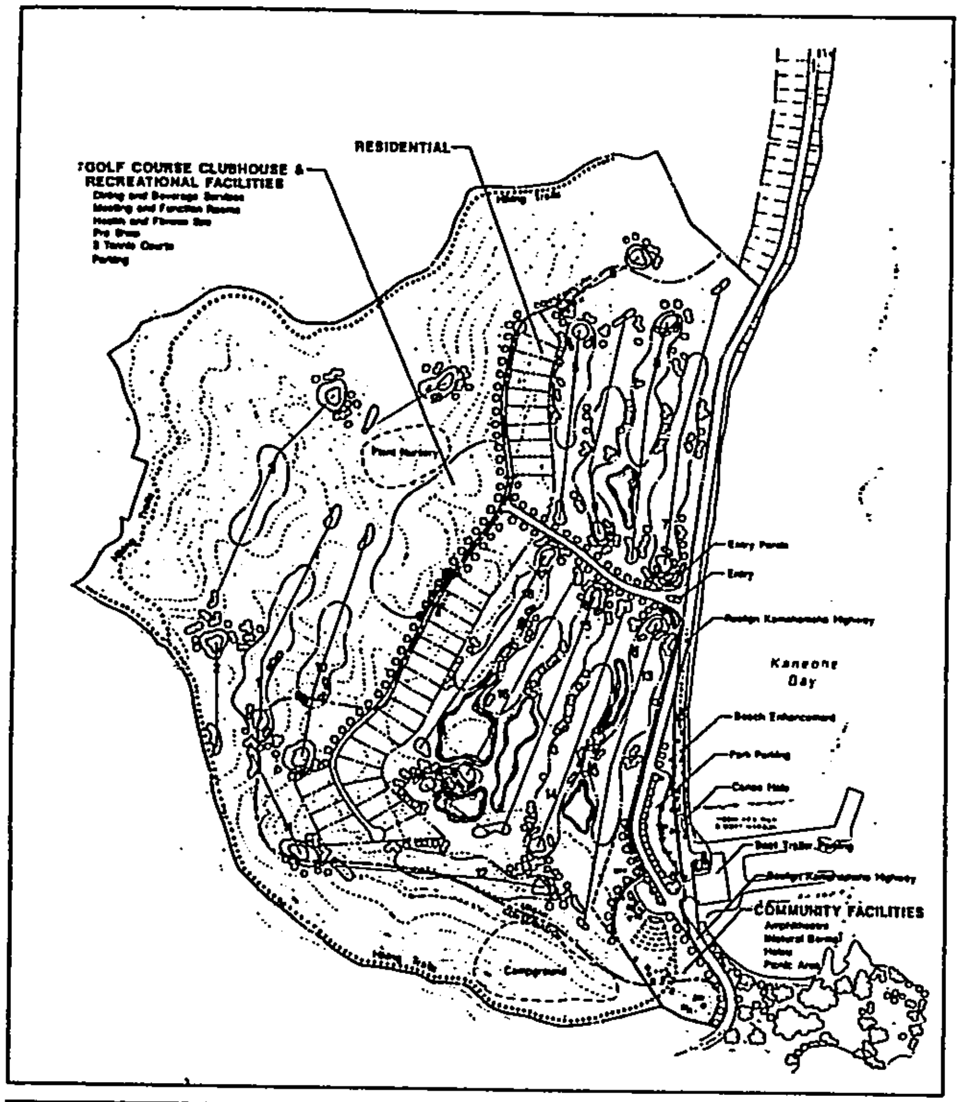


FIGURE 2 SPORTS COMPLEX PLAN

Malulani Sports Complex

Presently, the property is not serviced by the City and County of Honolulu's wastewater collection, treatment, and disposal system. The adjoining residential area between the subject property and the junction of Kamehameha Highway and Kahekili Highway is serviced by cesspools. Wastewater disposal by cesspools is a major issue within the Koolaupoko Development Plan (DP) area. The DP Public Facilities Map for Koolaupoko identifies the adjoining residential area as a Sewer Improvement District.

PROPOSED WASTEWATER INFRASTRUCTURE:

The major components of the proposed wastewater infrastructure are: (1) the wastewater collection system; (2) the treatment system; and (3) the wastewater effluent disposal system. The proposed wastewater infrastructure will serve only the Malulani Sports Complex and residential lots.

Projected Wastewater Flows: The wastewater flows from the Sports Complex are anticipated to be primarily generated from two sources: (1) the clubhouse activities and (2) 30 residential units. The clubhouse activities will include meal preparation; toilets and showers; and laundry area for washing towels.

The average daily wastewater generated by the golf clubhouse and the residences is estimated to be 50,000 GPD and will be typical of domestic wastewater in composition.

Collection System: The proposed wastewater collection system is shown in Figure 3. The collection system is located on the makai side of the residential lots. A gravity sewer will collect and convey the wastewater to the treatment facility from the clubhouse; maintenance facility and plant nursery; and residential lots.

Wastewater Treatment Plant (WWTP): The proposed WWTP is shown in Figure 4 located mauka of Kamehameha Highway. The solids (sludge) removed by the treatment process will be disinfected, dewatered and applied to the golf course and landscape areas as a soil conditioner. Any surplus sludge will be hauled to an approved City Sanitary landfill for final disposal in compliance with State of Hawaii Health Department requirements.

Effluent Disposal: The treatment wastewater effluent will be chorinated and conveyed to an aerated blending pond. The pond will be used for mixing effluent with non-potable irrigation water from storm runoff and /or brackish groundwater. The pond will be lined to prevent direct infiltration of irrigation water. Approximately 15 percent of the estimated golf course irrigation water requirement can be supplied by the treated effluent.

IMPACT AND MITIGATION:

Irrigation of the golf course with treated effluent will reduce the demand for irrigation water from non-potable sources.

With proper operation, objectionable odors will not be generated from the WWTP. Pumps and blowers normally associated with WWTP will be enclosed within a control building to reduce the impact of operating noises.

Placement of the WWTP below ground level and landscaping the perimeter fence area will reduce the visual impact on users of the Sports Complex and the general public passing on Kamehameha Highway.

REFERENCES:

1. "Application for Development Plan Amendment and Environmental Assessment, 1990 Annual Review, Malulani Sports Complex." Helber , Hastert and Kimura Planners, September 1989.

APPENDIX J

TRAFFIC REPORT
Sam O. Hirota, Inc.

TRAFFIC REPORT
FOR
HALULANI SPORTS COMPLEX

PREPARED BY:
SAM O. HIROTA, INC.
864 SOUTH BERETANIA STREET
HONOLULU, HAWAII

OCTOBER 30, 1989

TABLE OF CONTENTS

TRAFFIC REPORT

I. INTRODUCTION

A. Purpose and Scope:

This traffic study identifies and evaluates the probable impact of the forecasted traffic generated by the new Malulani Sports Complex in Heeia Kea. The analysis primarily focuses on the traffic impact at the proposed "T" intersection of Kamehameha Highway and the proposed entry road to the project. This study will also address the impact of forecasted traffic generated by the addition of parking stalls to the Heeia Kea Boat Harbor. The analysis will encompass the traffic impact at the existing and proposed access to Kamehameha Highway.

Presently the State Department of Transportation (DOT) and the City and County Department of Transportation Services (DTS) are evaluating the following article as a guideline for future policy: Traffic Access and Impact Studies for Site Development, by the Transportation Planners Council of the Institute of Transportation Engineers (ITE). ITE recommends that a complete traffic access/impact study should be conducted whenever a proposed development will generate 100 or more additional (new) peak direction trips (inbound or outbound) to or from the site during the adjacent roadways peak hour or the development's peak hour. The analysis area should encompass all roads and intersections through which peak hour site traffic composes at least 5 per cent of the existing capacity on an intersection approach, or roadway sections on which accident potential or residential traffic character is expected to be significantly impacted.

This report set forth the traffic generation characteristics of the Malulani Sports Complex. Recent traffic counts were obtained from the State Department of Transportation for two different locations on the Kamehameha Highway. Since these counts were taken on a weekday, i.e. Tuesday and Wednesday, Sam O. Hirota Inc. augmented this information with both a weekday and weekend traffic count.

B. Location:

Nanatomi Hawaii, Inc. owns approximately 220 acres of land in Heeia Kea Valley, Kaneohe, Oahu. The property is mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Boat Harbor, Figure 1 and Figure 2. The site is adjacent to existing residences that stretch along Kamehameha Highway from Hygenic Store, and is makai of Valley of the Temples and Ahuimanu residential and commercial development.

C. Project Description:

Nanatomi Hawaii proposes the development of a sports complex on the property, including a 18-hole golf course, golf clubhouse with quality dining facilities, meeting rooms, a tennis club, health spa and associated fitness facilities, as well as approximately 30 to 35 single family homes. The clubhouse will contain the requisite players facilities such as administrative office, bag handling area, lockers, pro shop, food and beverage facilities, golf cart storage area and back-of-house facilities. In addition, Nanatomi Hawaii intends to provide quality dining facilities, and meeting and function rooms. In response to community needs, the owners proposes to dedicate land to the County to enhance the Heeia Kea Boat Harbor. A portion of this land will provide a maximum of 96 additional parking stalls for passenger cars and a maximum of 16 additional parking stalls for boat trailers.

II. EXISTING CONDITIONS

A. General:

Historically a number of residential homes were built and subsequently removed along the mauka-side of Kamehameha Highway. Presently the access road and driveways along this stretch have been blocked to vehicle traffic.

During the traffic count conducted by Sam O. Hirota, Inc., numerous vehicles were parked along both sides of Kamehameha Highway and, in a 12-hour period, 139 pedestrians either walked along the highway or crossed the highway in the vicinity of Heeia Kea Boat Harbor. The boat harbor currently has 87 parking stalls for passenger cars and 39 parking stalls for boat trailers.

EXISTING ZONING/SMA

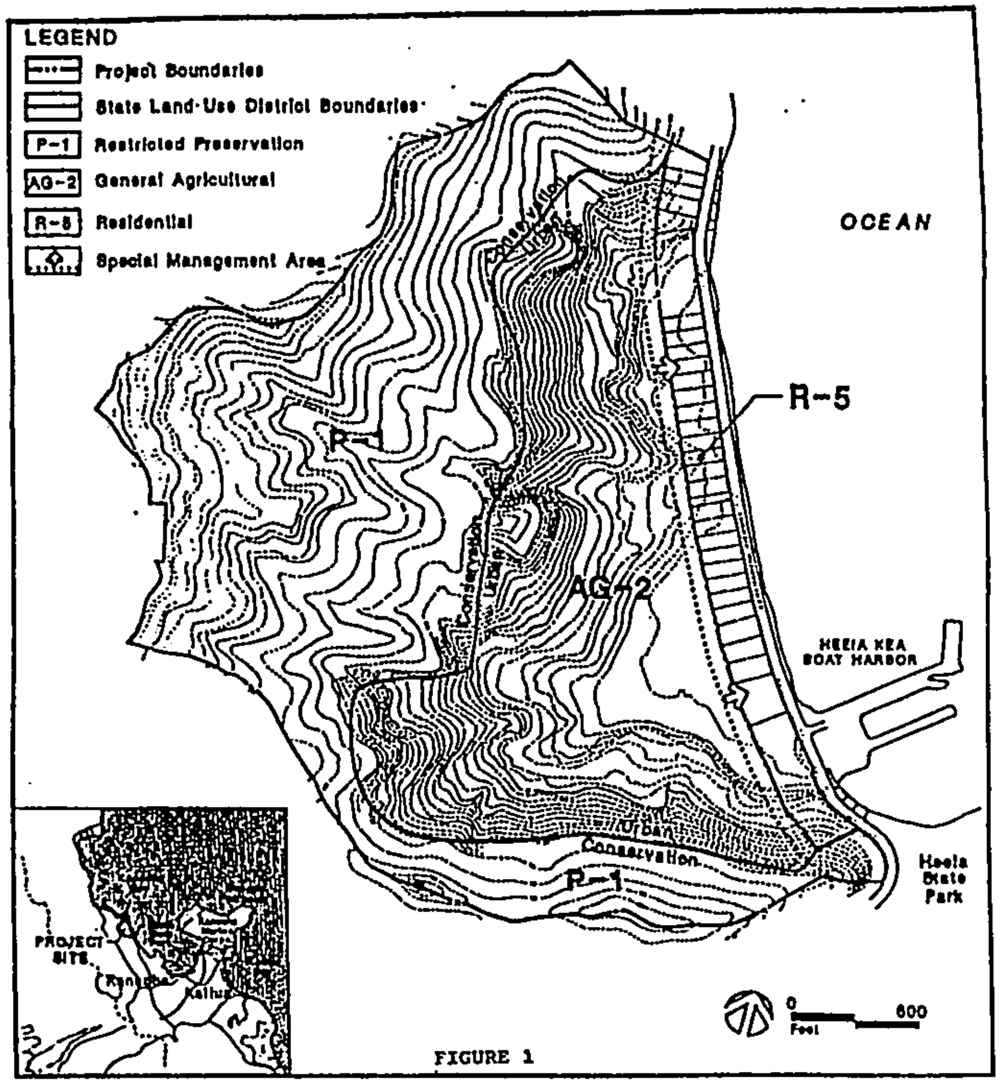


FIGURE 1

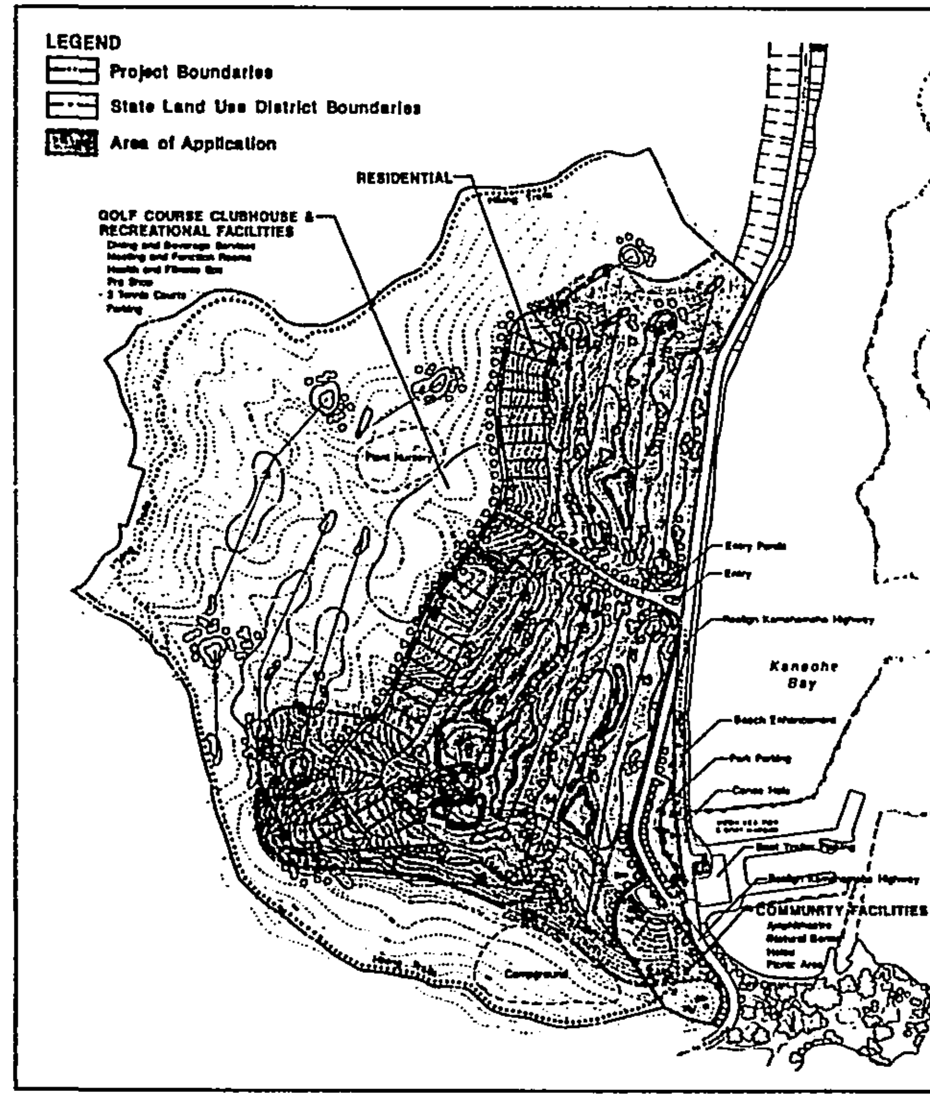


FIGURE 2 CONCEPTUAL PLAN

Malulani Sports Complex

0 600 Feet

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

B. **Roads:**

Kamehameha Highway is a 60-foot right-of-way, two-lane highway with a pavement width of 22 feet. A white strip delineates each of the 10 foot lanes from a 2 foot paved shoulder and a 6 foot crushed rock shoulder. As one proceeds from site to Kaneohe, the lanes are separated by dashed lines until approximately 200 feet north of the Heeia Kea Boat Harbor access road, where double yellow lines begin and continue for several thousand feet through the infamous "S" curve. The road is posted at 30 miles per hour. Kamehameha Highway forms a three-way, signalized intersection with Kahekili Highway approximately 2 miles north of the site. Two miles south of the site, Kamehameha Highway forms another signalized intersection with Haiku Road which is adjacent to the Windward Mall in Kaneohe.

C. **Traffic:**

1. **Highway Access**

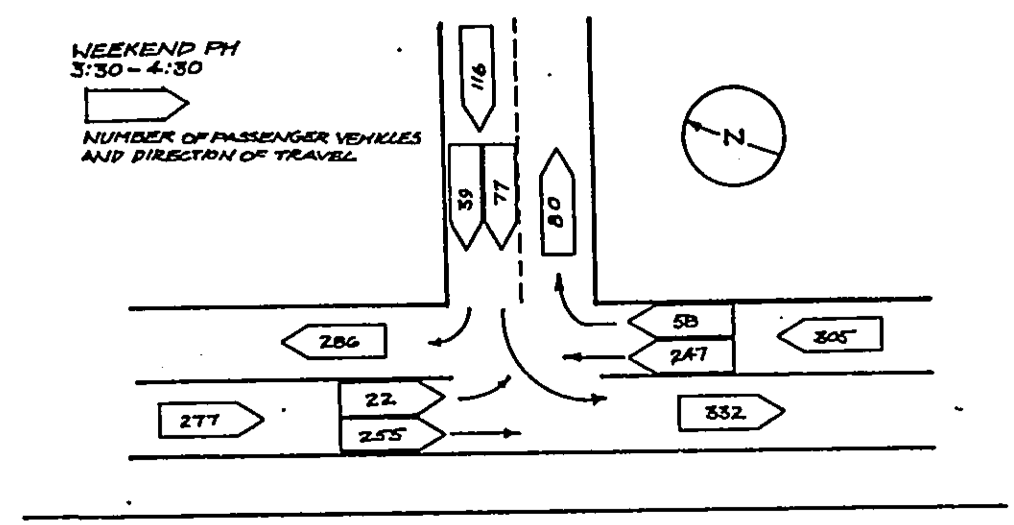
In previous years there have been as many as 10 driveways along this segment of the highway. All but one, to the Heeia Kea Boat Harbor, has been blocked to motor vehicles.

2. **Traffic Count Data**

Recent twenty-four hour traffic counts were made available by the State Department of Transportation for two locations. Station No. 3101 is at the intersection of Kahekili Highway and Kamehameha Highway. This traffic count was taken on Tuesday, November 1, 1988. Station C-31-C is on the south side of Heeia Bridge, 0.4 miles northwest of Ipuko Street. It was taken on Wednesday, November 4, 1987. These studies were augmented by traffic counts conducted by Sam O. Hirota, Inc. on August 12th thru 14th 1989. Figure 3 depicts the current peak hour traffic volumes for a typical weekend (8/12-13/89)and a typical weekday (8/14/89).

The traffic count study was undertaken in order to ascertain the weekend traffic flow characteristics. However, as shown in Table 1, the State DOT weekday morning peak hour traffic counts for Station C-31-C (1987) are

FIGURE 3
HEEIA KEA BOAT HARBOR
EXISTING ACCESS TO KAMEHAMEHA HWY
CURRENT 8/13/89 WEEKEND PEAK HOUR



CURRENT 8/14/89 WEEKDAY PEAK HOUR

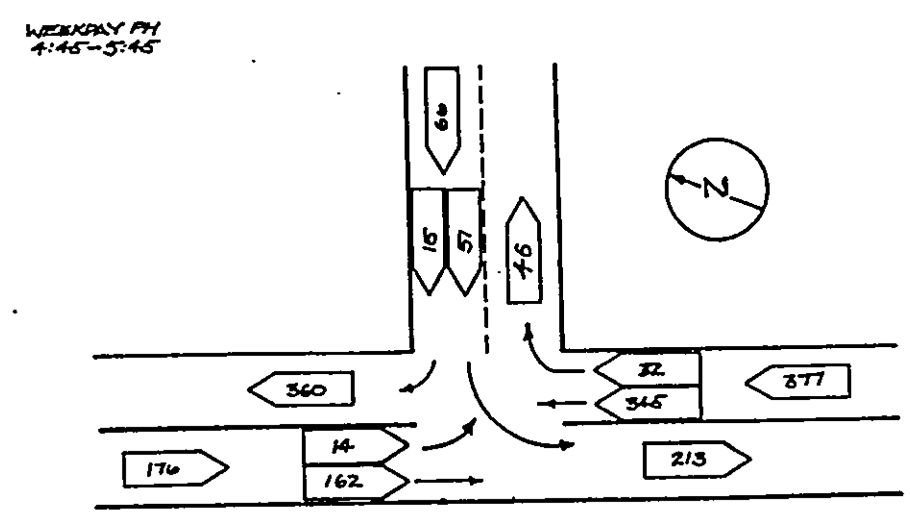


TABLE 1

TRAFFIC COUNT SUMMARY

KAMEHAMEHA HIGHWAY

	AT HEEIA PIER		AT HEEIA PIER		AT HEEIA PIER		AT KAHEKILI HIGHWAY		AT HEEIA BRIDGE	
DATE	8/12/89		8/13/89		8/14/89		11/1/88		11/04/87	
WEEKDAY	SATURDAY		SUNDAY		MONDAY		TUESDAY		WEDNESDAY	
	NORTH BOUND	SOUTH BOUND	NORTH BOUND	SOUTH BOUND	NORTH BOUND	SOUTH BOUND	NORTH BOUND	SOUTH BOUND	NORTH BOUND	SOUTH BOUND
TIME AM	9:45 - 10:45		11:30 - 12:30		11:30 - 12:30		7:15 - 8:15		6:00 - 7:00	
AM PEAK HR VOL	200	160	359	180	46	365	59	535	68	1724
AM K FACTOR	56%	44%	67%	33%	11%	89%	10%	90%	4%	96%
INTERSECTION TOTAL		502		676		458				
TIME PM	3:00 - 4:00		3:30 - 4:30		4:45 - 5:45		3:30 - 4:30		5:30 - 6:30	
PM PEAK HR VOL	275	173	247	255	345	162	270	163	298	339
PM K FACTOR	61%	39%	49%	51%	68%	32%	62%	38%	47%	53%
INTERSECTION TOTAL		594		698		619				
DIRECTIONAL PEAK										
TIME AM	11:15 -12:15	8:30 -9:30	11:30 -12:30	11:15 -12:15	11:45 -12:45	6:15 -7:15	7:30 -8:30	6:00 -7:00	10:45 -11:45	6:00 -7:00
AM PEAK HR VOL	269	172	359	192	213	365	112	535	224	1724
TIME PM	1:45 -2:45	3:30 -4:30	12:15 -1:15	12:15 -1:15	4:30 -5:30	4:45 -5:45	3:30 -4:30	3:45 -4:45	5:00 -6:00	5:30 -6:30
PM PEAK HR VOL	299	182	348	228	354	162	270	165	319	336

more than 5 times that of the most recent study. A staff member of the State Department of Transportation Planning Statistics and Traffic Counts Division researched the anomaly by comparing it with historical traffic counts for this area. He concluded that the results of this count are not correct and the most likely explanation is a malfunction in the mechanical counters (Reference 1).

The traffic counts are presented in Appendix A and were obtained for the purpose of documenting the existing baseline condition.

3. Trip Generation

Presently, there are no trips being generated by the project from the mauka side of the road. Table 2 summarizes the peak hour traffic generated by the Heeia Kea Boat Harbor.

4. Field Investigation

A field investigation and traffic counts were conducted along this segment of the Kamehameha Highway from August 12th thru 14th.

5. Traffic Accident Reports

The purpose of this review is to attempt to identify any undue hazards along this section of highway. It is not meant as a complete accident investigation report. Traffic accidents records maintained by the State DOT, Highways Division, are not available for this segment of the highway. However, accident statistics were aggregated from the intersection of Haiku Road and Kamehameha Highway and Kahekili Highway and Kamehameha Highway. During the calendar year 1987, 44 accidents were reported and 21 for 1988. No other details were available.

6. Level-of-Service Analysis of Existing Traffic

The intersection of Kamehameha Highway and the Heeia Kea Boat Harbor was analyzed to determine its Level-of-Service (LOS) using the field data from the manual traffic count and analysis techniques for unsignalized intersections from the Highway Capacity Manual

TABLE 2

TRAFFIC COUNT SUMMARY

HEEIA KEA BOAT HARBOR

DATE WEEKDAY	AT HEEIA PIER 8/12/89 SATURDAY BOAT HARBOR INGRESS	 EGRESS	AT HEEIA PIER 8/13/89 SUNDAY BOAT HARBOR INGRESS	 EGRESS	AT HEEIA PIER 8/14/89 MONDAY BOAT HARBOR INGRESS	 EGRESS
TIME AM	9:30 - 10:30		10:00 - 11:00		11:30 - 12:30	
AM PEAK HR VOL	81	69	96	57	100	57
AM K FACTOR	54%	46%	63%	37%	64%	36%
TOTAL 6 AM-12 NOON	1,708	1,162	1,791	1,178	1,329	855
TIME PM	4:30 - 5:30		2:15 - 3:15		12:00 - 1:00	
PM PEAK HR VOL	68	94	107	129	98	59
PM K FACTOR	42%	58%	45%	55%	62%	38%
TOTAL 12 NOON- 6PM	1,279	1,794			1,432	1,281
TOTAL 12 NOON -5:15PM			2,066	3,191		

(HCM) Special report 209 (1985 Edition). The LOS for the traffic movements in an intersection is classified into six categories ranging from little or no delay (LOS A) to very long delay (LOS F). At this intersection the results of the LOS analysis indicated: Little or no delay (LOS A) for all six movements.

III. PROPOSED IMPROVEMENTS

A. General:

Hanatomi Hawaii will dedicate approximately 9 acres of the property for community-oriented facilities. Approximately 1 acre will be dedicated to the City and County of Honolulu for the realignment of Kamehameha Highway near the entrance to the Heeia Kea Pier and Boat Harbor. By realigning a short section of Kamehameha Highway, approximately 3 acres adjacent to the Heeia Kea Pier and Boat Harbor will be available for a public beach park (desirable according to preliminary consultation with some segments of the community) and for the expansion of boat harbor facilities (which has limited parking, especially on weekends). Within this area makai of the realigned Kamehameha Highway, a maximum of 96 additional parking stalls for passenger cars and a maximum of 16 additional parking stalls for boat trailers are proposed in the improvements. Approximately 5 acres of land mauka of the realigned highway could be developed as an amphitheater, hula halau and picnic area.

B. Road:

Realigning Kamehameha Highway would have the advantage of eliminating the dangerous "S" curve and providing a straight section of roadway with adequate sight distance for entry to the proposed complex.

C. Traffic:

1. General

Up to this point, only the local traffic conditions have been addressed. The need to travel south bound beyond Kaneohe will expand the focus to Kahekili and Likelike Highways.

It is anticipated that traffic congestion will continue to worsen on these two highways if improvements aren't implemented. Projections have been made of traffic volumes between the intersections of the highway for the year 2008 in a recent draft Environmental Impact Statement (EIS) to widen Kahekili Highway (Reference 2).

Based on these traffic projections, travel time in morning peak hour traffic, from Kamehameha Highway to Likelike on Kahekili Highway, without improvements which now takes 24 minutes will take approximately 79 minutes in the year 2008.

It should be mentioned that one of the highway corridor alternatives in the EIS would entail widening of Kamehameha Highway to a minimum 120-foot wide right-of-way from Kaneohe Town to the intersection with Kahekili Highway. This would require the acquisition or partial acquisition of 280 parcels of land, mostly residential lots. Many of these lots would be affected to such an extent that the occupants would have to be relocated. A preliminary cost estimate for the right-of-way acquisition alone is $28 million. According to the EIS, due to Kamehameha Highway's relative proximity to Kaneohe Bay and its route through the Heeia Wetland area, the widening of this segment of the highway would have greater adverse impact on water quality and aquatic habitats than the proposed project on Kahekili Highway. The visual impact would also be greater, particularly in Heeia and to the north. In addition to these considerations, this section of Kamehameha Highway is primarily a collector road serving local traffic in the Kaneohe area. It is not linked as directly to trans-Koolau traffic routes as Kahekili Highway is, so the EIS concludes that widening of this highway segment would not do as much to improve regional peak hour traffic conditions.

The Department of Transportation Services, Planning Division, does not have projected traffic volumes for this segment of the highway. The Chief of the Planning Division concurs that this section of Kamehameha Highway will remain for the forseeable future,

a collector road serving local traffic in the Kaneohe area. In recent years the traffic volume has declined over this segment of the highway due to improvements on Kahekili Highway and this trend should continue as additional improvements are implemented to Kahekili Highway. Since this project is scheduled to be completed in 1993, it is preferred that the current traffic counts be used as opposed to a projected declining trend (see Reference 3). Figure 4 shows the projected traffic counts which were based on the average 24 hour traffic volume estimated from the SOH three day, (8/12-14/89) 12 hour traffic counts. Because these were not 24 hour traffic counts the night time traffic ratio was calculated from DOT Station C-31-C which is on the south side of Heeia Bridge, 0.4 miles northwest of Ipuko Street, using the traffic counts taken on Wednesday, November 4, 1987.

2. Highway Access

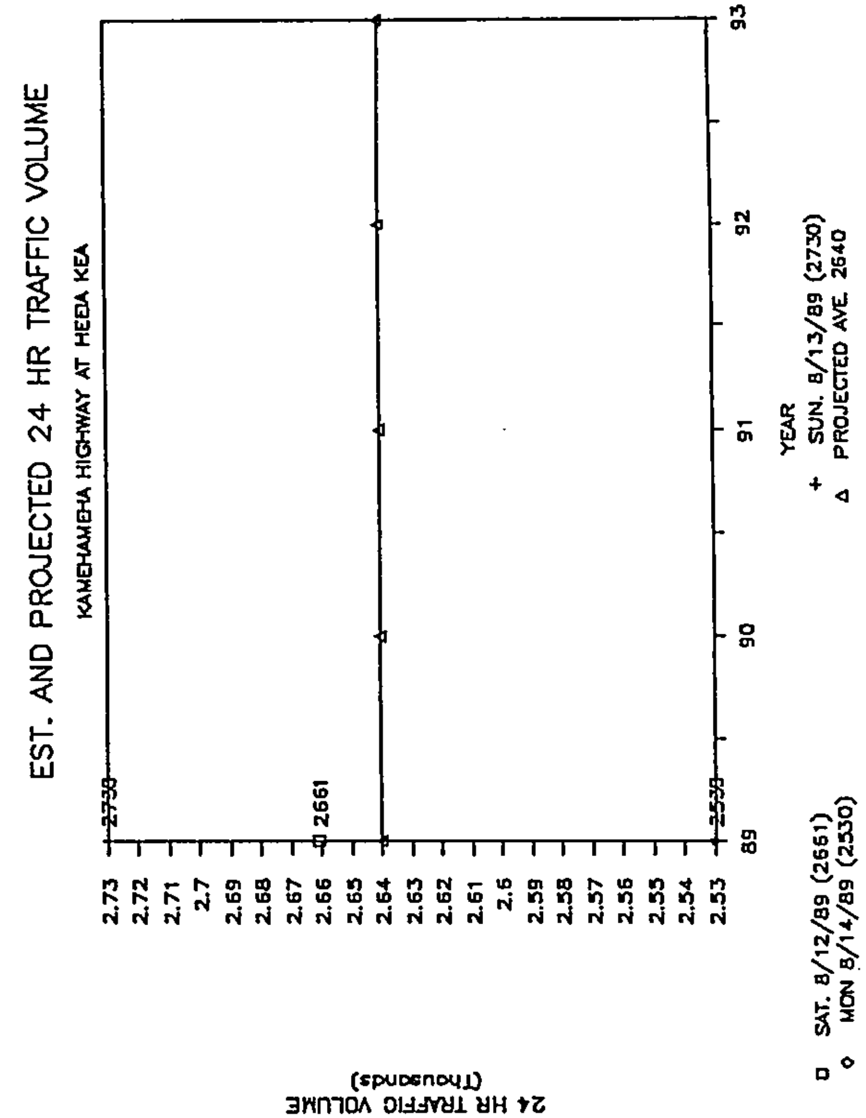
The proposed site will have only one major access and that access will be to Kamehameha Highway (see Figure 4). There will be one additional minor access to Kamehameha Highway for the golf maintenance facility. Both proposed accesses will create a new unsignalized T-intersection. Due to incidental use the impact of the minor access is deemed insignificant and only the major access will be analyzed.

The proposed location of the major access provides an unobstructive view for traffic on Kamehameha Highway for over 600 feet in both directions. The stopping sight distance for the posted speed of 30 miles per hour (MPH) is 200 feet. The distance calculated from the critical gap is 286 feet, which is the median time headway between two successive vehicles that is accepted by drivers engaged in crossing and/or merging with traffic.

3. Trip Generation

Because this is a new and higher use for the existing property, current trip generation is not available. In order to use an acceptable standard, the 4th Edition of "Trip Generation"

FIGURE 4



published by The Institute of Transportation Engineers, was employed as a reference. In order to look at distinct traffic generators, two demand functions will be delineated, trips generated by (1) number of parking stalls for the Club House and (2) the number of single family houses.

Tables 3 and 4 presents the times and peak hour volume of vehicles for both the generator (Halulani Sports Complex) and Kamehameha Highway. The following analysis uses the worst condition which would be the peak hour of the intersection with Kamehameha Highway.

IV. AN ASSESSMENT OF THE CHANGES IN THE ROADWAY OPERATING CONDITIONS

A. General:

The focus of the analysis is to determine the impact of the project generated traffic at the proposed entry road to the Halulani Sports complex and secondly at the existing and new access to the Heeia Kea Boat Harbor. The estimated traffic impact is calculated by adding the expected generated traffic to the estimates of future traffic on this section of Kamehameha Highway.

The two questions that need to be addressed are: will the proposed access decrease the level of service on this segment of Kamehameha Highway and and could improvements be constructed to mitigate such affect? The following section will address these questions.

B. Methodology of Analysis:

The recommended level-of-service analysis procedures for an unsignalized T-intersection, detailed in the most recent edition of the Highway Capacity Manual, were followed in this report. The analysis of unsignalized intersections is generally applied either to existing locations or to estimate the impacts of anticipated new demand. The methodology is specially structured to yield a level of service and an estimate of reserve capacity for an existing case. The procedure for capacity analysis is based on two factors:

-15-

TABLE 3 TRIP GENERATION CHARACTERISTICS FILE:HSCC430P

Land Use or Bldg Type GOLF COURSE ITE Code 430

Location HALULANI SPORTS COMPLEX TMK: 4-6-04

Independent Variable PARKING SPACING 200 UNITS

THE FOLLOWING WERE NOT AVAILABLE REFERENCE BUT APPROXIMATED BY AUTHOR

* PEAK HOUR OF GENERATOR

DIRECTIONAL DISTRIBUTION

AVERAGE VEHICLE TRIPS ENDS = 919			DIR. DISTR.	VOLUME
AVERAGE WEEKDAY				
PEAK	A.M.	ENTER	47%	45 #
HOUR	BETWEEN	EXIT	53%	51 #
OF	7 and 9	TOTAL		96 *
GENERATOR	P.M.	ENTER	64%	61 #
	BETWEEN	EXIT	36%	35 #
	4 and 6	TOTAL		96 *

AVERAGE VEHICLE TRIPS ENDS = 900	DIR. DISTR.	VOLUME
AVERAGE SATURDAY		
ENTER	28%	27
EXIT	72%	69
TOTAL		96

AVERAGE VEHICLE TRIPS ENDS = 894	DIR. DISTR.	VOLUME
AVERAGE SUNDAY		
ENTER	28%	22 #
EXIT	72%	58 #
TOTAL		80

PEAK	11:30-	NORTH BOUND	11%	46	9:45-	NORTH BOUND	56%	200	11:30-	NORTH BOUND	67%	359
HOUR	12:30	SOUTH BOUND	89%	365	10:45	SOUTH BOUND	44%	160	12:30	SOUTH BOUND	33%	180
ON	A.M.	TOTAL		411	A.M.	TOTAL		360	A.M.	TOTAL		539
KAM	4:45-	NORTH BOUND	73%	435	3:00-	NORTH BOUND	47%	275	3:30-	NORTH BOUND	47%	247
HWY	5:45	SOUTH BOUND	27%	162	4:00	SOUTH BOUND	53%	173	4:30	SOUTH BOUND	53%	255
TRAFFIC	P.M.	TOTAL		597	P.M.	TOTAL		448	P.M.	TOTAL		502

-16-

TABLE 4 TRIP GENERATION CHARACTERISTICS FILE:HSCC210D

Land Use or Bldg Type SINGLE FAMILY DETACHED HOUSING ITE Code 210

Location HALULANI SPORTS COMPLEX TMK: 4-6-04

Independent Variable 35 UNITS

AVERAGE VEHICLE TRIPS ENDS = 381			DIR. DISTR.	VOLUME
AVERAGE WEEKDAY				
PEAK	A.M.	ENTER	28%	11
HOUR	BETWEEN	EXIT	72%	27
OF	7 and 9	TOTAL		38
GENERATOR	P.M.	ENTER	64%	27
	BETWEEN	EXIT	36%	15
	4 and 6	TOTAL		42

AVERAGE VEHICLE TRIPS ENDS = 355	DIR. DISTR.	VOLUME
AVERAGE SATURDAY		
ENTER	53%	27
EXIT	47%	24
TOTAL		50

AVERAGE VEHICLE TRIPS ENDS = 282	DIR. DISTR.	VOLUME
AVERAGE SUNDAY		
ENTER	52%	22
EXIT	48%	20
TOTAL		43

PEAK	11:30-	NORTH BOUND	11%	46	9:45-	NORTH BOUND	56%	200	11:30-	NORTH BOUND	67%	359
HOUR	12:30	SOUTH BOUND	89%	365	10:45	SOUTH BOUND	44%	160	12:30	SOUTH BOUND	33%	180
ON	A.M.	TOTAL		411	A.M.	TOTAL		360	A.M.	TOTAL		539
KAM	4:45-	NORTH BOUND	68%	345	3:00-	NORTH BOUND	47%	275	3:30-	NORTH BOUND	47%	247
HWY	5:45	SOUTH BOUND	32%	162	4:00	SOUTH BOUND	53%	173	4:30	SOUTH BOUND	53%	255
TRAFFIC	P.M.	TOTAL		507	P.M.	TOTAL		448	P.M.	TOTAL		634

1. The distribution of gaps in the major street traffic stream.

2. Driver judgment in selecting gaps through which to execute their desired maneuvers.

Design applications are treated as trial-and-error computations based on anticipated improvements on the existing intersection or on the projected design of a new intersection.

Scenario number one will depict the proposed T-intersection with the following characteristics:

1. No left-turn lane or right-turn lane on Kamehameha Highway.

2. No left-turn lane or right-turn lane on the access road.

Scenario number two:

1. Left-turn lane on Kamehameha Highway.

2. Right-turn lane on the access road.

The analysis will use both the peak hour intersection traffic of a typical weekday and a weekend. The following two peak hour periods were selected:

1. The weekend peak hour which was recorded between 3:30 AM and 4:30 PM, August 13, 1989. See Figure 5.

2. The most recent weekday afternoon peak hour which was recorded between 4:30 and 5:30 AM, August 14, 1989. See Figure 6.

The peak hour traffic volume generated by the improvements to Heeia Kea Boat Harbor were taken from Table 2. The peak hour trips generated by the Malulani Sports Complex, were taken from Tables 3 and 4.

