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JOHN WAIHEE
GOVERNOR

February 7, 1994

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OFC. OF ENVIRONMENTAL QUALITY CONTROL
RECEIVED

TO: Keith W. Ahue, Chairperson
Department of Land and Natural Resources

SUBJECT: Final Environmental Impact Statement: Mariculture Research and Training Center, Koolaupoko, Oahu

I am pleased to accept the Final Environmental Impact Statement for the Mariculture Research and Training Center, Koolaupoko, Oahu as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

This environmental impact statement will be a useful tool in the process of deciding if the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the appropriate legislative bodies and governmental agencies to consider if the societal benefits justify the economic, social, and environmental impacts which will likely occur. These impacts are adequately described in the statement which, together with the comments made by reviewers, provides useful analysis of the proposed action.

/s/ John Waihee

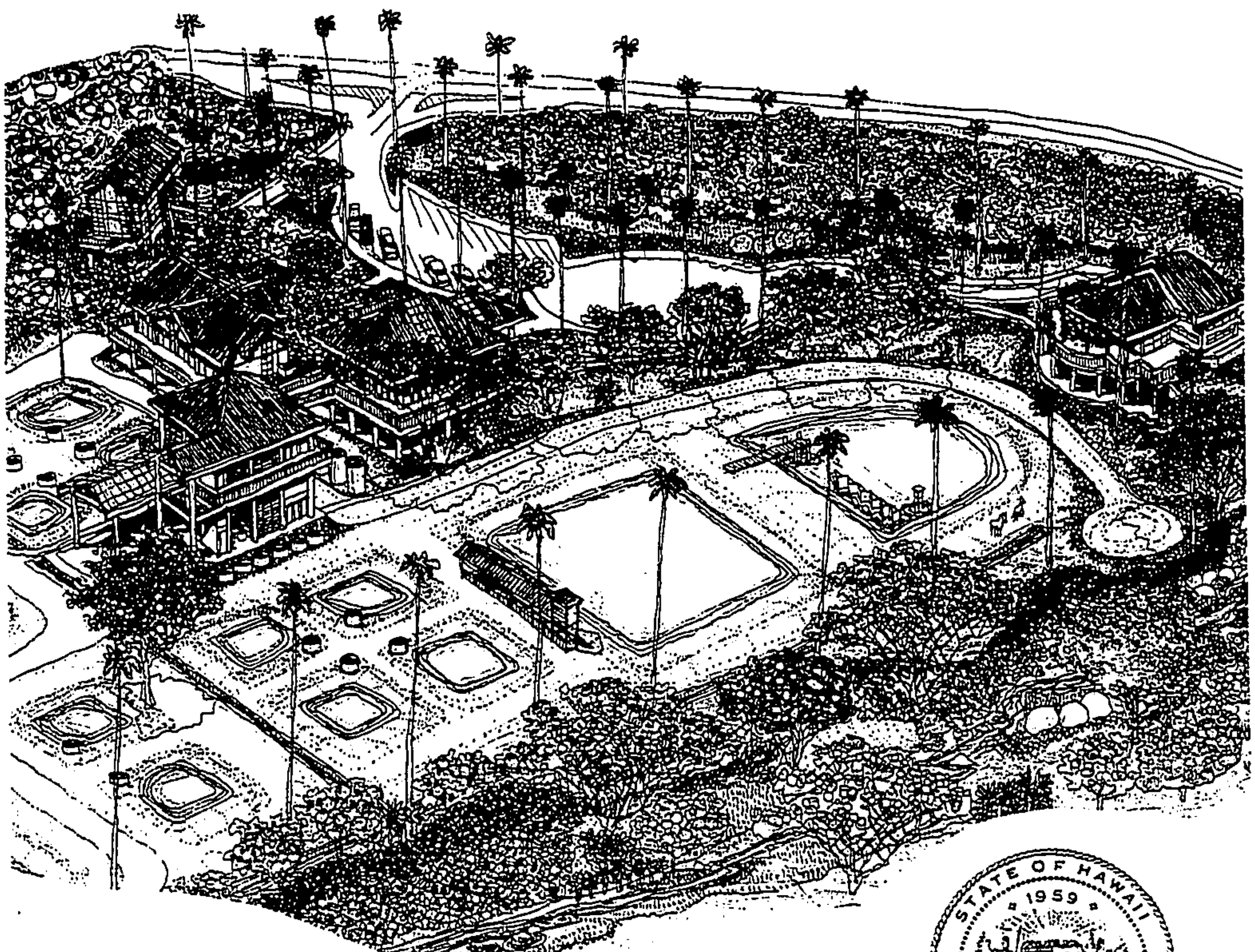
JOHN WAIHEE

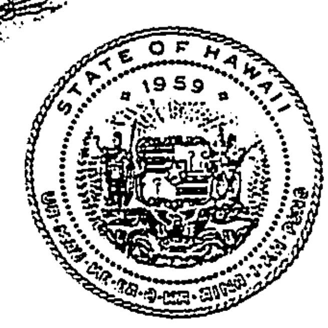
c: √ Office of Environmental Quality Control

1993 - Oahu - FEIS - Mariculture Research

FILE COPY

FINAL ENVIRONMENTAL IMPACT STATEMENT
for the
MARICULTURE RESEARCH AND TRAINING CENTER
Koolaupoko, Oahu, Hawaii





State of Hawaii
Department of Land and Natural Resources
Division of Water and Land Development
January 1994

DIVISION OF WATER AND LAND DEVELOPMENT
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE OF HAWAII

This Environmental Document is Submitted
Pursuant to Chapter 343, HRS

MARICULTURE RESEARCH AND TRAINING CENTER
Koolaupoko, Oahu, Hawaii

PROPOSING AGENCY:
Division of Water and Land Development
Department of Land and Natural Resources
P.O. Box 373
Honolulu, Hawaii 96809

ACCEPTING AGENCY:
Governor, State of Hawaii

Keith Ahue
Chairperson
Board of Land and Natural Resources

Prepared By:
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

January 1994

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PREFACE

This final environmental impact statement is subject to the EIS requirements set forth by Chapter 343, Hawaii Revised Statutes (HRS) and Chapter 200 of Title 11, Administrative Rules, Subchapter 6(b), based on a) the use of State land, b) the use of Conservation District land as classified under Chapter 205 HRS, and c) use within the shoreline area as defined by Section 205-31 HRS.

PROJECT SUMMARY

SUMMARY

THE MARICULTURE RESEARCH AND TRAINING CENTER

Proposing Agency:	The Division of Water and Land Development P.O. Box 373 Honolulu, HI 96809 Contact: Mr. Andrew Monden 587-0260
EIS Preparer:	Oceanit Laboratories, Inc. 1188 Bishop Street, Suite 2512 Honolulu, HI 96813 Contact: Ms. Robin Anawalt 531-3017
Accepting Authority:	Governor John D. Waihee State of Hawaii
Tax Map Keys:	4-9-01: 11, 12, 19, 31, 32 and portions of 14 and 18
Area:	28.3 acres
Location:	49-139 Kamehameha Highway Kaneohe, HI 96744
Ownership:	Kualoa Ranch, Inc. P.O. Box 615 Kaaawa, HI 96730 Contact: Mr. John Morgan
Leased to:	Hawaii Institute of Marine Biology Marine Science Building Room 212 University of Hawaii at Manoa Honolulu, HI 96822 Contact: Mr. Richard Longfield
Existing Uses:	Aquaculture research/production processes in commercial size ponds, education and technical training, and demonstration facility.
Proposed Action:	The action proposes to renovate an existing aquaculture research facility to create more, but smaller ponds, and to develop support facilities including an office/visitor's

center/laboratory building, a maintenance facility, a hatchery, and housing for students and manager. Continuation of current aquaculture uses on the site will preserve and maintain the open space character of the area.

The goals of the MRTC are to advance the aquaculture industry through research, education, extension, and training, while contributing to the development of new aquaculture technologies and culture species. The proposed renovation of the existing facility would help facilitate these goals. Besides use by University graduate and undergraduate educators, programs will also focus on environmental education for elementary and high school students and other public groups, including the mentally and physically challenged.

Impacts:

The beneficial impacts of the project, as intended by the DLNR Aquaculture Development Program, are to support and perpetuate a growing aquaculture industry within the State and to establish Hawaii as a leader in tropical aquaculture research.

Installation of an offshore pipeline, as part of a seawater system intake, requires dredging a shallow channel across approximately 800 feet of mudflat in Kaneohe Bay. This action will temporarily destroy benthic communities and create a silt plume during construction. Due to the nature of this back-reef area, the plume cannot be completely contained. This is not expected to create long-term adverse impacts.

Portions of currently unimproved wetland will be converted to aquaculture ponds or channels. Most of the area planned for expansion will remove some existing marsh grass and hau/mangrove jungle.

The addition of ponds may create a net increase in open wetland and improve bird habitat for several endangered waterbird species on-site. Appropriate landscaping with native polynesian plants would enhance the educational aspects of the site. Plans for re-use of freshwater effluent may provide water for adjacent agricultural uses.

Effluent from the renovated MRTC ponds will enter a proposed saltwater wetland or Managed Aquaculture Reclamation System Habitat (MARSH). The MARSH will be designed to settle solids and oxidize or absorb dissolved nutrients from the effluent prior to its discharge into the bay. Although it is anticipated that most pond effluent material will be absorbed or assimilated within the MARSH, some nutrients may enter the bay as plant litter and pieces of algae. Waters leaving the MARSH will flow either across a narrow hau/mangrove buffer by diffuse flow or through a controlled weir before entering Kaneohe Bay. The weir exit will accommodate a screen designed to remove litter, thereby improving water quality. Effluent from the MARSH will enter Kaneohe Bay and mix with the adjacent Hakipuu Stream flow as it crosses the shallow mudflat to the open bay.

Other adverse impacts resulting from the renovation project include an increased use of public utilities and infrastructure including fresh water.

Relationship to Plans & Policies:

The proposed renovation project will be carried out in harmony with various land use plans, policies and regulatory controls, including, but not limited to, the Hawaii State Plan and Functional Plans and the City and County General Plan. Specific permits and approvals that may be required for the project are listed in Chapter IV.

Alternatives Considered:

The no-action alternative would prevent a state center for aquaculture research and development from being founded until an alternate site is located. This alterative would probably cause the University of Hawaii to close the current MRTC facility and give up its lease on the property, consequentely affecting UH educational programs. Future development of the site would then be decided by Kualoa Ranch, Inc.

Any other proposal to partially implement aquaculture renovations may also include installation of a seawater intake system and a designed wetland to treat anticipated increased effluent from the site.

Unresolved Issues:

1) Obtaining fresh water through test well(s),
2) Delineation of property boundaries and renewal of lease,
3) Traffic safety measures along Kamehameha Highway,
4) Domestic wastewater treatment facility final design,
5) Seawater system final design,
6) Plan review use permit requirement, and
7) Civil defense siren requirement.

PROJECT DESCRIPTION

I. PROJECT DESCRIPTION

A. BACKGROUND

The University of Hawaii's Mariculture Research and Training Center (MRTC) is located on the windward side of Oahu at the extreme northwest corner of Kaneohe Bay and adjacent to Hakipuu Stream (see Figure 1). The Department of Land and Natural Resources (DLNR) Aquaculture Development Program (ADP) in cooperation with the University of Hawaii (UH), proposes to renovate MRTC. This renovation intends to establish a world-class facility in conjunction with a center for aquaculture research and development in Hawaii and the Pacific. The mission of MRTC includes implementing aquaculture research and technology transfer, thus enabling the facility to meet state, national and regional needs in aquaculture. In the process of promoting commercial aquaculture, Hawaii has emerged as a world leader in research, training, education, consultation, and consulting activities. To continue in this leadership role, MRTC will provide state-of-the-art infrastructure that will support long-term aquaculture development for Hawaii. MRTC would be unique in its ability to replicate pond conditions in balanced experimental studies.

The facility was operated privately by Aquatic Farms, Inc. from 1976 to 1985. Aquatic Farms, Inc. leased the land from Kualoa Ranch, Inc. and built the existing ponds and offices. The operation grew a number of species including oysters, prawns, shrimp, tilapia, and carp. Aquatic Farms, Inc. also provided training for local and foreign students and businessmen interested in aquaculture. In 1985, UH acquired the lease rights to MRTC, and the facility is now administered by the Hawaii Institute of Marine Biology (HIMB). There have been numerous research projects and several training courses and seminars carried out at MRTC since its operation by the UH.

This Final Environmental Impact statement (EIS) is being processed as an agency action by the DLNR-Division of Water and Land Development. This document describes the proposed actions, its anticipated impacts, and list comments on the EIS Preparation Notice and Draft EIS.

B. PROJECT NEED

The State of Hawaii has recognized the potential of aquaculture as a major agricultural activity. Research and development efforts at MRTC have focused on marine shrimp maturation and growout systems, polyculture systems incorporating cage-culture of hybrid tilapia in shrimp ponds, freshwater prawn production technologies, and engineering applications to increase aquaculture yields.

The long-term plan for Hawaii's aquaculture research and development calls for a network of pond facilities on Oahu and the neighbor islands. This network establishes a primary or "hub" facility on Oahu, as a focal point for aquaculture

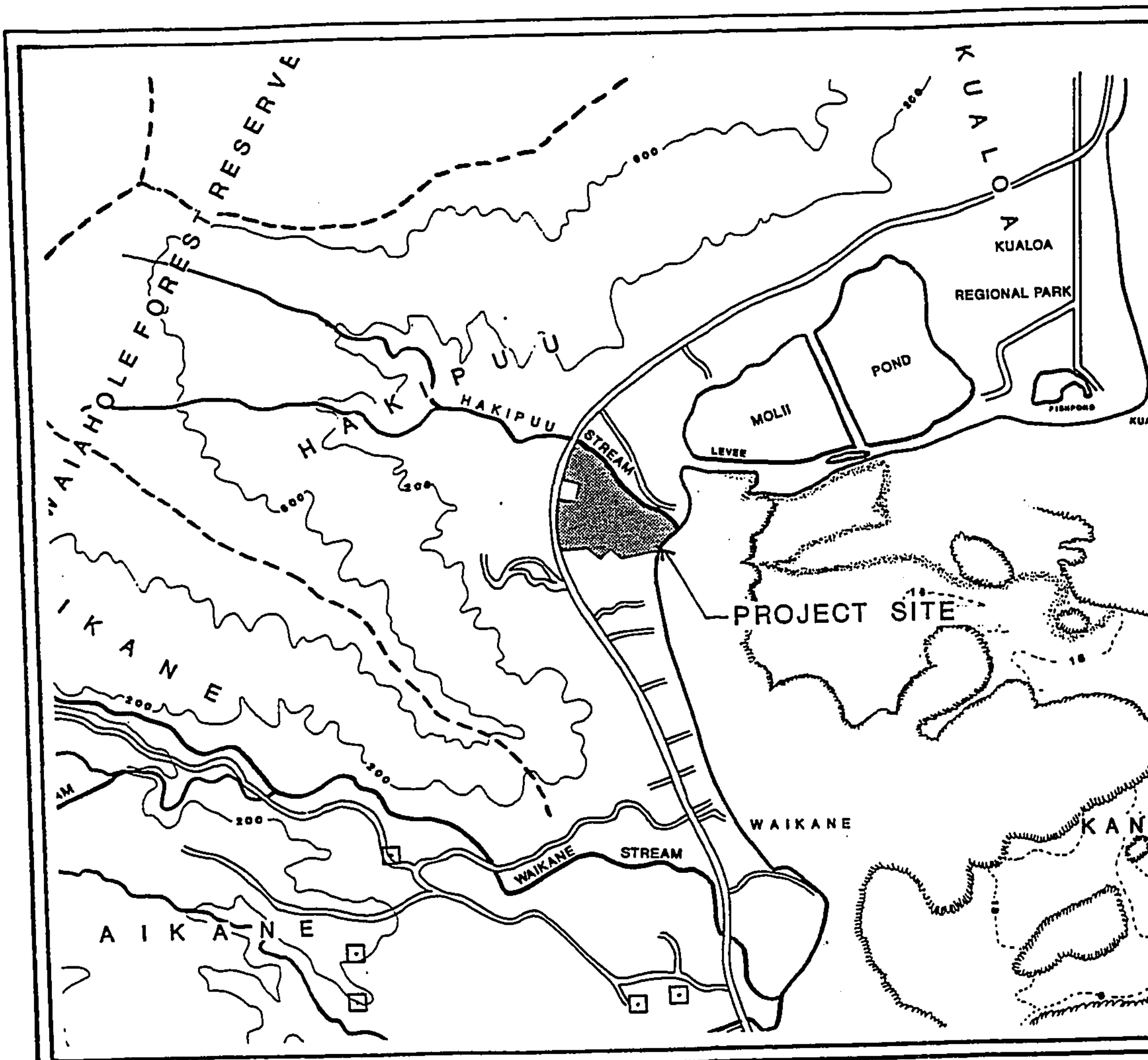
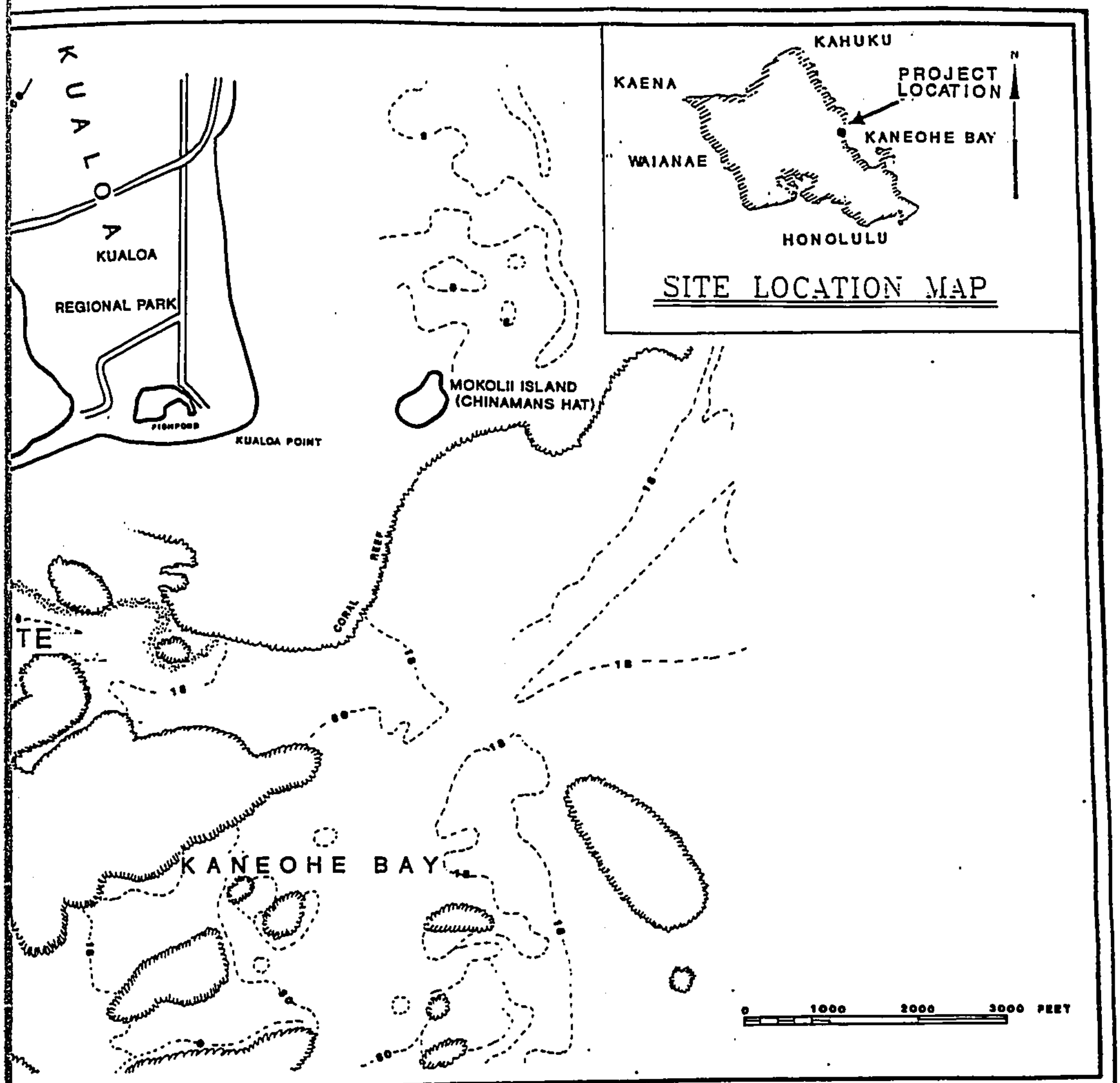


FIGURE 1. LOCATION MAP

MARICULTURE RESEARCH AND TRAINING CENTER



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development activities, such as research, training, workshops, demonstrations, community meetings, etc. The plan also specifies a series of secondary or "satellite" facilities on the neighbor islands for effective dissemination of technology throughout the state.

The renovation of MRTC would allow for freshwater, brackish water and seawater ponds to be available at one research facility. Existing ponds at MRTC (approximately 7.5 acres) were designed for a production farm and cannot accommodate proposed aquaculture research, development and training needs. There is land available to permit modest expansion of the present facility. Reconfiguration of the existing freshwater and saltwater ponds will provide greater scientific replication than is now possible.

C. LOCATION AND OWNERSHIP

MRTC encompasses a 28.3 acre site at Hakipuu; the extreme northwest corner of Kaneohe Bay (see Figure 2). The site is leased from the owner in fee, Kualoa Ranch, Inc., and is identified by Tax Map Key 4-9-01: 11, 12, 19, 31, 32 and portions of 14 and 18 (see Figure 3). Discussions are underway to renegotiate a 20-year lease and resurvey the boundary of the site for the mutual benefit of the renovated MRTC facility and surrounding landowners.

D. PRESENT CONDITIONS

The facility currently includes a laboratory, office and housing buildings, and 11 ponds. Existing infrastructure consists of fresh and salt water wells, water distribution and water quality monitoring systems, a small hatchery building, a pump house, 30 culture tanks ranging in size from four to 25 feet in diameter, and four concrete raceways. All ponds are supplied with electricity and PVC plumbing to provide fresh and salt water from shallow wells.

Since 1985, MRTC has served as a center for the UH's aquaculture research and extension activities. Extension activities are ongoing with informal interactions with commercial aquaculturists and through formal seminars jointly administered by the Sea Grant College Program and HIMB. MRTC also provides small fish fry for environmental monitoring programs of the Hawaiian Electric Company, scientific and vocational education efforts at numerous public schools, and at UH for studies on fish biology.

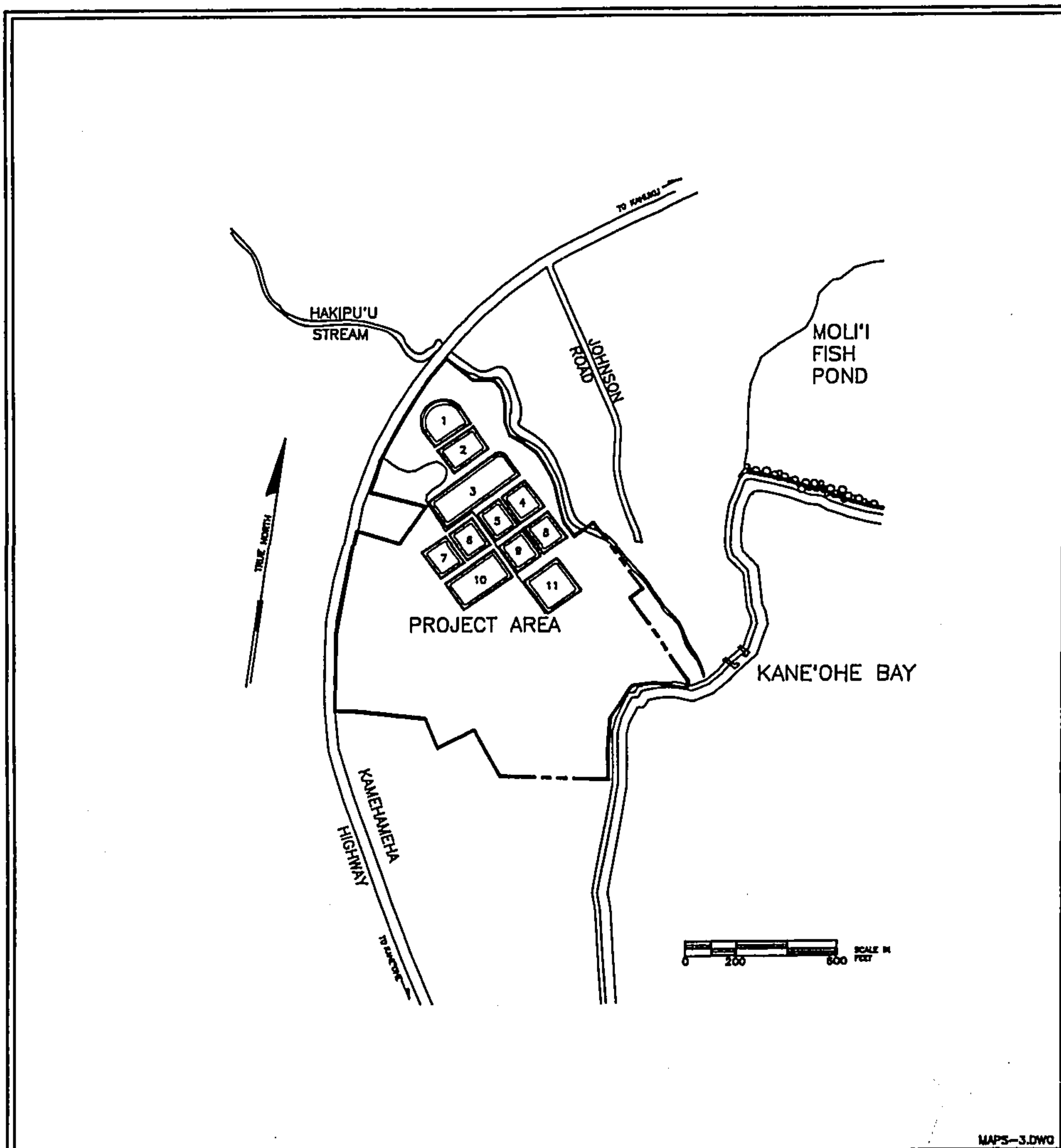

FIGURE 2. PROJECT SITE BOUNDARIES

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

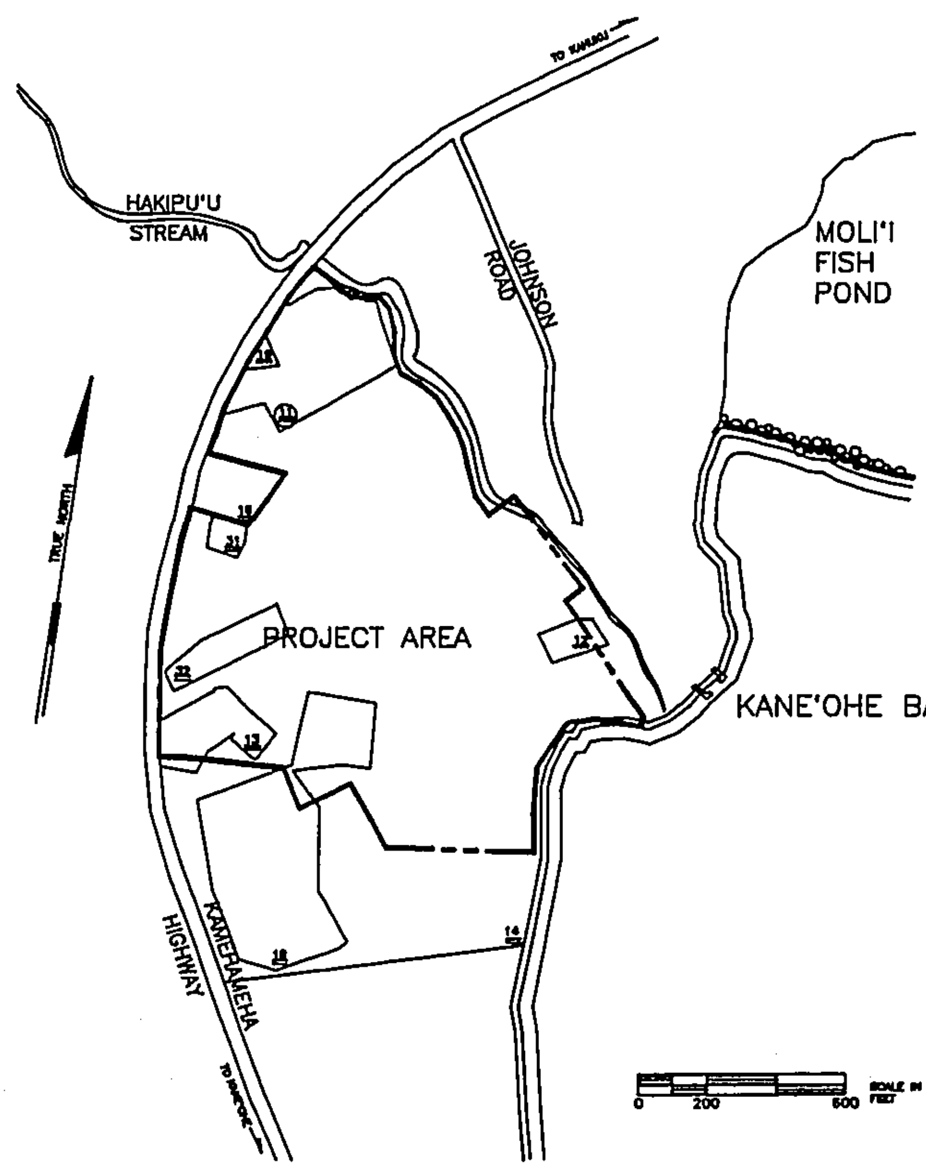

FIGURE 3. TAX MAP KEY PARCEL IDENTIFICATION

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

Species which have been cultured at MRTC are listed in Table 1. In addition to research on culture methods, some of these species are already used in natural stock replenishment programs for the benefit of commercial and recreational fishermen.

TABLE 1.
SPECIES CULTURED AT MRTC

Common name	Scientific Name
Oysters	Crassostrea sp.
Clams	Mercenaria mercenaria
Prawns	Macrobrachium rosenbergii
Shrimp	Penaeus vannamei, P. stylirostris, P. monodon
Tilapia	Various species including both red and black Tilapia mossambica
Chinese catfish	Clarius fuscus
Channel catfish	Ictalurus punctatus
Carp	Various species including silver and grass
Mollie	Mollienisia
Mosquito fish	Gambusia sp.
Tucunare	Cichla ocellaris
Snake head	Ophiocephalus striatus
Milkfish	Chanos chanos
Mullet	Mugil sp.
Native Gobi	Awaous sp.
Swordtail	Xiphophorus
Rainbow trout	Salmo gairdneri
Sailfin mollie	Mollienisia latipinna

E. PROPOSED FACILITY RENOVATIONS

The Brewer/Brandman Associates 1989 report entitled "Conceptual Planning and Alternative Site Evaluation for a Pond Research and Training Facility," stated that an advisory committee studied a "long standing, 10-year need for a large-scale research pond facility where significant research, training and demonstration projects can be carried out." With financial assistance of the Hawaii State Legislature, renovation plans and operating suggestions were gathered and reviewed. Proposed renovation plans to the existing facility were also formulated from extensive meetings within the scientific community, facility users and the surrounding neighborhood. The proposed uses include expansion of most of its present education and research activities, as well as a new role for networking with research sites on other Hawaiian islands. Detailed physical specifications have been derived for the offices, hatchery, maintenance structures, dormitories, ponds, and seawater system, and are described in the MRTC Master Plan. The utility, parking, and security requirements of the upgraded facility are also included in the renovation plans.

The three major categories of renovation activities are 1) salt water systems, 2) tanks and ponds, and 3) facilities layout. Several options have been offered for elements within each of these categories and are discussed below.

Δ Sea

1. Saltwater Systems

1.1 Intake

The average flow rate of seawater through the proposed facility is estimated to be about 1,200 gallons per minute. Aquaculture research requires seawater filtered to remove sediment and biological material larger than 50 microns. There are two possible sources of seawater for the facility; 1) saltwater wells near the coastline and 2) offshore in Kaneohe Bay. Preliminary studies have indicated that a salt water well on-site could yield silt-free water but may also have a high mineral content, variable salinity, and low oxygen levels. Bay water, although of high quality, would have to be filtered to remove suspended material and larval forms of marine organisms that could foul the water system.

Two alternative offshore intakes are proposed for the seawater system. The first method would use an open water intake located in 17 feet of water on the ocean side of Hakipuu Sandbar in Kaneohe Bay. Water from the open water intake would be filtered on-land using commercially available filters. The other alternative is to bury a seawater intake gallery in offshore sand formations, such as Hakipuu Sandbar, and use the sand as a natural filter. The alternative use of Hakipuu Sandbar as a seawater intake filter would eliminate the need for additional filtration except for the hatchery. Although it is probable that the volume and depth of Hakipuu Sandbar changes in multi-year cycles, the actual position of the sandbar body has been fairly stable. Aerial photographs taken prior to WWII show the sandbar in essentially the same position. The sandbar, however, could be subject to future erosion, due to shoreline stabilizing measures taken at adjacent Kualoa Beach Park.

In either case, the seawater intake would be located over 1,500 feet offshore from the MRTC site (see Figure 4). A pipeline will be required to transport water to the facility. A bundle of three to five high density polyethylene (HDPE) pipes will be buried below the surface in the mudflat and back reef sediments between the shore and the reef edge. The offshore pipeline will connect to a pumping facility just on-shore which will consist of a small building providing shelter and noise insulation for three pumps. The pumps will distribute seawater to both the ponds and hatchery through a network of underground pipes. In addition, a small booster pump and filtration system will be provided to service the hatchery and the upper level ponds. Construction methods incorporating sound environmental management practices will be used to lay the pipeline and install the intake manifold.

If the sandbar intake is selected, an excavation approximately 85 feet long, 50 feet wide, and 4 feet deep will be dredged in Hakipuu Sandbar for the intake gallery. This excavation will require dredging equipment capable of working in less than 3 feet of water. The intake is installed as a horizontal gallery in the sandbar. Parts of the intake gallery will be assembled on-shore and transported to the excavation by boat. Final assembly will be done underwater. The gallery will be installed with a gravel filter surrounding the intake screens, and the excavation will be back filled with the previously dredged sand.

Use of the sandbar for filtration may pose a deterrent to any State, County or private effort for use of the sandbar as a sand mining source for beach replenishment. However, because such use of shallow sand reservoirs is prohibited by state law, the use of the sandbar as an intake is in agreement with the long-term goals of the State (205A-44 HRS).

The HDPE intake pipes will be assembled on-shore. Concrete anchors will be fastened to the pipes at pre-calculated intervals. Alternately, two additional pipes will be deployed and then filled with pumped concrete

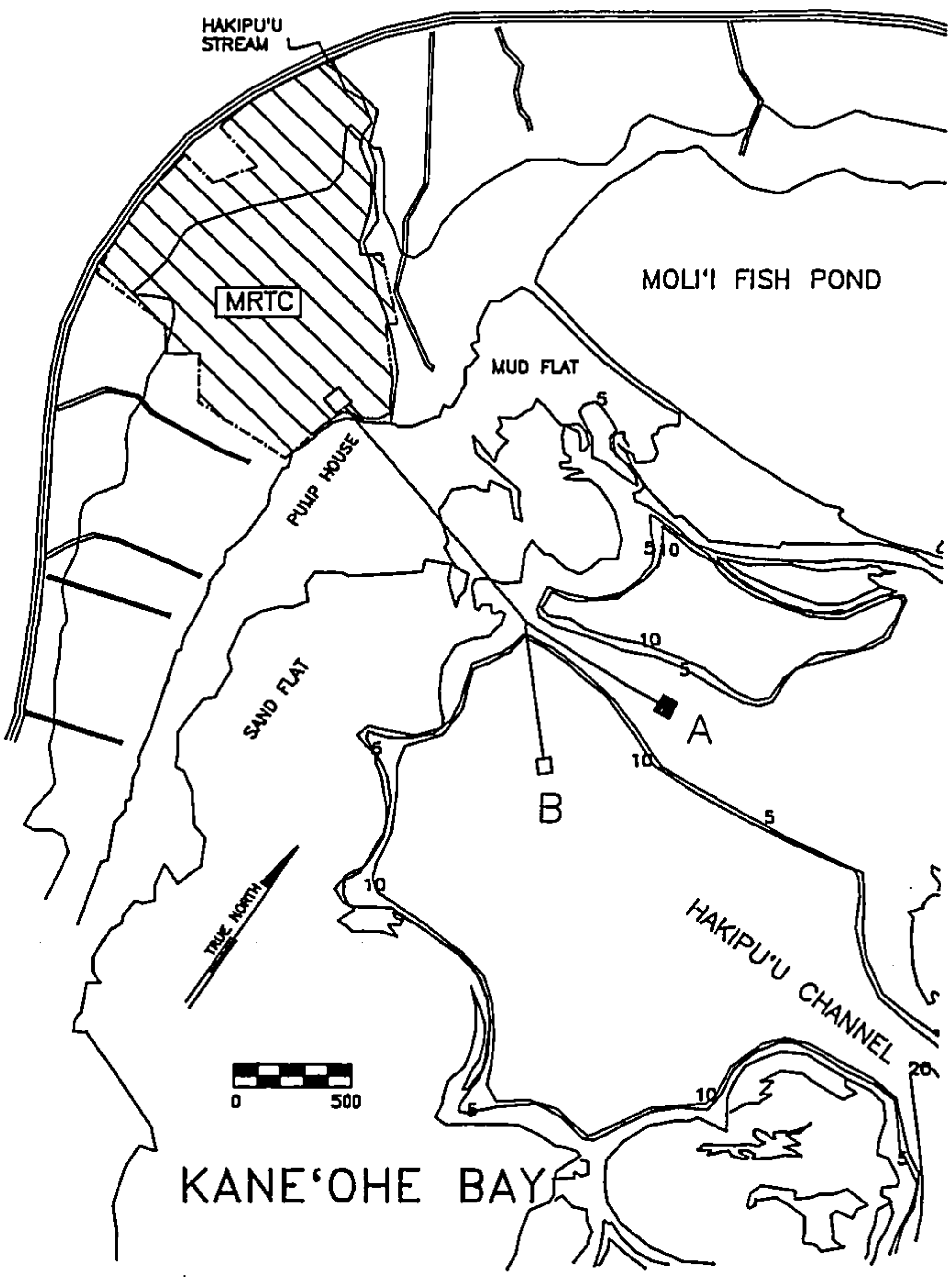

FIGURE 4. SEAWATER OPTIONS : A) BURIED INTAKE B) OPEN INTAKE

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

grout to act as anchors. The pipes will be filled with air, floated into position, and sunk by releasing the air and filling the pipes with water.

A buried intake is similar in concept to a water well; water is pumped through the sand, a gravel bed and through a well screen surrounding each intake pipe. For normal operation, seawater is pumped continuously to provide flow to the ponds and hatchery. Flow to each pond can be controlled in three ways; valves at the ponds, running one to three pumps, or by changing the pump bypass flow. Proper control will result in maximum pump efficiency and operating life. Pumps and bypass valves will be controlled in the pump house by an automatic system to regulate flow conditions and to prevent over pressure in the distribution pipes.

1.2 Seawater Effluent Drainage System

The effluent drainage system was designed to address the following requirements:

- Drain pipes should be resistant to internal blockage.
- Harvest area(s) should be provided.
- All ponds should have central standpipe drains with optional drain control near the bank and above the main drainline.

To accomplish the above, design of a system of interconnected open drainage/harvest channels and buried drainage pipes is necessary. One channel is proposed to run parallel to the topography of the land just below the first series of 1/10 acre ponds and will connect to a channel running parallel to Hakipuu Stream, down grade until it empties into a settling pond. This channel, proceeding down grade, will also receive drainage from other ponds. The channel will consist of a wide (5-8 foot) flat concrete slab with a plastic drainage trough down the center. This system allows the upper channel area to be used as a harvest basin while still allowing water from other ponds to pass in the trough underneath. Quarter acre ponds will drain through 8-inch pipes to a common 12-inch drain line that flows to one of three harvest stations at the lower end of the facility.

1.3 Settling Ponds and Designed Wetland

Approximately two acres of existing wetland, mangrove, hau and California grass between the ponds and the shoreline will be converted to a designed saltwater wetland called a Managed Aquaculture Reclamation System Habitat (MARSH).

The purpose of the MARSH is to remove sediments and nutrients from aquaculture effluent, and minimize runoff entering Kaneohe Bay. Effluent waters from aquaculture facilities may carry high levels of particulate matter and dissolved nutrients. Water leaving the ponds would be cleaned by passing through the MARSH. Although numerous wetlands have been constructed and successfully operated to treat fresh or brackish water effluent from domestic and aquaculture sources, similar systems have not been designed for seawater effluent treatment. The MRTC effluent control MARSH will be the first in the State of Hawaii designed to operate under high saline conditions.

Water drainage from the aquaculture ponds will enter one of two 16-foot deep settling ponds with a 4 hour average residence time. These two ponds will serve to remove initial unfiltered solids from the pond effluent. The ponds are designed so that additional silt removal techniques, such as biofiltration by racks of oysters, could be incorporated in the future. Effluent from these two settling ponds will enter a common channel. The proposed long, narrow (9' X 1200'), rock-lined channel will be approximately 3-feet deep and bordered on either side by a twenty-foot wide shallow area planted with salt-tolerant plants such as pickleweed and seashore paspalum. A proposed maintenance road for trucks and other utility vehicles will service the ponds.

The channel will wind through the low-lands of the site. Residence time in the channel will be at least 6 hours at low water height and up to 48 hours at maximum water height. Ogo and other benthic/indigenous algal species, such as Ulva, Acanthophora, Dictyota, Padina, Hypnea, and other species of Gracilaria may be grown in the central channel to remove nutrients from the effluent before it flows across a weir into Kaneohe Bay. Algae may be harvested periodically and used as fish food or processed by drying to produce soil additive products which may be sold or used on the project site grounds. Occasional harvest of land plants (mangrove, pickleweed, etc.) will minimize the release of plant waste into the ocean.

Outfall from the MARSH would be controlled either through a weir dam or by diffuse flow across a 20 to 30 foot wide hau/mangrove buffer between the wetlands and the bay. The weir dam can control water flow by either diffusing flow across a wide flat area or into a single outlet capable of pulsed flow. The MARSH is designed with a "pulsed" outflow option to take maximum advantage of tidal currents and dilution. With pulsed outflow, the natural environment would be subjected to effluent only during outgoing tides. Under the diffuse outflow regime, the MARSH saltwater wetland would overflow across a 20 to 30 foot wide hau\mangrove buffer extending along the entire ocean frontage. Measurements of nearshore currents indicate that water from the adjacent Hakipuu Stream flows diagonally out into the bay. Coral populations and general reef fauna are scarce along this reef edge, probably as a long-term result of Hakipuu Stream runoff. Effluent from MRTC would follow this same general flow pattern.

2. Ponds and Tanks

The proposed renovation will create 17 quarter-acre ponds, 16 tenth-acre ponds and a "tank farm" with small (10-20 foot diameter) above-ground circular tanks. The square ponds will be of earthen construction with a bank slope of 1:3. Each pond will have a primary central stand-pipe drain and a secondary control drain at one corner. A round, above-ground (8'-15' diameter) holding tank at one corner of each pond will facilitate various pond operations. Ponds 1 and 2 will retain their existing half-acre size and will only be used for fresh water cultivation.

3. Facilities Layout

Two site layouts and building designs were proposed and the ultimate site plan was derived from these (see Figure 5). The exterior building character will be designed to blend with the rural area. The primary buildings will be limited to two stories in height and to the upper portion of the property outside of the flood zone. Project designers are taking advantage of the site's natural slope away from the road to limit building height to a single story visible from the road. Impacts to coastal views are not anticipated. The existing foliage buffer will be maintained whenever possible between the road and the facility.

3.1 Structures

The Ultimate Site Plan concentrates all buildings in one section of the property (see Figure 5). The heights and square footage of all proposed structures are summarized in Table 2. Note that buildings represented in Table 2 are in the schematic design stage, thus area calculations and building heights are approximations as elevations have not been developed for most buildings. The student housing will be designed during phase II construction to allow on-site sleeping quarters for approximately 6 graduate students whose research requires close proximity to experimental tanks. Accommodations for up to 10 additional students enrolled in short-term (1-2 week) courses will be made during phase III construction. The existing maintenance area will be temporarily relocated to the basement of the graduate student structure during phase II construction and permanently moved to its own structure during phase III construction.

TABLE 2.
HEIGHTS & SQUARE FOOTAGE OF PROPOSED STRUCTURES

Ultimate Site Plan:	Building Height: (ft)	Building Area: (sq.ft)
Administration/Visitors/Hatchery	25	8104
Maintenance Building	15	2200
Manager/Guest Residence	20	2321
Graduate Student Housing	20	5352
Main Seawater Pump Shed	10	100
Booster Pump Shed	10	80
Backup Electrical Generator	10	960
Pump/Feed Building	10	300

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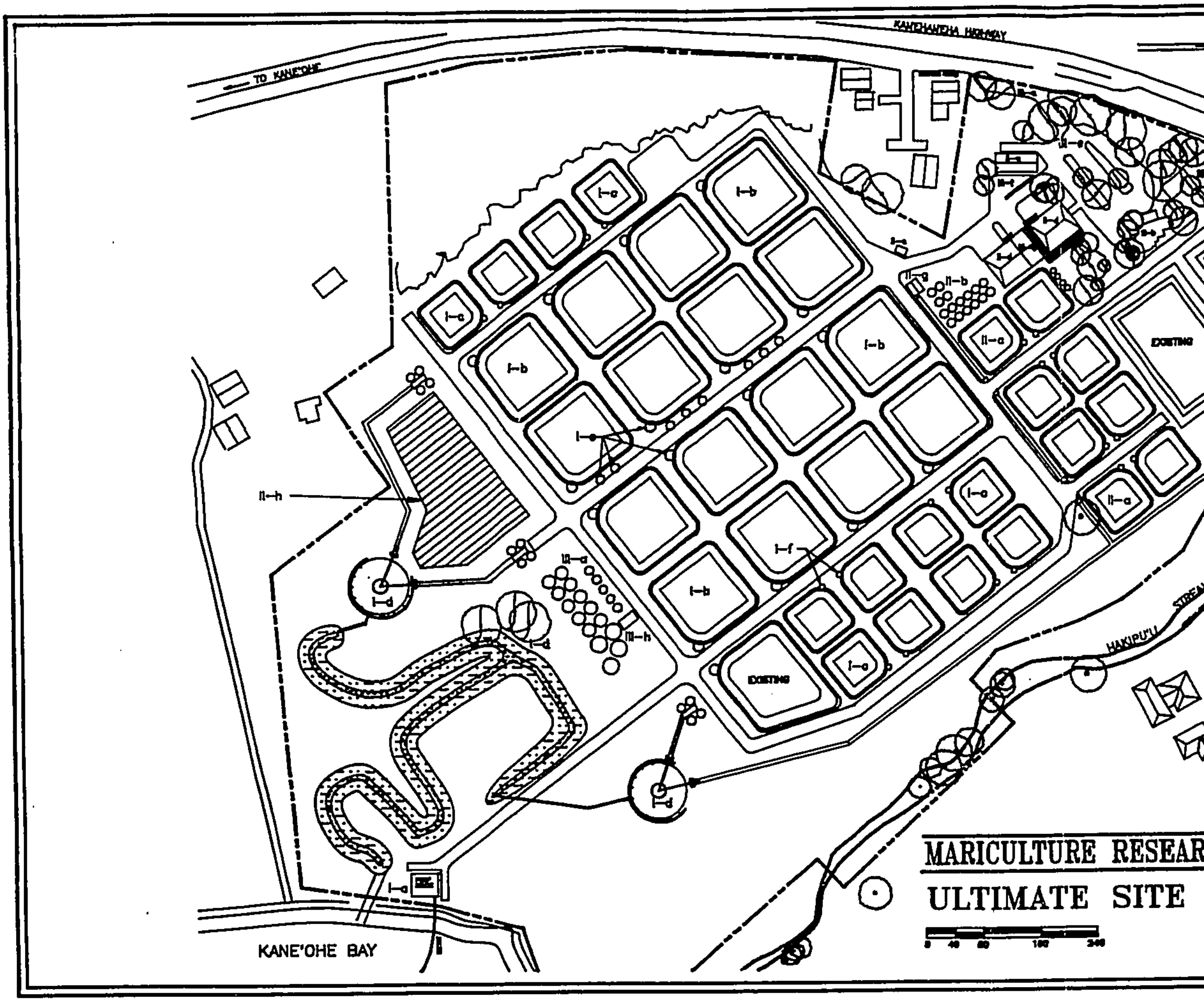
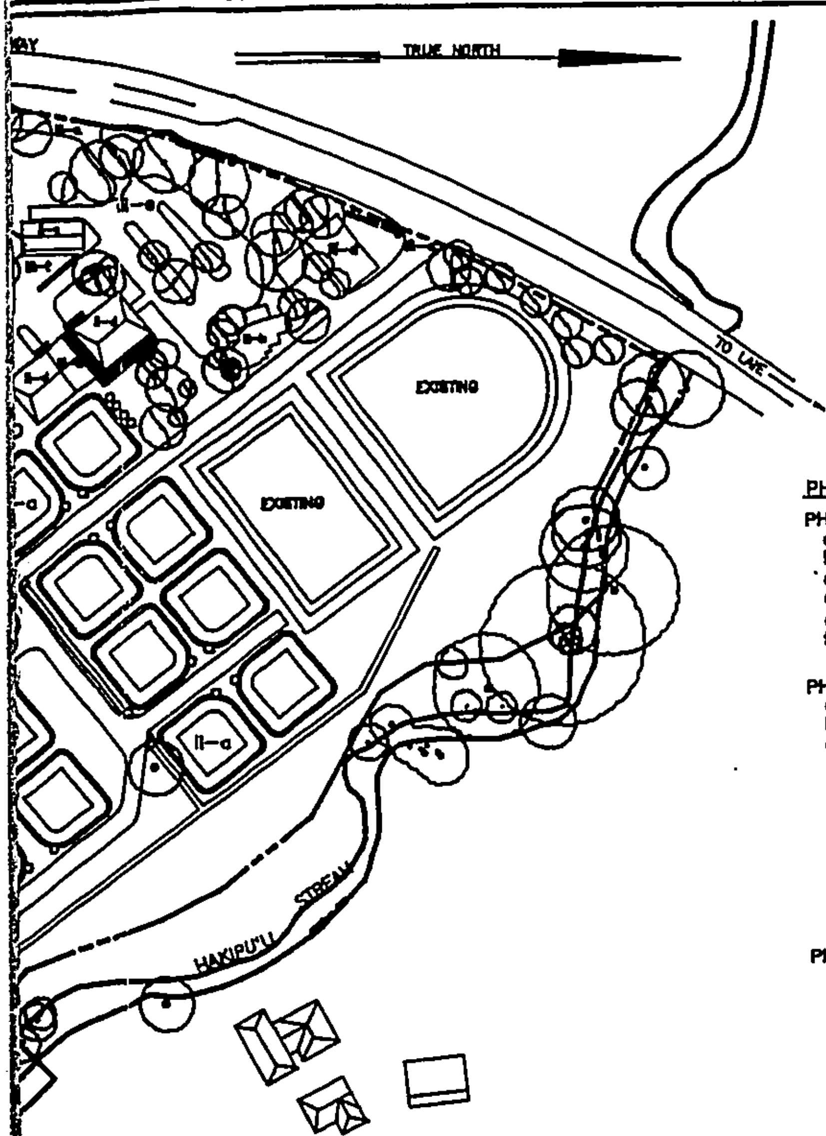


FIGURE 5. ULTIMATE SITE PLAN

MARICULTURE RESEARCH AND TRAINING CENTE



SITE LOCATION MAP

PHASING PLAN

PHASE I
a SEAWATER INTAKE SYSTEM
b 17-QUARTER-ACRE PONDS
c 12-TENTH-ACRE PONDS
d MARSH SYSTEM
e 17, 18' TANKS ADJACENT TO PONDS
f 20, 8' TANKS ADJACENT TO PONDS

PHASE II
a 3 TENTH-ACRE PONDS
b TANK FARM FRONTING ADMINISTRATION/HATCHERY/VISITORS BLDG
c MOVE AND RENOVATE STUDENT HOUSING
d MAIN BUILDING
1ST FLOOR - CLASSROOM & EDUCATION CENTER
2ND FLOOR - HATCHERY, WET LABS, & LARVAL REARING
2ND FLOOR - UNFINISHED LABORATORY AND OFFICES
e SEWAGE TREATMENT
f FRESHWATER WELLS & HEADER TANK
g FEED STORAGE & PUMP/AEREATOR/FILTER HOUSE
h LEACH FIELD

PHASE III
a 16, 12' TANKS IN TANK FARM
b MANAGER'S RESIDENCE
c LABS AND OFFICES IN ADMINISTRATION/HATCHERY/VISITORS BLDG
d MAINTENANCE BUILDING
e PARKING LOT & ASPHALT ROADWAYS
f VISITING STUDENT DORMITORY
g PAVE & COVER TANK FARM NEAR ADMIN. BLDG.
h RENOVATE EXISTING TANK FARM

CULTURE RESEARCH AND TRAINING CENTER

IMATE SITE PLAN

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G CENTER

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3.2 Domestic Wastewater Treatment

Now

A secondary wastewater treatment system is proposed on the MRTC site. The level of treatment will consist of a primary settling tank, an aerobic unit, a clarifier and a chlorinator to handle a maximum flow rate of about 3,000 gallons per day. Although the number of permanent residents at the site will probably average less than six people, the system shall be designed to handle the peak flow of day-time workers, researchers, students, and intermittent school-bus tours. The unit size recommendation is based on the flow estimates given in the table below:

TABLE 3.
PROJECTED DOMESTIC WASTEWATER FLOW

# People or Bedrooms	Flow/unit (Gal./day)	Total Flow (Gal./day)
25 employees	25	625
30 visitors	10	300
6 bedroom student	200	1200
4 bedroom residence	200	800
TOTAL		2925

Secondary level of treatment, which also includes primary treatment, consists of removal of large suspended solids, reduction of biological oxygen demand (BOD) by aeration, and partial disinfection of effluent through chlorination.

Secondary treatment of effluent is required by the State Department of Health Wastewater Branch and may be achieved through the use of a commercially available plant system package. Typically, the primary unit includes a settling tank and clarifier, while the secondary unit consists of an aerobic unit and clarifier. A chlorinator provides disinfection after the effluent passes through the primary and secondary treatment units (see Figure 6).

The primary settling tank allows solids to settle by gravity. The solids are retained in primary settling chambers while the liquid effluent passes to the secondary aerobic unit. Air pumped through the wastewater in this chamber, allows aerobic bacteria to break down the waste. The waste breakdown product consists primarily of carbon dioxide, dissolved nitrates and sulfates. The clarifier chamber removes the waste products of the aerobic unit. Effluent in the clarifier is disinfected as it passes over chlorine tablets and enters a pipe leading to the leach field. The leach field is a system of buried perforated pipes. The pipes disperse effluent over a broad area so that it may seep slowly into the soil. A percolation test conducted during the design stage will determine the permeability of the soil and the functional size of the leach field.

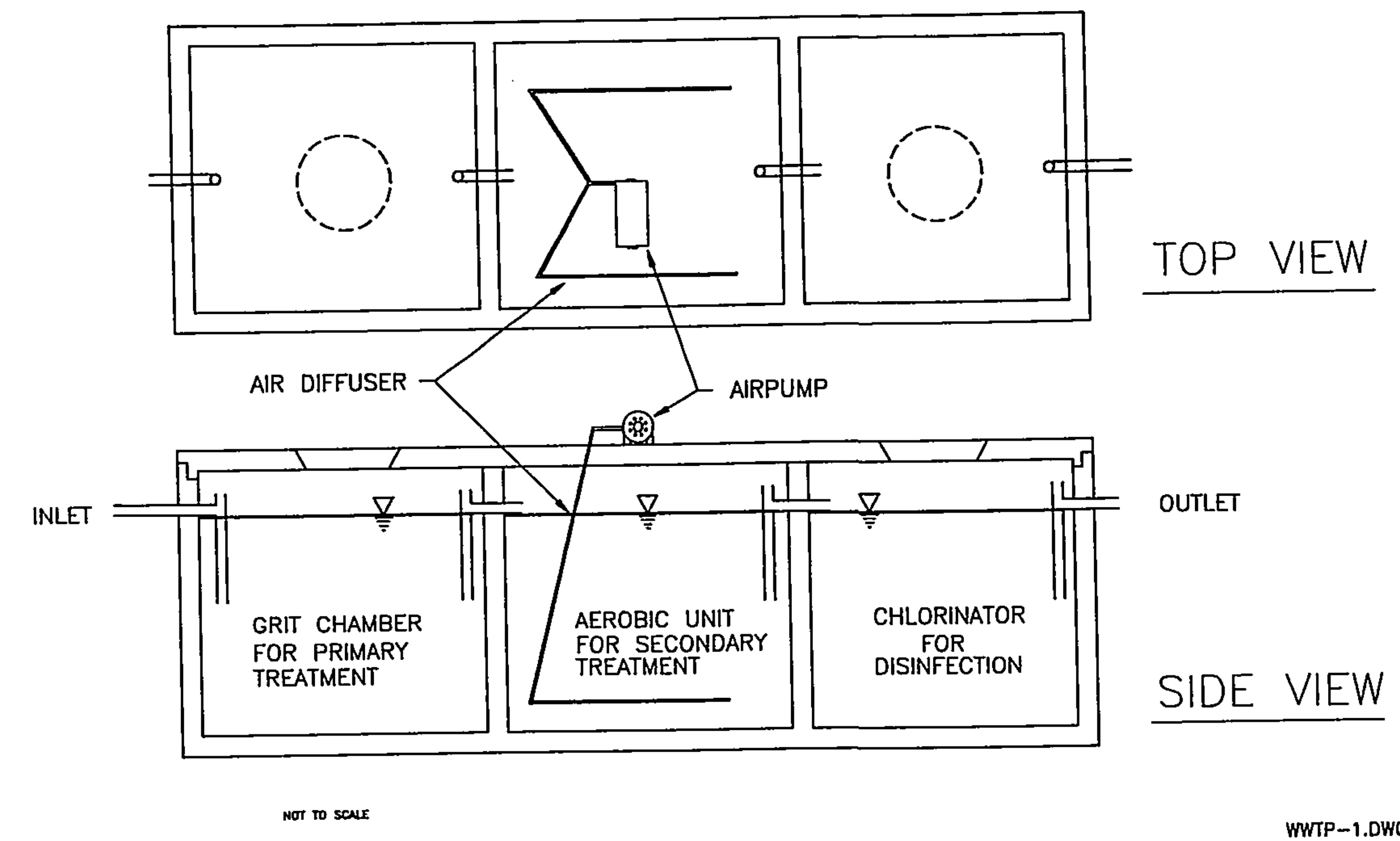

FIGURE 6. CONCEPTUAL DIAGRAM OF SECONDARY WASTEWATER TREATMENT PROCESS

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PHYSICAL ENVIRONMENT

II. PHYSICAL ENVIRONMENT

A. REGIONAL OVERVIEW

Oahu is the third largest island in the State of Hawaii. Its 593 square miles comprise 9.4 percent of the State's total area. It is the most populous of all the islands, with about 80 percent of the population, and includes the State Capitol of Honolulu.

The project site lies within the Hakipuu "ahupua'a", a small valley at the northern-most corner of Kaneohe Bay. The Hawaiian term "ahupua'a" indicates a self-contained, usually pie-shaped, piece of land that extends from the mountain ridge to the sea. The Kaneohe area is generally divided into a string of "ahupua'a," side by side, resting in deep amphitheater valleys and divided on the mauka (towards the mountain) side by precipitous cliffs which join to form the Koolau ridge. The valley divides are steep-sided ridges of basalt that extend to the northeast and are perpendicular to the Koolau ridgeline.

Hakipuu Valley lies between Waikane Valley, to the south, and Kualoa and Kaaawa communities to the north. Hakipuu Stream flows about 4,000 feet through the center of the valley and arises from several springs at about the 300-foot elevation. The project site is abutted by Hakipuu Stream to the northeast, Kamehameha Highway to the west, and Kaneohe Bay to the east.

B. CLIMATE

Average annual rainfall in Hakipuu Valley varies from 75 inches per year at the coast to nearly 150 inches per year at Puu Ohulehule at the top of the valley. There are significant differences in average rainfall throughout the year. Most rain falls during the period from November to May, although brief intermittent showers are common throughout the year. Temperatures at the project site are relatively constant throughout the year, with an average maximum ranging from 75 degrees Fahrenheit in December-January to 82 degrees Fahrenheit in August-September. Average minimum nighttime temperatures range from 62 degrees in December-March to 70 degrees in August-September.

The prevailing wind throughout the year is the northeast trade wind. The northeast trades are more persistent in summer than winter, averaging 90 percent in summer and about 50 percent in winter. Kona winds, more common in the months from October to April, are southerly and frequently associated with storm activity. Winds at the project site are generally moderate. Wind velocity rarely exceeds 20 miles per hour.

C. LANDWARD ENVIRONMENT

1. Geology and Hydrology

Windward Oahu rests on the interior fringe of an ancient volcanic crater. The present Koolau mountains represent a small segment from the fringe of the crater. Remnants of the crater rim form the Koolau mountain range; sculpted by erosion into a series of valleys and bays. Hakipuu Valley extends from Puu Ohulehule at the crest of the Koolaus to the edge of Kaneohe Bay.

The surface geology of the project site and surrounding area consists of a fairly thick soil layer underlain by alluvial sediments washed down by Hakipuu Stream. The sediments underlying the property consist of inter-fingered alluvial clay, silt, gravel, and marine clays. The marine clays may be interspersed with calcareous sands and gravel swept in from the reefs of the outer bay. Much of the land formation makai (seaward) of Kamehameha Highway likely resulted from alluvial fan stream deposits. Since 1922, when the highway bridge was constructed, stream flow has been restricted to the bridge under-crossing. Aerial photographs and maps of the area show an alluvial fan formed by Hakipuu Stream protruding into Kaneohe Bay. It is quite likely therefore, that the peninsula and the surface soils on both sides of the stream consist of layered deposits of stream bed materials and surface soil buildup of unknown depth over bedrock and dike complexes.

Groundwater on-site consists of a shallow aquifer fed directly from Hakipuu Valley rainfall, and a deep aquifer tied into the Koolau-Dike system. Because of the low elevation and proximity to sea level, the shallow water aquifer is presumed to be near the surface of the ground. The water level ranges from about ten feet below the surface at the highest point to ground level at several locations around the project site. Based on preliminary estimates, the shallow aquifer may not be adequate to support the fresh water needs of the facility. Tapping the deep aquifer for fresh water usage is under consideration and is discussed further in Chapter VII (Summary of Unresolved Issues). Appendix G provides a more detailed description of groundwater in Hakipuu Valley.

It is assumed that a deep aquifer (Koolau dike) exists within the basalt underlying Hakipuu Stream deposits. The source of water within the basalt probably extends beyond Hakipuu Valley and provides a greater resource upon which to draw. The deep geology of the site and the magnitude of the fresh water resource cannot be determined without construction of test well(s).

Hakipuu Stream, bordering the project site, originates at several springs at an elevation of about 300 feet in Hakipuu Valley. The stream is classified by the State as seasonal and intermittent, but it may be more accurately described as perennial with considerable variations in flow throughout the year. Droughts, for instance, reduce the flow. Above the highway, stream flow increases as one moves seaward, resulting from groundwater seeping into the stream bed. The stream bottom intersects the water table along the length of the MRTC property.

2. Topography and Drainage

Hakipuu Valley forms a well defined drainage basin of about 740 acres, isolated by distinct ridges from the adjacent valleys of Kaaawa and Waiahole-Waikane (see Figure 1). The topography of the area is dominated by the 2,265-foot peak Puu Ohulehule, the slopes of which define the mauka portion of Hakipuu Valley.

The project site slopes gradually towards the sea and has a maximum elevation of approximately 45 feet at Kamehameha Highway. The site drops to sea level over a distance of 1,500 feet; an average slope of about three percent.

Hakipuu Stream occupies a channel 30 to 50 feet wide and lies three to eight feet below the stream bank. Characteristics of the stream vary from the upper to the lower portion of the property. The top portion of the stream from the highway to about 800 feet downstream (adjacent to pond 10) is fairly steep (3% slope) with water flowing between occasional small pools. The stream bed falls from the 28-foot elevation (at the bridge) down to an elevation of seven feet about 800 feet from Kamehameha Highway. The stream bed has been eroded about 4 feet as evidenced by a pipe placed at streambed level by Aquatic Farms in 1976. Flood water discharge is very rapid along this stretch and has caused erosion of the bank, particularly along the Johnson Road side of the stream.

Along the approximately 700-foot length of the lower stream, the bed is choked with California grass and has a very slight slope to the sea (1%) as it drops the remaining seven feet. At the shoreline, the stream enters a thicket of hau and mangrove. On the ocean side of the mangrove thicket, a fairly recent alluvial fan has been formed from stream bed materials, and is rapidly being colonized by seedling mangrove.

3. Flood Hazard

The project site is located adjacent to the Hakipuu Stream outlet in the Hakipuu Valley drainage basin. Flood hazards along the lower reaches of the stream are characteristic of flood plain deltas and are related to the shallow stream bed, low slope, and increased foliage encroachment of the stream(s). An 1851 land

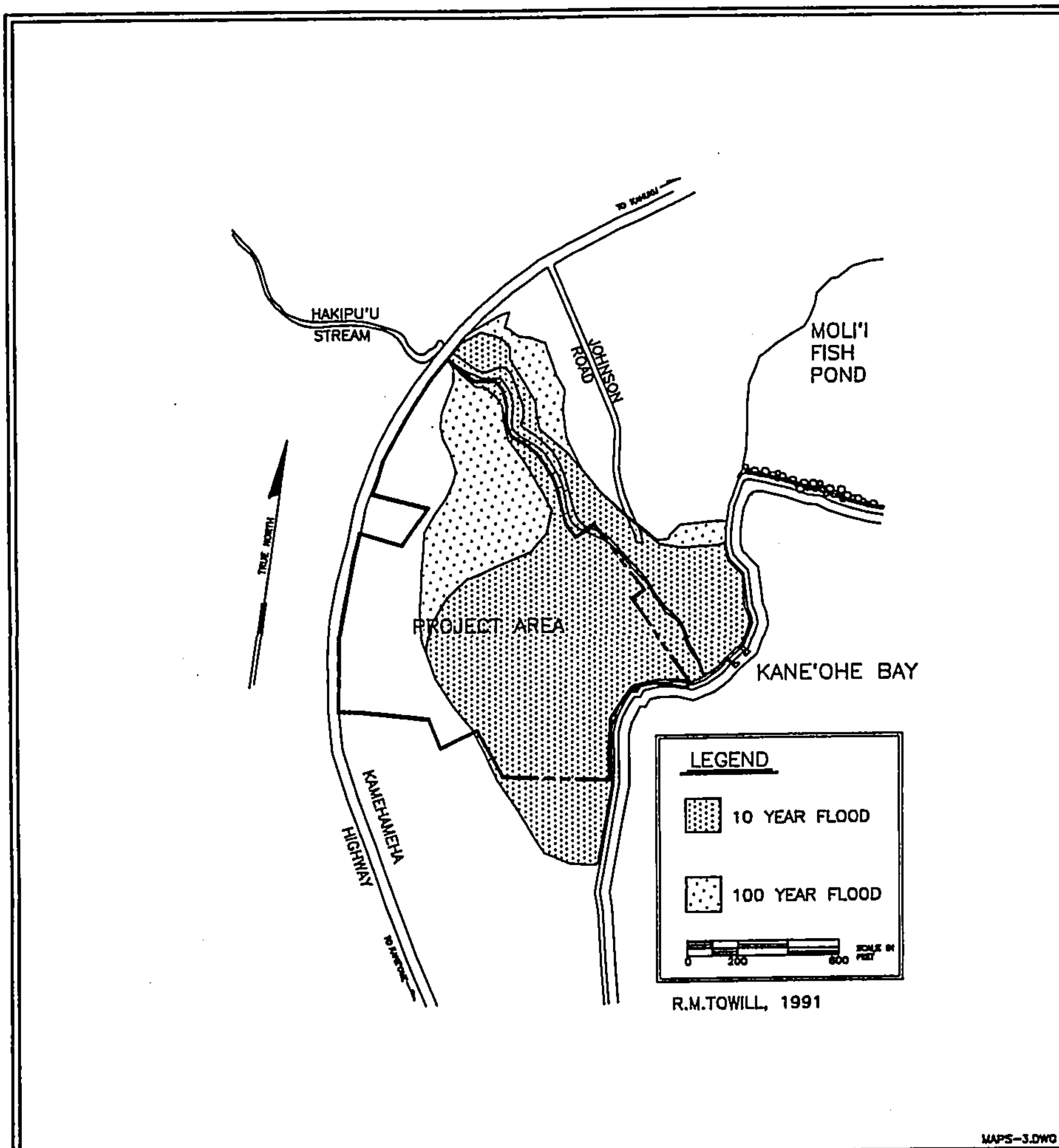

FIGURE 7. FLOOD BOUNDARY MAP

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survey indicates the lower portion of the present day stream has shifted 30 to 60 feet south towards MRTC.

The project area is within two specified flood hazard zones (10 year & 100 year) according to the Hakipuu Stream Flood Study by RM Towill in 1991 (see Figure 7). The proposed wetland, ponds and seawater system pumphouse will be inside the 10-year flood zone. No residence, student housing or classrooms are situated within any of the flood zones. These developments shall conform with Section 7.10 Flood Hazards District of the Land Use Ordinance.

Flooding from Hakipuu Stream, generally associated with short-term, intense rainfall events, has periodically inundated the lower reaches of the facility, damaging earthen ponds and other surrounding areas. In order to minimize the flooding of properties abutting Hakipuu Stream, the DLNR-Division of Water and Land Development implemented plans to remove the lowest pond (#12) on-site, half of adjacent pond #11, and grade the site to its original topography, prior to initial construction of the ponds. The project removed ponds 11 and 12, which were built by the previous users. Once the ponds were drained, the terrain was filled with soil. One smaller pond remains and an overflow bank was returned to its original topography before the ponds were built.

New

Design of the facility will take into consideration flooding potential. The proposed design will not aggravate flooding potential and will consider all possible aspects to decrease flooding impacts. Except for the proposed seawater system pumphouse, no structures will be created above ground level in the flood zone areas.

4. Soils

The soils of the project site fall roughly into two soil associations as defined by the U.S. Soil Conservation Service. Soils of the mauka half of the property are in the Lolekaa-Waikane association. This grouping includes deep, well-drained soils that have a dominantly fine textured sub-soil. Soils of this association are commonly found on alluvial fans, terraces and uplands along much of the windward side of the Koolau Range.

According to the U.S. Soil Conservation Service, soils on the makai half of the project site are of the Kaena-Waialua association soil type. These are generally deep, poorly drained soils that have fine textured sub-soils or underlying material found on coastal plains, talus slopes and in drainageways.

Portions of the site are dominated by the Hanalei silty clay soil type. In profile, the surface layer, about 10-12 inches thick, is a predominately dark brown with reddish and light gray mottles. The sub-surface layer is a very dark gray silty clay about three inches thick. The sub-soil, about 13 inches thick, is a mottled dark gray and dark grayish brown silty clay loam that has an angular blocky structure. The substratum is stratified alluvium. Permeability is moderate. Soil in the grassy area east of the existing pond #4 is very silty and water saturated forming a uniform black colloidal mass at least 4 feet deep. Runoff is very slow and the erosion hazard is not more than slight; the available moisture capacity is about 2.1 inches per foot of soil (U.S. Soil Conservation Service).

5. Flora and Fauna

A botanical survey of the site was performed by Char and Associates in January 1992. The study is included in Appendix D and portions are summarized below.

The majority of the site around the ponds and buildings is landscaped and maintained with several varieties of grass. Various small sections on the property (adjacent to Kamehameha Highway) are used by Kualoa Ranch personnel for the non-intensive cultivation of ti leaf, bananas, taro, papaya, and several other ornamental species. Adjacent to the present MRTC administration building, near the highway and along the banks of Hakipuu Stream, several varieties of mature trees are found including monkeypod, mango, royal palm, and Java plum. The numerous mature trees and understory plants along the highway serve to buffer the facility from highway noise and view. The undeveloped or "wild" portions of the property site consist of large areas of hau and mangrove thicket and some expanses of California grass wetlands.

Except for the hau, which is probably indigenous, the dominant flora on the project site are introduced or exotic plant species. Of the 129 plant species identified on-site, 89 percent are introduced, 7 percent were introduced by Polynesians and 4 percent (5 species) are indigenous or native. There were no indigenous threatened or endangered plants identified from the site.

A survey of the birds and feral mammals at MRTC was conducted in February 1992 by Dr. Phillip L. Brunner (see Appendix E). Native waterbirds recorded at the project site in the open water areas included the black-necked stilt, American coot and common moorhen. These birds are on the endangered species list. Birds were observed throughout the open wetlands, but rarely in the hau/mangrove jungle. The black-crowned night heron was the only native waterbird that is not on the endangered list. It is presumed that increased population levels of this species is a direct result of aquaculture development.

The Pacific golden plover was identified as the most abundant migratory shorebird in the area. Plovers prefer open areas such as intertidal reef, rocky shorelines, mud flats, lawns, plowed fields and pastures. These populations have remained relatively stable over many years. Other migratory birds sighted were ruddy turnstone and wandering tattler. These common migrants utilize mudflats and shallow ponds.

Fourteen species of introduced birds were recorded during the survey. The most abundant of these exotic birds were the red-vented bulbul, common myna, nutmeg mannikin and common waxbill. Few birds seemed to utilize the mangrove/hau thicket for roosting or foraging.

Mammals which may be encountered in the area include mongoose, mice, rats, domestic and feral dogs, and possibly the endangered Hawaiian hoary bat.

6. Noise

An acoustic study of the site was performed by Y. Ebisu & Associates in January 1992 and is contained in Appendix B.

Concerns regarding noise levels have been expressed by residents living adjacent to the project site. Due to the rural nature of the area and the very low background noise levels, almost any noise may be heard at a considerable distance.

Pond equipment noise is attributed primarily to aerators. In the past, one or more 2 HP aerator pumps have been louder than acceptable (but not beyond state standards) due to high frequency noise probably created by worn bearings. This situation has alerted MRTC personnel to monitor for potential noise level problems continuously through the renovation process.

The existing acoustic environment at the project site is characteristic of rural/agricultural settings. The major noise source is traffic along Kamehameha Highway. Other noise sources are water spillways and to a lesser extent, on-site pond equipment.

Federal noise standards and acceptability criteria for residential land use is categorized in Table 4 below:

TABLE 4.
MEASUREMENTS OF AMBIENT NOISE LEVELS

DECIBELS	EXPOSURE	FEDERAL STANDARD
< 55	Minimal	Unconditionally acceptable
65	Moderate	Acceptable
70	NA	State Ag. District Level
75	Significant	Normally Unacceptable
> 75	Severe	Unacceptable

Measurements of ambient noise levels were conducted near noise sensitive locations on the property. Average noise levels at the site with normal farm equipment running measured 46.8 dB during the day and 46.1 dB during early morning hours. The highest noise levels (62 dB) were measured 50 feet from the centerline of Kamehameha Highway.

7. Traffic

A traffic study of existing and predicted conditions was performed by Barton-Aschman & Associates. The study is included in Appendix A and is summarized below.

MRTC is accessed from Kamehameha Highway which runs parallel to the Kaneohe Bay coastline. Kamehameha Highway is a two-lane, two-way highway and the grade is generally flat. The posted speed limit is 45 miles per hour (mph) until one reaches the vicinity of the MRTC entrance, then the speed limit is reduced to 35 mph due to congestion at the "Coral Kingdom" facility across from MRTC. The highway along MRTC follows a curve which restricts site distance at the present MRTC entrance.

8. Archaeology

An archaeological survey of the site and of historical documents was performed by Cultural Surveys Hawaii. Their revised June 1993 report, including a thorough review of legends and land ownership patterns associated with Hakipuu, is included in Appendix C.

One archaeological site was identified on the property; a "mortuary house" near the road. The site was in poor condition, having been partially destroyed by construction of the "new" road (1922) and by the efforts of bottle collectors who have dug up some of the mortuary house ruins.

Portions of the project site in the past were terraced and used for agricultural activity. The terraces were quite large, up to an acre or more in extent and were fairly distinct in some areas while quite obscured in others. There is no evidence currently of any walls or mounds which might have remained from past cultivation efforts.

Prior to the initiation of the aquaculture facility, the site was used for cattle grazing operations for about fifty years. Before that, portions of the site were used for the production of taro and rice. Rice was commonly cultivated on lands which previously had been used for taro production. Frequently, farmers modified native taro lo'i extensively to grow rice. Common changes were the consolidation of several lo'i into a single unit, alteration of the configuration of terraces, and modification of auawai structures.

9. Surrounding Land Uses

The project area is surrounded by rural residential areas and undeveloped land. Paralleling the opposite bank of Hakipuu Stream, Johnson Road provides access to approximately 13 single-family homes. This area is also used for the commercial production of taro and ornamental plants. Approximately 1,000 feet north along the shoreline is the 120-acre Molii fish pond. West of the project site, across Kamehameha Highway, is undeveloped forest with pasture land and two residential homes. Also across the highway, the Coral Kingdom operates a tourist-oriented concession. Directly across the street from the Coral Kingdom, a single 2.5-acre lot containing several homes is surrounded on three sides by the MRTC property boundary. South of the project site on Kualoa Ranch property are additional single family units, taro ponds, and ornamental plant fields. Kaneohe Bay forms the east border of the site. The bay is routinely used for fishing and recreation by visitors and residents.

D. MARINE ENVIRONMENT

1. Kaneohe Bay

Kaneohe Bay is classified as a weakly developed estuary with terrestrial influences of freshwater, sediment, and nutrients. It is the largest estuary in the State of Hawaii. Both estuary and coral reef environments are found within the bay's boundaries. The bay is divided into three sections, north, central, and south, based upon water circulation patterns and their proximity to terrestrial inputs. In the north bay, input from six streams (including Hakipuu) is balanced by improved exchange with open ocean waters.

Silt and dissolved nutrients from streams and aquaculture ponds that adversely affect water quality in the bay are diluted and carried out to sea by currents within the bay. Currents within the bay are affected by the tides, wind, proximity to ocean channels, and bottom topography. Surface currents are typically wind-generated by tradewinds from the northwest. Currents in the south bay are generally circular, clockwise, forming a relatively stable water-cell with slow exchange rates. Currents in the north bay, near the project site, are dominated by a longshore current coming into the bay, particularly during flood tide. This current drift has carried sand from Kualoa Regional Park shoreline and deposited onto and formed Hakipuu Sandbar. A pictorial of current direction for incoming and outgoing tides is shown in Figure 8. Nearshore currents were measured in collaboration with the marine environmental survey described in the next section.

Initial studies indicate that a longshore current from Kualoa Point passes the MRTC site and turns out to the open bay through one of the bay's two deep fingers extending across the shallow back reef flat area towards the shoreline.

2. Marine Environmental Survey

A survey was performed by Oceanit Laboratories, Inc. in waters of Kaneohe Bay adjacent to the project site and is discussed in Appendix F. The primary purpose of this survey was to categorize the existing environment in terms of its water quality, current regime and community biotypes. This information was then used to predict impacts of the proposed project on the nearshore environment.

a. Water Quality

Waters of the bay are classified as class AA by the State Department of Health. According to the State's Water Quality Plan, the objective is to keep class AA waters "in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions." Uses to be protected are "oceanographic research, the support and propagation of shellfish and other marine life, conservation of coral reefs and wilderness areas, compatible recreation, and aesthetic enjoyment." However, it is recognized that water quality within the bay does not meet the state AA standards. Kaneohe Bay is therefore classified as a "water quality limited segment" with stricter standards applied to runoff into the bay.

Water quality fronting the project site was measured as a part of the water supply and disposal study contained in Appendix F. Additional water quality data was extracted from a larger data set compiled by Dr. Marlin Atkinson of the University of Hawaii Institute of Marine Biology under funding by the University of Hawaii Sea Grant Program as a part of the State of Hawaii's Main Hawaiian Island Marine Resource Investigation studies. These data were collected over a period of one year from surface waters at many sites throughout the bay. The data extracted are from approximately 12 sites in the north bay fronting the MRTC facility. They have been further divided into one set of nearshore stations and a second set of "offshore" stations (generally edge of the reef). Tabular and graphical data is presented in Appendix F.

Interpretation of the data indicates a definite difference in nearshore water quality adjacent to MRTC as compared to areas farther out in the bay. Existing water quality adjacent to the site often exceeds state standards for class AA waters. Effluent standards for the facility should be based on existing water quality adjacent to the site. Effluent from the aquaculture facility will enter into the constructed MARSH saltwater wetland. State water quality standards for saltwater wetlands are less stringent and are not likely to be violated. Effluent from the MARSH is not anticipated to adversely impact water quality in the nearshore areas.

b. Currents

Currents at the site are dominated by a long-shore current that enters the bay from the ocean around Kualoa Point bringing fresh seawater (and Kualoa beach sand) into the bay past Molii fishpond and Hakipuu Stream. Land runoff through Molii fishpond and Hakipuu Stream join this current and flow to the south and back out to the central bay, presumably through or over one of the deep bay inlets carved into the reef flat fronting the site. Such a flow pattern would explain the low prevalence of live corals along the reef edge along the inner most extension of these inlets. This would also explain the abundance of algae, particularly Caulerpa, on the back-reef area fronting the MRTC site.

c. Marine Life

The marine environment offshore of MRTC displays a gradient from a stream mouth mangrove marsh out to the open bay. Biotypes in Kaneohe Bay were identified as the; a) mangrove swamp and stream mouth, b) back-reef mud and sand flat, c) reef edge drop-off, d) Hakipuu Sandbar and e) deep bay basin. The mangrove and hau tree thicket

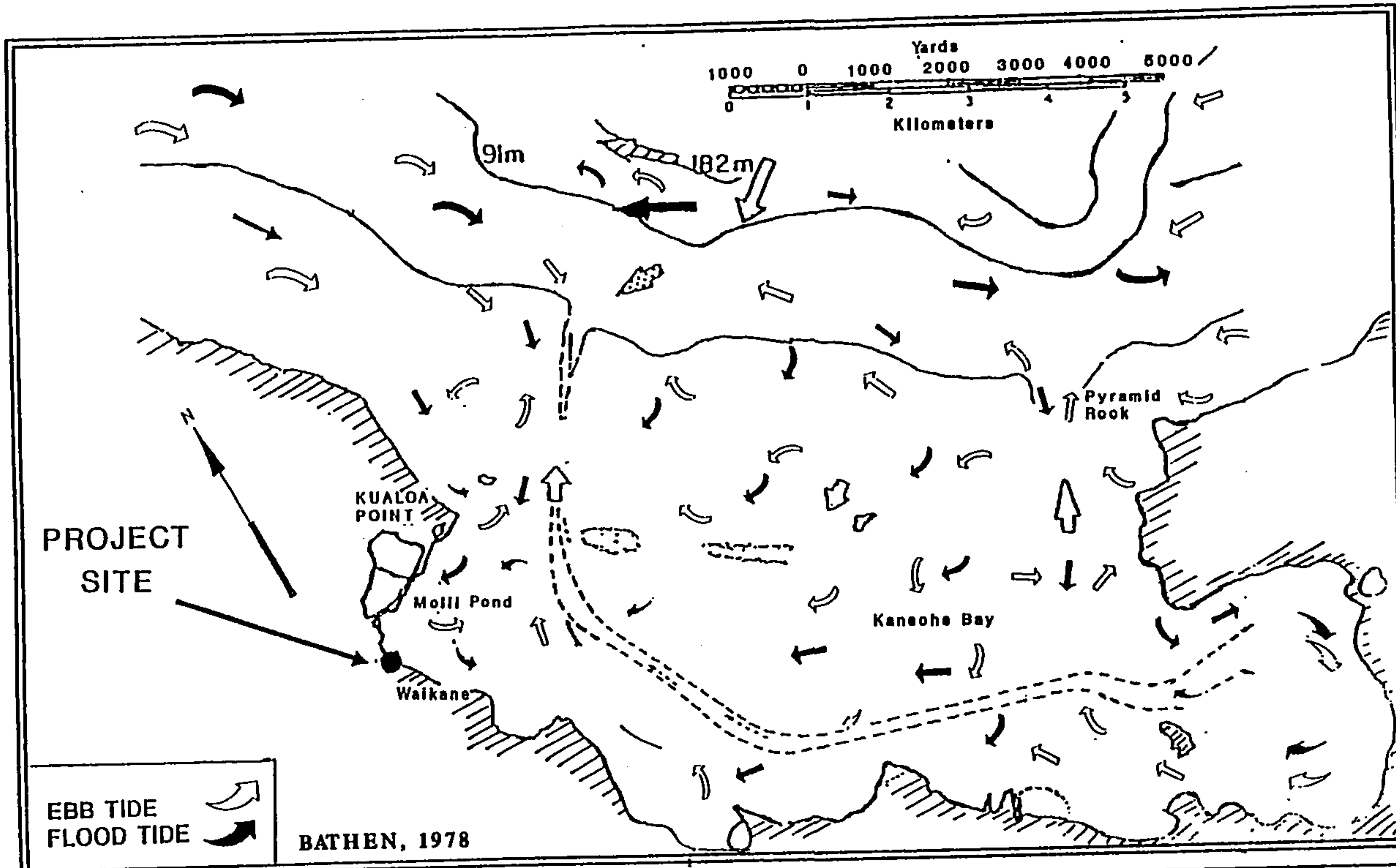

FIGURE 8. KANEOHE BAY CURRENT PATTERNS

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engulfs the stream mouth and extends at the high water mark along the site's shoreline. The back-reef area extends from the sea level edge of the mangrove and Hakipuu Stream outlet approximately 850 feet to the edge of the reef in about five feet of water. Hakipuu Sandbar just meets the edge of the reef offshore from MRTC. The reef edge north of Hakipuu Sandbar has significant coral coverage typical of Kaneohe Bay, but south of the bar there is almost no live coral for approximately 300 feet along the reef's flat edge. The absence of heavy coral coverage on this section of reef flat edge suggests that coral growth may be inhibited by freshwater outflow from Hakipuu Stream.

SOCIO-ECONOMIC ENVIRONMENT

III. SOCIO-ECONOMIC ENVIRONMENT

A. AREA TRENDS

Windward Oahu is econimcally dependent upon the resources of leeward Oahu, which is the financial, industrial and commercial center of the State. Although no specific figures are available, a significant proportion of the adult working population living in the Kaneohe area commutes daily to leeward Oahu to work. Employment opportunities in windward Oahu are too limited to support the total income requirements of windward residents.

Kaneohe employment opportunities, as of this writing, are primarily limited to government sector jobs (particularly Kaneohe Marine Corps Air Station), retail and service industry, and agriculture. There is virtually no industrial activity or manufacturing in the area. With the exception of the military and some department stores, most employers in the Kaneohe area operate with fewer than twenty employees (URS Research Company, 1976).

Agricultural activities in the area are comprised of small plots for the production of ornamental plants, fruits, vegetables, taro, and cut flowers. Beef, pork, milk, and eggs are also produced, although these activities are generally small-scale operations employing family members or a hired staff of five or less.

Kualoa Ranch, Inc. is the primary employer in the area of the project site. Cattle, taro, papaya, and vegetables are the main products, but the ranch also receives significant income from on-site tour-related activities. There is one small retail and curio establishment in the area (Coral Kingdom), catering largely to tourists.

B. POPULATION

The area identified for purposes of evaluating the socio-economic characteristics of the Kualoa area is bounded by the Koolau Range to the south and west, and Kaawa Stream (at Swanzy Beach State Park) to the north. Kaneohe Bay flanks the eastern side of the area. This area encompasses Census Tract 103.03. Census data of 1980 and 1990 has been used to describe existing population and housing characteristics. The breakdown of selected demographic characteristics is presented in Table 5.

TABLE 5.
SELECTED DEMOGRAPHIC CHARACTERISTICS (Data Book, 1990)

Demographic	City and County of Honolulu	Kualoa (C.T. 103.3)
POPULATION	836,231	4,660
ETHNICITY	(Percent 1987)	(Percent 1990)
Caucasian	24%	32.5%
Hawaiian	0.6%	27.9%
Japanese	23.8%	17%
Filipino	10.5%	9%
Chinese	6%	6%
Korean	1.4%	0.9%
Samoan	0.7%	0.7%
Tongan	N/A	0.4%

As Table 5 shows, residents of the Kualoa area are predominately of Caucasian and Hawaiian descent, making up 32.5 percent and 27.9 percent of the census tract population, respectively. Smaller portions of the area's population are of Japanese (17%), Filipino (9%), Chinese (6%), Korean (0.9%), Samoan (0.7%) and Tongan (0.4%) descent.

The affected population in the Kualoa area is small, with approximately 4,660 residents in 1990. This represents about 0.5 percent of Oahu's 836,231 population in 1990. While Oahu has experienced a 9.6 percent growth, from a resident population of 762,534 in 1980, the Kualoa area has increased substantially (44 percent) from a resident population of 3,232 in 1980. Due to its smaller population, the Kualoa area still retains its agricultural/rural character.

In the entire Kualoa area, there are fewer senior citizens and children and more persons in the 25 to 44 year category. This age group accounts for one-third of Kualoa's population. As of 1990, this characteristic also applies to the entire City and County of Honolulu.

Kualoa has been identified as an area of strong cultural continuity. The preservation of Hawaiian communities is important for the regeneration and subsistence of the Island's culture. These communities are reliant upon natural resources remaining intact to maintain their values and way of life. With employment opportunities and

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educational programs, continued use of MRTC for aquaculture research production is consistent with Hawaiian cultural objectives. Meetings with members of the adjacent community have included discussions of ways to integrate aquaculture programs with native lifestyles.

C. HOUSING AND FAMILIES

In 1990, there were 1,390 housing units in Kualoa, about 0.4 percent of Oahu's housing stock of 281,683 units. Almost seven-eights (85%) of Kualoa's units are single-family detached structures, indicative of an agricultural region.

In Kualoa, slightly more than half of all units are owner occupied (53.2%), with the remainder being renter occupied and a small percentage of units being vacant (0.3%). Median rent for renter occupied units in 1990 was $610. Whereas the median rent for Oahu in 1990 was slightly more at $615.

The Kualoa area has slightly larger families than the Oahu population, with 3.5 persons per unit compared to an average of three persons per unit island-wide.

D. PUBLIC UTILITIES

The existing aquaculture research facility is served by one public roadway, electric power, telecommunications and potable water supplies. There is no sewer service to the site. New cesspools are not permitted. Because the anticipated demand for wastewater disposal is expected to increase upon completion of renovation, a small sewage treatment facility will be incorporated into the project plans.

Several package plant systems are suitable. The selected system must be capable of treating an estimated maximum flow rate of 3,000 gallons per day (gpd). A 5,000 gpd unit, for example, is self-contained and fits into a 10 by 15 foot area. Placement of the treatment unit should allow gravity flow of influent and effluent. The unit must be situated to allow pump trucks to drive within 70 feet for waste extraction.

MRTC and other residences in the Hakipuu community currently use individual wastewater systems, consisting of either a septic tank with a drainage field or a cesspool. In both septic tank and cesspool systems, the solids settle in a tank or covered pit and must be pumped out regularly to keep the system functional. In a cesspool there is no drainage field to disperse fluid overflow and thus any excess fluids may flow into the ground around the cesspool. A septic tank system allows overflow fluids and floatable materials to disperse over a shallow drainage field. This field allows nutrients to dilute over a large area and become absorbed by surrounding grasses and plants. Both septic tank and cesspools are anaerobic systems that may produce odors if not properly maintained and can overflow during heavy rainfall.

Kamehameha Highway, adjacent to the project site, is a soft shouldered two-lane rural highway that directly accesses the facility. No other public roadway provides access to the project site.

Two branch lines provide the project site with potable water from a 30-inch water main laid alongside Kamehameha Highway. One line, used for water conservation purposes, is one inch in diameter. The other line is two inches in diameter. The existing water system and two water meters are considered adequate to serve the proposed renovation of MRTC for domestic water usage. If, however, additional water is required to service facility needs, the Board of Water Supply will determine availability when building permits are submitted for approval.

Electric power is supplied to the project site through a 37 KVA transformer from the Hawaiian Electric power grid. Three separate lines from the transformer provide power to the existing residential structure, the hatchery and for water circulation.

Six telephone lines are available from the Hawaiian Telephone system. Two lines serve the main office as telephone and facsimile connections. Three other lines are connected to the existing residential structure, and one line is disconnected.

E. SOCIAL CONCERNS

Although the renovation of MRTC is not anticipated to significantly impact the surrounding neighborhood, residents have expressed a strong desire, through community meetings, to maintain the present character of the neighborhood.

During the Draft EIS comment period, the Hakipuu Community Advisory Committee (HCAC) was formed to address community concerns through regular monthly meetings. Meetings will continue, even after submittal of the Final EIS and the HCAC will likely evolve into a permanent advisory body to MRTC. The following is a discussion of the Hakipuu Community's concerns.

Residents have voiced their concerns regarding the condition of the Hakipuu Stream and whether the MRTC renovation will affect the stream's water quality or runoff/erosion potential. Flooding continues to be a significant concern. Issues have been raised for preserving access to the site by adjacent residents, initiating program involvement to native Hawaiians, and maintaining research and development applicability for regional fishermen, particularly in the Kaneohe Bay area. Committee members have recommended offshore monitoring by the Hawaii Institute of Marine Biology of Kaneohe Bay as part of MRTC's research program. Members felt that monitoring the variation in salinity over time would provide a valuable data base of the bay's changing conditions and variable water quality status. Data collection techniques, such as infrared photography, should detect where fresh water enters the bay and where pockets of fresh water are believed to exist. The committee also suggested research geared towards food fish with an emphasis on compatibility with cultural values and economic development. Other communities, besides Hakipuu, would benefit from this type of MRTC research.

Residents have also expressed sensitivity to noise. The Hakipuu area, being zoned for agricultural use, has less stringent requirements for noise limitations. Historically, there has been very little noise within the valley. Consequently, any activity generating noise is noticeable to some residents. Project planners will continue to have open dialogue with surrounding residents to minimize noise and other impacts on the Hakipuu community.

As of this writing, the community expressed apprehension for ciguatera outbreaks because of dredging for the proposed seawater intake pipe. Accompanying water quality alteration and biota disturbances were said to further reduce fishing and water quality in the offshore areas. Water quality and ciguatera monitoring were suggested for the immediate and offshore areas surrounding the dredging work.

1) stream water quality
2) flooding. II.5
3) preserve access – rec. fishing
4) offshore monitoring – salinity baseline for future
5) rec. food fish
6) Noise – II.7 addressed; V-1
7) Ciguatera monitoring suggested

RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

IV. RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

The plans and policies relating to the proposed Mariculture Research and Training Center (MRTC) are numerous, ranging from broad program guidance offered by the Hawaii State Plan and various State Functional Plans, to land use controls governing the development of the site. MRTC will be developed in harmony with various land use plans, policies and regulatory controls. The following is a review of these plans and policies.

A. PLANS

1. Hawaii State Plan

The Hawaii State Plan provides goals, objectives and policies, which detail priority directions and concerns of the State of Hawaii (Chapter 226, Hawaii Revised Statutes). MRTC will reflect the growth in aquaculture technology and provide a highly accessible facility for aquaculture education, training and demonstration activities. The proposed improvements to the existing aquaculture facility are consistent with the following State goals, objectives, policies and priority guidelines:

1.1 Physical Environment - Land-Based, Shoreline, and Marine Resources

Objective:

PLANNING FOR THE STATE'S PHYSICAL ENVIRONMENT...SHALL BE DIRECTED TOWARDS...PRUDENT USE OF HAWAII'S LAND-BASED, SHORELINE, AND MARINE RESOURCES AND EFFECTIVE PROTECTION OF HAWAII'S UNIQUE AND FRAGILE ENVIRONMENTAL RESOURCES.

Policies:

1.1.1 Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

1.1.2 Take into account the physical attributes of areas when planning and designing activities and facilities.

1.1.3 Pursue compatible relationships among activities, facilities, and natural resources.

1.1.4 Promote increased accessibility and prudent use of inland and shoreline areas for...educational, and scientific purposes.

1.2 Socio-Cultural Advancement - Education

Objective:

PLANNING FOR THE STATE'S SOCIO-CULTURAL ADVANCEMENT WITH REGARD TO EDUCATION SHALL BE DIRECTED TOWARDS THE ACHIEVEMENT OF...THE PROVISION OF A VARIETY OF EDUCATIONAL OPPORTUNITIES TO ENABLE INDIVIDUALS TO FULFILL THEIR NEEDS, RESPONSIBILITIES, AND ASPIRATIONS.

Policies:

1.2.1 Provide higher educational opportunities that enable Hawaii's people to adapt to changing employment demands.

1.2.2 Emphasize quality educational programs in Hawaii's institutions to promote academic excellence.

1.2.3 Support research programs and activities that enhance the education programs of the State.

1.3 Agriculture

Objective:

PLANNING FOR THE STATE'S ECONOMY WITH REGARD TO AGRICULTURE SHALL BE DIRECTED TOWARDS ACHIEVEMENT OF CONTINUED GROWTH AND DEVELOPMENT OF DIVERSIFIED AGRICULTURE.

Policies:

1.3.1 Support research and development activities that provide greater efficiency and economic productivity in agriculture.

1.3.2 Expand Hawaii's agricultural base by promoting growth and development of...aquaculture and other potential enterprises.

1.3.3 Increase the attractiveness and opportunities for an agricultural education and livelihood.

2. State Functional Plans

The Statewide planning system requires the preparation of State Functional Plans which are approved by the Governor. State Functional Plans implement the goals, objectives, policies and priority guidelines of the Hawaii State Plan. They provide the detailed linkage of State programs to State policy. Seven functional plans were approved in 1991 by the Governor in accordance with Section 226-55, HRS: Agriculture, Conservation Lands, Energy, Historic Preservation, Recreation, Tourism, and Transportation.

The proposed renovation of MRTC is consistent with the following Functional Plans:

2.1 State Conservation Lands Functional Plan

The State Conservation Lands Functional Plan is directed "to provide for a management program allowing for judicious use of the State's natural resources balanced with the need to protect these resources to varying degrees." The Plan outlines the roles of both the public and private sectors in use, management, and protection of natural environmental resources.

Objective IA(1):

ESTABLISHMENT OF DATA BASES FOR INVENTORIES OF EXISTING LANDS AND RESOURCES.

Policy IA(3):

"Locate, preserve and encourage the availability of sites suitable for commercial aquaculture by both private and pubic sector landowners."