NUMBER OF PASSENGER VEHICLES AND DIRECTION OF TRAVEL
PEAK HOUR 3:30 - 4:30

FIGURE 5
(WEEKEND)
PROJECTED PEAK HOUR TRAFFIC
PLUS TRAFFIC FROM NEW IMPROVEMENTS

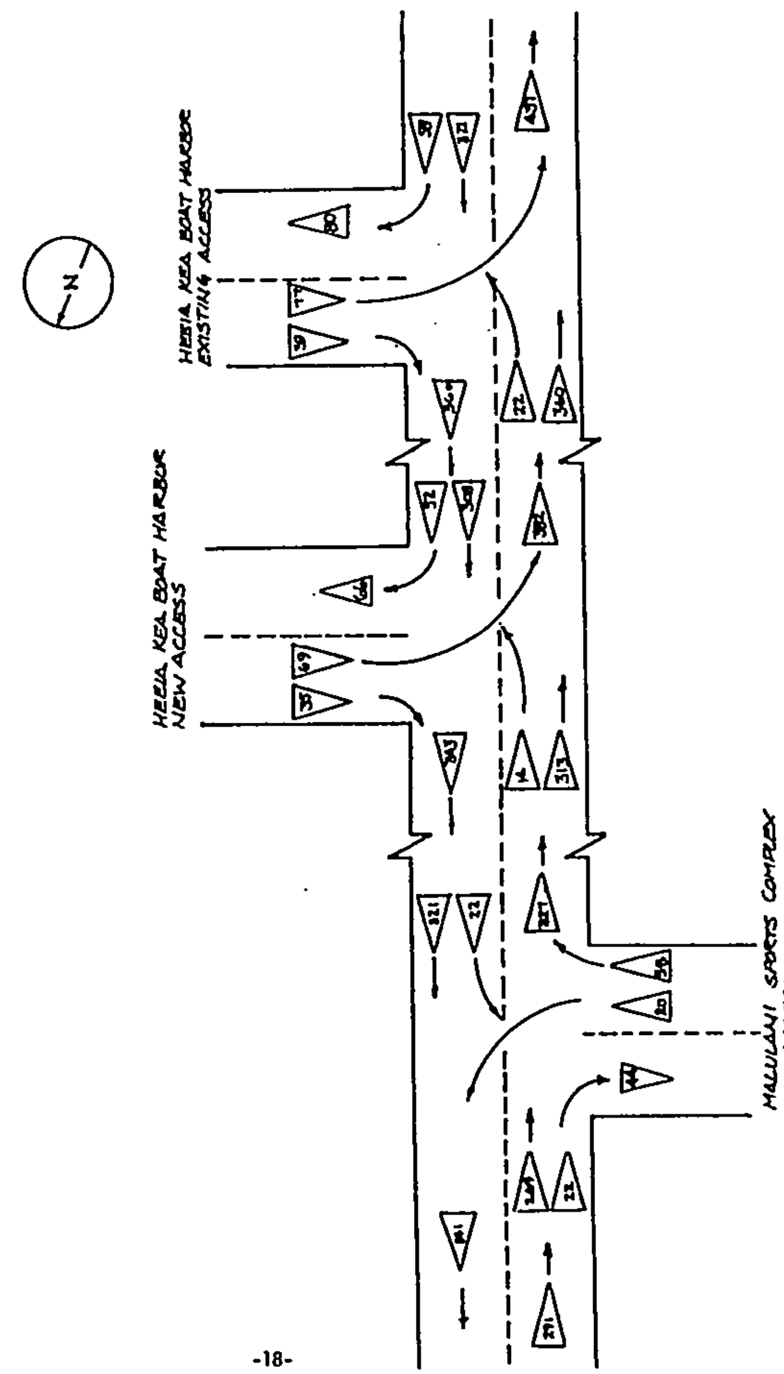
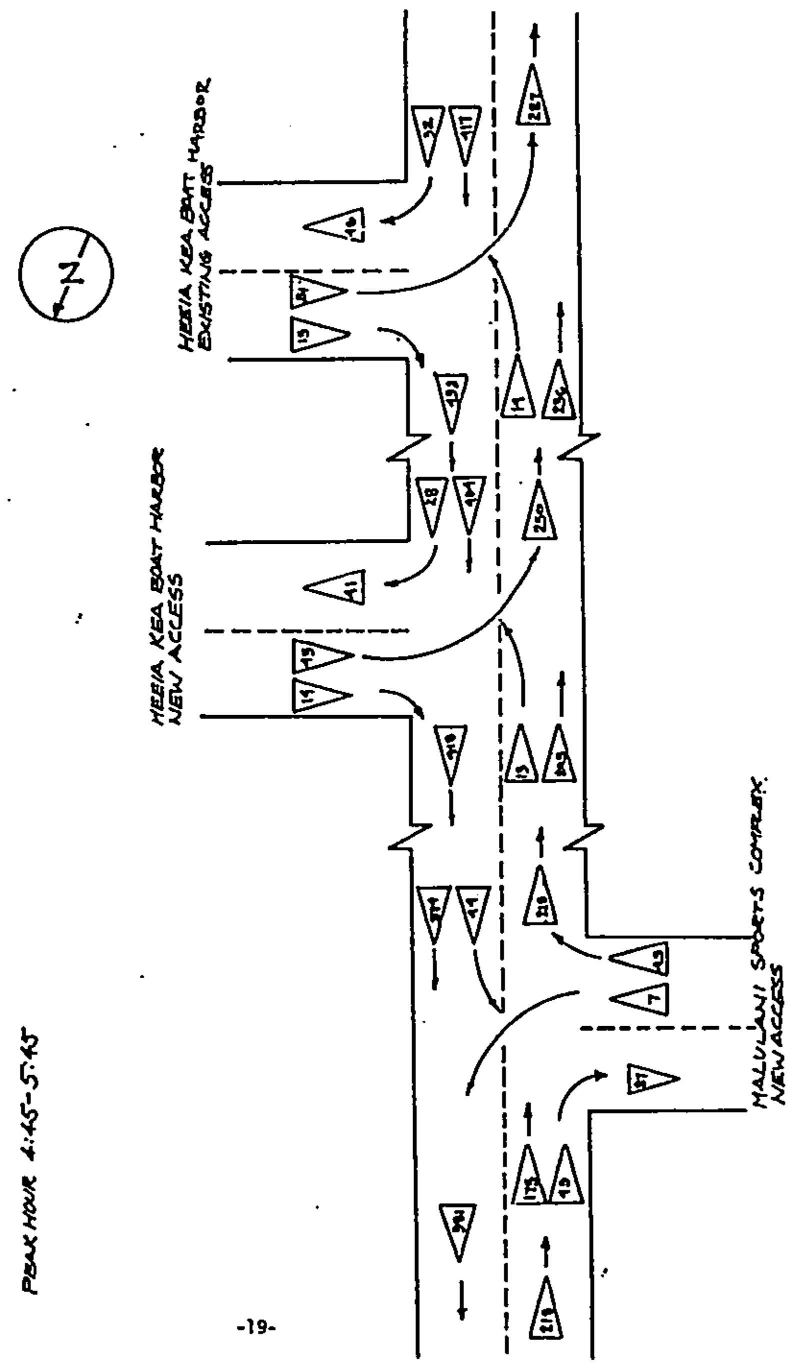


FIGURE 6
(WEEKDAY)
PROJECTED PEAK HOUR TRAFFIC
PLUS TRAFFIC FROM NEW IMPROVEMENTS

NUMBER OF PASSENGER VEHICLES AND DIRECTION OF TRAVEL

PEAK HOUR 4:45-5:45



C. Summary of Analysis

The level-of-service (LOS) A was calculated for each of the left turn movements from Kamehameha Highway to any of the access roads.

Table 5 summarizes the LOS analysis for passenger cars exiting from the access road to Kamehameha Highway. It also compares the results for the two scenarios, left and right turns from a shared lane, and left and right turns from separate lanes. The level-of-service (LOS) for each peak hour period is an "A" indicating little or no delay for the proposed access to the Malulani Sports Complex for both weekdays and weekends. The improvement proposed for the Heeia Kea Boat Harbor may increase the parking by 89 percent. In the analysis we allow the demand to be elastic in response to the additional available parking. Even with the addition of a new access, the LOS for the existing boat harbor access dropped one level of service for both the weekend and the weekday (from "B" to "C" and from "A" to "B" respectively). The new access registers a LOS of "B" for both weekdays and weekend. The problem is in the left turn lane from the access road to the highway. With a separate left turn lane on the existing access it improves the LOS for the right turn from a "C" to an "A" but it doesn't appreciably help the delay time in the left turn lane. The worksheets for these calculations can be found in Appendix B.

D. Conclusion:

The highest level of service is "A" which translates into little or no delay for left turns from the highway. Table 5 shows that the critical level of service falls during the weekend for the Heeia Kea Boat Harbor. Even with an additional access an 89 percent increase in overall traffic lowers the LOS for the existing access by one level.

The above analysis indicates the use of exclusive turn lanes from the access road as compared with a one combined lane does increase the level of service for the right turn lane but not for the left turn lane.

TABLE 5
SUMMARY OF ANALYSIS
FOR PASSENGER CARS EXITING FROM ACCESS TO KAMEHAMEHA HWY

	WEEKEND PEAK HOUR SHARED LANES LOS	WEEKEND PEAK HOUR SEPARATE LANES LOS L	WEEKEND PEAK HOUR SEPARATE LANES LOS R	WEEKDAY PEAK HOUR SHARED LANES LOS	WEEKDAY PEAK HOUR SEPARATE LANES LOS L	WEEKDAY PEAK HOUR SEPARATE LANES LOS R
EXISTING CONDITIONS						
HEEIA KEA BOAT HARBOR	B	B	A	A	B	A
PROJECTED CONDITIONS						
HEEIA KEA BOAT HARBOR	B	B	A	B	B	A
PROJECTED CONDITIONS WITH PROJECT & IMPROVMNTS						
EXISTING ACCESS HEEIA KEA BOAT HARBOR	C	C	A	B	B	A
PROPOSED ACCESS HEEIA KEA BOAT HARBOR	B	B	A	B	B	A
PROPOSED ACCESS HALULANI SPORTS COMPLEX	A	B	A	A	B	A

	LEVEL OF SERVICE (LOS)	RESERVED CAPACITY (CR) (PCPH)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAYS	E	0	99
EXCEEDS CAPACITY	F	<	0

Similarly, an exclusive left turn and right turn lane on Kamehameha Highway does not alter the level of service for the projected traffic flow.

However, since improvements and realignment are anticipated for this segment of Kamehameha Highway, the marginal utility of adding a left turn and right turn lane from the highway to the project now, is greater than making these improvements in response to unanticipated future traffic demands.

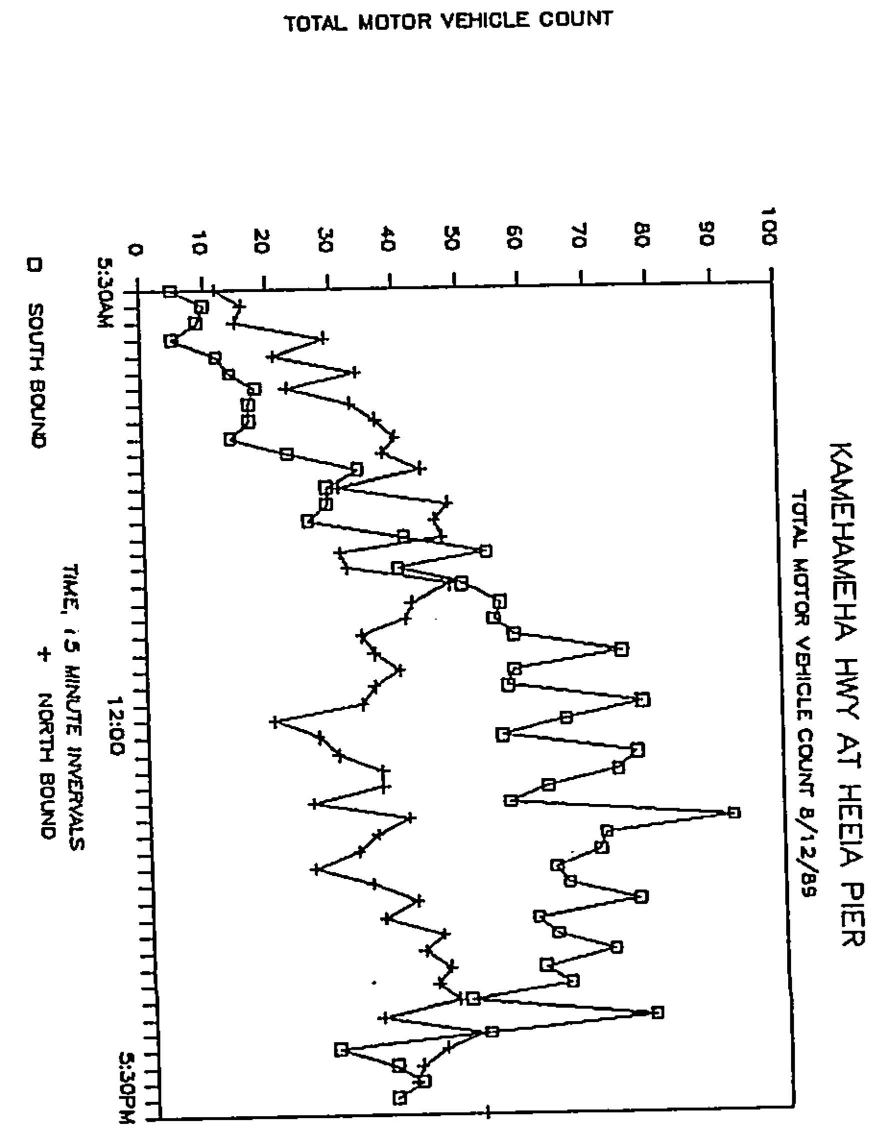
REFERENCES:

1. Telcon with Ken Miyazona, State Department of Transportation Planning Statistics and Traffic Counts Division 8/20/89.

2. Draft Environmental Impact Statement, Report No.:FHWA-HI-EIS-89-01-D, Kahekili Highway Widening and Interchange, City and County of Honolulu, Hawaii. U.S. Department of Transportation, Federal Highway Administration and State of Hawaii Department of Transportation, Highways Division.

3. Telcon with Michael Oshiro, Chief, The Department of Transportation Services, Planning Division, 10/10/89.

** APPENDIX A **



SUMMARY FOR PEAK HOUR TRAFFIC AT BOAT HARBOR

DATE: 8/12/89 DAY: SATUDAY

	ENTERING				EXISTING		
	V2	V3	V4	V5	V7	V9	TOTAL
AM PEAK TIME	9:30 -10:30						
AM PEAK HR VOL		66	15		47	22	150
DIRECTION		81%	19%		68%	32%	
TOTAL MOVEMENT		81			69		
AM K FACTOR		54%			46%		
TOTAL 6 AM TO 12 NOON		1,365	343		778	384	2,870

	ENTERING				EXISTING		
	V2	V3	V4	V5	V7	V9	TOTAL
PM PEAK TIME	4:30 - 5:30						
PM PEAK HR VOL		56	12		70	24	162
DIRECTION		82%	18%		74%	26%	
TOTAL MOVEMENT		68			94		
AM K FACTOR		16%			22%		
TOTAL 12 NOON TO 6 PM		977	302		1,241	553	3,073
12-HOUR TOTAL 6AM-6PM		2,342	645		2,019	937	5,943

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: GREGG ICHIMURA
MOVEMENT: V2

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
AM 5:30 - 5:45								
AM 5:45 - 6:00		5					5	29
AM 6:00 - 6:15		10					10	36
AM 6:15 - 6:30		8	1				9	40
AM 6:30 - 6:45		5					5	49
AM 6:45 - 7:00		11	1				12	61
AM 7:00 - 7:15		13	1				14	66
AM 7:15 - 7:30		18					18	66
AM 7:30 - 7:45	1	15	1				17	72
AM 7:45 - 8:00	1	15		1			17	89
AM 8:00 - 8:15		13		1			14	101
AM 8:15 - 8:30	1	21	1	1			24	116
AM 8:30 - 8:45	1	33					34	118
AM 8:45 - 9:00	2	24	3				29	125
AM 9:00 - 9:15		29					29	150
AM 9:15 - 9:30		26				1	26	161
AM 9:30 - 9:45		40	1				41	185
AM 9:45 - 10:00	1	50	1	1	1		54	200
AM 10:00 - 10:15		39	1				40	201
AM 10:15 - 10:30		49	1				50	219
AM 10:30 - 10:45		54	1	1			56	244
AM 10:45 - 11:00		54	1				55	247
AM 11:00 - 11:15		54	1	3			58	249
AM 11:15 - 11:30	1	72	1	1			75	269
AM 11:30 - 11:45	1	57		1			59	260
AM 11:45 - 12:00	1	54	1	1			57	257
PM 12:00 - 12:15		77	1				78	277
PM 12:15 - 12:30		66					66	273
PM 12:30 - 12:45	0	55	1				56	270
PM 12:45 - 1:00	2	74	1				77	271
PM 1:00 - 1:15	2	72					74	286
PM 1:15 - 1:30	1	62					63	284
PM 1:30 - 1:45	2	53	1	1			57	292
PM 1:45 - 2:00		91	1				92	299
PM 2:00 - 2:15		71	1				72	273
PM 2:15 - 2:30	3	67			1		71	278
PM 2:30 - 2:45		61	1	1	1		64	268
PM 2:45 - 3:00		65	1				66	268
PM 3:00 - 3:15	1	73	1	2			77	275
PM 3:15 - 3:30	1	59		1			61	260
PM 3:30 - 3:45		63	1				64	265
PM 3:45 - 4:00		72	1				73	251

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: GREGG ICHIMURA
MOVEMENT: V2

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
PM 4:00 - 4:15	1	58	1	2			62	257
PM 4:15 - 4:30		66					66	248
PM 4:30 - 4:45		49	1				50	214
PM 4:45 - 5:00	1	75	2	1			79	199
PM 5:00 - 5:15	1	51	1				53	162
PM 5:15 - 5:30		28	1		3		32	147
PM 5:30 - 5:45		35			0		35	115
PM 5:45 - 6:00		41	1				42	80
PM 6:00 - 6:15		38					38	38
PM 6:15 - 6:30							0	0
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TM81289
BY: GREGG ICHIMURA
MOVEMENT: V3

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
AM 5:30 - 5:45							0	27
AM 5:45 - 6:00		7			2		9	44
AM 6:00 - 6:15		3			6		9	48
AM 6:15 - 6:30		4			5		9	54
AM 6:30 - 6:45		12			5		17	59
AM 6:45 - 7:00		8			5		13	55
AM 7:00 - 7:15		9			6		15	76
AM 7:15 - 7:30		8			6		14	70
AM 7:30 - 7:45		10			3	1	13	75
AM 7:45 - 8:00		30			4	2	34	69
AM 8:00 - 8:15		6			3	3	9	48
AM 8:15 - 8:30		9			10		19	59
AM 8:30 - 8:45		6			1		7	49
AM 8:45 - 9:00		11			2		13	59
AM 9:00 - 9:15		14	3		3		20	63
AM 9:15 - 9:30		8			1	2	9	62
AM 9:30 - 9:45		11	1		5	1	17	66
AM 9:45 - 10:00		13	1		3	1	17	59
AM 10:00 - 10:15		16			3		19	56
AM 10:15 - 10:30		12			1	1	13	44
AM 10:30 - 10:45		10					10	48
AM 10:45 - 11:00		11	1		2		14	49
AM 11:00 - 11:15		6			1		7	47
AM 11:15 - 11:30		13			4		17	50
AM 11:30 - 11:45		10			1		11	52
AM 11:45 - 12:00		11			1		12	48
PM 12:00 - 12:15		9			1	1	10	55
PM 12:15 - 12:30		19				1	19	61
PM 12:30 - 12:45		6			1		7	48
PM 12:45 - 1:00	4	14			1		19	53
PM 1:00 - 1:15		13			3		16	47
PM 1:15 - 1:30		5			1	1	6	39
PM 1:30 - 1:45	1	9			2		12	46
PM 1:45 - 2:00		9			4		13	46
PM 2:00 - 2:15		8				2	8	42
PM 2:15 - 2:30		13					13	47
PM 2:30 - 2:45		12					12	45
PM 2:45 - 3:00		8			1		9	42
PM 3:00 - 3:15		6	3		4		13	35
PM 3:15 - 3:30		10	1				11	29
PM 3:30 - 3:45		9					9	25
PM 3:45 - 4:00		2					2	27

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TM81289
BY: GREGG ICHIMURA
MOVEMENT: V3

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
PM 4:00 - 4:15		7					7	46
PM 4:15 - 4:30		6			1		7	56
PM 4:30 - 4:45		10			1		11	56
PM 4:45 - 5:00	1	19			1		21	46
PM 5:00 - 5:15		16			1		17	32
PM 5:15 - 5:30		6			1		7	23
PM 5:30 - 5:45		1			0		1	16
PM 5:45 - 6:00		5			2		7	15
PM 6:00 - 6:15		7			1		8	8
PM 6:15 - 6:30					0		0	0
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: DAN HIROTA
MOVEMENT: V4

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIAN	TOTAL	PEAK HR
AM 5:30 - 5:45							0	10
AM 5:45 - 6:00	1						1	14
AM 6:00 - 6:15		4					4	19
AM 6:15 - 6:30		4			1		5	18
AM 6:30 - 6:45		2			2		4	16
AM 6:45 - 7:00		4			2		6	16
AM 7:00 - 7:15		3					3	21
AM 7:15 - 7:30		2		1			3	19
AM 7:30 - 7:45		2			2	2	4	19
AM 7:45 - 8:00		11					11	23
AM 8:00 - 8:15		1					1	14
AM 8:15 - 8:30		3					3	14
AM 8:30 - 8:45		6			2		8	18
AM 8:45 - 9:00		2					2	15
AM 9:00 - 9:15		1					1	16
AM 9:15 - 9:30		6			1		7	17
AM 9:30 - 9:45		1			4		5	15
AM 9:45 - 10:00		2			1	1	3	13
AM 10:00 - 10:15		2					2	14
AM 10:15 - 10:30		4			1	1	5	13
AM 10:30 - 10:45		3					3	8
AM 10:45 - 11:00		3			1		4	6
AM 11:00 - 11:15		1					1	5
AM 11:15 - 11:30							0	5
AM 11:30 - 11:45					1		1	9
AM 11:45 - 12:00		1		1	1		3	10
PM 12:00 - 12:15		1					1	9
PM 12:15 - 12:30		4					4	11
PM 12:30 - 12:45		2					2	11
PM 12:45 - 1:00		2					2	12
PM 1:00 - 1:15		3					3	12
PM 1:15 - 1:30		2		1	1		4	13
PM 1:30 - 1:45		3					3	13
PM 1:45 - 2:00		2					2	16
PM 2:00 - 2:15	1	3					4	19
PM 2:15 - 2:30	1	1			2		4	20
PM 2:30 - 2:45		5			1		6	23
PM 2:45 - 3:00		5					5	19
PM 3:00 - 3:15		5					5	16
PM 3:15 - 3:30		5	1		1		7	12
PM 3:30 - 3:45		1			1		2	5
PM 3:45 - 4:00		2					2	8

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: DAN HIROTA
MOVEMENT: V4

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIAN	TOTAL	PEAK HR
PM 4:00 - 4:15					1		1	9
PM 4:15 - 4:30							0	10
PM 4:30 - 4:45		5					5	12
PM 4:45 - 5:00		3					3	9
PM 5:00 - 5:15		2					2	10
PM 5:15 - 5:30		2					2	13
PM 5:30 - 5:45		2					2	11
PM 5:45 - 6:00		3			1		4	9
PM 6:00 - 6:15		4			1		5	5
PM 6:15 - 6:30							0	0
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TM81289
BY: DAN HIROTA
MOVEMENT: V5

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45		8			4		12	72
AM	5:45 - 6:00		15		1			16	81
AM	6:00 - 6:15		12	1	2			15	99
AM	6:15 - 6:30		27	1	1			29	107
AM	6:30 - 6:45		21					21	111
AM	6:45 - 7:00	1	33					34	127
AM	7:00 - 7:15		21	1	1		1	23	133
AM	7:15 - 7:30		32	1				33	148
AM	7:30 - 7:45		33	1	1	2		37	159
AM	7:45 - 8:00		38	1	1		1	40	153
AM	8:00 - 8:15	1	37					38	161
AM	8:15 - 8:30	2	38	2	2			44	169
AM	8:30 - 8:45		31					31	172
AM	8:45 - 9:00		47	1				48	172
AM	9:00 - 9:15		45			1		46	156
AM	9:15 - 9:30		45	2				47	158
AM	9:30 - 9:45	1	30				1	31	150
AM	9:45 - 10:00	1	30	1				32	160
AM	10:00 - 10:15		47	1			1	48	162
AM	10:15 - 10:30	1	37	1			1	39	150
AM	10:30 - 10:45	1	39			1		41	151
AM	10:45 - 11:00		33	1				34	146
AM	11:00 - 11:15		36					36	146
AM	11:15 - 11:30		36	2	2			40	130
AM	11:30 - 11:45	1	35					36	117
AM	11:45 - 12:00		33	1				34	111
PM	12:00 - 12:15	1	18		1			20	114
PM	12:15 - 12:30		25	2				27	131
PM	12:30 - 12:45		30					30	130
PM	12:45 - 1:00	1	34	1	1			37	141
PM	1:00 - 1:15		36	1				37	140
PM	1:15 - 1:30		25	1				26	136
PM	1:30 - 1:45		40		1	0		41	136
PM	1:45 - 2:00	1	34			1		36	130
PM	2:00 - 2:15		32	1				33	136
PM	2:15 - 2:30		25	1				26	140
PM	2:30 - 2:45		34	1				35	160
PM	2:45 - 3:00	1	40	1				42	168
PM	3:00 - 3:15		35		2			37	173
PM	3:15 - 3:30	8	37	1			1	46	181
PM	3:30 - 3:45		42		1			43	183
PM	3:45 - 4:00	1	46					47	176

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TM81289
BY: DAN HIROTA
MOVEMENT: V5

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		44	1				45	181
PM	4:15 - 4:30		47	1				48	182
PM	4:30 - 4:45	2	33	1				36	176
PM	4:45 - 5:00		50	1	1			52	181
PM	5:00 - 5:15		46					46	171
PM	5:15 - 5:30		40	2				42	177
PM	5:30 - 5:45		40		1			41	135
PM	5:45 - 6:00	1	41	0				42	94
PM	6:00 - 6:15	2	49	1				52	52
PM	6:15 - 6:30							0	0
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: DAN HIROTA
MOVEMENT: V7

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45							0	3
AM	5:45 - 6:00		2					2	5
AM	6:00 - 6:15							0	12
AM	6:15 - 6:30		1				1	1	16
AM	6:30 - 6:45		2					2	19
AM	6:45 - 7:00		9					9	27
AM	7:00 - 7:15		3			1		4	27
AM	7:15 - 7:30		1			3		4	31
AM	7:30 - 7:45		7		1	2	1	10	34
AM	7:45 - 8:00		7			2		9	32
AM	8:00 - 8:15		6			2	1	8	28
AM	8:15 - 8:30		6			1		7	30
AM	8:30 - 8:45		8					8	38
AM	8:45 - 9:00		5				1	5	41
AM	9:00 - 9:15		5	2		3		10	46
AM	9:15 - 9:30		14			1		15	43
AM	9:30 - 9:45		8	1		2	2	11	47
AM	9:45 - 10:00		8	1		1	1	10	42
AM	10:00 - 10:15		5	1		1	1	7	41
AM	10:15 - 10:30		19					19	49
AM	10:30 - 10:45		6					6	33
AM	10:45 - 11:00		9					9	29
AM	11:00 - 11:15		14			1		15	24
AM	11:15 - 11:30		2			1		3	21
AM	11:30 - 11:45		2					2	30
AM	11:45 - 12:00		2			2	1	4	38
PM	12:00 - 12:15		9			3		12	51
PM	12:15 - 12:30		12					12	50
PM	12:30 - 12:45		6		1	3		10	48
PM	12:45 - 1:00	1	14			2	1	17	41
PM	1:00 - 1:15	3	5			3		11	34
PM	1:15 - 1:30		9			1		10	32
PM	1:30 - 1:45		3					3	29
PM	1:45 - 2:00		7			3		10	41
PM	2:00 - 2:15		5			4	1	9	42
PM	2:15 - 2:30		4			3	1	7	54
PM	2:30 - 2:45		12			3		15	63
PM	2:45 - 3:00	1	8			2	1	11	60
PM	3:00 - 3:15		13			8		21	68
PM	3:15 - 3:30		11	3		2		16	66
PM	3:30 - 3:45		9	1		2		12	58
PM	3:45 - 4:00		17			2		19	68

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: DAN HIROTA
MOVEMENT: V7

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		14			5		19	68
PM	4:15 - 4:30		8				1	8	65
PM	4:30 - 4:45		15	2		5		22	70
PM	4:45 - 5:00		16			3		19	57
PM	5:00 - 5:15		14			2	2	16	58
PM	5:15 - 5:30		9			4	2	13	51
PM	5:30 - 5:45	1	5			3		9	38
PM	5:45 - 6:00		13			7	2	20	29
PM	6:00 - 6:15	1	7			1	1	9	9
PM	6:15 - 6:30							0	0
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

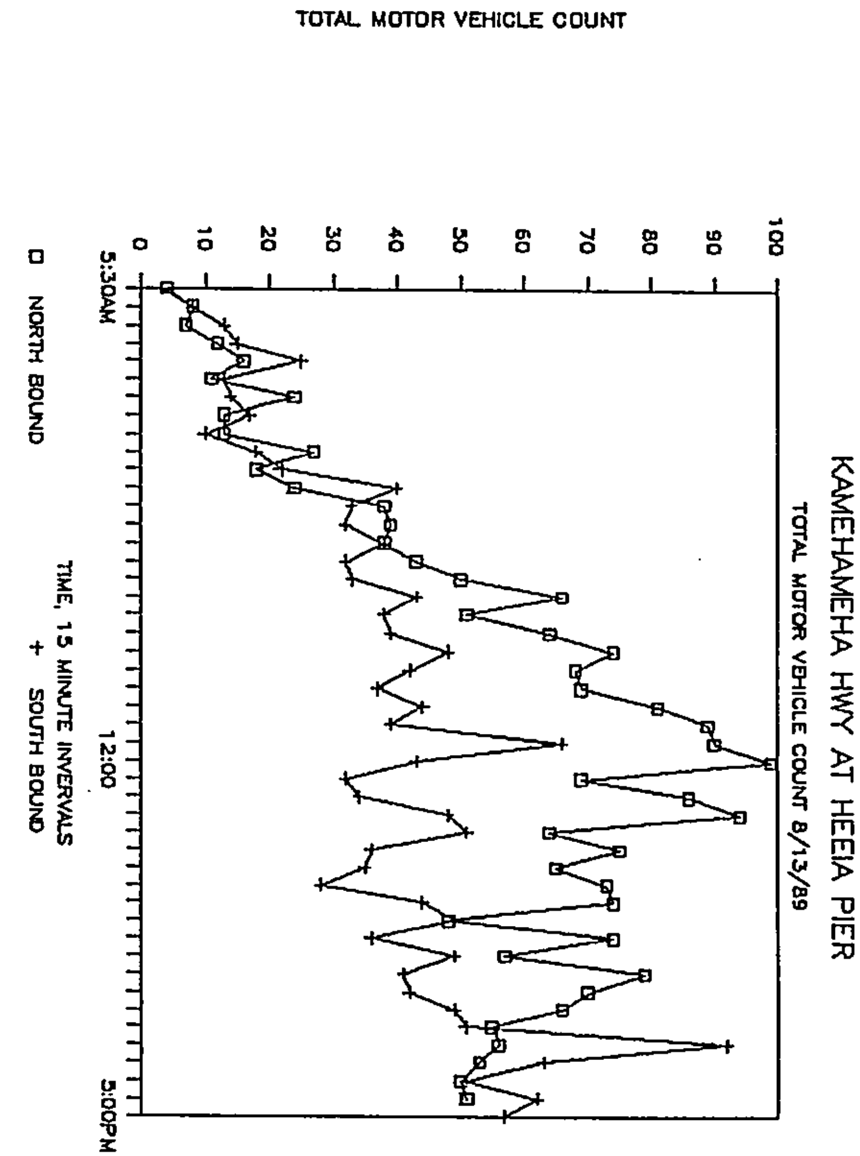
INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: GREGG ICHIMURA
MOVEMENT: V9

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45					2		2	5
AM	5:45 - 6:00		1					1	6
AM	6:00 - 6:15							0	8
AM	6:15 - 6:30		2					2	10
AM	6:30 - 6:45		3					3	9
AM	6:45 - 7:00		3					3	9
AM	7:00 - 7:15		2					2	8
AM	7:15 - 7:30		1					1	9
AM	7:30 - 7:45		2			1		3	12
AM	7:45 - 8:00		2					2	12
AM	8:00 - 8:15		3					3	14
AM	8:15 - 8:30		3			1		4	16
AM	8:30 - 8:45		3					3	15
AM	8:45 - 9:00		4					4	14
AM	9:00 - 9:15		5					5	19
AM	9:15 - 9:30		2			1		3	21
AM	9:30 - 9:45		2				2	2	22
AM	9:45 - 10:00		6			3		9	28
AM	10:00 - 10:15		6			1	2	7	19
AM	10:15 - 10:30		3			1		4	21
AM	10:30 - 10:45		7			1		8	17
AM	10:45 - 11:00		0					0	22
AM	11:00 - 11:15		8		1			9	24
AM	11:15 - 11:30		0					0	17
AM	11:30 - 11:45		12			1		13	23
AM	11:45 - 12:00		2					2	15
PM	12:00 - 12:15		2					2	16
PM	12:15 - 12:30		6					6	20
PM	12:30 - 12:45		5					5	16
PM	12:45 - 1:00		3					3	23
PM	1:00 - 1:15		6					6	28
PM	1:15 - 1:30		2					2	30
PM	1:30 - 1:45		12				1	12	35
PM	1:45 - 2:00		7			1	1	8	30
PM	2:00 - 2:15	1	6			1		8	31
PM	2:15 - 2:30		6			1		7	30
PM	2:30 - 2:45	1	5		1			7	30
PM	2:45 - 3:00		6		2	1	1	9	31
PM	3:00 - 3:15		6			1		7	27
PM	3:15 - 3:30		6			1		7	25
PM	3:30 - 3:45		5			3		8	23
PM	3:45 - 4:00		4			1		5	20

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/12/89 DAY: SATUDAY FILE:TH81289
BY: GREGG ICHIMURA
MOVEMENT: V9

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		4			1		5	25
PM	4:15 - 4:30		4			1		5	25
PM	4:30 - 4:45		4			1		5	24
PM	4:45 - 5:00		7			3		10	20
PM	5:00 - 5:15		3			2		5	17
PM	5:15 - 5:30		4					4	12
PM	5:30 - 5:45					1		1	8
PM	5:45 - 6:00		5			2		7	7
PM	6:00 - 6:15							0	0
PM	6:15 - 6:30							0	0
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0



SUMMARY FOR PEAK HOUR TRAFFIC GENERATED FROM BO HARBOR

DATE: 8/13/89 DAY: SUNDAY

	ENTERING				EXISTING		
	V2	V3	V4	V5	V7	V9	TOTAL
AM PEAK TIME	10:00-11:00						
AM PEAK HR VOL		86	10		33	24	153
DIRECTION		90%	10%		58%	42%	
TOTAL MOVEMENT			96			57	
AM K FACTOR			63%			37%	
TOTAL 6AM TO 12 NOON		1,453	338		716	462	2969

	ENTERING				EXISTING		
	V2	V3	V4	V5	V7	V9	TOTAL
PM PEAK TIME	2:15	3:15					
PM PEAK HR VOL		78	29		87	42	236
DIRECTION		73%	27%		67%	33%	
TOTAL MOVEMENT			107			129	
PM K FACTOR			45%			55%	
TOTAL 12 NOON TO 6PM		1,647	419		1,129	719	3914
12-HOUR TOTAL 5:30AM TO 5:15PM		2,758	793		2,042	1,149	4134

TRAFFIC COUNT SHEET SAM O. HIROTA

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89 DAY: SUNDAY FILE:TH81389
BY: GLENN KURASHIMA/COLIN CHING
MOVEMENT: V2

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
AM 5:30 - 5:45		3						
AM 5:45 - 6:00	1	3					4	31
AM 6:00 - 6:15		7	1			1	8	43
AM 6:15 - 6:30		7					7	46
AM 6:30 - 6:45	2	9	1				12	63
AM 6:45 - 7:00		16					16	64
AM 7:00 - 7:15	4	7				2	11	61
AM 7:15 - 7:30	8	15	1			1	24	77
AM 7:30 - 7:45		12	1				13	71
AM 7:45 - 8:00	1	12				1	13	82
AM 8:00 - 8:15	2	23	1		1		27	107
AM 8:15 - 8:30	2	16				1	18	119
AM 8:30 - 8:45	2	21	1				24	139
AM 8:45 - 9:00	3	34	1				38	158
AM 9:00 - 9:15		38	1				39	170
AM 9:15 - 9:30		38					38	197
AM 9:30 - 9:45		41	2				43	210
AM 9:45 - 10:00	2	48				1	50	231
AM 10:00 - 10:15	5	59	1	1			66	255
AM 10:15 - 10:30	1	50					51	257
AM 10:30 - 10:45	3	58	2	1			64	275
AM 10:45 - 11:00	2	71	1				74	292
AM 11:00 - 11:15		67		1			68	307
AM 11:15 - 11:30	2	66	1				69	329
AM 11:30 - 11:45		80	1				81	359
AM 11:45 - 12:00		88	1				89	347
PM 12:00 - 12:15		89			1		90	344
PM 12:15 - 12:30	12	86	1				99	348
PM 12:30 - 12:45	1	67	1				69	313
PM 12:45 - 1:00	1	84	1				86	319
PM 1:00 - 1:15		94					94	298
PM 1:15 - 1:30	1	62	1				64	277
PM 1:30 - 1:45	2	71		1	1		75	287
PM 1:45 - 2:00	1	63	1				65	260
PM 2:00 - 2:15	1	71		1			73	269
PM 2:15 - 2:30	7	65			2		74	253
PM 2:30 - 2:45		47	1				48	258
PM 2:45 - 3:00		72	2			1	74	280
PM 3:00 - 3:15	2	55					57	272
PM 3:15 - 3:30		78	1				79	270
PM 3:30 - 3:45	1	69					70	247
PM 3:45 - 4:00	1	63	2				66	230

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89 DAY: SUNDAY FILE:TH81389
BY: GLENN KURASHIMA/COLIN CHING
MOVEMENT: V2

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
PM 4:00 - 4:15	1	53	1				55	214
PM 4:15 - 4:30		55	1				56	210
PM 4:30 - 4:45		52	1				53	154
PM 4:45 - 5:00		49	1				50	101
PM 5:00 - 5:15		50	1				51	51
PM 5:15 - 5:30							0	0
PM 5:30 - 5:45							0	0
PM 5:45 - 6:00							0	0
PM 6:00 - 6:15							0	0
PM 6:15 - 6:30							0	0
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89 DAY: SUNDAY FILE:TH81389
BY: GLENN KURASHIMA/COLIN CHING
MOVEMENT: V3

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBINATION VEHICLE	PEDESTRIANS	TOTAL	PEAK HR
AM 5:30 - 5:45		4			5		9	39
AM 5:45 - 6:00		1			5		6	37
AM 6:00 - 6:15		4			7		11	43
AM 6:15 - 6:30		7			6		13	42
AM 6:30 - 6:45		4			3		7	44
AM 6:45 - 7:00		5			7		12	49
AM 7:00 - 7:15		6			4		10	49
AM 7:15 - 7:30		6			9		15	51
AM 7:30 - 7:45		9			3		12	48
AM 7:45 - 8:00		10			2	2	12	51
AM 8:00 - 8:15		10			2	1	12	63
AM 8:15 - 8:30		12					12	70
AM 8:30 - 8:45	1	10			4	1	15	69
AM 8:45 - 9:00		18	1		5		24	68
AM 9:00 - 9:15		16			3	1	19	58
AM 9:15 - 9:30		8	1		2		11	57
AM 9:30 - 9:45		9	2		3		14	70
AM 9:45 - 10:00		11			3		14	80
AM 10:00 - 10:15		12			6	5	18	86
AM 10:15 - 10:30		21			3	1	24	82
AM 10:30 - 10:45		21			3		24	71
AM 10:45 - 11:00		16	1		3	3	20	64
AM 11:00 - 11:15		13			1		14	57
AM 11:15 - 11:30		13				1	13	61
AM 11:30 - 11:45		16			1		17	62
AM 11:45 - 12:00		11			2		13	58
PM 12:00 - 12:15		13			5		18	61
PM 12:15 - 12:30	1	11			2		14	59
PM 12:30 - 12:45		11			2		13	68
PM 12:45 - 1:00		13			3	1	16	76
PM 1:00 - 1:15	1	15				1	16	74
PM 1:15 - 1:30		21			2		23	70
PM 1:30 - 1:45		20			1	1	21	65
PM 1:45 - 2:00		8			6		14	67
PM 2:00 - 2:15		10	1		1		12	73
PM 2:15 - 2:30		16			2		18	78
PM 2:30 - 2:45		22			1		23	77
PM 2:45 - 3:00		17	3				20	73
PM 3:00 - 3:15		16			1		17	65
PM 3:15 - 3:30	2	15					17	61
PM 3:30 - 3:45		17			2		19	58
PM 3:45 - 4:00		10			2	1	12	50

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89 DAY: SUNDAY FILE:TH81389
BY: GLENN KURASHIMA/COLIN CHING
MOVEMENT: V3

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBINATION VEHICLE	PEDESTRIANS	TOTAL	PEAK HR
PM 4:00 - 4:15		13					13	50
PM 4:15 - 4:30		12			2		14	45
PM 4:30 - 4:45		10			1		11	31
PM 4:45 - 5:00	1	9			2		12	20
PM 5:00 - 5:15		7			1		8	8
PM 5:15 - 5:30							0	0
PM 5:30 - 5:45							0	0
PM 5:45 - 6:00							0	0
PM 6:00 - 6:15							0	0
PM 6:15 - 6:30							0	0
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET   SAM O. HIROTA   PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89   DAY: SUNDAY   FILE:TH81389
BY: DAN HIROTA
MOVEMENT: V4

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIAN	TOTAL	PEAK HR
AM 5:30 - 5:45		1			3		4	7
AM 5:45 - 6:00		1					1	10
AM 6:00 - 6:15		1					1	14
AM 6:15 - 6:30		1					1	16
AM 6:30 - 6:45		5			2		7	20
AM 6:45 - 7:00		4			1		5	16
AM 7:00 - 7:15		2			1		3	18
AM 7:15 - 7:30		4			1		5	20
AM 7:30 - 7:45		3				1	3	18
AM 7:45 - 8:00		6		1			7	16
AM 8:00 - 8:15		4			1		5	13
AM 8:15 - 8:30		3				1	3	13
AM 8:30 - 8:45		1				2	1	11
AM 8:45 - 9:00		4					4	13
AM 9:00 - 9:15		5					5	11
AM 9:15 - 9:30		1					1	8
AM 9:30 - 9:45		2	1				3	10
AM 9:45 - 10:00		0			2		2	8
AM 10:00 - 10:15		2					2	10
AM 10:15 - 10:30		2			1		3	9
AM 10:30 - 10:45		1					1	11
AM 10:45 - 11:00		2			2		4	17
AM 11:00 - 11:15		1					1	18
AM 11:15 - 11:30	1	4					5	18
AM 11:30 - 11:45		7					7	17
AM 11:45 - 12:00		4			1		5	13
PM 12:00 - 12:15		1					1	13
PM 12:15 - 12:30		4					4	16
PM 12:30 - 12:45		3				2	3	17
PM 12:45 - 1:00		4			1		5	21
PM 1:00 - 1:15		3			1		4	20
PM 1:15 - 1:30		5				2	5	24
PM 1:30 - 1:45		5			2		7	30
PM 1:45 - 2:00		3			1		4	26
PM 2:00 - 2:15		7	1				8	27
PM 2:15 - 2:30		9			2		11	29
PM 2:30 - 2:45		3				3	3	21
PM 2:45 - 3:00		5					5	25
PM 3:00 - 3:15		10					10	21
PM 3:15 - 3:30		3					3	17
PM 3:30 - 3:45		5			2		7	22
PM 3:45 - 4:00		0			1		1	23

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89   DAY: SUNDAY   FILE:TH81389
BY: DAN HIROTA
MOVEMENT: V4

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIAN	TOTAL	PEAK HR
PM 4:00 - 4:15		5			1		6	29
PM 4:15 - 4:30	1	7					8	26
PM 4:30 - 4:45		7			1		8	18
PM 4:45 - 5:00		6			1		7	10
PM 5:00 - 5:15		3					3	3
PM 5:15 - 5:30							0	0
PM 5:30 - 5:45							0	0
PM 5:45 - 6:00							0	0
PM 6:00 - 6:15							0	0
PM 6:15 - 6:30							0	0
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET   SAM O. HIROTA   PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89   DAY: SUNDAY   FILE:TH81389
BY: DAN HIROTA
MOVEMENT: V5

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45		3					3	39
AM	5:45 - 6:00		8					8	61
AM	6:00 - 6:15		13	0				13	66
AM	6:15 - 6:30		14	1				15	67
AM	6:30 - 6:45		24	1				25	69
AM	6:45 - 7:00		13				1	13	54
AM	7:00 - 7:15		14	0				14	59
AM	7:15 - 7:30		17	0			4	17	67
AM	7:30 - 7:45		9	1	0	0	0	10	90
AM	7:45 - 8:00	2	14		1	1	2	18	113
AM	8:00 - 8:15		22		0	0	0	22	127
AM	8:15 - 8:30		37	2	0	1	1	40	143
AM	8:30 - 8:45	1	31		0	1		33	135
AM	8:45 - 9:00	3	27	1	0	1	1	32	135
AM	9:00 - 9:15	1	35	1	0	1	2	38	146
AM	9:15 - 9:30		31	1	0	0	0	32	146
AM	9:30 - 9:45	1	31	1	0	0		33	153
AM	9:45 - 10:00		43				2	43	168
AM	10:00 - 10:15	1	37				3	38	167
AM	10:15 - 10:30		38	1			1	39	166
AM	10:30 - 10:45		46	1		1		48	171
AM	10:45 - 11:00	1	40	1			17	42	162
AM	11:00 - 11:15		37				3	37	186
AM	11:15 - 11:30	2	41	1				44	192
AM	11:30 - 11:45	1	38					39	180
AM	11:45 - 12:00		65	1				66	175
PM	12:00 - 12:15	3	39	1				43	157
PM	12:15 - 12:30		30	1		1		32	165
PM	12:30 - 12:45		34				2	34	169
PM	12:45 - 1:00		47	1				48	170
PM	1:00 - 1:15		50	1				51	150
PM	1:15 - 1:30		35	1			1	36	143
PM	1:30 - 1:45	1	34					35	156
PM	1:45 - 2:00		27	1				28	157
PM	2:00 - 2:15	2	42				1	44	178
PM	2:15 - 2:30	4	44	1				49	175
PM	2:30 - 2:45		34	1	1			36	168
PM	2:45 - 3:00	2	44	1	2			49	181
PM	3:00 - 3:15		40	1				41	183
PM	3:15 - 3:30		41	1				42	234
PM	3:30 - 3:45	2	46	1				49	255
PM	3:45 - 4:00	2	48	1				51	257

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89   DAY: SUNDAY   FILE:TH81389
BY: DAN HIROTA
MOVEMENT: V5

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15	3	88		1			92	268
PM	4:15 - 4:30	2	60	1				63	233
PM	4:30 - 4:45	3	48		0			51	170
PM	4:45 - 5:00		60	1	1			62	119
PM	5:00 - 5:15	2	55					57	57
PM	5:15 - 5:30							0	0
PM	5:30 - 5:45							0	0
PM	5:45 - 6:00							0	0
PM	6:00 - 6:15							0	0
PM	6:15 - 6:30							0	0
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

TRAFFIC COUNT SHEET   SAM O. HIROTA   PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89   DAY: SUNDAY   FILE:TH81389
BY: DAN HIROTA
MOVEMENT: V7

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45		1					1	4
AM	5:45 - 6:00		1					1	6
AM	6:00 - 6:15		1					1	6
AM	6:15 - 6:30		1					1	12
AM	6:30 - 6:45		3					3	19
AM	6:45 - 7:00		0			1	1	1	21
AM	7:00 - 7:15		6			1		7	28
AM	7:15 - 7:30		6			2		8	32
AM	7:30 - 7:45		2			3		5	26
AM	7:45 - 8:00		8					8	29
AM	8:00 - 8:15	1	8			2	2	11	33
AM	8:15 - 8:30		1		1			2	29
AM	8:30 - 8:45	1	6			1		8	36
AM	8:45 - 9:00		12					12	36
AM	9:00 - 9:15		6			1		7	30
AM	9:15 - 9:30		7			2		9	33
AM	9:30 - 9:45		5	2		1		8	29
AM	9:45 - 10:00		4	1		1		6	32
AM	10:00 - 10:15		8			2		10	33
AM	10:15 - 10:30		4			1		5	31
AM	10:30 - 10:45		10			1		11	41
AM	10:45 - 11:00		3			4		7	35
AM	11:00 - 11:15		6			2		8	36
AM	11:15 - 11:30		13			2		15	37
AM	11:30 - 11:45		4			1		5	32
AM	11:45 - 12:00		7			1	3	8	40
PM	12:00 - 12:15		6			3		9	42
PM	12:15 - 12:30		7			3		10	43
PM	12:30 - 12:45		9			4		13	41
PM	12:45 - 1:00		8			2		10	40
PM	1:00 - 1:15		8			2	1	10	47
PM	1:15 - 1:30		6			2	1	8	48
PM	1:30 - 1:45		9			3	1	12	56
PM	1:45 - 2:00		11			6	3	17	59
PM	2:00 - 2:15		9			2		11	66
PM	2:15 - 2:30		12			4		16	87
PM	2:30 - 2:45		8			7		15	90
PM	2:45 - 3:00		20			4		24	101
PM	3:00 - 3:15		23	4		5	1	32	94
PM	3:15 - 3:30	2	15			2	2	19	76
PM	3:30 - 3:45		22			4	2	26	77
PM	3:45 - 4:00		8			9	3	17	74

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89   DAY: SUNDAY   FILE:TH81389
BY: DAN HIROTA
MOVEMENT: V7

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		10			4	1	14	80
PM	4:15 - 4:30		16			4	1	20	81
PM	4:30 - 4:45		19	1		3	1	23	61
PM	4:45 - 5:00	1	15			7		23	38
PM	5:00 - 5:15		10			5		15	15
PM	5:15 - 5:30							0	0
PM	5:30 - 5:45							0	0
PM	5:45 - 6:00							0	0
PM	6:00 - 6:15							0	0
PM	6:15 - 6:30							0	0
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89 DAY: SUNDAY FILE:TH81389
BY: GLENN KURASHIMA/COLIN CHING
MOVEMENT: V9

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45							0	3
AM	5:45 - 6:00		1					1	4
AM	6:00 - 6:15		1					1	4
AM	6:15 - 6:30		1					1	3
AM	6:30 - 6:45		1					1	5
AM	6:45 - 7:00		1					1	7
AM	7:00 - 7:15		0					0	9
AM	7:15 - 7:30		3					3	16
AM	7:30 - 7:45		3					3	19
AM	7:45 - 8:00		3					3	18
AM	8:00 - 8:15		7					7	20
AM	8:15 - 8:30		5			1		6	22
AM	8:30 - 8:45		2					2	24
AM	8:45 - 9:00		3			2	1	5	24
AM	9:00 - 9:15		9					9	25
AM	9:15 - 9:30		8					8	20
AM	9:30 - 9:45		2					2	17
AM	9:45 - 10:00		4	1		1		6	25
AM	10:00 - 10:15		4					4	24
AM	10:15 - 10:30		5				1	5	23
AM	10:30 - 10:45		9			1		10	25
AM	10:45 - 11:00		5					5	24
AM	11:00 - 11:15		2			1		3	29
AM	11:15 - 11:30		7					7	30
AM	11:30 - 11:45		9					9	26
AM	11:45 - 12:00		10					10	23
PM	12:00 - 12:15		3			1		4	22
PM	12:15 - 12:30		3				2	3	32
PM	12:30 - 12:45	1	5				19	6	39
PM	12:45 - 1:00		8			1	6	9	41
PM	1:00 - 1:15	1	12			1		14	40
PM	1:15 - 1:30		9			1		10	33
PM	1:30 - 1:45		8					8	32
PM	1:45 - 2:00		7			1		8	40
PM	2:00 - 2:15		6			1	1	7	41
PM	2:15 - 2:30		9					9	42
PM	2:30 - 2:45		16					16	36
PM	2:45 - 3:00		7			2		9	30
PM	3:00 - 3:15		8					8	27
PM	3:15 - 3:30		3					3	31
PM	3:30 - 3:45		8			2	7	10	39
PM	3:45 - 4:00		6				1	6	39

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/13/89 DAY: SUNDAY FILE:TH81389
BY: GLENN KURASHIMA/COLIN CHING
MOVEMENT: V9

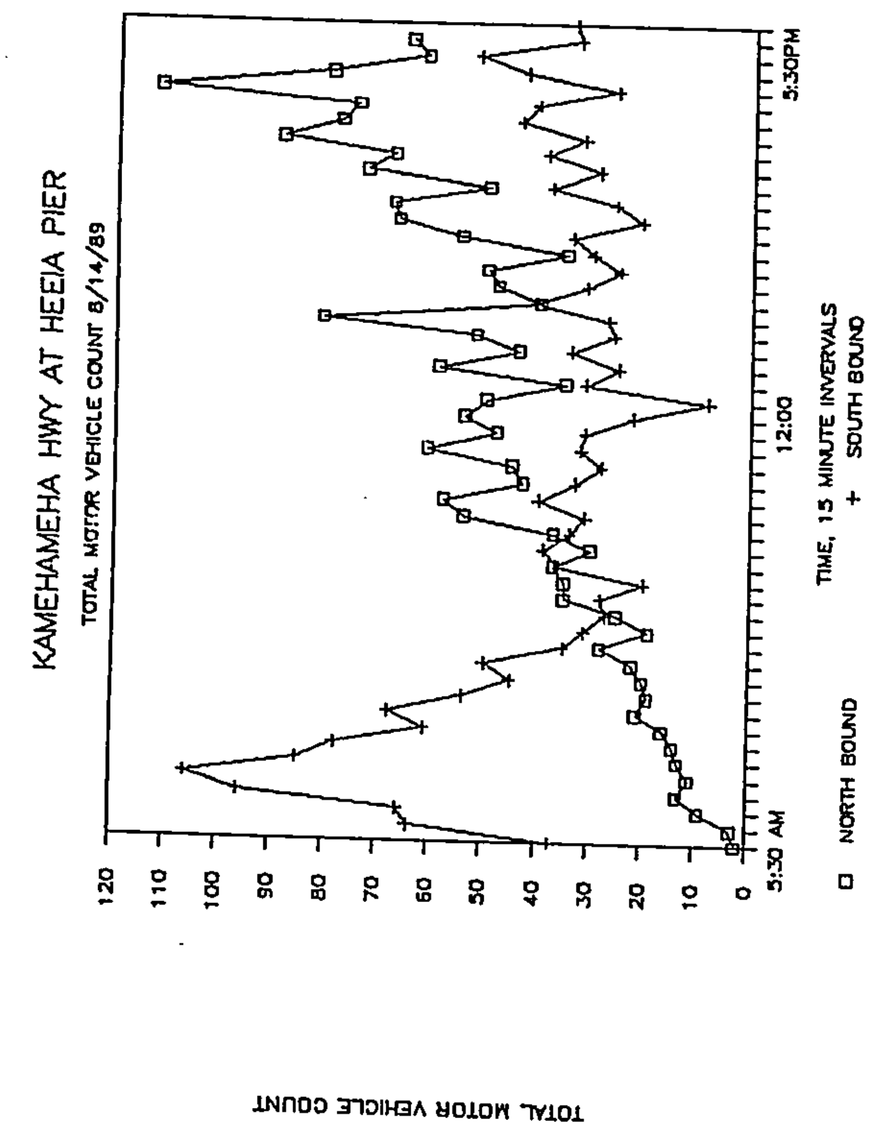
	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		12					12	38
PM	4:15 - 4:30	1	6			4		11	34
PM	4:30 - 4:45		9			1	0	10	23
PM	4:45 - 5:00		4			1	1	5	13
PM	5:00 - 5:15		6			2		8	8
PM	5:15 - 5:30							0	0
PM	5:30 - 5:45							0	0
PM	5:45 - 6:00							0	0
PM	6:00 - 6:15							0	0
PM	6:15 - 6:30							0	0
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

SUMMARY FOR PEAK HOUR TRAFFIC GENERATED FROM BOAT HARBOR

DATE: 8/14/89 DAY: MONDAY

	ENTERING				EXITING		
	V2	V3	V4	V5	V7	V9	TOTAL
AM PEAK TIME	11:30 - 12:30						
AM PEAK HR VOL		59	41		38	19	157
DIRECTION		59%	41%		67%	33%	
TOTAL MOVEMENT		100			57		
AM K FACTOR		64%			36%		
TOTAL 6AM TO 12 NOON		1,040	289		588	267	2,184

	ENTERING				EXITING		
	V2	V3	V4	V5	V7	V9	TOTAL
PM PEAK TIME	12:00 - 1:00						
PM PEAK HR VOL		53	45		41	18	157
DIRECTION		54%	46%		69%	31%	
TOTAL MOVEMENT		98			59		
PM K FACTOR		62%			38%		
TOTAL 12 NOON TO 6 PM		1,077	355		857	424	2,713
TOTAL 12-HOUR 6AM-6PM		1,848	596		1,578	760	4,782



TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TM81489
BY: GREGG ICHIMURA
MOVEMENT: V2

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
AM 5:30 - 5:45		2	1					
AM 5:45 - 6:00		1	1				2	27
AM 6:00 - 6:15		3					3	36
AM 6:15 - 6:30		9					9	46
AM 6:30 - 6:45		12	1				13	51
AM 6:45 - 7:00		10		1			11	54
AM 7:00 - 7:15	1	11	1				13	64
AM 7:15 - 7:30		12		1	1	1	14	70
AM 7:30 - 7:45		11	2	3			16	76
AM 7:45 - 8:00		15		5	1		21	82
AM 8:00 - 8:15		15	1	3			19	89
AM 8:15 - 8:30		18		1	1		20	89
AM 8:30 - 8:45		21	1				22	94
AM 8:45 - 9:00		26	2				28	107
AM 9:00 - 9:15		18		1			19	114
AM 9:15 - 9:30	1	22		1	1		25	132
AM 9:30 - 9:45		33	1	1			35	137
AM 9:45 - 10:00	1	31	2		1		35	139
AM 10:00 - 10:15	1	35		1			37	158
AM 10:15 - 10:30		28		2			30	179
AM 10:30 - 10:45	1	32	2	2			37	192
AM 10:45 - 11:00		52		2			54	200
AM 11:00 - 11:15	1	54	3				58	207
AM 11:15 - 11:30		41	1	1			43	197
AM 11:30 - 11:45		44	1				45	208
AM 11:45 - 12:00		58	2	1			61	213
PM 12:00 - 12:15		48					48	187
PM 12:15 - 12:30		53	1				54	198
PM 12:30 - 12:45	1	48	1				50	188
PM 12:45 - 1:00		34			1		35	190
PM 1:00 - 1:15	1	56	2				59	236
PM 1:15 - 1:30	1	41	1		1		44	217
PM 1:30 - 1:45		51	1				52	221
PM 1:45 - 2:00	2	78	0		1		81	219
PM 2:00 - 2:15	2	36	0		2		40	173
PM 2:15 - 2:30		46	2				48	188
PM 2:30 - 2:45		48	2				50	207
PM 2:45 - 3:00	1	34					35	225
PM 3:00 - 3:15		53	2				55	240
PM 3:15 - 3:30		67					67	258
PM 3:30 - 3:45		65	3				68	259
PM 3:45 - 4:00	3	43	3		1		50	280

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TM81489
BY: GREGG ICHIMURA
MOVEMENT: V2

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
PM 4:00 - 4:15		71	1	1			73	308
PM 4:15 - 4:30	1	63	2	1	1		68	310
PM 4:30 - 4:45		86	3				89	354
PM 4:45 - 5:00		77	1				78	345
PM 5:00 - 5:15	0	74	1				75	329
PM 5:15 - 5:30	2	108	2			1	112	319
PM 5:30 - 5:45	0	79	1			2	80	258
PM 5:45 - 6:00	1	60	1				62	178
PM 6:00 - 6:15		63	2				65	116
PM 6:15 - 6:30		50	1				51	51
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TM81489
BY: GREGG ICHIMURA
MOVEMENT: V3

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
AM 5:30 - 5:45		3					3	15
AM 5:45 - 6:00		4					4	20
AM 6:00 - 6:15		2			1		3	18
AM 6:15 - 6:30		4			1	1	5	25
AM 6:30 - 6:45		6			2		8	27
AM 6:45 - 7:00		1			1		2	29
AM 7:00 - 7:15		6			4		10	40
AM 7:15 - 7:30		5			2		7	42
AM 7:30 - 7:45		6			4		10	38
AM 7:45 - 8:00		12			1		13	41
AM 8:00 - 8:15		11		1			12	40
AM 8:15 - 8:30		1			2		3	37
AM 8:30 - 8:45		10			3		13	47
AM 8:45 - 9:00		7	1		4		12	47
AM 9:00 - 9:15		7			2		9	51
AM 9:15 - 9:30		9	1		3	1	13	50
AM 9:30 - 9:45		11	1		1		13	46
AM 9:45 - 10:00		12	1	2	1		16	45
AM 10:00 - 10:15		5			3		8	41
AM 10:15 - 10:30		7			2		9	50
AM 10:30 - 10:45		10	1		1		12	53
AM 10:45 - 11:00		11			1		12	58
AM 11:00 - 11:15		14		1	2		17	55
AM 11:15 - 11:30		11			1		12	50
AM 11:30 - 11:45		15			2		17	59
AM 11:45 - 12:00		6	1		2		9	51
PM 12:00 - 12:15		11			1		12	53
PM 12:15 - 12:30	1	20					21	49
PM 12:30 - 12:45		8			1		9	37
PM 12:45 - 1:00		11					11	33
PM 1:00 - 1:15	1	6			1		8	35
PM 1:15 - 1:30		9					9	30
PM 1:30 - 1:45		4			1		5	31
PM 1:45 - 2:00		10			3		13	39
PM 2:00 - 2:15		2			1		3	38
PM 2:15 - 2:30		9	1				10	38
PM 2:30 - 2:45		13					13	38
PM 2:45 - 3:00		9	3				12	38
PM 3:00 - 3:15		2	1				3	28
PM 3:15 - 3:30		10					10	33
PM 3:30 - 3:45		13					13	30
PM 3:45 - 4:00		1			1		2	21

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TM81489
BY: GREGG ICHIMURA
MOVEMENT: V3

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIANS	TOTAL	PEAK HR
PM 4:00 - 4:15		7			1		8	24
PM 4:15 - 4:30		7					7	28
PM 4:30 - 4:45		4					4	31
PM 4:45 - 5:00		5					5	32
PM 5:00 - 5:15		12					12	30
PM 5:15 - 5:30		10					10	27
PM 5:30 - 5:45		5					5	35
PM 5:45 - 6:00		3					3	30
PM 6:00 - 6:15		8	1				9	27
PM 6:15 - 6:30		17			1		18	18
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TH81489
BY: DAN HIROTA
MOVEMENT: V4

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIAN	TOTAL	PEAK HR
AM 5:30 - 5:45		0					0	7
AM 5:45 - 6:00		3					3	7
AM 6:00 - 6:15		2					2	5
AM 6:15 - 6:30		2					2	5
AM 6:30 - 6:45		0					0	7
AM 6:45 - 7:00		1					1	11
AM 7:00 - 7:15		1			1		2	13
AM 7:15 - 7:30		4					4	13
AM 7:30 - 7:45		4					4	11
AM 7:45 - 8:00		2			1		3	10
AM 8:00 - 8:15		1			1		2	12
AM 8:15 - 8:30		2					2	12
AM 8:30 - 8:45		1		1	1		3	12
AM 8:45 - 9:00		5					5	10
AM 9:00 - 9:15		2					2	6
AM 9:15 - 9:30		1	1				2	9
AM 9:30 - 9:45		1					1	9
AM 9:45 - 10:00		1					1	10
AM 10:00 - 10:15		4			1		5	10
AM 10:15 - 10:30		2					2	6
AM 10:30 - 10:45		2					2	6
AM 10:45 - 11:00		1					1	8
AM 11:00 - 11:15		1					1	8
AM 11:15 - 11:30		2					2	9
AM 11:30 - 11:45		4					4	41
AM 11:45 - 12:00		1				4	1	46
PM 12:00 - 12:15		2					2	45
PM 12:15 - 12:30	1	31			2		34	44
PM 12:30 - 12:45		9					9	11
PM 12:45 - 1:00		0					0	3
PM 1:00 - 1:15		1					1	6
PM 1:15 - 1:30		1					1	9
PM 1:30 - 1:45		1					1	11
PM 1:45 - 2:00		3					3	14
PM 2:00 - 2:15		4					4	13
PM 2:15 - 2:30		3					3	11
PM 2:30 - 2:45	1	2		1			4	10
PM 2:45 - 3:00		2					2	11
PM 3:00 - 3:15		2					2	10
PM 3:15 - 3:30		2					2	9
PM 3:30 - 3:45		5					5	10
PM 3:45 - 4:00		1					1	6

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TH81489
BY: DAN HIROTA
MOVEMENT: V4

PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICLE	PEDES-TRIAN	TOTAL	PEAK HR
PM 4:00 - 4:15		1					1	9
PM 4:15 - 4:30		2			1		3	12
PM 4:30 - 4:45		1					1	12
PM 4:45 - 5:00		4					4	14
PM 5:00 - 5:15		4					4	12
PM 5:15 - 5:30		3					3	10
PM 5:30 - 5:45		3					3	9
PM 5:45 - 6:00		2					2	6
PM 6:00 - 6:15		2					2	4
PM 6:15 - 6:30		2					2	2
PM 6:30 - 6:45							0	0
PM 6:45 - 7:00							0	0

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TM81489
BY: DAN HIROTA
MOVEMENT: V5

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45		37			0		37	263
AM	5:45 - 6:00		62	1	1			64	332
AM	6:00 - 6:15		64		2			66	353
AM	6:15 - 6:30		93	1	2			96	365
AM	6:30 - 6:45		99	2	1	4		106	330
AM	6:45 - 7:00		82		1	2		85	292
AM	7:00 - 7:15	1	71	2	3	1		78	261
AM	7:15 - 7:30	2	59					61	228
AM	7:30 - 7:45		64	1	3		2	68	217
AM	7:45 - 8:00		43	1	9	1	1	54	184
AM	8:00 - 8:15		42	1	2			45	161
AM	8:15 - 8:30		46	1	3			50	143
AM	8:30 - 8:45		34			1		35	121
AM	8:45 - 9:00		30	1				31	106
AM	9:00 - 9:15		26	1				27	111
AM	9:15 - 9:30	1	26	1			1	28	123
AM	9:30 - 9:45		20					20	129
AM	9:45 - 10:00	1	31	1	3			36	140
AM	10:00 - 10:15		39					39	144
AM	10:15 - 10:30	1	30	1	2			34	138
AM	10:30 - 10:45	1	25	1	4			31	132
AM	10:45 - 11:00	1	37	1		1		40	133
AM	11:00 - 11:15	1	29		2	1		33	124
AM	11:15 - 11:30		25	2	1			28	113
AM	11:30 - 11:45	1	30		1			32	93
AM	11:45 - 12:00		29	1	1			31	92
PM	12:00 - 12:15	1	21					22	86
PM	12:15 - 12:30		5	3				8	98
PM	12:30 - 12:45		31					31	116
PM	12:45 - 1:00	1	22	1	1			25	112
PM	1:00 - 1:15	2	32					34	128
PM	1:15 - 1:30		24	2				26	125
PM	1:30 - 1:45		25		2			27	124
PM	1:45 - 2:00	1	34	2	3	1		41	127
PM	2:00 - 2:15	1	29		1			31	120
PM	2:15 - 2:30		23	1	1			25	110
PM	2:30 - 2:45		27	2	1			30	111
PM	2:45 - 3:00		31	1	2			34	119
PM	3:00 - 3:15		19	1	1			21	114
PM	3:15 - 3:30		24	1	1			26	132
PM	3:30 - 3:45		38					38	138
PM	3:45 - 4:00	1	26	1		1		29	144

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TM81489
BY: DAN HIROTA
MOVEMENT: V5

	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		37	1	1			39	156
PM	4:15 - 4:30		28	2	2			32	143
PM	4:30 - 4:45		44					44	154
PM	4:45 - 5:00		41				1	41	162
PM	5:00 - 5:15	1	24	1				26	154
PM	5:15 - 5:30		40	2	1			43	162
PM	5:30 - 5:45		50	1	1			52	155
PM	5:45 - 6:00	3	28	2				33	103
PM	6:00 - 6:15	1	33					34	70
PM	6:15 - 6:30		36					36	36
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TH81489
BY: DAN HIROTA
MOVEMENT: V7

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45		0					0	7
AM	5:45 - 6:00		1			1		2	8
AM	6:00 - 6:15		4					4	7
AM	6:15 - 6:30	0	1	0	0	0	0	1	4
AM	6:30 - 6:45		1					1	4
AM	6:45 - 7:00		1					1	4
AM	7:00 - 7:15		1					1	13
AM	7:15 - 7:30		1					1	19
AM	7:30 - 7:45		1					1	23
AM	7:45 - 8:00		10					10	29
AM	8:00 - 8:15		7				1	7	22
AM	8:15 - 8:30		5					5	18
AM	8:30 - 8:45		7					7	18
AM	8:45 - 9:00		3					3	20
AM	9:00 - 9:15		2	1				3	27
AM	9:15 - 9:30		5					5	33
AM	9:30 - 9:45		7	1		1		9	35
AM	9:45 - 10:00		8	2				10	31
AM	10:00 - 10:15		8		1			9	28
AM	10:15 - 10:30		6			1		7	28
AM	10:30 - 10:45		5					5	34
AM	10:45 - 11:00		5		1	1		7	40
AM	11:00 - 11:15		7			2		9	39
AM	11:15 - 11:30		13					13	36
AM	11:30 - 11:45		9			2		11	38
AM	11:45 - 12:00		6					6	38
PM	12:00 - 12:15		6					6	41
PM	12:15 - 12:30		15					15	42
PM	12:30 - 12:45	1	9			1		11	36
PM	12:45 - 1:00		8			1		9	30
PM	1:00 - 1:15		7					7	25
PM	1:15 - 1:30		9					9	29
PM	1:30 - 1:45		4			1		5	29
PM	1:45 - 2:00		4					4	42
PM	2:00 - 2:15		5		1	5		11	48
PM	2:15 - 2:30		9					9	50
PM	2:30 - 2:45	1	16		1			18	58
PM	2:45 - 3:00		8			2		10	50
PM	3:00 - 3:15		7	1		5		13	54
PM	3:15 - 3:30		10	1	2	4		17	51
PM	3:30 - 3:45		10					10	41
PM	3:45 - 4:00		12	1		1		14	38

TRAFFIC COUNT SHEET SAM O. HIROTA PAGE 2

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89 DAY: MONDAY FILE:TH81489
BY: DAN HIROTA
MOVEMENT: V7

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		8			2		10	38
PM	4:15 - 4:30		4		2	1		7	44
PM	4:30 - 4:45		3		1	3		7	50
PM	4:45 - 5:00		12	1		1		14	51
PM	5:00 - 5:15	1	13	1		1		16	44
PM	5:15 - 5:30		12			1		13	41
PM	5:30 - 5:45		7			1	1	8	33
PM	5:45 - 6:00		6			1		7	25
PM	6:00 - 6:15		12			1		13	18
PM	6:15 - 6:30		3			2		5	5
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

TRAFFIC COUNT SHEET   SAM O. HIROTA   PAGE 1

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89   DAY: MONDAY   FILE:TM81489
BY: GREGG ICHIMURA
MOVEMENT: V9

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
AM	5:30 - 5:45					0		0	3
AM	5:45 - 6:00		1					1	4
AM	6:00 - 6:15							0	4
AM	6:15 - 6:30		2					2	5
AM	6:30 - 6:45		1					1	3
AM	6:45 - 7:00		1					1	8
AM	7:00 - 7:15		1				1	1	8
AM	7:15 - 7:30							0	9
AM	7:30 - 7:45		6					6	13
AM	7:45 - 8:00		1					1	8
AM	8:00 - 8:15		2					2	7
AM	8:15 - 8:30		3			1		4	6
AM	8:30 - 8:45		1					1	5
AM	8:45 - 9:00							0	7
AM	9:00 - 9:15		1					1	13
AM	9:15 - 9:30		3					3	13
AM	9:30 - 9:45		2	1				3	12
AM	9:45 - 10:00		6					6	16
AM	10:00 - 10:15	1						1	11
AM	10:15 - 10:30		2					2	16
AM	10:30 - 10:45		6			1		7	18
AM	10:45 - 11:00		1					1	16
AM	11:00 - 11:15		5		1			6	18
AM	11:15 - 11:30		4					4	18
AM	11:30 - 11:45		5					5	19
AM	11:45 - 12:00		2		1			3	14
PM	12:00 - 12:15		6					6	18
PM	12:15 - 12:30		5					5	17
PM	12:30 - 12:45							0	14
PM	12:45 - 1:00		6			1		7	19
PM	1:00 - 1:15		5					5	19
PM	1:15 - 1:30		2					2	18
PM	1:30 - 1:45		5					5	20
PM	1:45 - 2:00		7					7	25
PM	2:00 - 2:15		2			2		4	23
PM	2:15 - 2:30		4					4	23
PM	2:30 - 2:45		10					10	37
PM	2:45 - 3:00		5					5	36
PM	3:00 - 3:15		3	1		0		4	35
PM	3:15 - 3:30		16			2		18	36
PM	3:30 - 3:45		7			2		9	22
PM	3:45 - 4:00		3			1		4	17

INTERSECTION, KAMEHAMEHA HWY AND HEEIA PIER
DATE: 8/14/89   DAY: MONDAY   FILE:TM81489
BY: GREGG ICHIMURA
MOVEMENT: V9

---	PERIOD	MOTOR CYCLES	PASS CARS	BUSES	SINGLE UNIT TRUCKS	COMBI-NATION VEHICL	PEDES-TRIAN	TOTAL	PEAK HR
PM	4:00 - 4:15		5					5	15
PM	4:15 - 4:30		4					4	15
PM	4:30 - 4:45		4					4	17
PM	4:45 - 5:00		2					2	15
PM	5:00 - 5:15		5					5	13
PM	5:15 - 5:30		6					6	13
PM	5:30 - 5:45		2					2	14
PM	5:45 - 6:00							0	12
PM	6:00 - 6:15		4	1				5	12
PM	6:15 - 6:30		7					7	7
PM	6:30 - 6:45							0	0
PM	6:45 - 7:00							0	0

ISLAND: U	STATION DESCRIPTION: KAHEKILI HW KAM HWY (LE, OAHU	(KAM HWY AND AHAOLELO ST	TC NO. 00003101 ID NO. 00002913
STATIC			
AUX NO: 31V	COUNT GROUP ID:	CORRIDOR ID:	
FUND SYSTEM:	ROUTE NO M.P.:	SURVEY DATE:	ASSIGNED DATE:
FILE:	HWY ST NAME1-MOV 2,2-MOV 6		
	MOV(2), DIR: TO KAHEKILI & KAM HWY	D-01 BEG SURVEY DATE: 11/01/88	START TIME: 10:30
	MOV(6), DIR: MAKAI BD	D-02 BEG SURVEY DATE: 11/01/88	START TIME: 10:30

TIME-AM	MOV 2	MOV 6	TOTAL	TIME-AM	MOV 2	MOV 6	TOTAL	TIME-PM	MOV 2	MOV 6	TOTAL	TIME-PM	MOV 2	MOV 6	TOTAL
12:00-12:15	4	2	6	6:00- 6:15	10	138	148	12:00-12:15	50	28	78	6:00- 6:15	53	25	78
12:15-12:30	5	2	7	6:15- 6:30	18	147	165	12:15-12:30	40	17	57	6:15- 6:30	64	35	99
12:30-12:45	3	1	4	6:30- 6:45	13	143	156	12:30-12:45	34	13	47	6:30- 6:45	28	21	49
12:45- 1:00	3	0	3	6:45- 7:00	18	107	125	12:45- 1:00	54	26	80	6:45- 7:00	31	16	47
1:00- 1:15	2	0	2	7:00- 7:15	24	83	107	1:00- 1:15	32	20	52	7:00- 7:15	22	15	37
1:15- 1:30	1	0	1	7:15- 7:30	24	75	99	1:15- 1:30	46	34	80	7:15- 7:30	16	17	33
1:30- 1:45	2	0	2	7:30- 7:45	29	72	101	1:30- 1:45	45	23	68	7:30- 7:45	20	17	37
1:45- 2:00	0	0	0	7:45- 8:00	33	48	81	1:45- 2:00	74	38	112	7:45- 8:00	22	16	38
2:00- 2:15	0	0	0	8:00- 8:15	21	32	53	2:00- 2:15	41	26	67	8:00- 8:15	24	13	37
2:15- 2:30	1	0	1	8:15- 8:30	29	35	64	2:15- 2:30	30	31	61	8:15- 8:30	23	13	36
2:30- 2:45	1	1	2	8:30- 8:45	20	23	43	2:30- 2:45	45	29	74	8:30- 8:45	13	14	27
2:45- 3:00	0	0	0	8:45- 9:00	21	18	39	2:45- 3:00	38	26	64	8:45- 9:00	31	6	37
3:00- 3:15	0	0	0	9:00- 9:15	28	27	55	3:00- 3:15	57	34	91	9:00- 9:15	16	11	27
3:15- 3:30	1	0	1	9:15- 9:30	30	17	47	3:15- 3:30	49	32	81	9:15- 9:30	17	10	27
3:30- 3:45	1	0	1	9:30- 9:45	36	22	58	3:30- 3:45	99	44	143	9:30- 9:45	20	12	32
3:45- 4:00	2	2	4	9:45-10:00	33	25	58	3:45- 4:00	46	34	80	9:45-10:00	11	5	16
4:00- 4:15	0	0	0	10:00-10:15	32	14	46	4:00- 4:15	71	41	112	10:00-10:15	14	3	17
4:15- 4:30	1	1	2	10:15-10:30	40	18	58	4:15- 4:30	54	44	98	10:15-10:30	10	8	18
4:30- 4:45	1	1	2	10:30-10:45	48	18	66	4:30- 4:45	69	46	115	10:30-10:45	5	5	10
4:45- 5:00	4	5	9	10:45-11:00	41	19	60	4:45- 5:00	50	24	74	10:45-11:00	7	6	13
5:00- 5:15	4	3	7	11:00-11:15	46	23	69	5:00- 5:15	55	35	90	11:00-11:15	11	1	12
5:15- 5:30	9	18	27	11:15-11:30	40	17	57	5:15- 5:30	42	29	71	11:15-11:30	3	4	7
5:30- 5:45	7	42	49	11:30-11:45	42	30	72	5:30- 5:45	44	35	79	11:30-11:45	7	3	10
5:45- 6:00	7	83	90	11:45-12:00	41	27	68	5:45- 6:00	53	21	74	11:45-12:00	3	2	5

AM COMMUTER PERIOD (05:00 - 09:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK:			
AM-PEAK HR TIME	—	—	6:00 AM- 7:00 AM
AM-PEAK HR VOLUME	59	535	594
AM-K FACTOR(%)			12.34
AM-D %	9.93	90.07	100.00
DIRECTIONAL PEAK:			
AM PEAK-HR TIME	7:30 AM- 8:30 AM	6:00 AM- 7:00 AM	
AM PEAK-HR VOLUME	112	535	

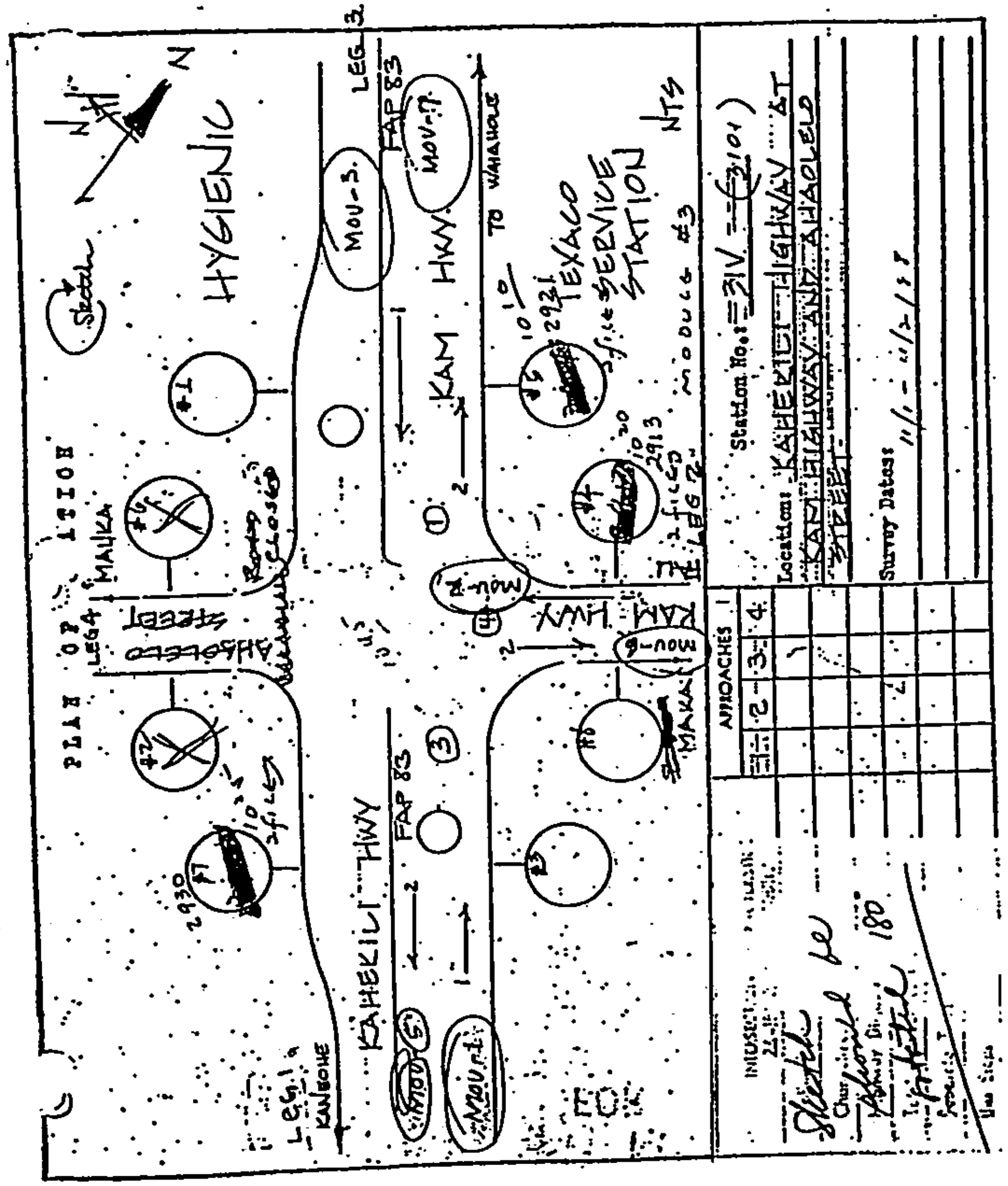
PM COMMUTER PERIOD (15:00 - 19:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK:			
PM-PEAK HR TIME	—	—	3:30 PM- 4:30 PM
PM-PEAK HR VOLUME	270	163	433
PM-K FACTOR(%)			9.00
PM-D %	62.36	37.64	100.00
DIRECTIONAL PEAK:			
PM-PEAK HR TIME	3:30 PM- 4:30 PM	3:45 PM- 4:45 PM	
PM-PEAK HR VOLUME	270	165	

AM PERIOD (00:00-12:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK:			
AM-PEAK HR TIME			6:00 AM- 7:00 AM
AM-PEAK HR VOLUME	59	535	594
AM-K FACTOR(%)			12.34
AM-D %	9.93	90.07	100.00

PM PERIOD (12:00-24:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK:			
PM-PEAK HR TIME			3:30 PM- 4:30 PM
PM-PEAK HR VOLUME	270	163	433
PM-K FACTOR(%)			9.00
PM-D %	62.36	37.64	100.00

NON-COMMUTER PERIOD (09:00 - 15:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK:			
PEAK HR TIME	—	—	1:15 PM- 2:15 PM
PEAK HR VOLUME	206	121	327
DIRECTIONAL PEAK:			
PEAK HR TIME	1:15 PM- 2:15 PM	1:45 PM- 2:45 PM	
PEAK HR VOLUME	206	124	

6-HR, 12-HR, AND 24-HR PERIODS	MOV 2	MOV 6	TOTAL
AM 6-HR PERIOD (06:00 - 12:00)	712	1,178	1,890
AM 12-HR PERIOD (00:00 - 12:00)	776	1,335	2,113
PM 6-HR PERIOD (12:00 - 18:00)	1,210	730	1,940
PM 12-HR PERIOD (12:00 - 24:00)	1,689	1,008	2,697
24 HOUR PERIOD	2,465	2,347	4,812
D %	51.23	48.77	100.00



STATION C-31-C KAMEHAMEHA HWY

0.4 MILE NORTHWEST OF IPUKA STREET (HEEIA VIADUCT)

DATE OF SURVEY 11/4/87

	TIME AM/PM		NORTH BOUND	SOUTH BOUND	TOTAL	TWO DIR PEAK HOUR	PEAK HOUR NORTH BOUND	PEAK HOUR SOUTH BOUND
12	00:00	00:15	12	9	21	45	24	21
	00:15	00:30	5	8	13	29	15	14
	00:30	00:45	5	0	5	23	15	8
	00:45	01:00	2	4	6	22	12	10
1	01:00	01:15	3	2	5	19	13	6
	01:15	01:30	5	2	7	19	11	8
	01:30	01:45	2	2	4	14	8	6
	01:45	02:00	3	0	3	14	9	5
2	02:00	02:15	1	4	5	19	8	11
	02:15	02:30	2	0	2	18	9	9
	02:30	02:45	3	1	4	18	7	11
	02:45	03:00	2	6	8	17	6	11
3	03:00	03:15	2	2	4	16	6	10
	03:15	03:30	0	2	2	15	5	10
	03:30	03:45	2	1	3	27	8	19
	03:45	04:00	2	5	7	30	9	21
4	04:00	04:15	1	2	3	53	10	43
	04:15	04:30	3	11	14	86	13	73
	04:30	04:45	3	3	6	141	24	117
	04:45	05:00	3	27	30	229	25	204
5	05:00	05:15	4	32	36	392	32	360
	05:15	05:30	14	55	69	717	41	676
	05:30	05:45	4	90	94	1103	40	1063
	05:45	06:00	10	183	193	1506	54	1452
6	06:00	06:15	13	348	361	1792	68	1724
	06:15	06:30	13	442	455	1768	88	1680
	06:30	06:45	18	479	497	1656	114	1542
	06:45	07:00	24	455	479	1452	135	1317
7	07:00	07:15	33	304	337	1181	148	1033
	07:15	07:30	39	304	343	985	142	843
	07:30	07:45	39	254	293	775	139	636
	07:45	08:00	37	171	208	608	134	474
8	08:00	08:15	27	114	141	507	138	369
	08:15	08:30	36	97	133	497	151	346
	08:30	08:45	34	92	126	491	156	335
	08:45	09:00	41	66	107	494	165	329
9	09:00	09:15	40	91	131	509	183	326
	09:15	09:30	41	86	127	464	169	295
	09:30	09:45	43	86	129	465	185	280
	09:45	10:00	59	63	122	451	189	262
10	10:00	10:15	26	60	86	440	188	252
	10:15	10:30	57	71	128	450	211	239
	10:30	10:45	47	68	115	442	216	226
	10:45	11:00	58	53	111	433	224	209
11	11:00	11:15	49	47	96	425	216	209
	11:15	11:30	62	58	120	436	215	221
	11:30	11:45	55	51	106	451	205	246
	11:45	NOON	50	53	103	454	197	257
12	12:00	12:15	48	59	107	469	196	273
	12:15	12:30	52	83	135	511	210	301
	12:30	12:45	47	62	109	487	195	292
	12:45	01:00	49	69	118	526	225	301
1	01:00	01:15	62	87	149	550	239	311