Objective IIE:

PROMOTION AND MARKETING OF APPROPRIATE NATURAL RESOURCES DESIGNATED FOR COMMERCIAL DEVELOPMENT.

Policy IIE(2):

"Expand aquaculture business assistance and investment incentives in the public sector to increase Hawaii's attractiveness as a location for aquaculture."

Policy III(3):

"Increase the demand for Hawaii's aquaculture products and services in local, national and international markets."

MRTC represents a concerted effort on the part of the State's Department of Land and Natural Resources' Aquaculture Development Program and the landowner, Kualoa Ranch, Inc. to expand the use and diversity of aquaculture in Hawaii.

2.2 State Agriculture Functional Plan

The State Agricultural Functional Plan is a guide to "promote the conservation, development, and utilization of agricultural resources in the State." Inclusive of this is the welfare of farmers, information distribution, and increasing the productivity of lands, as well as maintenance of agriculture in an area with competing economic activity that demands more land.

Objective E:

ACHIEVEMENT OF ADEQUATE CAPITAL, AND KNOWLEDGE OF ITS PROPER MANAGEMENT, FOR AGRICULTURAL DEVELOPMENT.

Action E(1)(a):

"Provide additional funds as required to assist agricultural and aquacultural industries and their development in general."

Objective I:

ACHIEVEMENT OF EFFICIENT AND EQUITABLE PROVISION OF ADEQUATE WATER FOR AGRICULTURAL USE.

Action I(l)(a):

"Develop new, expanded, or improved water source and delivery systems in support of agriculture and aquaculture, as needed and economically feasible."

Objective J:

ACHIEVEMENT OF MAXIMUM DEGREE OF PUBLIC UNDERSTANDING AND SUPPORT OF AGRICULTURE IN HAWAII.

Action I(3)(a):

"Update maps showing existing agricultural and aquacultural land use, and crop ecological zones suitable for such uses, at quad map scale."

Aquaculture is regarded as an important agricultural use in the State of Hawaii. Expansion and improvements to put aquaculture at the forefront of the agricultural production are emphasized in the State Agriculture Functional Plan.

2.3 State Higher Educational Functional Plan

The Draft version of the State Higher Educational Functional Plan is directed, in a broad sense, to "provide post-secondary educational opportunities..." and, more specifically, to "expand vocational training in diversified agriculture, aquaculture and other areas where growth is desired and feasible."

A. Objective:

MAINTAIN A NUMBER AND VARIETY OF POST-SECONDARY EDUCATION INSTITUTIONS SUFFICIENT TO PROVIDE THE DIVERSE RANGE OF PROGRAMS REQUIRED TO SATISFY INDIVIDUAL AND SOCIETAL NEEDS AND INTERESTS.

A(2). Policy:

"Focus increased attention on the role higher education plays in supporting the economic development of the State.

Provide increased research, education, and cooperative and vocational training opportunities in programs which respond to the changing State economy, job market, and work place, including: ...diversified agriculture and aquaculture...."

The educational opportunities that MRTC proposes will also address the demands of expanding research and development.

3. General Plan of the City and County of Honolulu

The General Plan of the City and County of Honolulu establishes long-range objectives and policies for guiding both the quantity and quality of future growth on Oahu.

In 1977, the City and County of Honolulu adopted the Oahu General Plan containing long-range planning objectives and policies, which the City and

County government hopes to achieve for the Island of Oahu through the year 2000. The General Plan was revised and expanded in subsequent years and includes the following subject areas: population, economic activity, natural environment, housing, transportation and utilities, energy, physical development and urban design, public safety, health and education, culture and recreation, and government operations and fiscal management. The MRTC renovation will be consistent primarily with the following policies of the General Plan:

> Economic Activity Objective C, Policy 5:
>
> "Maintain agricultural land along the Windward, North Shore, and Waianae coasts for...aquaculture...and...diversified agriculture."
>
> Economic Activity Objective D, Policy 2:
>
> "Encourage the development of aquaculture, ocean research, and other ocean-related industries."
>
> Health and Education Objective C, Policy 1:
>
> "Encourage continuing improvement in the quality of higher education in Hawaii."

MRTC will facilitate implementation of the General Plan. In addition to the stated objectives above, it specifically addresses the objective to "provide opportunities for...educational use and physical contact with Oahu's natural environment." The proposed renovation will strive to maintain the rural character of the windward side of Oahu. In addition, the entire development plan is in keeping with maintenance of the sites natural resources such as the stream, fishpond, shoreline, watershed areas, forests, and reefs.

B. LAND USE POLICIES AND ZONING

1. State Land Use Law

According to Chapter 205 Hawaii Revised Statutes (HRS), four major land use districts are defined in the State: urban, rural, agricultural, and conservation. The State Land Use Commission has designated the project site and adjacent lands as a part of the Agricultural District (see Figure 9). The Agricultural District designation permits a wide variety of agricultural uses and related activities. Specifically included within the scope of permitted activities are "game and fish production" and "other aquatic life...propagated for economic or personal use." The Agricultural District permits aquaculture activities,

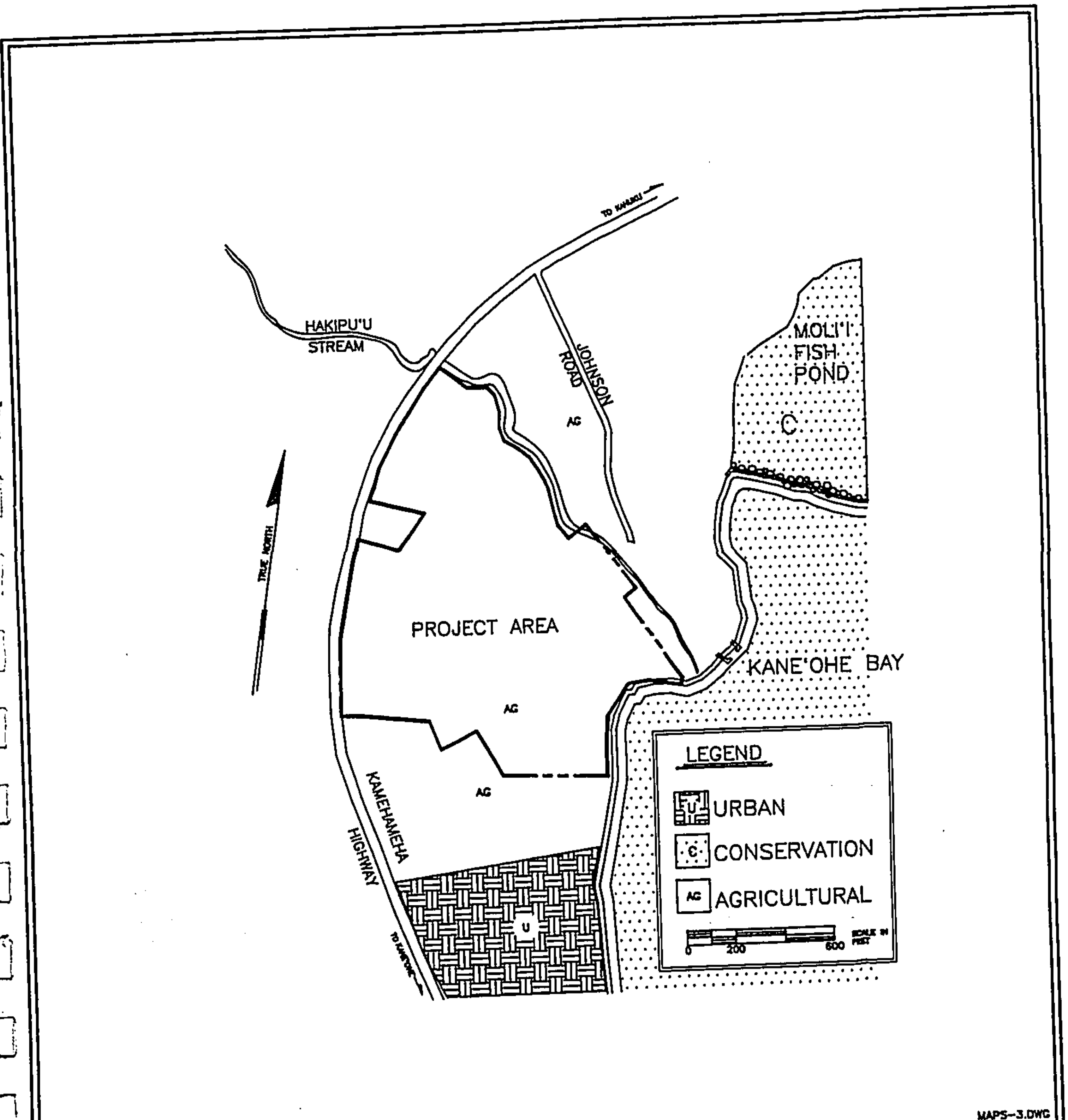

FIGURE 9. STATE LAND USE DISTRICT DESIGNATIONS

Mariculture Research and Training Center

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which is defined as "the production of aquatic plant and animal life for food and fiber within ponds and other bodies of water."

The proposed renovation project is in conformance with current State Land Use Commission District regulations. Permissible aquaculture uses within the agricultural districts include: "fish...or aquatic life that are propagated for economic or personal use" and "public institutions and buildings which are necessary for agricultural practices (204-4.5)."

All submerged land offshore of the islands is within the State's Conservation District, as established by the State Land Use Commission. The proposed seawater intake system is located in the State's Conservation District (see Figure 9).

2. City and County of Honolulu Development Plan

Development Plans (DPs) are relatively detailed guidelines for the physical development of the island and are based on the policy guidance of the General Plan. Eight DPs have been adopted covering the entire island. Each Development Plan Ordinance consists of Common Provisions applicable to all Development Plan areas, Special Provisions for each area, Land Use Map, and Public Facilities Map.

The proposed renovations to MRTC shall be generally consistent with the City and County of Honolulu Development Plan and zoning.

3. Koolaupoko Development Plan

MRTC is within the Koolaupoko Development Plan area which includes the agricultural communities from Waimanalo to Kualoa, and the suburban communities of Kaneohe and Kailua. This area comprised 14 percent of the island's total population in 1985 and conveys both an "urban-fringe" and "rural" character. MRTC will be in conformance primarily with the following common and special provisions of the Koolaupoko Development Plan.

3.1 <u>Common Provisions</u>

3.1.1 <u>Open Space</u>

Open space areas consist of, but are not limited to, the ocean, beaches, parks, plazas, institutional properties with park-like grounds, streams, inland bodies of water...agricultural and preservation lands. The functions of open space areas are to provide visual relief and contrast to the built environment, to serve as outdoor space for public use and enjoyment. The preservation and enhancement of areas that are well suited to perform these functions shall be given high priority.

The City's mountains, hills, shoreline and streams shall be considered as major scenic, open space and recreational resources.

Existing natural stream beds and drainageways shall be retained wherever possible. Where further channelization must occur, materials that are harmonious with the setting, such as stone, shall be used whenever feasible.

Additional setback requirements exceeding the minimum permitted under zoning shall be established along shorelines subject to high erosion risks. These setback requirements shall apply to all construction activity, including structures, roads, seawalls, groins, revetments and other improvements which contribute towards shoreline erosion.

3.1.2 <u>Energy Efficiency in Developments</u>

Efficient energy use shall be encouraged in all developments. Existing development controls and regulations shall be reviewed and revised as necessary to eliminate any provisions which unnecessarily restrict energy efficiency and the use of alternative energy sources.

Development incentives may be provided for projects that propose the use of alternative energy sources and energy-efficient designs.

3.1.3 <u>Rural Areas</u>

Rural areas are characterized by a preponderance of open and agricultural lands with limited development clustered in small, low density residential areas which have a strong sense of community and a country-like environment. Large-scale agricultural operations or small farms are major economic activities and constitute the predominant land use.

The location and character of new development in rural areas shall be consistent with the above-described characteristics of such areas and shall be guided by the following principles and controls:

- The visual attractiveness that distinguishes rural from urban and country from city shall be maintained.

- In designating areas for development, primary consideration shall be given to the protection and preservation of good agricultural land and uses, the shoreline, streams and wetlands, the mountains and watershed areas, ridgelines and steeply sloping areas and other natural resources and environments.

- Development along the shoreline and makai of arterial highways that are within 1,000 feet of the shoreline shall be generally limited to parks, agricultural operations, and single-family residential dwellings.

- Appropriately located sites shall be provided for community-based economic activities which utilize locally available raw materials and the skills of crafts people living in the area.

3.2 Special Provisions

Special provisions apply to several areas within Koolaupoko. MRTC being located in the Kualoa area is subject to principles and controls of these special provisions. Kualoa is characterized as a rural and agricultural area and is, thus, slated to "remain a relatively lightly settled" and "rural area."

The general height limit of buildings in the agricultural area is 25 feet. The density control for the agricultural area is one dwelling unit per two acres.

Development priorities that apply to Koolaupoko mandate the "improvement of water resources to support development of aquacultural uses in appropriate areas which include Kahaluu-Kualoa."

4. Development Plan Land Use Map Designation

The Development Plan Land Use Map designates the entire project area as Agriculture. Agricultural areas are those areas suitable for crop growing, grazing and the raising of livestock, flower gardening, nurseries or orchards, aquaculture, or similar activities. This classification also includes areas surrounded by or contiguous to such lands but not well suited to agricultural or accessory activities due to topography, soils or similar constraints, and areas otherwise identified by the City as implementing related general plan objectives and policies. In such areas, uses complementary to agriculture may be permitted.

5. Development Plan Public Facilities Map Designation

The Development Plan Public Facilities maps show the general location of proposed public and private facilities such as road, parks and utilities. Kamehameha Highway, which borders the project site, is designated for water

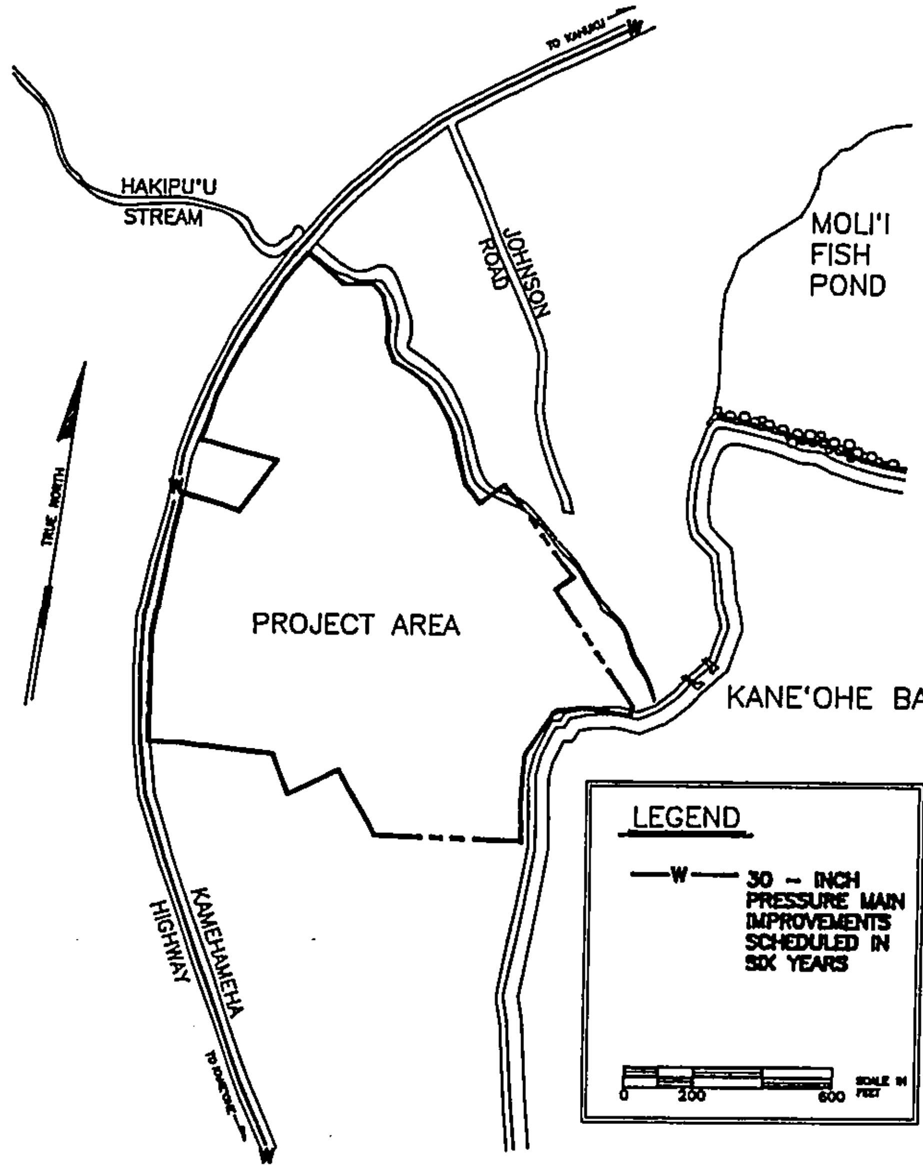

FIGURE 10. DEVELOPMENT PLAN PUBLIC FACILITIES MAP

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system line improvements within six years (see Figure 10). Although the intensity of facility usage will increase due to the addition of classrooms, student housing and research areas, the proposed renovation is not anticipated to require designation on the Public Facilities Map. According to the Board of Water Supply, the present capacity of the 30-inch water main is sufficient to accommodate the maximum additional load of 2,000 gpd for domestic use.

6. County Zoning

Under the City and County of Honolulu's Land Use Ordinance, the site is predominately zoned AG-2, which permits aquaculture use. Scattered areas of the project site as shown on Figure 11 are zoned Country; which is recognized as having "limited potential for agricultural activity," while maintaining open space character. Aquaculture is also a permitted principal use in this designation.

In the AG-2 zoning district, several buildings are not considered principal uses: a) administration main laboratory, b) graduate research/resident dormitory, and c) visiting research/student dormitory. Because these structures serve more of an academic use as opposed to agricultural, a Plan Review Use permit may be required as specified in Section 3.160-1 of the Land Use Ordinance. The Plan Review Use permit is described in more detail in the next section of this chapter.

C. ENVIRONMENTAL PERMITS

1. Department of the Army Permits

The Department of Army permit is administered by the U.S. Army Corps of Engineers, Honolulu District, under section 10 of the Rivers and Harbors Act (33 USC 403), section 404 of the Clean Water Act (33 USC 1344) and section 103 of the Marine Protection, Research and Sanitation Act of 1972 (33 USC 1413). The Environmental Protection Agency, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and other appropriate agencies will review the permit. This permit is required for all work within water of the United States, including ocean and coastal waters, inland and tidal waters, tidal ponds, fishpond, rivers, streams, and adjacent wetlands, perched wetlands, and intermittent streams.

Issuance of the permit is based on an evaluation of the probable impact of the proposed activity on the public interest, reflecting national concern for both protection and utilization of important resources. Factors considered include those relating to conservation, economics, aesthetics, flood damage prevention,

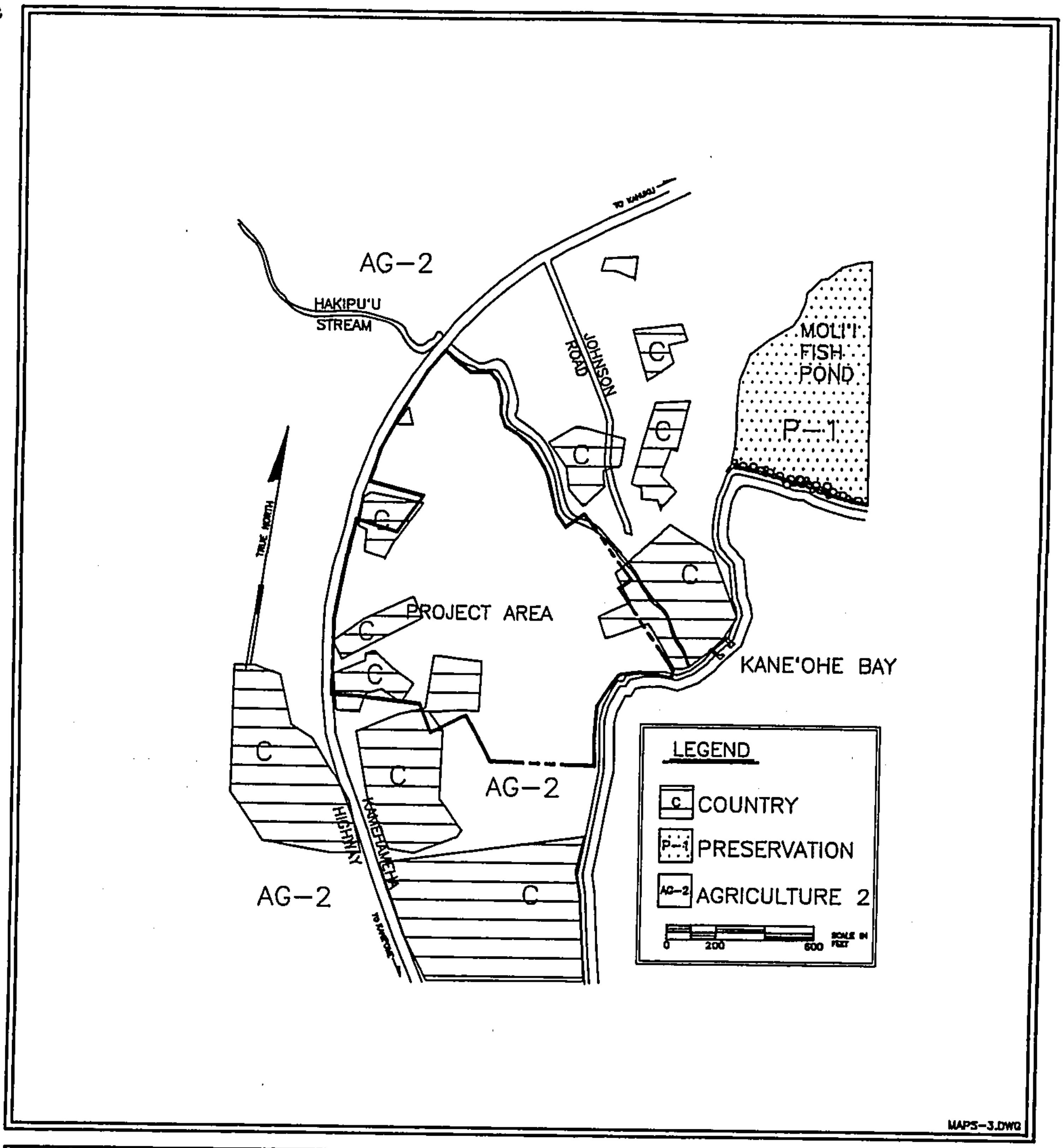

FIGURE 11. CITY AND COUNTY OF HONOLULU ZONING DISTRICTS

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land use, navigation, recreation, water supply, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people.

Portions of MRTC potentially subject to review under the Department of Army permit would include any pipeline with offshore disposal, and improvements extending into navigable waters under the jurisdiction of the Corps of Engineers. In addition, specific and official determination has not been made with respect to the project area's wetland boundaries. Under federal regulations, much of the unused project site and all project site ponds will probably be eligible as wetland. A map indicating approximate wetland positions is shown in Figure 12.

2. National Pollutant Discharge Elimination System (NPDES) Storm Water and Dewatering Permits

Administered by the Environmental Protection Agency (EPA) with general permitting authority granted to the State Department of Health (DOH), Clean Water Branch, the NPDES Storm Water permit is required for construction activities greater than 5 (five) acres that include clearing, grading, and excavation activities. The regulations apply to both public and private facilities that discharge storm water via one or more point sources and/or into waters of the United States, either directly or through a separate storm sewer system. An application should be submitted to the Department of Health at least 90 days before the date on which construction is to commence.

The MRTC project site, adjacent to the shoreline and wetlands, is subject to the requirements of the NPDES permit requirements. Any portion of the project site anticipated to generate runoff that will discharge into waters of the United States (Kaneohe Bay), also includes interstate "wetlands." According to CFR 122.2, wetlands means "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

A NPDES permit may not be required (at the discretion of the Director of DOH and EPA) if yearly warm water aquaculture production is less than 100,000 pounds. If the discharge volume on any single day of the year exceeds 500,000 gallons, a "fact sheet" must be prepared indicating the amount of discharge entering the nearshore water.

Kaneohe Bay is considered a "water quality limited segment," because it does not meet the minimum water quality criteria set forth by the State Department

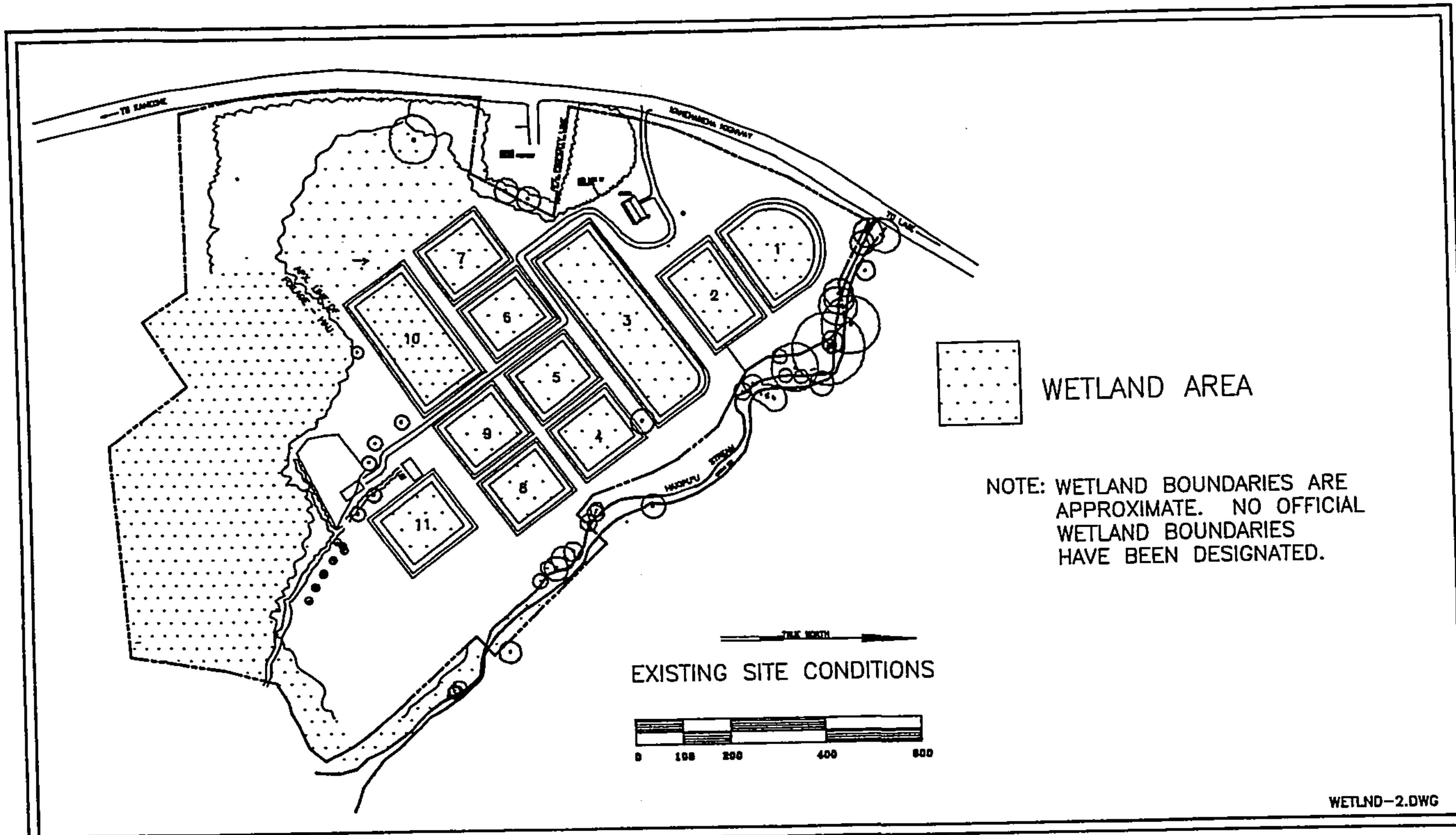

FIGURE 12. SUGGESTED WETLAND DESIGNATIONS

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of Health. Direct point source discharge from the MARSH to the bay is not likely to be permitted. However, the MARSH system does qualify as a saltwater wetland under current interpretation of state water quality standards. Discharge from the saltwater wetland via diffuse flow into the bay may be permitted under existing statutes (11-54-.05.2). As a condition of the NPDES permit, a water quality and/or environmental monitoring program may be required.

For the proposed seawater intake system's pump house on the shoreline, a NPDES dewatering permit will be required by DOH as well the Department of Public Works for construction activity 12 feet below grade.

3. Hawaii Coastal Zone Management Program Federal Consistency Review

Section 307 of the National Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et. seq.) provides for State review of federal actions affecting the coastal zones of States with approved Coastal Zone Management Programs. Hawaii's Coastal Zone Management (CZM) Program, established pursuant to Chapter 205A HRS, was federally approved in 1977. It is administered by the Office of State Planning (OSP).

Among federal actions to review is the issuance of federal permits, including the Department of Army permit, which will be required for improvements extending into the water. Before the federal permit can be issued, the OSP must determine its consistency with the enforceable policies of the Hawaii CZM Program. These policies encompass broad concerns such as impact on recreational resources, historic and archaeological resources, coastal hazards, and the management of development.

4. Section 401 Water Quality Certification

The State Department of Health is charged with the responsibility of establishing and administering a State certification system pursuant to Section 401 of the Clean Water Act (33 USC 1344) and Section 342-32(13), HRS. Water quality certification is required of any applicant for a Federal license or permit to conduct any activity that may result in any discharge into navigable water. This includes the Department of Army permit.

5. Conservation District Use Permit

Any use of lands, including submerged lands within the State's Conservation District, requires a Conservation District Use Permit which is processed through the Office of Conservation and Environmental Affairs of DLNR. The Conservation District Use Application is subject to review pursuant to Chapter

183, HRS and Title 13, Chapter 2, Administrative Rules of the Department of Land and Natural Resources. Approval by the State Board of Land and Natural Resources will be required for all dredging and construction offshore of the seawater system intake in the Conservation District. A temporary variance may also be required for any test borings conducted in the offshore submerged lands.

As part of the Conservation District Use Permit, any construction seaward of the project site, being in submerged lands, will also require a State Land Use Disposition from the Division of Land Management.

6. Permit for Work in Shores and Shore Waters

The Ocean Water Construction Permit is administered by the Department of Transportation (DOT) pursuant to Section 266-16, HRS and Section 19-42-161, Hawaii Administration Rules, DOT, Harbors Division.

This permit is required for any construction, dredging or filling within the shorewaters of the State, as defined by Chapter 266, HRS. Jurisdiction extends to shores, shorewaters, navigable streams and harbors, belonging to or controlled by the State.

DOT review of this permit is normally conducted via interagency coordination with the Department of Land and Natural Resources on the Conservation District Use Application. The DOT, however, could request an independent review.

Portions of the MRTC renovation project subject to review include seawater system improvements extending into Kaneohe Bay.

7. Special Management Area

The entire project is within the Special Management Area (SMA) as defined by Ordinance 4529, City and County of Honolulu. This ordinance was adopted pursuant to Chapter 205-A HRS, as amended by Act 176, Session Laws of Hawaii 1975. The purpose of the SMA ordinance is to maintain, restore and enhance the overall quality of the coastal environment, including but not limited to its amenities and aesthetic values. The SMA is primarily directed at development activities which will adversely affect the aesthetic and other environmental resources of the shoreline area. The border of the Special Management Area extends along Kamehameha Highway (see Figure 13).

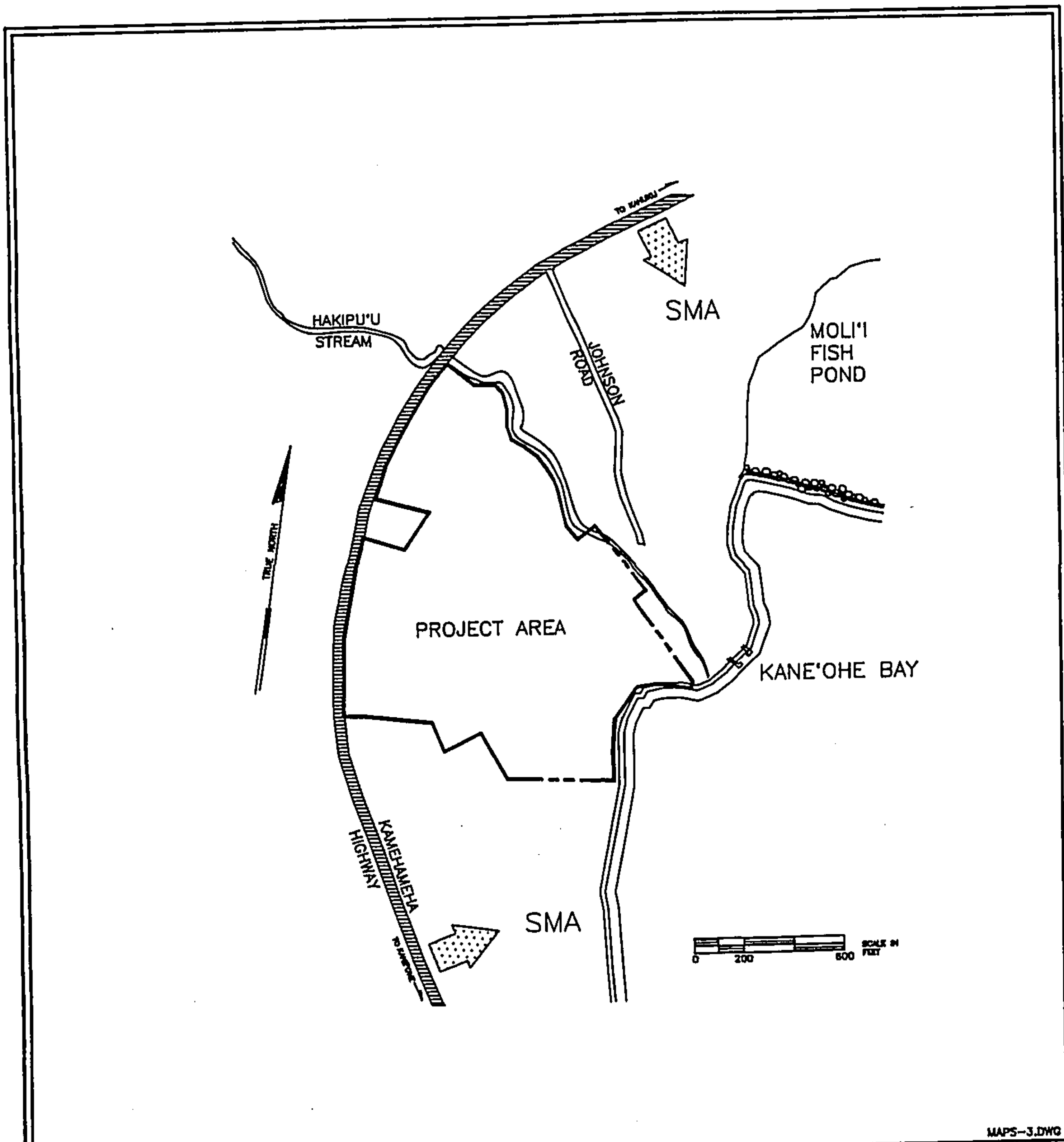

FIGURE 13. SPECIAL MANAGEMENT AREA

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8. Shoreline Setback Variance

Shoreline setback lines are established throughout the Island of Oahu at 40 feet inland from the upper reaches of the wave wash other than storm and tidal waves. All construction, improvements, grading, clearing, grubbing, filing, and other related activities involving land within the shoreline setback are subject to application of a shoreline setback variance from the Department of Land Utilization. The MRTC pump house and seawater system piping, being within the shoreline setback area, requires a variance.

9. Plan Review Use permit

Plan Review Use (PRU) approval is required for private and public uses of a permanent and institutional nature, which provide essential community services but could also have an adverse impact on the environment. According to Section 3.160-1 of the Land Use Ordinance (LUO), these uses include hospitals, prisons, airports, colleges and universities. This same section specifies the applicability of the PRU permit to academic use and agricultural products processing (under certain circumstances). MRTC carries out research and extension activities associated with the University of Hawaii making the renovation eligible for PRU approval. Proposed facilities, such as the dormitories, are not considered principal uses in the AG-2 zoning district and are more directly related to the University of Hawaii. In addition, proposed on-site uses may constitute "agricultural products processing - major" which meet the conditional use criteria listed in Section 4.40-1 of the LUO. Certain conditions of agricultural products processing trigger the PRU application process as specified in Section 4.40-1.

10. Grubbing, Grading and Stockpiling permits

The City and County's Soil Erosion Standards and Guidelines require the application of the above mentioned permits prior to construction activities. Article 2 of Chapter 23 gives the Chief Engineer of the Department of Public Works authority to process and grant such permits. In the event a PRU permit is required for the MRTC renovation, then PRU approval must be obtained prior to approval of grading permit.

D. OTHER PERMITS

- Building permits, including electrical, sewer & water (Building Department)
- Well Drilling permit (DLNR)
- Pump Installation permit (DLNR)

PROJECT IMPACTS

V. PROJECT IMPACTS

A. OVERVIEW

Potential impacts of developing the Mariculture Research and Training Center have been divided into several categories to facilitate assessment. Short-term construction related impacts are transitory and are expected to occur only during the construction phase of the project. Within the short-term impacts category, both landward impacts and marine impacts are assessed since construction spans the land/water interface, each with unique concerns in both realms. Long-term impacts relate to the permanent alteration of landward and marine environments resulting from project development. Social impacts relate to the long-term changes the proposed project may have on the population in the vicinity.

B. SHORT-TERM IMPACTS-LANDWARD

The agricultural/rural environment at the existing MRTC and in the adjoining taro farms and residential neighborhood establishes the context for assessing potential construction impacts. There are existing concerns regarding noise, traffic and flooding. A range of studies addressing these areas have been conducted and are contained in appendices at the end of this EIS.

1. Traffic

During the construction period, traffic in the vicinity of the project site will be affected by the movement of construction vehicles and commuting construction workers. To minimize traffic impacts, arrivals and departures of construction vehicles shall be coordinated to avoid disruption of peak hour traffic flows. Similarly, commuting schedules of workers may be adjusted, if necessary, to avoid peak traffic hours. If necessary, flagmen or police officers will be employed to direct traffic during critical phases of the project (see Appendix A).

2. Noise

During construction, significant noise levels will be generated by equipment and heavy machinery performing grading and earth moving, trenching, concrete pouring, hammering, etc. on the project site (see Appendix B).

Adverse impacts from construction will be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site. The use of properly muffled construction equipment will be required on the job site. However, mitigation of all construction noise to inaudible levels will not be possible in all cases due to the intensity of construction noise sources.

3. Air Quality

Air quality at the construction site is expected to be temporarily degraded by some fugitive dust from excavation activities and exhaust emissions from construction equipment and possible traffic disruption.

Fugitive dust generated during construction will be mitigated through compliance with the State of Hawaii Department of Health Rules and Regulations (Chapter 43, Section 10) which stipulates that controls are employed to reduce fugitive dust. Primary control consists of frequent wetting down of loose soil areas with water. Emissions from internal combustion will be mitigated by properly functioning emission control devices as required by law.

4. Archaeology

An archaeological survey was conducted to identify potential significant features and to determine mitigation measures that may be necessary to protect such features during renovation. No sub-surface features or cultural remains were found in the three areas chosen for test excavation. Expansion of the present mariculture ponds is not expected to have an impact on archaeological sites. However, expansion will result in dredging of most of the remaining lo'i land of the lower flood plain of Hakipuu Stream (see Appendix C).

additional surveys.

Three additional trenches were excavated via backhoe on December 2, 1993 to further determine the presence of any archaeological features. The history of sedimentation was recovered from 9 representative soil profiles. The resulting analysis of the soil profiles concluded that encountering any archaeological features, except for remaining lo'i, in the "grassy swamp area south of the existing ponds," is unlikely during the construction phase of the project. The archaeological study contained in Appendix C has been revised to reflect these additional backhoe excavations.

5. Flora and Fauna

Earthwork operations will remove vegetative cover consisting mostly of California grass, hau jungle, and mangrove. Although much of the original vegetation will be replaced by aquatic ponds, the proposed renovations of the facility are not anticipated to have a significant negative impact on the botanical resources. All of the species found on the MRTC site can be found in similar habitats throughout the islands. There are no known rare or endangered species of flora located in the immediate vicinity of the project site (see Appendix D).

The project area supports the typical array of fauna that one would expect to find in this type of environment on Oahu. Waterbird species will be temporarily driven to nearby habitats, however, food is available in the surrounding area. In addition, their temporary displacement to other nearby wetlands during the proposed renovations is expected to be minor compared to the benefit gained from the creation of additional wetlands suitable for their habitation (see Appendix E). It is anticipated that recruitment time for waterbirds will take several months after project completion before stable populations are achieved.

C. SHORT-TERM IMPACTS - MARINE

Short-term marine environmental impacts from construction of the facility and the salt water intake line are related primarily to the production of silt from construction activities. The use of silt control measures during construction will not guarantee the elimination of plume impacts.

1. Marine Impacts Nearshore

Sediments will be produced during construction by two activities, on-site grading for new ponds and trenching across the reef flat for the intake pipe and gallery installation. Erosion and runoff during on-site grading will be controlled through standard use of settling basins and grading area limits. The first portion of the project to be graded will be the MARSH which will act as the silt control basin to catch remaining construction activity runoff.

Installation of the seawater system pipeline and intake gallery will require limited dredging using a suction pipe to remove sediments from beneath the deployed pipe. Subsurface benthic fauna, primarily mollusks and polychaetes (worms), will be displaced or destroyed. During dredging operations a silt plume will be created. Due to the nature of the back reef area and its frequent silty condition from stream inflow, it is not expected that additional silt will generate detrimental long-term impacts. The benthic substrate is typical of the wide Kaneohe Bay back reef flat areas with inputs of sediments, fresh water and nutrients from Hakipuu Stream, particularly during rainy weather. Impacts of dredging on these soft sediments is anticipated to be temporary as substrate colonies will re-establish themselves on the new sand and debris covering the pipe.

Construction of the MARSH will create a saltwater wetland in place of the existing hau/mangrove jungle. The saltwater wetland will treat all aquaculture discharges from the MRTC facility and minimize discharge impacts to Kaneohe Bay. Possible impacts to the bay from the saltwater wetland includes an increase in nutrient loads to the nearshore water. Aquaculture discharge may contain bits of algae and leaf litter grown in the MARSH system broken off during growth or harvest. The impact, however, is anticipated to be less significant than the inflow of nutrients from Hakipuu Stream.

2. Marine Impacts Offshore

If putting an intake gallery within Hakipuu Sandbar is chosen, then sand will be removed and replaced, and a silt plume will form during construction. The plume would be carried by currents into the Hakipuu puka, which surrounds the Hakipuu Sandbar and functions as a natural settling basin. On the sandbar, the silt plume will be minimal due to the predominantly large grain size of the sand.

Dredging within the area of the proposed pipeline will potentially displace or destroy benthic habitat. Damage to corals from silt generated during construction is expected to be minimal as; a) live coral down current from the proposed pipeline is scarce and b) Porites compressa, which comprises most of the live reef, is more resistant to silt damage than most other species of coral. Adverse impacts are not anticipated in the immediate area and other parts of the bay, including the adjacent Molii Pond and nearby live coral beds. Impacts to existing recreational fishing in the surrounding area are expected to be negligible. Large scale dredging and coastal construction projects have been associated with ciguatera outbreaks. However, construction projects of this magnitude have not been known to trigger outbreaks of ciguatera.

Identification of construction details including gravel size specifications, well screen type, gallery type and gallery pipe spacing has yet to be determined.

D. LONG-TERM IMPACTS - LANDWARD

The proposed renovation of the MRTC will permanently change the face of the entire facility. New, small and numerous ponds are proposed to cover more area than the existing ponds on site. The greatly intensified use of the site is anticipated to have the following long-term impacts in the area:

1. Flora, Fauna and existing wetlands

The renovation plans for MRTC are not anticipated to have any net negative impacts on existing botanical resources. The botanical study recommends that more plants of the Polynesian variety be incorporated in the landscaping plans for the renovated facility to balance the overabundance of exotic plant species. The additional planting could include breadfruit or 'ulu, milo, more banana and taro cultivators, mountain apple, kamani, hala, etc.

The construction of additional aquaculture ponds is not expected to have negative impacts on animal life in the area. The faunal survey states that the existing and proposed ponds provide a foraging and nesting habitat for native waterbirds. The adjoining hau thickets are not considered primary habitat to native waterbirds as opposed to the pond areas. The conversion of densely vegetated hau patches to open usable wetlands should result in an increased population of waterbirds. The value of additional wetland habitat provided for native waterbirds will increase with the absence of hau and mangrove. Except for temporary displacement during construction, the renovation is <u>not</u> anticipated to impact any endangered waterfowl species on-site, including stilts, gallinules (moorhens), and coots (mudhens).

Population levels of nuisance animals from the proposed MARSH system will be less than from the existing wetlands. Any mongoose and rat populations may decrease due to partial removal of the hau/mangrove thicket. Snail and larval toad populations will be limited due to anticipated high salinity of the wetlands. New

2. Traffic

The traffic impact study estimated traffic flow for the proposed project site and surrounding area for 1997 and assessed how the project will affect traffic patterns (see Appendix A). Future traffic volumes associated with the project were determined by superimposing the site-generated traffic on the cumulative traffic volumes. Cumulative traffic conditions are defined as future traffic conditions resulting from background growth and related projects. The Level of Service (LOS) method was used to determine cumulative traffic conditions for 1997. The LOS method utilizes an A through F rating scale where A represents the best driving conditions and F represents the worst. Results of the study revealed that Kamehameha Highway presently operates at LOS "C" during peak hours.

Traffic conditions projected in 1997 on Kamehameha Highway, without the project, will operate at LOS "C" during peak hours. The project estimates to have a maximum of 15 employees with facilities for 40 visitors at the conference center. The study assigned the site-generated traffic to the anticipated traffic patterns. A summary of the LOS results for the intersections under study is presented in Table 6. Long-term traffic impacts from the project will be negligible.

TABLE 6.
TRAFFIC LEVEL OF SERVICE ANALYSIS

Traffic Projections	AM Peak Hour			PM Peak Hour		
	Max Flow	Volume	v/c Ratio	Max Flow	Volume	v/c Ratio
Existing	2548	695	.27	2478	1045	.42
Cumulative	2548	845	.33	2478	1285	.52
Cumulative + project	2548	867	.34	2478	1289	.52

Traffic volume was found to be greatest during morning and evening rush hours when 695 vehicles per hour (vph) and 1,045 vph, respectively, were present on the road. About 55 percent of the traffic was traveling towards Honolulu in the morning and away from Honolulu in the evening. Large vehicles such as trucks and busses accounted for 6 to 7 percent of the total traffic. The impact of the proposed facility on traffic volume was predicted to be negligible.

The sight distance from the existing MRTC entrance/exit is considered less than optimal according to State and Federal guidelines. This problem is more critical with large vehicles (trucks or busses) that require more time to safely turn from or onto the highway from the facility. To maximize ingress and egress accessibility, two vehicular accesses are proposed for the site from Kamehameha Highway. The Ultimate Site Plan (see Figure 5 in Chapter I) shows the location of both proposed vehicular entrance/exits for the MRTC. The first proposed entrance/exit for passenger vehicles will be positioned to minimize vehicle stacking around the curve. This requires moving the existing entrance approximately 75 to 100 feet towards Kaneohe, where site distance meets state standards for passenger car ingress and egress as well as improving vehicle visibility. This particular locale offers the maximum sight distance anywhere along the MRTC property. A recommendation was made to provide the alternate second entrance for direct access to the ponds and maintenance area by trucks along the property border at the extreme east (Kaneohe side) corner of the property.

Project planners have consulted with the abutting property owners/inhabitants for their input and to reconcile any concerns regarding the driveway and traffic safety.

3. Noise

The noise study concluded that noise levels produced from on-site pond equipment are very low in the "Minimal Exposure, Unconditionally Acceptable" category (see Appendix B). The proposed ponds are smaller than the existing ponds, thus allowing for a downsizing of the electrical pond aerators from two horsepower units to quieter 1/2 horsepower (HP) units. The State Department of Health noise limit set for Agriculture Districts will not be exceeded.

By 1997, traffic noise in the project area is expected to increase noise levels by approximately 0.8 Ldn as a result of non-project traffic. Project generated traffic is not expected to cause any noticeable increases in traffic noise.

Pond equipment noise is attributed primarily to aerators. The 1/2 HP aerators of the type proposed for use with smaller ponds are anticipated to produce a sound level of 47 dB at 18 feet. With sixteen 1/2 HP aerators operating at once, the noise levels at the property borders (80-120 feet distant) are predicted to be less than 32 dB.

4. Infrastructure and Utilities

An evaluation based on inventory of the existing sewer, water, and drainage systems was conducted by Oceanit Laboratories, Inc. in 1992 (see Appendix H). These findings are preliminary and a follow-up study will be conducted once design plans have been finalized.

The proposed MRTC renovation will be served by a variety of infrastructure including the Kamehameha State Highway, water, and public utilities that provide electricity, telephone and cable television services. The capacity of the highway serving the site was assessed in the previously discussed traffic study. Other services include the capacities with respect to serving the proposed renovation, the need for off-site improvements, and service charges to provide required connections.

The existing water system and two water meters will supply potable water to serve the proposed main administration building, student housing, hatchery, resident manager's home and maintenance buildings. The maximum daily demand for potable water is approximately 2,000 gallons. No uses are anticipated of public city water for aquaculture. According to the City and County of Honolulu Board of Water Supply, the present capacity of the water main is sufficient to accommodate the additional requirement.