STATION C-31-C KAHEHAMEHA HWY

0.4 MILE NORTHWEST OF IPUKA STREET (HEEIA VIADUCT)

DATE OF SURVEY 11/4/87

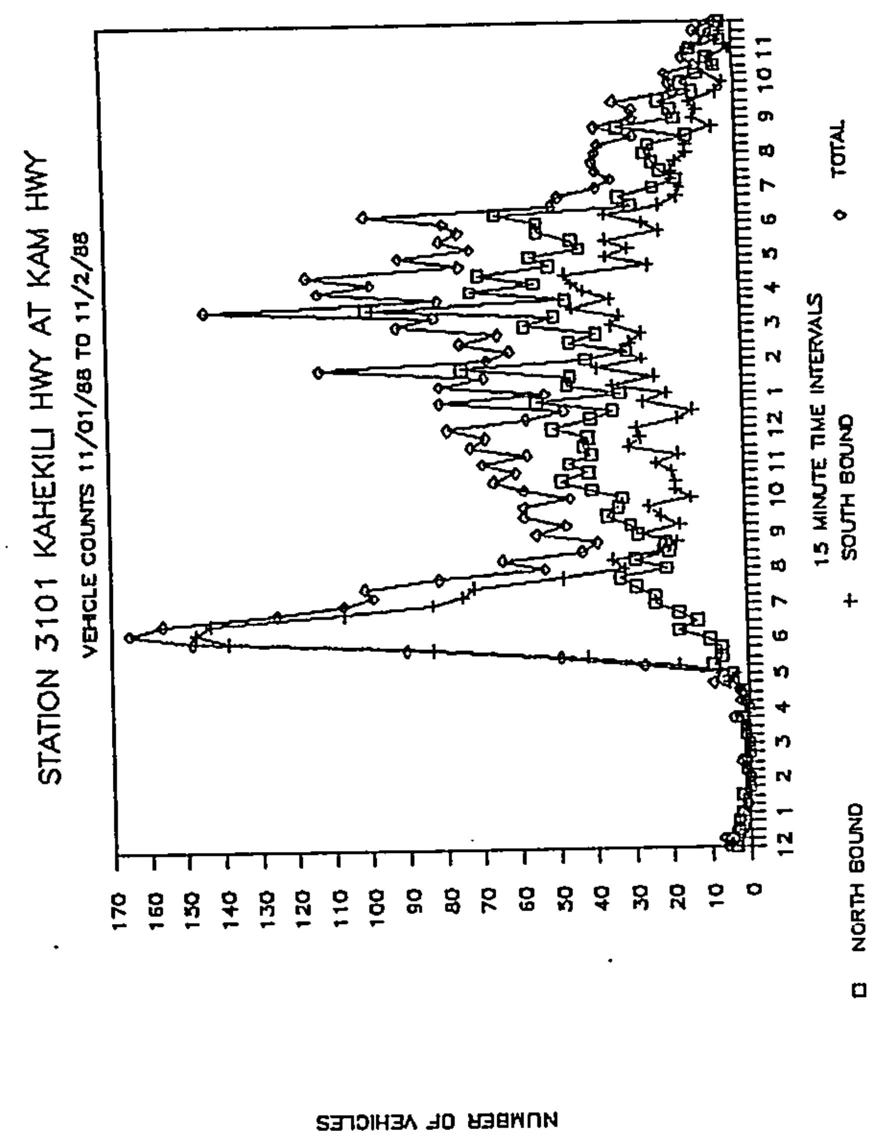
	TIME AM/PM		NORTH BOUND	SOUTH BOUND	TOTAL	TWO DIR PEAK HOUR	PEAK HOUR NORTH BOUND	PEAK HOUR SOUTH BOUND
	01:15	01:30	37	74	111	534	228	306
	01:30	01:45	77	71	148	540	254	286
	01:45	02:00	63	79	142	503	219	284
2	02:00	02:15	51	82	133	460	215	245
	02:15	02:30	63	54	117	426	218	208
	02:30	02:45	42	69	111	442	215	227
	02:45	03:00	59	40	99	500	251	249
3	03:00	03:15	54	45	99	524	252	272
	03:15	03:30	60	73	133	568	269	299
	03:30	03:45	78	91	169	611	294	317
	03:45	04:00	60	63	123	574	286	288
4	04:00	04:15	71	72	143	600	299	301
	04:15	04:30	85	91	176	593	316	277
	04:30	04:45	70	62	132	564	305	259
	04:45	05:00	73	76	149	599	312	287
5	05:00	05:15	88	48	136	616	319	297
	05:15	05:30	74	73	147	611	306	305
	05:30	05:45	77	90	167	634	298	336
	05:45	06:00	80	86	166	599	272	327
6	06:00	06:15	75	56	131	582	254	328
	06:15	06:30	66	104	170	561	226	335
	06:30	06:45	51	81	132	493	212	281
	06:45	07:00	62	87	149	429	193	236
7	07:00	07:15	47	63	110	361	170	191
	07:15	07:30	52	50	102	346	157	189
	07:30	07:45	32	36	68	318	145	173
	07:45	08:00	39	42	81	311	141	170
8	08:00	08:15	34	61	95	280	125	155
	08:15	08:30	40	34	74	278	131	147
	08:30	08:45	28	33	61	268	124	144
	08:45	09:00	23	27	50	286	146	140
9	09:00	09:15	40	53	93	287	151	136
	09:15	09:30	33	31	64	254	146	108
	09:30	09:45	50	29	79	222	130	92
	09:45	10:00	28	23	51	185	102	83
10	10:00	10:15	35	25	60	168	93	75
	10:15	10:30	17	15	32	133	73	60
	10:30	10:45	22	20	42	126	68	58
	10:45	11:00	19	15	34	111	64	47
11	11:00	11:15	15	10	25	90	52	38
	11:15	11:30	12	13	25	65	37	28
	11:30	11:45	18	9	27	40	25	15
	11:45	12 MI	7	6	13	250	7	13

NORTH BOUNPEAK HOUR AM 224

PEAK HOUR PM 319

SOUTH BOUNPEAK HOUR AM 1724

PZAK HOUR PM 336



** APPENDIX B **

MAKULANI SPORTS COMPLEX FILE: MSCUNE1
WEEKEND PEAK HOUR ON KAM HWY 8/13/89 SOH
EXISTING CONDITIONS AT HEEIA KEA BOAT HABOR ACCESS

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	247	58	22	255	77	39
TOTAL	247	58	22	255	77	39

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	247	58	24	255	85	43
TOTAL	247	58	24.2	255	84.7	42.9

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNE1
WEEKEND PEAK HOUR ON KAM HWY 8/13/89 SOH
EXISTING CONDITIONS AT HEEIA KEA BOAT HABOR ACCESS

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	276 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	802 pcph
Actual Capacity, Cm	Cp = Cm	802 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	305 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	879 pcph
Percent of Cp Utilitized	V4/Cp4x100	2.8%
Impedance Factor	Figure 10-5	0.99
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	553 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	446 pcph
Actual Capacity, Cm	Cm = Cp x P4	440 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	84.7	439.85	355.15	B
9	42.9	802.41	759.51	A
4	24.2	710	685.8	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	84.7	439.85			
9	42.9	802.41	519	391	B
4	24.2	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNE2
WEEKDAY PEAK HOUR ON KAM HWY 8/14/89 SOH
EXISTING CONDITIONS AT HEEIA KEA BOAT HABOR ACCESS

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	345	32	14	162	51	15
TOTAL	345	32	14	162	51	15

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	345	32	15	162	56	17
TOTAL	345	32	15.4	162	56.1	16.5

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNE2
WEEKDAY PEAK HOUR ON KAH HWY 8/14/89 SOH
EXISTING CONDITIONS AT HEEIA KEA BOAT HABOR ACCESS

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	361 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	725 pcph
Actual Capacity, Cm	Cp = Cm	725 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	377 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	808 pcph
Percent of Cp Utilitized	V4/Cp4x100	1.9%
Impedance Factor	Figure 10-5	0.99
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	537 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	456 pcph
Actual Capacity, Cm	Cm = Cp x P4	452 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	56.1	451.85	395.75	B
9	16.5	724.65	708.15	A
4	15.4	710	694.6	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	56.1	451.85			
9	16.5	724.65	494	422	A
4	15.4	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNP1
WEEKEND PEAK HOUR ON KAH HWY 8/13/89 SOH
MALULANI SPORTS COMPLEX ACCESS TO KAMEHAMEHA HWY

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	269	22	22	321	20	58
TOTAL	269	22	22	321	20	58

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	269	22	24	321	22	64
TOTAL	269	22	24.2	321	22	63.8

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNP1
WEEKEND PEAK HOUR ON KAH HWY 8/13/89 SOH
MALULANI SPORTS COMPLEX ACCESS TO KAMEHAMEHA HWY

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	280 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	799 pcph
Actual Capacity, Cm	Cp = Cm	799 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	291 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	894 pcph
Percent of Cp Utilitized	V4/Cp4x100	2.7%
Impedance Factor	Figure 10-5	0.99
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	623 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	404 pcph
Actual Capacity, Cm	Cm = Cp x P4	399 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	22	398.68	376.68	B
9	63.8	798.70	734.90	A
4	24.2	710	685.8	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	22	398.68			
			635	549	A
9	63.8	798.70			
4	24.2	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNP2
WEEKEND PEAK HOUR ON KAM HWY 8/13/89 SOH
HEEIA KEA BOAT HARBOR NEW ACCESS WITH IMPROVEMENTS

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	308	52	14	313	69	35
TOTAL	308	52	14	313	69	35

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	308	52	15	313	76	39
TOTAL	308	52	15.4	313	75.9	38.5

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNP2
WEEKEND PEAK HOUR ON KAM HWY 8/13/89 SOH
HEEIA KEA BOAT HARBOR NEW ACCESS WITH IMPROVEMENTS

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	334 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	749 pcph
Actual Capacity, Cm	Cp = Cm	749 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	360 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	824 pcph
Percent of Cp Utilitized	V4/Cp4x100	1.9%
Impedance Factor	Figure 10-5	0.99
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	661 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	383 pcph
Actual Capacity, Cm	Cm = Cp x P4	379 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	75.9	379.25	303.35	B
9	38.5	749.14	710.64	A
4	15.4	710	694.6	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	75.9	379.25			
			455	340	B
9	38.5	749.14			
4	15.4	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNP3
WEEKEND PEAK HOUR ON KAM HWY 8/13/89 SOH
HEEIA KEA BOAT HARBOR EXISTING ACCESS WITH IMPROVEMENTS

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	321	58	22	360	77	39
TOTAL	321	58	22	360	77	39

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	321	58	24	360	85	43
TOTAL	321	58	24.2	360	84.7	42.9

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNP3
WEEKEND PEAK HOUR ON KAM HWY 8/13/89 SOH
HEEIA KEA BOAT HARBOR EXISTING ACCESS WITH IMPROVEMENTS

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	350 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	735 pcph
Actual Capacity, Cm	Cp = Cm	735 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	379 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	806 pcph
Percent of Cp Utilitized	V4/Cp4x100	3.0%
Impedance Factor	Figure 10-5	0.98
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	732 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	345 pcph
Actual Capacity, Cm	Cm = Cp x P4	340 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	84.7	339.59	254.89	C
9	42.9	734.61	691.71	A
4	24.2	710	685.8	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	84.7	339.59			
9	42.9	734.61	415	287	C
4	24.2	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/31/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNP11
WEEKDAY PEAK HOUR ON KAM HWY 8/14/89 SOH
MALULANI SPORTS COMPLEX ACCESS TO KAMEHAMEHA HWY

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	175	43	44	374	7	43
TOTAL	175	43	44	374	7	43

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	175	43	48	374	8	47
TOTAL	175	43	48.4	374	7.7	47.3

DATE 10/31/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNP11
WEEKDAY PEAK HOUR ON KAH HWY 8/14/89 SOH
MALULANI SPORTS COMPLEX ACCESS TO KAMEHAMEHA HWY

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	196.5 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	877 pcph
Actual Capacity, Cm	Cp = Cm	877 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	218 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	974 pcph
Percent of Cp Utilitized	V4/Cp4x100	5.0%
Impedance Factor	Figure 10-5	0.97
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	614.5 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	409 pcph
Actual Capacity, Cm	Cm = Cp x P4	398 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	7.7	398.09	390.39	B
9	47.3	877.10	829.80	A
4	48.4	710	661.6	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	7.7	398.09			
9	47.3	877.10	751	696	A
4	48.4	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNP12
WEEKDAY PEAK HOUR ON KAH HWY 8/14/89 SOH
HEEIA KEA BOAT HARBOR NEW ACCESS WITH IMPROVEMENTS

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	404	28	13	205	45	14
TOTAL	404	28	13	205	45	14

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	404	28	14	205	50	15
TOTAL	404	28	14.3	205	49.5	15.4

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNP12
WEEKDAY PEAK HOUR ON KAM HWY 8/14/89 SOH
HEEIA KEA BOAT HARBOR NEW ACCESS WITH IMPROVEMENTS

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	418 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	674 pcph
Actual Capacity, Cm	Cp = Cm	674 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	432 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	757 pcph
Percent of Cp Utilitized	V4/Cp4x100	1.9%
Impedance Factor	Figure 10-5	0.99
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	636 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	397 pcph
Actual Capacity, Cm	Cm = Cp x P4	393 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	49.5	393.10	343.60	B
9	15.4	673.57	658.17	A
4	14.3	710	695.7	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	49.5	393.10			
9	15.4	673.57	436	371	B
4	14.3	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 1

MAKULANI SPORTS COMPLEX FILE: MSCUNP13
WEEKDAY PEAK HOUR ON KAM HWY 8/14/89 SOH
HEEIA KEA BOAT HARBOR EXISTING ACCESS WITH IMPROVEMENTS

REF. HIGHWAY CAPACITY MANUAL, SPECIAL REPORT 209,
TRANSPORTATION RESERACH BOARD, NATIONAL RESEARCH COUNCIL

PASSENGER-CAR EQUIVALENT FOR UNSIGNALIZED INTERSECTIONS

Type of Vehicle	Grade (%) -4%	-2%	0%	+2%	+4%
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RV's	1.0	1.2	1.5	2.0	3.0
Combination Veh.	1.2	1.5	2.0	3.0	6.0
All Vehicles	0.9	1.0	1.1	1.4	1.7

INPUT GRADE 0%

HOURLY VOLUMES (VPH)

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	0	0	0	0	0
All Vehicles	417	32	14	236	51	15
TOTAL	417	32	14	236	51	15

VOLUME ADJUSTMENT (PCPH) FROM TABLE 1

MOVEMENT	V2	V3	V4	V5	V7	V9
Motorcycles	0	0	0	0	0	0
Passenger Cars	0	0	0	0	0	0
SU/RV's	0	0	0	0	0	0
Combination Veh.	0	.0	0	0	0	0
All Vehicles	417	32	15	236	56	17
TOTAL	417	32	15.4	236	56.1	16.5

DATE 10/30/89 UNSIGNALIZED T-INTERSECTION ANALYSIS PAGE 2

MAKULANI SPORTS COMPLEX FILE: MSCUNP13
WEEKDAY PEAK HOUR ON KAM HWY 8/14/89 SOH
HEEIA KEA BOAT HARBOR EXISTING ACCESS WITH IMPROVEMENTS

STEP 1: RT from minor street	V9	
Conflicting Flow, Vc	1/2V3 + V2=	433 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.5 sec
Potential Capacity, Cp	Figure 10-3	660 pcph
Actual Capacity, Cm	Cp = Cm	660 pcph
STEP 2: LT from major street	V4	
Conflicting Flow, Vc	V3 + V2=	449 vph (Vc9)
Critical Gap, Tc	Table 10-2	5.0 sec
Potential Capacity, Cp	Figure 10-3	742 pcph
Percent of Cp Utilitized	V4/Cp4x100	2.1%
Impedance Factor	Figure 10-5	0.99
Actual Capacity, Cm	Cm = Cp	710 pcph
STEP 3: LT from minor street	V7	
Conflicting Flow, Vc	1/2V3+V2+V5+V4 =	683 vph (Vc9)
Critical Gap, Tc	Table 10-2	6.5 sec
Potential Capacity, Cp	Figure 10-3	371 pcph
Actual Capacity, Cm	Cm = Cp x P4	367 pcph

FOR THE SEPARATE LANE CASE

Movement No.	v (pcph)	Cm (pcph)	Cr	LOS
7	56.1	366.93	310.83	B
9	16.5	660.25	643.75	A
4	15.4	710	694.6	A

FOR THE SHARED LANE CASE Csh = (V7+V9)/((V7/Cm7)+(V9/Cm9))

Movement No.	v (pcph)	Cm (pcph)	Csh (pcph)	Cr	LOS
7	56.1	366.93			
9	16.5	660.25	408	336	B
4	15.4	710			

	LEVEL OF SERVICE	RESERVED CAPACITY (pcph)	
LITTLE OR NO DELAY	A	>	400
SHORT TRAFFIC DELAYS	B	300	399
AVERAGE TRAFFIC DELAYS	C	200	299
LONG TRAFFIC DELAYS	D	100	199
VERY LONG TRAFFIC DELAY	E	0	99
EXCEEDS CAPACITY	F		

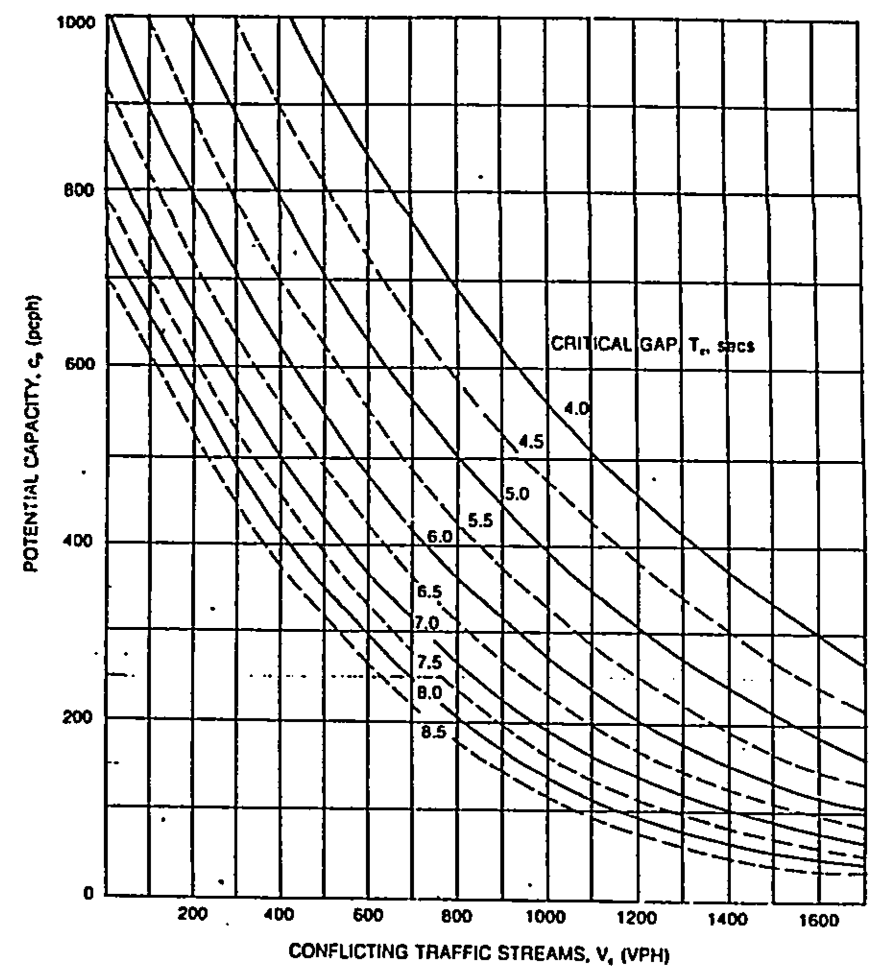


Figure 10-3. Potential capacity based on conflicting traffic volume and critical gap size.

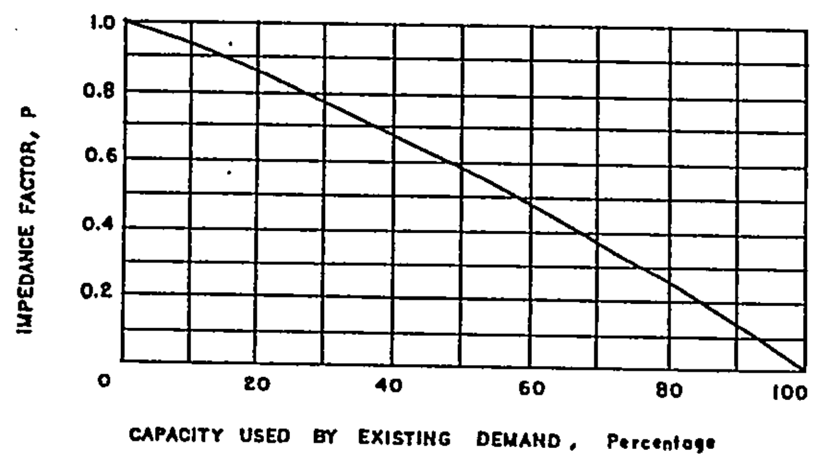


Figure 10-5. Impedance factors as a result of congested movements.

APPENDIX K

AIR QUALITY STUDY
Barry D. Root and Barry D. Neal

AIR QUALITY STUDY FOR THE PROPOSED MALULANI SPORTS COMPLEX

KOOLAUPOKO, OAHU

Prepared for:

Helber Hastert & Kimura Planners

Prepared by:

Barry D. Root & Barry D. Neal

November 1989

CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION AND PROJECT DESCRIPTION

Nanatomi Hawaii, Inc. is proposing for development the Malulani Sports Complex and a small residential subdivision on approximately 220 acres of land in Heeia Kea Valley, Koolaupoko, Oahu. As indicated in Figure 1, the site of the development is located mauka of Kaneohe Bay and Kamehameha Highway near the Heeia Kea Pier and Boat Harbor. The sports complex would consist of an 18-hole golf course, a golf club house with dining facilities and meeting and function rooms, a tennis club, a health spa, and associated fitness facilities. The proposed housing subdivision would include 30 to 35 single-family homes. Figure 2 is a conceptual plan of the proposed project. Development would be completed by 1993 at the earliest.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate these impacts are suggested where possible and appropriate.

2.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, AAQS have been established for six air pollutants. These regulated air pollutants

include: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide standards to the national levels, but at present there are no indications that such a change is being considered.

3.0 PRESENT AIR QUALITY

Present air quality in the Heeia Kea area could potentially be affected by air pollutants from natural, industrial, agricultural and/or vehicular sources. Natural air pollutant producers which could affect the Heeia Kea area include the ocean (sea spray), plants (aero-allergens), dust (from the wind blowing over areas with no vegetative cover), or perhaps distant volcanic emissions from the Island of Hawaii.

Industrial and agricultural sources of air pollutants are located primarily on the leeward and central portions of Oahu. These sources are generally downwind from the project location and thus

should have little if any impact. Upwind in the normal trade wind direction there are no industrial or agricultural air pollution sources for thousands of miles.

Emissions from motor vehicles traversing Kamehameha Highway undoubtedly impact the project site to some extent. However, even during peak-hour traffic periods, traffic is relatively light.

The only long-term State of Hawaii air quality monitoring station on the windward side of Oahu is located at Waimanalo. This monitoring site was selected by the State to measure background levels of particulate matter. None of the other regulated pollutants are monitored at this location. Table 2 is a summary of data collected at the Waimanalo monitoring station for a three-year period beginning with 1985. Twenty-four hour samples during the 1985-87 monitoring period ranged from 10 to 72 ug/m^3, while the annual arithmetic averages ranged between 25 and 28 ug/m^3. These values are well within the State AAQS for particulate matter and are probably typical of most locations on the windward coast of Oahu.

Any air pollution currently affecting the project area probably emanates mainly from either natural or vehicular sources. Unfortunately, there are no nearby long-term measurements of vehicular-related pollutants (i.e., carbon monoxide, nitrogen oxides, ozone or lead) on the windward side of Oahu, so current levels of these pollutants in the project area are difficult to estimate very accurately. Some monitoring data for vehicular-related pollutants are available for the leeward side of Oahu, but these data are not representative of the project site. However, due to the low level of activity and development in the area and the persistent trade winds from the northeast, current air pollution levels are almost certainly low. Later in this report, present concentrations of carbon monoxide in the project area are estimated based on air quality modeling of emissions from vehicles traversing Kamehameha Highway.

4.0 SHORT-TERM IMPACTS OF PROJECT

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

Fugitive dust emissions may arise from grading and dirt-moving activities within the project site. The emission rate for fugitive dust is nearly impossible to estimate accurately because of its elusive nature and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions in the project area would probably be somewhat lower because the PE index for the Heeia Kea

area is greater than 50. In any case, State of Hawaii Air Pollution Control Regulations [4] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by establishment of a frequent watering program to keep bare-dirt surfaces in work areas from becoming significant dust generators. In some cases, limiting the area that can be disturbed at any given time may be necessary. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

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

Indirectly, slow-moving construction vehicles on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. Thus, most potential short-term air quality impacts from project construction can be mitigated.

5.0 LONG-TERM IMPACTS OF PROJECT

After the proposed project is completed, there will be no significant direct sources of air pollution. However, long-term impacts may potentially occur indirectly as a result of project-related motor vehicle traffic using nearby roadways. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides, and those burning leaded gasoline contribute lead to the atmosphere. The use of leaded gasoline in new automobiles is now prohibited. As older vehicles continue to disappear from the numbers of those currently operating on the state's roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is proposing a total ban on leaded gasoline. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations also call for increased efficiency in removing carbon monoxide and nitrogen oxides from the exhausts of new vehicles. By the year 1995 carbon monoxide emissions are expected to be about 30 percent less than the amounts now emitted due to the replacement of older vehicles with newer ones. Further reductions in vehicular emissions have recently been

proposed by the President for areas of the country which do not currently meet AAQS, mainly through the use of alternative fuels.

To evaluate the potential long-term indirect air quality impact of increased roadway traffic associated with a project such as this, it is standard practice to utilize computerized emission and atmospheric dispersion models to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the motor vehicle generated pollutants. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem, whereas nitrogen oxides air pollution most often is a regional issue. This is reflected in the fact that the AAQS for carbon monoxide are specified on a short-term basis (1-hour and 8-hour averaging times) while the AAQS for nitrogen dioxide is set on an annual basis.

For this project, three scenarios were selected for study: year 1989 with present conditions and year 1993 (the expected project completion date) both with and without the project. To begin the carbon monoxide modeling study, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic cycling: decelerating, stopping, queueing and accelerating.

The traffic impact assessment report for the project [5] describes the present and the expected future conditions and configurations of the roadway system in the vicinity of the project. Briefly, access to the Heeia Kea Boat Harbor adjacent to the proposed project is presently achieved by means of a two-lane road that forms a T-intersection with Kamehameha Highway. After completion of the proposed project, Kamehameha Highway would be realigned so as to eliminate the existing S-curve that currently exists on this stretch of roadway while maintaining the existing access road to the boat harbor. A two-lane road forming a new T-intersection with Kamehameha Highway on the makai side would provide access to land north of the existing boat harbor facilities that is to be donated for a public beach park. Further to the north, a two-lane road on the mauka side would create another new T-intersection with Kamehameha Highway to give access to the proposed project. More detailed descriptions of the roadways in the vicinity of the project are provided in the traffic report cited above.

The main objectives of the modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentrations in the project area which could be directly compared to the national and the state AAQS. The three intersections along Kamehameha Highway described above were selected for analysis.

The traffic impact assessment report indicates that peak-hour traffic volumes in the project vicinity occur on weekend afternoons. Afternoon traffic on weekdays causes a secondary peak. Worst-case meteorological dispersion conditions usually occur during the early morning hours, but traffic volumes associated with the proposed project would not be very large then. Thus, for this particular case, afternoon meteorological conditions are most likely to coincide with peak traffic volumes.

The EPA computer model MOBILE4 [6] was used to calculate vehicular carbon monoxide emission estimates for both the present and the future years studied. Based on recent vehicle registration figures, the present and projected vehicle mix in the project area is estimated to be 91.9% light-duty gasoline-powered vehicles, 4.2% light-duty gasoline-powered trucks and vans, 0.5% heavy-duty gasoline-powered vehicles, 1% diesel-powered trucks and buses, and 1% motorcycles. It was assumed that about 21 percent of all vehicles would be operating in the cold-start mode and that about 27 percent would be operating in the hot-start mode. These operational mode values reflect the same conditions that are assumed during emissions testing by EPA. Unless site-specific data are available, these values are generally used in calculating cold/hot start emissions. National averages for "mis-fueling" were assumed. An ambient temperature of 68 degrees F was used for afternoon peak-hour emission computations. This is a conservative assumption since ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE4 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE4, these data were then input to the latest version of the computer model CALINE4 [7]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. The traffic volumes given in the traffic study for the future scenarios include traffic from other growth that is expected to occur in the area by the year 1993, and in the with project case, traffic that would be generated by the proposed project.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Model receptor sites were located approximately 10 meters from the edge of the roadways near all roadway intersections at a height of 1.5 meters above grade to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 4 was assumed. This is the most conservative stability category that can be used for estimating afternoon pollutant dispersion in model calculations. A surface roughness length of 100 cm was assumed with a mixing height of 300 meters. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration.

Existing background concentrations of air pollution in the project vicinity are believed to be low. Hence, background contributions of carbon monoxide from distant sources not directly considered in the analysis were assumed to be close to zero. A small concentration of 0.1 ppm was added to all predicted concentrations to make allowance for background.

Table 3 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 1989 with existing traffic, year 1993 without project traffic, and year 1993 with project traffic. The locations of these estimated worst-case 1-hour concentrations all occurred at or near the indicated intersections.

Insofar as present conditions are concerned, the predicted worst-case 1-hour carbon monoxide concentration in the project area was 1.6 mg/m^3. This was predicted to occur on a weekend afternoon near the intersection of Kamehameha Highway and the Heeia Kea Boat Harbor access road. Further to the north in the vicinity of the proposed new roadways, predicted existing worst-case concentrations along Kamehameha Highway were about 0.5 mg/m^3. In 1993 without the proposed project, worst-case 1-hour concentrations were estimated to range from 0.3 to 1.3 mg/m^3, with the highest concentration occurring during the weekend. In the 1993 with project scenario, the worst-case 1-hour concentrations at the three locations studied were all 0.9 mg/m^3 for the weekday case and ranged from 1.0 to 1.4 mg/m^3 during a weekend peak hour. The highest value for the with project scenario occurred at the Kamehameha Highway/Boat Harbor Road intersection. All predicted worst-case 1-hour carbon monoxide concentrations were well within both the state and the national AAQS.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a "meteorological persistence factor" of 0.6. This procedure is recommended in EPA guidelines [8] to account for two factors: (1) traffic volumes averaged over eight hours are lower than the peak 1-hour value, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. The resulting estimated maximum 8-hour concentrations are indicated in Table 4. The estimated maximum 8-hour carbon monoxide concentration for 1989 was 1.0 mg/m^3 at the intersection of Kamehameha Highway and Heeia Kea Boat Harbor Access Road during the weekend. Either with or without the project, the predicted maximum value for the year 1993 was 0.8 mg/m^3 and would occur during the weekend near the same location as the 1989 value. In the 1993 with project case, concentrations would increase somewhat in the vicinity of the new intersections compared to the without project scenario. All predicted 8-hour maximum carbon monoxide concentrations are within both the state and the national AAQS.

The results of this study reflect several assumptions that must be made concerning traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a steady wind of 1 meter per second from any direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and it may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

6.0 SUMMARY OF IMPACTS AND MITIGATIVE CONSIDERATIONS

6.1 Impacts Summary

The major short-term air quality impact of the project will be project construction and the potential emission of significant

quantities of fugitive dust. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, but control measures will reduce this substantially. During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers traveling to and from the project.

The primary potential long-term air pollution impact from the project will arise from carbon monoxide emissions from the increased motor vehicle traffic associated with the project. Based on mathematical modeling of the emissions from and of the movement of present vehicular traffic and combining this with atmospheric dispersion calculations, it is estimated that current carbon monoxide concentrations in the vicinity of the project are well within both state and national 1-hour and 8-hour standards. Traffic projections show that future traffic levels without the project are expected to remain about the same and that traffic attracted by the project would be relatively minimal. Thus, concentrations predicted by air quality modeling for 1993 either with or without the project are about the same as present levels.

6.2 Mitigative Considerations

Strict compliance with State of Hawaii Air Pollution Control Regulations regarding establishment of a regular dust-watering program and covering of dirt-hauling trucks will be required to effectively mitigate fugitive dust emissions from construction activities. Twice daily watering is estimated to reduce dust emissions by up to 50 percent, although this may be unnecessary in this case since the proposed site has frequent rainfall. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

The long-term projected impacts of carbon monoxide emissions from vehicular traffic associated with the completed development assume that the mitigative measures suggested in the traffic report will be employed to move traffic efficiently through the project area and adjacent locations. This includes right and left turn lanes for traffic entering Kamehameha Highway from the boat harbor, the beach park and the sports complex. (The design and construction of the beach park road, however, will be the responsibility of appropriate governmental agencies.)

REFERENCES

1. U.S. Congress. Clean Air Act Amendments of 1977 (P.L. 95-95), Section 109, National Ambient Air Quality Standards, August 1977.
2. U.S. Environmental Protection Agency. Revisions to National Ambient Air Quality Standards for Particulate Matter, Federal Register, Vol. 52, p. 2463, July 1, 1987.
3. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fourth Edition Including Supplements A and B, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.
4. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.
5. Traffic Report for Malulani Sports Complex, Sam O. Hirota, Inc., October 30, 1989.
6. User's Guide to MOBILE4 (Mobile Source Emission Factor Model), EPA-AA-TEB-89-01, U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Mobile Sources, Emission Control Technology Division, Test and Evaluation Branch, Ann Arbor, Michigan, February 1989.
7. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.
8. Guidelines for Air Quality Maintenance Planning and Analysis: Indirect Sources, Volume 9 Revised, U.S. Environmental Protection Agency, September 1978.

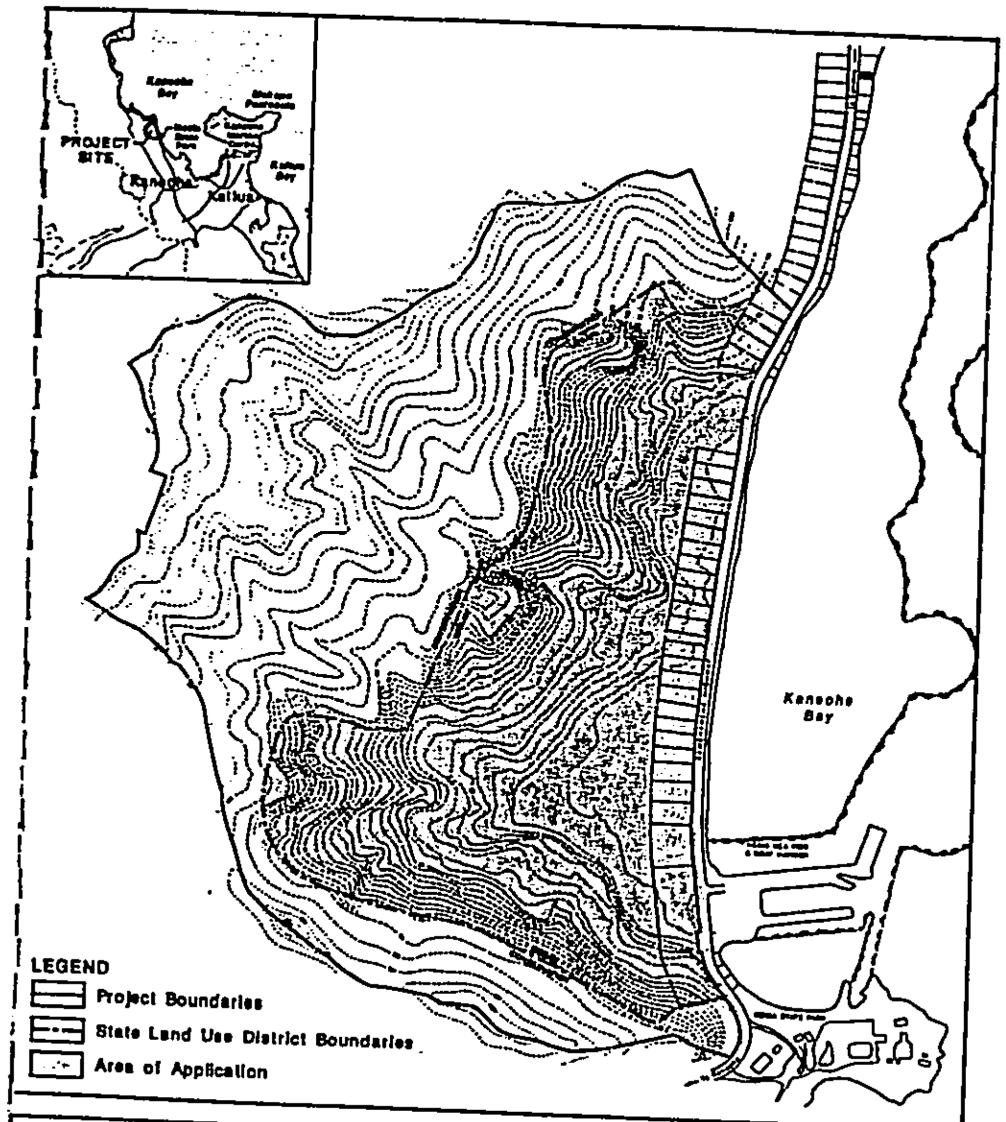


Figure 1
LOCATION MAP

Malulani Sports Complex

NANATOMI HAWAII, INC.
HELBER, HASTERT & KIMURA

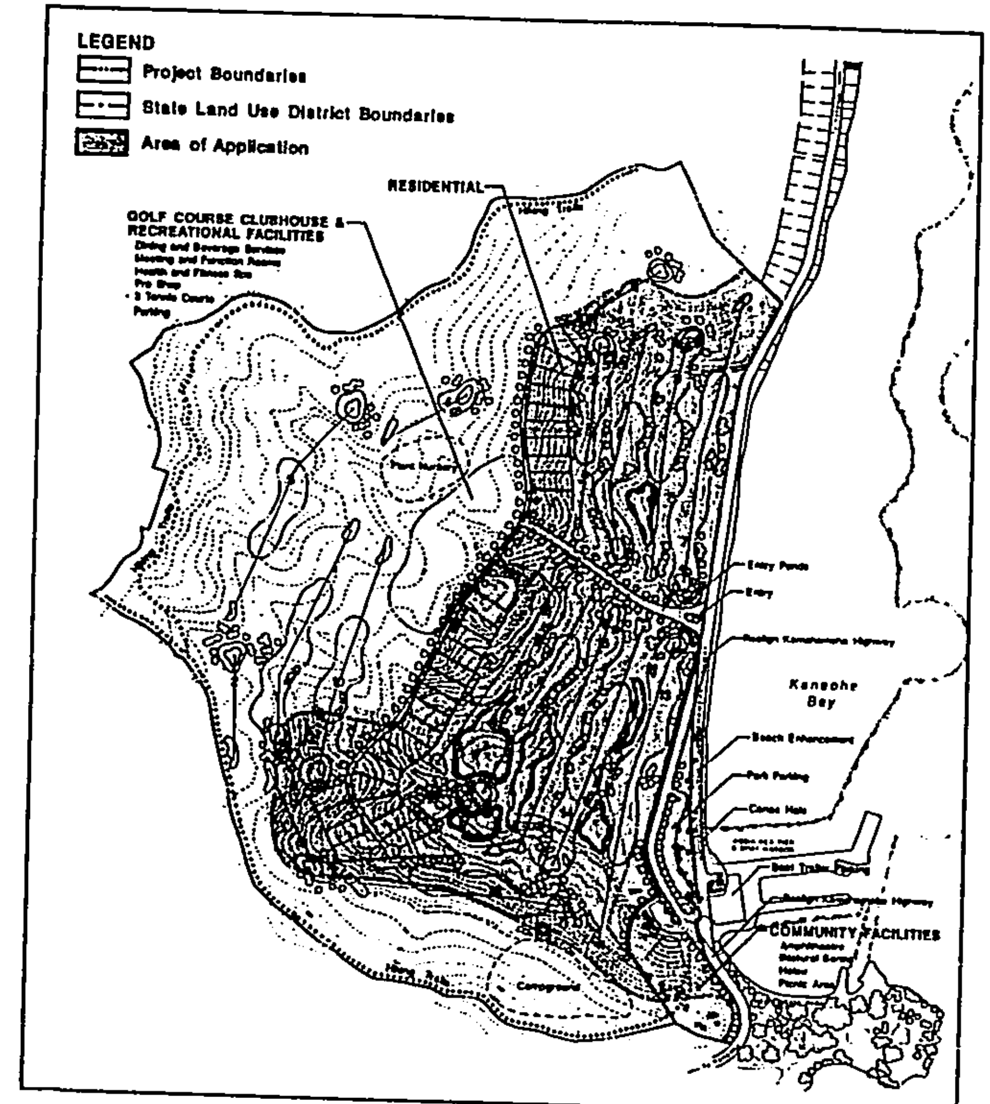


FIGURE 2 CONCEPTUAL PLAN

Malulani Sports Complex

NANATOMI HAWAII, INC.
HELBER, HASTERT & KIMURA

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration: National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter	ug/m^3	Annual	-	-	60[a]
		24 Hours	-	-	150[b]
Particulate Matter[c]	ug/m^3	Annual	50	50	-
		24 Hours	150[b]	150[b]	-
Sulfur Dioxide	ug/m^3	Annual	80	-	80
		24 Hours	365[b]	-	365[b]
		3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide	ug/m^3	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours	10[b]	-	5[b]
		1 Hour	40[b]	-	10[b]
Ozone	ug/m^3	1 Hour	235[b]	235[b]	100[b]
Lead	ug/m^3	Calendar Quarter	1.5	1.5	1.5

[a]Geometric mean

[b]Not to be exceeded more than once per year

[c]Particles less than or equal to 10 microns aerodynamic diameter

Table 2

SUMMARY OF PARTICULATE MATTER MEASUREMENTS AT WAIMANALO MONITORING STATION

Parameter	Year: 1985	1986	1987
No. of 24-Hour Samples	57	59	54
Range of Values (ug/m3)	13-52	10-72	13-45
Arithmetic Average of Values (ug/m3)	26	28	25
No. of Days State AAQS Exceeded	0	0	0

Source: "Hawaii Air Quality Data for the Period of January 1985-Decembe 1987", State of Hawaii, Department of Health

Table 3

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR PROPOSED HALULANI SPORTS COMPLEX PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario 1989/ Present	1993/ Without Project	1993/ With Project
Weekday:			
Kamehameha Highway at Project Access Road	0.5[a]	0.3[a]	0.9
Kamehameha Highway at Beach Park Access Road	0.5[a]	0.3[a]	0.9
Kamehameha Highway at Heeia Kea Boat Harbor Access Road	1.2	0.9	0.9
Weekend:			
Kamehameha Highway at Project Access Road	0.5[a]	0.3[a]	1.0
Kamehameha Highway at Beach Park Access Road	0.5[a]	0.3[a]	1.3
Kamehameha Highway at Heeia Kea Boat Harbor Access Road	1.6	1.3	1.4

Hawaii State AAQS: 10
National AAQS: 40

[a]Assumes through traffic only on Kamehameha Highway. Project access road and beach park access road built only in with project scenario.

Table 4

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR PROPOSED HALULANI SPORTS COMPLEX PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario 1989/ Present	1993/ Without Project	1993/ With Project
Weekday:			
Kamehameha Highway at Project Access Road	0.3[a]	0.2[a]	0.5
Kamehameha Highway at Beach Park Access Road	0.3[a]	0.2[a]	0.5
Kamehameha Highway at Heeia Kea Boat Harbor Access Road	0.7	0.5	0.5
Weekend:			
Kamehameha Highway at Project Access Road	0.3[a]	0.2[a]	0.6
Kamehameha Highway at Beach Park Access Road	0.3[a]	0.2[a]	0.8
Kamehameha Highway at Heeia Kea Boat Harbor Access Road	1.0	0.8	0.8

Hawaii State AAQS: 5
National AAQS: 10

[a]Assumes through traffic only on Kamehameha Highway. Project access road and beach park access road built only in with project scenario.

APPENDIX L

AGRICULTURAL FEASIBILITY STUDY

Frank S. Scott, Jr.

FEASIBILITY AND NEED OF MALULANI PROJECT LANDS FOR AGRICULTURE

Prepared for
Helber, Hastert & Kimura, Planners

By
Frank S. Scott, Jr.
Agricultural Economist

June 1989

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY AND CONCLUSIONS

This report addresses potentials for crop production at Malulani and the probable effect on agriculture if the subject lands are converted to other uses.

Based on SCS soil capability classifications, only 11 acres of the 219-acre project are Class II lands, which are well adapted to cultivated crop production, and 27 acres are Class III (marginal). LSB classifications are somewhat less restrictive and designate 43 acres as Class B (good) and 50 acres as Class C (marginal).