One-inch lines will connect the student housing, office and maintenance building to a 2-inch supply line. The 2-inch supply line will connect to a 30-

inch main that runs under Kamehameha Highway. Significant impacts on the existing water supply system are not anticipated due to only a slight increase in demand.

The proposed facility will require an average power supply of about 60 KVA with both water systems running at average capacity. Hawaiian Electric Company officials have stated that the existing infrastructure facilities can handle up to 60 KVA without modifications. However, any additional load would require upgrading of the transformer. Since peak loads may be more than the present capacity of the system, installation of a higher capacity transformer is anticipated. Action will be taken with Hawaiian Electric Company to upgrade the power supply to mitigate any impacts to other users.

5. Sewage Treatment Plant Impacts

As discussed in Chapter I, a secondary treatment unit and leach field to handle domestic wastewater effluent is proposed on the MRTC project site. Figure 7 in Chapter I shows the location of the treatment unit and leach field.

To minimize environmental impacts, state regulations require that the leach field be located so that it can not contaminate aquaculture ponds. The leach field must be at least 50 feet from the ocean (or stream) and the bottom of the leach field trenches must be at least 3 feet above the ground water table. No permanent buildings may be placed on top of the leach field, although it may be possible to locate temporary tanks and above-ground plumbing over this site. The area of the leach field is determined by flow rate and soil percolation rates at the site. The large size of the leach field shown in Figure 5 in Chapter I assumes a worst case condition of extremely silty soil with a high clay content and low permeability. The condition of the soil at the site must be determined, via percolation testing, during mass grading for the ponds. It may be more economical to reduce the area of the leach field by raising the bed level through the addition of highly permeable sand and gravel. During flood conditions the leach field will drain into the MARSH system.

Solids will be removed by a pump truck from the primary wastewater treatment unit. The possibility of overflow is minimal if the unit is properly maintained. However, odors may escape periodically. The treatment unit will be positioned a reasonable distance from residential households.

6. Drainage and Flood Impacts

As discussed in Chapter II, the state undertook a flood improvement program at MRTC which removed all of the lowest pond (#12), half of the next pond

(#11) and installed a silt basin for runoff control during construction. The proposed MRTC renovation is not anticipated to alter this flood plain.

Along the southern border of the designated flood plain, a roadbed raised to an elevation of four feet above sea level is proposed to cross the lower portion of the site from the shoreline at the proposed pump house to the aquaculture pond area. The roadbed will serve as a vehicular access to the pump house and support for two 16-inch seawater supply pipes.

During periods of heavy rainfall when flooding is anticipated, the water level within the pond system will be dropped. Screens will be put on all pipe entrances and operation protocols will be defined for containment and to minimize the escape of animals.

7. Socio-Economic Impacts

The MRTC renovation is likely to stimulate the Kualoa area economically, through an increase in jobs associated with increased aquaculture production. However, the renovation is not anticipated to have any effect on the availability of housing or the property values of existing homes. The renovation is also expected to have little effect on medical and transportation facilities, and police and fire protection.

The MRTC renovation will affect the existing natural environment with a pond configuration which will increase both water surface and open space. The aesthetic value of the property will be improved with the creation of greater water surface area and additional wetlands. The height limitation on building design will preserve scenic views.

In response to concerns expressed by the surrounding community, the Hakipuu Community Advisory Committee (HCAC) was formed. The HCAC expressed concerns about potential impacts resulting from: a) fresh water well(s), b) property boundaries of project site, c) traffic safety, d) a domestic wastewater treatment facility, e) the degree of community use of ponds and tanks, and f) ciguatera. Tentative approaches acceptable to the HCAC have been reached on some issues. Monthly meetings will continue even after submittal of the Final EIS until all issues have been addressed.

bullet mention

Unresolved?!

E. LONG-TERM IMPACTS - MARINE

1. Seawater System Intake

The seawater system will pull an average of 1,200 gpm of salt water from either the Hakipuu Sandbar or from the adjacent channel. Locating the intake within

Hakipuu Sandbar could limit the ability of state or private concerns to utilize the sandbar as a source of sand for beach reclamation or other uses. Long-term impacts are not expected from this action.

The use of a suction pipe to dredge beneath and then fill on top of the seawater pipelines crossing the mudflat area will cause an area of disrupted sediment approximately 6 feet wide and 1,000 feet long from the shore to reef edge. This disrupted zone may be visible from the air for several years until benthic communities are re-established and blending occurs with the surrounding areas. Because materials resultant from dredging will be replaced on the pipeline and due to the sedimentary nature of surface deposits, long-term impacts are expected to be negligible.

The Hakipuu community expressed concerns for long-term effects that included ciguatera, water quality, and biota disturbances. These concerns are discussed? in the previous section and Chapter III. III-4

not really - just mentioned

2. Proposed Wetlands

Aquaculture effluent from MRTC will be released into the MARSH saltwater wetland. Waters from the MARSH system will flow through a hau/mangrove forest either by diffuse flow or controlled by a weir before entering Kaneohe Bay. The MARSH system is designed for settling of particulates, isolation of nonindigenous species, nutrient stripping, and polishing of effluent water prior to discharge into Kaneohe Bay or for reuse of waters within the facility's water distribution system. Water from the saltwater wetland will be thoroughly mixed with Hakipuu Stream waters and long-shore currents before it flows out to the open bay.

Effluent from the renovated MRTC ponds will consist of suspended solids and nutrients that will be absorbed, decomposed, or otherwise removed during its transit through the proposed MARSH. Effluent from the aquaculture ponds will first be directed to one of two settling ponds where suspended solids will be collected through settlement or possibly by biofiltration using oysters or similar species. The nutrient rich water will then flow into a long, sinuous shallow channel. Salt tolerant marsh plants and algae, incorporated into and placed along the banks of the 3-foot deep, rock-lined channel, will stabilize the banks and extract nutrients from the water. Seaweed, planted along the length of the channel, will strip nutrients from the water and will also provide substrate for the growth of filter feeding invertebrates that should further reduce the particulate load.

Algae in the saltwater wetland (MARSH) is anticipated to grow rapidly. Occasional cropping will be necessary to maintain a balanced flow within the system. Algae will also produce gametes or seeds that will wash out from the wetland area into the adjacent backreef area in Kaneohe Bay. Observations of significant populations of other algal species on the adjacent reef flat indicate substantial nutrient availability to support the constantly seeded population of offshore algae. Algal gametes flushed from the saltwater wetland will compete with already abundant and established macro-algae populations, potentially changing the species composition and increasing the overall population of algae on the reef flat near Hakipuu Stream outlet.

The designed MARSH system will not only rely upon algae for nutrient removal but will also incorporate the few varieties of emergent vegetative plants adaptive to anticipated high salinity, such as saltgrass and pickleweed. Algae, however, will remain a primary portion of the system due to its extraordinary ability to absorb nutrients and its relative ease of removal (harvest) from the system.

The introduction of alien species into the local ecosystem is a concern to any research facility. The experimental use of exotic species is controlled by state agencies to prevent unwanted introductions to Hawaii's ecosystems. The draft operational procedure guidelines for MRTC state that no experimentation with species deemed to be a potential threat to the environment will occur. Further, the MARSH system with its series of settlement ponds and screens along its winding channels will help to limit escape risks.

The population of nuisance animals, such as insects and rodents, from the MARSH system is anticipated to be less than from the existing hau/mangrove forest. The MARSH system will not provide an extensive canopy, nor will it harbor standing or stagnant water which could provide habitat for nuisance animals. The existing hau/mangrove forest will be replaced by wetlands which are more conducive habitats to endangered waterbirds on-site. This is considered to be a positive impact.

Unpleasant odors are commonly associated with sewage control plant and natural marsh lands. The methane smell is a product of anaerobic digestion of waste products. If the MARSH became anaerobic it is more likely to produce a hydrogen sulfide smell which occurs in the presence of salt water. However, the MARSH is designed to be aerobic through the use of shallow beds, fluctuating water levels and rapid flow rate. The system should not emit noxious fumes, unless the system is overloaded with anaerobic sediments from a fouled pond.

No artificial salt marsh systems in the State are known to exist and natural saltwater marsh systems within the State are not regulated. The degree of system efficiency cannot be tested until the MARSH is operational and will undoubtedly undergo some "fine tuning" over time. The proposed MARSH system allows for conserving water resources and preventing violation of state water quality standards. An operational protocol for monitoring and managing water quality standards at MRTC will be defined at a later stage of project development.

F. SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY

1. Short-Term Uses

In the short-term, the project will confer some positive benefits in the local area. Direct economic benefits may result from construction expenditures both through the purchase of material from local suppliers and through the employment of local labor. Indirect economic impacts may include benefits to local Kaneohe retail businesses from construction activities.

Construction of the proposed project will provide the necessary materials and human resources in planning, designing, engineering, management services, construction labor, landscaping and maintenance functions.

2. Long-Term Productivity

The proposed action is expected to enhance the long-term viability of this presently underutilized aquaculture site by upgrading the infrastructure, by incorporating the latest in high technology and innovation in aquaculture systems, and by providing additional improvements and amenities to the project site. If high quality fresh water resources are tapped from beneath the project site, then property values will very likely increase in the long-term.

Also in the long-term, the project will result in greater accommodations for students and researchers; increased guided public access to the facility; higher a greater quantity of production yields; and accrued benefits resulting from scientific replication and best available technologies.

G. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction and operation of the proposed project would involve the irretrievable commitment of certain natural and fiscal resources. Major resource commitments include money, construction materials, manpower, and energy. The impacts of using these resources should, however, be weighed against the economic benefits to the residents of the state, and the consequences resulting from taking no action. But because the purpose of the MRTC is to support aquaculture education and research, the main product is information. Revenues, derived from demonstrations and ongoing studies in terms of dollars generated, are difficult to predict and are of secondary importance to educational accomplishments.

The commitment of resources required to accomplish the project includes labor and materials, which are mostly nonrenewable and irretrievable. Benefits will accrue to the State's construction industry. Operation of the facility will also include the irretrievable consumption of water and electricity.

Portions of the project site expansion will remove the existing hau and mangrove jungle inhabiting the Kaneohe Bay side of the project site. In addition, portions of the existing unimproved wetland will be replaced with settling ponds, channels and a wetland designed to treat aquaculture effluent prior to its discharge into Kaneohe Bay. This subsequent renovation of the site would create a net increase of additional wetland and improve the bird habitat for several endangered species.

Considering fresh water as an irretrievable resource, the need for water is likely to increase. As more fresh water sources are tapped on the windward side of Oahu, water supplies are likely to diminish. For balancing fresh water use, the feasibility of recycling outflow for irrigation or recirculating treated effluent to ponds are several options under consideration for MRTC. As part of this balance of fresh water use, the feasibility of recycling outflow for irrigation and/or recirculation of treated effluent back into ponds are several options under consideration for MRTC. new

ALTERNATIVES TO THE PROPOSED PROJECT

VI. ALTERNATIVES TO THE PROPOSED PROJECT

The no-action alternative would preserve the status quo, and the economic, educational and social benefits of the MRTC renovation would not be realized. In all probability, the University of Hawaii would not renew its lease on the site. Alternative pond sites were considered in a report by Brewer/Brandman Associates (1989). Other options considered in the report are as follows:

- Upgrading MRTC and adding ponds and infrastructure on State lands at Waialee.
- Upgrading MRTC and adding additional ponds and infrastructure on leased Bishop Estate north shore lands, currently being used for grazing dairy cattle.
- Upgrading MRTC and adding additional ponds and infrastructure at one or more Neighbor Island Satellite Facility sites.

According to the report, these options maximize the "use of existing resources and infrastructure now in place at MRTC, provide additional land for pond research and expansion not available at MRTC, and recognize that increasing development pressure for coastal lands on Oahu may rule out development of pond facilities...in the future."

SUMMARY OF UNRESOLVED ISSUES

VII. SUMMARY OF UNRESOLVED ISSUES

As part of the planning process, which includes the EIS and formation of the Hakipuu Community Advisory Committee, importance issues were identified, which affect the renovation and the surrounding neighborhood. Every attempt is being made to develop appropriate mitigative measures.

Property Lease: The University of Hawaii is in negotiations with Kualoa Ranch, Inc. to delineate the project site's final boundary configuration and to negotiate terms and conditions of the lease agreement.

Seawater System and Saltwater Wetland: Final design of the seawater system, including the intake, effluent drainage, wetland, and settling ponds, has yet to be completed.

Plan Review Use Permit: The Department of Land Utilization (DLU) has not yet determined the use classification for the: a) administration/main laboratory, b) graduate research/student housing, and c) visiting research housing. These proposed uses are not principal uses for the Ag-2 zoning designation. If DLU determines that most of these facilities constitute academic research, then a Plan Review Use permit will be required.

Domestic Wastewater Treatment Facility: Final selection, design and incorporation of a small sewage treatment facility and leach field on the project site is not complete. Determining the type and level of treatment proposed for the wastewater treatment facility according to DOH standards is not complete. Who will operate and maintain the facility has not been determined.

Harnessing Fresh Water: Based on preliminary estimates, the shallow groundwater aquifer may not be adequate to support the fresh water needs of the facility without adverse impact to the surrounding community. If fresh water is available, it must be extracted from the Koolau-dike aquifer. Proposed drilling of test well(s) by professional hydrologists will determine the extraction feasibility of fresh water. It is difficult to predict the structure of the Koolau-dike aquifer without further investigation by test well extraction. Depending on the water source tapped, there is concern that MRTC usage of fresh water may contribute to flow reduction in Hakipuu Stream. There is also concern that fresh water extraction will impact the springs located mauka of the project site. If these impacts result from groundwater well extraction, then the test wells will be sealed to cancel further extraction.

Due to the limitation of the Board of Water Supply system's capacity, there is no intent to use city tap water for MRTC aquaculture purposes. Peak uses and quantities of fresh water for aquacultural purposes have yet to be determined. Initial estimates for fresh water aquaculture usage have since been reduced as it is unlikely that ample quantities of groundwater exist. Other options to well drilling are being examined. If a well of acceptable capacity is found, monitoring wells between the source well and the stream will be maintained to determine seasonal impacts on stream flows. Adjustments to water usage by the facility will be made accordingly.

Traffic Safety: Project planners will meet with the State Department of Transportation to discuss installation of a flashing yellow light and speed limit reduction sign on Kamehameha Highway.

State Civil Defense: Although the Hakipuu Community Advisory Committee is not in favor of a civil defense siren on Kamehameha Highway, the Civil Defense Department is suggesting that one be installed during the construction phase of the project.

ORGANIZATIONS AND INDIVIDUALS ASSISTING IN PREPARATION OF THE EIS

VIII. ORGANIZATIONS AND INDIVIDUALS ASSISTING IN PREPARATION OF THE EIS

PRINCIPAL EIS CONSULTANT:

Oceanit Laboratories, Inc.	Dr. Patrick K. Sullivan, Principal Mr. Robert Bourke, Project Manager Ms. Robin L. Anawalt, Planner Dr. Warren Bucher, Ocean Engineer Dr. Dayanada Vithanage, Coastal Engineer Mr. David Takeyama, Planner Mr. Wayne Yoshimura Ms. Lori Kahikina Ms. Tomoko Ito Mr. Val Bueno

SPECIALISTS:

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Y. Ebisu & Associates	Mr. Yosh Ebisu
Cultural Surveys Hawaii	Dr. Hallett H. Hammatt Mr. Michael T. Pfeffer Ms. Helen Wong-Smith
Char & Associates	Ms. Winona Char
Environmental Consultants	Dr. Philip L. Bruner Ms. Jackie Parnell
University of Hawaii	Dr. Phil Helfrich Dr. Gordon Grau Dr. Chris Brown Dr. Marlon Atkinson Mr. Bo Alexander Mr. Jim Ure
Aquaculture Development Program	Mr. John Corbin Dr. Leonard Young

REFERENCES

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CONSULTATION

X. AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED IN THE PREPARATION OF THE DRAFT EIS

The notice of availability of the EIS Preparation Notice for the MRTC was published in the OEQC Bulletin by the Office of Environmental Quality Control on May 23, 1992. As part of the preparation of the Draft EIS, the following agencies, organizations, and individuals were sent copies of the EIS Preparation Notice and were asked to comment on the project. A total of 23 comments were received as of August 3, 1992.

The following parties which responded to the Preparation Notice are marked with an asterisk(s). A double asterisk (**) indicates comments to which substantive responses were required. Both comment and response letters are reproduced in this section. A single asterisk (*) indicates letters which provided "no comment" responses.

Federal

Army-DAFE (Facilities Eng.-USASCH)
Environmental Protection Agency
** U.S. Department of Agriculture, Soil Conservation Service
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Fish and Wildlife Service
National Marine Fisheries Service

State Agencies

Department of Agriculture
* Department of Accounting and General Services
* Department of Defense
* Department of Education
* Department of Hawaiian Home Lands
** Department of Health
** Department of Land and Natural Resources - 3 copies
    Aquatics Resources Division
    Office of Environmental and Conservation Affairs
    State Historic Preservation Division
Department of Business, Economic Development and Tourism
DBED Library
Housing Finance and Development Corporation
** Department of Transportation
DOT, Harbors Division
** DOT, Highways Division
State Archives
State Energy Office

Office of State Planning
OSP, Coastal Zone Management
Hawaii Community Development Authority
Office of Hawaiian Affairs
Office of Environmental Quality Control

City and County of Honolulu

** Board of Water Supply
* Building Department
* 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
** Planning Department
* Police Department

University of Hawaii

Hawaii Institute of Marine Biology
Environmental Center
Marine Programs
Water Resources Research Center

Media

Honolulu Star-Bulletin
Honolulu Advertiser
Pacific Business News
Downtown Planet
Windward Sun Press

Elected Officials

Council Chair Gary Gill
Councilman Steve Holmes
State Representative Reb Bellinger
Senator Mike McCartney

Libraries

University of Hawaii Hamilton Library, Hawaiian Collection
Legislative Reference Bureau
State Main Library and windward branches

Others

American Planning Association
American Lung Association
Eight Bells (Sea Grant)
* Hawaiian Electric Company
Hawaiian Telephone Company
Outdoor Circle
Hawaii Audubon Society
** Kahaluu Neighborhood Board
Greenpeace Hawaii
** Mr. Mark Newman
Mr. John Morris
Mr. Herbert Hoe

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

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96850

June 18, 1992

Mr. Robert Bourke, Project Manager
Oceanic Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Environmental Impact Statement Preparation Notice (EISPN) -
The Mariculture Research and Training Center
Large Scale Pond Research, Training and Demonstration
Facility, Koolaupoko, Oahu, Hawaii

We have reviewed the EISPN and would like to make the following comments:

We recommend that the issue of sediment production during construction be addressed in the Draft EIS. It is important that specific sediment control treatments, alternatives, and potential effects be discussed.

We support the concept of using designed (artificial) wetlands to treat the effluent of the aquaculture operation. We believe that this technology holds promise in the treatment and disposal of liquid wastes. However, we do have one concern about the designed wetlands as proposed. We suggest the Draft EIS thoroughly review the use of seaweed to strip nutrients from the effluent. Submerged vegetation may not be capable of removing enough nutrients from the effluent and may increase the potential for introduced or "weed" species of algae spreading to nearby deep-water reef areas. Emergent vegetation as nutrient "scrubbers" may be safer in that they would provide more nutrient uptake and not be able to invade the deeper reef areas.

Thank you for the opportunity to review this document. We would appreciate the opportunity to review the Draft EIS.

Sincerely,

Warren M. Lee

WARREN M. LEE
State Conservationist

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

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

SUBJECT: Environmental Impact State Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Lee:

Thank you for your comments on the subject EISPN. We offer the following responses, in respective order, to your comments:

1. Sediment production during construction will emanate from two sources, on-site grading for new ponds and trenching across the reef flat for intake pipe installation. Erosion and runoff control during on-site grading will be controlled through standard use of settling basins, grading area limits, and groundcover planting. Sediment produced during burial of the offshore pipelines is proposed to be controlled initially with a land based sediment basin and subsequently with a silt curtain "tunnel" over the previously trenched pipeline. This will allow excavated materials from one section of the pipeline trench to be used for fill in previous sections. These methods are discussed in detail in the Draft EIS.

2. The designed marsh system will not rely only upon algae for nutrient removal but will also incorporate the few varieties of emergent vegetative plants adaptive to anticipated high salinity. These plants include mangrove, saltgrass and pickleweed. Algae, however, will remain a primary portion of the system because of its extraordinary ability to absorb nutrients and its relative ease of removal from the system. The goal is a stable system with high diversity and efficiency that requires minimal maintenance. A more complete description of the marsh system is contained in the Draft EIS.

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

We hope that we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

JOHN WAIHEE
GOVERNOR

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

RUSSEL S. NAGATA
COMPTROLLER
ROBERT P. TAKUSHI
[redacted]
DEPUTY COMPTROLLER

LETTER NO. (P)1524.2

JUN 3 1992

Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Attention: Mr. Robert Bourke

Gentlemen:

Subject: Mariculture Research and Training Center
Koolaupoko, Oahu, Hawaii
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 have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

GORDON MATSUOKA
State Public Works Engineer

RY:jk

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

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

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Matsuoka:

Thank you for responding to the subject EISPN. We shall continue to seek your review and comments as a consulted party during the public review procedures for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
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JOHN WAIHEE
GOVERNOR

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

EDWARD V. RICHARDSON
MAJOR GENERAL
ADJUTANT GENERAL

MYLES M. NAKATSU
COLONEL
DEPUTY ADJUTANT GENERAL

June 3, 1992

Engineering Office

Robert Bourke
Project Manager
Oceanit Laboratories
Century Square, Suite 2512
1188 Bishop Street
Honolulu, Hawaii 96813

Subject: Environmental Impact Statement Preparation Notice
The Mariculture Research and Training Center
Large Scale Pond Research, Training and
Demonstration Facility, Koolaupoko, Oahu, Hawaii

Dear Mr. Bourke:

Thank you for providing us the opportunity to review the above mentioned environmental impact statement.

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

Sincerely,

Jerry M. Matsuda

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

NATIONAL GUARD
Americans At Their Best.

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Lieutenant Colonel Jerry M. Matsuda
Department of Defense
Office of the Adjutant General
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Lieutenant Colonel Matsuda:

Thank you for responding to the subject EISPN. We shall continue to seek your review and comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

JOHN WAIHEE
GOVERNOR

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

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

June 19, 1992

Mr. Robert Bourke
Project Manager
Century Square
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center
Koolaupoko, Oahu, Hawaii

Our review of the subject EISPN indicates that the proposed renovations of the Mariculture Research and Training Center operated by the University of Hawaii will have no impact on the schools in the area.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi
Superintendent

CTT:hy

cc: Dr. M. Nakashima
A. Suga
J. Sosa

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

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

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Toguchi:

Thank you for responding to the subject EISPN. We shall continue to seek your review and comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

June 16, 1992

Mr. Robert Bourke, Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke

Kualoa Mariculture Research & Training Center

Thank you for transmitting a copy of your EIS Preparation Notice and Environmental Assessment for the proposed Mariculture Research and Training Center, Large Scale Pond Research Training and Demonstration Facility, at the mouth of Hakipuu Stream, Kualoa, Koolaupoko, O'ahu.

We understand that this project involves upgrading an existing UH facility. We do not expect that it will impact Hawaiian home lands, except of course to establish greater understanding of the feasibility of such projects for others. We have no comment at this time.

Warmest aloha,

Hoaliku L. Drake
Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Mr. Hoaliku L. Drake, Chairman
State of Hawaii
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Drake:

Thank you for your memorandum of June 16, 1992 in which you indicated that you had no comments on the subject EISPN. We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Bob Bourke
Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

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:
92-187/epo

August 3, 1992

Mr. Robert Bourke
Project Manager
Oceanit Laboratories, Inc.
Century Square
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC)
49-139 Kamehameha Highway
Kaneohe, Oahu, Hawaii

Thank you for allowing us to review and comment on the subject document. We have the following comments to offer:

Water Pollution

Besides the environmental permits mentioned in the EISPN, a storm water National Pollutant Discharge Elimination System permit application is required for construction activities which involves the clearing, grading, and excavation of equal to or greater than five (5) acres of total land area. This application should be submitted to the Director of Health at least 90 days before the date on which construction is to commence.

If you should have any questions on this matter, please contact Mr. Alec Wong, of the Clean Water Branch at 586-4309.

Wastewater

The subject project is located in the "Pass" zone, makai of the Underground Injection Control (UIC) Line, and in the critical wastewater disposal area as determined by the Oahu Wastewater Advisory Committee. Consequently, no new cesspools will be allowed in the subject area.

As infrastructure improvements will not be constructed in the near future and there is no existing sewer service system in the area, the Department of Health (DOH) concurs with the innovative system where effluent from the renovated MRTC pond facilities (estimated at 1250 gpm) will not have a significant adverse impact on the environment, if the majority of suspended solids and nutrients are absorbed, complexed, or otherwise removed in the proposed designed wetland area. However, we are concerned with the collection, treatment, and disposal of domestic wastewater from

the numerous buildings (offices, dormitories, educational and maintenance buildings). Wastewater from these facilities cannot be disposed of into cesspools. Treatment and disposal must be consistent with both the DOH Administrative Rules, Chapter 11-62 and the pond/seawater system. Details of the domestic wastewater system should be submitted to the Department for review and approval.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290.

Noise

1. Construction activities must comply with the provisions of DOH Administrative Rules, Chapter 11-43, "Community Noise Control for Oahu."

   a. The contractor must obtain a noise permit if the noise levels from the construction activities are expected to exceed the allowable levels of the rules.

   b. Construction equipment and on-site vehicles requiring an exhaust of gas or air must be equipped with mufflers.

2. Heavy vehicles travelling to and from the project site must comply with the provisions of DOH Administrative Rules, Chapter 11-42, "Vehicular Noise Control for Oahu."

If you should have any questions, please contact Mr. Jerry Haruno of the Noise and Radiation Branch at 586-4701.

Food Processing

The subject document indicates that oysters, and maybe clams as well, will be cultured at MRTC. DOH Administrative Rules, Chapter 11-35, "Shellfish Sanitation", requires that a shellfish permit be obtained from the Food and Drug Branch if MRTC intends to sell these bivalves for food consumption purposes.

If you should have any questions on this matter, please contact Mr. Maurice Tamura of the Food and Drug Branch at 586-4725.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

c: Clean Water Branch
Wastewater Branch
Noise and Radiation Branch
Food and Drug Branch

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Dr. John C. Lewin
Director of Health
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Dr. Lewin:

Thank you for your comments on the subject EISPN. We offer the following responses to your comments.

Water Pollution

We concur that a NPDES permit will be required prior to renovation of the existing pond facility. This permit requirement will be discussed further in the Draft EIS.

Wastewater

Inasmuch as domestic wastewater disposal requirements have yet to be completely determined, the Draft EIS shall provide an overview of potential concerns regarding overall system capabilities. As mentioned in your letter, no sewer service is provided and new cesspools are not permitted. The remaining option is to build a treatment and disposal facility on-site. Several possible treatment and disposal methods are currently under review including commercially available "off the shelf" secondary and tertiary treatment modules. In accordance with DOH Administrative Rules, Chapter 11-62, we acknowledge the requirement for preparing and filing details of the planned system to your office for review and approval. The wastewater system will be designed to eliminate any possible contamination of aquaculture ponds with domestic effluent.

We appreciate your positive comments regarding our innovative MARSH system for treatment of aquaculture effluent. As designs for the MARSH system become more complete, we look forward to working with your staff to incorporate any suggestions and comments.

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
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Noise

All construction activities will comply with standards set by DOH Administrative Rules, Chapter 11-43, "Community Noise Control for Oahu" and Chapter 11-42 "Vehicular Noise Control for Oahu."

The Hakipuu area being zoned for agricultural use, has less stringent requirements for noise limitations. However, adjoining agriculture and country zoned property is under residential use and residents have expressed sensitivity to noise. Project planners have, and will continue to have, open dialogue with surrounding residents to minimize impacts on the Hakipuu community.

Food Processing

The primary function of the facility is research and extension. Any aquaculture animals or plants resulting from research are seen as secondary products. Although MRTC will produce products for consumption, there is no intention to actively market products in competition with private sector aquacultural ventures. Prior to processing any fish products it is understood that appropriate permits must be approved by the Food and Drug Branch. This would include a shellfish permit should any shellfish be grown and distributed. Any distribution of product will be in accordance with industry accepted sanitation procedures and with DOH Administrative Rules, Chapter 11-35, "Shellfish Sanitation."

We hope that we have satisfactorily responded to your comments. Please write or call me if you have any additional questions. Your letter will be included in the Draft EIS.

Very truly yours,

Robert Bourke for
Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

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
JOHN P. KEPPELER II
DONA L. HANAIKE

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

REF:OCEA:SKK

JUL 6 1992

FILE NO.: 92-761
DOC. ID.: 943

Mr. Robert Bourke, Project Manager
Ocean Laboratories, Inc.
Century Square
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility, Koolaupoko, Oahu, Hawaii, TMK: 5-6-3: 161

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.

Brief Description:

The renovation of MRTC is being proposed by UH-HIMB, with the DLNR, DOWALD processing the EIS as an agency action. The applicant proposes to make renovations to the existing center that will include changes to the seawater system, tanks and ponds, and building structures. The proposed seawater system has an expected average maximum flow rate of 1,250 gallons per minute. There are two possible sources of saltwater for the facility 1) a buried intake pipe offshore and 2) a non-buried intake located in 17 feet of water on the ocean side of the Hakipuu sandbar. A bundle of five pipes within a pipe extending 1,500 feet offshore would transport the water from the intakes. Pipeline installation would require some suction dredging with the dredged spoils being used to refill the dredged pipe trench.

Division of Aquatic Resources Comments:

The proposed dredging would displace or destroy the benthic habitat and the animals that live within the area of the proposed pipeline. The forthcoming draft EIS should address the potential impacts that the

dredging and the resulting silt might have on the resources in the immediate area and other parts of the bay, including those in the adjacent Molii fishpond and the live coral beds that exist nearby. The extent of, and degree to which fishing activity may be impacted should be included in the draft document.

Historic Preservation Division Comments:

The EISPN notes that an historic sites inventory survey has been completed for the project parcels and that a report of this survey will be included in the Environmental Impact Statement. We will review and comment on this report when it is available.

Division of Forestry and Wildlife Comments:

We recommend that the DOWRM and Oceanit Labs consult with Mr. Ron Walker, DOFAW Wildlife Program Manager, in all phases regarding wetland protection and enhancement.

Division of Land Management Comments:

We have no objections to the proposed project. However, we believe that it should include a parkway alongside the stream and fronting the ocean including parking and bath facilities for use by the general public during normal operating hours.

Office of Conservation and Environmental Affairs Comments:

Any use of lands, including submerged lands within the State's Conservation District, as established by the State Land Use Commission, are subject to review pursuant to Chapter 183, HRS and Title 13, Chapter 2, Administrative Rules of the Department of Land and Natural Resources. A Conservation District Use Application will be required for all dredging and construction offshore in the Conservation District. A temporary variance may also be required for any test borings conducted in the offshore submerged lands.

Thank you for your cooperation in this matter. Please feel free to call Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

John P. Keppeler "
for WILLIAM W. PATY

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

The Honorable William W. Paty, Chairperson
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility
[REF:OCEA:SKK]

Dear Mr. Paty:

Thank you for responding to the subject EISPN. We offer the following responses, in respective order to your comments:

1. Division of Aquatic Resources: We do not anticipate permanent adverse impacts from dredging and resultant silt on resources in the immediate area and other parts of the bay, including the adjacent Molii pond and nearby live coral beds. As you are aware, all parts of Kaneohe Bay are periodically subjected to inundation with flood-borne silt. Benthic resident populations are subsequently adapted to this siltation. Natural silt load at the mouth of Hakipuu Stream is heavy and the reef edge directly offshore is mostly devoid of live coral coverage. Sediment produced during burial of the offshore pipelines is proposed for control initially with a land based sediment basin and subsequently with a silt curtain "tunnel" over previously trenched pipeline. This will allow excavated materials from one section of pipeline trench to be used for fill in previous sections. These methods are discussed in the Draft EIS.

2. Historic Preservation Division: There are no sites of significant archaeological value found on the project site. The archaeological inventory survey is included in its entirety as an appendix in the Draft EIS.

3. Division of Forestry and Wildlife: Thank you for providing the name of Mr. Ron Walker. We have been in contact with Mr. Walker regarding wetland protection and enhancement and have found his suggestions and comments to be very helpful in the preparation of plans for the marsh area.

4. Division of Land Management: With respect to your suggestion to provide a parkway (broad landscaped highway) alongside Hakipuu Stream, with parking and bath facilities along the ocean. However, because the proposed renovation serves as a research, development and extension facility, and the lack of any appealing wading area along the shoreline, bathing facilities for the general public is not considered within the project scope.

   According to the architectural renderings, parking facilities are positioned as close as possible to Kamehameha Highway (see Figures 4 and 5 of the Draft EIS). The parking lot(s) and most of the structures are positioned outside of the Flood Zone (see Figure 6). In keeping with the major objectives, access by the public will be limited, for the most part, to staff, researchers and educational groups. Additional public uses of the facility will include guided tours and a continuation of the pond fishing activities for the physically challenged.

5. Office of Conservation and Environmental Affairs: We understand that a Conservation District Use Application will be required for all dredging and construction offshore in connection with the seawater system. This is addressed in Chapter IV of the Draft EIS.

We hope we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Bob Bourke

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

JOHN WAIHEE
GOVERNOR

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

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.4736

June 22, 1992

Mr. Robert Bourke
Project Manager
Oceanit Laboratories, Inc.
Century Square, Suite 2512
1188 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: EIS Preparation Notice (EISPN)
The Mariculture Research and Training Center Large Scale Pond Research, Training and Demonstration Facility
Koolaupoko, Oahu, Hawaii

We reviewed the EISPN for the proposed renovation of the Mariculture Research and Training Center and have the following comments:

1. A traffic impact study should be prepared and included in the draft environmental impact statement for our review and comments.

2. The number of accesses to Kamehameha Highway should be minimized.

3. Sight distance at the project's access(es) must conform to applicable State highway design standards.

4. Subsequent plans you develop for any work within the State highway right-of-way should be submitted to our Highways Division for review and approval.

We appreciate this opportunity to provide comments.

Sincerely,

Rex D. Johnson
Director of Transportation

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

The Honorable Rex D. Johnson,
Director of Transportation
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale
Pond Research, Training and Demonstration Facility

Dear Mr. Johnson:

Thank you for your comments on the subject EISPN. We offer the following responses, in respective order, to your comments:

1. A traffic study is included in the Draft EIS as an appendix.

2. The number of accesses to the facility from Kamehameha Highway will be no greater than two.

3. The sight distance at the current facility access road does not meet highway design standards. This problem is being addressed by relocating the entrance approximately 75 feet towards Kaneohe where the site distance will meet state standards. The second proposed entrance, located approximately 800 feet south of the first access, will meet state standards for passenger car entrance (ingress) and egress.

4. Any changes to plans that encroach the State highway right-of-way shall be submitted to the Highways Division for review and approval.

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

We hope that we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Oceanit Laboratories, Inc.

JOHN WAIHEE
GOVERNOR

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

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
HWY-PS
2.2503

JUN 18 1992

Mr. Robert Bourke
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center,
Hakipuu, Koolaupoko, Oahu, TMK: 4-9-01: vars.

Thank you for your letter of May 26, 1992, requesting our review of the subject EISPN.

We have the following comments:

1. The traffic impact study should be included in the draft Environmental Impact Statement for our review and comment.

2. The number of accesses to Kamehameha Highway should be minimized. The location of the existing driveway on a curve is not desirable.

3. Sight distances at the project access must conform to applicable State highway design standards.

4. Plans for construction work within the State highway right-of-way must be submitted for our review and approval.

Very truly yours,

T. Harano
T. HARANO
Chief
Highways Division

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

September 22, 1992

Mr. T. Harano, Chief
State of Hawaii
Department of Transportation
Highways Division
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Harano:

Thank you for your comments on the subject EISPN. We offer the following responses, in respective order, to your comments:

1. The traffic impact study is included in the Draft EIS as an appendix.

2. The number of accesses to the project from Kamehameha Highway will be no more than two. Due to the limited sight distance at the curve, every effort will be made to position the access to minimize traffic stacking on the curve. At a minimum, the current entrance will be moved approximately 75 feet towards Kaneohe, where site distance meets State standards.

3. The sight distance of the project's access shall conform to State highway design standards.

4. Any proposed construction work that encroaches on the State highway right-of--way shall be submitted to your Division for review and approval.

We hope that we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Rob Bourke
Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

630 SOUTH BERETANIA STREET

HONOLULU, HAWAII 96843

June 23, 1992

Mr. Robert Bourke
Oceanit Laboratories, Inc.
Century Square
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Your Letter of May 26, 1992 Regarding the Environmental Impact Statement Preparation Notice (EISPN), For the Proposed Mariculture Research and Training Center, TMK: 4-9-01: 11, 12, 31, 32, Por. 13 and 14, Kamehameha Highway - Kualoa

We are still evaluating the proposed project and will complete our review by July 15, 1992.

If you have any questions, please contact Bert Kuioka at 527-5235.

Very truly yours,

FOR KAZU HAYASHIDA
Manager and Chief Engineer

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

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

630 SOUTH BERETANIA STREET

HONOLULU, HAWAII 96843

July 13, 1992

Mr. Robert Bourke
Oceanit Laboratories, Inc.
Century Square
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Your Letter of May 26, 1992 Regarding the Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Mariculture Research and Training Center, TMK: 4-9-01: 11, 12, 31, 32, Portion 13 and 14, Kamehameha Highway, Kualoa

Thank you for the opportunity to review and comment on the proposed Mariculture Research and Training Center. We have the following comments to offer:

1. The existing water system is presently adequate to accommodate the proposed facility. There are two existing water meters currently serving the site.

2. The availability of additional water will be confirmed when the building permit is submitted for our review and approval. If additional water is made available, the applicant will be required to pay our Water System Facilities Charges for source-transmission and daily storage and any meter installation charges.

3. If a three-inch or larger meter is required, the construction drawings showing the installation of the meter should be submitted for our review and approval.

4. The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

5. Board of Water Supply approved reduced pressure principle backflow prevention assemblies should be installed on each domestic water service immediately after the property valves.

If you have any questions, please contact Bert Kuioka at 527-5235.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

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

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

The Honorable Kazu Hayashida,
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Hayashida:

Thank you for your comments on the subject EISPN. We offer the following responses, in respective order, to your comments:

1. We acknowledge your comment that the existing water system and two water meters are adequate to serve the proposed renovation of the MRTC.

2. We understand that the availability of any additional water required by the development will be confirmed by your office when building permits are submitted for approval. At this preliminary planning stage we do not anticipate additional water usage beyond 2,000 gallons per day, however, we understand that if additional water is required and made available, there may be a Water System Facilities Charge.

3. At this time, we do not anticipate that a 3-inch meter is necessary. However, construction drawings will be submitted to your office should a meter be required.

4. On-site fire protection requirements shall be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

5. In our project development document we will specify the use of approved reduced pressure principle backflow prevention valves on each water service line.

We hope that we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Bob Bourke

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

Oceanit Laboratories, Inc.

BUILDING DEPARTMENT
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

PB 92-527

June 1, 1992

Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Attn: Robert Bourke

Gentlemen:

Subject: Environmental Impact Statement Preparation Notice (EISPN) The Mariculture Research and Training Center Large Scale Pond Research, Training and Demonstration Facility Koolaupoko, Oahu, Hawaii

This is in response to your letter dated May 26, 1992.

We have reviewed the EISPN for the subject project and have no comments to submit.

Very truly yours,

Herbert K. Muraoka
HERBERT K. MURAOKA
Director and Building Superintendent

cc: J. Harada

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

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

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Muraoka:

Thank you for responding to the subject EISPN. We shall continue to seek your review and comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Bob Bourke
Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET 5TH FLOOR
HONOLULU HAWAII 96813
PHONE: (808) 523-4427 • FAX: (808) 527-5498

FRANK F. FASI
MAYOR

E. JAMES TURSE
DIRECTOR

GAIL M. KAITO
DEPUTY DIRECTOR

June 9, 1992

Mr. Robert Bourke, Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center
Large Scale Pond Research, Training and Demonstration Facility
Koolaupoko, Oahu, Hawaii

We have reviewed the EISPN for the subject project and have no comments to offer at this time.

Thank you for the opportunity to comment.

Sincerely,

E. JAMES TURSE
Director

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

September 22, 1992

Mr. E. James Turse, Director
Department of Housing and Community Development
City and County of Honolulu
650 South King Street, 5th Floor
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Turse:

Thank you for your memorandum of June 9, 1992 in which you indicated that you had no comments on the subject EISPN. We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

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

ROLANDO LIBBY JR
DEPUTY CHIEF PLANNING OFFICER

ET 5/92-1815

June 16, 1992

Mr. Robert Bourke, Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center
Large Scale Pond Research, Training and Demonstration Facility
Koolaupoko, Oahu, Hawaii. TMK 4-9-01:11,12,31,32 & por. 13 & 14

In response to your letter of May 26, 1992, we have reviewed the subject EISPN for the Mariculture Research and Training Center (MRTC) and have the following comments to offer:

1. The Draft Environmental Impact Statement (DEIS) should describe the proposed wastewater system for the MRTC. It should also describe mitigation measures considered to prevent soil and water contamination.

2. The EISPN states that the settling ponds and wetlands will be designed to treat all discharges from the daily operation of MRTC facilities. The overall impact of this discharge on the water quality of Kaneohe Bay should be addressed.

3. The DEIS should identify wetlands within and adjacent to the MRTC facility, and elaborate on whether there has been a specific determination of their boundaries.

4. The Facility and Layout Schemes used in the EISPN should be clarified in the DEIS to indicate both proposed and existing facilities.

Thank you for the opportunity to comment. Should you have any questions, please contact Eugene Takahashi of our staff at 527-6022.

Sincerely,

BENJAMIN B. LEE
Chief Planning Officer

BBL:ft

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

The Honorable Benjamin B. Lee,
Chief Planning Officer
Department of General Planning
650 South King Street
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Lee:

Thank you for your review of the subject EISPN. We offer the following responses, in respective order, to your comments:

1. We shall expand on the proposed wastewater system discussion for the MRTC in the Draft EIS. Wastewater disposal requirements have been determined. The Draft EIS shall provide an overview regarding system capacities including the issues of soil and water contamination you have noted. We are currently designing a small wastewater treatment facility capable of handling the anticipated load.

2. The settling ponds and marsh system are designed to treat all aquaculture discharges from the MRTC facility so as to minimize the overall impacts to Kaneohe Bay. Possible impacts from the inflow of treated aquaculture discharge include an increase in nutrient loads to the nearshore water. The impact, however, is anticipated to be less significant than the inflow of nutrients from Hakipuu Stream. Aquaculture discharge may contain bits of algae grown in the marsh system broken off during growth or harvest but this is not seen as a detrimental impact.

3. A specific and official determination has not been made with respect to the project area's wetland boundaries. Under current federal regulations, much of the unused project site and all of the ponds will probably be eligible as wetlands. A map indicating the approximate position of the wetlands is presented in the Draft EIS.

4. The Draft EIS includes figures indicating both existing and proposed schemes 1 and 2.

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

Thank you for your comments. Your memorandum will be included in the Draft Environmental Impact Statement.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

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

LU5/92-4089(ASK)

July 22, 1992

Mr. Robert Bourke
Oceanit Laboratories
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center
49-139 Kamehameha Highway, Kaneohe, Oahu
4-9-01: 11, 12, 31 and portions of 13 and 14

This responds to your May 26, 1992 letter requesting comments on the EISPN for the Mariculture Research and Training Center to be located near the mouth of Hakipuu Stream in Kaneohe.

We have reviewed the EISPN and offer the following comments:

1. Fresh water species are among those to be cultivated at the proposed Mariculture Research and Training Center (MRTC). The source and volume of fresh water to be used at the facility should be identified in the Draft Environmental Impact Statement (DEIS).

2. Page II-2 of the EISPN describes the abundance of ground water underlying the subject project. The DEIS should discuss the impacts saltwater applications may have on the ground water resource.

3. The EISPN notes that public sewers are unavailable. The DEIS should describe how domestic wastewater will be disposed of.

4. The DEIS should identify the impacts which listed potential cultivars could have if introduced into the local ecosystem.

5. Previous grading work done at this site has allegedly resulted in flooding to surrounding properties. The

EISPN notes that the project site is the alluvial fan formed by the Hakipuu Valley drainage basin. The DEIS should discuss impacts to drainage and flood hazards.

6. Options for seawater intake include burial of a well-like intake system in an offshore sand bar. While Kaneohe Bay is not an excessively dynamic ocean system, sand bars can be transitory. The DEIS should discuss the stability of the sand bar. Further, the DEIS should disclose that use of the sand bar for a well-like intake system may preclude use of the sand resource for beach replenishment activities.

7. The DEIS should describe in detail the particulate, nutrient load and biological components of aquaculture effluent and their potential impact to Kaneohe Bay.

8. Page I-9 of the EISPN refers to ponds 1 and 2 which are not identified on the enclosed site plans. This should be corrected in the DEIS.

9. The site plan should identify the location of the proposed dormitories. The narrative description should generally describe the heights and bulk of all proposed structures, including impacts to coastal views.

Regulatory Requirements

10. New structures within the shoreline setback require a variance from the Shoreline Setback Ordinance.

11. The EISPN indicates the site is within the State Agricultural District. It is unclear whether all of the proposed uses are permissible within the State Agricultural District. The DEIS should expand on how the proposed project conforms with applicable sections of Chapter 205, HRS, especially Sections 205-2, 205-4.5 and 205-5, HRS. For your information, State Special Use Permit may be required for uses not permitted within the State Agricultural District.

12. As noted on page IV-9 of the EISPN, a majority of the site is located within the City & County of Honolulu AG-2 General Agricultural District. While aquaculture is a principal use within this zoning district, other proposed activities and structures, such as the proposed office/classroom/laboratory building, and students residences are generally not considered principal uses.

The DEIS should describe consistency with Land Use Ordinance (LUO) requirements. The proposed project may be subject to a Plan Review Use Permit due to its association with the University of Hawaii.

13. The site is entirely within the Special Management Area. While Chapter 205A, Hawaii Revised Statutes (HRS) generally exempts agricultural uses from SMP requirements, however, Section 205A-22 defines development in part as "Construction....of any structure." As such, construction of multi-level structures to serve a variety of uses as is proposed, requires a Special Management Area Use Permit.

14. The Federal Insurance Rate Maps dated September 4, 1987 indicate that a portion of the property is within the AE Flood Hazard District. Development within the Flood Hazard Districts must be in accordance with Section 7.10, Flood Hazards District of the Land Use Ordinance.

Procedures for applying for a Shoreline Setback Variance, Shoreline Management Area Use Permit, Plan Review Use Permit, and State Special Use Permit are attached for your information.

Thank you for the opportunity to comment on the EISPN. We request that a copy of the DEIS be circulated to us for our further review of the project. Should you have questions regarding the above, contact Ardis Shaw-Kim of our staff at 527-5349.

Very truly yours,

DONALD A. CLEGG
Director of Land Utilization

DAC:ct

s:bourke.ss2

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF LAND UTILIZATION

CONTENT GUIDE for Preparing an ENVIRONMENTAL ASSESSMENT Required with an Application for a Shoreline Setback Variance (SV) Ordinance No. 4631, as amended. Shoreline Setback Rules and Regulations

I. GENERAL INFORMATION

A. APPLICANT: Name; Mailing Address; Phone No.

B. RECORDED FEE OWNER: Name; Mailing Address; Phone No.

C. AGENT *(if any)*: Name; Mailing Address; Phone No.

D. TAX MAP KEY: Zone, Section, Plat, and Parcel(s).

E. LOT AREA: Acreage or square footage.

F. AGENCIES CONSULTED IN MAKING ASSESSMENT: Indicate Federal, State, and County agencies consulted. Attach copies of correspondence.

II. DESCRIPTION OF THE PROPOSED ACTION

A. GENERAL DESCRIPTION: (1) brief narrative description of proposed project; (2) relation of parcel to the Shoreline Setback (i.e., entirely within, partially); (3) location map (1" = 1000' scale preferred); and (4) land use approvals granted; approvals required.

B. Technical Characteristics: In general (1) use characteristics; (2) physical characteristics - layout drawing showing property lines, lot size, certified shoreline, shoreline setback line, reference datum, ground elevations, existing structures; (3) construction characteristics, including demolition, removal, or modification of existing structures, clearing, grubbing, grading, filling, new structure height and design; and (4) other pertinent information.

For shore protection structures (e.g., seawall, revetment) a coastal engineer's report must be prepared addressing: (1) the affected shoreline, including beach profile, offshore depths, foreshore and backshore areas, littoral transport, cyclical and abnormal changes of beach form, changes to water level, wave run-up and changes in sources of sand; and (2) structure description, including functional and structural stability, structural life expectancy, toe protection, foundation, flank protection, stone underlayment and filters, relation to wave run-up, and potential effects of the design on the shoreline.

III. AFFECTED ENVIRONMENT

A. A brief description of subject site and surrounding area. Include information on existing land uses; General Plan and Development Plan land use designations; zoning; population; unique features; etc.

B. Federal FIRM zone, LUO Flood Hazard District and other geologically hazardous land conditions.

C. Where applicable, coastal views from surrounding areas, especially from the adjacent beach.

D. Project site in relation to publicly owned or used beach access points, beach parks and recreation areas; rare, threatened, or endangered species and their habitats; wildlife and wildlife preserves; wetlands, lagoons, tidal lands and submerged lands; fisheries and fishing grounds; other coastal/natural resources.