Median irrigation requirements for crops ecologically adaptable to the project area are sustantial because of extremes in annual and seasonal variations in rainfall. Median annual per acre cost of irrigation would amount to $444 for truck crops, $731 for bananas and $1,059 for flowers and foliage. These costs are excessive and would make commercial crop production noncompetitive with lower cost of production areas and probably uneconomic.

The market for products that could be produced on the limited area of good land in the project is not, in itself, a limiting factor, but because of higher costs of production, crops produced on project lands would be at a disadvantage in competing in the marketplace. Centers of crop production for bananas and some of the truck crops considered are shifting to neighbor islands where costs of production are lower.

There is no indicated need of project lands for agricultural production on Oahu. Acreage in cultivated crop production on Oahu declined by 8,000 acres during the past 10 years, from 49,100 acres in 1978 to 41,100 acres in 1987. During the same period, land zoned agricultural by the State Land Use Commission decreased by only 2,828 acres, from 143,903 acres in 1978 to 141,065 acres in 1987. The acreage of LSB A and B lands (SCS I and II lands) outside of urban zoning on Oahu declined from 53,039 acres at the time of LSB classification in 1972 to an estimated 49,121 acres in 1987. This exceeds the 49,100 acres in cultivated crop production in 1987 by 8,021 acres. The acreage of unused A and B lands is greater than this, since an undetermined amount of land in cultivated crop production is classified as C or lower.

Application of appropriate criteria for agricultural feasibility indicates that project lands have limited potentials for agriculture. None of the soil types are rated above SCS IV and LSB C without irrigation. A maximum of only 20 percent of the land area is ecologically well adapted to cultivated crop production and 23 percent is marginal if irrigated based on less restrictive LSB capability classifications. The better lands consist of isolated parcels separated by or contiguous to inferior soil types which adversely affects the potential for economies of scale and would substantially increase costs of production in relation to better land areas. The high cost of irrigation water would render the project at an economic disadvantage for most crops. This, in turn, would affect the ability to compete in the market-place. Better lands and better production conditions can be found elsewhere on Oahu.

The project would provide fairly minor employment opportunities if the 74 acres of LSB good and marginal lands in excess of infrastructures were converted to agricultural crops determined to be most feasible, namely bananas and some truck crops. Total employment for these crops would range from 10.2 man units of field labor and 1.5 units of management personnel for bananas to 25.2 man units of field labor and 2.2 management personnel for intensive crops such as green peppers. Most truck crops would require only minor acreages individually because of market limitations. The most labor intensive enterprise considered is potted flowers and foliage, but minimal production would be expected on the project due to ecological and market limitations. Pineapple and sugarcane are not feasible for the project area because of lack of economies of scale and processing facilities. These crops are also more extensive than fruit and truck crops and labor requirements per acre are minimal.

The study provides no conclusive indication that project lands would be used for commercial crop production if made advailable for that purpose.

Utilization of the project area for a golf course would provide a higher use value than for agriculture and , at the same time, would better control erosion and provide more attractive open space.

FEASIBILITY AND NEED OF MALULANI PROJECT LANDS FOR AGRICULTURE

By

Frank S. Scott, Jr.
Agricultural Economist

INTRODUCTION

This report investigates the feasibility and need for utilizing the 219 acres of land in the Malulani Project for agricutural production. The property, as identified by Tax Map Keys 4-6-16: 32 and 4-6-06: 1, 7, 9, 11, 13, 15, 22-24 and 48-51, is shown in Figure 1.

Determination of agricultural feasibility is based on appropriate criteria as defined below. The need for utilizing project lands for crop production considers the comparative advantage of producing ecologically adaptable crops in the project as compared to alternative production areas and the availability of prime agricultural lands on Oahu relative to potential needs for crop production.

AGRICULTURAL FEASIBILITY CRITERIA

The feasibility of utilizing the land area in the Malulani Project for agriculture in based on the following criteria:

1. Ecological Adaptation
   Ecological criteria consist of soil types and configurations, topography, rainfall and irrigation requirements, temperature, wind, light intensity and environmentally related disease problems.

2. Sales Potentials
   Production trends and the competitive position of the project area in competing for market potentials of crops which are ecologically adaptable.

3. Economic Viability
   Potential profitability and comparative costs of production of adaptable crops in relation to competing areas.

4. Intensity of Production
   Output per acre as an indicator of use value of the land.

CITY AND COUNTY OF HONOLULU ZONING

City and County of Honolulu Zoning classifies approximately 16 acres bordering Kam highway as R-5, 87 acres mauka of the urban area as AG-2 and 116 acres in the steep area mauka of the AG-2 zone as P-1 (Preservation) as shown in Figure 1.

ALISH CLASSIFICATIONS

The Hawaii State Department of Agriculture classifies approximately 48 acres in the central part of the project as Other Important Agricultural Land and about 64 acres bordering Kam Highway as Urban (Figure 2). The remaining 107 acres are designated as Conservation.

LAND CAPABILITY CLASSIFICATIONS

Land capability classifications for agricultural production in this report are based on soil classifications by the USDA Soil conservation Service (20), the University of Hawaii Land Study Bureau (12) and on-site observations. LESA (Land Evaluation and Site Assessment System, 13) is not utilized because it was not finalized and approved by the 1989 Hawaii State Legislature.

SOIL CONSERVATION SERVICE CLASSIFICATIONS (SCS)

SCS soil capability classifications are based on soil profile, topography, water holding capacity, drainage, erosion hazard, pH, workability and depth of root penetration. SCS soil capability classifications range from I to VIII, with I being the best. Class I soils have no more than minimal limitations that restrict crop production. Class II has moderate limitations. Class III is marginal and classes IV to VIII are unsuitable for crop production, with Class VIII having the most severe limitations. SCS capability classifications for each soil type in the project are delineated in Figure 3.

LAND STUDY BUREAU CLASSIFICATIONS (LSB)

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 7 crops, namely, pineapple, vegetables, sugarcane, forage, grazing, orchards and timber. The timber rating is not utilized in this report, since timber is not included in agricultural crop production or grazing.

LSB overall ratings for cultivated crop production and grazing range from A to E, with A being the best. The overall productivity ratings evaluate each land type in its general productive capacity in agricultural use and not for the specific

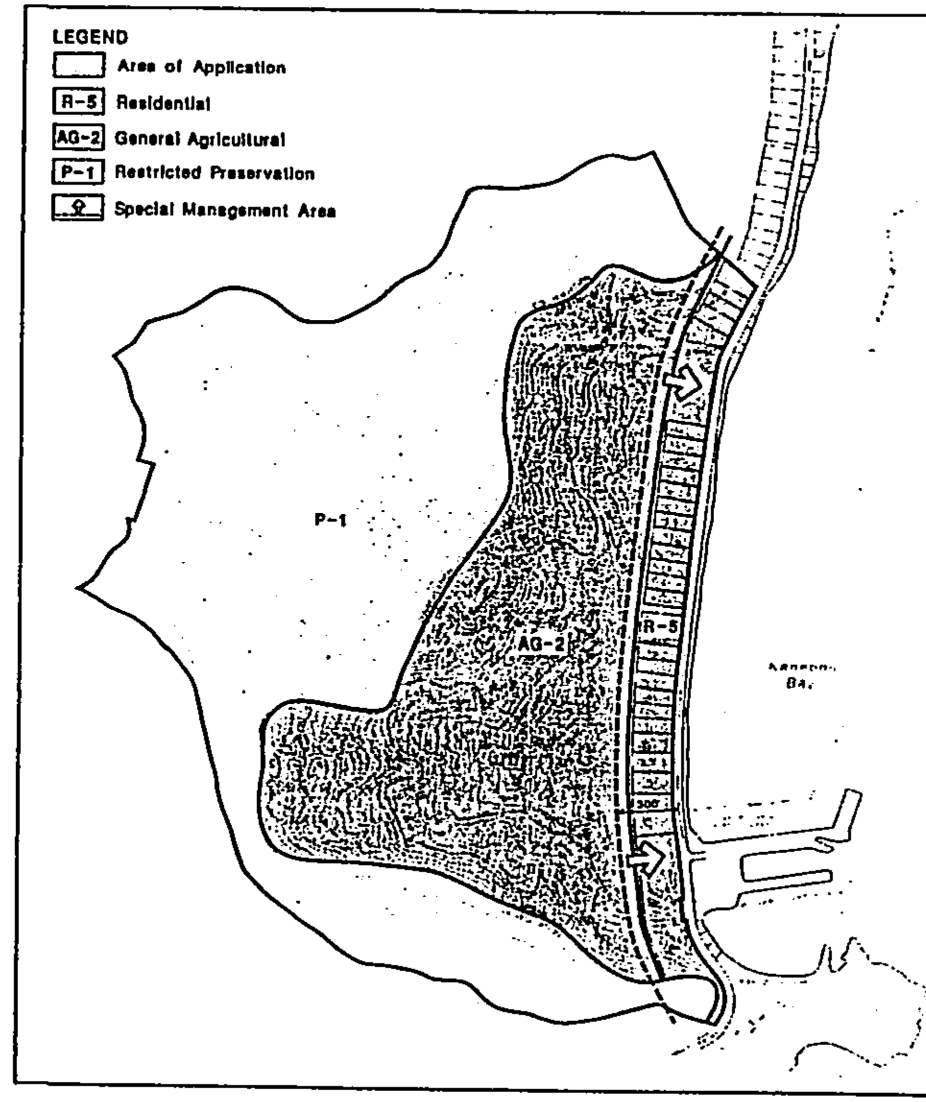


Figure 2. Project Site, Halulani

Halulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

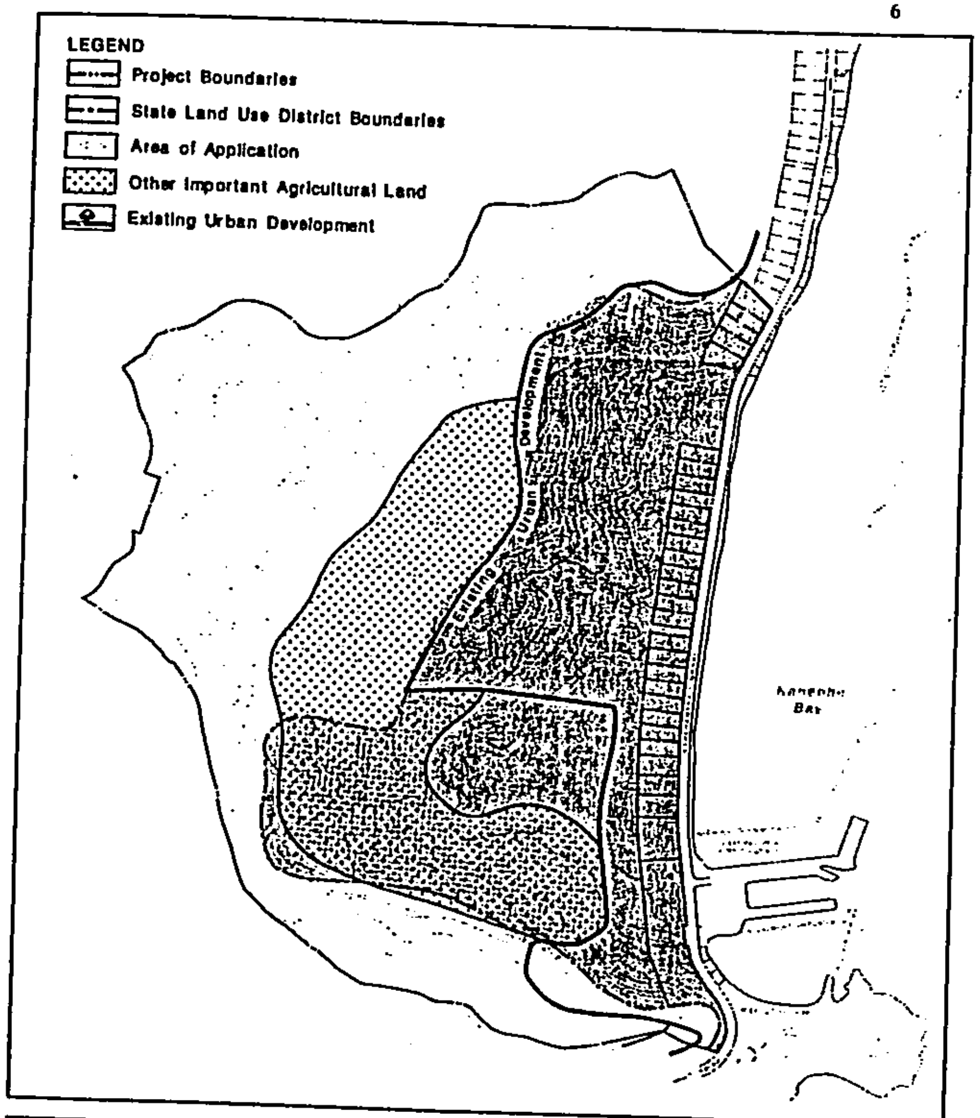


Figure 2. ALISH Classifications, Halulani

0 Feet 600

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

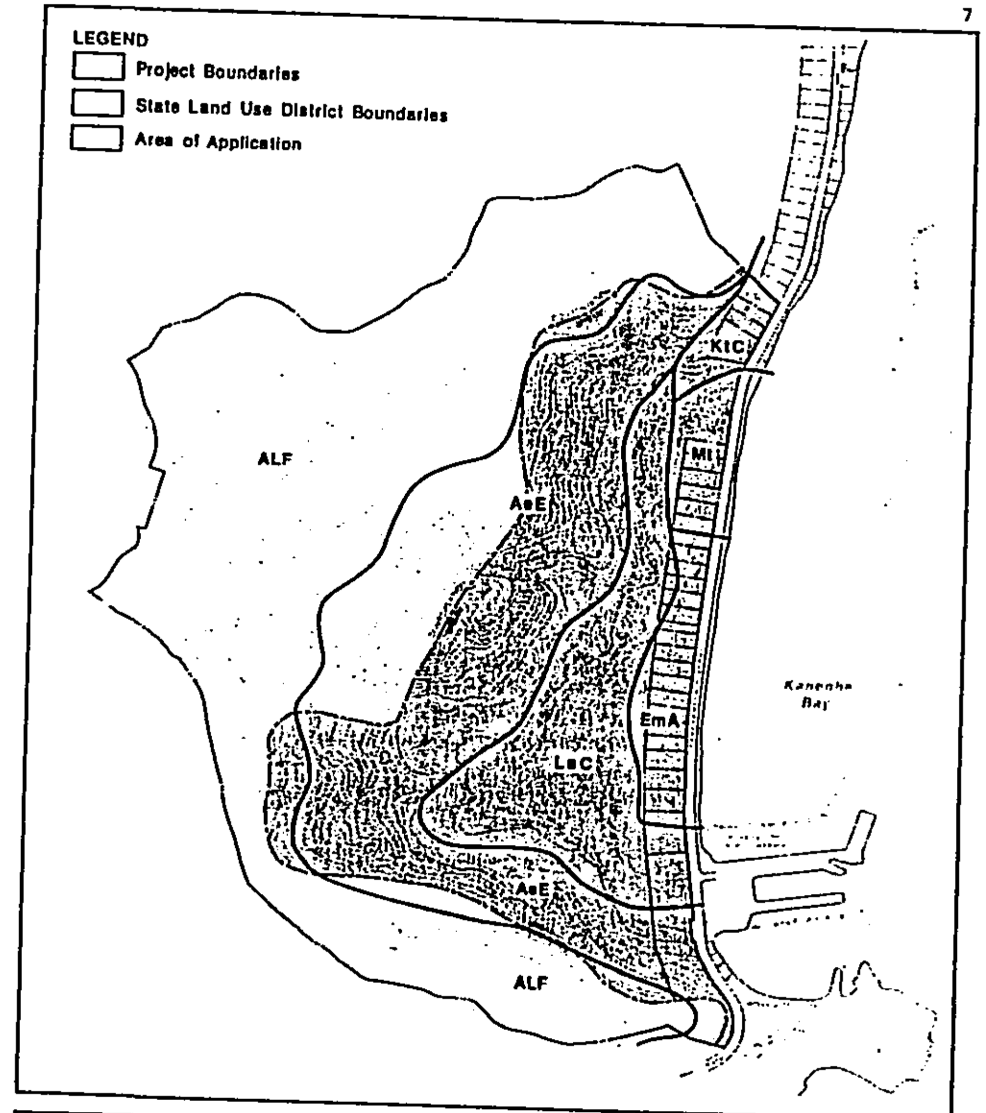


Figure 3. Soil Conservation Service Classifications, Halulani

0 Feet 600

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

crop. The ratings interpret the interacting complex influence of climate, surface relief, drainage, wind velocities and soil characteristics under modal cultural practices. Selected ratings for individual crop categories range from a to e, with a being the best. Ratings are generally comparable to those of SCS, but differ somewhat because of fewer categories (A to E for LSB and I to VIII for SCS) and some differences in evaluating soils in specific areas. Differences also result from somewhat different soil capability criteria. In spite of minor differences, the use of both methods is considered to lead to a more thorough evaluation than can be obtained by the use of one system, alone. LSB land capability classifications are shown in Figure 4.

APPLICATION OF CLASSIFICATIONS

The following analyses identify soils by SCS series and provide classifications by both SCS and LSB land capability criteria.

EWA Series

This series consists of well-drained soils in basins and on alluvial fans. The soils developed in alluvium derived from basic igneous rock.

Ewa Silty Clay Loam, Moderately Shallow, 0 to 2 Percent Slopes (EmA), 7 Acres. This subseries of the Ewa series occupies a narrow strip of land bordering Kam Highway on the Kaneohe side of the property. Existing residential lots encompass most of the area.

The topsoil of this unit consists of dark reddish-brown silty clay about 18 inches in depth. The subsoil is dark reddish- brown and dark-red silty clay loam, with a subangular blocky structure, moderately shallow and varying in depth. The sub-stratum consists of coral limestone at a depth of 20 to 50 inches below the surface. Both the topsoil and the subsoil have a pH of neutral. The available water holding capacity is 1.3 inches per foot in the topsoil and 1.4 inches per foot in the subsoil. Runoff is very slow and erosion hazard is not more than slight. The SCS capability classification is IIs, if irrigated, with the moderate downgrading due to texture and shallowness.

LSB classifies this parcel as D8 (C81, with irrigation). The overall capability rating, if irrigated, is C and selected crop productivity ratings are c for sugarcane, forage, grazing and orchards, d for vegetables and e for pineapple. This land is marginal to submarginal for any type of crop production and appropriately classified as Urban.

Mokuleia Series

This series consists of well-drained soils on coastal planes.

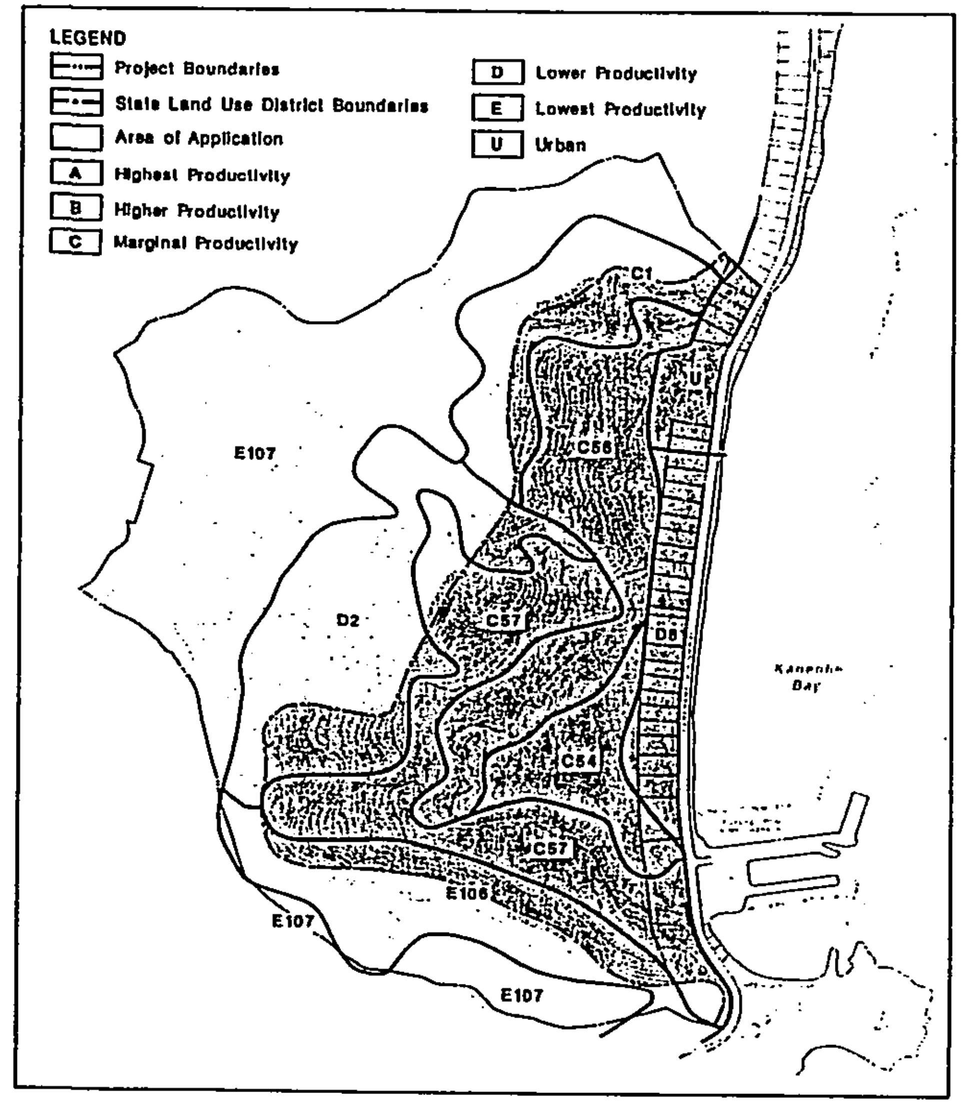


Figure 4. Land Study Bureau Land Capability Classifications, Halulani

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA

These soils formed in recent alluvium deposited over coral sand.

Mokuleia Clay Loam (Mt). 4 Acres. This subseries of the Mokuleia series occupies a narrow strip of land bordering Kam Highway on the Kahuku side of the property. Most of this area is occupied by residential lots and by the Hawaiian Electric Company baseyard. The topsoil consists of a very dark grayish-brown loam about 16 inches in depth. The subsoil is a dark-brown to light-gray single grain or loam sand of 34 to 48 inches in depth. The topsoil is neutral and the subsoil is moderately alkaline. the available water holding capacity is 1.8 inches per foot in the topsoil and a very low 1.0 inch per foot in the subsoil. Permeability is moderate in the topsoil and rapid in the subsoil. Runoff is slow and erosion hazard is not more than slight. Roots may penetrate to a depth of 5 feet or more. The overall SCS capability classification is IIs, if irrigated. This type of soil in appropriate areas has been used for sugarcane, vegetables and pasture. It would not be used for sugarcane in this area because of the very limited land area suitable for crop production.

LSB classifies part of this parcel as D8 and part is unclassified. The overall rating is C, if irrigated, and selected crop productivity ratings are c for sugarcane, forage, grazing and orchards, d for vegetables and e for pineapple. The above information plus on-site observation indicates that this parcel is marginal to submarginal for crop production.

Kokokahi Series

This series consists of moderately well drained soils on talus slopes and alluvial fans. The soils developed in colluvium and alluvium derived from basic igneous rock.

Kokokahi Clay, 6 to 12 Percent Slopes (KtC). 3 Acres. This subseries occupies a small pocket of land bordering Kam Highway in the makai-Kahuku corner of the project. Most of this parcel is located in the existing residential area.

The topsoil of this unit consists of very dark gray and dark gray clay about 14 inches in depth. The subsoil is a dark grayish-brown clay with a subangular blocky structure of about 12 inches in depth. The substratum is a grayish-brown and light brownish-gray clay 14 to 20 inches thick. The topsoil is slightly acid to neutral and the subsoil and substratum are slightly acid to mildly alkaline. The available water holding capacity is about 1.6 inches per foot of soil at all levels. Runoff is medium and the erosion hazard is slight to moderate. Roots may penetrate to a depth of 5 feet or more. The soil has a high shrink-swell potential and workability is difficult because of the sticky, plastic nature of the clay and because of the resulting narrow range of moisture content. SCS gives this soil a very low crop capability classification of VIe, because of the potential for

severe erosion if cultivated and not protected. The soil is marginal for pasture and is not adaptable to cultivated crop production.

LSB provides an unclassified designation for this soil due to its lack of adaptability for agricultural use.

Lahaina Series

This series consists of well drained soils on uplands. The soils developed in material weathered from basic igneous rock.

Lahaina Silty Clay, 7 to 15 Percent Slopes (LaC), 27 Acres. This 27-acre parcel of the Lahaina series is located in the makai-Kaneohe section of the project mauka of the lands zoned Urban. This unit includes a small amount of the urban zoned land.

The topsoil consists of dark reddish-brown silty clay about 15 inches in depth. The subsoil is a dusky-red and dark reddish-brown, subangular blocky silty clay and silty clay loam about 45 inches thick. The substratum is soft, weathered basic igneous rock. The topsoil is medium acid and the subsoil is slightly acid to medium acid. The available water holding capacity is about 1.3 inches per foot in the topsoil and 1.4 inches per foot in the subsoil. Permeability is moderate, runoff is medium and the erosion hazard is moderate. This subseries includes some steep areas and areas with a few stones on the surface. Roots may penetrate to a depth of 5 feet or more. The overall SCS capability classification is IIIe, irrigated or nonirrigated. The downgrading is due to the potential erosion hazard when cultivated and not protected. The severe limitations because of the erosion hazard reduce the choice of plants and require special conservation practices. This type of soil is used for sugarcane, pineapple, truck crops and pasture in appropriate areas. Only truck crops would be applicable to this comparatively small parcel.

The LaC parcel encompsasses primarily LSB soil classes C54 and C56. Very small parcels of D8 and C 57 are also included. The C54 classification, which constitutes about 25 percent of the LaC parcel, is given an overall rating of C, with irrigation, and selected crop productivity ratings of b for sugarcane, vegetables and forage, c for orchards and grazing and e for pineapple. Soil type C56, which constitutes about 30 percent of the LaC parcel, is given an overall crop productivity rating of B, if irrigated, and selected crop productivity ratings of a for forage, grazing and orchards and b for pineapple, vegetables and sugarcane.

Alaeloa Series

This series consists of well-drained soils on uplands. The soils developed in material weathered from basic igneous rock.

<u>Alaeloa Silty Clay, 15 to 35 Percent Slopes (AeE), 75 Acres.</u> This subseries is located mostly in the Conservation zone, mauka of the Lahaina Silty Clay soils. It divides the fairly level lowlands from the steep mauka ridge areas.

The topsoil consists of dark reddish-brown silty clay about 10 inches thick. The subsoil is dark red and red silty clay with a subangular blocky structure about 48 inches thick. The substratum is soft, weathered basic igneous rock. The topsoil is medium acid and the subsoil is strongly acid. The available water holding capacity is about 1.2 inches per foot of topsoil and 1.6 inches per foot of subsoil. Permeability is moderately rapid, runoff is medium and the erosion hazard is moderate. Roots may penetrate to a depth of 5 feet or more in some areas. Workability is difficult because of the slope. SCS gives this unit a very low overall crop capability rating of VIe because of the severe erosion hazard and difficult workability which make it submarginal for crop production. Bananas and truck crops would require terracing and other severe conservation measures, which would likely make the use of the land economically infeasible for these enterprises.

Most of this parcel is classified as either C1 or D2 by LSB. If properly terraced and irrigated, the C1 section of the parcel is given an overall LSB rating of B and selected crop productivity ratings of a for forage and grazing, b for pineapple and orchards and c for vegetables and sugarcane. On-site inspection indicates that the more restrictive SCS crop capability rating of VIe is the most appropriate for this area.

<u>Alaeloa Silty Clay, 40 to 70 Percent Slopes (ALF), 103 Acres.</u> This subseries is located entirely on conservation land on the upper slopes in the mauka section of the project. The soil is the same as AeE of lesser slopes, except that runoff is rapid to very rapid, the erosion hazard is severe and workability is extremely limited. The overall SCS crop capability classification is VIIe and the land is not adaptable to any type of agriculture.

This land is classified as E107 by LSB. The overall crop productivy rating is E and selected crop productivity ratings are d for grazing and e for all other crops.

<u>SUMMARY - SOIL CAPABILITY CLASSIFICATIONS</u>

Crop capability ratings for lands in the project area are summarized for SCS classifications in Table 1 and for LSB classifications in Table 2. Proportions of each soil type for both SCS and LSB are shown in Figure 5.

SCS classifies only 11 acres or 5 percent of the 219 acres in the project area in crop capability classification II, if irrigated, which has only minimal limitations for crop production or gra-

Table 1. Acreage of Each Land Type, Malulani Project, SCS Land Capability Classifications

Soil Type	Acreage	Capability Classification Nonirrigated	Irrigated
EmA	7	IVs	IIs
Mt	4	VIs	IIs
KtC	3	VIe	VIe a/
LaC	27	IIIe	IIIe
AeE	75	VIe	VIe a/
ALF	103	VIIe	VIIe a/
Total	219	219	219
Class II		0	11
Class III		27	27
Class IV to VIII		192	181

a/ Nonirrigated rating used when no rating is given for irrigated.

Table 2. Acreage of Each Land Type, Malulani Project, LSB Land Capability Classifications

Soil Type	Acreage	Capability Classification Nonirrigated	Irrigated
C1	16	C	B
C54	9	C	C
C56	27	C	B
C57	32	C	C
D2	29	D	D
D8	9	D	C
E106	19	E	E a/
E107	73	E	E a/
U	5	U	U
Total	219	219	219
Class B		0	43
Class C		84	50
Class D, E and U		135	126

a/ Nonirrigated rating used when no rating is given for irrigated.

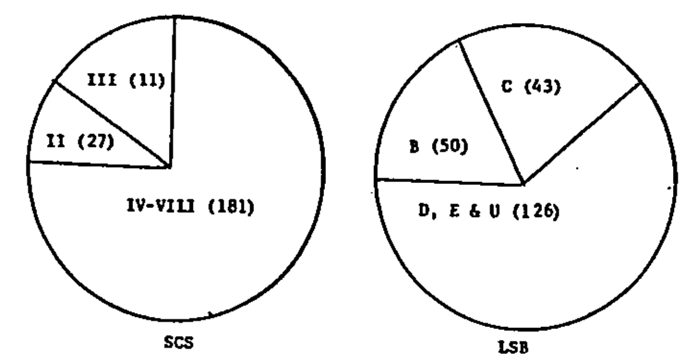


Figure 5. Acreage of Each Land Type, Malulani Project, SCS and LSB Classifications if Irrigated

zing. None of the land area is in class I. Twenty-seven acres are classified in crop capability group III, if irrigated, which is marginal for crop production and the remaining 181 acres are unsuitable for cultivated crop production.

LSB crop capability ratings place 43 acres in the B category as compared with the SCS classification of only 11 acres in Class II. LSB classifies 50 acres in Class C and the remaining 126 acres in classes D, E and U. Even with the less restrictive LSB classifications, only 20 percent of the area consists of good agricultural land with minor limitations for crop production .

The analyses of crop capability classifications based on both SCS and LSB criteria indicate that bananas, truck crops and orchards would be well adapted ecologically to LSB Class B lands and marginally adapted to LSB Class C lands, provided that irrigation water can be made available. Papayas would not be well adapted to these lands because of the limited land area available for replanting to control phytophtera root rot. Prevailing trade winds would also have some adverse effects on papayas.

Both the 43-acre area of Class B land and the 50-acre area of Class C land have the disadvantage of consisting of several isolated, non-contiguous parcels separated by or bordering Class D and E lands. These lands have the further disadvantage of forming a strip of land bordered by inferior soils along the highway and a steep ridge area on the mauka side. This area would not be adaptable to crops requiring large contiguous areas for economies of scale, such as sugarcane, pineapple and feed and forage crops.

Floriculture and nursery crops could be grown on the better soils as stock plants or on the more level areas for shade house production. Some types of flowers and foliage would be adversely affected by prevailing salt laden winds because op proximity to the ocean.

The central part of the project is ecologically adaptable to cattle grazing under stricktly controlled management to prevent erosion. Hog, dairy and poultry enterprises are best adapted to drier, level areas.

In summary, a maximum of 20 percent of the project land area is ecologically well adapted to cultivated crop production, but the area is seriously disadvantaged for commerical agriculture because of the dispersion of good land parcels among areas of inferior soils. Better locations for production of crops ecologically adapted to the project area can be found elsewhere on Oahu.

CLIMATE

Temperature

Temperature recordings for the Kaneohe Mauka Station are used in this anaylysis to approximate temperatures at Heeia. Recordings for a 29-year period are presented in Table 3. The annual mean daily average temperature in Fahrenheit is 74.1 degrees, ranging from 70.9 degrees in February to 77.1 degrees in August. The annual mean daily maximum is 79.9 degrees and the mean daily minimum is 68.2 degrees. The mean daily maximum ranges from 77.3 degrees in March to 82.6 degrees in September and the mean daily minimum ranges from 64.8 degrees in February to 71.5 degrees in August. Extreme recordings during the period consisted of a high of 93.0 degrees and a low of 54.0 degrees.

Temperatures in the project area are near optimal for warm climate truck crops, bananas, papayas and tropical orchard crops.

Light Intensity and Humidity

Light intensity is less than optimal for crops requiring full sunshine, due to frequent heavy cloud cover, particularly during the winter months.

The humidity is sufficiently high to promote fungus diseases of fruits, melons and vegetables.

Wind

Bananas, papayas, tree fruits, truck crops and shadehouse flowers and nursery plants are subject to minor damage from prevailing trade winds, both from the standpoint of velocity and from salt air carried inland from the ocean.

Almost complete devastation of banana and papaya crops can be expected from Kona storms on the average of once in three years. The Kona storms also damage staked vegetables, but have less serious effects on root crops. The Kona storms may also be highly destructive to shadehouses.

Windbreaks are essential for partial protection for all crops and support systems are required for bananas.

Rainfall

Rainfall recordings for the project area area based on historical records of the nearby Heeia station, where rainfall was recorded for a 66-year period (Table 4). The median annual rainfall for this station is 59.1 inches and the mean annual rainfall is 59.8

Table 3. Temperatures Recorded at the Kaneohe Mauka Station by the National Oceanic and Atmospheric Administration for a 29-Year Period

Month	Mean Daily	Mean Daily Maximum	Mean Daily Minimum	Highest	Lowest
		(degrees F)			
Jan	71.1	77.6	65.1	88	57
Feb	70.9	77.5	64.8	90	54
Mar	71.4	77.3	65.1	90	54
Apr	72.5	78.1	66.9	87	56
May	74.2	79.7	68.3	92	56
Jun	75.8	81.5	70.1	89	61
Jul	76.6	82.1	70.9	89	61
Aug	77.1	82.3	71.5	90	63
Sep	76.9	82.6	70.6	92	60
Oct	76.2	81.9	70.3	93	61
Nov	74.1	80.0	68.4	91	59
Dec	72.4	77.9	66.3	90	56
Annual	74.1	79.9	68.2	93	54

Table 4. Rainfall Recorded at SKN 839.20, Heeia, 1906 to 1971

Month	Median	Mean	Maximum	Minimum	75% Max.a/	25% Min.b/
			(inches)			
Jan	4.1	7.3	23.6	0.1	11.3	2.6
Feb	4.0	4.0	8.7	0.1	4.8	2.1
Mar	5.8	7.3	20.5	1.0	9.8	3.3
Apr	4.6	6.7	27.1	0.9	9.8	2.7
May	3.2	4.2	11.3	0.8	5.3	2.0
Jun	1.9	2.4	7.0	0.6	2.8	1.4
Jul	1.7	2.1	4.7	0.5	2.7	1.2
Aug	2.6	2.9	7.6	0.9	3.9	1.7
Sep	2.8	3.4	15.1	1.1	3.7	1.6
Oct	4.0	4.3	8.6	1.2	5.4	2.5
Nov	4.7	5.1	9.6	1.1	6.8	3.0
Dec	6.2	6.8	16.4	1.0	7.6	4.5
Annual	59.1	59.8	94.1	31.1	71.2	45.8

a/ 75% of the recordings did not exceed amounts indicated.

b/ 25% of the recordings were below amounts indicated.

inches. The maximum annual rainfall recorded was 94.1 inches and the minimum was 31.1 inches. Annual recordings did not exceed 71.2 inches 75 percent of the time and were not less than 45.8 inches 25 percent of the time.

Annual rainfall in this area is not meaningfull relative to crop requirements because of extremely uneven seasonal distribution and variation both annually and monthly from year to year.The annual median ranges from 6.2 inches in December to only 1.2 inches in July and is inadequate for truck crop production for all months, except March and October. The extreme minimum by months ranges from 0.1 inches in January and February to 1.2 inches in October.

IRRIGATION REQUIREMENTS

Any month may occasionally depend almost entirely upon irrigation water. Thus, the irrigation system would require delivery adequate for complete dependence on irrigation, although most of the time only supplemental irrigation would be required, depending upon the crop.

Truck crops require a net delivery of 4,073 gallons of water per acre per day (4.5 acre-inches per month) and a gross delivery of approximately 5.0 acre-inches per month. Bananas have a higher requirement of a net delivery of 5,431 gallons of water per acre per day (6.0 acre -inches per month) and a gross delivery of 6.7 acre-inches per month.

Annual supplemental irrigation requirements based on the aggregate of monthly median rainfall would amount to a minimum of 391,000 gallons (14.4 acre-inches) for truck crops and 944,000 gallons (34.8 acre-inches) for bananas. During 25 percent of the time, annual supplemental irrigation requirements would amount to 852,000 gallons (31.4 acre-inches) for truck crops and 1,406,000 gallons (51.8 acre-inches) for bananas.

The only identified source of quality water for crop production in the project is from the Board of Water Supply. The consulting hydrologist has indicated that ground water development does not appear promising. Prior research by the consultant indicates that the development of a system to store seasonal runoff would be too costly for the small acreage adaptable to crop production.

Based on Board of Water Supply Use, the median annual cost for truck crops would be $274 per acre for water (13,000 gallons @ 98 cents/1,000 gallons plus 278,000 gallons @ 69 cents/1,000 gallons) plus an annual amortized cost of $170 per acre for an on-site irrigation system, for a total cost of $444 per acre.

For bananas, the median annual cost would be $574 per acre for water (13,000 gallons @ 98 cents/1,000 gallons plus 813,000 gallons @ 69 cents/1,000 gallons) plus an annual amortized cost of $170 for the on-site irrigation system, for a total cost of $731 per acre.

Floriculture and nursery products would require 3,000 gallons per acre per day throughout the year for a total of 1,095,000 gallons. This would result in an annual water cost of $759 per acre for water (13,000 gallons @ 98 cents/1,000 gallons plus 1,082,000 gallons @ 69 cents/1,000 gallons) plus an estimated annual cost of $300 for an on-site irrigation system, for a total cost of $1,059 per acre.

Based on the assumption that water would be obtained from the Board of Water Supply, as assumed in the foregoing analysis, the cost of irrigation would be excessive and render agriculture in the project non-competitive and probably uneconomic, except possibly for subsistence farming where the primary income comes from outside sources and no charge is made for family labor.

SALES POTENTIALS

Sales potentials in this analysis are estimated only for those crops that are ecologically adaptable to the better soils in the project area and for which land area is sufficient to allow necessary economies of scale. Based on LSB classifications, only 43 acres are well adapted to cultivated crop production and 50 acres are marginally adapted. SCS classifications indicate that only 11 acres are well adapted and 27 acres are marginally adapted. Projections of sales potentials are based on production trends and the indicated ability to compete in the marketplace against output from alternative production areas.

Crops considered best adapted to the project area from a production standpoint are some varieties of vegetables, melons and bananas. Sugarcane and pineapple require large acreages to permit economies of scale and are not feasible for the small, separated parcels that contain the better soils. The area is not considered a good location for livestock production and most livestock enterprises would be incompatible with the existing urban development. Some varieties of flowers and nursery products could be grown in the project area, but these enterprises require limited acreages and are better adapated to other areas on Oahu.

The market potential for Hawaii produced truck crops, bananas and tree fruits is essentially the acreage required to displace imports. Sales potentials of the project area for these crops depend on the ability to compete in the marketplace against imports and against competing producing areas in Hawaii. For flowers and nursery products, the project sales potential depends upon the ability to compete with other growers both for the local market and for exports.

Analyses of sales potentials for appropriate crops for Malulani lands are as follows:

Bananas

Hawaii banana production has made considerable progress toward displacing imports during recent years. Hawaii production increased from 4.8 million pounds representing 38 percent of the market supply of 12.6 million pounds in 1978 to 11.4 million pounds representing 52 percent of the market supply of 22.0 million pounds in 1987. Research indicates that Hawaii has a good chance of further displacing imports through improved cultural and marketing practices, leading to quality control and a more uniform month to month supply. More efficient Hawaii producers are indicated to be able to deliver quality bananas to wholesalers at less than Honolulu prices of imports.

Banana acreage increased during the past 10 years in all counties in the state and total plantings increased from 640 acres in 1978 to 1,110 acres in 1987. Oahu acreage in crop increased from 420 acres in 1978 to 525 acres in 1987. Displacement of the 10.6 million pounds of bananas imported in 1987 would require an additional 303 acres at a net yield under good management of 35,000 pounds per acre. Oahu is the primary producer of Brazilian bananas. The data indicate that some expansion in banana production can be expected on Oahu, but not necessarily in the project area in the event that area were converted to crop production.

Papayas

Although papayas, as indicated previously, would be subject to environmental problems if produced in the project area, there is sufficient potential to warrant a market analysis.

Growth in U.S. mainland and export markets for Hawaii papayas appeared promising until 1985, at which time marketings levelled off because of serious problems facing the industry. No fully satisfactory treatment has been found as a substitute for EDB for disinfesting outshipments of fruit fly eggs. Various hot water and vapor treatments currently being used are less than satisfactory. Irradiation, which has been found effective against fruit flies and extends shelf life of the product may eventually offer the best treatment, but it is costly and has not yet been accepted by consumers in spite of approval by the FDA.

Hawaii papaya marketings increased only minimally during the past 10 years, from 64 million pounds from 2,190 acres in 1978 to 67 million pounds from 2,350 acres in 1987. Most of the production is in Hawaii county, where producers depend primarily on rainfall rather than irrigation and land is available for replanting to

control root rot. Although some expansion is indicated for the state, this does not likely include Oahu, where 1987 utilized production of 1.7 million pounds was the same as in 1978.

Truck Crops

Vegetables and melons in Hawaii are produced almost entirely for the Hawaii market. Thus the required acreage for these enterprises is extremely limited. This small acreage has, however increased from 4,000 acres in 1978 to 5,600 acres in 1987. But Oahu plantings of 1,400 acres in 1987 showed no increase over 1978.

Potentials for displacement of imports for crops relevant to the project area are shown in Table 5 and presented in the following analyses.

Snap Bean production in the state declined from 1.3 million pounds from 200 acres in 1978 to 890,000 pounds from 150 acres in 1987. During the same period, imports increased from 275,000 pounds in 1978 to 416,000 pounds in 1987. At a yield of 12,000 pounds per acre, only 35 acres would be required to displace 1987 imports. Oahu acreage decreased more sharply than state acreage, from 75 acres in 1978 to 40 acres in 1987. Thus, even if the state should become more competitive, it is not likely that there would be a significant production increase on Oahu.

Sweet Corn production in Hawaii decreased from 1.6 million pounds from 400 acres in 1978 to 1.5 million pounds from 345 acres in 1987. From self sufficiency in 1978, Hawaii imported 865,000 pounds of sweet corn in 1987. In the unlikely event that Hawaii would again become self sufficient, 108 additional acres would be required to displace imports at an estimated yield of 8,000 pounds per acre. Oahu is the leading producer of sweet corn in the state, but acreage declined from 355 acres in 1978 to 275 acres in 1987. It is difficult to predict the market for fresh sweet corn because of competition from high quality and more convenient frozen sweet corn and canned corn.

Cucumber production in Hawaii has shown a slight decline during the past 10 years, from 4.3 million pounds from 260 acres in 1978 to 4.0 million pounds from 200 acres in 1987. During the same period, inshipments increased from 1.2 million pounds to 1.7 million pounds. Displacement of 1987 imports at a yield of 20,000 pounds per acre would require an additional 87 acres, but the 10-year trend indicates an inability to displace imports under existing technology. Oahu plantings decreased from 100 acres in 1978 to 55 acres in 1987, which was more rapid than for the state total, which indicates little possibility of revival.

Hawaii production of eggplant increased from 1.1 million pounds

Table 5. Hawaii Market Supply and Acreage Required to Displace Imports, Selected Fruits and Vegetables, 1987

Crop	Market Supply Hawaii	Market Supply Imports	Yield per Acre	Acreage Required to Displace Imports
	(1,000 pounds)		(pounds)	(acres)
Beans, snap	890	416	12,000	35
Corn, sweet	1,480	865	8,000	108
Cucumbers	3,960	1,732	20,000	87
Eggplant	1,290	308	30,000	10
Peppers, green	2,300	1,595	20,000	80
Sweet potatoes	1,600	799	20,000	40
Tomatoes	7,700	11,378	35,000	325
Watermelon	13,800	1,104	20,000	55
Bananas	11,400	10,607	30,000	354
Total				1,094

from 65 acres in 1978 to 1.3 million pounds from a smaller area of 55 acres in 1987. Inshipments are comparatively small, but increased from 126,000 pounds in 1978 to 308,000 pounds in 1987. Only 10 acres would be required to replace inshipments. Any increase might likely take place on Oahu, where plantings increased from 35 acres in 1978 to 38 acres in 1987.

Green Pepper production in Hawaii expanded appreciably during the past 10 years from 820,000 pounds from 60 acres in 1978 to 2.3 million pounds from 200 acres in 1987. Imports of 1.6 million pounds in 1987 showed no change from 1978. Although trends indicate little opportunity for displacement of imports, the increase in local production is encouraging and some displacement may take place. This would require 80 acres at a yield of 20,000 pounds per acre. Oahu is a minor producer of green peppers and acreage declined during the 10-year period from 19 acres to 15 acres, while state production was increasing. Thus Oahu production does not appear to be a candidate for expansion.

Hawaii sweet potato production increased minimally from 1.5 million pounds from 130 acres in 1978 to 1.6 million pounds from 180 acres in 1987. Imports increased from 533,000 pounds in 1978 to 799,000 pounds in 1987. The trends indicate that the opportunity for displacement is not promising. Imports are generally of a different variety than local production and are of better quality. If displacement were to take place, only 40 additional acres would be required. Any increase would not likely take place on Oahu, where plantings declined from 60 acres in 1978 to only 10 acres in 1987.

Tomatoes, although only marginally adaptable to the project area, offer the best opportunity for displacement of imports by Hawaii producers. Marketings of Hawaii produced tomatoes of 7.0 million pounds in 1987 showed no change from 1978, but inshipments increased from 7.9 million pounds in 1978 to 11.4 million pounds in 1987. At a field production yield of 35,000 pounds per acre under good management, 325 acres would be required to displace 1987 imports. Less than half of this acreage would be required under greenhouse production. Oahu is a very minor and declining producer of tomatoes, from 60 acres in 1978 to 17 acres in 1987 and, based on historical trends, does not appear to be a likely candidate for displacement of imports.

Watermelon production in Hawaii has made a significant breakthrough during recent years and production increased from 1.9 million pounds from 190 acres in 1978 to 13.8 million pounds from 740 acres in 1987. During the same period, inshipments decreased from 3.7 million pounds in 1978 to 1.1 million pounds in 1987. Most watermelon production is on Molokai, with the reported combined Maui/Molokai production increasing from 875,000 pounds from 53 acres in 1978 to 11.5 million pounds from 575 acres in

1987.

Floriculture and Nursery Products

The Hawaii floriculture and nursery products industry has undergone major expansion in recent years, from a gross value of sales of $17.5 million in 1978 to $55.8 million in 1987. Oahu is a major producer of these products and expansion has been more rapid than for the state as whole, increasing from $6.1 million in 1978 to $23.0 million in 1987. But in spite of encouraging historical trends, competition both from the outer islands and from producing areas outside of Hawaii is a continuing threat because of lower labor costs and caution is advised in projecting sales potentials for Oahu. Whereas the market appears to justify expansion of floriculture and nursery production on Oahu, this does apply to the project area, which is indicated to have a comparative disadvantage in relation to other areas of Oahu. Of particular concern are the effects of salt air and the projected high cost of irrigation water from the municipal system.

Beef Cattle and Grazing

Hawaii produced marketings of beef and veal increased from 62.3 million pounds in 1978 to 62.9 million pounds in 1987. During the same period, however, Oahu marketings decreased from 3.2 million pounds in 1978 to 2.9 million pounds in 1987. Most of the Oahu decrease was in marketings of feedlot cattle, which decreased from 853,000 in 1978 to 384,000 in 1984. The data indicate that Oahu has lost its former advantage in feedlot operations and beef cattle grazing is uneconomic on higher value lands. such as in the project area. Gross returns from beef production on grazing land are estimated at only $26 per acre for 1987.

Summary and Conclusions

The foregoing analysis indicates that although there is a possibity of expanding state production of several agricultural products, the project area is at a disadvantage in competing in the marketplace for most of the products considered. Thus, although the market is not an absolute limiting factor to agricultural development in the project area, it is a major deterrent.

POTENTIAL FOR AGRICULTURAL EMPLOYMENT

Potential agricultural employment in the project area is comparatively small, even if lands classified as B and C by the Land Study Bureau were not limited for crop production by other factors. LSB classifies 43 acres as B, which has only minor limitations for crop production, if irrigated, and 50 acres as C, which is marginal, but could be utilized for crop production. An

estimated 74 acres of the 93 acres of good and marginal lands could be made available for crop production after allowing for infrastructures. SCS classifications are more restrictive, with only 11 acres classified as II and 27 acres classified as III.

Manpower requirements for selected crops that are ecologically adaptable to production in the project, subject to varying limitations, are presented in Table 6. Data for these computations were derived from various primary studies. An attempt was made to obtain modal labor requirements from the subject data, considering substantial variations from farm to farm due to technological and management differences and other factors. Data were derived on a per acre basis and applied to the 74 acres which were determined to be usablee for cultivated crop production. To provide uniformity in the analysis, limitations to acreage requirements based on sales potentials were not considered.

Employment opportunities are far higher on a per acre basis for potted flowers and foliage than for any other crop considered. Approximately 100 man units of labor plus 10 management and supervisory personnel per year would be required for 74 acres of potted flowers and foliage. At an estimated usable area of 28,000 square feet per acre, the total area in production would amount to approximately 1.6 million square feet, which is equivalent to 23 percent of the existing 7.1 million square feet of shade house structures on Oahu. Such a development, as indicated in other setions of the report, would not be feasible because of ecology, market limitations and comparative costs of production in relation to competing areas. Only a limited development of probably not more than 10 acres of this intensive enterprise can be realistically projected. This size of unit would require 13.5 man units of labor and 1.4 management personnel.

Banana production, which is one of the more feasible enterprises considered for the project, would provide employment for 10.4 laborers and 1.5 management personnel if the entire 74 acres were converted to this crop. Papaya production, which is possible but less feasible, would provide about the same employment as bananas.

Truck crops, which are relatively labor intensive, would provide employment ranging from 12.6 man units of labor and 2.2 management personnel for snap beans to 27.4 laborers and 3.7 management personnel per crop per year for staked tomatoes.

Pineapple production, based on budget analyses of medium sized farms would provide limited employment of 7.4 field workers and 0.7 management personnel if the entire 74 acres were planted in this crop.

Table 6. Labor and Management Requirements for Crop Production, Malulani Project

Crop	Man Units/Acre/Year				Man Units/74 Acres/Year			
	mgt	skil. labor	other labor	total labor	mgt	skil. labor	other labor	total labor
Bananas	.02	.06	.08	.14	1.5	4.4	5.9	10.3
Papayas	.02	.04	.11	.15	1.5	3.0	8.1	11.1
Pineapple	.01	.03	.07	.10	0.7	2.2	5.2	7.4
Sugarcane	.01	.02	-	.02	0.7	1.5	-	1.5
Beans, snap	.03	.04	.13	.17	2.2	3.0	9.6	12.6
Cucumbers	.04	.04	.22	.26	3.0	3.0	16.3	19.3
Egg plant	.03	.04	.30	.34	2.2	3.0	22.2	25.2
Peppers, gr	.03	.04	.30	.34	2.2	3.0	22.2	25.2
Swt potato	.03	.05	.15	.20	2.2	3.7	11.1	14.8
Tomatoes	.05	.05	.32	.37	3.7	3.7	23.7	27.4
Potted flowers & foliage	.14	-	1.35	1.35	10.4	-	99.9	99.9

Sugarcane production, based on economic viability studies of small sugarcane farms on the Hilo coast, would require only 1.5 field workers and 0.7 management and supervisory personnel annually for the 58 acres.

Summary and Conclusions

Labor requirements for agricultural procuction in this analysis are presented under the assumption that the entire 74 acres of land considered available for agriculture could be utilized by any of the selected crops which are ecologically adaptable in varying degrees. The analysis indicates that full development of the 74 acres would provide only limited employment opportunities. It is important to place the analysis in proper perspective with respect to determinations of agricultural feasibility elsewhere in the report, which indicate that it is very unlikely that the entire 74 acres would be utilized for agriculture and potential employment opportunities would be less than indicated by an undetermined amount.

Utilization of the land for a golf course, which might be considered an alternative form of agricultural crop production, would provide substantially more employment than conventional crop production in the agricultural sense. Based on other golf course feasibility studies, an 18 hole golf course as proposed for the project might be expected to provide as many as 80 jobs in golf course maintenance and club house servicing combined.

LAND REQUIREMENTS IN RELATION TO AVAILABILITY OF AGRICULTURAL LAND ON OAHU

The land area in cultivated crop production on Oahu has steadily decreased during the past ten years from 49,100 acres in 1978 to 41,100 acres in 1987. The very marked decline of 8,000 acres in crop production during the 10-year period substantially exceeded that which was converted to uses other than agriculture, resulting in a stockpile of unused land of good quality.

Land zoned agricultural by the State Land Use Commission decreased by only 2,828 acres during the same period, from 143,903 acres in 1978 to 141,065 acres in 1987. Land zoned urban increased by only 3,831 acres, from 86,489 acres in 1978 to 90,320 acres in 1987, resulting in a substantial net increase in the stockpile of unused land of good quality. Most of the decline in land area in crop production has been in sugarcane and pineapple acreages. Some of this land offers a potential for expanded crop production with respect to ecology, but high land prices, market limitations, infeasibility of leasing the land in small parcels and difficulty in obtaining agricultural subdivision permits from the City and County of Honolulu have prevented its use for agriculture.

The LSB classified 53,039 acres of land outside of urban areas on Oahu as good agricultural land in 1972, of which 20,583 acres were given crop productivity ratings of A and 32,456 acres were rated as B. With the addition of 17,837 acres classified as C, which is marginal for crop production, a total of 70,876 acres was available for crop production. The 1972 total of A and B lands exceeded the 1987 acreage in crop production by 11,939 acres. With the inclusion of Class C lands, the total land area adaptable to crop production exceeds the 1987 acreage in crop production by 29,776 acres. However, an undetermined amount of land adaptable to crop production has been converted to other uses and is no longer available for agriculture.

It is reasonable to assume that most of the 70,786 acres of land given LSB crop capability ratings of A, B and C in 1972 were included in the 148,900 acres zoned agricultural by the State Land Use Commission. In addition, 74,257 acres of land with ratings lower than C would have been included in the land zoned agricultural. Acreage zoned agricultural decreased by 7,835 acres, from 148,900 acres at the time of LSB classifications in 1972 to 141,065 acres in 1987. An undetermined amount of the 7,835 acres would have been A and B lands. Under the reasonable assumption that a maximum of 50 percent or 3,918 acres of the 7,835 acres zoned out of the agricultural classification were A and B lands, the total acreage of A and B lands available for crop production would have declined from 53,039 acres in 1972 to 49,121 acres in 1987. The 1987 acreage of A and B lands would then have exceeded the 1987 acreage in cultivated crop production by 8,021 acres (49,121 minus 41,100). Assuming that all 7,835 acres zoned out of agricultural from 1972 to 1987 consisted of A, B and C lands, the land area available for agriculture in these classes exceeds the 1987 land area in crop production by 29,776 acres (70,876 minus 41,100).

Another important consideration with respect to land requirements for crop production on Oahu is that agricultural land is available at lower cost on the outside Islands. Because of lower land cost and lower or no irrigation water cost, production centers for crops such as bananas, guava and truck crops are moving to the outside islands. Substantial areas of former sugarcane and pineapple fields on Oahu are fallow. Only part of these lands will be diverted to other uses, such as housing.

NEED OF LANDS FOR AGRICULTURAL PRODUCTION IN THE PROJECT AREA

The foregoing section of the report indicates a substantial ex-

cess of prime agricultural land over what is required for agricultural production on Oahu. The surplus continues to increase as crop production declines.

The project area contains no SCS Class I soils and, if irrigated, only 11 acres of Class II Soils and 27 acres of Class III soils out of a total of 219 acres. Most of the land area consists of soils with crop capability classifications of IV to VIII, which are infeasibile for cultivated crop production or grazing. LSB indicated slightly higher soil capability classifications in the project, but with only 43 acres of Class B and 50 acres of Class C.

The limited acreages of better lands have the further disadvantage of consisting of isolated parcels, separated by or contiguous to lands less adaptable or non-adaptable to cultivated crop production.

According to Dennis M. Devaney, et. al. (Kaneohe - A History of Change), there was a small sugar mill at Heeia Kea in the 19th cnetury which milled sugarcane in areas nearby the project and possibly in the project area . This operation closed in 1902 and there is no history of commercial crop production in the project area since then, although the lands have been used for subsistence grazing. There is no indication that the lands would be used for crop production if made available for that purpose.

The project is unsuitable for commercial agricultural production as one unit because of the limited acreage of arable land and the poor configuration of the parcels that are adaptable to crop production. It is adaptable to a limited amount of small scale subsistence farming in conjunction with homesites.

The need for erosion control is crucial, not only for maintaining the soils, but for preservation of watersheds and for flood control. Conversion to golf course use would both stabilize the erosion problem and provide improved open space.

SELECTED REFERENCES

1. Camp, S. G. II and Perry F. Philipp, The Economics of Growing Dendrobium on Oahu for Mainland Export, DP 37, Agricultural Experiment Station, University of Hawaii, March, 1986, 12 pp.

2. Department of Agriculture, State of Hawaii, State Agriculture Plan, October, 1982, 31 pp.

3. Department of Planning and Economic Development, State of Hawaii, The Hawaii State Plan - The Economy, 1977, pp. 6-1 to 10-13.

4. Department of Business and Economic Development, The State of Hawaii Data Book - A Statistical Abstract, Various Issues Through 1987.

5. Devaney, Dennis M., Marion Kelly, Polly Jae Lee and Lee S. Mottler, Kaneohe - A History of Change, U.S. Army Corps of Engineers (Fisher Printing), September, 1976, 271 pp.

6. Division of Land and Water Development, Median Rainfall - State of Hawaii, Circular C88, Department of land and Natural Resources, State of Hawaii, June, 1982.

7. Hawaii Agricultural Reporting Service, Statistics of Hawaiian Agriculture, Hawaii State Department of Agriculture in Cooperation with USDA, Various Issues Through 1987.

8. Hawaiian Sugar Planters Association, Hawaiian Sugar Manual 1988, 1989, 27 pp.

9. Holderness, James F., Gary R. Vieth and Frank S. Scott, Jr., Economic Viability of Independent Sugarcane Farms on the Hilo Coast, HITAHR, University of Hawaii, in Cooperation with Hawaii State Department of Agriculture, December, 1979, 63 pp.

10. Huang, Wen-Yuan ahd Herbert K. Marutani, Costs and Returns of Producing Sweet Potatoes in Hawaii, DP 24, Agricultural Experiment Station, University of Hawaii, December, 1979, 14 pp.

11. Keeler, Joseph K., Cost of Production of Hawaii Crops, Agricultural Experiment Station, University of Hawaii, Unpubished Computer Printouts, 1977.

12. Land Study Bureau, Detailed Land Classification - Island of Oahu, Land Study Bureau, University of Hawaii, LSB Bulletin No. 11.

13. Legislative Reference Bureau, A Report of the State of Hawaii Land Evaluation and Site Assessment System, State of Hawaii Land Evaluation and Site Assessment Commission, Honolulu, Hawaii, February, 1986.

14. Marutani, Herbert K., Cost of Eggplant Production on Kauai: 1979, Farm Management Report No. 9, Cooperative Extension, CTAHR, University of Hawaii, October, 1980, 7 pp.

15. Marutani, Herbert K., Cost of Bell Pepper Production on Kauai, Farm Management Report No. 8, Cooperative Extension, CTAHR, University of Hawaii, October, 1980, 7 pp.

16. Marutani, Herbert K., Cost of Cucumber Production in the Hamakua Area, Farm Management Report No. 5, Cooperative Extension, HITAHR, University of Hawaii, July, 1979, 6 pp.

17. Mogi, H. Planning and Research, Inc., Statewide Agricultural Park Action Plan - Phase II - Implementation Program, Hawaii State Department of Agriculture, February, 1984, 249 pp.

18. Muench, M. N., R. K. Roberts and F. S. Scott, Jr., The Economic Viability of Papaya Farms in the Puna District, Research Series 027, HITAHR, University of Hawaii, February, 1984, 58 pp.

19. Philipp, Perry F. and Harold L. Baker, Cost of Production of Fresh Pineapple on Molokai, Research Report 231, Hawaii Agricultural Experiment Station, Un iversity of Hawaii, August, 1975, 39 pp.

20. Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai - State of Hawaii, SCS, USDA, in Cooperation with the University of Hawaii Agricultural Experiment Station, August, 1972, 232 pp.

21. Taylor, Timothy G. and Scott A. Smith, Production Costs for Selected Florida Vegetables 1988-89, Economic Information Report 257, Institute of Food and Agricultural Sciences, University of Florida, June, 1989, 60 pp.

APPENDIX M

ANALYSIS OF ECONOMIC AND
FISCAL IMPACTS
Nateleson Levander Whitney Inc.

ANALYSIS OF ECONOMIC AND FISCAL IMPACTS

MALULANI DEVELOPMENT PROGRAM

November 1989

Prepared for:

Nanatomi Hawaii, Inc.

Prepared by:

Natelson-Levander-Whitney, Inc.
10960 Wilshire Boulevard, Suite 222
Los Angeles, California 90024
(213) 478-5016

TABLE OF CONTENTS

I. INTRODUCTION

A. OVERVIEW

The following report provides an economic evaluation of the Malulani development program, a proposed residential community featuring a championship golf course and other recreational activities at a 220-acre site located on the oceanfront in the Windward Oahu community of Kaneohe. The developer for Malulani is Nanatomi Hawaii, Inc., a company with extensive experience in the development and operation of recreational activities.

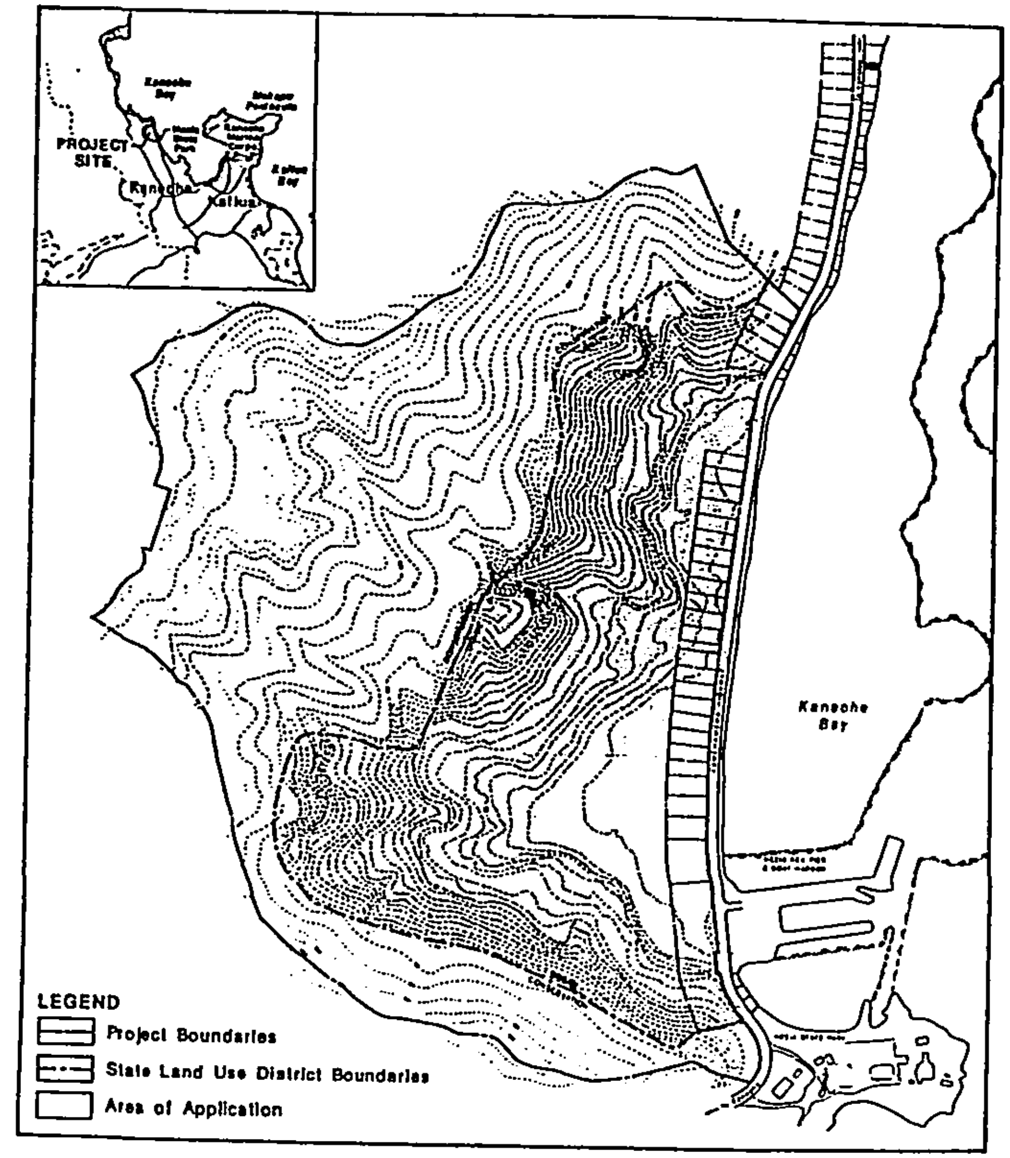
The following analysis is presented in three major sections. The first section reviews the market potentials for development of residential, golf facilities and other recreational uses on the site. The second section reviews the development program with respect to its probable economic impacts, which are defined in this report as effects on the private sector economy. The third section analyzes the development program with respect to its probable fiscal impacts, which are defined as the effects on the public sector economy as embodied in the governments of the City and County of Honolulu and State of Hawaii.

B. PROJECT DESCRIPTION

The proposed development program consists of 30 to 35 residential units oriented around an 18-hole golf course with ocean views. The residential units will be situated on 10,000 to 20,000 square foot lots and will provide from 3,000 to 5,000 square feet of living space per unit. The golf course is planned as a par 70, 18-hole championship course covering 150 acres. The course will be a privately-owned facility which is open for public play on a daily fee basis. In addition, there will be a clubhouse facility with a restaurant, an aerobics facility, a health spa and a tennis facility. The site location is identified in Figure 1.

FIGURE I

SITE LOCATION



II. SUMMARY OF FINDINGS

Project Description

Nanatomi Hawaii, Inc. owns approximately 220 acres of land in Heeia Kea Valley, Kaneohe, Oahu. The subject property is mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor. The proposed development program consists of 30 to 35 residential units oriented around an 18-hole championship golf course.

Market Potential for Residential Development

The demand for higher-value single family housing on the Island of Oahu has increased substantially over the past several years. The demand for this type of housing, particularly housing that offers ocean frontage and/or ocean views, can be seen in the increase in the prices of homes located in the Hawaii Kai and Kahala neighborhoods.

The subject property is located in the Koolaupoko District, an area which has historically been characterized as a moderate income residential environment. However, during the past several years the area has seen significant changes in the character of its housing market, particularly in the growth of a market for homes priced in excess of $300,000. There is currently a strong demand for oceanfront and oceanview homes, as the availability of these sites is shrinking with the urbanization of greater Honolulu. The strength of this demand can be seen in such neighborhoods as Lanikai and Kailua Beach in Kailua and Haiku Plantation and Alii Landing in Kaneohe, where prices for oceanview units currently range from $500,000 to $750,000 and oceanfront lots can exceed $1 million in price.

The major advantages of the property as a better-quality residential environment are as follows:

- The site can be effectively designed as an exclusive community around an 18-hole championship golf course;
- The 30 to 35 units proposed for the site can be designed to offer golf course frontage locations with unobstructed ocean views;
- The site is in a location which should witness significant appreciation in the future following the completion of the H-3 connector to downtown Honolulu; and
- In addition to the golf course the site would allow development of a recreation complex, centered around the golf clubhouse, and featuring a pro shop, health spa/aerobics center and restaurant.

Given these considerations, the Malulani property should be able to market 30 to 35 better quality units offering ocean views and golf course frontage locations over a two-year development period. The development should provide units offering from 3,000 to 5,000 square feet of living space on lots ranging from 10,000 to 20,000

square feet in size. While the majority of the units should be priced in the $500,000 to $900,000 price range, it may be possible to achieve higher prices for larger units commanding the best views. In addition to the basic golf course amenity, the development should feature a recreational complex anchored by the golf clubhouse, and include a pro shop, restaurant, health spa with aerobics facilities, and tennis courts.

Market Potential for Recreational Facility Development

There is a significant growing demand for golf course facilities in the United States generally and in warm weather environments such as Hawaii in particular. The National Golf Foundation (NGF) reports that over 10 percent of the population or 23.4 million people participated in golf in 1988, and by the Year 2000 this number could approach 40 million if sufficient courses are made available. Also fueling demand for facilities in Hawaii is the growth of tourists who play golf. Current estimates suggest that at least one-third of the rounds played on Honolulu in 1988 were played by visitors to the island.

Based upon nationally-derived participation rates and actual tourist rounds played, there is currently a demand for golf on the Island of Oahu approaching 3.1 million rounds annually; by the Year 2010 this demand should approach 5.1 million rounds annually.

In comparison to the potential demand, in 1988 a total of 2.3 million rounds of golf were played on the Island of Oahu, thus indicating a current undersupply of facilities. Of this number, a total of 420,000 rounds of golf were played in the Koolaupoko District. The supply of golf facilities in the Koolaupoko District is very limited in that there are currently only two 18-hole regulation golf courses open for public use in the area, Pali Golf Course and Olomana Golf Links. In 1988 a total of 175,000 rounds of golf were played at the Pali Golf Course, perhaps triple what most courses typically accommodate in terms of play.

Given the shortage of courses in the immediate market area and the probable significant growth in demand for golf facilities on the Island of Oahu, an 18-hole championship course with a par 70 should achieve market success on the Malulani site. There are several constraints however, that the developer must address prior to development of a golf course. There is a growing concern on Oahu over conversion of agricultural land to golf courses, as evidenced by the current moratorium on new course development. In addition, there are 10 golf courses planned for the primary market area. Of these, six courses are significantly ahead of the proposed Heeia Kea course in the approval process. In order to position itself with respect to gaining necessary entitlements, the Malulani course should be planned as a course open for public play. Also, the course should be affordable to local residents who have demonstrated an unwillingness to pay the high fees charged at the resort courses.

In order to maximize the market potentials for a championship golf course the developers should provide a better-quality clubhouse facility which offers a number of recreational and retail/service activities, including the following: a pro shop; a small health spa with aerobics facilities; a restaurant with a seating capacity of 100 to 150 seats; and a tennis complex with three lighted clay courts.

Economic Impacts

Direct Employment Impacts - Construction Period

The Malulani development will provide short-term employment opportunities during construction of the various components of the project. Presented below is a summary of the employment supported by a major development component:

Golf Course/Clubhouse Construction (1991):

Employment Sector		Employment Years
Golf Course		25.5
Landscaping		12.5
Clubhouse/Health Spa/Tennis		39.0
	Total	77.0

Residential Unit Construction

Total Employment

Units Constructed	1990	1991	1992	1993
30 units	0	65	16	0
35 units	0	65	30	0

Direct Employment Impacts - Operational Period

At full development permanent employment at Malulani should approach 54 persons as delineated below:

Employment Source	Number Employed
Golf Course	20
Security	3
Restaurant	18
Pro Shop	3
Health Spa	10
Total	54

Fiscal Impacts

The projected public costs and revenues engendered by the program are examined for both the City and County of Honolulu and State of Hawaii, the two entities that provide local municipal governmental services to the Koolaupoko District. The basic methodology employed is that of a case study wherein public sector cost and revenue categories are examined within specific local context of the proposed development.

City and County of Honolulu

The City and County of Honolulu would normally provide the following major services to Malulani residents and businesses: General Government; Public Safety; Sanitation; Health and Welfare; Road Maintenance and Repair; Culture and Recreation; and Retirement and Pensions. The costs to the City and County and are projected at approximately $10,000 and will be more than off-set by the projected $161,500 in anticipated revenues.

State of Hawaii

The State of Hawaii provides the following services to local residents which could be directly impacted by the proposed development: Education; Highways; Hospitals; Health; and Sanitation. Costs to the State will also be minimal and should be more than offset by the $173,000 generated from general excise taxes.

III. ANALYSIS OF RESIDENTIAL MARKET POTENTIALS

The following section examines the market potential for development of higher-quality single-family residential units at the Malulani site.

The market potential for higher-value single-family housing at the Malulani site is determined below through a review of regional market forces on the Island of Oahu as well as the more local trends within the Windward side of the island. In general, the demand for housing in a given location will largely be determined by the following factors:

1) An area's population base and rate of growth;
2) The size, composition, and quality of the area's existing housing stock;
3) Household formation rates as a result of local population trends;
4) The socioeconomic characteristics of permanent residents; and
5) The access and amenity attributes of the property and its immediate surroundings to both local residents and visitors.

The analysis first examines the major determinants of housing demand as they have developed on the Island of Oahu on an overall basis, then analyzes the Malulani property and its unique potentials within both the larger regional and local market contexts.

Regional Market Area

The regional market area for residential development at Malulani encompasses the entire Island of Oahu, which is referred to for statistical purposes as the City and County of Honolulu Standard Metropolitan Statistical Area. The historic and projected population and household characteristics of the island serve as primary influences upon the potential scope and character of residential development on the study property.

Population Trends

1. Historic Population Growth

The City and County of Honolulu has experienced rapid population growth since 1960, expanding from 500,400 persons to a 1988 level of 838,500 persons. As indicated in Table 1, over the last 28 years Oahu has accounted for nearly 75 percent of the State's total population growth, and during the 1980s the island has grown at a rate of approximately 9,500 persons annually. While Oahu is by far the dominant island with respect to the number of residents, in recent years its actual rate of growth has fallen below that of the State. Overall, between 1980 and 1988, the State of Hawaii grew at a rate of 1.6% annually, reaching a total of nearly 1.1 million persons; in contrast, Oahu grew at a rate of only 1.2%.

Table 1
HISTORIC POPULATION TRENDS
STATE OF HAWAII AND CITY & COUNTY OF HONOLULU
1960-1988
(Rounded to the Nearest Hundred)

Area	1960	1970	Net Change, 1960-1970: Number	Net Change, 1960-1970: Annual Percent
State of Hawaii	632,800	769,900	137,100	1.98%
City & County of Honolulu	500,400	630,500	130,100	2.34%
Neighbor Islands	132,400	139,400	7,000	0.52%
City & County of Honolulu as Percent of State	79.08%	81.89%		

Area	1970	1980	Net Change, 1970-1980: Number	Net Change, 1970-1980: Annual Percent
State of Hawaii	769,900	964,700	194,800	2.28%
City & County of Honolulu	630,500	762,600	132,100	1.92%
Neighbor Islands	139,400	202,100	62,700	3.78%
City & County of Honolulu as Percent of State	81.89%	79.05%		

Area	1980	1988	Net Change, 1980-1988: Number	Net Change, 1980-1988: Annual Percent
State of Hawaii	964,700	1,098,200	133,500	1.63%
City & County of Honolulu	762,600	838,500	75,900	1.19%
Neighbor Islands	202,100	259,700	57,600	3.19%
City & County of Honolulu as Percent of State	79.05%	76.35%		

Sources: DBED (Data Book 1988, Table 4); MLW.

Note: Figures are for April 1 of year noted except 1988, which was taken on July 1.

2. Population Projections

The population for State of Hawaii is presented in Table 2 and is projected by the State Department of Business and Economic Development (DBED) per its Series M-K forecast to reach 1,435,500 persons by 2010, representing an annual net growth of 1.2%. Over the same period the City and County of Honolulu is expected to reach 999,500 persons by virtue of an anticipated growth rate about two-thirds of the State's or 0.8%. Oahu is projected to achieve the following annual population increases by time period:

Period	Projected Growth	Annual
1988-1990	23,100	11,500
1990-1995	48,800	9,760
1995-2000	22,400	4,480
2000-2005	28,300	5,660
2005-2010	38,400	7,680

3. Population in Households

The resident population forecasts for Oahu delineated above include all civilians and military personnel who live permanently or are stationed on the island. Of this resident population, a substantial number reside in group quarters such as military barracks, military ships, hospitals, dormitories, and prisons, thus they do not require dwelling units from the local housing market. Residents utilizing group accommodations accounted for approximately 4.8 percent of the total resident population in 1980; they are expected to remain constant and constitute 4.5 percent of the total future population between 1990 and 2010. After residents utilizing group quarters are removed, the remaining resident population -- referred to in this analysis as "Net Population in Households" -- constitutes the source of demand for housing units. In 1988 the net population in households for the City and County of Honolulu was estimated at approximately 800,800 persons. This figure is expected to increase to 954,500 persons by 2010. These figures are presented in Table 3. The net population in households is the basis from which trends in household formation and housing demand are derived below.

Household Size

As shown in Table 4, household size, a key determinant of housing requirements for a given population, has declined greatly on Oahu since 1970. In 1988 the ratio of the total number of residents living in households to the total number of occupied dwelling units was estimated at 2.98, a figure substantially below the 3.15 ratio recorded in 1980 and the 3.61 ratio measured in 1970. The decline in household size is consistent with national patterns, and reflects recent socioeconomic trends toward smaller families, fewer families as a percent of total households, and delays in family formation and child-bearing. The result of the trend toward smaller households on Oahu has been an increased demand for housing units per unit of population increase. In effect, even if population growth does not occur, high-

Table 2 (a)
HISTORIC POPULATION GROWTH, STATE & CITY & COUNTY OF HONOLULU
1960-1988

	1960	1970	1980	1985	1988	Net Change, 1960-1988 Annual Percent
State	632,800	769,900	964,700	1,051,500	1,098,200	1.99%
City & County of Honolulu	500,400	630,500	762,600	831,100	838,500	1.86%

Table 2 (b)
PROJECTED POPULATION GROWTH, STATE & CITY & COUNTY OF HONOLULU
1988-2010

	1988	1990	1995	2000	2005	2010	Net Change, 1988-2010 Annual Percent
State	1,098,200	1,137,200	1,223,200	1,285,100	1,330,800	1,435,500	1.22%
City & County of Honolulu	838,500	861,600	910,400	932,800	961,100	999,500	0.80%

Sources: DBED (Data Book 1988, Table 4; M-K Series, Table 6); PLU.

Note: Figure for 1980 is a measure taken as of April 1, while figures for 1985 and 1988 are as of July 1.

Table 3
CURRENT AND PROJECTED POPULATION IN HOUSEHOLDS,
CITY & COUNTY OF HONOLULU
1970 - 2010

	1970	1980	1985	1988	1990	1995	2000	2005	2010
Total Resident Population	630,500	762,600	811,100	838,500	861,600	910,400	932,800	961,100	999,300
Less: Persons in Group Quarters	36,000	36,700	36,700	37,700	38,800	41,000	42,000	43,200	45,000
Net Population in Households	594,500	725,900	774,400	800,800	822,800	869,400	890,800	917,900	954,300

Sources: U.S. Census 1970, 1980; DBED (Data Book 1988, Table 34); PLU.

Note: Figures for 1970 and 1980 are as of April 1 while figures for 1980 & 1988 are as of July 1.

Table 4
TRENDS IN AVERAGE HOUSEHOLD SIZE AS MEASURED
BY AVERAGE PERSONS PER OCCUPIED UNIT
CITY & COUNTY OF HONOLULU
1970, 1980, 1988

			Net Change, 1970-1988	
Year	Number of Households	Persons Per Household	Number	Annual Percent
1970	164,763	3.61		
1980	230,214	3.15	(0.46)	(1.33)
1988	268,422	2.98	(0.17)	(0.78)

Sources: U.S. Census 1970, 1980; DBED (Data Book 1988, Table 34); PLU.

Note: Figures for 1970 and 1980 are as of April 1 while figure for 1988 is as of July 1.

household formation rates engendered by the continuing decline in household size (often referred to as "undoubling" of households) may result in a steady demand for new housing.

Housing Market Trends

1. Existing Dwelling Unit Inventory

The total dwelling unit inventory in the City and County of Honolulu was estimated at 280.7 thousand units in 1988, a net increase of 28.7 thousand units over the 252.0 thousand units recorded in the 1980 census. Slightly less than half of the 1988 inventory, or 139.0 thousand units, were single-family detached units; the balance, 141.7 thousand units were multiple-family units. These figures are presented in Table 5.

Table 5 also shows the changes in the composition of the dwelling unit inventory from 1970 to 1988. These changes indicate a significant trend toward higher density multiple-family units between 1970 and 1980. The production of multiple family units during that decade was more than twice that of single-family units. However, with the changes in the 1986 tax laws, production of multiple-family units decreased sharply. It should also be noted that the recent market trends suggest that Hawaii residents prefer purchasing single-family units to multiple-family units, and that the high proportion of multiple units is explained in part by the high cost of single-family units.

The occupied dwelling unit inventory is also shown in Table 5. In 1988, there were approximately 268.6 thousand occupied dwelling units, representing an increase of 38.4 thousand units over the 1980 figure. The vacancy for all dwelling units was 4.3 percent in 1988 as compared to an 8.7 percent vacancy rate in 1980. However, the Department of General Planning of Oahu indicated that the 1980 figure was inflated due to an over-estimation of the total dwelling units on the island. Actual vacancy rates for 1980 ranged from 1.3 to 4.8 percent according to estimates provided by U.S. Mail Carriers and the Hawaii Health Surveillance Program. Notwithstanding these discrepancies, the number of occupied units, used as a basis for calculating household size and housing unit absorption, remains unaffected by the vacancy rate.

2. Housing Absorption Rates

The number of new units occupied or absorbed by the market was roughly 103.8 thousand units between 1970 and 1988. This indicates that one new housing unit was absorbed for every 1.99 persons of population increase, or 503 units per thousand population change. Table 6 compares the changes in net population in households to changes in occupied dwelling units. The absorption rate results from increased rates of household formation, i.e., new households entering the market, as well as second home purchases by both residents and non-residents. As these market forces can be expected to continue into the future, the 1970 to 1988 absorption rate forms the basis for projecting future housing demand on the Island of Oahu.

Table 5
CHANGE IN DWELLING UNIT INVENTORY, CITY & COUNTY HONOLULU
1970-1988

			Net Change, 1970-1980	
	1970	1980	Number	Annual Percent
All Dwelling Units	174,351	252,038	77,687	3.77%
Single Family	102,402	125,367	22,965	2.04%
Multiple Family	71,749	126,671	54,922	5.85%
Occupied Dwelling Units	164,763	230,214	65,451	3.40%
Vacancy Rate	5.40%	8.66%(1)		

			Net Change, 1980-1988	
	1980	1988-(2)	Number	Annual Percent
All Dwelling Units	252,038	280,692	28,654	1.08%
Single Family	125,367	139,017	13,650	1.04%
Multiple Family	126,671	141,675	15,004	1.33%
Occupied Dwelling Units	230,214	268,622	38,408	1.55%
Vacancy Rate	8.66%(1)	4.30%		

(1) - General Planning indicates that this figure may be inflated due to the inclusion apartment buildings and condominiums which are primarily used as hotels. However, this figure does not affect housing demand projections. Actual vacancy rates have been estimated by various surveys at 1.3 to 4.8 percent.

(2) - Estimate.

Sources: U.S. Census 1980; General Hawaii Planning Department; HLV.

Table 6 (a)
HOUSING ABSORPTION RATE
CITY & COUNTY OF HONOLULU
1970-1980

	1970	1980	Change in Dwelling Units Per 1,000 Population Change
Persons in Occupied Dwelling Units	594,500	725,900	
			498
Occupied Dwelling Units	164,800	230,200	

Table 6 (b)
HOUSING ABSORPTION RATE
CITY & COUNTY OF HONOLULU
1980-1988

	1980	1988	Change in Dwelling Units Per 1,000 Population Change
Persons in Occupied Dwelling Units	725,900	800,600	
			513
Occupied Dwelling Units	230,200	268,600	

Table 6 (c)
HOUSING ABSORPTION RATE
CITY & COUNTY OF HONOLULU
1970-1988

	1970	1988	Change in Dwelling Units Per 1,000 Population Change
Persons in Occupied Dwelling Units	594,300	800,800	
			503
Occupied Dwelling Units	164,800	268,600	

Sources: U.S. Census 1970, 1980; DBED (Data Book 1988, Table 34); HLW.

Note: Figure for 1980 is a measure taken as of April 1, while figure for 1988 is as of July 1.

3. Projected Demand for Housing

As shown in Table 7, the total housing requirement for the City and County of Honolulu is expected to reach 346.0 thousand units by 2010. This projection is based on the Series M-K population projections and the 1970 to 1988 housing absorption rate. The housing figure for 2010 represents an increase of 77.3 thousand units over the existing 1988 inventory. After allowance is made for replacement of obsolete units and modest rate of vacancy in the new units, the total building requirements for the 22-year period is 92.4 thousand units.

Projected housing demand for the City and County of Honolulu is distributed by time period and summarized as follows:

NEW HOUSING REQUIREMENTS
BY PERIOD, CITY AND COUNTY OF HONOLULU

Period	Total	Average Annual
1988-1990	12,643	6,321
1990-1995	27,169	5,434
1995-2000	13,856	2,771
2000-2005	16,867	3,373
2005-2010	21,886	4,377
Total	92,421	4,201

LOCAL MARKET AREA

The local housing market area for the Malulani development encompasses a geographic locale which is commonly referred to as the Koolaupoko Judicial District. Geographically and statistically the Koolaupoko district is coterminous with census tracts 103.02 through 113. The area includes the towns of Kaneohe, Kailua, Kahaluu, Maunawili, Heeia, and Waimanalo. The market area is depicted in Figure 2.