E. Include suitable and adequate location and site maps. (Dated aerial, low-oblique, or ground-level photographs should be used whenever location and site maps are not sufficient to adequately describe the project.)

IV. IMPACTS AND ALTERNATIVES CONSIDERED

Identify and summarize major impacts of the proposed action on the affected environment. Discuss alternative uses and/or designs, including the "no project" alternative. For shore protection structures, describe the effects of the proposal and alternative designs on natural shoreline processes.

V. MITIGATION MEASURES

Indicate proposed mitigation measures, if any.

This document is provided only as a guide for preparation of an Environmental Assessment. For procedural requirements, see Administrative Rules of the Department of Health, Chapter 200 of Title 11, "Environmental Impact Statement Rules," Sections 10, 11, and 12.

City & County of Honolulu
Department of Land Utilization

CONTENT GUIDE for Preparing an ENVIRONMENTAL ASSESSMENT Required with an Application for a Special Management Area Use Permit (SMP) Chapter 33, Revised Ordinances of Honolulu, as amended

I. GENERAL INFORMATION

A. APPLICANT: Name; Mailing Address; Phone No.

B. RECORDED FEE OWNER: Name; Mailing Address; Phone No.

C. AGENT (if any): Name; Mailing Address; Phone No.

D. TAX MAP KEY: Zone, Section, Plat, and Parcel(s).

E. LOT AREA: Acreage or square footage.

F. AGENCIES CONSULTED IN MAKING ASSESSMENT: Indicate Federal, State, and County agencies consulted. Attach copies of correspondence.

II. DESCRIPTION OF THE PROPOSED ACTION

A. GENERAL DESCRIPTION: (1) brief narrative description of proposed project; (2) relation of parcel to the SMA (i.e., entirely within, partially); (3) location map (1" = 1000' scale preferred); and (4) land use approvals granted; approvals required.

B. TECHNICAL CHARACTERISTICS: (1) use characteristics; (2) physical characteristics - layout drawing showing property lines, lot size, certified shoreline, shoreline setback line, reference datum, ground elevations, existing structures; (3) construction characteristics including demolition, removal, or modification of existing structures, clearing, grubbing, grading, filling, new structure height and design; (4) utility requirements (water, electricity, gas, etc.); (5) liquid waste disposal (municipal sewer system, septic tanks, or injection wells); (6) solid waste disposal (includes refuse); (7) access to site; and (8) other pertinent information.

C. ECONOMIC AND SOCIAL CHARACTERISTICS: (1) estimated cost and time phasing of construction; and (2) other pertinent information.

D. ENVIRONMENTAL CHARACTERISTICS: (1) soils; (2) topography (indicate relationship to major topograhic features such as mountains, headlands, valleys, streams, channels, springs, marshes, etc.; (3) surface runoff,

drainage, and erosion hazard; (4) Federal FIRM zone, LUO Flood Hazard District, other geological hazards; and (5) other information pertinent to the Special Management Area.

III. AFFECTED ENVIRONMENT

A. A brief description of subject site in relation to surrounding area. Also, description of surrounding area. Include considerations and information on existing land uses; General Plan and Development Plan land use designations; zoning; unique features.

B. Project site in relation to publicly owned or used beaches, parks and recreation areas; rare, threatened, or endangered species and their habitats; wildlife and wildlife preserves; wetlands, lagoons, tidal lands and submerged lands; fisheries and fishing grounds; other coastal/natural resources.

C. Relation to historic, cultural, and archaeological resources.

D. Coastal views from surrounding public viewpoints and from the nearest coastal highway across the site to the ocean or to coastal landforms.

E. Quality of receiving waters and ground water (including potable water) resources. Describe effects on the groundwater recharge cycle within the groundwater control area; show existing and proposed well locations with pumping estimates. Describe effects on receiving waters--streams and ocean waters.

F. Include suitable location and site maps. (Dated aerial, low-oblique, or ground-level photographs should be used whenever location and site maps are not sufficient to adequately describe the project.)

IV. PROJECT IMPACTS: Identify impacts of the project relative to the Coastal Zone Management objectives and policies (Section 205A-2, HRS) and the Special Management Area guidelines (Section 33-3.2, ROH).

V. MITIGATION MEASURES: Indicate proposed mitigation measures, if any.

... ...

This document is provided only as a guide for preparation of an Environmental Assessment. For procedural requirements, see Administrative Rules of the Department of Health, Chapter 200 of Title 11, "Environmental Impact Statement Rules," Sections 10, 11, and 12.

For processing with DLU, submit twenty (20) copies of the Environmental Assessment.

City and County of Honolulu
Department of Land Utilization

Instructions for Filing an Application for a
SPECIAL MANAGEMENT AREA USE PERMIT (SMP)
Chapter 33, Revised Ordinances of Honolulu, as amended

Application for a SMP is a two-step procedure.

I. ENVIRONMENTAL ASSESSMENT

Note: This step may be waived if you present an acceptable Negative Declaration or Environmental Impact Statement (EIS) prepared under NEPA or Chapter 343, HRS, regulations. (If this step is waived, proceed to Step 2. PERMIT.)

A. Completed Application Form

B. Environmental Assessment Document

Twenty copies of the assessment including all necessary exhibits, drawings and a description of the technical, economic, social and environmental characteristics of the project. (See attached CONTENT GUIDE.)

C. Drawings/Plans

1. Accurate drawings of the parcel(s) and adjacent land affected by the proposal, showing, when pertinent, easements, slope, and all existing and proposed locations of structures, including building elevations and sections with dimensions and heights meeting appropriate district height requirements, streets, property lines, uses, off-street parking areas, yards (front, side, and rear), and landscape areas.

2. If property lies on the shoreline, a shoreline survey certified by the State within one year of the application date.

3. When applicable, grading plans showing existing and finish grade conditions by contours, spot elevations or other means. Elevations should be marked on the site plan.

D. Additional Information As May Be Required By the Director of Land Utilization

Note: Upon acceptance of the Environmental Assessment, the department has 30 days to assess the project's impact on the SMA and determine whether an EIS is required or issue a Negative Declaration. The assessment is made using significant criteria of the objectives, policies and guidelines of Chapter 205A. You will be notified in writing when the assessment is completed.

When the environmental assessment is complete, the department will begin processing of the permit upon receipt of the application fee unless: (1) an EIS has been required, in which case processing of the SMP will not begin until acceptance of the EIS; (2) the Negative Declaration indicates that additional information is required prior to the processing of the SMP; (3) the applicant indicates that he is not ready to proceed with the SMP procedure; or (4) plans have substantially changed indicating the need for a new assessment.

II. PERMIT (Special Management Area Use Permit)

A. Written Information

A copy of either the Negative Declaration or Environmental Impact Statement required under NEPA or Chapter 343, HRS, regulations. [Note: If either the Negative Declaration or EIS was required by this department, it is not necessary to submit a copy.]

B. Drawings/Plans

If plans have already been submitted as part of the ASSESSMENT procedure, you need not submit additional plans, unless they have been substantially changed.

C. Supplemental Information

Additional information may be required by the Director of Land Utilization as necessary.

D. Fee:

1. For agriculture, aquaculture or outdoor recreation developments. $200

2. For all other developments. . . . . $200, plus an additional $100 per acre or major fraction thereof, up to a maximum of $2,000.

For further information, please call the Environmental Affairs Branch at 523-4077.

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

CONTENT GUIDE
FOR PREPARING AN APPLICATION FOR CONDITIONAL USE PERMIT TYPE 2, SITE PLAN REVIEW AND PLAN REVIEW USE

GENERAL NOTES:

A. You are encouraged to review this guide and schedule a preliminary conference with the Zoning Division staff to go over the requirements. Please call staff at 523-4299. (Submit with the DLU Master Permit Application Form)

B. General Information

This document is intended only as a guide to preparing an application. See Land Use Ordinance (LUO) for application procedures, general and minimum development standards.

C. LUO References

Article 3. General Development Standards

Section 3.120 Nonconformities
Section 3.130 Existing Uses
Section 3.160 Plan Review Uses

Article 4. Conditional Uses

Section 4.10 Conditional Uses
Section 4.20 Application Requirements
Section 4.30 General Requirements
Section 4.40 Minimum Development Standards
Section 4.50 Site Plan Review
Section 4.60 Application Requirements
Section 4.70 General Requirements
Section 4.80 Minimum Development Standards

D. Standards

- General and minimum development standards must be met for all new Conditional Use Permits (CUP) or Site Plan Reviews (SPR).
- Existing uses may be considered, provided documentation is submitted to show the use and structures were validly established. (See Existing Use)
- Density, height and yards shall be determined by considering surrounding land use, adopted land use policy and zoning.

E. Copies

1. Two sets of reduced drawings/plans, maps and the narrative description must be submitted with your application form.
2. Additional copies may be required for agency review, upon acceptance of the application.

F. Fees

Existing Use - $100

Conditional Use Permit, Type 2 - $200 plus $100 per acre or major fraction, up to a maximum of $2,000.

Site Plan Review - $100.

Plan Review Use - $200 plus $100 per acre or major fraction, up to a maximum of $2,000.

G. Attachments

1. Application Information
2. Narrative Description
3. Applicant's Justification
4. Infrastructure, Environmental, Impacts
5. Drawings and Plans
6. Photos
7. Mitigative Measures
8. Existing Use
9. Sections 10, 11, and 12, Common Provisions, Development Plans

I. <u>Application Information</u>

A. <u>Type of Application</u>:

Indicate type of application:

- ☐ Conditional Use Permit Type 2 for: ____________
- ☐ Site Plan Review for: ____________
- ☐ Existing Use for: ____________
- ☐ Plan Review Use for: ____________

B. <u>Applicant</u>:

Applicant is the person or entity proposing the action. It may be the recorded owner or a lessee.

Name: ____________
Address: ____________
____
Phone No.: ____________

A developer, owner or lessee (holding a recorded lease for the property, the unexpired term of which is more than 5 years from the date of filing of the application) may file as an applicant.

C. <u>Recorded Fee Owner</u>:

Recorded fee owner is the person or corporate entity that owns the land in fee simple.

Name: ____________
Address: ____________
____
Phone No.: ____________

D. <u>Authorized Agent (if any)</u>:

Authorized agent is the person who is processing the permit(s). This is the person that the Department will contact for additional information. Again, it may be the same person as the recorded fee owner, or the applicant. The authorized agent may also be the project architect or contractor. For government agencies, the authorized agent is the contact person for the project.

Name: ____________
Addresss: ____________
____
Phone No.: ____________

If you are filing as an agent, supply the information for the owner and applicant and submit a letter authorizing you to act as an agent.

E. <u>Location</u>: ____________
____
Address, General Location

F. <u>Tax Map Key</u>: ____________
Zone, Section, Plat, Parcel

G. <u>Land Area</u>: ____________
Acres or Square Feet

H. <u>State Land Use District</u>: ____________

I. <u>Development Plan Map</u>: ____________________

J. <u>Public Facilities Map</u>: ____________________

K. <u>Existing Zoning</u>: ____________________

L. <u>Land Use Relationship</u>: Describe existing and surrounding land uses in relationship to the project: ____________________

II. <u>Narrative Description</u> (Attach sheets if necessary)

A. <u>Project Description</u>

1. Details of operation and activities such as number of persons on the site, occupancy of structures (use and number):

2. Details of existing and proposed structures and physical alterations of the site including parking areas, grading and landscaping:

3. Describe how general and minimum development standards of the Land Use Ordinance are met:

4 A 5-year master plan, accompanied by review and comment of all applicable City, State and Federal planning and development agencies. (For PRU only)

5. Future development shall indicate height, bulk concepts, land expansion, landscaping, setbacks, and buffering from adjoining parcels.

6. Parking, loading and sign requirements shall be specified.

B. Applicant's Justifications:

Describe how the following concerns are met:

Note: Consider traffic flow and control; access to and circulation within the property; off-street parking and loading; sewerage; drainage and flooding; refuse and service areas; utilities; screening and buffering; signs; setbacks; yard and open spaces, lot dimensions; height; bulk and location of structures; location of uses; hours and manner of operation; noise; lights; dust; odor and fumes.

1. Indicate how the proposed use will not alter the character of the surrounding area. (The proposal shall not limit, impair or preclude uses permitted in the underlying zoning district):

2. Indicate, as appropriate, how the proposed use will provide a service or facility which will contribute to the general welfare of the community-at-large or surrounding neighborhood:

C. <u>Infrastructure Requirements</u>: (It is a good idea to make preliminary checks with the appropriate agency.)

1. Method of wastewater disposal: ______

   Contact: Dept. of Public Works or Dept. of Health

2. Water needs: ______

   Contact: Board of Water Supply

3. Drainage problems, if any. Flood map should be checked: ______

   Contact: Dept. of Public Works

4. Streets and transportation:

   a. Contact Department of Transportation Services and/or Department of Transportation for details.

   b. Include transportation issues; i.e. park and ride facilities: ______

D. <u>Environmental Requirements (if applicable)</u>:

1. Historic site/archaeology: ______

2. Chapter 343, HRS, EIS Law: ______

E. <u>Impacts</u>: Discuss the following, if applicable:

1. <u>Public Services</u>:

   a. Refuse collection: ______

   b. Fire protection: ______

   c. Police: ______

   d. Schools: ______

2. Housing and Population: ______

3. Employment: ____

4. Parks and recreation: ____

5. Day care: ____

6. Community Concerns: ____

7. Other: ____

F. Social Impact Requirements: (For Plan Review Use only)

Evaluated the project's social impact guidelines for the required social impact certificate are attached as Attachment 9.

G. Drawings/Plans:

1. Site Plans

   a. Show the relationship of the site to adjoining properties, structures and uses.

   b. Identify existing structures to be removed and/or modified.

   c. Show on-site traffic circulation patterns and access.

2. Elevation Plans

   If appropriate, new structures should be shown as they relate to finished and existing grade.

3. Floor Plans

   a. Include dimensions of area.

   b. Identify activities.

   c. Number of people (occupancy).

4. Landscape Plans

   a. Show existing and proposed landscaping.

   b. Identify plant material by typical name.

   c. Identify size, location and quantity.

   d. Indicate landscaping to be removed.

   e. Show details of irrigation system.

5. Parking Plans

   Details of parking areas should include typical parking spaces, regular, compact stalls and maneuvering aisle space for the physically disabled.

H. <u>Photos</u> - Attach sheets, if necessary. Photo should reflect the relationship of the proposal to adjoining uses.

III. <u>Mitigative Measures</u>

Identify major concerns and indicate proposed mitigative measures to address these concerns:

9-104.2 of the charter, the Council may, upon findings of fact relating to sequencing and other relevant criteria, add new items to, or delete or amend any item or items in the proposed capital budget.

SECTION 24-1.10. SOCIAL IMPACT OF DEVELOPMENT

(a) Purpose.

A major purpose of preparing a general plan and development plans is to recognize and state the major problems and opportunities concerning the needs and development of the City and the social, economic and environmental effects of such development. In pursuit of such purpose the general plan has identified social, economic and environmental policies that should be taken into consideration in making development decisions. As required by Section 5-408 of the charter, the general plan contains statements of objectives with respect to the distribution of social benefits. These statements of objectives provide general guidelines for identifying the range of potential social impacts of a proposed development project upon residents within the local area.

(b) Social Impact Factors.

In evaluating any proposed development, the general plan policies and objectives relating to the distribution of social benefits and the mitigation of negative social impacts shall be considered. The following factors shall be examined as they pertain to such objectives:

(1) Demographic: Whether the development will:

(A) Increase or decrease the residential population.
(B) Increase or decrease the visitor population.
(C) Change the character or culture of the neighborhood.

(2) Economic: Whether the development will affect:

(A) The rate and pattern of economic growth and development.
(B) Public costs or revenues.
(C) The availability and diversity of jobs in the development plan area.
(D) The principal economic activities on Oahu.

ATTACHMENT 9

(3) Housing: Whether the development will affect:

(A) The range of available housing choices.
(B) Speculation in land and housing.
(C) Property values of existing homes.
(D) The provision of housing for low to moderate income and gap group families.

(4) Public Service: Whether the development will affect:

(A) Medical facilities.
(B) Educational facilities.
(C) Recreational facilities.
(D) Transportation facilities.
(E) Police and fire protection.
(F) Public utilities facilities.

(5) Physical; Environmental: Whether the development will affect:

(A) The natural environment.
(B) Existing natural monuments, landmarks and scenic views.
(C) Open space.
(D) The physical attractiveness and qualitites of the area.

SECTION 24-1.11. SOCIAL IMPACT MANAGEMENT SYSTEM

(Section 24-1.11 Repealed in its entirety by Ordinance 87-43).

SECTION 24-1.12. CERTIFICATE OF COMPLIANCE WITH THE SOCIAL IMPACT FACTORS

All applicants for a development plan amendment shall include, as part of their application, a certification that the social impact factors listed above have been given careful consideration, and shall report the conclusions of such consideration. The consideration of social impact factors shall include an opportunity for parties affected by a proposed project to identify alternative ways of managing or mitigating any expected negative social impacts. The completed application and certification shall be made a public record.

City and County of Honolulu
Department of Land Utilization

Instructions for Filing a
STATE SPECIAL PERMIT APPLICATION
(Agricultural District)
Chapter 205 Hawaii Revised Statutes
(PART B)

With your completed application form, please submit:

1. Written Information

   a. Statements to show how the proposal meets the following State Land Use Commission "guidelines" for granting such a permit:

      (1) Such use shall not be contrary to the objectives sought to be accomplished by the (State) Land Use Law and Regulations.

      (2) That the desired use would not adversely affect surrounding property.

      (3) Such use would not unreasonably burden public agencies to provide roads and streets, sewers, water, drainage and school improvements, and police and fire protection.

      (4) Unusual conditions, trends and needs have arisen since the district boundaries and regulations were established.

      (5) That the land upon which the proposed use is sought is unsuited for the uses permitted within the District.

   b. State method of sewage disposal if public sewer is not used.

2. Drawings/Plans

   Accurate scale drawings of the land parcel(s) and and any adjacent land affected by the proposal, showing, when pertinent, easements, slope, and all existing and proposed locations of structures, streets, property lines, uses, driveways, pedestrian walks, off-street parking and loading spaces, yards (front, side, and rear), and landscaped areas.

3. Fee: $100.00 plus $50.00 per acre or major fraction thereof up to a maximum of $1,000. Fees are not refundable.

NOTE: To avoid errors or delays, supply all the required information. Fill out all blanks on the application form clearly, concisely, completely, and sign the application.

If you are not the recorded fee owner of the property, you are considered the authorized agent of the owner. If you are filing as an agent, supply the information for both the owner and yourself, and submit a letter authorizing you to act as agent.

September 1980

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Mr. Donald A. Clegg, Director
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813-4432

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility [LU5/92-4089(ASK)]

Dear Mr. Clegg:

Thank you for your comments on the subject EISPN. We offer the following responses, in respective order, to your comments:

1. The volume of fresh water to be used for aquaculture purposes will vary considerably depending upon current experimental protocols used at the MRTC. Aquaculture pond water exchange rates are generally 100 GPM per acre. Between two and seven acres of ponds will be under production at any given time. Therefore, factoring in a 200 GPM emergency use buffer translates to a water use rate of 200 to 900 GPM. Initial estimates indicate that an average use of approximately 500 GPM is reasonable for a research facility of this size. Engineering studies performed for the EIS indicate that the shallow ground water from the Hakipuu Valley watershed is not sufficient to meet this need. We are currently researching the possibility of drilling a well to tap the deep Koolau Dike aquifer underlying the site. A full discussion is presented in the Draft EIS.

2. The impact of saltwater intrusion into the local freshwater aquifer is anticipated to be slight without long-term negative impacts. Aquaculture ponds are designed to be relatively water tight allowing only slight flow into the aquifer. If, for example, this were an up-land aquaculture site, even a slight flow would be of concern due to down-stream water use. However, in the case of MRTC, water below the site will flow under (or through) a brackish marsh area and directly into Kaneohe Bay. The two highest ponds on the facility (1 & 2) are designated for fresh water use only to eliminate any possibility of salt water intrusion from the ponds into Hakipuu Stream. Intrusion into the stream from lower ponds will be prevented by the lower elevation of these ponds and a drainage channel barrier located parallel to the stream.

3. Domestic wastewater is presently disposed of via septic tanks. Because the anticipated demand for wastewater is expected to increase significantly upon completion of the renovation, we are considering a small commercially available sewage treatment facility adapted to the project site. Facility design is discussed in greater detail in the Draft EIS.

4. The introduction of potential cultivars into the local ecosystem is a concern to any aquaculture research facility. The experimental use of exotic species is controlled by state agencies to prevent unwanted introductions to Hawaii's unique ecosystems. The mechanisms, both physical and regulatory to prevent undesirable introductions from the facility, are discussed in the Draft EIS.

5. The project site is located adjacent to a stream outlet in the Hakipuu Valley drainage basin. The lower portion of the project site rests on the southern half of the alluvial fan delta formed during the past thousand years by Hakipuu Stream. The northern half of the flood-plain delta is private property containing several single family dwellings. Flood hazards along the lower reaches of the stream are characteristic of flood plain deltas and are related to the shallow stream bed, low slope, and increased foliage encroachment of the stream bed(s). An 1851 land survey indicates that the lower portion of the present day stream has shifted 30 to 60 feet to the south (towards MRTC). Prior to project improvements, the state undertook a flood improvement program at MRTC which involves removing all of the lowest pond (#12), half of the next pond (#11) and installation of a silt basin for runoff control during construction. The proposed MRTC renovation project will not impact upon this flood plain and has asked that the settling basin constructed for the flood control project be left in place. A raised roadbed crosses the lower portion of the site from the shoreline at the pump house to the aquaculture pond area. The road bed will serve as vehicular access to the pump house and support for two 16-inch seawater supply pipes. The roadbed will be laid over conduits that allows any flood waters to pass beneath the road and into the designed marshland.

6. Two alternative intake mechanisms are proposed for the seawater system. The open water intake alternative will utilize on shore mechanical filters. The alternative use of Hakipuu sandbar as a seawater intake filter would eliminate the need for additional filtration. Although it is known that the volume and depth of Hakipuu sandbar changes in multiyear cycles, the actual position of the body of the sandbar is remarkably stable. Aerial photographs from before WWII show the sandbar in essentially the same position.

   Use of the sandbar for filtration may pose as a deterrent to any State, County, or private effort for the use of Hakipuu Sandbar as a sand mining source for beach replenishment. However, because such use of shallow sand reservoirs is generally prohibited by state law, and is specifically prohibited for Hakipuu Sandbar, the use of the sandbar as a well site is in agreement with the long-term goals of the State.

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

7. The particulate nutrient load and biological components of aquaculture effluent is discussed in the Draft EIS. The subject of aquaculture effluent water quality has been reviewed for Hawaiian aquafarms in a paper titled Aquaculture Effluent Discharge Program prepared for the Center for Tropical and Subtropical Aquaculture (Ziemann, Pruder, and Wang 1989). In this paper, effluent from aquafarms was analyzed and correlated with the type of aquaculture practiced. There are significant differences in effluent water quality depending upon what crops are grown, intensity of cultivation, and the volume of water flowing through the facility. If you wish to review this material we will forward to you a copy of the report. The marsh system was designed to handle flow from a "worst case" scenario, theoretically combining the worst pollution problems from the most intense mix of aquaculture species. Such a dense population of diverse aquaculture animals would not ever be present at the MRTC facility, but the marsh must be able to handle any reasonable effluent load.

   The potential impact of effluent on Kaneohe Bay is a function of the quality and quantity of the effluent water, it's residence time in the bay, and the sensitivity of the natural biological systems in the vicinity. These are discussed in detail in the Draft EIS. However, in brief, the quality of the effluent water is anticipated to be high. The marsh is designed with the "pulsed" outflow option to take maximum advantage of tidal currents and dilution. In addition, the natural environment is subjected to effluent only half of the time. Measurements of nearshore currents indicate that water often flows diagonally into the bay towards the "puka" where the proposed water intake will be located. Coral populations and general reef fauna are scarce along this reef edge, probably as a long-term result of Hakipuu Stream run-off.

8. Both facility scheme layouts (see Figures 4 & 5) in the EISPN have been revised and ponds 1 and 2 have been labeled for inclusion in the Draft EIS.

9. The location of the proposed dormitories will be finalized for inclusion in the Draft EIS. A narrative description shall also list the heights and bulk of all proposed structures. No structure is planned to be more than two stories high. Project designers are taking advantage of the site's natural slope away from the road to limit building height to a single story visible from the road. No impacts to coastal views are anticipated from any proposed structure on the project site. The existing foliage buffer will be maintained between the road and the facility.

10. We acknowledge the requirement for preparing and filing for a variance for new structures, including the proposed pumphouse for the seawater system, within the shoreline setback area.

11. We shall expand upon the discussion of the renovation's conformity to Section 205-2, 205-4.5 ad 205-5 of Chapter 205, HRS in the Draft EIS. We understand that proposed uses not permissible within the State Agricultural District will require a State Special Use Permit.

12. We concur that the proposed office/classroom/laboratory/dormitory are not principal uses in AG-2 zoning district. The principal use of the site will be as an experimental aquaculture farm, a similar designation to other University of Hawaii experimental farm lots. Inclusion of classroom, laboratory, and dormitory facilities are accessory (but necessary) to the function of the principal use. We shall expand upon the discussion of the projects relationship with the Land Use Ordinance requirements in the Draft EIS.

13. We concur that the construction of any structures for other than agricultural use requires an SMA Use Permit. Until the project layout is finalized, we cannot ascertain the extent of permits required. This will be completed for discussion in the Final EIS.

14. According to the Hakipuu Stream Flood Study by R.M. Towill (July 1991), the proposed wetland, ponds and seawater system pumphouse will be inside the 10-year Flood Zone. No residences, dormitories or classrooms are situated within the flood zone. These developments shall conform with Section 7.10 Flood Hazards District of LUO.

We hope that we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

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

ALVIN K. C. AU
DEPUTY DIRECTOR

June 16, 1992

Mr. Robert Bourke
Oceanit Laboratories, Inc.
Century Square
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Thank you for providing us with the opportunity to review your Environmental Impact Statement Preparation Notice (EISPN) for the Mariculture Research and Training Center.

We note that on page I-6 of your EISPN, you indicate that the project will involve the placement of a 1,500 feet of offshore intake line. In Section V you also discuss the possibility that this intake line may have some impacts on the Hakipuu Sandbar. Just a few years ago, we experienced serious problems with shoreline erosion at Kualoa Regional Park. Recently we managed to reduce some of the erosion through the use of offshore surgebreakers. Because of the previous cultural sensitivities shown by neighbors of Kualoa Regional Park, we are very concerned about other activities in the area which might disturb the delicate cycle of sand movement in the offshore cell.

Although your project is some distance away from our park, we would like to have your ocean engineers evaluate the possible impacts that the proposed project may have on the circulation of sand within the cell system, especially in relation to the problem of shoreline erosion at Kualoa Regional Park.

On page V-6 you wrote, "Locating the intake within Hakipuu Sandbar would adversely impact the ability of State or private concerns to utilize the sandbar as a source of sand for beach reclamation or other uses." We would also like a more detailed explanation of how the new intake system will

adversely impact the ability to utilize the sandbar as a source of sand for beach reclamation. Do you expect both the buried intake and the nonburied water intake to have the same impacts on the Hakipuu Sandbar?

We look forward to the opportunity to comment on your draft EIS. If you have any questions, please call John Morihara of our Advance Planning Branch at 523-4246.

Sincerely,

WALTER M. OZAWA, Director

WMO:ei

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

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

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Ozawa:

Thank you for your comments on the subject EISPN. In regards to sand circulation in Hakipuu Sandbar, we recognize both the physical and cultural importance of Hakipuu Sandbar to the regional park and the surrounding communities. It is for this reason that we have chosen two alternative intake mechanisms for the facility. The open water intake proposal would utilize shore-side mechanical filters and would not impact the sand bar. The alternative use of Hakipuu sandbar as a seawater intake filter would eliminate the need for additional filtration. Although it is known that the volume and depth of Hakipuu sandbar changes in multiyear cycles, the actual position of the body of the sandbar is remarkably stable. Aerial photographs from as far back as before WWII show the sandbar in essentially the same position.

Use of the sandbar for filtration would act as a deterrent to any State, County, or private effort for the use of Hakipuu Sandbar as a sand mining source for beach replenishment. If the filter was in the sandbar, then any mining of the sandbar could have a deleterious impact on the function of the filter. This fact would be taken into account by any agency responsible for issuing a permit for sand mining in the area. However, because such use of shallow sand reservoirs is in general prohibited by State law, and is specifically prohibited for Hakipuu Sandbar, the use of the sandbar as a well site is seen to be in agreement with the long term goals of the State.

Neither intake system would impact sand circulation within the sand bar or in relation to shoreline erosion at Kualoa Park. The State has recently let a contract to Oceanit Laboratories Inc. for construction of an oceanographic model of the Kualoa area to test various hypothesis concerning water and sediment transport around this point. This model will be constructed to extend from Chiniman's Hat island to the shoreline off MRTC. In addition to it's designed purpose, the model will also provide valuable information relative to currents and sand movements off the MRTC site.

We hope we have satisfactorily responded to your comments. Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

C. MICHAEL STREET
ACTING DIRECTOR AND CHIEF ENGINEER

ENV 92-126

June 1, 1992

Mr. Robert Bourke
Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center
Large Scale Pond Research, Training and Demonstration
Facility, Koolaupoko, Oahu, Hawaii
TMK:4-9-01:11, 12, 31, 32 & Por. 13 & 14

We have reviewed the subject EISPN and have no comments to offer at this time.

Very truly yours,

C. Michael Street

C. MICHAEL STREET
Acting Director and Chief Engineer

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

September 22, 1992

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

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond
Research, Training and Demonstration Facility

Dear Mr. Street:

Thank you for your response to the subject EISPN. We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

TE-2264
PL92.1.178

June 16, 1992

Mr. Robert Bourke, Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Mariculture Research and Training Center
Environmental Impact Statement
Preparation Statement (EISPN)
TMK: 4-9-01: 11, 12, 31, 32, Portion 13 and 14

This is in response to your letter of May 26, 1992 requesting our comments on the subject EISPN.

It appears that the proposed internal roadways that will access to Kamehameha Highway, which is a State Department of Transportation facility, are not intended to be dedicated to the City. This being the case, we have no comments or objections to the proposed development.

Should you have any questions, please contact Mr. Watanabe at 523-4199.

Sincerely,

JOSEPH M. MAGALDI, JR.
Director

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

September 22, 1992

Mr. Joseph M. Magaldi, Jr., Director
City and County of Honolulu
Department of Transportation Services
650 South King Street
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility
Koolaupoko, Oahu, Hawaii

Dear Mr. Magaldi:

Thank you for your memorandum of June 16, 1992 in which you indicated that you had no comments on the subject EISPN. We concur that the on-site internal roadways are not to be dedicated to the City. We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

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

June 8, 1992

Mr. Robert Bourke, Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center
Large Scale Pond Research
Training and Demonstration Facility
Koolaupoko, Oahu, Hawaii

We have reviewed the application for the above subject. Fire protection services provided from Kaneohe and Kahaluu engine companies with ladder service from Kaneohe are adequate. Access for fire apparatus, water supply and building construction shall be in conformance to existing codes and standards.

Thank you for the opportunity to comment on the project. If you have any questions, please call Acting Assistant Chief Attilio Leonardi at 943-3838.

Very truly yours,

LIONEL E. CAMARA
Fire Chief

AKL:ny

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Mr. Lionel E. Camera, Chief
Fire Department
City and County of Honolulu
1455 South Beretania Street, Room 305
Honolulu, Hawaii 96814

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Chief Camera:

Thank you for your response on the subject EISPN. The designers, as part of the next planning phase, will assure conformance with all applicable fire codes and standards. We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

FRANK F. FASI, MAYOR

MICHAEL S. NAKAMURA, CHIEF

HAROLD M. KAWASAKI, DEPUTY CHIEF

OUR REFERENCE MS-LK

June 15, 1992

Mr. Robert Bourke
Project Manager
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Mr. Bourke:

Subject: Environmental Impact Statement Preparation Notice
The Mariculture Research and Training Center
Large Scale Pond Research, Training/Demonstration
Facility, Koolaupoko, Oahu, Hawaii

We have reviewed the information and maps provided regarding the above project and do not foresee a major impact on calls for police services in the area.

However, it is expected that an additional 40 visitors at the conference center will increase traffic congestion in and around the site. As mentioned in the preparation notice, relocation of the existing entrance or provision of an alternate second entrance might be advisable.

Thank you for the opportunity to comment.

Sincerely,

MICHAEL S. NAKAMURA
Chief of Police

By
CHESTER E. HUGHES
Assistant Chief of Police
Support Services Bureau

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

September 22, 1992

Mr. Michael S. Nakamura,
Chief of Police
Police Department
City and County of Honolulu
1455 South Beretania
Honolulu, Hawaii 96814

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Chief Nakamura:

Thank you for your comments on the subject EISPN. We concur with your concern regarding increased vehicular congestion in the area resulting from the proposed project. Recommendations for an alternative entrance to the facility to mitigate congestion and enhance safety are presently being considered and will be included in the Draft EIS. Initial responses from our traffic engineer indicate that moving the existing entrance approximately 75 feet towards Kaneohe will significantly improve the visibility from this entrance.

We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS. Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

William A. Bonnet
Manager
Environmental Department

June 26, 1992

Mr. Robert Bourke
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, HI 96813

Dear Mr. Bourke:

Subject: **Environmental Impact Statement Preparation Notice (EISPN)**
The Mariculture Research and Training Center
Large Scale Pond Research, Training and Demonstration Facility
Koolaupoko, Oahu, Hawaii

We have reviewed the subject EISPN, and have no comments at this time on the the proposed project. HECO shall reserve further comments pertaining to the protection of existing power lines bordering and servicing the project area until construction plans are finalized.

Sincerely,

William A. Bonnet

An HEI Company

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Mr. William Bonnet, Manager
Environmental Department
Hawaiian Electric Company, Inc.
P.O. Box 2750
Honolulu, Hawaii 96840-0001

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Bonnet:

Thank you for your memorandum of June 26, 1992 in which you indicated that you had no comments on the subject EISPN. We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS.

Your memorandum will be included in the'Draft EIS.

Very truly yours,

Bob Bourke
Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

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."

June 19, 1992

Oceanit Laboratories, Inc.
1188 Bishop St. Suite 2512
Honolulu HI 96813
Attention: Robert Bourke

Dear Mr. Bourke:

Thank you for the opportunity to review the EIS Preparation Notice for the renovation of the Mariculture Research and Training Center (MRTC). The Kahalu'u Neighborhood Board #29 supports the MRTC in our community.

The issues that we would like to ensure continue to be addressed in the EIS are: flooding along Hakipu'u Stream and what MRTC can do to minimize such events; noise mitigation to minimize impacts on the residents along Johnson Rd; the benefits and impacts of a second access road from Kamehameha Highway; continued access to the site for the local community; and the potential for training and employment of area residents.

At our regular meeting on June 10, 1992, the Kahalu'u Neighborhood Board #29 voted unanimously to: "send a letter of general support but want to see MRTC and Oceanit Laboratories Inc. continue to work with neighbors across the stream to address any concerns they might have."

We look forward to continuing to work with you, MRTC and the area residents on the renovations at MRTC.

Please call me (239-5603) if you have any questions.

Sincerely,

Amy Luersen, Chair
Kahalu'u Neighborhood Board #29

Oahu's Neighborhood Board System-Established 1973

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

September 22, 1992

Ms. Amy Luersen, Chair
Kahaluu Neighborhood Board #29
c/o Key Project
47-200 Waihee Road
Kaneohe, Hawaii 96744

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Ms. Luersen:

Thank you for your comments on the subject EISPN. We concur that maintaining communication with the Johnson Road residents and other neighbors is important to the ultimate success of the project. Meetings with the residents occur on a regular basis and shall continue during the course of development. Concerns of the residents, including noise mitigation, access to the site for neighboring residents, and employment opportunities at MRTC are discussed in the Social Impacts section of the Draft EIS. The impacts of a second vehicular access from Kamehameha Highway will be addressed in the traffic section (Chapter V) of the Draft EIS.

We shall continue to seek your comments as a consulted party during the public review process for the Draft EIS. Your memorandum will be included in the Draft EIS.

Very truly yours,

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

PO Box 1313
Kailua, HI 96734
June 6, 1992

Robert Bourke, Project Manager
Oceanit Laboratories
1188 Bishop St., Suite 2512
Honolulu, HI 96734

Dear Mr. Bourke:

After reading the article in the Sun Press this week, I have questions about the displacement of existant hau and mangrove jungle for the creation of additional wetland and improvement of bird habitat.

The privately owned facility at Kailua-Kona has a problem with funds for a mariculture project. Has the windward coast, specifically Kaneohe bay, enough elasticity to adsorb more developement?

If people want to study aquaculture, they need to do it in an area that will provide a chance of developement. Research, development and extension in this part of the Hawaiian chain would not offer much expansion in place. The students could explore the principal of mariculture but would the specifics learned at the Kaneohe location be applicable in other areas?

Why not have the facilities that will allow for training students in a place that will offer expansion? The greatest inconvenience would be felt by the staff of the Hawaii Institute of Marine Biology but students are a mobile group of people interested in obtaining marketable skills. With availability of jobs after graduation being the main concern of todays student, the student is more concerned about learing about an area that has possibility of future expansion and will be willing to relocate to obtain his technical training.

The changes proposed will adversly affect the ability of the area to resist erosion. If the payoff for the students was adequate and timely, I feel the benefits would outweigh the costs. My question is, will the facility be able to justify it's displacement of a hau and mangrove jungle?

With Respect,
Mark Newman
Mark Newman

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

September 22, 1992

Mr. Mark Newman
P.O. Box 1313
Kailua, Hawaii 96734

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN)
The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Dear Mr. Newman:

Thank you for your comments on the subject EISPN. In your letter you question the removal of existing hau and mangrove trees. This hau/mangrove habitat is not uncommon along the shores of Kaneohe Bay. While it does provide an excellent buffer between the land and the ocean, such jungles do not support a varied bird habitat and also block public access to the bay from land. The proposed marsh land will provide a valuable function for the facility, open up the view (and access) plane to the ocean, and provide bird habitat. The operational, environmental and social benefits gained from the MRTC far outweigh the value of habitat lost by removal of the hau and mangrove jungle.

The potential ill effects of overdevelopment in Hawaii you mention is a valid concern. The Kaneohe Bay area does not necessarily have more elasticity to absorb development. This, however, is not an issue for the renovation as it will not expand from its current boundaries but will make greater use of its present resources. MRTC property has been used for aquaculture for the past 15 years. Prior to that it served in the production of rice, taro and other crops. Upgrading the facility to conduct scientific research is in character with past and present land uses.

Your letter also indicates a concern for the reasoning behind locating the facility on Oahu. Briefly, of the possible site studies from around the State, the MRTC site offered the greatest attributes for a research facility as follows: a) the site is reasonably close to the University of Hawaii and several community colleges, as well as being available to the majority of the State's high school students, b) both fresh and salt water is available so that research can encompass both possibilities, and c) to foster an undergraduate and graduate curriculum to provide students with appropriate skills applicable to other mariculture facilities anywhere in the Pacific Basin. Facility location was studied in a report by Brewer-Brandman in 1990. A copy of this report can be made available for your review.

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
TELEX: 7431404 MCI: OCEANIT Ph: (808) 531-3017 FAX: (808) 526-1519

That portion of the project least resistant to erosion is the Hakipuu Stream environs which abuts the northern side of the site. The lower portion of the project site rests on approximately half of the alluvial fan delta formed during the past thousand years by Hakipuu Stream. Erosion hazards along the lower reaches of the stream are characteristic of flood plain deltas and are related to the shallow stream bed and low slope. Prior to project improvements, the state undertook a flood improvement program at MRTC which involves removing all of the lowest pond (#12), half of the next pond (#11) and installation of a silt basin for runoff control during construction.

Much of this lower project area will be converted into a designed marshland. The purpose of the marsh is to act as a filter, removing sediments and nutrients from aquaculture effluent providing more effectiveness in protecting the shoreline and Kaneohe Bay.

We hope that we have satisfactorily responded to your comments. Please write or call me if you have any additional questions. Your letter will be included in the Draft EIS.

Very truly yours,

Bob Bourke

Robert Bourke
Project Manager

cc: Mr. Andrew Monden, DLNR

CONSULTATION

XI. AGENCIES, ORGANIZATIONS AND PERSONS WHO RECEIVED A COPY OF THE DRAFT EIS, WRITTEN COMMENTS RECEIVED DURING PUBLIC REVIEW PERIOD, AND RESPONSES

The Draft EIS was officially submitted to the Office of Environmental Quality Control (OEQC) on February 10, 1993 and notice of its availability published in the <u>OEQC Bulletin</u> on February 23, 1993. The official date for receipt of comments was April 9, 1993, which was extended, at the request of the Kahaluu Neighborhood Board, to May 21, 1993, to accommodate additional public review. All comments received as a result of the 60-day review period, and responses thereto, are as follows.

A double asterisk (**) indicates substantive comments were received from that party. Both comment and response letters are reproduced in this section. A single asterisk (*) indicates letters which provided "no comment" responses. A (·) indicates substantive comments were received from individuals who did not receive the Draft EIS.

<u>Federal</u>

Army-DAFE (Facilities Eng.-USASCH)
Environmental Protection Agency
U.S. Department of Agriculture, Soil Conservation Service
* U.S. Army Corps of Engineers (Department of the Army)
* U.S. Coast Guard
U.S. Fish and Wildlife Service
U.S. Geological Survey
* U.S. Department of Interior
National Marine Fisheries Service
* Naval Base Pearl Harbor

<u>State Agencies</u>

Department of Agriculture
* Department of Accounting and General Services
** Department of Defense
Department of Education
* Department of Hawaiian Home Lands
* Department of Health
1 = ** Department of Land and Natural Resources - 4 copies
** Aquatics Resources Division
** Office of Environmental and Conservation Affairs
** State Historic Preservation Division
1 letter
** Division of Forestry and Wildlife
Separate

** Department of Business, Economic Development and Tourism
* Energy Division
DBED Library
* Housing Finance and Development Corporation
** Department of Transportation
DOT, Harbors Division
** DOT, Highways Division
State Archives
State Energy Office
** Office of State Planning
OSP, Coastal Zone Management
Hawaii Community Development Authority
Office of Hawaiian Affairs
** Office of Environmental Quality Control

City and County of Honolulu

** Board of Water Supply
Building Department
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
Municipal Records and Reference Center
** Planning Department
** Police Department

University of Hawaii

Hawaii Institute of Marine Biology
** Environmental Center
Marine Programs
Water Resources Research Center

Media

Honolulu Star-Bulletin
Honolulu Advertiser
Pacific Business News
Downtown Planet
Windward Sun Press

Elected Officials

Council Chair Gary Gill
Councilman Steve Holmes
State Representative Ululani Beirne
Senator Mike McCartney

Libraries

University of Hawaii Hamilton Library, Hawaiian Collection
Legislative Reference Bureau
State Main Library and windward branches
Waimanalo Community School Library
Kailua Library

Others

American Planning Association
American Lung Association
Eight Bells (Sea Grant)
* Hawaiian Electric Company
Hawaiian Telephone Company
Outdoor Circle
Hawaii Audubon Society
** Kahaluu Neighborhood Board
Greenpeace Hawaii
Mr. Mark Newman
Mr. John Morris
Mr. Herbert Hoe
Mr. John Reppun
Mr. Charlie Reppun
** Mr. Henry Kaawa & Family
Mr. Calvin Kaawa
Environment Hawaii
** Oceanic Institute
Mr. & Mrs. George Fukumitsu
** Mr. & Mrs. Kurt Johnson
** Mr. & Mrs. Chester Uyemura
Ms. Charlene Hoe
** Mr. Patrick White
** Ms. Joan K. Tisalona
• Ms. Edna Aniu
• Mr. John Aniu
• Ms. Davelyn I.L.P. Aniu

- Mr. Ronnie Uyemura
- Ms. Maria McBee

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

April 16, 1993

REPLY TO ATTENTION OF
Operations Division

RECEIVED
APR 20 1993
OCEANIT LABORATORIES, INC.

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

Dear Mr. Choy:

This is in response to your request for a review of the draft Environmental Impact Statement for the Mariculture Research and Training Center renovation, Hakipuu, Hawaii.

The draft Environmental Impact Statement indicates that a Department of the Army (DA) permit may be required. However, at this time, no permit application has been received by this office.

File No. PO91-140 has been assigned to this project. Please refer to this number in future correspondence. Should you have any questions please contact my staff at 438-9258.

Sincerely,

for Michael T. Lee
Chief, Operations Division

Copies Furnished:

Department of Land & Natural Resources, Division of Water & Land Development, P.O. Box 373, Honolulu, Hawaii, 96898 (ATTN: Mr. Edward Lau)
Oceanit Laboratories, Inc., 1188 Bishop Street, Suite 2512, Honolulu, Hawaii, 96813 (ATTN: Ms. Robin Anawalt)

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 21 1993

Mr. Michael T. Lee
Chief
Operations Division
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Lee:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of April 16, 1993 regarding the subject project. An application for a DOA permit will be submitted to your office when the next stage of project development commences.

If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

U.S. Department of Transportation

United States Coast Guard

Commander
Fourteenth Coast Guard District

300 Ala Moana Blvd., 9th Floor
Honolulu, HI 96850-4982
Staff Symbol: (m)
Phone: 808-541-2114

5050

MAR 23 1993

Office of Environmental Quality Control
220 S. King St., 4th Floor
Honolulu, HI 96813

Dear Gentlemen:

This is in response to your request for comments concerning your proposed Mariculture Research and Training Center Renovations.

After review, it appears that your planned renovations do not impact any areas within our jurisdiction.

Thank you for continuing to inform us of your activities adjoining our shorelines.

Sincerely,

CC Martin

C. C. Martin
Captain, U. S. Coast Guard
Chief, Marine Safety Division
By direction of Commander
Fourteenth Coast Guard District

RECEIVED
MAR 24 1993
OCEANIT LABORATORIES, INC.

Encl: (1) Mariculture Research & Training Center Renovation Plan

Copy: Dept. of Land & Natural Resources
Oceanit Laboratories, Inc.

2

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Capt. C. C. Martin
Chief
Marine Safety Division
Fourteenth Coast Guard District
300 Ala Moana Blvd., 9th Floor
Honolulu, Hawaii 96850-4982

Dear Captain Martin:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 23, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, HI 96813

February 22, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

Governor, John D. Waihee
c/o Office of Environmental Quality Control
220 S. King Street, 4th Floor
Honolulu, HI 96813

Dear Governor Waihee:

Subject: Mariculture Research and Training Center Renovation, Draft Environmental Impact Statement (DEIS), Oahu, Koolaupoko

We are in receipt of the subject DEIS. We regret that due to prior commitments, we are unable to review the DEIS by the March 25th deadline.

As requested, we are returning the DEIS to your office for your future use.

Sincerely,

William Meyer
District Chief

Enclosure

cc: Mr. Edward Lau
Department of Land and Natural Resources
Division of Water and Land Development
P.O. Box 373
Honolulu, Hawaii 96898

Mr. Robin Anawalt
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, HI 96813

3

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

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

Dear Mr. Meyer:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
<u>Large Scale Pond Research, Training and Demonstration Facility</u>

Thank you for your letter of February 22, 1993 regarding the subject project. We are sorry that your Division was unable to review the Draft EIS. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO

11015
Ser N4(237)/1041
17 MAR 1993

Governor
State of Hawaii
c/o Mr. Brian J. J. Choy
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, HI 96813

RECEIVED
MAR 25 1993

Dear Mr. Choy:

REVIEW OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
FOR THE MARICULTURE RESEARCH AND TRAINING CENTER,
KOOLAUPOKO, OAHU, HAWAII

OCEANIT LABORATORIES, INC

Thank you for the opportunity to review the subject DEIS for the Mariculture Research and Training Center, Koolaupoko, Oahu, Hawaii. The Navy has no comments to offer at this time.

The Navy's point of contact is Mr. Bill Liu at telephone, 471-3324.

Sincerely,

W. K. Liu

W. K. LIU
FACILITIES ENGINEER
BY DIRECTION OF
THE COMMANDER

Copy to:
Mr. Edward Lau
Department of Land & Natural Resources
Division of Water & Land Development
P.O. Box 373
Honolulu, HI 96898

Ms. Robin Anawalt
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, HI 96813

4

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P O BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. W.K. Liu
Facilities Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Liu:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 17, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR

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

ROBERT P. TAKUSHI
COMPTROLLER

LLOYD T. UNEBASAMI
DEPUTY COMPTROLLER

LETTER NO. (P)1113.3

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

MAR 4 1993

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental
Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii

Dear Governor Waihee:

Subject: Mariculture Research and Training Center
Koolaupoko, Oahu
Draft EIS

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

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Respectfully,

ROBERT P. TAKUSHI
State Comptroller

RY:jy
cc: Department of Land and Natural Resources,
Division of Water & Land Development
✓Oceanit Laboratories, Inc.
OEQC

5

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

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

REF:WL-LC

OCT 27 1993

Honorable Robert Takushi
State Comptroller
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Takushi:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
<u>Large Scale Pond Research, Training and Demonstration Facility</u>

Thank you for your letter of March 4, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Very truly yours,

KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

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

PHONE (808) 734-2161

March 18, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

TO: The Honorable John Waihee
Governor of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense RCP

SUBJECT: MARICULTURE RESEARCH AND TRAINING CENTER RENOVATION; DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

We appreciate this opportunity to comment on the DEIS by the Department of Land and Natural Resources, Division of Water and Land Development, State of Hawaii, on the island of Oahu, Koolaupoko, Oahu, Hawaii: THK 4-09-01: 11, 12, 31, 32, and portions of 14 and 18.