Population Trends

1. Historic Population Growth

Table 8 presents the growth in resident population within the Koolaupoko Judicial District for the period 1970 to 1988. In 1988 the resident population stood at 117,900 persons. This represents an increase of 8,500 persons over the 1980 census figure of 109,400 persons. The change in population represents an additional 1,063 residents per year in the primary market area. Over the period 1980 to 1988 the Koolaupoko Judicial District captured 11.2 percent of 75,900 new residents of Oahu. Overall, the annual percentage growth for the area was 0.94 percent or just under the 1.19 percent annual growth rate achieved by the Island of Oahu.

Table 7
PROJECTED DEMAND FOR NEW RESIDENT-ORIENTED HOUSING,
CITY & COUNTY OF HONOLULU
1988-2010

		1988	1990	1995	2000	2005	2010
Total Population in Households		800,800	822,600	869,400	890,800	917,900	954,500
Potential Occupied Dwelling Units (1)		268,622	279,691	303,138	313,906	327,341	345,756

		1988-1990	1990-1995	1995-2000	2000-2005	2005-2010
Incremental Demand For New Housing		11,069	23,447	10,767	13,435	18,415
Add: Allowance for Vacancy Rate @	5.00%	553	1,172	538	682	921
Add: Replacement of Obsolete Units @	510 Per Year	1,020	2,550	2,550	2,550	2,550
Total Increase in Resident-Oriented Housing Per Period		12,643	27,169	13,856	16,667	21,886
Annual		6,321	5,434	2,771	3,333	4,377
Cumulative Increase		12,643	39,812	53,668	70,335	92,221

----
(1) - Based upon 1970-1980 absorption rate.

Sources: DBED (Data Book 1989, Table 618); U.S. Census; HLW.

FIGURE 2

LOCAL RESIDENTIAL MARKET AREA

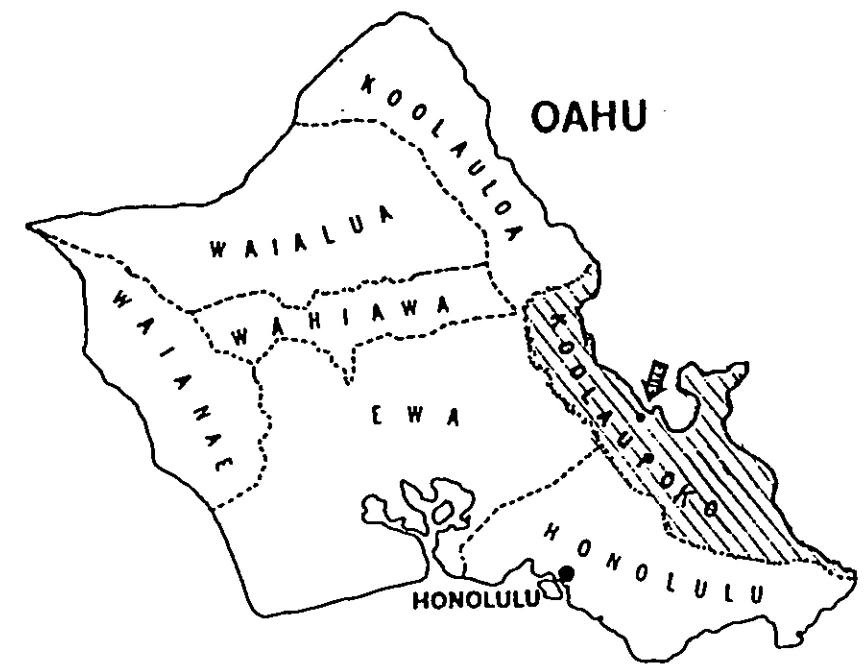


Table 8
HISTORIC POPULATION AND HOUSING GROWTH
KOOLAUPOKO DISTRICT AREA
1970-1988

	1970	1980	Net Change, 1970-1980: Number	Net Change, 1970-1980: Annual Percent
Population	92,200	109,400	17,200	1.73%
All Dwelling Units	21,032	29,241	8,209	3.33%

	1980	1985	Net Change, 1980-1985: Number	Net Change, 1980-1985: Annual Percent
Population	109,400	114,600	5,200	0.93%
All Dwelling Units	29,241	30,983	1,742	1.16%

	1985	1988	Net Change, 1985-1988: Number	Net Change, 1985-1988: Annual Percent
Population	114,600	117,900	3,300	0.95%
All Dwelling Units	30,983	32,023	1,040	1.11%

Sources: U.S. Census 1970 and 1980; NLW.

2. Population Projections

Population projections prepared by the DBED, Department of General Planning and NLW indicate that the population in the Koolaupoko District should reach 122,600 persons in 1995 and 129,900 by 2010. Based on this projection the Koolaupoko District population should increase by 545 persons per year. These projections suggest that Koolaupoko will account for a declining share of the island's total population; the forecasted population for 2010 would account for only 13.0% of the island total as compared to its 14.1% share in 1988. These projections are detailed in Table 9.

<u>Housing Market Trends</u>

1. Historic Housing Growth

Table 8 also presents the growth in housing units within the Koolaupoko Judicial District for the period 1970 to 1988. From 1970 to 1980 the dwelling unit inventory grew from 21,032 units to 29,241 units, representing a net increase of 8,209 units or 821 units per year. The 1980 housing inventory accounted for 11.6% of Oahu's total housing units. In 1988 the housing unit inventory was estimated at 32,023 units, a net gain of 2,782 units over the 1980 total. Under current development activities, an average of nearly 350 units per year is being added to the dwelling unit inventory in the primary market area.

2. Changes in the Composition of Dwelling Unit Inventory

The Department of General Planning and NLW also have detailed information regarding the distribution of the housing unit inventory by type of unit through 1988. Changes in dwelling unit inventory are delineated in Table 10 for the period 1980 to 1988. In 1980, the total inventory of 29,241 dwelling units was distributed between 23,842 single-family (81.5%) and 5,399 multiple-family units (18.5%). In 1988 total dwelling units increased to 32,023, of which 25,566 (79.8%) were single-family and 6,457 (20.1%) were multiple-family. Occupied dwelling units were estimated at 30,742, representing a 4.0 percent vacancy rate. The high percentage of single-family dwelling units in Koolaupoko demonstrates the family-oriented character of the district. This information is presented in Table 10. In comparison, the City and County of Honolulu's percentage of single-family units to total occupied units has dropped from 59% in 1970 to just under 50% in 1988. These figures are presented in Table 10(a).

3. Market Trends

The Koolaupoko District has historically been characterized as a low to moderate income district. However, during the past several years the area has witnessed significant changes in the character of its housing market. Increases in the prices, quality, and size of homes have occurred in several neighborhoods. These changes occurred initially in the Kailua area, and more recently have spread to Kaneohe neighborhoods.

Table 9
POPULATION PROJECTIONS CITY & COUNTY OF HONOLULU,
PRIMARY MARKET AREA
1980-2010

	1980	1985	1988	1990	1995	2000	2005	2010
City & County of Honolulu	762,600	811,100	838,500	861,600	910,400	932,800	961,100	999,500
PRIMARY MARKET AREA								
Koolaupoko	109,400	114,600	117,900	119,100	122,600	123,700	125,100	129,900
PMA as % City & Co. Total	14.35%	14.13%	14.06%	13.82%	13.47%	13.26%	13.02%	13.00%

Sources: DBED (Data Book 1985, Table 7; Data Book 1988, Table 8); KLV.

Note: Figure for 1980 is a measure taken as of April 1, while figures for 1985 and 1988 are as of July 1.

Table 10
CHANGE IN DWELLING UNIT INVENTORY, PRIMARY MARKET AREA
1980-1988

	1980	1985	Net Change, 1980-1985: Number	Net Change, 1980-1985: Annual Percent
All Dwelling Units	29,241	30,983	1,742	1.16%
Single Family	23,842	24,806	964	0.80%
Multiple Family	5,399	6,177	778	2.73%
Occupied Dwelling Units	28,024	29,746	1,722	1.20%
Vacancy Rate	4.16%	3.99%		

	1980	1988	Net Change, 1980-1988: Number	Net Change, 1980-1988: Annual Percent
All Dwelling Units	29,241	32,023	2,782	1.34%
Single Family	23,842	25,566	1,724	0.88%
Multiple Family	5,399	6,457	1,058	2.26%
Occupied Dwelling Units	28,024	30,742	2,718	1.16%
Vacancy Rate	4.16%	4.00%		

Sources: U.S. Census 1980; Department of General Planning; KLV.

Table 10 (a)
SINGLE FAMILY UNITS AS PERCENT OF TOTAL
DWELLING UNITS IN CITY AND COUNTY
OF HONOLULU AND DISTRICT OF KOOLAUPOKO
(1970 - 1988)

	1970	1980	1988
CITY & COUNTY OF HONOLULU			
All Dwelling Units	174,131	252,038	280,692
Single Family	102,402	125,367	139,017
Single Family as % of Total	58.8%	49.7%	49.5%

	1970	1980	1988
PRIMARY MARKET AREA			
KOOLAUPOKO			
All Dwelling Units	21,032	29,241	32,029
Single Family	17,142	23,842	25,566
Single Family as % of Total	81.5%	81.5%	79.8%

Source: U.S Census 1970, DBED (Data Book 1980,85,88); KLV.

Although there has been a limited number of new, higher-priced number of homes constructed, resale prices of existing and renovated homes have increased significantly in recent years. In Kailua the trend can be seen particularly in the established neighborhoods of Lanikai and Kailua Beach. From August 1988 to August 1989 the average sales price for a unit was nearly $600,000 in Lanikai and nearly $750,000 in Kailua Beach.

The Lanikai neighborhood is a secluded oceanfront community where over the past two years a significant number of the oceanfront homes have been renovated and resold. The upgrading activity in this neighborhood is comparable in many respects to the changes which have previously occurred in the Wailae and Kahala areas. In Kailua over the one-year period August 1988 to August 1989 there have been 31 sales or resales of homes priced over $500,000 as distributed below:

Price Range	Numbers Sold
$1,000,000+	8
$750,000 to $999,999	6
$500,000 to $749,999	17
Total	31

A similar though less pronounced trend can be seen in the Kaneohe area. Over the 12-month period August 1988 to August 1989 there have been 14 sales or re-sales of homes priced over $500,000 as distributed below:

Price Range	Numbers Sold
$1,000,000+	1
$750,000 to $999,999	0
$500,000 to $749,999	13
Total	14

Higher priced homes in Kaneohe are found almost exclusively in the Haiku Plantation. The community offers a gated entrance to the homes which are situated on lots averaging one to two acres in size, having at least 2,500 square feet of living area, and offering ocean and mountain views. The resales of these homes have averaged nearly $500,000 over the past year. Another development offering higher-priced homes is the Alii Landing project which is currently under construction. The project includes 10 homes with ocean views and prices starting at $457,800. Of the 10 homes initially offered four have been sold, all at prices over $500,000.

Interviews were conducted with numerous real estate brokers knowledgeable about the windward Oahu residential market who indicated that there has been an increase in both the demand for and supply of higher-priced residential units. Most brokers felt that there is a shortage of high-quality, oceanfront homes not only in the Koolaupoko

District but also on an island-wide basis. They also indicated that the demand for these types of units priced in the $500,000 to $750,000 price range is extremely high.

4. Residential Capacities -- Koolaupoko District

Information regarding planned residential projects in the Koolaupoko area is somewhat sketchy as the Department of General Planning can only provide residential capacities for the area rather than description of future products(s). Planners from the agency indicated that a maximum of 2,950 residential units can be built on 703.0 acres of zoned residential land in the Koolaupoko District. Of this total, the Department of General Planning indicated that there are 920 units potentially developable in the Kaneohe area. Presented below is a table of currently-zoned residential land areas and potential limit capacities for Koolaupoko District communities:

POTENTIAL CAPACITY FOR RESIDENTIAL DEVELOPMENT ON VACANT LANDS

Community	Residential Acreage	Potential Housing Units
Waimanalo	41.4	165
Kailua	196.0	1,022
Kaneohe	171.1	920
Kahaluu	268.2	715
Waiahole	26.3	128
Total	703.0	2,950

5. Potential for Residential Development on the Malulani Property

The market investigations indicate that the Malulani property has a number of positive attributes which combine to make it a highly desirable location for development of higher quality residential units. These advantages include the following:

- The property can be effectively designed as a private exclusive community oriented around its own par 70 18-hole championship golf course and other recreational amenities;
- The units on the property can be designed to offer golf course frontage locations with unobstructed ocean views, amenities which are highly desirable as witnessed by the prices achieved for comparable units in nearby residential neighborhoods such as Lanikai, Kailua Beach and Alii Landing;
- The site is located in an area undergoing significant appreciation as prices for closer-in residential waterfront communities such as Hawaii Kai and Kahala are built out and reach unit price levels well above the million dollar range; and
- The Koolaupoko District's better neighborhoods have established themselves as locations for residential units priced between $500,000 and $1,000,000.

Given these considerations, the Malulani property should be able to market 30 to 35 better quality units offering ocean views and/or golf course frontage locations over a two-year development period. The development should provide units offering from 3,000 to 5,000 square feet of living space on lots ranging from 10,000 square feet to 20,000 square feet in size. While the majority of the units should be priced in the $600,000 to $900,000 price range, it may be possible to achieve higher prices for larger units commanding the best views. In addition to the basic golf course amenity, the development should feature a recreational complex anchored by the golf clubhouse, and include a pro shop, restaurant, health spa with aerobics facilities, and tennis courts.

IV. ANALYSIS OF RECREATIONAL MARKET POTENTIALS

The following section examines the market potential for the major recreational land uses proposed for the property, including: an 18-hole championship golf course; a health spa; an aerobics facility; a tennis facility; and a retail/restaurant facility.

A. MARKET POTENTIALS FOR GOLF COURSE DEVELOPMENT

The following section analyzes the market potential for the development of an 18-hole golf course at the Malulani residential development. The essential components of this section are as follows:

- Market area delineation;
- National golfing demand characteristics;
- Demand for golfing facilities;
- A summary description of existing and proposed golf course facilities operating on the Island of Oahu; and
- An assessment of the proposed course's market potential based on the existing and projected demand for golf facilities through the year 2010.

Market Area Delineation

The primary competitive market area for the proposed Malulani Development Golf Course has been delineated to include the population centers within the Koolaupoko Judicial District. This district encompasses census tract numbers 103.02 through 113. The secondary market area for the Malulani Golf Course extends southwesterly from the primary market area to include the greater Honolulu metropolitan area. Finally, the tertiary market area for the proposed project is the remaining portions of the Island of Oahu. Figure 3 illustrates the primary, secondary and tertiary market areas as outlined above.

National Golfing Demand Characteristics

Presented below is a summary of the general characteristics of those who participate in golf.

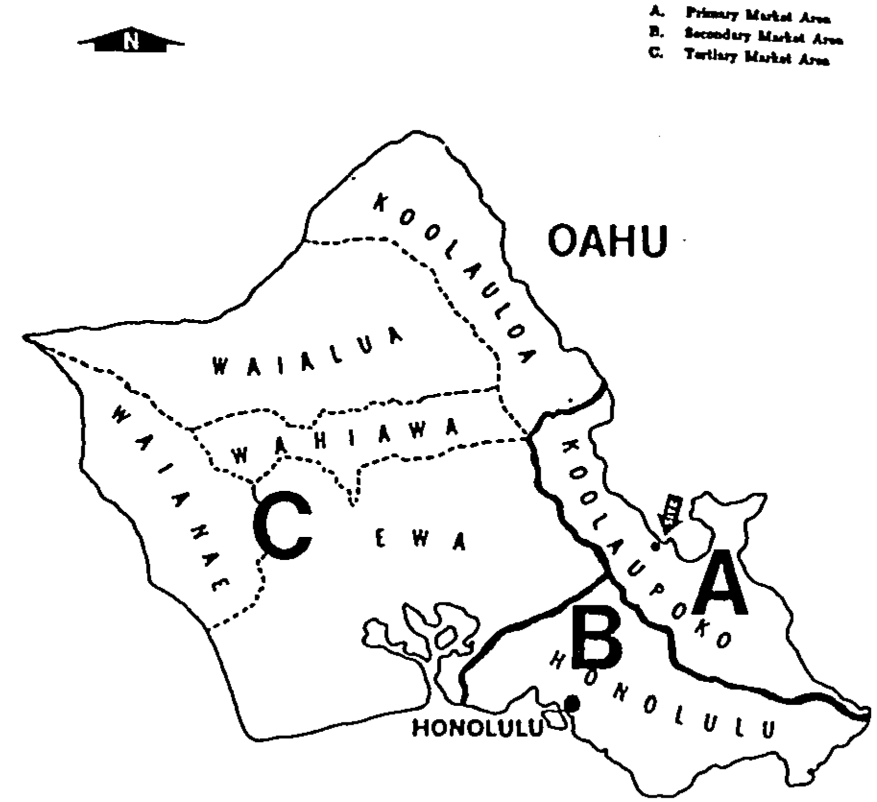
1. Golf Participation Characteristics

The National Golf Foundation (NGF) reported that 10.4 percent of the population, or 23.4 million persons, had participated in the sport of golf at least once in 1988. This figure represents an increase of 7.8 percent over the 1987 figure of 21.7 million persons. A total of 487 million rounds of golf were played in 1988. Of the 23.4 million golfers in 1988, 24 percent or 5.6 million golfers accounted for 75 percent or 365 million rounds of all rounds played.

In 1988 the average golfer played 20.8 rounds of golf, up from 19.4 rounds per golfer in 1987. NGF projects that by 2000 there will be 40 million golfers nationally.

FIGURE 3
MARKET AREA DELINEATION

A. Primary Market Area
B. Secondary Market Area
C. Tertiary Market Area



2. Socioeconomic Profiles of Golfers

The following demographics apply to annual golf participants:

- o Participation is highest among the 20-29 year old age group which has a participation level estimated at 15 percent.
- o Participation among males (16.6%) is greater than among females (4.5%).
- o Participation is highest in the East North Central region of the U.S. at 13.8 percent participation and lowest in the East South Central region at 7.6 percent participation.
- o Participation is greatest among individuals belonging to higher socio-economic profile households, identified as having the following characteristics:
  - Income of $75,000 and above;
  - College graduates; and
  - Professionally employed.

3. Distribution of Rounds Played

Presented below is the distribution of rounds played by course type in 1988:

Course Type	Number of Rounds (In Millions)	Percent of Total
Municipal	133	27.3%
Daily Fee	186	38.3%
Private	168	34.4%
Total	487	100.0%

Demand for Golf Facilities

In this section, the demand for golf measured in rounds per year is projected for the primary, secondary and tertiary market areas. These projections are made based upon anticipated resident population increases, participation rates characterizing the Hawaiian golf industry, and the percentage of total market demand attributable to tourism.

1. Resident Population Projections

Population projections prepared by the Department of General Planning for each of the market areas is presented in Table 11. It is projected that by 2010 the population of Oahu will reach 999,500 persons to be distributed by market area as follows: primary market area, 129,900 persons; secondary market area, 499,800 persons; tertiary market area, 369,800 persons.

Table 11
MALULANI GOLF COURSE
MARKET AREA DEMAND PROJECTIONS
(1988 - 2010)

MARKET AREA	1988	1990	1995	2000	2005	2010
Primary	314,225	340,626	372,398	398,314	426,278	467,640
Secondary	1,242,269	1,312,740	1,441,294	1,534,330	1,646,845	1,799,280
Tertiary	739,382	810,810	931,649	1,070,972	1,201,825	1,331,380
Tourists	796,000	882,599	1,004,133	1,138,687	1,290,816	1,459,913
TOTAL DEMAND FOR GOLF, HONOLULU COUNTY (Rounds per Year)	3,091,875	3,346,275	3,749,473	4,142,303	4,565,764	5,058,113

Sources: State of Hawaii, Department of General Planning; PLV.

2. Golf Participation, City and County of Honolulu

The sport of golf is a very popular recreational activity in Hawaii, with the favorable climate encouraging both greater participation and frequency of play among the resident population. While the national golf participation rate represents 10.4% of the total residential population, it is believed that local participation -- due to relatively high involvement levels of women and persons over 60 -- is somewhat higher, perhaps approaching closer to 12.5%. Moreover, with year-round good weather, the opportunity for play is increased, with annual potential rounds per golfer approaching 22 to 24 per year.

3. Demand Attributable to Tourism

A comprehensive survey of golf facilities operating in the City and County of Honolulu has indicated that demand attributable to tourism has increased considerably over the past few years, growing from approximately 20% of the total annual rounds played in 1985 to an estimated 34% of total annual rounds played in 1988. In the resort developments, tourist demand represents an estimated 75% of the total annual rounds played, an increase of over 25% from 1985 figures.

These participation rates are further validated by the Hawaii State Department of Parks and Recreation. The Department concluded that of the total annual golf rounds played in 1988 in Hawaii, 66% were attributable to resident play while the remaining 34% were a result of non-resident or tourist demand. Given that 2,312,000 total rounds of golf were played on Oahu in 1988, roughly 786,000 rounds were played by tourists.

The increase in the number of tourists playing golf can be attributed to: 1) the increase in the popularity of golf worldwide; and 2) the increase in the number of visitors to Hawaii which rose from 4.9 million visitors in 1985 to 6.1 million visitors in 1988. A large portion of the increase in the number of visitors can be accounted for by the Japanese. In 1988, 1.3 million Japanese visited Oahu, with approximately 9 percent of the total participating in golf.

4. Demand Projections by Market Area, 1988-2005

Demand projections for annual rounds of golf for the Primary, Secondary and Tertiary resident markets as well as tourists are provided in Table 12 below, based upon the following considerations:

- Golf participation in the resident population will increase from its current level of 12.5% to 15% by 2010;

- Rounds played per resident golfer will expand from a current level of 22 per year to 25 by 2010; and

Table 11
MALULANI GOLF COURSE
MARKET AREA RESIDENT POPULATION
(1985 - 2010)

MARKET AREA	1985	1988	1990	1995	2000	2005	2010
Primary	114,600	117,900	119,100	122,400	123,700	125,300	129,900
Secondary	440,201	451,734	459,000	474,300	476,300	483,300	499,800
Tertiary	256,299	269,866	283,500	313,300	332,600	352,700	369,800
TOTAL RESIDENT POPULATION ON THE ISLAND OF OAHU	811,100	839,500	861,600	910,400	932,800	961,100	999,500

Source: State of Hawaii, Department of General Planning; PLV.

- Tourist play will expand at a rate of approximately 1% annually above the projected growth of tourism to Oahu over the period 1988 to 2010.

The projected demand for golf on a "rounds per year" basis for the Island of Oahu from all sources is as follows:

Year	Annual Rounds Demanded
1988	3,091,875
1990	3,346,775
1995	3,769,473
2000	4,142,303
2005	4,565,764
2010	5,058,113

Over the 22-year projection period, demand for golf is projected to increase from 3.1 million rounds annually to 5.1 million rounds annually, an increase of 63.6%. It should be noted that the projected demand for golf in 1988 substantially exceeds the actual rounds played. This difference indicates that there were insufficient facilities available at a reasonable price(s) to adequately accommodate current demand levels on the Island of Oahu.

Existing and Proposed Golf Facilities

1. Existing Golf Courses

According to a recent survey conducted by Linda J. Sox and James R. Hollyer of the University of Hawaii at Manoa, there are a total of 62 golf courses in the State of Hawaii. Of the 62 courses, 71 percent or 44 courses are public courses; the remaining 29 percent are private courses. A total of 28 courses, or 45% of the State total, are located in the City and County of Honolulu. These courses may be delineated into five separate groupings depending upon their user characteristics: Municipal Courses, which are open to the public; Private Open to Public Courses, which are privately owned and operated but available for public use; Military Courses, which are restricted to the military and their guests; Private Courses, which are restricted to club members and their guests; and Resort Courses, which are privately operated facilities to satisfy their hotel guests' golf needs yet typically permit some non-hotel guest play. The distribution of facilities by type on Oahu is provided below:

Number	Course Type
4	Municipal Courses (three 18-hole, one 9-hole)
9	Private Open to Public (seven 18-hole, one 18-hole Par 3, one 9-hole)
9	Military Courses (six 18-hole, one 9-hole, two 9-hole Par 3)
4	Private Courses (four 18-hole)
2	Resort Courses (two 18-hole)
28	Total

The locations of existing courses are shown in Figure 4 and their current usage characteristics summarized in Table 13.

a. Usage Patterns

A field survey of existing golf courses in the City and County of Honolulu was conducted in order to determine the annual number of rounds played. In 1988 a total of 2.3 million rounds were played, representing an increase of 0.65 million rounds over the 1985 figure of 1.64 million rounds.[1] A total of 0.61 million rounds were played at four municipal golf courses in 1988 in the City and County of Honolulu. This figure represents 26.3 percent of the total rounds played, while the actual number of municipal courses represents only 14.3 percent of the 28 courses on the island. The most rounds played in 1988 at any golf course was the 191,625 rounds played at the Ala Wai municipal golf course in Honolulu. The Pali municipal golf course was second with 175,000 rounds played in 1988.

b. Prices

There are marked variations between course types with regard to charges for playing them. Generally speaking, the resort course charged the highest fees while the military courses charged the lowest. Of the existing courses, green fees at the Turtle Bay Hilton were the most expensive on average. Green fees ranged from $65 per hotel guest to $90 per non-resident at the resort. The most inexpensive green fees for non-military persons could be found at the municipal courses which charged $8 on weekdays and $12 on weekends.

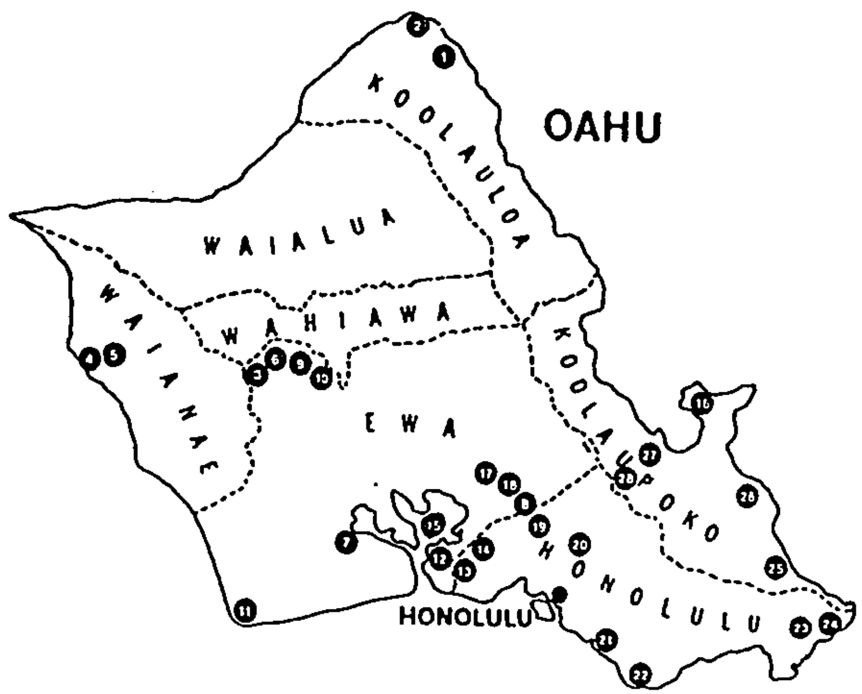
2. Proposed Golf Courses

There are currently 37 golf courses proposed for the Island of Oahu. The location of these courses is presented in Figure 5, and their major characteristics presented in Table 14. These courses represent a total of 756 planned additional holes. The development time frame for many of these courses is unknown as they are still in the conceptual planning stages. Of the 37 planned courses, 10 would be located within or near the primary market area of the Nanatomi site.

[1]The 1985 figure is slightly understated because the number of rounds played for several courses was not available.

FIGURE 4

EXISTING GOLF COURSES ON THE ISLAND OF OAHU



1. Kahuku Golf Club - 9 Holes
2. Turtle Bay Hilton
3. Hawaii Country Club (C.C.)
4. Sheraton Makaha Resort & C.C.
5. Makaha Valley C.C.
6. Mililani Golf Course
7. Ted Makalena Golf Course
8. Fort Shafter Golf Course - 9 Holes
9. Leilehua Golf Course
10. Kalakaua Golf Course
11. Barber's Point Golf Course
12. Hickam Golf Course
13. Hickam Par-3 Golf Course
14. Navy Marine Golf Course
15. Ford Island Golf Course - 9 Holes
16. Kaneohe Klipper Golf Course
17. Pearl Country Club
18. Moanalua Golf Club - 9 Holes
19. Honolulu International C.C.
20. Oahu Country Club
21. Ala Wai Golf Course
22. Waialae Country Club
23. Hawaii Kai Championship Golf Course
24. Hawaii Kai Executive Golf Course
25. Olomana Golf Links
26. Mid Pacific Country Club
27. Bay View Center
28. Pali Golf Course

Table 12
MUNICIPAL GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Municipal Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1985	Rounds Played 1988	Driving Range	— Green Fees — Weekday	Weekend	— Cart Fees — Weekday	Weekend	Ownership	Opened	Course Rating
1. Ala Wai GC	Honolulu	18	71	6,111	339.5	182,658	191,625	N	$8.00	$12.00	$7.50	$7.50	County	1931	71.00
2. Kahuku GC	Kahuku	9	35	2,699	299.9	31,663	86,000	N	8.00	12.00	7.50	7.50	County	1937	63.20
3. Pali GC	Kaneohe	18	72	6,472	360.7	140,177	175,000	Y	8.00	12.00	7.50	7.50	County	1953	70.00
4. Ted Makalena GC	Waipahu	18	71	5,946	330.3	129,876	155,000	N	8.00	12.00	7.50	7.50	County	1971	69.00
Subtotal		63				484,374	607,625								

Source: Hawaii's Golf Guide; H.V.

Table 13 (Continued)
PRIVATE OPEN TO PUBLIC GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Private Open To Public Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1985	Rounds Played 1988	Driving Range	Resident (RES) Non-Resident (NON)	Green Fees Weekday	Green Fees Weekend	Cart Fees Weekday	Cart Fees Weekend	Ownership	Opened	Course Rating
1. Bay View GC Par - 3	Kaneohe	18	54	2,231	123.9	N/A	30,000	Y	ALL	$5.00	$5.00	$3.00	$3.00	Pacific Atlas	1963	54.00
2. Hawaii Country Club GC	Kunia	18	71	5,664	314.7	72,000	86,000	Y	RES NON	21 40	28 40	Included		Sumitomo Realty Co.	1957	64.40
3. Hawaii Kai GC	Hawaii Kai	18	72	6,350	352.8	78,000	87,000	Y	RES NON	18 50	34 50	Included		Atsugi Kohatsu Kanko Co.	1972	71.00
4. Hawaii Kai Exec. GC	Hawaii Kai	18	55	2,443	135.7	64,000	74,000	N	RES NON	12 50	30 50	Included		*	1962	55.00
5. Makaha Valley Cntry GC	Makaha	18	71	6,251	347.3	53,000	78,000	Y	RES NON	24 35	31 40	Included		Hitta HI	1969	67.60
6. Mililani GC	Mililani	18	72	6,813	378.6	94,000	96,000	Y	RES NON	25 50	30 50	Included		Sports Shinko	1970	72.50
7. Moanalua GC	Moanalua	9	36	2,973	330.3	N/A	75,000	N	RES NON	12 12	20 20	9.00		Member-Owned	1967	70.40
8. Olomana Golf Links	Waimanalo	18	72	6,449	358.3	100,000	81,000 *	Y	RES NON	21 39	30 49	Included		Hirano Kogyo	1968	68.00
9. Pearl Country Club GC	Aiea	18	71	6,491	360.6	80,000	80,000	Y	RES NON	30 30	34 34	Included		Honda Kaihatsu Kogyo	1967	71.00
Subtotal		153				535,000	680,000									

* Due to damage caused by flooding in January 1988, fewer Rounds Played were registered for 1988.

Source: Hawaii's Golf Guide; N.V.

Table 13 (Continued)
MILITARY GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Military Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1985	Rounds Played 1988	Driving Range	Military (MIL) Civilian Guest (CIV) — Green Fees — (Depending upon rank)	— Cart Fees —	Ownership	Opened	Course Rating
1. Barbers Point Civ. GC	Ewa	18	72	6,394	355.2	74,000	83,000	Y	MIL $5.00 - $8.00 CIV $22.00	$10.00	Government	1965	69.50
2. Ford Island GC	Pearl Harbor	9	27	1,200	133.3		Closed				Government	1962	
3. Fort Shafter Civ. GC	Fort Shafter	9	68	5,661	629.0	N/A	50,000	N	MIL $5.00 - $7.00 CIV $11.00	$10.00	Government	1919	67.40
4. Hickam GC	Hickam AFB	18	72	6,793	377.4	84,000	81,000	Y	MIL $5.00 - $8.00 CIV $20.00	$8.00	Government	1966	70.30
5. Hickam Par - 3	Hickam AFB	9	27	1,403	155.9		28,000		MIL $5.00 - $7.00 CIV $11.00	$10.00	Government	1959	27.00
6. Kalakaua Civ. GC	Schofield Barracks	18	72	6,186	343.7	N/A	78,000	Y	MIL $6.00 - $8.00 CIV $18.00	$10.00	Government	1918	68.10
7. Kaneohe Klipper Civ. GC	Kaneohe MCAS	18	72	6,269	348.3	N/A	80,000	Y	MIL $8.00 CIV $22.00	$10.00	Government	1949	69.50
8. Leilehua Civ. GC	Schofield	18	72	6,521	362.3	N/A	100,000	Y	MIL $7.00 - $9.00 CIV $23.00	$10.00	Government	1949	70.70
9. Navy Marine Civ. GC	Aliamanu	18	72	6,578	365.4	96,000	66,000	Y	MIL $5.00 - $8.00 CIV $22.00	$10.00	Government	1948	71.00
Subtotal		135				254,000	571,000						

Table 13 (Continued)
PRIVATE OPEN TO PUBLIC GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Private Open To Public Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1985	Rounds Played 1988	Driving Range		Resident (RES) Non-Resident (NON) -- Green Fees -- Weekday	Green Fees Weekend	-- Cart Fees -- Weekday	Cart Fees Weekend	Ownership	Opened	Course Rating
1. Bay View GC Par - 3	Kaneohe	18	54	2,231	123.9	N/A	30,000	Y	ALL	$5.00	$5.00	$3.00	$3.00	Pacific Atlas	1963	54.00
2. Hawaii Country Club GC	Kunia	18	71	5,664	314.7	72,000	86,000	Y	RES NON	21 40	28 40	Included		Sunlove Realty Co.	1957	64.40
3. Hawaii Kai GC	Hawaii Kai	18	72	6,350	352.8	78,000	87,000	Y	RES NON	18 30	34 30	Included		Atsugi Kokusai Kanko Co.	1973	71.00
4. Hawaii Kai Exec. GC	Hawaii Kai	18	55	2,443	135.7	68,000	74,000	N	RES NON	12 30	30 30	Included		"	1962	55.00
5. Makaha Valley East GC	Makaha	18	71	6,251	347.3	59,000	78,000	Y	RES NON	24 35	31 40	Included		Hilla HI	1969	67.60
6. Mililani GC	Mililani	18	72	6,815	378.6	94,000	96,000	Y	RES NON	25 30	30 30	Included		Sports Shinko	1898	72.90
7. Moanalua GC	Moanalua	9	36	2,973	330.3	N/A	75,000	N	RES NON	12 12	20 20	9.00		Member-Owned	1967	70.40
8. Olomana Golf Links	Waimanalo	18	72	6,449	358.3	100,000	81,000 *	Y	RES NON	21 39	30 49	Included		Hirano Kogyo	1968	66.00
9. Pearl Country Club GC	Aiea	18	71	6,491	360.6	80,000	80,000	Y	RES NON	30 30	34 34	Included		Honda Kaihatsu Kogyo	1967	71.00
Subtotal		153				535,000	680,000									

* Due to damage caused by flooding in January 1988, fewer Rounds Played were registered for 1988.

Source: Hawaii's Golf Guide; HEW.

Table 13 (Continued)
MILITARY GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Military Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1985	Rounds Played 1988	Driving Range	Military (MIL) Civilian Guest (CIV) -- Green Fees -- (Depending upon rank)	-- Cart Fees --	Ownership	Opened	Course Rating
1. Barbers Point Civ. GC	Ewa	18	72	6,394	355.2	74,000	85,000	Y	MIL $5.00 - $8.00 CIV $22.00	$10.00	Government	1956	69.50
2. Fort Island GC	Pearl Harbor	9	27	1,200	133.3		Closed				Government	1962	
3. Fort Shafter Civ. GC	Fort Shafter	9	68	5,661	629.0	N/A	58,000	N	MIL $5.00 - $7.00 CIV $11.00	$10.00	Government	1919	67.40
4. Hickam GC	Hickam AFB	18	72	6,793	377.4	84,000	81,000	Y	MIL $5.00 - $8.00 CIV $20.00	$8.00	Government	1956	70.30
5. Hickam Par - 3	Hickam AFB	9	27	1,403	155.9		20,000		MIL $5.00 - $7.00 CIV $11.00	$10.00	Government	1959	27.00
6. Kalakaua Civ. GC	Schofield Barracks	18	72	6,186	343.7	N/A	78,000	Y	MIL $6.00 - $8.00 CIV $18.00	$10.00	Government	1918	68.10
7. Kaneohe Klipper Civ. GC	Kaneohe MCAS	18	72	6,269	348.3	N/A	88,000	Y	MIL $8.00 CIV $22.00	$10.00	Government	1949	69.50
8. Leilehua Civ. GC	Schofield	18	72	6,521	362.3	N/A	100,000	Y	MIL $7.00 - $9.00 CIV $23.00	$10.00	Government	1949	70.70
9. Navy Marine Civ. GC	Aliamanu	18	72	6,570	365.4	96,000	88,000	Y	MIL $5.00 - $8.00 CIV $22.00	$10.00	Government	1948	71.90
Subtotal		135				254,000	574,000						

Table 13 (Continued)
PRIVATE MEMBERSHIP GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Private Membership Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1983	Rounds Played 1988	Driving Range	Membership Fee	Cart Fees	Ownership	Opened	Course Rating
1. Honolulu Int'l. CC	Salt Lake	18	72	6,182	343.4	60,000	70,000	Y	$21,000	$9.00	Takahashi	1977	70.30
2. Mid Pacific CC	Lanikai	18	72	6,504	361.3	66,000	84,000	Y	28,000	7.00	Member-Owned	1927	71.00
3. Oahu Country Club CC	Nuuanu	18	71	6,000	333.3	50,000	52,000	N	33,000		Member-Owned	1906	68.00
4. Waialae Country Club CC	Waialae-Kahala	18	72	6,906	383.7	75,000	76,000	Y	N/A	N/A	Member-Owned	1927	70.00
Subtotal		72				251,000	282,000						

Source: Hawaii's Golf Guide; H.W.

Table 13 (Continued)
RESORT HOTEL GOLF COURSE SURVEY
CITY & COUNTY OF HONOLULU
September 1989

Resort Hotel Golf Course	Location	Holes	Par	Course Yards	Yards/ Hole	Rounds Played 1983	Rounds Played 1988	Driving Range	Hotel Guest (HOT) Resident (RES) Non-Resident (NON) Daily		-- Cart Fees --	Ownership	Opened	Course Rating
1. Sheraton Makaha	Makaha	18	72	6,400	355.6	40,000	63,875	Y	HOT RES NON	$45.00 33.00 55.00	Included	All Nippon Airways	1966	71.00
2. Turtle Bay Hilton	Kahuku	18	72	6,366	353.7	70,000	104,500	Y	HOT RES NON	$63.00 70.00 70.00	Included			70.00
Subtotal		36				110,000	168,375							
Total						1,635,354	2,312,000							

Source: Hawaii's Golf Guide; H.W.

FIGURE 5
PROPOSED OAHU
GOLF COURSES

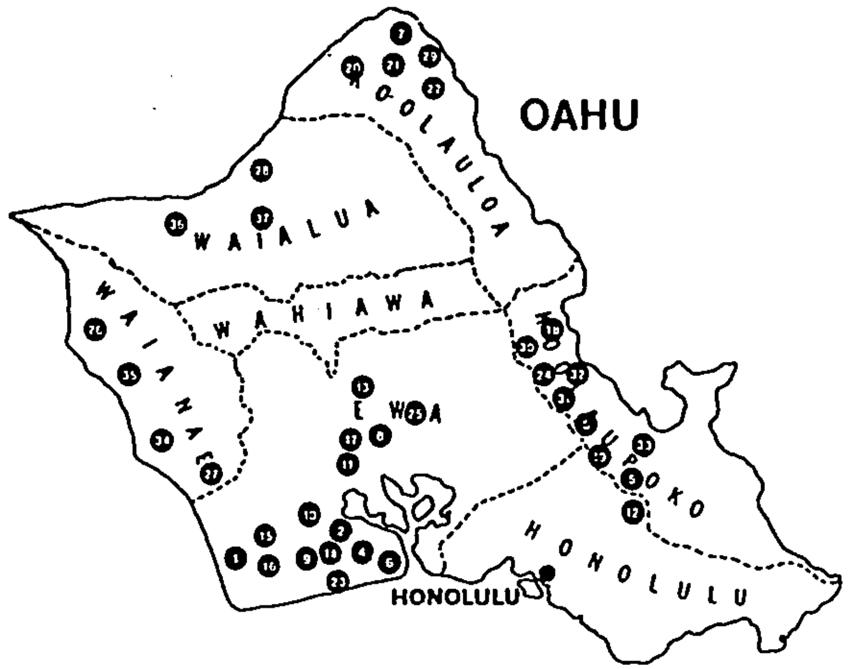


Table 14
PROPOSED GOLF COURSES
CITY & COUNTY OF HONOLULU
(As of June 1989)

------GOLF COURSE------	ACRES	DEVELOPER	STATUS
A. UNDER CONSTRUCTION			
1) Ko' Olina #1-(*)	171	West Beach Estates	Under Construction
2) West Loch	197	City & County of Honolulu	Under Construction
3) Minami	240	Minami Corp.	Under Construction
B. NEARING CONSTRUCTION			
4) Ewa (27 Holes)	270	Myers Corp.	CUP Approved 10/88
5) Royal Hawaiian Country Club #1-(*)	225	Y Y Valley Corp.	Access Road Under Construction
6) Pouloa	133	H. Morita Realty	CUP Approved
7) Turtle Bay (Expansion)-(*)	194	Kuilima Development Co.	Zoning Aproved 8/86
8) Waikele-(*)	142	Amfac Properties	Zoning Aproved 12/86
C. NEEDS SOME ADDITIONAL DISCRETIONARY APPROVAL			
9) Kapolei	200	Hawaii Housing Authority	Exempted Under Act 15
10) Makakilo	232	Finance Realty	CUP Approved 2/89
11) Royal Kunia #1	172	Halekua Development Co.	Needs rezoning to P-2
12) Royal Hawaiian Country Club #2-(*)	225	Y Y Valley Corp.	Access Road Under Construction
13) Kiapa Ridge Estates (9 Holes)	45	City & County of Honolulu	Needs City Council Approval
D. NEEDS SUBSTANTIAL ADDITIONAL DISCRETIONARY APPROVAL			
14) Ewa Gentry	170	Gentry Pacific Corp.	Pending SLUC boundary adjustment
15) Ko' Olina #2	160	West Beach Estates	DP and Rezoning Required
16) Ko' Olina #3	160	West Beach Estates	DP and Rezoning Required
17) Royal Kunia #2	163	Halekua Development Co.	Needs rezoning to P-2

(*) - Indicates Golf Course Proposal Prior to 1986.

Source: Department of Land Utilization; HLW.