We do not have negative comments specifically directed at the DEIS. However, the proposed area is not covered by an existing siren warning device. We propose that a siren and siren support infrastructure be purchased and installed by the developer to help alert residents of an impending or actual event that threatens the area. This siren must be solar powered, have a minimum output of 121 DB and be compatible with the existing civil defense siren system. The proposed siren requires a 250-foot radius buffer zone in which there is no residential building as shown in "Figure 4, Facility Layout - Scheme 1." The suggested location for such a siren would be along Kamehameha Highway as shown in "Figure 1, Location Map."

why? what kind of event? related to project?

Our State Civil Defense planners and technicians are available to discuss this further if there is a requirement. Please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

Enc.

c: Mr. Edward Lau
DOWALD, DLNR

Ms. Robin Anawalt
Oceanit Laboratories, Inc.

6

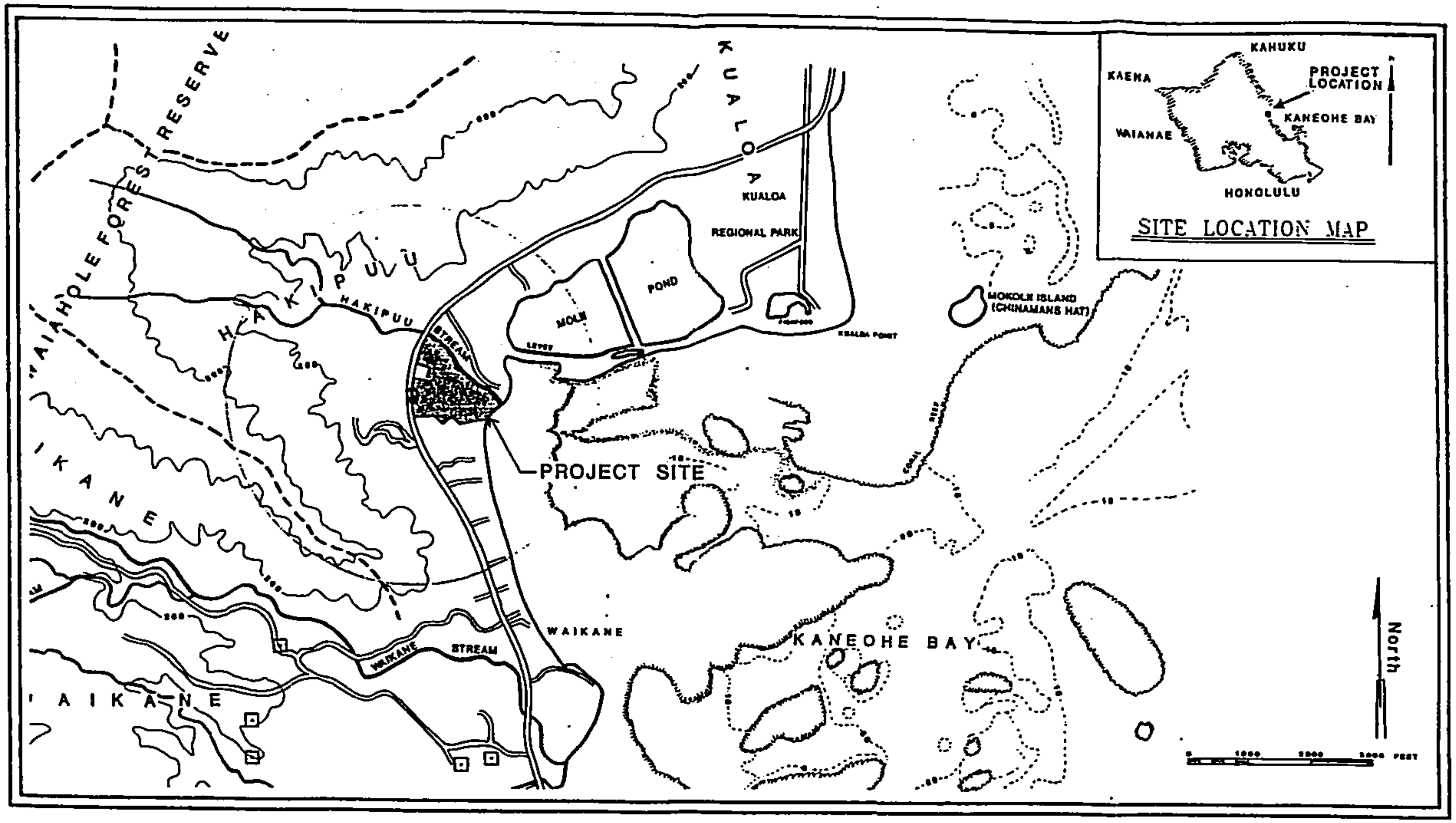

FIGURE 1. LOCATION MAP

MARICULTURE RESEARCH AND TRAINING CENTER

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

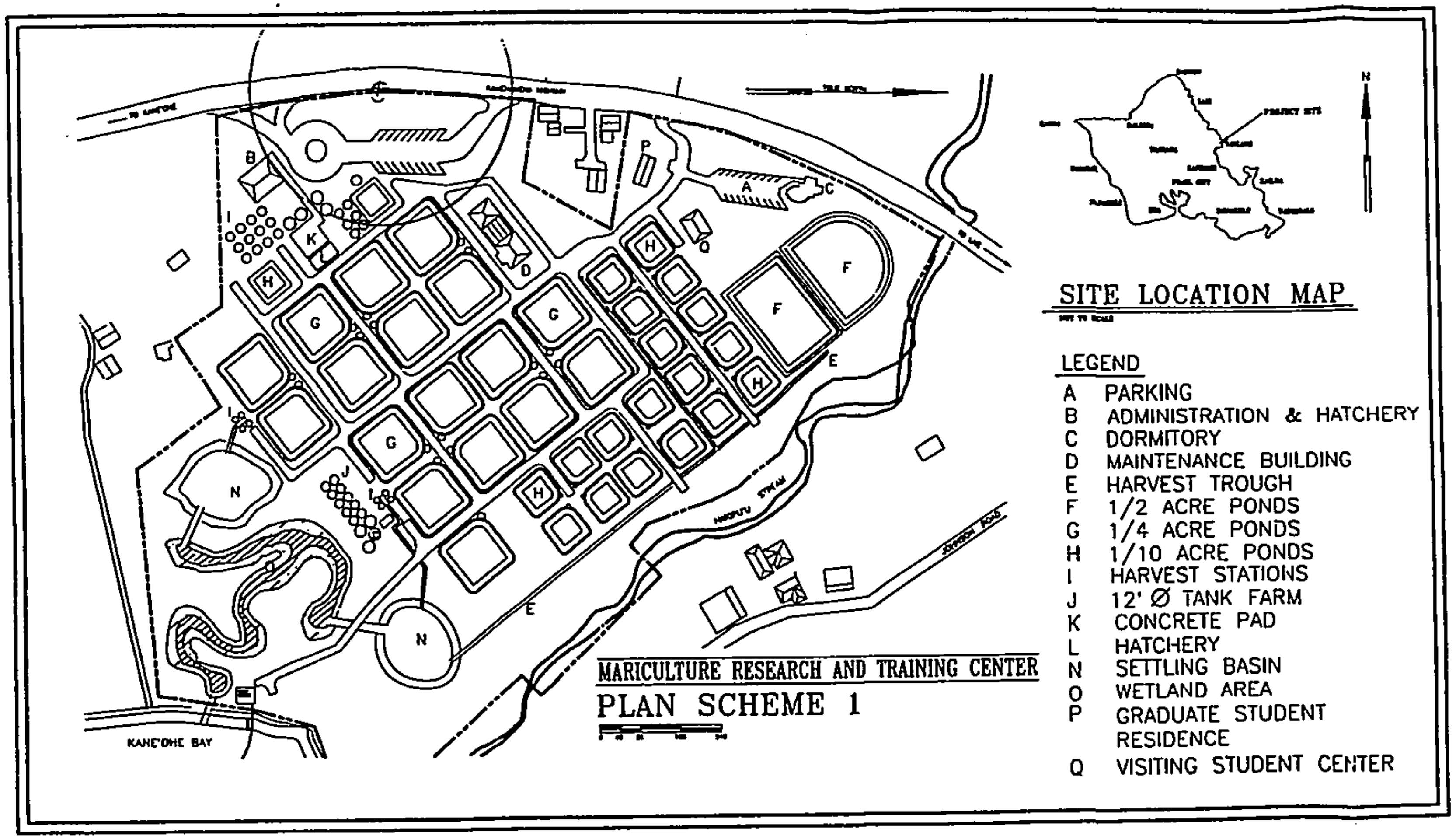

FIGURE 4. FACILITY LAYOUT - SCHEME 1

MARICULTURE RESEARCH AND TRAINING CENTER

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

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

REF:WL-LC

OCT 27 1993

Mr. Roy C. Price, Sr.
Vice Director of Civil Defense
Department of Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Mr. Price:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 18, 1993 regarding the subject project. We appreciate your input regarding the installation of a civil defense siren for the area. The project planners have not factored in such a device in the renovation plans as it is not part of the project's scope and/or objective. However, with available state funding we can incorporate the device in conjunction with the project renovation.

We hope that we have satisfactorily responded to your comments. If you have any further questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

RECEIVED
MAR 3 1993
OCEANIT LABORATORIES, INC.

March 2, 1993

MEMORANDUM

TO: The Honorable John D. Waihee, Governor
State of Hawaii
c/o Office of Environmental Quality Control

FROM: Hoaliku L. Drake, Chairman *Hoaliku Drake*
Hawaiian Homes Commission

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: MARICULTURE RESEARCH AND TRAINING CENTER, Koolaupoko, Oahu, TMK: 4-9-01: 11, 12, por. 14, por. 18, 19, 31 and 32

The Department of Hawaiian Home Lands has no comments or objections regarding the subject proposal to renovate the existing aquaculture facility and to develop additional support facilities.

If you have any questions, please call Ben Henderson of our Planning Office at 586-3838.

HLD:BH:JEC:asy/2739L

cc: DLNR-DOWALD
Oceanit Laboratories, Inc.

1

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
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HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:WL-LC

OCT 27 1993

Honorable Hoaliku L. Drake
Chairperson
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

Dear Ms. Drake:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
<u>The Mariculture Research, Training and Demonstration Facility</u>
<u>Large Scale Pond Research, Training and Demonstration Facility</u>

Thank you for your letter of March 2, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

CORRECTION

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

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 2, 1993

RECEIVED
MAR 3 1993
OCEANIT LABORATORIES, INC.

MEMORANDUM

TO: The Honorable John D. Waihee, Governor
State of Hawaii
c/o Office of Environmental Quality Control

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT: MARICULTURE RESEARCH AND TRAINING CENTER, Koolaupoko, Oahu, TMK: 4-9-01: 11, 12, por. 14, por. 18, 19, 31 and 32

The Department of Hawaiian Home Lands has no comments or objections regarding the subject proposal to renovate the existing aquaculture facility and to develop additional support facilities.

If you have any questions, please call Ben Henderson of our Planning Office at 586-3838.

HLD:BH:JEC:asy/2739L

cc: DLNR-DOWALD
Oceanit Laboratories, Inc.

7

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
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KEITH W. AHUE, Chairperson
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STATE PARKS
WATER AND LAND DEVELOPMENT

REF:WL-LC

OCT 27 1993

Honorable Hoaliku L. Drake
Chairperson
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, Hawaii 96805

Dear Ms. Drake:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 2, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

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:

March 29, 1993

93-046/epo

RECEIVED
APR 13 1993
OCEANIT LABORATORIES, INC.

To: The Honorable John Waihee
Governor, State of Hawaii

From: John C. Lewin, M.D. [signature] for
Director of Health

Subject: Draft Environmental Impact Statement (DEIS)
Mariculture Research & Training Center Renovation
Koolanpoko, Oahu
THK: 4-9-01: Various

Thank you for allowing us to review and comment on the subject document. We do not have any comments to offer at this time.

c: Department of Land & Natural Resources
Oceanit Laboratories

8

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
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CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:WL-LC

OCT 27 1993

Honorable John C. Lewin, M.D.
Director
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 29, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Very truly yours,

[signature]
KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR OF HAWAII

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

Keith W. Ahue, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
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DONA L. HANAIKE

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FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
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WATER AND LAND DEVELOPMENT

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

MAR 23 1993

File No.: 93-440
DOC. NO.: 2408

MEMORANDUM

TO: Mr. Brian J.J. Choy, Director
Office of Environmental Quality Control

FROM: Keith W. Ahue, Chairperson
Board of Land and Natural Resources

SUBJECT: Draft Environmental Impact Statement (DEIS) for the Mariculture Research and Training Center (MRTC) Renovation, Koolaupoko, Oahu, TMK: 4-9-01: 11, 12, por. 14 and 18, 31, 32

We have reviewed the DEIS information for the proposed renovation project and have the following comments:

Brief Description:

The applicant proposes to renovate the existing aquaculture research facility to create additional ponds, and to develop support facilities including an office/classroom/laboratory building, a maintenance facility, a hatchery, and housing for students and caretakers. In addition to the renovations, the applicant proposes to dredge a shallow channel across approximately 800 feet of mudflat for a seawater pipeline. The seawater pipeline intake would be located approximately 1500 feet offshore.

Division of Aquatic Resources

The Division of Aquatic Resources (DAR) comments that the proposed renovation of the existing MRTC facility is not expected to have significant long-term adverse impact on aquatic resource values in the area. However, since the proposed project is adjacent to near-shore water and involves dredging offshore, construction and dredging activities could have short-term impacts on aquatic resources such as temporary turbidity and biota displacement and disturbance. Mitigation measures should be described in the Environmental Assessment to prevent potential adverse impacts of both short-term (e.g. construction and dredging) and long-term (e.g. runoff, flooding, introduction of alien species, etc.)

addressed.

9

DAR supports the following measures to minimize erosion and siltation during construction:

1. Site work should be scheduled for periods of minimal rainfall;
2. Dredging for seawater intake system should be scheduled during periods of low tide;
3. Lands denuded of vegetation should be replanted or covered as quickly as possible to control erosion; and
4. Construction materials, petroleum products, and debris should be prevented from falling blowing, or leaching into the aquatic environment.

DAR comments that the DEIS does not address the following concerns:

1. In the event of heavy rainfall, how the ponds would be prevented from overflowing to prevent the introduction of alien species into the environment and:
2. What other types of algae (besides ogo) are to be used in the MARSH filter system. Types of algae that should be used included those that are native species or species already established in the area.

Historic Preservation Division

The Historic Preservation Division (HPD) comments that the DEIS contains as Appendix C an inventory survey report (Archaeological Inventory Survey of the Proposed Kualoa Oceanic Mariculture Pond Expansion Area by Pfeffer, Wong-Smith and Hammatt) for these parcels. This inventory survey report is not acceptable because it appears that historic sites might be present at the project area and these are not documented in the report. HPD believes that additional field, laboratory and archival work is needed to make this report acceptable.

Survey techniques included 100% surface coverage and excavation of two test pits. A third test pit, excavated in a marshy portion of the project area, was abandoned due to the wet conditions. No significant historic sites were found. The authors of the report appear to believe that possibly significant historic sites exist in the marshy portion of the property, although the authors do not classify these as "archaeological sites" (p. 27). These are hypothesized to be "sediments in normal stratigraphic context" — HPD believes these sediments are potentially significant for the information on Hawaiian prehistory and history that they contain.

In HPD's reading of the report, there is no information with which to rule out the possibility that traditional irrigated taro fields (lo'i) will be found within the marshy area. Although the report contains a discussion of the distribution of traditional habitation and agricultural sites at the time of the Mahele, and posits in general terms a settlement pattern for the ahupua'a, a map or other indication for the relationship of Mahele-era land use to the proposed project is lacking. The authors appear to believe that the Mahele-era lo'i have been destroyed, though the list of agents implicated in this destruction varies (cf. pp. 25 and 26). Without detailed archival and test excavation data, followed by analysis of cultural materials recovered during excavation, HPD sees no reason to rule out the possibility that the posited "sediments in normal stratigraphic context" are in fact remains of traditional agricultural sites that would be significant for the information the development of traditional Hawaiian agriculture that they contain.

addressed

The report contains some errors that were missed in proofs. These are listed for the authors' convenience in revising the report. 1) The sentence on p. 21 that begins with "This was followed..." is not clear as it stands. 2) The end of Appendix A in the report, especially the Summary and Conclusions section, is mixed up.

HPD looks forward to reviewing a revised inventory survey report for this project that makes clear the relationship of the Mahele-era agricultural fields to the project, and that describes sediments in the marshy area in sufficient detail to determine their significance.

Commission on Water Resource Management

The Commission on Water Resource Management (CWRM) comments that the DEIS refers to the possible drilling of deep wells further inland to serve as sources of freshwater for the Mariculture Center project. While the project developer is cognizant of the need to secure the necessary well construction permits from CWRM, the developer is to be reminded of the need to also secure the associated ~~water use~~ and pump installation permits. Further, should the withdrawal of water ~~from the wells~~ result in a reduction in the flow of nearby Hakipuu Stream, the developer may need to petition the CWRM for an amendment of the prevailing instream flow standard for Hakipuu Stream. Furthermore, should any of the proposed facility renovations at the Mariculture Center encroach upon the bed and banks of Hakipuu Stream, the developer should determine whether a Stream Channel Alteration Permit (SCAP) is applicable.

unresolved

In light of the foregoing, CWRM believes it appropriate that the Draft EIS be expanded to address those project activities that may possibly require permits from CWRM.

Office of Conservation and Environmental Affairs

The Office of Conservation and Environmental Affairs (OCEA) comments that page IV-15 should specifically indicate that a Conservation District Use Permit (CDUP) will be required for the seawater intake on the submerged lands of Kaneohe Bay and any work seaward (makai) of the certified shoreline. OCEA also comments that such work will also require Land Disposition from the Division of Land Management (DLM) and that the project developer should consult with DLM when planning for this portion of the proposed renovation.

addressed

Division of Conservation and Resources Enforcement

The Division of Conservation and Resources Enforcement comments that any CDUP issued for the proposed project should caution the permittee to minimize ~~damage to coral~~ that may be encountered during laying of the offshore seawater intake pipe. Particular care should be taken in excavation.

addressed

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to call Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

cc: Robin Anawalt

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

OCT 27 1993

TO: Mr. Henry Sakuda, Administrator
Division of Aquatic Resources

FROM: Manabu Tagomori, Manager-Chief Engineer

SUBJECT: Draft Environmental Impact Statement (DEIS), The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments regarding the subject project.

We concur that near and off shore construction and dredging activities will indicate short-term impacts on aquatic resources and possible long-term impacts as well. We also are in agreement with your stated measures to minimize erosion and siltation during construction.

1. During periods of heavy rainfall when flooding is anticipated, the water level within the pond and system will be dropped. Screens will be put on all pipe entrances and operation protocols will be defined for containment and minimizing the escape of nonindigenous species.

2. We note your comment on selection of other algal species established in the area for use in the MARSH system. We will use indigenous algal species such as Ulva, Acanthophora, Dictyota, Padina, Hypnea, and Gracilaria in the MARSH system.

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt or Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

AM:lc

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
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AQUACULTURE DEVELOPMENT PROGRAM
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CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

TO: Dr. Don Hibbard, Director
Historic Preservation Division

FROM: Manabu Tagomori, Manager-Chief Engineer

SUBJECT: Draft Environmental Impact Statement (DEIS), The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments regarding the subject project.

Your comments regarding the archaeological report have been noted. Discussions with Dr. Hal Hammatt of Cultural Surveys Hawaii and Mr. Tom Dye of your staff have indicated that the previous study is not acceptable as a test pit was attempted but left incomplete. The first attempt to dig a test pit in the marshy area was unsuccessful due to inundation by water. A more recent attempt to dig a test pit under drought conditions was successful and these results are included in the updated Appendix C of the Final EIS. Additional results will be included with the archaeologist's revised report and will be sent to your office prior to submittal of the Final EIS.

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt or Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

AM:lc

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR OF HAWAII

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HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1995

TO: Ms. Rae Loui, Deputy Director
Commission on Water Resource Management

FROM: Manabu Tagomori, Manager-Chief Engineer

SUBJECT: Draft Environmental Impact Statement (DEIS), The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments regarding the subject project.

Prior to obtaining a water use or pump installation permit for possible drilling of deep wells, other options to well drilling are currently being explored. Nevertheless, we have no intention of reducing the flow of Hakipu'u Stream from deep water well(s). The issue of fresh water for aquaculture usage is one that will necessitate an extremely careful investigation of all possible options and requirements, including the permits you have mentioned. This issue is discussed further in the Final EIS (see Chapter VII -Summary of Unresolved Issues).

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt or Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

AM:lc

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR OF HAWAII

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HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1995

TO: Mr. Roger Evans, Administrator
Office of Conservation and Environmental Affairs

FROM: Manabu Tagomori, Manager-Chief Engineer

SUBJECT: Draft Environmental Impact Statement (DEIS), The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments regarding the subject project.

Your correction on the Conservation District Use Permit requirement for the seawater intake has been incorporated into the Final EIS. As part of the CDUP, we understand that any construction seaward of the project site, being in submerged lands, will require a State Land Disposition from Division of Land Management.

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt or Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

AM:lc

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

TO: Mr. Maurice Matsuzaki, Enforcement Chief
Division of Conservation and Resources Enforcement

FROM: Manabu Tagomori, Manager-Chief Engineer

SUBJECT: Draft Environmental Impact Statement (DEIS), The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments regarding the subject project.

Your comment regarding damage to coral during laying of offshore pipe has been noted. Assessing the potential of silt damage to corals resulting from construction work considers two conditions: a) live coral down current from the proposed pipeline is very scarce and b) the Porites compressa which comprises most of the live reef is more resistant to silt damage that most other species of corals. Excavation on the sandbar should not produce a significant silt plume due to the large grain size mix of the sandbar sediments. Any plume created during these excavations would be carried by currents into the Hakipu'u puka, which surrounds the Hakipu'u Sandbar and is a natural settling basin. Care will be taken to insure preservation of the marine environment (see Appendix F in the Final EIS).

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt or Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

AM:lc

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

RECEIVED

DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife

93 APR 12 P 3:43

MEMORANDUM April 12, 1993

TO: Andrew Monden, Division of Water and Land Development

FROM: Ron Walker, Wildlife Program Manager

DIV. OF WATER & LAND DEVELOPMENT

SUBJECT: Draft EIS, Mariculture Research and Training Center

Comments on subject draft EIS:

?

1. Pg. I-9- A more detailed description of the two acres of "existing wetland" would help resolve the question of converting a natural marsh to "reclamation" ponds and the possible impact on endangered waterbird use.

2. Pg. I-10- In the first paragraph, the proposal indicates that the MARSH will be under "high saline conditions". Any reference thereafter to the value of this system to endangered waterbirds should note that at least one species, the moorhen, favors freshwater habitats, and the saline habitats are not primary habitats for the other three endangered waterbirds, the coot, duck and stilt.

The deliberate planting of mangroves (second paragraph) may not be environmental acceptable from the standpoint of maintaining viable waterbird habitat. Mangrove is extremely aggressive and may destroy good habitat in the long run.

3. Pg. I-11- In discussing the design of the facility, some reference should be made to the potential for black-crowned night herons feeding extensively on the organisms being raised. At other aquaculture farms (notably Kahuku), heron depredation became a serious problem at open topped impoundments and it was necessary to "control" them.

4. Pg. IV-11- Additional environmental " permits" needed at the Federal and State levels may be reviews of the proposed action in terms of possible "taking" of endangered species under the Federal and State Endangered Species acts, particularly if natural wetlands are to be altered.

5. Pg. V-3- At the top of the page, it is stated that endangered waterbirds will go to "other nearby wetlands", as if this means no impact. Under normal circumstances, habitats support a finite number of birds, and it is not necessarily true that displaced birds will adjust by crowding into areas already occupied by their species.

6. Pg. V-4- While the creation of new or improved habitat may result in increased use by endangered waterbirds, it would depend on the design of the habitat and there would be an adjustment

2.

period before they do so. The EIS should be clear that there might be a temporary negative effect in the process. Note also that in this analysis it is pointed out that the removal of mangrove would have a positive effect, whereas elsewhere in the document it suggests planting mangrove (see 2., above).

7. Pg. V-9- A description of what constitutes "nuisance animals" should be included for clarity.

8. Pg. VII-1- In the Summary of Unresolved Issues, the EIS should state that clearance from the State and Federal governments as to whether or not the project will have an adverse impact on endangered species and will be in compliance with the laws is needed .

9. In general, the documentation on existing flora and fauna is complete.

difference of opinion - unresolved?

10

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P O BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
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LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

TO: Mr. Michael Buck, Administrator
Division of Forestry and Wildlife

FROM: Manabu Tagomori, Manager-Chief Engineer

SUBJECT: Draft Environmental Impact Statement (DEIS), The Mariculture Research and Training Center (MRTC) Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments regarding the subject project. We offer the following in response to your comments:

1. It is our understanding that the Division monitors native waterbird species and is familiar with the carrying capacity of two acres of existing wetlands on-site that consist of the hau and mangrove thicket. Various waterfowl use the MRTC grounds and ponds for habitat but are not known to reside in the dense hau and mangrove thicket (see Appendix E of the Final EIS).

2. Two permanent freshwater ponds will remain. But there will be a net increase in saltwater/brackish pond area. No impact to the moorhen is anticipated as it prefers ~~freshwater habitats~~. Regarding saline ponds as primary habitats for other endangered waterfowl; a) stilts are found on the banks of MRTC's brackish ponds, b) coots have a low carrying capacity and prefer to be distributed as a mated pair per pond, without regard to pond size, and c) the fresh water Koloa duck has not been observed on MRTC grounds since UH has operated the facility.

We concur that mangrove is a good soil stabilizer, nutrient user and is aggressive in its growth pattern. It is likely that more mangrove will be removed than planted. Growth control will be taken to retard their spread as part of the management for the MARSH system.

3. We concur that the black-crowned heron is a potential nuisance. However, we do not anticipate instilling a "control" program unless their numbers dramatically increase. The researchers at MRTC would prefer to have the birds feeding, rather than have them "controlled." The State's aquaculture extension agent, who have dealt favorably with this problem in the past, will be stationed at the new MRTC facility.

4. The addition of the MARSH system will increase the available brackish wetland habitat. No negative impacts on endangered waterfowl species are anticipated as this new habitat will be created primarily from mangrove and hau jungle which does not currently provide appropriate habitat for those species. Because the renovation will create more ponds, we do not anticipate significant alteration of the habitat to the detriment of endangered waterfowl species.

5. The waterbird species may be temporarily driven to nearby habitats. Food is available in the area. Upon completion of construction, positive impacts are anticipated with the creation of additional ponds. Project completion will offset temporary impacts and allow for recruitment and population growth.

6. We anticipate that recruitment time for the water birds will take several months before stable populations are achieved. Temporary negative effects may occur during construction. The Final EIS will reflect the removal of hau/mangrove thicket. See item 2 above.

7. As stated in the Final EIS, population levels of nuisance animals from the proposed MARSH system will be less than from the existing wetland. The presence of mongoose and rats will decrease due to absence of hau/mangrove thicket. Mosquitos, snails and larval toads will be limited due to anticipated high salinity of the wetlands.

? 8. Because the renovation project is not anticipated to impact any endangered waterfowl species on-site for the reasons stated above, this is not considered an unresolved issue.

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt or Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

AM:lc

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

JOHN WAIHEE, Governor
MUFI HANNEMANN, Director
BARBARA KIM STANTON, Deputy Director
RICK EGGED, Deputy Director
TAKESHI YOSHIHARA, Deputy Director

March 3, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

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

Dear Mr. Choy:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Draft Environmental Impact Statement for the Mariculture Research and Training Center.

The comments were provided by Land Use Commission. Questions regarding these comments may be directed to Esther Ueda, LUC Executive Officer, at 587-3826.

Thank you for the opportunity to comment.

Sincerely,

Mufi Hannemann

Enclosure

cc: Mr. Edward Lau
Ms. Robin Anawalt

11

LUC

February 18, 1993

Subject: Draft Environmental Impact Statement for the Mariculture Research and Training Center

We have reviewed the subject Draft Environmental Impact Statement (DEIS) and have the following comments to offer:

1) We verify that the 28.3 acre Project Site, as depicted on Figure 1 and identified as TMK: 4-9-01: 11, 12, 31, 32, por. 13, and por. 14, are within the State Land Use Agricultural District.

2) We suggest that the Project Site be depicted on a reproduction of the State Land Use District Boundary Map for the area to illustrate the relationship between the Project Site and the surrounding districts. This map should be included in the Final Environmental Impact Statement (FEIS).

3) We further suggest that the Project Site be depicted on a reproduction of the tax map of the area. This map should also be included in the FEIS.

We have no further comments to offer at this time.

EU:LRA:th

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

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

REF:WL-LC

OCT 27 1993

Honorable Mufi Hannemann
Director
Department of Business, Economic Development and Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Hannemann:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 3, 1993 regarding the subject project. We offer the following in response to your comments:

1. Thank you for your verification on the subject parcels within the project site.

2. The Final EIS shall contain a figure in Chapter IV depicting the approximate project site boundaries within the State Land Use District Boundaries.

3. A copy of the Tax Map Key with the approximate project site boundaries shall be included in the Final EIS in Chapter I.

We hope that we have satisfactorily responded to your comments. If you have any further questions, please contact Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

March 9, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

SUBJECT: Mariculture Research and Training Center Renovation

We wish to inform you that we have no comments to offer on the subject Draft Environmental Impact Statement (DEIS).

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHKeis73hk

cc: DLNR-Div. of Water & Land Development
Oceanit Laboratories, Inc.

12

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P O BOX 373
HONOLULU HAWAII 96809

OCT 27 1993

Mr. Maurice H. Kaya
Energy Program Administrator
Energy Division
Department of Business, Economic Development and Tourism
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Kaya:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 9, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
93:PPE/1479

March 30, 1993

RECEIVED
APR 13 1993
OCEANIT LABORATORIES INC.

TO: The Honorable John Waihee, Governor
c/o Office of Environmental Quality Control

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft EIS for the Proposed Mariculture Research and Training Center

Thank you for the opportunity to review the enclosed draft EIS. We have no comments to offer.

Enclosure

c: Mr. Edward Lau, DLNR
✓ Ms. Robin Anawalt, Oceanit Laboratories, Inc.

13

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

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

REF:WL-LC

OCT 27 1993

Mr. Joseph K. Conant
Executive Director
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

Dear Mr. Conant:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 30, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Very truly yours,

Keith W. Ahue

KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR

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

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.5112

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

March 17, 1993

TO: The Honorable John Waihee, Governor
c/o Office of Environmental Quality Control

FROM: Rex D. Johnson
Director of Transportation

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)
MARICULTURE RESEARCH AND TRAINING CENTER

We have reviewed the draft EIS for the proposed Mariculture Research and Training Center and offer the following comments:

1. The proposed two accesses onto Kamehameha Highway must be consolidated into one main access point.
2. Left-turn storage and right-turn deceleration lanes should be provided on Kamehameha Highway at the project's main access.
3. Sight distance requirements for autos, trucks, and buses at the project's main access must conform to State highway design standards.
4. All required roadway improvements must be implemented at no cost to the State.
5. Plans for construction work within the State highway right-of-way must be submitted to our department for review and approval.

Thank you for the opportunity to provide comments.

c: Mr. Edward Lau, Dept. of Land & Natural Resources
Ms. Robin Anawalt, Oceanit Laboratories, Inc.

14

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

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

REF:WL-LC

OCT 27 1993

Honorable Rex D. Johnson
Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Attn: Mr. Dan Tanaka

Dear Mr. Johnson:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 17, 1993 regarding the subject project. We offer the following responses, in respective order, to your comments:

1. We assume you are referring to Scheme 1 regarding consolidation of two accesses into one main access point. Schemes 1 and 2 have since been consolidated into an Ultimate Site Plan which is contained in the Final EIS. We would like to meet with members of your transportation staff to discuss the accesses onto Kamehameha Highway and what can be accomplished to increase the safety factor.
2. The Ultimate Site Plan just mentioned displays the left-turn storage and right-turn deceleration lanes on Kamehameha Highway in the Final EIS.
3. The sight distance requirements for automobiles conform to state highway design standards. However, these requirements do not conform to the sight distance for trucks and buses. Please refer to Table 1 in Appendix A in the Final EIS for the sight distance analysis.
4. We understand that all roadway improvements will be done at no cost to the State Department of Transportation.
5. We understand that plans for construction work will be submitted to the Department of Transportation for review and approval.

We hope we have responded satisfactorily to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Very truly yours,

Keith W. Ahue

KEITH W. AHUE

cc: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

c: Edward Lau, DLNR, DOWALD
Robin Anawalt, Oceanit Laboratories, Inc.

SEND COPIES TO APPROPRIATE PARTIES

FILE

POSTED

OFFICE OF STATE PLANNING
Office of the Governor

'93 MAR 19 P1:12

Ref. No. P-4131

March 17, 1993

OFC. OF QUALITY

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

MEMORANDUM

TO: Mr. Brian Choy, Director
Office of Environmental Quality Control

SUBJECT: Draft Environmental Impact Statement for the Mariculture Research and Training Center, Koolaupoko, Oahu, Hawaii

We have reviewed the referenced document and have the following comments.

Water quality, coastal water quality in particular, is a leading environmental issue. A relevant statutory Coastal Zone Management (CZM) policy as expressed in Chapter 205A, HRS, is to "promote water quality and quantity planning and management practices which reflect the tolerance of freshwater and marine ecosystems and prohibit land and water uses which violate State water quality standards."

With an increase in the number of cultivation ponds and use intensity, an increase in nutrient-rich effluent discharge is a concern. Although treatment techniques are discussed which will attempt to reduce effluent concentration levels, it is unclear as to their effectiveness in preventing violations of State water quality standards. Exploration of alternative mitigation techniques should be discussed in the final EIS.

Thank you for the opportunity to comment on this draft environmental impact statement. If you have any questions, please contact Harold Lao at 587-2883.

Harold S. Masumoto
Director

5

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Mr. Harold S. Matsumoto
Director
Office of State Planning
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Mr. Matsumoto:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 17, 1993 regarding the subject project. We sincerely appreciate the time taken by your staff to review our document.

We agree that coastal water quality is an important environmental issue and of concern at this early stage of planning and development. The proposed MARSH system is, however, unique and experimental. The system is for settling of particulates, isolation of nonindigenous species, nutrient stripping, and polishing of effluent waters prior to discharge into Kaneohe Bay or reuse of waters within the facility's water distribution system. The system allows for conserving water resources and preventing violation of State water quality standards. As such, we will define, at a later stage of project development, operational protocol for monitoring and managing water quality standards at MRTC.

We hope we have satisfactorily addressed your comments. If you have any questions, please call Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

March 11, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

Mr. Manabu Tagamori, Manager-Chief Engineer
Department of Land and Natural Resources
Division of Water and Land Development
P.O. Box 373
Honolulu, Hawaii 96809

Attention: Mr. Edward Lau

Dear Mr. Tagamori:

SUBJECT: DRAFT EIS FOR THE MARICULTURE RESEARCH AND TRAINING CENTER, KOOLAUPOKO, OAHU

We have completed our review of the subject document and have several comments. Please include the following information when submitting the Final EIS for this project, as required by §11-200-17 Hawaii Administrative Rules:

- Concisely discuss the unresolved issues, mentioned in Chapter 7, in the Project Summary section of the Final EIS.
- Since the sewage treatment facility portion of the project was not discussed in detail in the Draft EIS, the public and appropriate agencies will not have the opportunity to comment on this issue until the Final EIS is released. Therefore, we suggest that questions concerning the development of a sewage treatment facility on the project site be included in the list of unresolved issues.
- The unresolved issues section of the Final EIS should also include a discussion of the alternatives for supplying freshwater to the project site since no decision has been made as to which method the project will utilize.

If you have any questions, please call Margaret Wilson at 586-4185. Thank you.

Sincerely,

Brian J.J. Choy

Brian J.J. Choy
Director

16

c: Robin Anawalt, Oceanit Laboratories, Inc.

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 2 1993

Mr. Brian J.J. Choy
Director
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 11, 1993 on the subject project. We offer the following responses, in respective order to your comments:

1. Due to an oversight, unresolved issues were not discussed in the summary section of the Draft EIS. We shall incorporate a concise discussion of unresolved issues into the Final EIS in both Chapter VII and in the summary section.

2. In the Final EIS, a more thorough description of the domestic wastewater treatment system shall be included. We shall also incorporate your suggestion of listing questions concerning the system into Chapter VII, Unresolved Issues.

3. We will provide a list of alternatives regarding provision of fresh water to the project site under unresolved issues. Due to the complexity of this issue, it is unlikely that any final decisions will be selected from the alternatives prior to publication of the Final EIS.

We hope that we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc, our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

COPY

March 24, 1993

RECEIVED
MAR 30 1993
OCEANIT LABORATORIES, INC.

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement (DEIS) for the Proposed Mariculture Research and Training Center Renovation, TMK: 4-9-01: 11, Portion 13, Portion 14, 31 and 32, Kamehameha Highway

Thank you for the opportunity to comment on the DEIS for the Proposed Mariculture Research and Training Center Renovation. Our previous comments of July 13, 1992 on the Environmental Impact Statement Preparation Notice are still applicable and are included in Section VIII. We have the following additional comments:

1. Water from the Board of Water Supply's system can only accommodate the project's domestic water requirements. The fresh water requirement of 720,000 gpd for aquaculture uses should be provided by other sources.

2. We have plans to develop a well in Hakipuu Valley which could affect the deep wells that are recommended for development (1992 MTRC Groundwater Study) to meet the project's freshwater requirements for aquaculture purposes. However, we have no objections to the proposed drilling and use of the deep wells for the proposed project.

If you have any questions, please contact Bert Kuioka at 527-5235.

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Department of Land and Natural Resources,
Division of Water and Land Development
Oceanit Laboratories, Inc.

17

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
PO BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments of March 24, 1993 regarding the subject project. We offer the following in response to your comments:

1. We concur with the Board of Water Supply's system capacity limitations. We are investigating the feasibility of an exploratory well study. Fresh water requirements for aquaculture will be decided after the recommendations of a well study are reviewed and evaluated at a later date.

2. We appreciate your disclosure of plans to develop a well in Hakipu'u Valley. While your agency may have no objections to the possibility of MRTC's proposed fresh water well, please be advised that a well for MRTC is viewed as one of several alternatives to fulfill fresh water aquaculture requirements. We are presently soliciting the Hakipu'u community's concerns regarding fresh water extraction and its potential impacts to surrounding users.

We hope that we have satisfactorily responded to your comments. If you have any further questions, please contact Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

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

FRANK F. FASI
MAYOR

RECEIVED
APR 29 1993
OCEANIT LABORATORIES, INC.

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

93-00943AC)

April 29, 1993

Ms. Robin Anawalt
Oceanit Laboratories, Inc.
1188 Bishop Street, Suite 2512
Honolulu, Hawaii 96813

Dear Ms. Anawalt:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center
49-139 Kamehameha Highway, Kaneohe, Oahu
TMK: 4-9-01: 11, 12, 31 and portions of 13 and 14

Thank you for providing the Department of Land Utilization (DLU) the opportunity to review and comment on the above-mentioned DEIS. We have reviewed the document and offer the following comments:

Flood Hazard and Drainage

The DEIS generally discusses flood characteristics associated with the area, however, specific information related to the project impacts is lacking. Over a period of several years, the DLU has become aware of flooding problems created as a result of aquaculture ponds built by Aquafarms Inc. Recent discussions with neighborhood residents affected by flooding indicate that permanent solutions to this problem are needed. Developments that may increase the potential for flood hazard are subject to Special Management Area Permit requirements.

The final EIS should include a more detailed drainage and flood analysis to demonstrate that the ongoing flooding problems at the lower portions of Hakipuu Stream have been resolved and that further grading and development associated with this project will have no additional adverse impacts.

Water Supply System

The proposed water supply system will encroach into the Shoreline Setback. As stated previously in our earlier correspondence, a shoreline setback variance will be required prior to construction.

The aquaculture effluent would be disposed through a proposed Managed Aquaculture Reclamation System Habitat (MARSH). As presented in the DEIS, the MARSH would be created to replicate a natural salt marsh system for the purpose of nutrient uptake. As there are few natural salt marsh systems in the State, this concept would appear to be experimental in its design. The final EIS should give examples, if any, where these systems have functioned successfully in Hawaii.

Due to the wide range of potential impacts that this project may generate, the DLU has determined that a Major Special Management Area Use Permit and a Shoreline Setback Variance will be required.

Thank you for the opportunity to comment on the DEIS. Should you have any questions, please call Mr. Art Challacombe of our staff at 523-4107.

Very truly yours,

Donald Clegg

DONALD A. CLEGG
Director of Land Utilization

DAC:ak

G:mrtc.ac

18

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Mr. Donald A. Clegg
Director
Department of Land Utilization
City & County of Honolulu
650 South King Street
Honolulu, HI 96817

Dear Mr. Clegg:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of April 29, 1993 on the subject project. We appreciate the time taken by your staff to review our document. We offer the following responses to your comments:

1. As referenced in a study done by RM Towill Corporation in 1991, the majority of the project site and surrounding neighborhood are in a flood plain. We concur that a Special Management Area Permit is required owing to potential flooding situations. We have defined design specifications to minimize flooding hazards for the facility. A more complete and permanent solution is not within the scope and funding for this project. However, development of the MARSH system will serve to capture more waters from a flooding situation.

2. As is stated in the Draft EIS, we understand that a Shoreline Setback Variance is required prior to construction of the seawater system.

3. Saltwater marsh systems within the State are limited and very small. Artificial salt marsh systems elsewhere and in the State are not known to us. State of the art systems are all freshwater. We agree that coastal water quality is an important environmental issue and of concern when we are at this early stage of planning and development.

Da

The MARSH system proposed is both unique and experimental. The facility is for settling of particulates, isolation of nonindigenous species, nutrient stripping and polishing of effluent water prior to discharge into Kaneohe Bay, or reuse of waters within the water distribution system. This system allows for conserving water resources and preventing violation of State water quality standards. As such, we will define, at a later stage of project development, operational protocol for monitoring and managing water quality standards at MRTC.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

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

ALVIN K. C. AU
DEPUTY DIRECTOR

March 2, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

The Honorable John Waihee
Governor
c/o Office of Environmental
Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement (DEIS) for Mariculture Research and Training Center Renovation Koolaupoko, Oahu, Hawaii Tax Map Key 4-9-01: 11, 12, 19, 31, 32 & Pors. 1 & 18

Thank you for the opportunity to review the DEIS for the Mariculture Research and Training Center Renovation. We have no comments to offer at this time.

Should you have any questions, please contact Lester Lai of our Advance Planning Branch at extension 4696.

Sincerely,

For WALTER M. OZAWA, Director

WMO:ei

cc: Department of Land & Natural Resources (Edward Lau)
Oceanit Laboratories, Inc. (Robin Anawalt)

19

We Add Quality to Life

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
PO BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

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 (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 2, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

JOSEPH M. MAGALDI, JR.
DIRECTOR

AMAR SAPPAL
DEPUTY DIRECTOR

TE-647
PL93.1.057

March 10, 1993

The Honorable John D. Waihee
Governor
State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Mariculture Research and Training Center
Draft Environmental Impact Statement (DEIS)
TMK: 4-9-01: 11, 12, 31, 32, Pors. 13 & 14

This is in response to the Draft Environmental Impact Statement submitted to us for review by the Office of Environmental Quality Control.

As stated in our response to the EISPN, we understand that the project access roadway will connect to Kamehameha Highway, which is a State Department of Transportation facility and is not intended to be dedicated to the City. This being the case, we have no comments or objections to the proposed development.

Sincerely,

JOSEPH M. MAGALDI, JR.
Director

cc: Department of Land & Natural Resources
Oceanit Laboratories, Inc.

70

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

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DONA L. HANAIKE

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STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Joseph M. Magaldi, Jr.
Director
Department of Transportation Services
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Magaldi:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 10, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

C. MICHAEL STREET
DIRECTOR AND CHIEF ENGINEER

FELIX B. LIMTIACO
DEPUTY DIRECTOR

ENV93-47

February 23, 1993

The Honorable John D. Waihee
Governor
c/o Office of Environmental Quality
Control
State of Hawaii
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement (DEIS)
Mariculture Research and Training Center Renovation
TMK:4-9-01:11, 12, 31 and Por. 13 and 14

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

1. The DEIS should address the potential impacts on water quality at the Kaneohe Bay as a result of the storm water discharge associated with the construction activities.

2. The DEIS should also state what structural or non-structural best management practices (BMP) will be provided to control and reduce the discharge of pollutants during the construction and/or dewatering operations.

3. For your information, if dewatering activity is anticipated during the construction, construction dewatering permits will be required by the State Department of Health as well as the Department of Public Works, City and County of Honolulu.

Should there be any questions, please contact Alex Ho at 523-4150.

Very truly yours,

C. Michael Street

C. MICHAEL STREET
Director and Chief Engineer

cc: Department of Land and Natural Resources (Ed Lau)
Oceanit Laboratories, Inc. (Robin Anawalt)

21

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
PO BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
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STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

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

Dear Mr. Street:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of February 23, 1993 regarding the subject project. We offer the following in response to your comments:

1. Impacts to Kaneohe Bay water quality as a result of storm water discharge during construction activities are discussed in the Final EIS in Chapter V (Marine Impacts Nearshore).

2. As stated in the Draft EIS, erosion and runoff into Kaneohe Bay during on-site grading will be controlled through the standard use of settling basins and grading area limits. The proposed MARSH will act as the silt control basin for subsequent construction activities.

3. Your comments regarding dewatering activity have been noted. We anticipate construction dewatering for the seawater intake system's proposed pump house to be located near the shoreline. As part of the requirements for the NPDES program, we understand that any dewatering activity requires permits from the State Department of Health and your department.

We hope we have satisfactorily addressed your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

FIRE DEPARTMENT
CITY AND COUNTY OF HONOLULU
3375 KOAPAKA STREET, SUITE H425
HONOLULU, HAWAII 96819-1869

FRANK F. FASI
MAYOR

DONALD S.M. CHANG
FIRE CHIEF

RICHARD R. SETO-MOOK
DEPUTY FIRE CHIEF

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

February 26, 1993

Honorable John D. Waihee
Governor
State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Mariculture Research and Training Center

We have reviewed the subject material provided and have no additional comments.

Should you have any questions, please call Assistant Chief Attilio Leonardi of our Administrative Services Bureau at 831-7775.

Very truly yours,

DONALD S. M. CHANG
Fire Chief

AKL:lm

cc: Mr. Edward Lau, Department of Land & Natural Resources
Ms. Robin Anawalt, Oceanic Laboratories, Inc.

22

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
PO BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
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FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Donald S.M. Chang
Fire Chief
Fire Department
City and County of Honolulu
3375 Koapaka Street, Suite H425
Honolulu, Hawaii 96819-1869

Dear Mr. Chang:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of February 26, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

PLANNING DEPARTMENT

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

ROBIN FOSTER
CHIEF PLANNING OFFICER

ROLAND D. LIBBY, JR.
DEPUTY CHIEF PLANNING OFFICER

RECEIVED
MAR 30 1993
OCEANIT LABORATORIES, INC.

ET 2/93-379

March 23, 1993

The Honorable John D. Waihee
Governor of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center
Large Scale Pond Research, Training and
Demonstration Facility, Koolaupoko, Oahu, Hawaii
Tax Map Key 4-9-01: 11, 12, 31, 32, & Por. 13 & 14

We have reviewed the subject DEIS for the Mariculture Research and Training Center and have the following comments to offer:

1. The proposed project site is currently designated as "Agriculture" on the Development Plan Land Use Map for Koolaupoko.

2. Due to the intensive nature of the uses proposed for the center (i.e., dormitories, administrative offices, etc.), the facility should be designated on the Development Plan Public Facilities Map for Koolaupoko.

3. The Final Environmental Impact Statement (FEIS) should disclose and detail potential impacts to the existing wetlands.

4. The DEIS states that plans for a sewage treatment facility will be discussed further in the FEIS. We request that the following information be disclosed: 1) type and level of treatment proposed for the sewage treatment facility, and 2) who will be operating and maintaining this facility.

23

Thank you for the opportunity to comment. Should you have any questions, please contact Eugene Takahashi of our staff at 527-6022.

Sincerely,

ROBIN FOSTER
Chief Planning Officer

RF:ft

cc: DLNR, Attn: Edward Lau
✓Oceanit Laboratories, Inc.,
Attn: Ms. Robin Anawalt

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
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DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
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STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your comments of March 23,1993 regarding the subject project. We offer the following in response to your comments:

1. As indicated on page IV-9 of the Draft EIS, the subject project is designated Agriculture on the Development Plan Land Use Map. This information is also provided in the Final EIS.

2. As you mention, the intensity of land usage will increase due to the addition of classrooms, dormitory and research facilities. However, we are not convinced that the proposed renovation will necessitate designation on the Public Facilities Map, because the carrying capacity of the existing 30-inch water main is very large compared to the projected increased demand for domestic water use by the facility. According to the Board of Water Supply, the present capacity of the existing 30-inch water main is sufficient to accommodate the additional requirement of a maximum of 2,000 gallons per day. Additional loads to electricity and telephone are not anticipated and solid waste disposal will be self contained on-site with a proposed wastewater treatment system.

3. The Final EIS discusses in detail the impacts to the existing wetlands on the project site. See Chapter V Section D, Long-Term Impacts — Landward.

4. The Final EIS discloses the proposed wastewater treatment system for the MRTC. See Chapter I — Proposed Facility Renovations (Facility Structures and Site Layout). The type and level of treatment consists of a primary settling tank, an aerobic unit, a clarifier and a chlorinator to handle an anticipated maximum flow rate of approximately 3,000 gallons per day. The stated flow rate exceeds the maximum required capacity including provisions for large groups of visiting students. The facility will be operated and maintained by the on-site facilities manager.

We hope we have satisfactorily responded to your comments. If you have any questions, please contact Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

801 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96813 - AREA CODE (808) 529-3111

FRANK F. FASI
MAYOR

MICHAEL S. NAKAMURA
CHIEF

HAROLD M. KAWASAKI
DEPUTY CHIEF

OUR REFERENCE CS-LK

March 18, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

The Honorable John D. Waihee
Governor of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement for the Mariculture Research and Training Center, Koolaupoko, Oahu, Hawaii

We have reviewed the subject document relative to the effect that the proposed project will have on the services and facilities of the Honolulu Police Department.

The subject document addresses the impacts and proposed mitigation of construction noise, fugitive dust and added traffic during that phase of the project. It also states that the planners are working closely with the community. We encourage that this be continued throughout the construction phase of the project and beyond. It will probably help in minimizing calls for police service, but we have found that these calls are inevitable.

The proximity of the "Coral Kingdom" and the increase in traffic due to the nature of the proposed project may generate calls for police service.

Further, because there are already complaints about current operating equipment noise and although the planners, according to the document, seem to be working closely with the surrounding community, we can anticipate calls which would be attributable to the same problem.

Thank you for the opportunity to comment.

MICHAEL S. NAKAMURA
Chief of Police

By
CHESTER E. HUGHES
Assistant Chief of Police
Support Services Bureau

cc: Office of Environmental Quality Control
Department of Land & Natural Resources
Oceanit Laboratories, Inc.

24

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
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WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Michael S. Nakamura
Chief of Police
Police Department
City and County of Honolulu
801 South Beretania Street
Honolulu, Hawaii 96813

Attn: Chester E. Hughes

Dear Mr. Nakamura:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 18, 1993 regarding the subject project. Project planners are forming a Hakipu'u Community Advisory Committee to address concerns and issues that have been raised since issuance of the Draft EIS. This committee will meet regularly and intends to stay in place after the Final EIS has been submitted to achieve a consensus on unresolved issues.

Regarding the traffic situation, we are currently working with the Hakipu'u community to receive their input on ways to deal with potential increases in traffic as a result of the subject project.

We hope we have satisfactorily addressed your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

RECEIVED
APR 13 1993
OCEANIT LABORATORIES, INC.

April 12, 1993
RE:0623

Governor John Waihee
State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, Suite 400
Honolulu, Hawaii 96813

Dear Governor Waihee:

Draft Environmental Impact Statement
Mariculture Research and Training Center
Koolaupoko, Oahu

The project proposes to renovate the existing 28-acre Mariculture Research and Training Center (MRTC) administered by the University of Hawaii Institute of Marine Biology. Renovations will include: 1) installation of a new seawater and fresh water system for aquaculture purposes; 2) modification of the current pond configuration to provide a greater number of smaller ponds to replicate scientific studies; 3) development of classroom/conference room with additional office, a residence and dormitory for students and the caretaker; and 4) development of a new hatchery, laboratory, and maintenance buildings for research programs.

Our review of the Draft Environmental Impact Statement (EIS) was prepared with the assistance of Richard Brock, Hawaii Institute of Marine Biology/Sea Grant; Peter Flachsbert, Urban and Regional Planning; Leonard Freed, Zoology; Franciscus Gerritsen, Ocean Engineering; Hans-Jurgen Krock, Ocean Engineering/Look Laboratory; Edwin Murabayashi, Water Resources Research Center; and Elizabeth Gordon, Environmental Center.

General Comments

Our reviewers have expressed considerable concern with the potential impacts associated with the water resource demands and effluent disposal operations required by the MRTC facility. As presently described in the Draft EIS, the shallow aquifer has insufficient water to supply the project, so deep wells into the Koolau-Dike Aquifer will be required. Futhermore, the environmental impacts of the project are dependent upon the successful operation of a Marine Aquaculture Reclamation System Habitat (MARSH) for water quality control, yet no quantitative documentation is provided as to the effectiveness of this system.

While the use of freshwater marsh "systems" for biological control of waste waters is fairly well-known and documented, relatively little or no information is currently available on the effectiveness of similar systems for the treatment of saltwater aquaculture effluent. Without sufficient quantitative analysis, the quality of water (in terms of sediments and nutrients from aquaculture effluent) to be discharged into Kaneohe Bay can not be adequately assessed nor can its impact to the water quality in the nearshore areas be predicted. A smaller-scale experimental study is needed to confirm the feasibility of the weir-marsh-nutrient removal system being proposed prior to initiating a full-scale development of the MRTC facility.

Seawater System Intake

The Draft EIS describes two possible sources of seawater for the facility: 1) saltwater wells near the coastline, or 2) offshore in Kaneohe Bay. The offshore intake is apparently the preferred alternative, and two techniques are proposed for tapping this resource: 1) an "open water intake located in 17 feet of water on the ocean side of Hakipuu Sandbar", where water would be filtered through a commercially available filter system; or 2) to bury a seawater intake gallery in offshore sand formations (i.e., the sandbar) that would then serve as a natural filter. A more detailed discussion is needed on the whole intake design and operations including the design of the sand/gravel filter (I-7). For example, will different successive layers of sizes of gravel be used? Will a filter cloth be used? If so, where will it be placed?

The impacts of dredging, implacement, and backfill of materials associated with the pipeline construction are virtually non-existant in the Draft EIS. The magnitude of the area/volume to be dredged is not inconsequential; it is 1,500 feet long, with a proposed intake gallery of 85 x 50 x 4 feet. No information is provided as to the characteristics of the benthic environment and the potential impacts to the bay and coastal wetlands created by the dredging operations. Furthermore, if the sandbar is used as a filter, it is likely that the characteristics of the bar will be significantly altered. The grains will tend to become sucked together into a far more cohesive and stable configuration. There is no indication in the Draft EIS if this modification to the Hakipuu Sandbar has been considered in light of its affects on the Kualoa Beach coastal system. The document also states that "while the volume and depth of Hakipuu Sandbar changes in multi-year cycles, the actual position of the sandbar has been stable" (I-6). However, hydraulic studies currently underway are looking into how to stabilize the beaches at Kualoa. If action is taken to stabilize the Kualoa beaches in the future, this may cause the erosion of the Hakipuu Sandbar; so it may not be stable. The Final EIS should address this potential issue in terms of the proposed project.

Kaneohe Bay

The document states that "current drift is primarily responsible for the sand deposits that have formed Hakipuu Sandbar from Kualoa Point beach sand" (II-9). However, waves, as well as current drift, are important for the deposition of sand.

Appendix G

The document estimates that 720,000 gallons/day of fresh water will be required for the MRTC facility, and that it is very likely the Koolau-Dike Aquifer will be tapped to supply the water. If this water is of potable quality, it seems incongruous given the shortage of potable water supplies, that this source will be tapped for aquaculture. Particularly since aquaculture does not necessarily need such high quality water. The commitment of such a large quantity of freshwater and the likelihood of tapping into the Koolau-Dike Aquifer should be discussed as a significant environmental impact in the main section of the document and a full discussion of the ramifications of its use should be provided. The Final EIS should include a discussion of the cumulative impacts associated with the use of this freshwater resource as it applies to meeting future water needs in this area. Recycling the outflow for irrigation is mentioned, but there is no substantive discussion of its feasibility or even if it is being seriously considered.

Thank you for the opportunity to review the Draft EIS. We hope that our comments will be helpful in the preparation of the final document.

Sincerely,

Jacquelin N. Miller

Jacquelin Miller
Associate Environmental Coordinator

cc: DLNR, Div. of Water & Land Dev.
Oceanit Lab ✓
Roger Fujioka
Richard Brock
Peter Flachbert
Leonard Freed
Franciscus Gerritsen
Hans-Jurgen Krock
Edwin Murabayashi
Elizabeth Gordon

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P O BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Ms. Jacquelin Miller
Associate Environmental Coordinator
Environmental Center
A Unit Water Resources Research Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Ms. Miller:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of April 12, 1993 regarding the subject project. We offer the following responses, in respective order, to your comments:

General Comments

According to initial study conducted for the Draft EIS, it was determined that the shallow groundwater aquifer is not adequate to support the fresh water needs of the facility without adverse impact to the surrounding community. For this reason, we have concluded that if fresh water is available, it must be extracted from the Koolau-dike aquifer. To determine extraction feasibility, we propose an exploratory well study to be performed by a professional hydrologist. Other alternatives, including the possibility of re-use of freshwater for agricultural purposes will also be considered.

We concur that the Managed Aquaculture Reclamation System Habitat (MARSH) has not been tested as a mariculture effluent management tool. The system is unique and experimental. However, a body of information exists that quantifies uptake of nutrient laden seawater by marine plants. The system is for settling of particulates, isolation of nonindigenous species, nutrient stripping, and polishing of effluent waters prior to discharge into Kaneohe Bay or reuse of waters within the facility's water distribution system. The system allows for conserving water resources and preventing violation of State water quality standards. As such, we will define, at a later stage of project development, operational protocol for monitoring and managing water quality standards at MRTC. However, the degree of efficiency cannot be tested until the MARSH is operational. We suggest that a research component be established through the University of Hawaii to study the efficiency of the MARSH system.

Seawater System Intake

Your questions regarding the offshore intake design and operation including the design of the sand/gravel filter have been noted. As stated in Appendix F in the Final EIS, an intake buried in Hakipu'u Sandbar is similar in concept to a water well. Water ispumped through the sand, then a gravel bed, and through a well screen surrounding each intake pipe. The intake is installed as a horizontal gallery in the sandbar. Commercially available well screens made of high density polyethylene (HDPE) can be used to construct the gallery. Identification of the construction details including gravel size sorting specifications, well screen type and gallery pipe spacing would be premature at this conceptual stage of planning.

Please see Appendix F (Conceptual Water Supply System and Marine Environmental Assessment) for a description of the potential impacts of dredging, emplacement, and backfill of materials associated with the pipeline construction. In general, the benthic substrate is typical of the wide Kaneohe Bay back reef flat areas with a heavy impact from terreginous silt and mud. This area receives additional inputs of sediments, fresh water, and nutrients from Hakipu'u Stream, particularly during seasonally rainy weather. There is a strong macro-algae component fronting the stream attached to coral reef rubble on the bottom, but the substrate is primarily unconsolidated silty sand. Impacts of dredging on these soft sediments is anticipated to be temporary as colonies will reestablish themselves on the new sand and debris covering the pipe.

Kaneohe Bay

It is true that hydraulic studies are being conducted at Kualoa to assess beach stability. Until results are quantified, determination of erosion of adjacent shorelines, including Hakipu'u is premature. As of this writing, Oceanit Laboratories, Inc. is performing hydraulic model testing and data collection of Kualoa Regional Beach Park.

Appendix G

Before the project can proceed, we propose to have Hakipu'u Valley's water resources studied by professional hydrologists. An exploratory well study and all available alternatives, including recycling of irrigation outflow, will be investigated. An exploratory well should reveal the extent to which any fresh water may be extracted at all, on or off the project site. The subject of groundwater is discussed further in the body of the Final EIS. However, because the Final EIS will be submitted prior to conduction of a proposed hydrogeological study, those results will not be included in the Final EIS.

We hope we have responded satisfactorily to your comments. If you have any questions, please call Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu HI 96840-0001

William A. Bonnet
Manager
Environmental Department

March 2, 1993

RECEIVED
MAR 25 1993
OCEANIT LABORATORIES, INC.

The Honorable John Waihee
c/o Office of Environmental
Quality Control
220 South King Street, 4th Floor
Honolulu, HI 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement (DEIS) for the Mariculture Research and Training Center Koolaupoko, Oahu, Hawaii

We have reviewed the subject DEIS, and have no comments on the proposed project. HECO shall reserve comment pertaining to the protection of existing powerlines bordering the development area until construction plans are finalized.

Sincerely,

William A. Bonnet

cc: Edward Lau, DLNR
Robin Anawalt, Oceanit Laboratories, Inc.

26

An HEI Company

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P O BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Mr. William Bonnet
Manager
Environmental Department
Hawaiian Electric Company, Inc.
P.O. Box 2750
Honolulu, Hawaii 96840-0001

Dear Mr. Bonnet:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of March 2, 1993 regarding the subject project. Your letter will be included in the Final EIS.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

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."

April 8, 1993

RECEIVED
APR 12 1993
OCEANIT LABORATORIES, INC.

Oceanit Laboratories, Inc.
1188 Bishop St. Suite 2512
Honolulu, HI. 96813
Attn: Robert Bourke

Dear Mr. Bourke:

Thank you for coming to the Kahalu'u Neighborhood Board meeting on March 10, 1992 and for organizing the meeting with the Hakipu'u community on April 7, 1993. Unfortunately, many of the residents did not have copies of the DEIS prior to that meeting. At the meeting there was a commitment by Oceanit Laboratories to provide the residents with copies of the DEIS so we are requesting that the **comment period for the DEIS be extended until 30 days after the documents are received by the community.**

As the Board stated at the March meeting, we are in general support of this project but we wished to hear from the Hakipu'u community since they are the most directly affected by the project.

The Kahalu'u Neighborhood Board feels that a number of the issues raised at the Hakipu'u meeting last night are serious and warrant full investigation and disclosure. Specifically, this includes the property boundaries and ownership of the property, the fresh water well and its potential impact on water resources throughout the Windward side, traffic and the proposed sewer system. While traffic is discussed, the resolution of the property boundaries issue may directly affect the traffic analysis as presented in this DEIS. The property boundaries and the sewage treatment plant are listed as Unresolved Issues in this DEIS. These are major issues that the community must have the opportunity to address. Also, the potential well is not discussed in the DEIS except in an Appendix. Water, both surface water and ground water, is a major issue on the Windward side and a discussion of this must be included in the impact section of the DEIS. How community use of the ponds and tanks for aquaculture could be achieved should also be discussed.

We are recommending that the Final EIS not be published until these issues have been fully addressed. This may mean reissuing the Draft EIS or issuing a Supplemental DEIS. In any case, there must be clear opportunity for the community to comment on the results of further investigation prior to a Final EIS.

In addition, we strongly recommend that a Community Advisory Committee be established. Composition of this committee should include representatives of the Hakipu'u community, the Kahalu'u Neighborhood Board, the Waiahole-Waikane Community Association, and the Moli'i Fishpond. Establishing such a committee would help resolve some of the issues surrounding this project and result in a project more acceptable to the community.

We look forward to working with you, MRTC, and the area residents to develop an acceptable project for this site.

Sincerely,

Amy Luersen, Chair
Kahalu'u Neighborhood Board #29

cc: Herbert Hoe, Hakipu'u Community
Charlene Hoe, Hakipu'u Community
John Morris, Hakipu'u Community
Office of Environmental Quality Control
Dr. Phil Helfrich, HIMB
John Corbin, Aquaculture Development Program
Senator Mike McCartney
Representative Ululani Bierne
Councilmember Steve Holmes

27

JOHN WAIHEE
GOVERNOR OF HAWAII

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

KEITH W. AHUE, Chairperson
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

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

REF:WL-LC

OCT 27 1993

Ms. Amy Luersen, Chair
Kahalu'u Neighborhood Board #29
c/o Key Project
47-200 Waihe'e Road
Kaneohe, Hawaii 96744

Dear Ms. Luersen:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of April 8, 1993 on the subject project. We appreciate your interest and facilitation of community involvement.

Per your request, we distributed 12 copies of the Draft EIS on April 22, 1993 to the surrounding neighborhood and extended the comment period until May 21, 1993.

We are working with the neighborhood residents to form a Hakipu'u Community Advisory Committee. The objective of the committee is to serve as an arena for discussion of the concerns and issues that have surfaced from the initiation of the proposed renovation of the MRTC. The Kahalu'u Neighborhood Board will be kept apprised of all meetings and will include per your request, several representatives from the Hakipu'u community, one from the neighborhood board, one from the University, and one from Kualoa Ranch.

As you have pointed out, several issues were raised as a result of the April 7, 1993 community meeting:

1. Fresh water: In the Final EIS, the proposed demand for fresh water for aquaculture use will be discussed under Unresolved Issues. We do not expect to have all options fully investigated in time for publication of the Final EIS. Most likely, an exploratory well study will be conducted and all available alternatives carefully investigated. All of this will take some time, but please be assured that when investigations are completed results will be disclosed to the community via the Hakipu'u Community Advisory Committee. Also be assured that the project developers have no intention of limiting or impacting the current level of water supplies to any surrounding users. A well study should reveal the extent to which any fresh water may be extracted at all, on or off the project site.

2. Property lines of the project site are a legal matter including the lease agreement that go beyond the bounds of this particular project. Although several aspects of the project may not proceed until delineation of the property boundaries, this issue will be discussed under Unresolved Issues (Chapter VII).

3. We concur that the resolution of property boundaries may directly affect the traffic analysis as presented in the Draft EIS. We are working with adjacent neighbors to negotiate a compromise for placement of the proposed driveway. In addition, project planners are working with the Hakipu'u Community and the State Department of Transportation to maximize the safety of entering and exiting Kamehameha Highway. We feel the community is best equipped to make constructive suggestions for minimizing traffic impacts from ingress and egress. Results are in the Final EIS under long-term traffic impacts (Chapter V).

4. The wastewater treatment system for sewage disposal is discussed in the Final EIS in Chapter I.

5. Community use of the ponds and tanks for aquaculture will be explored as the renovation process progresses and will be a point of discussion for the Hakipu'u Community Advisory Committee.

We feel that the community will have ample opportunity to comment on the above mentioned issues and any others that arise in the renovation process. We feel therefore, that either reissuing the Draft EIS or providing a supplemental EIS is not necessary. The Hakipu'u Community Advisory Committee should provide clear opportunity for communication long after the Final EIS has been submitted.

We hope we have responded satisfactorily to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Very truly yours,

Keith W. Ahue
KEITH W. AHUE

c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

The KAAWA OHANA
49-129 Kamehameha Highway
Kaneohe, Hawaii 96744

April 9, 1993

To Whom This May Concern,

SUBJECT: Our objections to the following:
1. Dredging/digging of natural spring(well)
2. Relocation of driveway onto Kam Highway
3. Dormitory
4. Raising of ornamental fishes

We would like to address the issues above in the order that they are listed. First on the list is the natural spring(well). It is our understanding and as history has passed onto us that a fresh water spring exists at the base of our property. Our Ohana presently have taro patches on the Mauka side of Kam Highway which depends on the water which is extracted from a fresh water sping for its mere existence. Your having or wanting to dredge/dig the fresh water spring on the makai side of Kam Highway or the base of our property may indeed have an affect of the natural spring that our family is presently dependent on for the continued growth of TARO!

The second issue is the relocation of your road. Well, I have news for you! We have a difficult time pulling out of our present driveway, especially in the mornings and evenings (before & after working hours). We believe that a reduction of the speed limit as well as a blinking caution light would be a possible solution as cars during those hours are going between 55 to 60 miles per hour.......may be even more. It has been our experience over the years that cas tail end us, even to the point of passing us by the time we hit the property of the Judd's place or an eight of a mile from where we live. So, your moving or relocating your driveway to solve your problem as far as entering onto Kam Highway is not it, for our's is where it is, and we have a problem of speeding cars. Definitely, if there was a reduction of the speed limit and a caution blinking light, our neighborhood would be a SAFER PLACE FOR OUR YOUNG CHILDREN!

Thid, a dormitory. Dormitory if constructed to conform to our community may not be an issue, but if it looks like anything that is two, three, four, and five level high..........then, that presents a problem. The problem being not conforming to the rural way of life.

last of all the raising or ornamental fishes. You are planning to dig up the fresh water spring/well to help offset the water supply you would normally have gotten from the Board of Water Supply to raise ornamental fishes. I question the priority as to the value of water and to whom/what/where it should be, but in our opinion, water that is natural or provided by GOD SHOULD be to feed/nuture/nourish animals or vegetation that is our Aina(land). What better use than that of our TARO. With polution being such a problem, we

were hopeful that your role here in our neighborhood would be to increase the knowledge of fish raising that would benefit mankind especially here in the islands. Fish was and still is a food necessity of our island people, regardless of how expensive it may be, the people here will go to all means to purchase the fish and provide their families with it. With this in mind, this is how we thought your intentions would be towards and not towards fishes that would be raised for showing only.

In our final closing, we anticipate that much consideration will be done on your part in why we object to the improvements or changes that you had in the making.

May we be able to work in a partnership that would best benefit this unique neighborhood.

Sincerely yours,

CALVIN K Kaawa

Henry M. & Harriet H. Kaawa
Herbert F. & Maria K. McBee
Edwin & Harriet K. Kaawa
Freida L. Kaawa
Eric Kealii Pascal
[redacted]
Glenn & Joan Tisalona

Edmund & Grace Tisalona

IN GOD WE TRUST !

28

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

The Kaawa Ohana
49-129 Kamehameha Highway
Kaneohe, Hawaii 96744

Dear Kaawa Ohana:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of April 9, 1993 regarding the subject project. We offer the following responses, in respective order, to your comments.

Fresh Water Well

We are aware that any extraction of fresh water for the MRTC fresh water ponds may affect the supply of surrounding users. All available alternatives for fresh water demand are being carefully investigated and an exploratory well study is being considered. The purpose of the study is to determine if water is available underground and to assess whether tapping this source will impact the shallow aquifer. Please be assured that when investigations are completed, results will be disclosed to the community. As you are aware we are discussing this, and other, issues with representatives from your community involved in the MRTC Hakipu'u Advisory Committee. A well study should reveal the extent to which any fresh water may be extracted at all, on or off the project site.

MRTC Driveway Relocation

We concur that the bend along Kamehameha Highway diminishes the safety of entering and exiting the Highway. Your suggestions are being given consideration regarding lowering the speed limit and installation of a blinking caution light. Project planners will continue to work with the community to gain input and minimize adverse impacts of moving the driveway. Our primary concern with relocating the driveway is to increase the sight distance and improve the safety of entering and exiting the highway. The proposed location of the access would offer the maximum sight distance. You will be notified at a later date regarding the next meeting on this subject.

Student Housing

The proposed two story student housing building will be constructed on two levels on the MRTC side and one level on your side of the property due to the slope of the land. Only the top story will be visible from the road with the lower story built into the hill and facing towards the ponds. At a recent meeting on-site with the Kaawa Ohana, the placement and dimensions of the proposed building were shown in relation to your property. The building is intended to house no more than 4 full-time graduate students and a maximum of 12 students periodically for up to two weeks. The housing is cost effective for students who assist in day to day facility operations and others whose research predicates full-time residency in close proximity to their experiments.

Ornamental Fish Raising

Your concern that raising fish for the ornamental industry will not conform with the concept that fish should be raised for consumption only has been noted. As a research facility, the MRTC will not be restricted to growing certain types of fish. The mission of the MRTC is to serve aquacultural research and technology transfer needs to more effectively address state, national and regional demands in aquaculture. Ornamental fish production may constitute a portion of the entire program at MRTC. Since 1985, research efforts have focused on marine shrimp, hybrid tilapia, freshwater prawn production, and engineering applications to increase aquaculture yields. As part of the renovation process and as research programs are developed, you will be updated on the progress.

We hope we have satisfactorily responded to your comments. If you have any further questions, please contact Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

To M.R.T.C

I want to say I object to the digging of a well in Wak-piu because we raise Taro and any water loss would hurt us. I also think instead of moving the road the speed limit on the Highway should be lowered because if the road is moved it would be dangerous for my grandchildren. I also object to the building of a dormintory because it doesn't fit in with the area this is an agricultural area and I think that ornamental fish shouldn't be raised but fish for eating should be.

Henry K. Kaawa Eric K Pascal
Harriet Kaawa

29

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Mr. & Mrs. Henry Kaawa
Mr. Eric K. Pascal
49-129 Kamehameha Highway
Kaneohe, HI 96744

Dear Mr. & Mrs. Kaawa and Mr. Pascal:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. Although we have responded to an earlier letter to the above address that discusses the issues raised in this letter, we will provide an additional response here to your comments:

All available alternatives for fresh water demand are being carefully investigated and an exploratory well study is being considered. Please be assured that when investigations are completed, results will be disclosed to the community for discussion.

Your suggestions are being given consideration regarding lowering the speed limit and installation of a blinking caution light. Again, these will be topics of discussion with the community.

The mission of the MRTC is to serve aquacultural research and technology transfer needs to more effectively address state, national and regional demands in aquaculture. Ornamental fish production may constitute only a portion of the entire program at MRTC. Since 1985, research efforts have focused on marine shrimp, hybrid tilapia, freshwater prawn production, and engineering applications to increase aquaculture yields. As part of the renovation and as research programs are developed, you will be kept informed on progress.

We hope we have satisfactorily responded to your comments. If you have any questions, please contact Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

RECEIVED
JUN 2 1993
OCEANIT LABORATORIES, INC.

Oceanic Institute
CENTER FOR APPLIED AQUACULTURE

May 13, 1993

Mr. Keith W. Ahue
Chairperson
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

93-440

Dear Mr. Ahue:

Recently we reviewed the draft Environmental Impact Statement (EIS) for the Mariculture Research and Training Center (MRTC) dated December 1992. After reading the document we feel compelled to point out some facts concerning the draft EIS and the proposed project.

Much of that described as an impact of the proposed project seems to duplicate our existing project. The impact described is the same as that of the already-funded Center for Applied Aquaculture (CAA) currently under construction at The Oceanic Institute (OI). If the proposed MRTC project was initiated, it would be, to a large extent, a duplication of the CAA and therefore a poor use of tax money. Further, there is no mention of an identified source of operating funds should the proposed project be constructed.

The no-action alternative mentioned on page iv is moot since the CAA is already a designated center. The use of the proposed ponds is not clearly described or justified. A reconfiguration of the existing ponds into numerous smaller ponds defeats the goal of creating a large pond demonstration site which was the original intent.

The proposed settling ponds and designed wetland as an effluent disposal system has two apparent weaknesses. The first is that there is the possibility of recycling the effluent flow back into the seawater supply with the proposed seawater system. The second is the inability of such a system to address the restrictions placed on effluent disposal from nonindigenous species. The proposed system is essentially an oxidation pond with no means of mitigating accidental release of nonindigenous or diseased animals, or hazardous substances.

30

• THE OCEANIC INSTITUTE MAKAPUU POINT/PO BOX 25280/HONOLULU, HI 96825/PHONE:(808)259-7951 FAX:(808)259-5971

Mr. Keith W. Ahue
May 13, 1993
Page 2

The cost for the proposed renovations would be very high given the scope of work and size of facilities described. The state of Hawaii is experiencing serious budget constraints that must be considered. The CAA can fulfill most of the needs described in the EIS. We anticipate working closely with the state on meeting their objectives and needs within the field of aquaculture research and training through the CAA.

We appreciate this opportunity to comment on the MRTC EIS and proposed renovations. Please contact Dr. Paul K. Bienfang if you have any questions.

Sincerely,

W C Rowland

W. C. Rowland
President

WCR/gek

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Mr. W.C. Rowland
President
The Oceanic Institute
P.O. Box 25280
Honolulu, HI 96825

Dear Mr. Rowland:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of May 13, 1993 regarding the subject project. We sincerely appreciate the time taken by your staff to review our document. We offer the following in response to your comments:

1. The rationale and support for proceeding with the renovation of MRTC can be found in the study entitled "Conceptual Planning and Alternative Site Evaluation for A Pond Research and Training Facility" by Brewer/Brandman (August, 1989). The study describes the siting of a large-scale pond complex hub and satellite system of state-wide facilities.

2. The renovation of MRTC would allow for freshwater, brackish water and seawater ponds to be available at one research facility. MRTC as a research facility would be unique for its ability to replicate pond conditions in balanced experimental studies. However, we recognize that Oceanic Institute contributes much to the field of applied aquaculture in addition to what MRTC provides.

3. The proposed MARSH system is both unique and experimental. Design and engineering safeguards were elaborated and considered for the recycling of water from the MARSH to the facility, polishing of water prior to discharge, and control of nonindigenous species. Operationally, these aspects of managing the facility are very important. We intend to define the necessary protocol at a later stage of project development for preventing violation of State water quality standards.

4. The EIS is a public disclosure document that reveals probable environmental and social impacts of the proposed project. Sources of funding are not part of the scope of an EIS. Operating management and funding is revealed under separate cover entitled "Project Development Report Mariculture Research and Training Center Renovation" by Oceanit Laboratories, Inc..

public project.

We will consider your comments and suggestions further in preparation of the Final EIS. We hope we have responded satisfactorily to your comments. If you have any questions, please call Mr. Robert Bourke of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

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HAR 200-17
economic.

RECEIVED
MAY 27 1993
OCEANIT LABORATORIES, INC.

DATE: MAY 19, 1993

TO: OCEANIT LABORATORIES, INC./ MS. ROBIN ANAHALT

FROM: COL. & MRS. KURT E. JOHNSON
49-051 JOHNSON ROAD, P.O.BOX 381, KANEOHE, HI.96744
PH-808/2378448 FAX 808/2378663

RE: RESPONSE TO APPENDIX G, MRTC GROUNDWATER STUDY

MS. ANAHALT:

1. AFTER HAVING READ THROUGH THE MRTC GROUNDWATER STUDY, WE HAVE SOME OBSERVATIONS AND CONCERNS. WE WISH TO CONVEY THESE THOUGHTS TO YOU, AND EXPECT A WRITTEN RESPONSE AND ANOTHER MEETING WITH REPRESENTATIVES OF YOUR GROUP.

2. AS YOUR E.I.S. ELABORATED, HAKIPUU WAS A VERY IMPORTANT VALLEY TO THE ANCIENT HAWAIIAN SETTLERS. IT HAD, AND STILL HAS, HISTORIC AND RELIGIOUS SIGNIFICANCE. THE VALLEY PROVIDED FERTILE LANDS FOR FARMING, ABUNDANT WATER FOR IRRIGATION AND HUMAN USE. ALONG WITH WAIAHOLE, WAIKANE, AND KUALOA, HAKIPUU SHARED IN THE MAJESTY OF BEING ONE OF THE FOUR MOST SACRED AREAS OF OAHU. THOSE OF US WHO LIVE HERE ALL FEEL ITS BLESSED EFFECT ON US. I WOULD HOPE THAT THE PERSONNEL OF MRTC WOULD ALSO APPRECIATE ITS MAJESTY. CLAIRE AND I FEEL THAT WE ARE THE CARETAKERS OF OUR LAND MORE THAN WE FEEL THE SENSE OF OWNERSHIP.

3. OBSERVATIONS:
A. IN FIGURE 2 OF APPENDIX G, MRTC GROUND WATER STUDY, IT IS APPARENT THAT A 200' WELL AT YOUR FACILITY WOULD TAP THE KOOLAU-DIKE AQUIFER. YOUR ESTIMATED DAILY USE WOULD MAKE MRTC THE GREATEST SINGLE USER OF WATER IN THE KANEOHE AREA. THIS USE RATE COULD, IN TIME, LOWER THE AQUIFER TO THE POINT THAT THE ZONES OF DISCHARGE (SPRINGS) MAUKA OF MRTC WOULD CEASE FLOWING.
B. THESE UPPER ZONES OF DISCHARGE PROVIDE WATER FOR IRRIGATION AND AQUACULTURE BY SOME RESIDENTS OF THE VALLEY.
C. ALL RESIDENTS ALONG STREAMS IN HAKIPUU KNOW THAT SEASONAL DROUGHTS REDUCE THE FLOW IN THE STREAMS SIGNIFICANTLY. MRTC DAILY WATER USE WOULD ADD TO THAT DROUGHT EFFECT.
D. A STATE MARINE FISHERY ON SAND ISLAND USES UP TO 2 MILLION GALS/DAY OF COMMERCIAL CITY WATER. THEIR USE RATE FLUCTUATES WITH THE NEEDS OF ON GOING PROJECTS IN THEIR FACILITY. WE'RE SURE THAT YOU WOULD HAVE PEAK USE PERIODS AT MRTC.
E. YOUR APPENDIX G ADMITS TO AN UNPREDICTABLE STRUCTURE OF THE KOOLAU-DIKE AQUIFER, WHICH CALLS FOR A HYDROGEOLOGICAL INVESTIGATION. OTHER STATEMENTS IN YOUR STUDY USE WORDS THAT TO US SOUND UNCERTAIN.

4. CONCERNS:
A. WE OWN A 4 PLUS ACRE PROPERTY MAUKA OF THE MRTC LOCATION. WE GROW FLOWERS AND FOLIAGE ON THIS PROPERTY FOR CLAIRE'S FLORAL DESIGNING BUSINESS, FLOWER FARM, INC. THIS PROPERTY

3

HAS THREE (3) SPRING OUTLETS THAT SERVE AS FLORACULTURE IRRIGATION AND AN AQUACULTURE POND. WE DO NOT WANT THE OUTPUT OF THESE SPRINGS TO BE ADVERSELY EFFECTED BY THE DRAIN ON THE SYSTEM OF MRTC WATER USAGE. THE SPRINGS ARE REGISTERED WITH THE STATE.
B. WE FEEL THAT SINCE MRTC ULTIMATELY COMES UNDER STATE CONTROL (FUNDING THROUGH THE DEPARTMENT OF LAND AND NATURAL RESOURCES) THAT HAKIPUU'S PRISTINE AMBIANCE COULD SUFFER FROM A CONSTANT GROWTH BY MRTC INTO THE DISTANT FUTURE. PLEASE DON'T LET THAT HAPPEN; HELP TO PRESERVE WHAT IS ALREADY HERE.

5. CLAIRE AND I THANK YOU FOR PROVIDING US WITH A COPY OF THE DRAFT OF THE ENVIRONMENTAL IMPACT STATEMENT, AND THE ACCESS INTO COMMUNICATIONS SYSTEM OF STATE VS RESIDENTS. WE RESPECTFULLY SUBMIT THIS LETTER OF OUR CONCERNS AND HOPE IT IS ACCEPTED IN THE SAME LIGHT IN WHICH IT WAS WRITTEN.

6. IN CLOSING, WE HOPE TO BE INVITED TO FUTURE NEIGHBORHOOD MEETINGS AS MRTC MOVES ON. WE ALSO HOPE THAT THE VARIOUS AREAS OF THE STUDY THAT ARE INDEFINITE COULD BE AIRED AND MADE CERTAIN IN THE FUTURE.

MOST SINCERELY,
Kurt & Claire Johnson
KURT & CLAIRE JOHNSON

cc: Dr. Phillip Helfrich

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Colonel and Mrs. Kurt E. Johnson
P.O. Box 381
Kaneohe, HI 96744

Dear Colonel and Mrs. Johnson:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
<u>Large Scale Pond Research, Training and Demonstration Facility</u>

Thank you for your letter of May 19, 1993 regarding the subject project. We offer the following in response to your comments:

1. You will be contacted regarding an upcoming meeting with the Hakipu'u Community Advisory Committee. The issues raised in your comments will be discussed in this committee and hopefully resolutions your concerns will follow.

2. We appreciate your thoughts regarding the historical significance of Hakipu'u Valley. We assure you that we will keep you informed of each step of the renovation process.

3. MRTC Ground Water Study

   a. Tapping the deep aquifer for MRTC usage is, at this time, viewed as an alternative. If, after the results of a well study reveal, that the stated rate would lower the springs significantly, then other alternatives, including no action, will be considered.

   b. Your observation regarding upper springs has been noted.

   c. We concur that droughts reduce the flow of Hakipu'u Stream. Depending upon the source of water tapped, MRTC water usage could add to that reduction.

   d. There is no intent to use commercial city water for MRTC aquaculture purposes. Peak uses have yet to be determined. Initial estimates of fresh water requirements were for "optimal" conditions and have been reduced according to the latest estimates.

   e. An exploratory well study is presently being considered. We realize that the unpredictable structure of the Koolau-dike aquifer requires further investigation and a hydrogeological study should provide more pertinent information.

4. Fresh Water Usage

   a. Your concern regarding your three registered springs has been noted. We assure you that we have no intention of depleting any of the water resources used by the neighbors in Hakipu'u Valley.

   b. We are aware that the community desires to maintain the rural nature of the area. The MRTC has been designed with this concept in mind. Because aquaculture practices are predominately agricultural, the facility, though upgraded, will retain its present ambiance as it fits with the community.

5. You will be provided with a copy of the Final EIS and results of the proposed hydrogeological study. You will also be informed of meetings with the Hakipu'u Community Advisory Committee.

6. Because the concerns raised by the community will take some time to resolve, it was felt that the formation of the Hakipu'u Community Advisory Committee will provide a forum to eventually resolve these concerns, even after submittal of the Final EIS. We look forward to receiving your input as part of this process.

We hope we have responded satisfactorily to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

My husband and his family are native Hakipuuians. His makua built the fish pond, were the Kahuna's for the Heiau, worked the very lois that M.R.T.C uses.
To this very day we still grow taro, work and love this aina.
Any water loss even a minute amount would cause our springs to dry. Dry springs mean dry taro lois which mean death cultural and spiritual to us.
Dig this well and the State and M.R.T.C. in actuality would be committing the horrible act of genocide. Killing of a people and culture. Therefore I'm against any well digging.

Joyce A Uyemura
49-076 Johnson Rd
Hakipuu Oahu.

RECEIVED
1993

32

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

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WATER AND LAND DEVELOPMENT

OCT 27 1993

Ms. Joyce A. Uyemura
49-076 Johnson Road
Kaneohe, HI 96744

Dear Ms. Uyemura:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. We appreciate your concern regarding the proposed fresh water well. We wish to convey our concern for the Hakipu'u Valley fresh water resources. The scarce supply of fresh water can cause hardship for many users in the Valley and we do not intend to aggravate the situation.

Before the project can proceed, an exploratory well study is proposed and all available alternatives will be carefully investigated. All of this will take some time, but please be assured that when investigations are completed, results will be disclosed for your input. An exploratory well study should reveal the extent to which any fresh water may be extracted, on or off the project site. As you are aware, we are discussing this, and other issues, with members of your community involved in the MRTC Hakipu'u Advisory Committee

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

RECEIVED
APR 9 1993

I dont want the digging of a well in Hakipuu, because in doing so it will dry the springs in Hakipuu Waikane, Ka'aawa and Kahana.

It's a fact and not an asumption Kahaluu is a perfect example thats exactly what happend there

I'm sure that the State doesn't want to be sued again.

My family and I raise taro. The digging of this well will greatly effect our taro patches up mauka and the only existing working Hawaiian fish pond in Hawaii.

I dont think its right for you folks to do this to only benifit M.R.T.C. and hurt the natives of Hakipuu rights of water and culture and way of life because you're only leasing, which means that you're only here temporary and the damage that the well will do is for life, mine and my future generation.

I ask M.R.T.C. to please not to dig this well. If you do you'll be breaking our native water rights.

You folks are not showing respect for the natives of Hakipuu Waikane, Ka'aawa and Kahana in fact it could be considired genocide Killing US!!

I told you folks once and I'll tell you again that this place is not sufficient for this type of Program that M.R.T.C. is doing.

I will do everything in my power to stop this well.

Chester S. Uyemura
49-076 Johnson Rd
Hakipuu, Oahu 96744

33

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
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JOHN P. KEPPELER, II
DONA L. HANAIKE

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WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Chester S. Uyemura
49-076 Johnson Road
Kaneohe, HI 96744

Dear Mr. Uyemura:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. We appreciate your concern regarding the proposed fresh water well. We wish to convey our concern for the Hakipu'u Valley fresh water resources. Water rights have been an issue in Hakipu'u Valley and have been the source of more than a few discussion among neighbors. The scarce supply of fresh water can cause hardship for many users in the Valley and we do not intend to aggravate the situation.

Be assured that the project developers have no intention of limiting or impacting the current level of water supplies to any of the surrounding users. Before the subject project can proceed, we propose to have the Valley's water resources studied by a professional hydrologist. An exploratory well study and all available alternatives for extraction of fresh water will be considered. All of this will take some time, but please be assured that when the hydrogeological investigations are completed, results will be disclosed for your input. The exploratory well study should reveal the extent to which any fresh water may be extracted, on or off the project site. As you are aware, we are discussing this, and other issues, with members of your community involved in the MRTC Hakipu'u Advisory Committee.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

JUN 03 '93 09:35AM STATE/DLNR/DOWALD (808)587-0283 P.2

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JUN 2 1993
OCEANIT LABORATORIES, INC.

RECEIVED
93 MAY 17 AM 10:55

Keith W. Ahue, Chairperson
State of Hawaii
Department of Land and Natural Resources
Division of Water and Land Development
P.O. Box 373
Honolulu, Hawaii 96809

Mr. Patrick White
49-129 Kamehameha Highway
Kaneohe, Hawaii 96744

Dear Mr. Ahue:

This letter is regarding the MRTC renovation project and the concerns of the Kaawa family. Mr. Henry Kaawa has requested that I represent the Kaawa's in relaying the concerns regarding MRTC project.

First let me state that Mr. Henry Kaawa is not in opposition to the MRTC project and feels that any issues regarding the MRTC project can be worked out satisfacturly between the concerned parties.

Mr. Kaawa's primary concern pertains to the land he has used for the past 25 to 30 years that he now considers to be his property. After my conversations with Robert Bouke and Robin Anawalt, I feel this problem can be resolved simply by agreeing upon the boundaries and this agreement being acknowledged and respected by both Kaawa's and the State of Hawaii.

Mr. Kaawa's secondary concerns pertains to jobs at the MRTC project becoming available to the local residents of Hakipu'u. Also that the waste water treatment plant and the proposed water well, have no adverse impact on the surrounding environment.

Let me reconferm at this time, that Mr. Kaawa understands the merits the MRTC project will have for all the people of Hawaii and fully supports this project.

Patrick E. White
Patrick White
spokesperson

34

JUN- 3-93 THU 9:24 808 587 0283 P.02

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

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LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Mr. Patrick E. White
49-129 Kamehameha Highway
Kaneohe, HI 96744

Dear Mr. White:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. We appreciate your interest and representation on behalf of the Kaawa Ohana. We also appreciate your support of the project and will continue to meet with the Kaawa's to address their concerns.

On June 11, 1993 Oceanit Laboratories staff met with you, Mr. Kaawa and members of his family and walked the boundaries of the Kaawa and MRTC property. The location of the proposed driveway and the student house were located and discussed. We acknowledge and respect your concerns as the Kaawa parcel abuts the MRTC property. All parties involved in this meeting appeared satisfied with the positioning and location of the driveway and student house as proposed in the Final EIS (see Ultimate Site Plan).

Mr. Kaawa's concerns regarding employment at MRTC, the wastewater treatment plant, and the fresh water well have been noted. These concerns are presented in detail in the Final EIS. While project planners will do everything possible to minimize adverse environmental impacts, please be assured that these topics will also be discussed and your input solicited in future meetings with the Hakipu'u community.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

To M.R.T.C

I don't want a well dug. Any water loss would hurt my families taro patches. Also by moving the road it would endanger my children.

Joan K. Tisalona

35

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

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DONA L. HANAIKE

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STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Ms. Joan K. Tisalona
P.O. Box 381
Kaneohe, Hawaii 96744

Dear Ms. Tisalona:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. Your concerns regarding the proposed fresh water well and driveway relocation have been noted.

Be assured that the project developers have no intention of limiting or impacting the current level of water supplies to any of the surrounding users. Before the subject project can proceed, we propose to have the Hakipu'u Valley's water resources studied by professional hydrologists. An exploratory well study and all available alternatives for extraction of fresh water will be considered. All of this will take some time, but when hydrogeological investigations are completed, results will be disclosed for your input. The exploratory well study should reveal the extent to which any fresh water may be extracted, on or off the project site.

At this time, project planners are working with the Kaawa Ohana to minimize adverse impacts of moving the driveway. Our primary objective with relocating the driveway is to increase the sight distance and improve the safety of entering and exiting the highway. The proposed location of the access would offer the maximum sight distance. We will continue to solicit your input regarding this matter.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

MY NAME IS EDNA M.K. ANIU
I'VE LIVED AT 49-066 JOHNSON ROAD
SINCE 1964 WHEN WE BUILT OUR HOUSE
HERE. MANY CHANGES HAVE
OCCURED ~~HAVE~~ SINCE THAT TIME.
I STRONGLY OPPOSE ANY DRILLING
IN THIS AREA. MY FAMILY HAVE
GROWN TARO IN HAKIPUU FOR MANY
YEARS. I DON'T WANT TO SEE
THEIR EFFORTS SPOILED BY LOSS
OF WATER DUE TO ANY DRILLING.

Edna M. K. Aniu
APRIL 7, 1993

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APR 9 1993
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36

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

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DONA L. HANAIKE

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STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 27 1993

Ms. Edna M.K. Aniu
49-066 Johnson Road
Kaneohe, HI 96744

Dear Ms. Aniu:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. We appreciate your concern regarding the proposed fresh water well. We wish to convey our concern for the Hakipu'u Valley fresh water resources and our resolve not to limit the availability of water to any members of the Hakipu'u community.

Before the project can proceed, we propose to have the valley's water resources studied by a professional hydrologist. An exploratory well study and all available alternatives will be investigated. All of this will take some time, but please be assured that when the well study is completed, results will be disclosed for your input. An exploratory well study should reveal the extent to which any fresh water may be extracted at all, on or off the project site.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

I WAS RECENTLY INFORMED THAT DRILLING OF A WELL FOR FRESH WATER WAS PROPOSED ON THE PRAWN FARM SITE. I AM STRONGLY AGAINST ANY DRILLING OF WELLS IN THIS AREA. I OPPOSE THE DRILLING MAINLY BECAUSE I FEEL IN DOING SO IT WILL DEPLETE EXISTING SPRINGS WHICH PRESENTLY PROVIDE WATER FOR LO'I KALO (TARO PATCHES) IN HAKIPU'U VALLEY.

THE MASSIVE CHANGE THAT HAKIPU'U STREAM HAS TAKEN SINCE THE FARM HAD STARTED AND VAST DESTRUCTION CAUSED BY THE HEAVY FLOW OF WATER WHICH USUALLY WOULD OVERFLOW BUT IS PREVENTED BY HIGH EMBANKMENTS, TO ME SHOULD BE A HIGH CONCERN RATHER THAN FURTHER EXPERIMENTATION!

MAHALO FOR YOUR TIME,

JOHN ANIU
49-066 JOHNSON ROAD
HAKIPU'U (KANEOHE) HAWAII 96744
(MAILING ADDRESS)

37

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

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OCT 27 1993

Mr. John Aniu
49-066 Johnson Road
Kaneohe, HI 96744

Dear Mr. Aniu:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. Before the subject project can proceed, an exploratory well study is proposed and all available alternatives for extraction of fresh water will be carefully investigated. All of this will take some time, but please be assured that when hydrogeological investigations are completed, results will be disclosed for your input. Also be assured that the project developers have no intention of depleting any surrounding user's water supplies for any reason whatsoever. The exploratory well study should reveal the extent to which any fresh water may be extracted, on or off the project site.

We realize that fresh water is a major concern to the Hakipu'u community. We wish to convey our concern for the Hakipu'u Valley fresh water resources and our resolve not to limit the availability of water to any members of the Hakipu'u community. We are aware of the rapid rate of erosion that occurs to the banks of Hakipu'u Stream and that flooding occasionally occurs. As stated in the Final EIS, design of the facility will take in to consideration flooding potential. The proposed design does not intend to aggravate flooding and will consider all possible aspects to decrease flooding impacts.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

April 7, 1993

To Whom it May Concern,

I have been a resident of Hakipu'u from 1988 to Present. I was recently informed about the drilling of a well for fresh Water. I strongly disagree on the drilling of a well.

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APR 9 1993
OCEANIT LABORATORIES, INC.

Davelyn I.L.P. Aniu
49-066 Johnson Road
Kaneohe, H 96744

36

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
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HONOLULU, HAWAII 96809

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OCT 27 1993

Ms. Davelyn I.L.P. Aniu
49-066 Johnson Road
Kaneohe, HI 96744

Dear Ms. Aniu:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter of April 7, 1993 regarding the subject project. We appreciate your concern regarding the proposed fresh water well. We wish to convey our concern for the Hakipu'u Valley fresh water resources and resolve not to limit the availability of water to any members of the Hakipu'u community.

Before the project can proceed, we propose to have the Valley's water resources studied by professional hydrologists. An exploratory well study and all available alternatives will be investigated. All of this will take some time, but please be assured that when the well study is completed, results will be disclosed to the community for your input. An exploratory well study should reveal the extent to which any fresh water may be extracted at all, on or off the project site.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

I dont think that the well should dug because we raise taro and even a small amount of water loss would effect our loi, our way of life. Were very lucky to live the way we do theres not many Hawaiians can.
So Im againist this well and will do anything to stop it. I dont see any benifit for the native of Hakipuu only loss.

49-076 Johnson Rd
Hakipuu Oahu
Ronnie Uyemura

OCEANIT LABORATORIES, INC.
APR 9 1993
RECEIVED

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

OCT 27 1993

Mr. Ronnie Uyemura
49-076 Johnson Road
Kaneohe, HI 96744

Dear Mr. Uyemura:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. We appreciate your concern regarding the proposed fresh water well. We wish to convey our concern for the Hakipu'u Valley fresh water resources. The scarce supply of fresh water can cause hardship for many users in the Valley and we do not intend to aggravate the situation.