Table 14 (Continued)
PROPOSED GOLF COURSES
CITY & COUNTY OF HONOLULU
(As of June 1989)

------GOLF COURSE------			
D. NEEDS SUBSTANTIAL ADDITIONAL DISCRETIONARY APPROVAL (CONT.)	ACRES	DEVELOPER	STATUS
18) Waikane #1 (27 Holes)	505	Waikane Development Co.	DP Amendment Pending/Needs Rezoning...
19) Kailua Drive-In	238	Windward Park, Inc.	Needs SMP, CDUA
20) Lihi Lani Resort (36 Holes)	430	Ohbayashi Hawaii Corp.	Pending SLUC Application
21) Pumaomao (36 Holes)	540	Campbell Estate	DP Amendment Pending
22) Makakilo-Kahana	490	Campbell Estate	DP Amendment Pending
23) Ewa Marina	160	Hasegawa Komuten	Preliminary Inquiry
24) Waihee Valley	150	City & County of Honolulu	DP Amendment Pending
25) Waiawa (36 Holes)	480	Gentry Companies	DP Approved/Rezoning Required
E. NO OFFICIAL SUBMITTALS			
26) Ohikilolo	190	Alpha Kai	Preliminary Inquiry
27) Lualualei	236	Sanjiro Nakade	Preliminary Inquiry/Denial Recommended
28) Kaleiwa (9 Holes)	90	KDI Land Co.	Preliminary Inquiry
29) Kahuku	150	City & County of Honolulu	Feasibility Study Underway
30) Waikane #2	300	Undetermined	Preliminary Inquiry
31) Hoola	N/A	Undetermined	Preliminary Inquiry
32) Hoola Kea (Malulani)	200	Kanatomi Hawaii Inc.	Preliminary Inquiry/Needs SMP
33) Bay View (9 Hole Expansion)	140	Pacific Atlas Hawaii	Preliminary Inquiry/Needs SMP/Needs Land
F. APPLICATIONS DENIED OR WITHDRAWN			
34) Maili Kai	180	Kaiser Cement Co.	Preliminary Inquiry
35) Waianae Kai (27 Holes)	250	K. Morita Investment Inc.	CUP Application Withdrawn
36) Mokuleia (36 Holes)-(*)	413	Mokuleia Land Co.	CUP Application Withdrawn
37) Waialua	216	Oceanic Properties, Inc.	SLUC/DP Amendment Withdrawn

(*) - Indicates Golf Course Proposal Prior to 1986.

Source: Department of Land Utilization; HLW.

Market Potential for the Malulani Development Golf Course

1. Existing Golf Courses and Participation Rates

There are currently five golf courses located in the Primary Market Area. The courses total 90 holes and are distributed by type as follows:

Course	Type	Number of Holes	1988 Rounds Played
Pali Golf Course	Municipal	18	175,000
Olomana Golf Links	Private Open to Public	18	81,000[2]
Mid-Pacific Golf Course	Private	18	54,000
Bay View Golf Course	Par 3	18	30,000
Kaneohe Klipper	Military	18	80,000
	TOTAL, 5 Courses		420,000

In 1988 approximately 420,000 rounds of golf were played in the Primary Market Area. This figure includes resident and tourist play as well as leakage from the secondary and tertiary market areas. Further scrutiny of these facilities reveals shows that there are only two 18-hole regulation golf courses open to the public in the Primary Market Area. Moreover, the Pali Golf Course is currently operating at nearly three times normal capacity and the Olomana Golf Links is operating over normal capacity.

Competitive facilities within the Primary Market Area were contacted to determine the degree to which current capacity is consumed by the current demand for golf. Representatives from these courses indicated that their respective facilities are currently operating to capacity during weekends and holidays. Weekday demand was described as moderate to heavy among the courses surveyed. Given the existing supply of golf courses and the demand demonstrated by actual play, it is evident that there is a shortage of at least two to three golf courses in the Primary Market Area at this time.

2. Planned Golf Courses

There are 10 golf courses planned for the Primary Market Area. If all courses were to be developed there would be an additional 180 holes available for use. The planned courses for the primary market area are summarized as follows:

[2]Fewer rounds were played in 1988 than prior years due to flooding.

CORRECTION

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

Table 14 (Continued)
PROPOSED GOLF COURSES
CITY & COUNTY OF HONOLULU
(As of June 1989)

------GOLF COURSE------	ACRES	DEVELOPER	STATUS
D. NEEDS SUBSTANTIAL ADDITIONAL DISCRETIONARY APPROVAL (CONT.)			
18) Waikane #1 (27 Holes)	505	Waikane Development Co.	DP Amendment Pending/Needs Rezoning...
19) Kailua Drive-In	238	Win'ward Park, Inc.	Needs SMP, CDUA
20) Lihi Lani Resort (36 Holes)	430	Ohbayashi Hawaii Corp.	Pending SLUC Application
21) Puuonane (54 Holes)	540	Campbell Estate	DP Amendment Pending
22) Makaakahana	490	Campbell Estate	DP Amendment Pending
23) Ewa Marina	160	Hasegawa Komuten	Preliminary Inquiry
24) Waihee Valley	130	City & County of Honolulu	DP Amendment Pending
25) Waiawa (36 Holes)	400	Gentry Companies	DP Approved/Rezoning Required
E. NO OFFICIAL SUBMITTALS			
26) Ohikilolo	190	Alpha Kai	Preliminary Inquiry
27) Lualualei	236	Kanjiro Nakada	Preliminary Inquiry/Denial Recommended
28) Haleiwa (9 Holes)	90	SDI Land Co.	Preliminary Inquiry
29) Kahuku	150	City & County of Honolulu	Feasibility Study Underway
30) Waikane #2	300	Undetermined	Preliminary Inquiry
31) Heeia	N/A	Undetermined	Preliminary Inquiry
32) Heeia Kea (Maluhani)	200	Kanatomi Hawaii Inc.	Preliminary Inquiry/Needs SMP
33) Bay View (9 Hole Expansion)	140	Pacific Atlas Hawaii	Preliminary Inquiry/Needs SMP/Needs Land
F. APPLICATIONS DENIED OR WITHDRAWN			
34) Maili Kai	160	Kaiser Cement Co.	Preliminary Inquiry
35) Waianae Kai (27 Holes)	250	H. Morita Investment Inc.	CUP Application Withdrawn
36) Mokuleia (36 Holes)-(*)	415	Mokuleia Land Co.	CUP Application Withdrawn
37) Waialua	214	Oceanic Properties, Inc.	SLUC/DP Amendment Withdrawn

(*) - Indicates Golf Course Proposal Prior to 1986.

Sources: Department of Land Utilization; HLM.

Market Potential for the Malulani Development Golf Course

1. Existing Golf Courses and Participation Rates

There are currently five golf courses located in the Primary Market Area. The courses total 90 holes and are distributed by type as follows:

Course	Type	Number of Holes	1988 Rounds Played
Pali Golf Course	Municipal	18	175,000
Olomana Golf Links	Private Open to Public	18	81,000[2]
Mid-Pacific Golf Course	Private	18	54,000
Bay View Golf Course	Par 3	18	30,000
Kaneohe Klipper	Military	18	80,000
	TOTAL, 5 Courses		420,000

In 1988 approximately 420,000 rounds of golf were played in the Primary Market Area. This figure includes resident and tourist play as well as leakage from the secondary and tertiary market areas. Further scrutiny of these facilities reveals shows that there are only two 18-hole regulation golf courses open to the public in the Primary Market Area. Moreover, the Pali Golf Course is currently operating at nearly three times normal capacity and the Olomana Golf Links is operating over normal capacity.

Competitive facilities within the Primary Market Area were contacted to determine the degree to which current capacity is consumed by the current demand for golf. Representatives from these courses indicated that their respective facilities are currently operating to capacity during weekends and holidays. Weekday demand was described as moderate to heavy among the courses surveyed. Given the existing supply of golf courses and the demand demonstrated by actual play, it is evident that there is a shortage of at least two to three golf courses in the Primary Market Area at this time.

2. Planned Golf Courses

There are 10 golf courses planned for the Primary Market Area. If all courses were to be developed there would be an additional 180 holes available for use. The planned courses for the primary market area are summarized as follows:

[2] Fewer rounds were played in 1988 than prior years due to flooding.

Course	Developer	Number of Holes	Type	Approval Status
1) Minami Golf Course	Minami Corp.	18	Private Open to Public	Under Construction
2) Royal Hawaiian #1	YY Valley Corp.	18	Private Open to Public	Access Road Under Construction
3) Royal Hawaiian #2	YY Valley	18	Uncertain	Need Grading Permit. DP Amendment Pending
4) Waikane #1	Waikane Dev.	27	Uncertain	Need Rezoning/SMP
5) Waihee Valley	City & County	18	Private Open to Public	DP Amendment Pending
6) Kailua Drive-In	Windward Park, Inc.	18	Uncertain	Needs SMP/CDUA[3]
7) Waikane #2	Unknown	18	Uncertain	Preliminary Inquiry
8) Heeia	Unknown	18	Uncertain	Preliminary Inquiry
9) Heeia Kea (MALULANI)	Nanatomi Hawaii, Inc.	18	Private Open to Public	Preliminary Inquiry/ Need SMP
10) Bay View Expansion	Pacific Atlas	9	Private Open to Public	Preliminary Inquiry/ Need SMP/Need Land
	TOTAL	180		

The Minami and Royal Hawaiian #1 golf courses will be open for play in the next one to two years. Golf courses identified as #3 through #6 on the above list are further along in the approval process than the Malulani course and will likely be constructed at some point in the future.

3. Malulani Golf Course Development Potential

Presented below is a summary of opportunities and constraints associated with the development of a golf course at the Malulani site.

[3]CDUA - Conservation District Use Application.

Opportunities:

- o Hawaii is becoming one of the world's premier golf resort destinations and should broaden its appeal to the tourist market segment seeking a variety of golf experiences.
- o Development of the H-3 highway will improve accessibility to Windward Oahu and to the Nanatomi site for resident and tourist population concentrations located in Honolulu and Waikiki.
- o Representatives of existing courses in the primary market area indicate courses are operating at full capacity on weekends and holidays with weekday play described as moderate to heavy.
- o There are only two 18-hole regulation courses open to the public in the primary market area.
- o NGF projects national demand to increase to 40 million players by 2000 -- nearly double the 23.4 million players in 1988.
- o Visitor arrivals to the State are projected to increase from 6.1 million visitors in 1988 to 11.5 million visitors in 2010. In addition, Japanese visitors are projected to increase from 1.3 million visitors in 1988 to 2.9 million visitors in 2010.
- o The site is an attractive location that offers ocean and mountain views.
- o There are currently no additional municipal courses planned.

Constraints:

- o There are 10 courses currently planned for the primary market area. Development of these courses would add 180 holes to a market which currently has only 90 holes.
- o There are six proposed courses which are significantly ahead of the Heeia Kea course in the approval process.
- o There is a growing concern in Hawaii over conversion of agricultural land to golf courses, as evidenced by the recent moratorium imposed on golf course development in Oahu.
- o The site is somewhat remote from the major resident population and visitor centers in the Honolulu area.

Given the opportunities and constraints discussed above, the Malulani site has an opportunity to provide an 18-hole championship golf course. To summarize, the demand for golfing facilities on the island should follow national trends and is projected to increase to nearly 5.1 million rounds by 2010. With the existing and projected supply of golf courses, the Malulani site should develop a private golf course which is open for public play on a daily fee basis.

Presented below is a series of recommendations regarding development of a golf course at the Malulani site.

- The golf course may be privately owned and operated, but it should be open for public play in order to satisfy local need and ensure maximum community support.
- The golf course should feature an attractive clubhouse with a restaurant, pro shop and other facilities.
- The course should be affordable to residents who have displayed price sensitivity as demonstrated by the level of play at existing municipal courses.
- Tourists should be charged more expensive rates than residents.
- The developer should promote the course in Japan to attract this market segment.
- The developer should attempt to sponsor a pro or celebrity event to gain prestige and notoriety.
- The developer should offer incentives to players of the course. Some incentives may include the following:
    - Discounts for weekday play;
    - Corporate discounts;
    - Use of clubhouse facilities such as the health spa, tennis facility, and aerobics facility;
    - Use of carts;
    - Offer of free play for certain number of rounds played.

B. MARKET POTENTIALS FOR ANCILLARY RECREATION AND RETAIL/RESTAURANT

An important consideration in the marketablility of the golf course would be the development of a better quality clubhouse with facilities open to the public. Logical facilities for the clubhouse complex include: a pro shop; a restaurant with a seating capacity for 100 to 150 persons which would cater to the residents of Malulani, the residents of the Kaneohe community, and persons using the golf course facilities; a small health spa with aerobics facilities; and a tennis complex featuring three lighted clay courts.

V. REVIEW OF ECONOMIC IMPACTS

This section measures the direct economic impacts resulting from the Malulani development in terms of projected total population, total employment, total development value, and other economic indicators for the planning area.

Development Location

Nanatomi Hawaii, Inc. owns approximately 220 acres of land in Heeia Kea Valley, Kaneohe, Oahu. The subject property is mauka of Kaneohe Bay and Kamehameha Highway, in the vicinity of the Heeia Kea Pier and Boat Harbor.

Residential Development Summary

The proposed development program consists of 30 to 35 residential units oriented around an 18-hole golf course with ocean views. The unit value -- including the combination of the lot and completed house -- will range from $500,000 to $900,000, with the median home value approaching $700,000. Total residential development value based on a 30 to 35 unit program is projected to range from $21.0 to $24.5 million as expressed in 1989 dollars.

Unit absorption is projected to begin in 1992 at a rate of 20 to 24 units per year. At these rates buildout of the project should take from one- and one-half to two years. A residential absorption schedule is delineated below:

MALULANI DEVELOPMENT PROGRAM
RESIDENTIAL ABSORPTION SCHEDULE

Absorption By Year

	1990	1991	1992	1993	1994	1995	Total
@ 30 units	0	0	24	6	0	0	30
@ 35 units	0	0	24	11	0	0	35

Golf Course and Recreation Facilities Development Summary

The current plan provides for a par 70, 18-hole regulation golf course totaling 150 acres. The course will be a privately owned golf course which is open for public play for a daily fee. Water features will be distributed throughout the course to function as fairway amenities as well as irrigation reservoirs and siltation basins.

For purposes of this analysis the following recreational amenities are also assumed to be developed in the site:

- Golf Course Clubhouse;
- Pro Shop;
- Restaurant;
- Health Spa/Aerobic Facilities; and
- Three Tennis Courts.

Population Impact

The Malulani residential development will cater almost exclusively to full-time residents. Based on an average household size of 3.5 persons, the average daily population should ultimately range from 105 persons to 123 persons, depending upon the number of units constructed. These projections are exclusive of housekeeping assistance, and are delineated below:

MALULANI DEVELOPMENT PROGRAM
POPULATION IMPACTS

Average Population (Year End)

	1990	1991	1992	1993	1994	1995
@ 30 units	0	0	84	105	105	105
@ 35 units	0	0	84	123	123	123

Age Distribution of Homeowners

The median age of Malulani community heads-of-household should approach 40 years. The anticipated age distribution of the resident population is projected as follows:

Age Level	Percent
Under 35	15%
35 - 45	35%
45 - 55	40%
55 and Over	10%
Total	100%

Income Characteristics of Households

The median annual income for households should approach $100,000, while the average annual household income should be well over $120,000. The projected distribution of households by income level is presented below:

Income Level	Percent
Under $75,000	5%
$ 75,000-$100,000	30%
$100,000-$125,000	35%
Over $125,000	15%
Total	100%

Direct Employment Impacts - Construction Period

The State Department of Labor and Industrial Relations (DLIR) indicated that the unemployment rate through June 1989 was 2.9 percent on Oahu or 11,085 persons. Of that total 581 were Kaneohe residents, of which 539 were without earnings.

Golf Course/Clubhouse Construction

Beginning in 1991 the project will generate short-term employment for the construction of the golf course. The golf course will generate 25.5 full-time equivalent (FTE) person year positions. The planting and landscaping phase of the golf course is estimated to create a 12.5 FTE positions. Construction of the clubhouse and health spa/tennis facilities is projected to provide 39 FTE jobs. To summarize:

Employment Sector	Employment Years
Golf Course	25.5
Landscaping	12.5
Clubhouse/Health Spa	39.0
Total	77.0

Residential Unit Construction

Beginning in 1991 the planned community would generate short-term employment for the construction of residential units. The construction of each residential unit would require 2.7 persons on a full-time basis, with the average construction period per unit requiring approximately one year. Given the small scale of the project and the relatively low anticipated rate of absorption it is assumed that the local labor market can easily supply the necessary construction work force. The project will require a maximum of 65 employees. Presented below is a summary of the full-time employees required during the construction period.

MALULANI DEVELOPMENT PROGRAM
DIRECT EMPLOYMENT FOR RESIDENTIAL UNIT CONSTRUCTION

Employment

	1990	1991	1992	1993	1994	1995
@ 30 units	0	65	16	0	0	0
@ 35 units	0	65	30	0	0	0

Direct Employment Impacts -- Operational Period

Golf Course

Based upon comparable facilities, employment at the golf course would number 20 persons and include the following:

1	Superintendent for Golf Course;
1	Superintendent for Club/House Grounds;
1	Mechanic;
6	Light Equipment Operator; and
11	Maintenance.
20	Total

Security for the golf course and the residential community will be provided by a gated entrance at the main entry. Three employees will be required to operate the entrance.

Clubhouse Operations

As previously mentioned, the clubhouse will provide the following amenities:

- Restaurant;
- Pro Shop;
- Health Spa; and
- Tennis Facilities.

Restaurant

The restaurant will provide seating capacity for 100 to 150 persons. The facility will require approximately 3,000 square feet of space. Industry trends indicate that six employees are required per 1,000 square feet of restaurant space. Applying this factor, the restaurant will require 18 employees.

Pro Shop

It is assumed that the pro shop will provide golf and tennis equipment. The shop will also be responsible for tennis reservations. It is assumed that the pro shop will generate three employees on a full-time basis.

Health Spa

The health spa will provide minimal facilities in the form of weight training and aerobics classes. The health spa will require 10 employees to be distributed as follows: one manager; three weight trainer; and six aerobics instructors.

Tennis Facilities

The tennis courts will be primarily operated through the pro shop. There will likely be no employment impact other than what has previously been mentioned.

Total Permanent Employment

Summarizing the various employment components, the total persons employed at Malulani should approach 54 persons, as derived below:

Employment Source	Number Employed
Golf Course	20
Security	3
Restaurant	18
Pro Shop	3
Health Spa	14
Total	54

VI. REVIEW OF FISCAL IMPACTS

The following section examines the fiscal impacts of the proposed Malulani residential development program upon the public sector. The projected public costs and revenues engendered by the program are examined for both the City and County of Honolulu and the State of Hawaii, the two entities that provide local municipal governmental services to the Koolaupoko District. The basic methodology employed is that of a case study wherein public sector cost and revenue categories are examined within specific local context of the proposed development.

County Expenditures

The City and County of Honolulu would normally provide the following major services to Malulani residents and businesses: General Government; Public Safety; Sanitation; Health and Welfare; Road Maintenance and Repair; Culture and Recreation; and Retirement and Pensions. The total general fund budget for fiscal year 1989-1990 indicates that the City and County was scheduled to spend $485.7 million or $571 per capita[4] on various governmental services. These monies are distributed by major categories as follows:

Budget Category	FY 1989-90 Allocation (in millions)
General Government	$65.0
Public Safety	123.9
Police Protection	85.5
Fire Protection	38.4
Highways and Streets	3.5
Sanitation	30.4
Health, Culture and Recreation	42.4
Miscellaneous (Retirement & Pensions)	110.7
Debt Service	102.2
Total	$485.7

Sources: City and County of Honolulu; NLW, Inc.

The major expenditure areas are examined below with specific reference to the proposed residential impacts.

General Government

General government consists of salaries and overhead expenditures for the executive and legislative branches of government as well as major departments such as Finance, Planning and Zoning, Law, and Public Works. During the pre-development and development phases the project will undergo zoning and building review procedures, thus incurring costs in this government sector. These costs will be of a transitory nature, and will be largely offset by governmental charges for current services in the form of applicant/permit fees and other processing charges. They are not considered to be long-term recurring costs to the City and County Government.

[4] Based upon an estimated 1989 population of 850,503 persons.

Public Safety

Two major cost areas within this service category are police protection and fire protection.

Police Protection. Police protection for the Kaneohe area is currently provided from the Kaneohe Station. It is unlikely that the development will impact the need for the deployment of additional police personnel in the area. In addition, security for the golf course and residential community will be provided by the Malulani Community Association in the form of a 24-hour manned, gated community.

Fire Station. The existing fire station facility located in Kahaluu has a primary service radius which includes land encompassing the Malulani development program. Existing levels of capital facilities and manpower are sufficient to service the projected development without significant cost impact in this public protection category.

Highways and Streets

Road maintenance and repair together with street lighting and signalization is normally financed from a separate Highway Fund. However, the Malulani residential development intends to construct all streets within the development. The development also plans to maintain and repair these streets privately. Therefore, there will be no significant public fiscal impact from the internal roadway maintenance, though the residents will generate a minor cost impact emanating from their use of the regional and local roadways located outside the development.

Sanitation

Wastewater will be generated by the residences, the golf clubhouse, the health spa/tennis facility, and the golf maintenance facility. The proposed wastewater generated by the project would be collected and treated on-site and disposed of in the proposed golf course.

Solid waste will be collected by a private collection company and disposed of at the City and County of Honolulu windward sanitary landfill.

At present the annual cost for these categories stands at $30.4 million or the equivalent of $35.74 per capita. Assuming maximum buildout of the project, homeowners would require expenditures approaching $4.4 thousand as measured in 1989 constant dollars.

Health

The primary expenditures by the City and County of Honolulu for this function relate to welfare/recreation activities for the elderly, emergency ambulance services (EMS), and salaries for a County Coroner and related staff. It is unlikely that the development will generate any significant fiscal impact in this sector.

Culture and Recreation

The primary expenditures associated with this function are for park maintenance, recreation services, and administration. Given the fact that the development will provide its own recreational opportunities it is unlikely that the Malulani residents will generate significant fiscal impacts on this sector except for minor costs associated with residents visiting local facilities off the site which are maintained by the City and County.

Cost Summary

The Malulani residential development is anticipated to have minimal financial impacts on the sectors examined. Projected in 1989 constant dollars, incremental public costs associated with the proposed development are projected at less than $10,000 on an annual basis.

County Revenues

Public sector revenues generated by the proposed development which will accrue to the City and County General Fund include property taxes and licenses and permits. Public sector revenues accruing to the Highway Fund which can offset roadway construction and maintenance requirements include public utility franchise taxes, fuel taxes, and licenses for street use. These revenue sources are reviewed and projected for the development.

Property Taxes

Property tax generation by the proposed development is projected to reach $159 thousand annually at buildout, derived from the application of the current tax rate of $6.09 for land per $1,000 value of residential land and $6.56 per $1,000 of residential buildings to an anticipated total development valuation of $25.2 million.[5]

Business Licenses/Non-Business Licenses and Permits.

Revenues from licenses and permits for FY 1989-90 were $7.9 million for the County, representing a per capita figure of $9.25. Because of the small scale of commercial development at the development, the revenues generated will be minimal, and are projected to approach $1,150 in 1989 constant dollars based on the per capita figure.

Highway Fund Revenues

Monies channeled to the Highway Fund are provided by three major sources: public utility franchise tax; fuel tax; and licenses and permits related to street use. These three sources combined are expected to provide $41.5 million to the Highway Fund in 1989-90, or $48.77 per capita. The development is projected to generate funds to this source at approximately 20 percent of the current County per capita

[5] The valuation expressed here covers only the residential component; the golf course and related facilities would generate additional property tax base.

figure or $9.75 per capita. Total revenues to the Highway Fund should approach $1,200 at the completion of the development based on the per capita figure.

Revenue Summary

Public revenues generated for the City and County of Honolulu General Fund and Highway Fund by the development are projected to reach $155.4 thousand upon completion. The revenues are summarized by source below:

CITY AND COUNTY REVENUES UPON COMPLETION
MALULANI DEVELOPMENT PROGRAM
(in Thousands of 1989 Constant Dollars)

Revenue Source	Annual Revenue
Property Taxes	$153.0
Licenses and Permits	$ 1.2
Public Utility Franchise Tax, Street Use Licenses/Permits, and Fuel Tax	$ 1.2
Total	$155.4

These revenues should more than offset the projected annual increase in City and County expenditures required by the development of $10 thousand, and should provide a revenue surplus for use in other areas on Oahu.

Fiscal Impact on the State of Hawaii

The State of Hawaii provides the following services to local residents which could be directly impacted by the proposed development: education; highways; hospitals; and health/sanitation.

Education

Due to the high land values it is unlikely that many of the residents will have children living at the residences on a permanent basis and attending local public schools. The development is thus unlikely to generate any financial impact in this sector.

Highways

Given its small scale, the development will have little impact on the existing highway system, as the number of vehicle trips generated by the development should represent less than one-tenth of one percent of trips emanating from the Koolaupoko area.

Hospital/Health and Sanitation

Medical services are provided to the area by the Castle Medical Center. It is unlikely that additional hospital capacity will be required because of the development.

State Revenues

Recurring revenues generated to be State of Hawaii by the development will include monies from the following major sources:

- General Excise Tax revenue from various businesses such as the restaurant and the retail/fuel facility; and
- Personal and corporate income tax collected from persons and businesses residing in the development.

While it is beyond the scope of this study to project income taxes emanating from the development, general excise taxes are projected to reach $173 thousand on an annual basis, as developed below:

	Square Feet	Sales Per Square Foot	Total Sales	Taxes @ 4.167 Percent
Restaurant	7,000	$375	$2,625,000	$109,384
Pro Shop	1,500	350	1,525,000	63,547
	8,500		$3,150,000	$172,931

When combined with state income taxes these anticipated revenues should be sufficient to offset state expenditures required locally to service the development.

APPENDIX N

HAZARDOUS WASTE
EVALUATION
Industrial Analytical Laboratory

INALAB, INC.

INDUSTRIAL ANALYTICAL LABORATORY

3615 Harding Avenue • Suite 304 • Honolulu, Hawaii 96816 • (808) 735-0422 • FAX (808) 735-0047

EPA/NBS Accredited AHERA Inspectors/Management Planners
Directed by Ph.D. Chemists, Toxicologists & ABIH Board Certified
Industrial Hygienists

Report of a Hazard Assessment Survey Conducted on Property Located in Heeia Kea, Koolaupoko on O'ahu, Hawaii.

Prepared for Kobayashi, Watanabe, Sugita, Kawashima and Goda
Attorneys at Law
by INALAB, Inc.

12 February 1990

In review of our proposed site evaluation of Lot 45 on the Heeia Kea Property, we submitted the following project outline:

We envisioned three basic phases, as you recall, Phase 1 involved the thorough search throughout lot 45 in an attempt locate and identify all above surface wasto drums or containers. The location and complete description of each drum was to be carefully documented. In this preliminary survey we were to attempt initial physical and chemical characterization of the contents of each drum with various in situ field techniques. This was to give us an immediate indication of which drums / containers would be of concern in Phase 2 and which drums might be simply disposed of without further concern.

Phase 2 would involve the complete chemical characterization of the contents of each selected drum from phase 1 according to standard EPA laboratory format and protocol. Once the characterization had been accomplished, arrangements would be made for the disposal of the contents through proper disposal channels, outlined below, in phase 3.

Phase 3 was to involve a remedial effort designed for the proper disposal and/or disposition of each of the waste items located and identified. Some items, which represent no significant environmental or health hazard could remain as they are until the land is cleared. As we mentioned should other items identified as possessing characteristics of a potentially toxic or hazardous waste be present, further environmental sampling (soil or ground water) may be indicated, particularly if we found indications of leaching or spillage, etc.

We have now completed Phase 1 of our investigation concerning the evaluation of waste drums/containers located near and about Lot 45 on the Heeia Kea Property.

On the basis of this investigation we are pleased to inform you that no further action will be necessary with respect to characterization or special disposal activity of potentially toxic or hazardous drums/containers on site. It will not be necessary for us to conduct further Phase 2 or 3 evaluations.

Of the total of 32 drums/containers located and labeled (refer to Figure 1 enclosed) as present most were empty, a few were filled with rain water and one container, an old gasoline pump, was noted to contain a small quantity (less than 5 gallons) of gasoline at the time of inspection.

The major occupational hazard on the property are the bee hives within the drums/containers. Some of the hives are 2 to 4 feet across inhabited with literally thousands of bees.

As outlined in our earlier Fax of 22 January 1990 which presented our preliminary findings, there was a considerable amount of other debris (e.g., abandoned vehicles, some small cans of what appeared to be latex, exterior paint, a jet engine, and a few abandoned buses). There were roughly 13 cans (about 13 gallons) of latex paint, all grouped together (see Figure 1). We also noted a large stack of corrugated asbestos transite paneling also present.

The majority of drums and containers were noted (due to the remnants of labels) to have once held paint removal and degreasing solvents. These solvents and degreasing materials even if originally present, have long ago dissipated and there was no discernable effect on surrounding and adjacent fauna and flora.

One acetylene cylinder was noted to be present (no. 2) but was obviously non-pressurized because it was missing (via corrosion) its entire bottom. Other cylinder-like containers were located and identified to be a combination of discarded water heaters and softeners.

Approximate field locations, labeled identifications, and relative orientations (upright and laying) for each container identified are presented in Figure 1, included with this report.

Our recommendations regarding clearing the debris are as follows:

1) Any operation must be conducted well protected from the activity of bees. This can be accomplished with protective webbing surrounding the cockpits of tractors, trucks, etc. (It would be a good idea to employ a professional exterminator prior to taking these precautions as an added safeguard).

2) Major groups of drums and containers should be carefully cleared with bulldozers and trucks. No special precautions (with the exception of the bee hazard) are necessary with respect to the 32 labeled drums/containers we located, labeled and examined. You might be aware, however, landfill disposal at the City and County Landfill at Kapaa may require triple washing of container carcasses before disposal, please check with Mr. John Lee, Chief Engineer, City and County refuse division. Should you require our intercession please don't hesitate to contact us.

3) Even under ideal conditions it is possible for us to have missed either subsurface or crushed and impacted waste hidden from a typical Phase 1 review. This should not represent a problem in the majority of cases. However, should significant amounts of this material be uncovered or noticed during the clearing operations, in particular, material containing liquids or solids of any type, you should: 1) immediately suspend operations at that specific location, concentrating your activities in other areas of the property; 2) immediately call a qualified chemist from INALAB to quickly investigate the situation before proceeding with the demolition/clearing efforts. If necessary Inalab will sample and arrange for the efficient and safe removal of any potentially occupational or environmental hazard.

4) The Transite asbestos paneling may be disposed of by first thoroughly wetting panels with water and then wrapping, either individually or in small lots (2 to 3 panels), in triple layer, 6 mil thick plastic sheets which are prominently labeled (in accordance with OSHA regulations) as containing "ASBESTOS".

If the paneling is contained in this manner (referred to as secondary encapsulation), they may be gently "finger lifted" onto a truck and disposed of without further problems in any one of the common sanitary landfills available on the island for asbestos disposal. Remember...asbestos abatement must be conducted by a State of Hawaii licenced asbestos abatement contractor (Licence # C-19). We are EPA certified to assist you in asbestos project management routines such as described above. The major occupational hazard associated with this material is that it contains potentially releasable fibers of asbestos, particularly if it is cut or crushed without proper engineering controls. As with recommendation number 3 above, should any problems or questions arise, an INALAB Industrial Hygienist should be consulted during the disposal operation.

5) As a simple safety precaution, the small amount of gasoline still present in the pumping container (#30) should be removed and recycled in non-critical gasoline burning machinery.

Sincerely,

Mark R. Hagadone
DIRECTOR, INDUSTRIAL ANALYTICAL LABORATORY, INC.

MRH:me

f: Donna8.rpt

INALAB, INC.

INDUSTRIAL ANALYTICAL LABORATORY

3615 Harding Avenue • Suite 304 • Honolulu, Hawaii 96816 • (808) 735-0422 • FAX (808) 735-0047

EPA/NBS Accredited AHERA Inspectors/Management Planners
Directed by Ph.D. Chemists, Toxicologists & ABIH Board Certified
Industrial Hygienists

Report of a Hazard Assessment Survey of 3.64 Acres on Property Located in Heeia Kea on O'ahu, Hawaii, THK 4-6-06:62, Presently Occupied by South Pacific Construction Company.

Prepared for Kobayashi, Watanabe, Sugita, Kawashima and Goda Attorneys at Law by INALAB, Inc.

10 March 1990

We have completed preliminary field investigations involving a property hazard assessment at the South Pacific Construction site at 46-640 Kamehameha Avenue, Heeia Kea, Hawaii. As a summary of our findings presented below, we do not anticipate any further analytical sampling or analyses to be necessary at this time nor do we anticipate the need to return to the location described above.

We found evidence of two minor surface spills of waste oil. We noticed one rusted drum of waste oil leaking its contents onto the asphaltic surface beneath it. This is typical of a location used for storage and maintenance of heavy equipment. You will want to inform the current occupants to contain these minor spills. They should clean them up with either steam or de-greasing surfactant cleaning before they vacate the property.

The second minor surface spill was next to the entrance onto the property. There were two five gallon pails filled with what appeared to be waste oil spilling out as they filled with rain water. This material needs to be transferred into a properly designed waste oil drum (55 gallon steel drum) and capped to prevent the intrusion of rain water. The asphalt in the area should be cleaned (as above) before the Tenant vacates the property.

We noted a large full drum of Wolmanizing compound apparently for treatment of freshly cut ends of wood structures built on site.

As this is toxic and of potential environmental concern, it will be important for this to be removed when the tenant leaves. I believe it is the tenants. We looked for spills and noted none. We believe the material has been properly carefully used and as such represents a very small potential hazard.

Within the plant or building structure situated on the property we discovered a limited amount of suspected asbestos containing ceiling material (SACCM). Remember that any demolition of this structure must address the removal of this material first, before the demolition occurs. INALAB, Inc. can handle this if you wish, but asbestos abatement is expensive and not something to consider until you absolutely need to.

We found no visual or physical indication of any potential surface contamination involving PCB fluids or other industrial chemical contaminants. We noticed no old transformers, no fluid stains, and no apparent harm to the environment from foreign substances. This is with the exception for the waste oil spillage mentioned above.

In general, we noticed no indication of any significant environmental impact from prior year operations that may have taken place. From inspections that took place in this preliminary survey, we noted no real property hazards currently present. The potential property hazards noted above were of a minor and easily correctable nature.

Our basic recommendations are:

To suggest to tenant that they take care of the waste oil spills by steam cleaning the asphalt surface area before turning over the site. Suggest to tenant that all (very minor) dumping cease and that waste oil be stored in non-leaking 55 gallon drums. These drums may then be taken to a proper disposal organization when full (Service stations will usually take waste oil if you certify that it only contains waste oil).

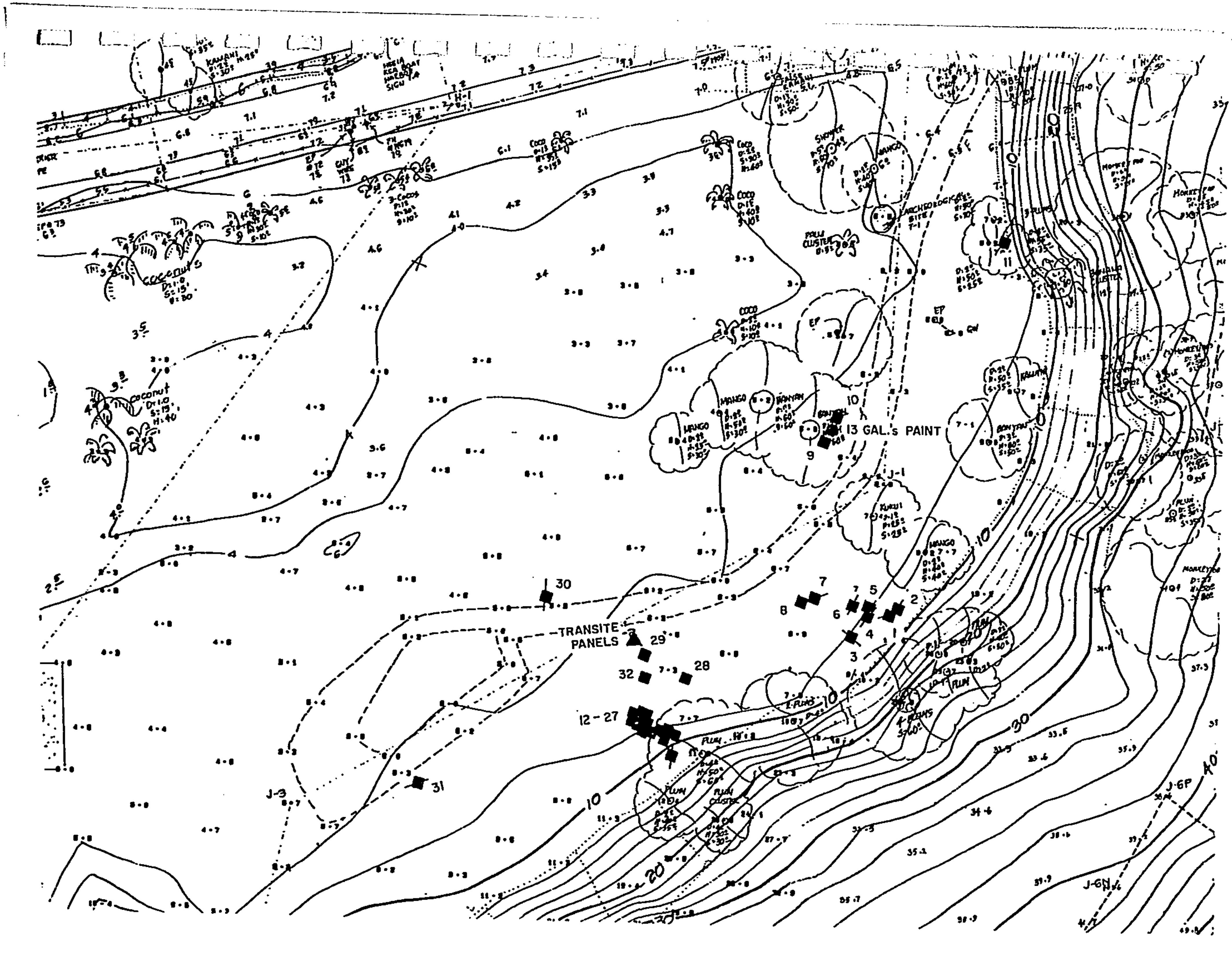
The future owner of this property should be aware that the building probably contains asbestos ceiling material in the office. They should be aware that it may potentially hamper future demolition plans. Please note that we did not confirm, through laboratory analysis, the presence of asbestos. We can do this whenever the need may arise.

We saw no surface evidence of any underground tanks, or holding structures of major concern in this screening survey.

Should there be any further questions, please don't hesitate to contact us at your earliest convenience.

Mark R. Hagadone
DIRECTOR, INDUSTRIAL ANALYTICAL LABORATORY, INC.

MRH: me
f: d:\wp5\work\donna7.rpt


13 GAL.s PAINT
TRANSITE PANELS
12 - 27
28
29
30
31
32
J-1
J-3
J-6P
J-6N
MANGO
BANYAN
COCO
COCONUT
PLUM
PALM CLUSTER
ARCHAEOLOGICAL SITE
10
20
30
40

APPENDIX O

VISUAL ANALYSIS-SECTION
Sam O. Hirota, Inc. and Helber Hastert
& Kimura Planners

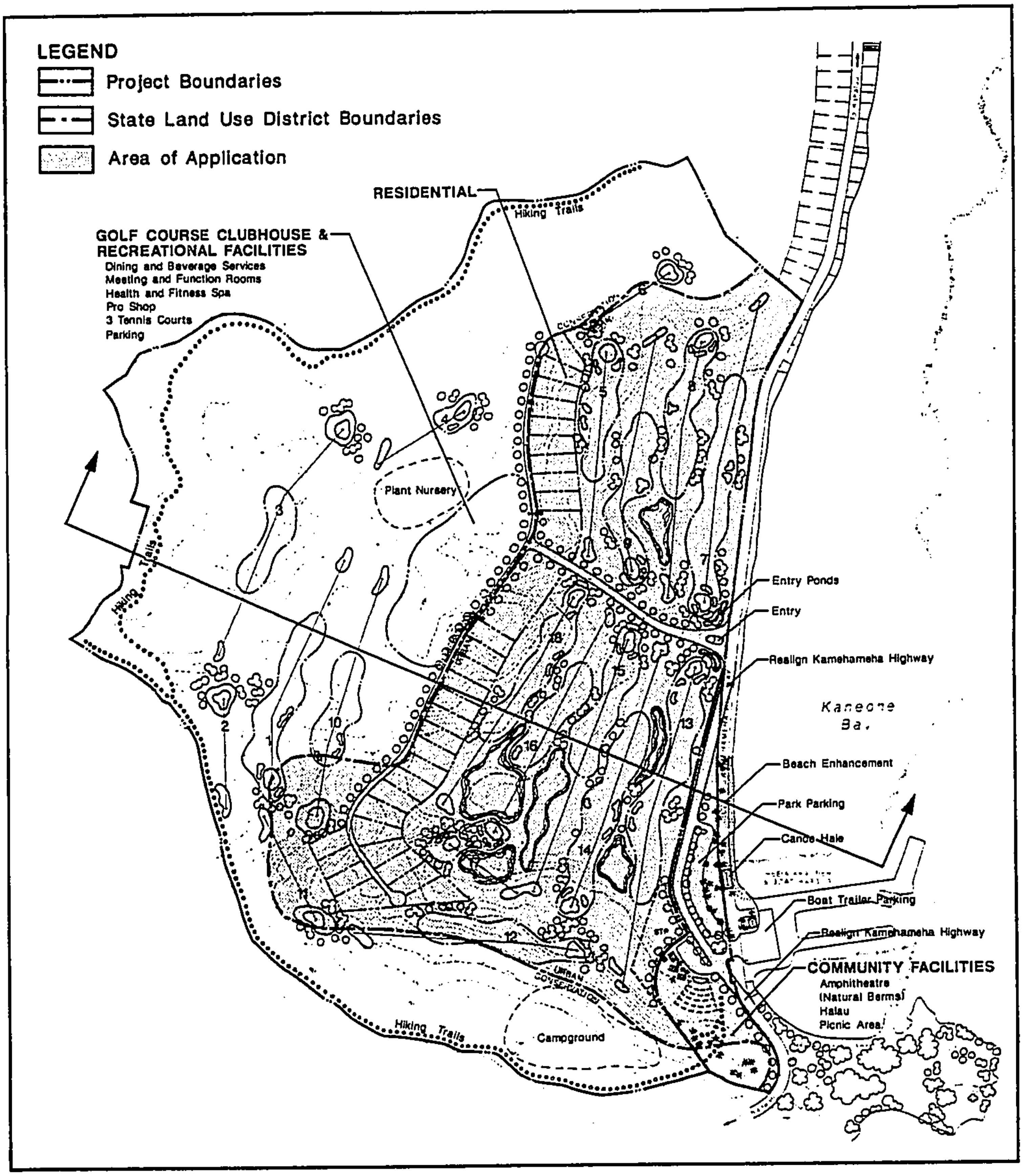


Figure 0-1: Visual Analysis
- Section Key Map

0 600
Feet

Malulani Sports Complex

NANATOMI HAWAII, INC.

HELBER, HASTERT & KIMURA PLANNERS

Malulani Sports Complex

FIGURE O-2: VISUAL ANALYSIS SECTION

0 50' 100'

SOURCE: SAM O. HIROTA, INC.

NANATOMI HAWAII, INC.

HELBER HASTERT & KIMURA, PLANNERS

73_001