Be assured that the project developers have no intention of limiting or impacting the current level of water supplies to any of the surrounding users. Before the subject project can proceed, we propose to have the Valley's water resources studied by a professional hydrologist. An exploratory well study and all available alternatives for extraction of fresh water will be considered. All of this will take some time, but please be assured that when the hydrogeological investigations are completed, results will be disclosed for your input. The exploratory well study should reveal the extent to which any fresh water may be extracted, on or off the project site. As you are aware we are discussing this, and other issues, with your representatives on the MRTC Hakipu'u Advisory Committee.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

To: M.R.T.C.

I don't want a well dug because we raise taro and our spring will dry up. No water no taro no can do.

Also I object to the moving of the road we have children here and try to make it easier for the school buses makes it more dangerous for us.

Sincerely Yours
Maria McBee

40

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT
P.O. BOX 373
HONOLULU, HAWAII 96809

KEITH W. AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

NOV - 2 1993

Ms. Maria K. McBee
49-129 Kamehameha Highway
Kaneohe, Hawaii 96744

Dear Ms. McBee:

Draft Environmental Impact Statement (DEIS)
The Mariculture Research and Training Center (MRTC)
Large Scale Pond Research, Training and Demonstration Facility

Thank you for your letter regarding the subject project. Your concerns regarding the proposed fresh water well and driveway relocation have been noted.

Be assured that the project developers have no intention of limiting or impacting the current level of water supplies to any of the surrounding users. Before the project can proceed, we propose to have the Hakipu'u Valley's water resources studied by professional hydrologists. An exploratory well study and all available alternatives for extraction of fresh water will be considered. All of this will take some time, but please be assured that when hydrogeological investigations are completed, results will be disclosed for your input. The exploratory well study should reveal the extent to which any fresh water may be extracted, on or off the project site.

Project planners will continue to work with the community to gain input and minimize adverse impacts of moving the driveway. Our primary concern with relocating the driveway is to increase the sight distance and improve the safety of entering and exiting the highway. The proposed location of the access would offer the maximum sight distance.

We hope we have satisfactorily responded to your comments. If you have any questions, please call Ms. Robin Anawalt of Oceanit Laboratories, Inc., our EIS consultant, at 531-3017.

Sincerely,

MANABU TAGOMORI
Manager-Chief Engineer

AM:lc
c: Ms. Robin Anawalt, Oceanit Laboratories, Inc.
Mr. John Corbin, Aquaculture Development Program

APPENDIX A

TRAFFIC STUDY

TRAFFIC IMPACT STUDY FOR
AN AQUACULTURE RESEARCH FACILITY
IN KANEOHE, HAWAII

Prepared For

OCEANIT LABORATORIES, INC.

Prepared By

BARTON-ASCHMAN ASSOCIATES, INC.

HONOLULU, HAWAII

April 1992

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1. INTRODUCTION

Barton-Aschman Associates Inc. has been retained by Oceanit Laboratories, Inc. to conduct a traffic impact study for an Aquaculture Research Facility in Kaneohe, Hawaii. The facility will also contain conference and meeting facilities for 30-40 persons.

The following report has been prepared to describe the traffic characteristics of the project, the traffic-related impacts of the project on the adjacent roadway network and to examine access/egress conditions of the project (sight distance restrictions). In this report, the Aquaculture Research Facility is referred to as the "project".

This introductory chapter discusses the location of the project, the proposed development and the study methodology.

PROJECT LOCATION AND DESCRIPTION

The site plan and location of the project is shown on Figure 1. Access to the project will be via two driveway intersections along Kamehameha Highway. The existing driveway which will be used by employees will be relocated to improve sight distance as will be discussed in Chapter 2 of this report. A second driveway is planned for the southern end of the project. This driveway would be as close to the property line as possible and will be used by visitors to the conference center.

The feasibility of a single driveway is also examined. This alternate is referred to as the "alternate driveway plan".

The project will have a maximum of 15 employees. A visitors center will have a maximum capacity of 40 persons.

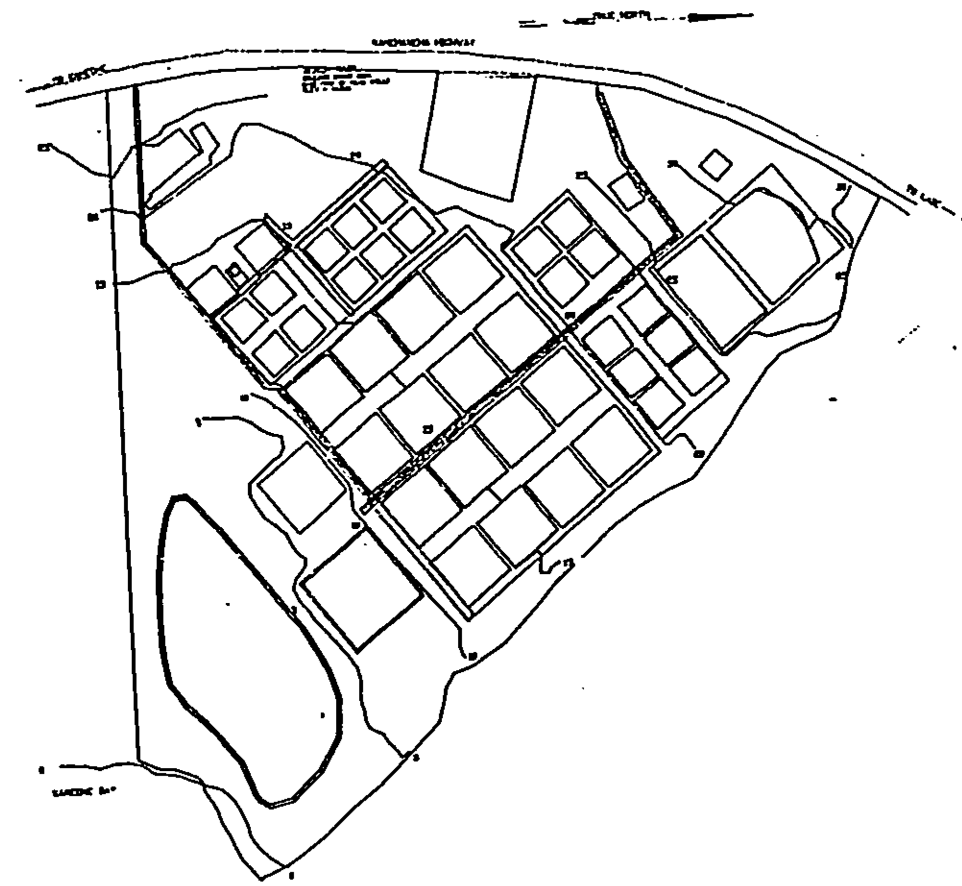
OBJECTIVES OF STUDY

The objective of this study are based upon the typical requirements of the traffic impact analysis process and a specific requirement that the sight distances that Kamehameha Highway adjacent to the site be analyzed. Therefore, the objectives of the traffic study are:

(1) Determine the traffic impacts of the proposed project;

(2) Determine the adequacy of the sight distance from the existing driveway along Kamehameha Highway, and

(3) Determine the construction related traffic impacts of the project.



Source: Oceanit

SITE LOCATION

OCEANIT AQUACULTURE RESEARCH FACILITY
KANEOHE, HAWAII

STUDY METHODOLOGY

In order to conduct this traffic study, several tasks were performed. These are discussed in the following paragraphs.

1. Data Collection

Traffic-related information was collected in order to analyze the existing traffic conditions and to estimate the future traffic volumes on the roadway adjacent to the study site. The data collected included the following:

- development planning data;
- roadway network data;
- existing morning and afternoon (AM and PM) peak hour traffic volumes;
- traffic information for other planned projects; and
- previous traffic studies conducted for projects in the adjacent area.

2. Selection of Analysis Techniques

The methodology described in the 1985 Highway Capacity Manual (HCM) was used to conduct a level-of-service (LoS) for Kamehameha Highway adjacent to the project and the driveways. Level-of-Service is a qualitative measure of the operating conditions at an intersection. The LoS concept is presented and discussed in Chapter 2 of this report. Utilizing the existing data, the traffic conditions in the vicinity of the study area were determined for 1992 conditions.

3. Determination of Cumulative Traffic Projections

Based on comments from the County regarding previous studies, 1997 was used as the design year.

Future 1997 cumulative traffic volumes have two components. The first is background growth. The second is traffic generated by other planned projects in the vicinity and these volumes are referred to as "related project trips." The total future cumulative traffic is the sum of existing plus background growth plus related project trips. The assumptions used to estimate the 1997 cumulative trips and the resulting traffic projections are presented in Chapter 3 of this report. Operating conditions were analyzed using level-of-service calculations.

4. Analysis of Project-Related Traffic Impacts

The next step in the traffic analysis of the project was to estimate the AM and PM peak-hour traffic that would be generated by the proposed development. This was done using trip generation rates from Trip Generation (Fourth Edition, 1987), an informational report prepared by the Institute of Transportation Engineers (ITE).

These trips were distributed and assigned to the various traffic turning movements at the adjacent intersections. The site-generated traffic was then superimposed on 1997 cumulative traffic volumes. The HCM planning method was then used again to conduct a level-of-service analysis.

A comparison of 1997 cumulative peak hour conditions to 1997 conditions with the project was made in order to determine the impact of this additional traffic on the roadway network. The resulting traffic projections for 1997 with the project are presented in Chapter 4.

The analysis of the project-related impacts and the conclusions of the analyses are discussed in Chapter 5.

5. Conduct Sight-Distance Analysis

The sight distance analysis was conducted using HDOT standard for driveway entrances and exits. The project civil engineer provided a contour map and topographic survey from which the existing roadway profile was plotted and used for the analysis. As will be discussed in Chapter 2, an alternative driveway location was determined to improve the sight distance for driveway users.

2. ANALYSIS OF EXISTING CONDITIONS

This chapter presents and discusses the existing traffic conditions and volumes on the roadways in the vicinity of the proposed project. The level-of-service concept and the results of the level-of-service analysis for existing conditions are also presented. The purpose of this analysis is to establish the base conditions for the determination of the project impacts the project which are described in a subsequent chapter.

EXISTING ROADWAY CONDITIONS

Kamehameha Highway adjacent to the project is a two-lane, two-way highway. Both lanes are 12 feet wide. The grades, as shown on Exhibit A, are 2% and 3.7%, which are relatively flat. The speed limit along most of Kamehameha Highway is 45 miles per hour (mph).

However, in the vicinity of the entrance, the roadway is signed as a congested area and the speed limit reduced to 35 mph.

SIGHT DISTANCE ANALYSIS

A sight distance analysis for the driveway entrance was conducted using the procedures and parameters in the Hawaii Statewide Uniform Design Manual for Streets and Highways. There are three elements to be examined when conducting a sight distance analysis. These elements are:

D_L = Safe Sight Distance to the Left
D_R = Safe Sight Distance to the Right
S = Line of Sight for Left Turns into Driveway

For a two-lane highway with a design speed of 40 mph (posted speed of 35 mph), the required distances are as shown in Table 1 along with the measured sight distances from the existing driveway to the project.

The analysis concluded:

(1) Because the roadway profile is relatively flat, sufficient vertical sight distance for automobiles at the existing entrance for a design speed of 40 mph, or a posted speed of 35 mph, based on the profile. However, lateral sight distance is restricted to both left and right directions because of the horizontal curvature. In both directions, there is not sufficient sight distance. (See Table 1)

(2) The existing driveway should be relocated approximately 120 feet south of the existing driveway. Trucks and buses should be directed to the new driveway to be located along the southern property line. Lateral sight distances for this new proposal driveway meet and exceed the sight distance requirements for auto established by HDOT is shown in Table 1.

TABLE 1
SIGHT DISTANCE ANALYSIS[1]
April 1992

Element	Required Distance (Ft) Autos	Required Distance (Ft) Trucks	Measured Existing Driveway	Distance (Ft) Proposed Driveway
D_L	530	850	325	540
D_R	440	850	390	510
S	370	570	365	540

D_L = Safe Sight Distance to the Left
D_R = Safe Sight Distance to the Right
S = Line of Sight for Left turn into Driveway

Note: (1) Reference HDOT, Hawaii Statewide Uniform Design Manual for Streets and Highways, p. 5-12 thru 5-14.

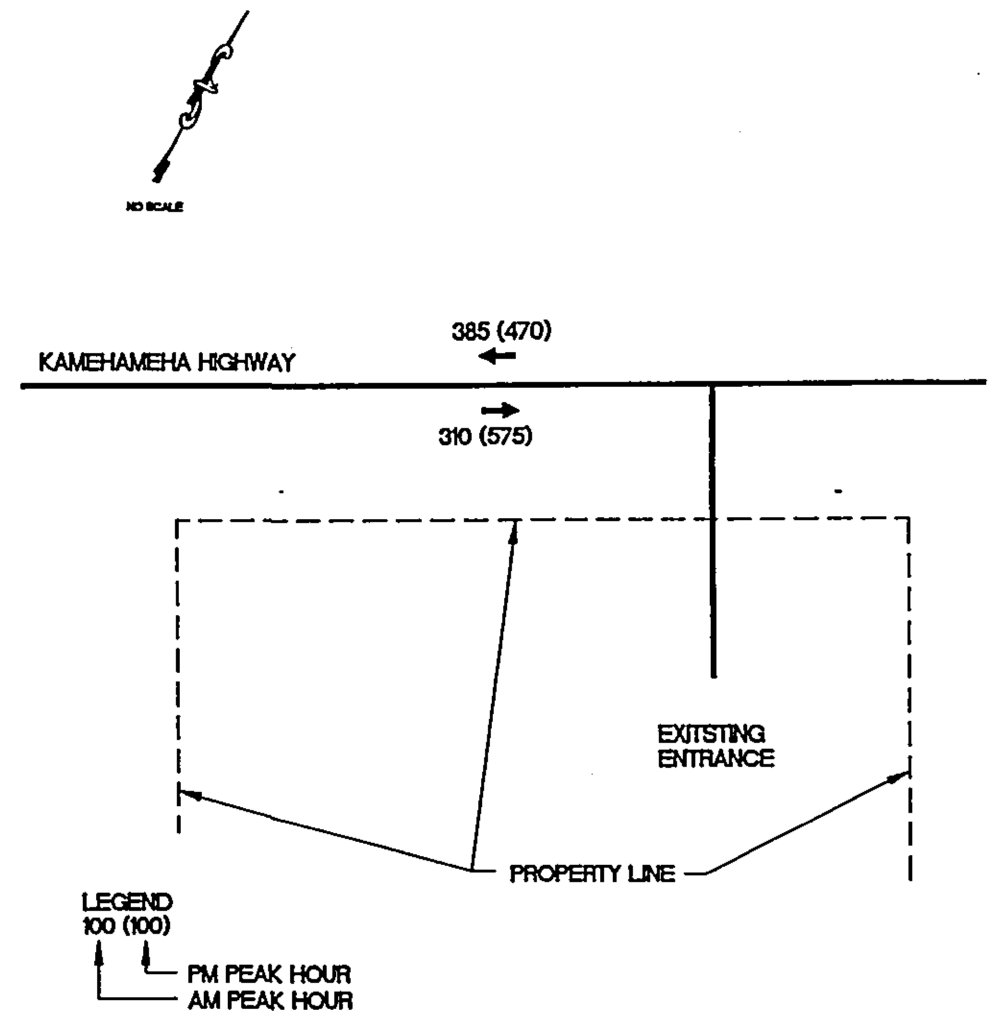
(3) The right-of-way north of the driveway along the project property line should be cleared sufficiently to provide adequate lateral sight distance. Clearing an area 20 feet from the edge of pavement of the roadway would provide adequate lateral clearance.

EXISTING PEAK HOUR TRAFFIC VOLUMES

The existing AM and PM peak hour traffic volumes were obtained from HDOT traffic records. The latest counts available are 1988/89. The average growth rate from 1986 to 1989 was 4.4 per cent per year (compounded). Therefore, 1992 traffic volume were estimated on applying or growth factor of 13.8 per cent to 1989 counts. The 1992 AM and PM peak hour volumes are 695 and 1045 vehicles per hour (both directions), respectively and are shown in Figure 2. Other traffic factors are shown in Table 2.

The operating conditions of driveway and intersections controlled by stop signs can be classified by a Level-of-Service (LoS) from A to F. The method for determining LoS for unsignalized intersections is based on the use of gaps in traffic on the major street by vehicles crossing or turning through that stream of traffic. The capacity of the controlled legs of an intersection (in this case, the proposed driveway) is based on two factors: 1) the distribution of gaps in the major street traffic stream, and 2) driver judgement in selecting gaps through which to execute a desired maneuver.

The criteria for level-of-service at an unsignalized intersection is therefore based on delay of each turning movement. Table 3 summarizes the definitions for level-of-service and the delay parameters. A subsequent calculation to determine an overall level-of-service was made, and these results are presented using parameters similar to those used for signalized intersections in order to compare the impacts of the proposed project.



EXISTING PEAK HOUR TRAFFIC VOLUMES

MARICULTURE RESEARCH AND TRAINING CENTER
KANEOHE, HAWAII

Barton-Aschman Associates, Inc.

Figure 2

TABLE 2
EXISTING TRAFFIC CONDITIONS
April 1992

1989 Average Daily Traffic	10,182 vpd
1992 Average Daily Traffic	11,610 vpd
1992 AM Peak Hour	695
K Factor	6.0
D	55/45
T	7.0
1992 PM Peak Hour	1045
K Factor	9.0
D	55/45
T	6.5

Notes:

K = Percentage of daily traffic occurring during the peak hour.
D = Directional distribution of traffic with the higher percentage in the peak direction.
T = Percentage of truck during peak hour.

Source: HDOT

TABLE 3
LEVEL-OF-SERVICE DEFINITIONS FOR UNSIGNALIZED INTERSECTIONS[1]
April 1992

Level-of-Service	Expected Delay to Minor Street Traffic	Reserve Capacity	Delay (sec)
A	Little or no delay	> 400	≤5.0
B	Short traffic delays	300 - 399	5.1 to 15.0
C	Average traffic delays	200 - 299	15.1 to 25.0
D	Long traffic delays	100 - 199	25.1 to 40.0
E	Very long traffic delays	0 - 99	40.1 to 60.0
F	See Note (2) below	—	>60.0

Notes: (1) Source: Highway Capacity Manual, 1985.
(2) When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvement to the intersection.

Another method of defining LoS of an unsignalized intersection is reserve capacity. Reserve capacity is defined as "the capacity of a lane at an unsignalized intersection minus the demand for that lane." LoS definitions and the corresponding reserve capacities are also shown in Table 3.

A LoS analysis was conducted for the roadway and the driveway. It was determined that all conditions are LoS "B" or better except for the left turns from the driveway which is expected to operate at LoS "D" during the peak hours. This reduced LoS is the result of the restricted sight distance to the right and the heavy outbound traffic stream that left turning vehicles must cross.

3. PROJECTED CUMULATIVE TRAFFIC CONDITIONS

This chapter is to discusses the assumptions and data used to estimate 1997 cumulative traffic conditions. Cumulative traffic conditions are defined as future traffic conditions resulting from background growth and related projects.

BACKGROUND TRAFFIC GROWTH RATE

The first component of cumulative trips is ambient background growth which is not associated with any particular project. The background growth rate was determined from historical traffic counts conducted by HDOT for Kamehameha Highway adjacent to the project. The historical traffic counts are shown in Table 4. Since 1986, traffic has grown

TABLE 4
HISTORICAL TRAFFIC VOLUMES ALONG
KAMEHAMEHA HIGHWAY
April 1992

Year	ADT	Growth
1986	8877	
1987	9644	+8.6%
1988	10079	+4.5%
1989	10102	+1.0%
Average Growth Rate		4.4%

Notes:

ADT = Average Daily Traffic

Source: HDOT

an average of 4.4 percent per year. Therefore, a growth rate of 4.4 percent per year for the next five years (1992 through 1997) was used in this study. The growth factor to adjust the 1989 counts from HDOT was therefore 41 per cent.

RELATED PROJECTS

The second component in estimating future traffic conditions without the project is the traffic generated by related projects in the vicinity. Related projects are defined as those projects that are approved or planned for construction during the time frame of this study which would significantly impact traffic at the intersections being analyzed.

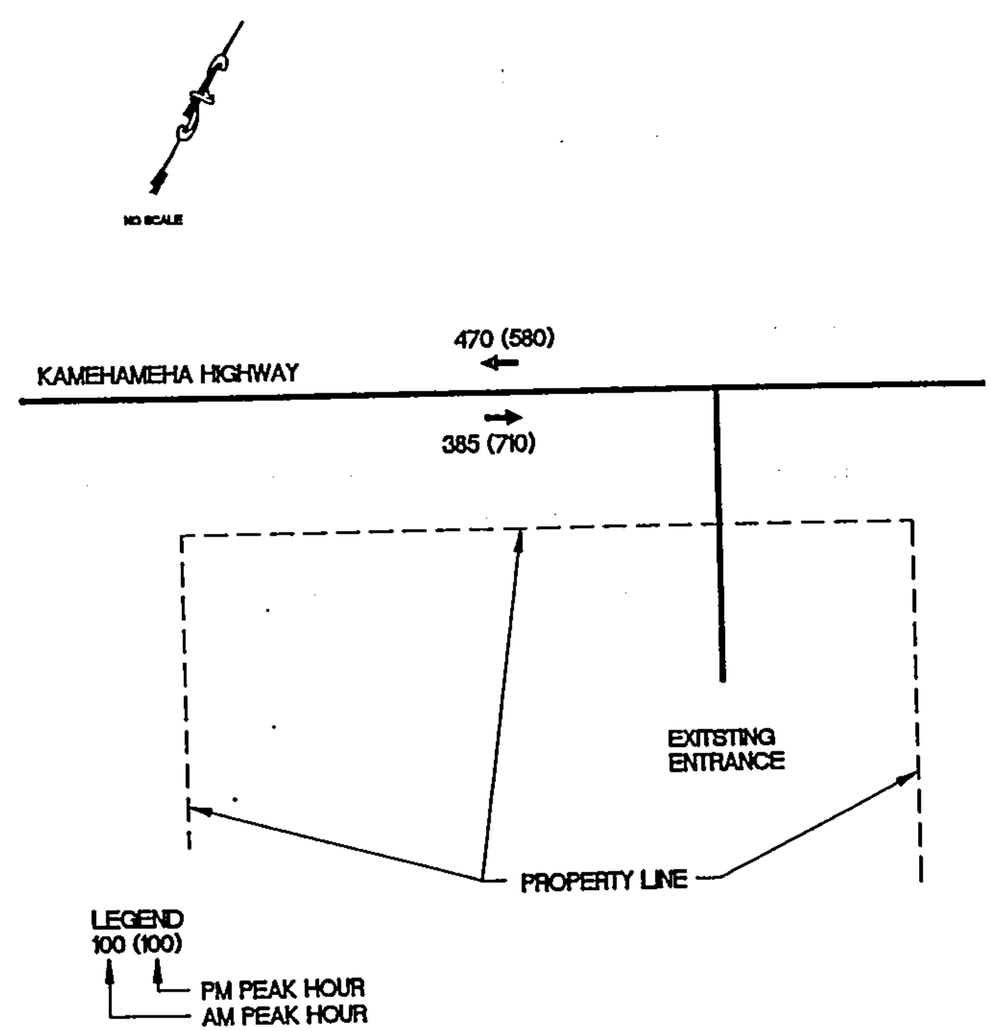
Based upon the information obtained from the County and discussions with local developers, no other projects that would generate traffic are planned for this area.

1997 CUMULATIVE TRAFFIC VOLUMES

Cumulative traffic volumes for 1997 were calculated by superimposing background growth onto existing traffic volumes. A factor of 1.41 was applied to existing traffic to obtain the 1997 cumulative traffic volumes. Volumes were assigned to the existing roadway network for both peak hours as shown on Figure 3.

1997 CUMULATIVE LEVEL-OF-SERVICE ANALYSIS

A level-of-service analysis for 1997 cumulative conditions was conducted to provide a basis for determining the projects impacts. The results are that Kamehameha Highway operates at level-of-service "C" during both peak hours.



CUMULATIVE PEAK HOUR
TRAFFIC VOLUMES

MARICULTURE RESEARCH AND TRAINING CENTER
KANEOHE, HAWAII

Barton-Aschman Associates, Inc.

Figure 3

TABLE 5
TRAFFIC GROWTH ANALYSIS
April 1992

	1989[1]	1992	1997[2]
ADT (vpd)	10,182	11,590	14,360
AM Peak Hour (K=6%)			
K = 6%	610	695	860
D = 55/45	335/275	385/310	475/385
PM Peak Hour			
K = 9%	915	1,045	1,290
D = 55/45	505/410	575/470	710/580

Notes:

(1) 1989 - 1992 Growth Factor = 1.138
(2) 1989 - 1997 Growth Factor = 1.411

4. CUMULATIVE PLUS PROJECT TRAFFIC CONDITIONS

This chapter discusses the methodology used to identify the traffic-related impacts of the proposed project. This methodology involves the three step process of trip generation, distribution and assignment. First, the number of weekday AM and PM peak-hour trips that would be generated by the proposed project was determined. These trips were then distributed on the major approach and departure routes. Next, each trip was assigned a specific path to and from the site based on ingress/egress locations and travel patterns. Finally, the level-of-service was calculated for the roadway.

TRIP GENERATION

Traffic volumes for the proposed project were determined using trip generation equations contained in Trip Generation (Fourth Edition, 1987), an informational report prepared by the ITE. The project will have a maximum of 15 employees and facilities for 40 visitors at the conference center. The rates for light general industrial per employee were used for the employee portion of the trip generation analysis. For the visitor portion, assumptions used for conference and exhibition centers in LA were used. These assumptions were:

(1) During the morning peak hour, 50 per cent of the visitors would arrive; the ratio of inbound to outbound is 90/10.

(2) During the afternoon peak hour, 60 per cent of the visitors would arrive; the ratio of inbound to outbound is 10/90.

This trip generation analysis is shown as Table 6.

TRIP DISTRIBUTION

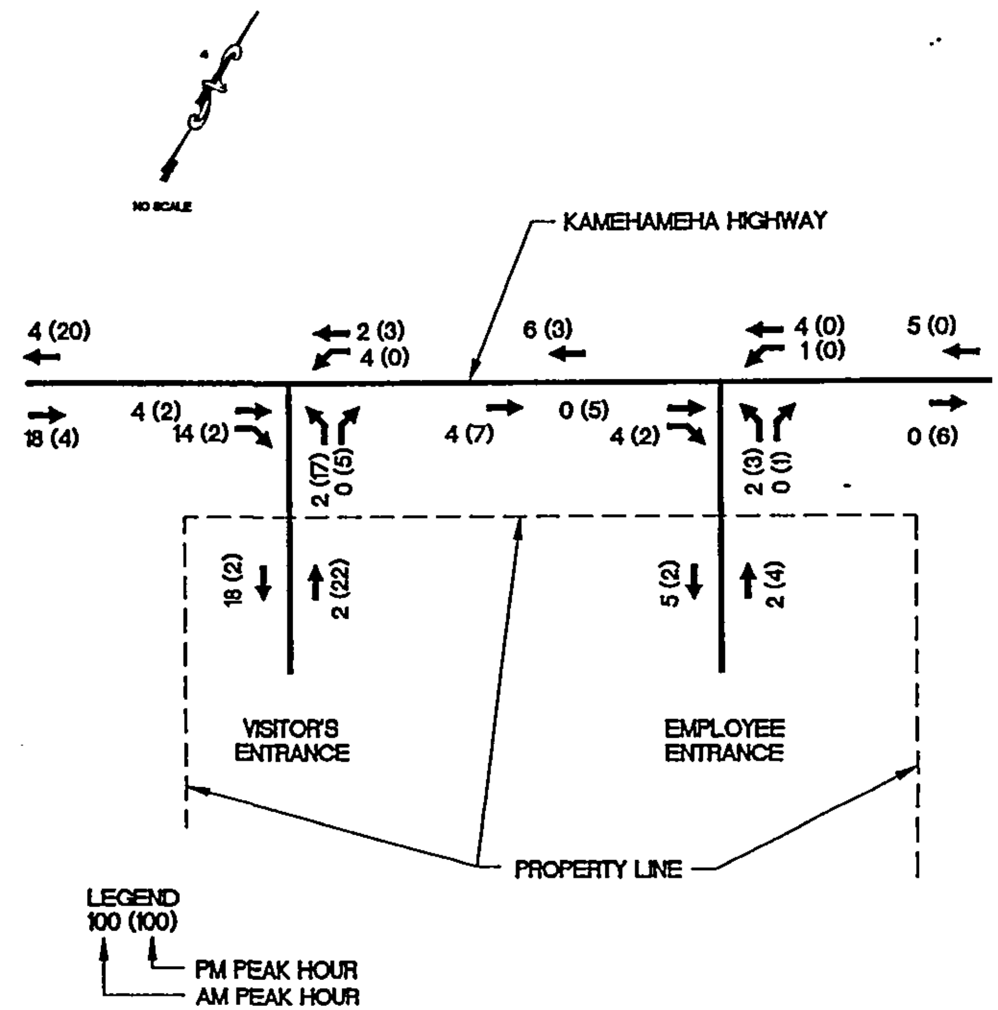
The project-related trips were distributed based on the future distribution of population and the anticipated approach and departure routes to the project site. For this study,it was assumed that 75% of the trips would be from Kaneohe.

TRIP ASSIGNMENT

Using the trip generation and trip distribution previously discussed, site-generated traffic was assigned to the various turning movements at the intersections studied. The trip assignments for the AM and PM peak hours, are shown on Figures 4 and 5. Figure 4 is for the plan using two driveways and Figure 5 is for the alternate driveway plan which consider only one driveway.

TABLE 6
TRIP GENERATION ANALYSIS
April 1992

	Employees	Visitors	Total
AM Peak Hours	7	20	27
In	5	18	23
Out	2	2	4
PM Peak Hour	6	24	30
In	2	2	4
Out	4	22	26



PROJECT TRIP
ASSIGNMENT

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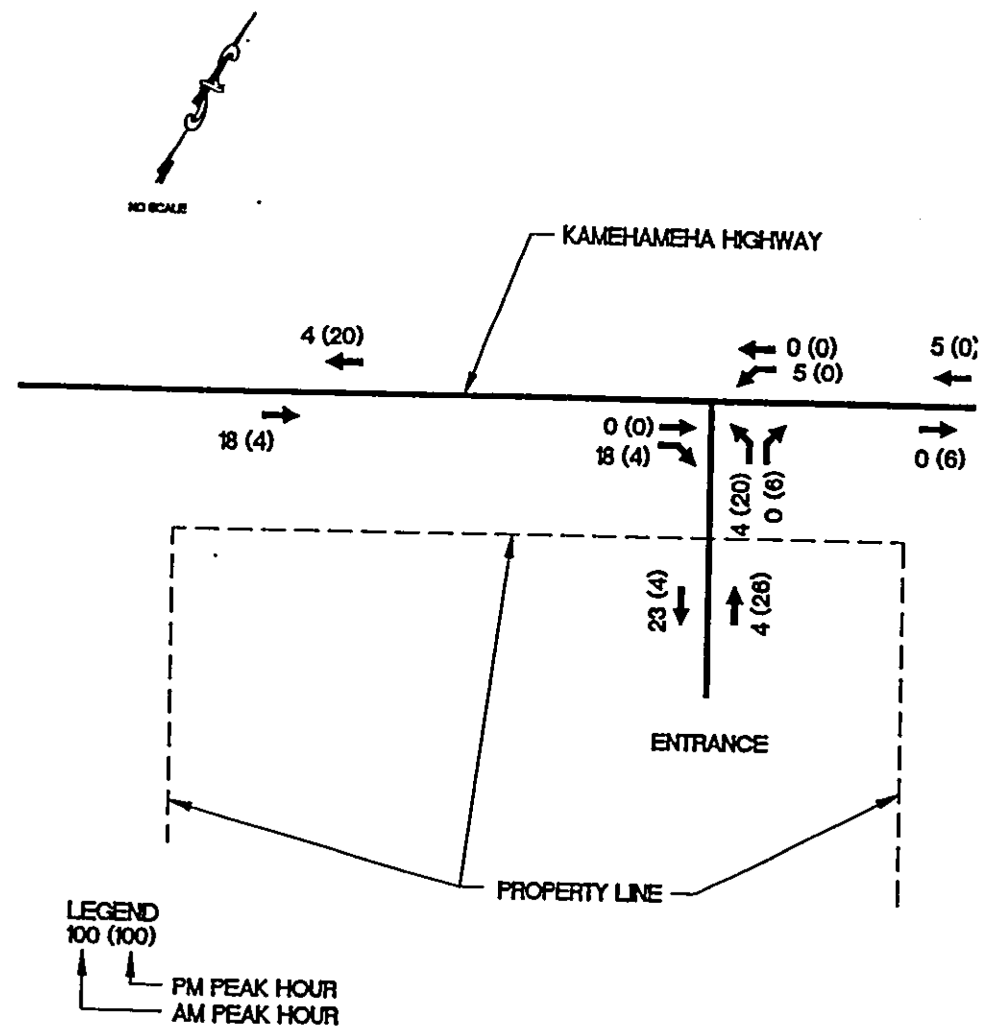
KANEOHE, HAWAII

Barton-Aschman Associates, Inc.

Figure 4



PROJECT TRIP ASSIGNMENT
ALTERNATIVE ENTRANCE PLAN

MARICULTURE RESEARCH AND TRAINING CENTER
KANEOHE, HAWAII

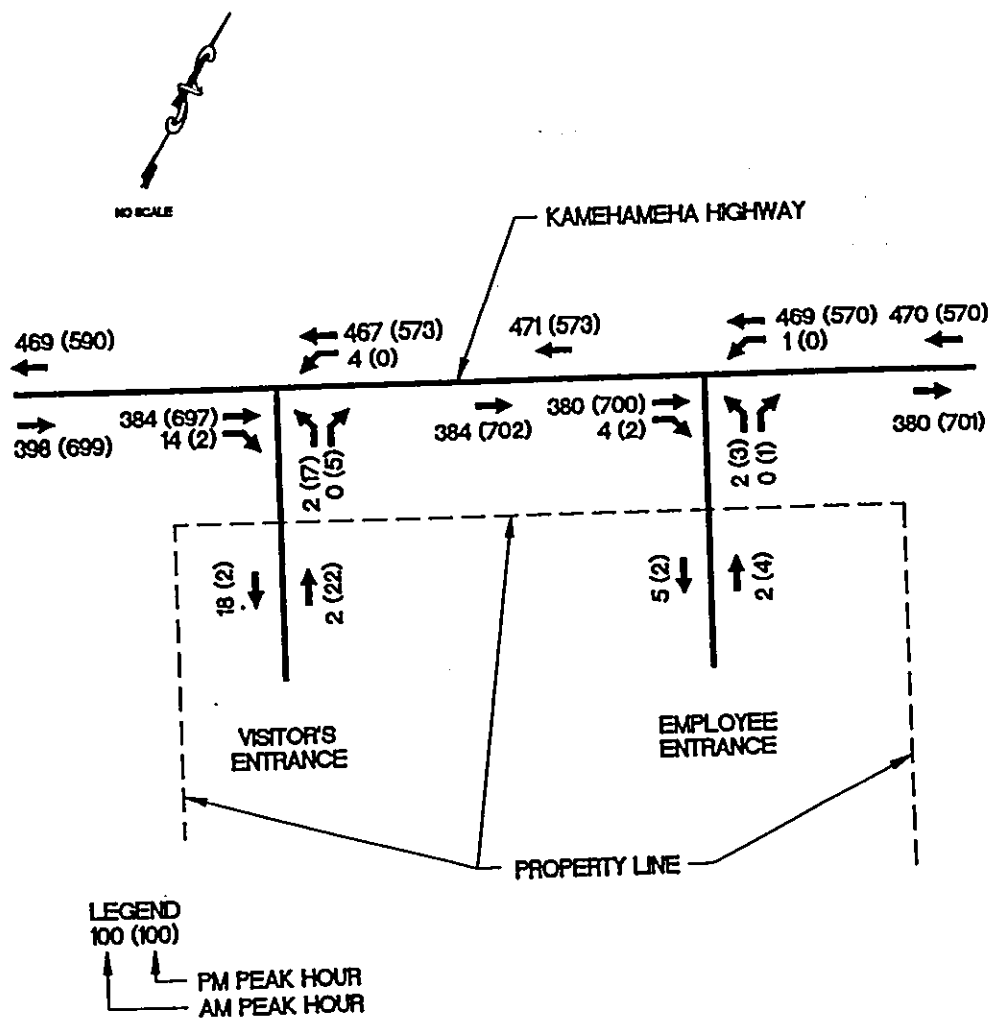
Barton-Aschman Associates, Inc.

Figure 5

TOTAL PEAK HOUR TRAFFIC VOLUMES

Future traffic volumes with the project were determined by superimposing the site-generated traffic on the cumulative traffic volumes presented in the previous chapter. Thus, operating conditions under this scenario include existing traffic, background growth, related projects and proposed project trips on the roadway network.

The resulting 1995 cumulative plus project traffic volumes are shown for the AM and PM peak hours on Figure 6 and 7, is for the two and one driveway plans respectively.

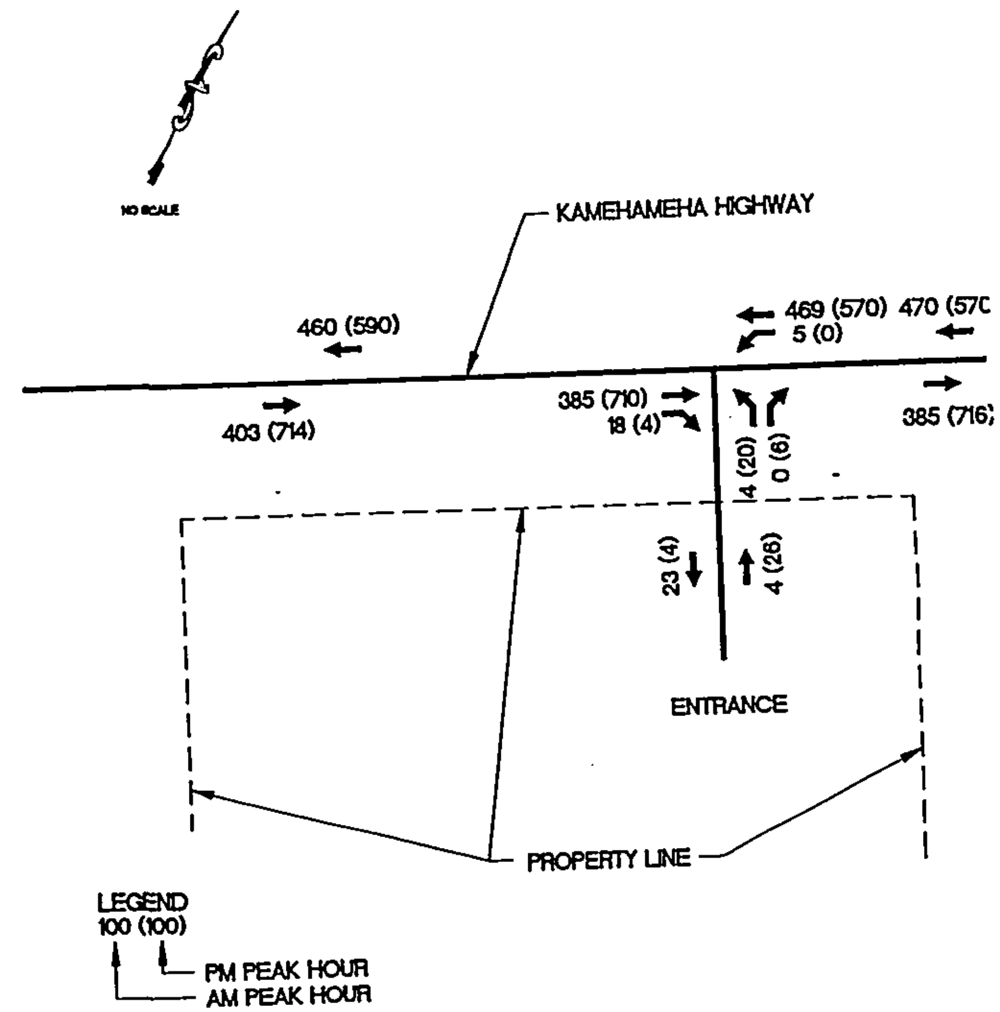


CUMULATIVE PLUS PROJECT PEAK HOUR
TRAFFIC VOLUMES

MARICULTURE RESEARCH AND TRAINING CENTER
KANEOHE, HAWAII

Figure 6

Barton-Aschman Associates, Inc.



CUMULATIVE PLUS PROJECT PEAK HOUR
TRAFFIC VOLUMES
ALTERNATIVE ENTRANCE PLAN

MARICULTURE RESEARCH AND TRAINING CENTER
KANEOHE, HAWAII

Barton-Aschman Associates, Inc.

Figure 7

5. SUMMARY OF IMPACTS AND MITIGATION MEASURES

The purpose of this chapter is to summarize results of the level-of-service analyses which identify the project-related impacts on the surrounding roadway network. In addition, any mitigation measures necessary and feasible are identified.

DEFINITION OF SIGNIFICANT IMPACTS

Criteria have been established in various cities to define a significant traffic impact requiring mitigation. Generally, the criteria are as follows: if the level-of-service under cumulative conditions without the project is E or F, and the volume/capacity (V/C) ratio changes 0.030 or less, the project's traffic impacts are considered insignificant. However, if the V/C ratio change is greater than 0.030, then mitigation measures which will reduce the V/C ratio

change to less than 0.030 must be identified. For this project, the 0.030 criterion has been used. If the LOS with project traffic is D or better, then no mitigation measures need to be identified.

PROJECT-RELATED TRAFFIC IMPACTS

A summary of the level-of-service analyses results for the intersections under study is presented in Table 7. As shown the project impacts are neglible. Since the cumulative plus project traffic volumes are the same for either driveway plan. The volume/capacity ratios are the same. With the v/c ratios as low as shown, the roadway is expected to operate at LoS "B" or better.

Analysis of the anticipated operating conditions at the driveway was also constructed. This analysis determined that left turns from the driveway for either alternative will have delays of 40 to 60 seconds. This is common of unsignalized exits onto a major roadway.

MITIGATION MEASURES

Since the level-of-service impacts are neglible, no improvements are required to mitigate the project impacts. However, there are sight distance restrictions which should be addressed. These sight distance restrictions can be mitigated be relocating the existing driveway approximately 120 feet to the south and constructing a second driveway adjacent to the south property line which should be used by trucks and buses.

It is also recommend that the new driveways be constructed to provide turning radii of 30 feet minimum and that acceleration and deceleration lanes be constructed to HDOT standards.

TABLE 7
LEVEL-OF-SERVICE ANALYSIS
April 1992

	AM Peak Hour			PM Peak Hour		
	Max Flow[1]	Vol	v/c	Max Flow[1]	Vol	v/c
Existing	2548	695	0.27	2478	1045	0.42
Cumulative	2548	860	0.34	2478	1290	0.52
Cumulative + Project	2548	872	0.34	2478	1304	0.53

Notes: (1) Maximum flow is the maximum theoretical volumes allowable based on roadway geometrics and traffic characteristics such as percentage heavy vehicles, buses, etc.

CONSTRUCTION TRAFFIC

During construction, a flagman should be provided to assist heavy vehicles entering and exiting the sight because of the limited sight distances. This is in addition to construction area sighting warning through traffic of the construction activity and advising a reduced speed. The construction area signing should be placed in accordance with the guideline of HDOT and the Manual of Uniform Traffic Control Devices.

RECOMMENDATIONS

(1) A new driveway should be constructed to replace the existing one as discussed in Chapter 2.

(2) A second driveway should be constructed adjacent to the Kaneohe side property line. A new driveway does not provide.

(3) Sufficient sight distance for trucks and buses. Therefore, the new driveway should be limited to use by employees and smaller delivery vehicles.

(4) Driveways should be designed to provide deceleration and acceleration lanes.

APPENDIX B

NOISE STUDY

ACOUSTIC STUDY
FOR THE LARGE SCALE POND RESEARCH, TRAINING, AND DEMONSTRATION FACILITY
KANEOHE BAY, OAHU

Prepared for:

OCEANIT LABORATORIES, INC.

Prepared by:

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

MARCH 1992

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CHAPTER I. SUMMARY

The proposed project will involve the construction of a series of experimental ponds, new tank facilities, new salt and freshwater pumping systems, and new laboratory, office and visiting student facilities. In conjunction with the evaluation of potential noise impacts associated with the project, existing and future traffic noise levels in the vicinity of the proposed project were evaluated for their potential impacts on noise sensitive residents in the project environs. The future traffic noise levels along the primary access roadways to the project site were calculated for the Year 1997 for conditions with the proposed project in operation and for conditions without the project (or status quo).

Along Kamehameha Highway north and south of the project site, traffic noise levels are expected to increase moderately by 0.8 to 0.9 Ldn. The Ldn is a single number rating which is used to describe the average noise level during a 24-hour day, and is described more fully in Chapter III of this report. The greatest increases in future traffic noise levels are expected to occur south of the project site toward Waikane, and project traffic contributions to these increases are predicted to be 0.1 Ldn, which is considered to be insignificant. Traffic noise impacts resulting from the proposed project are expected to be minimal.

Predicted noise levels from on-site pond equipment are very low at the nearest noise sensitive receptors due to the anticipated downsizing of the electrical pond aerators from 2 to 1/2 horsepower units. This downsizing of the pond aerators will occur as a direct result of the planned downsizing of the ponds within the facility. For these reasons, risks of adverse noise impacts are considered to be very low, and special noise mitigation measures are not required. In order to further reduce risks of adverse noise impacts from on-site equipment, location of the 1/2 horsepower aerators as far as possible from the property boundary

lines is recommended, as well as the repair of any aerators with noisy or defective components. The location of water spillways as close as possible to the property boundary lines is also recommended to increase their effectiveness as sound masking sources.

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

CHAPTER II. PURPOSE

One objective of this study was to describe the existing and future noise environment in the environs of the proposed project site, which is located between Waikane and Kualoa on the island of Oahu. Traffic noise level increases and impacts associated with the proposed project were to be determined along the public roadways expected to service the project traffic. A specific objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible future impacts from on-site equipment noise were also included as noise study objectives. Recommendations for minimizing potential noise impacts were also to be provided as required.

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

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

TABLE 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in FIGURE 1. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways (see FIGURE 2). In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. In the populated communities near the project site, noise associated with roadway traffic are typically less than 65 Ldn due to the rural character of the populated areas.

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

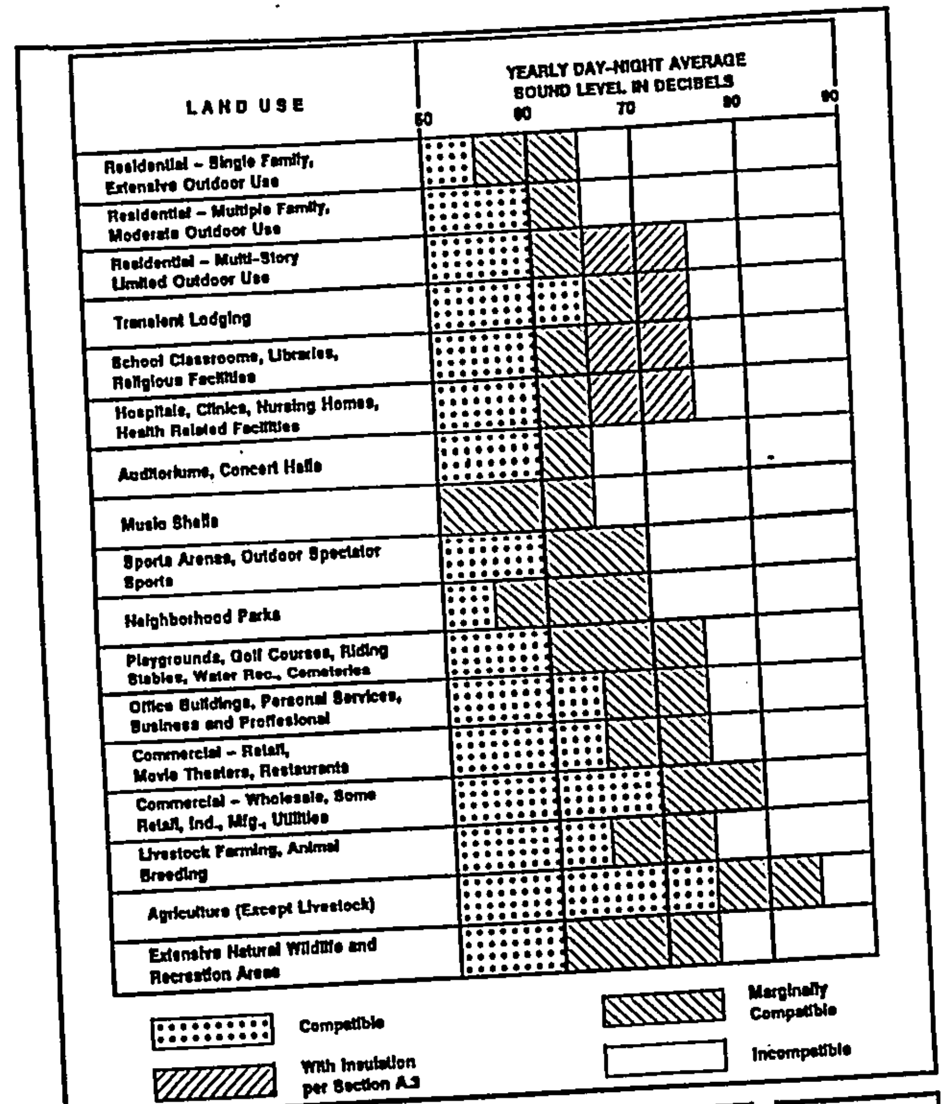
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION
(RESIDENTIAL LAND USE)

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

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

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

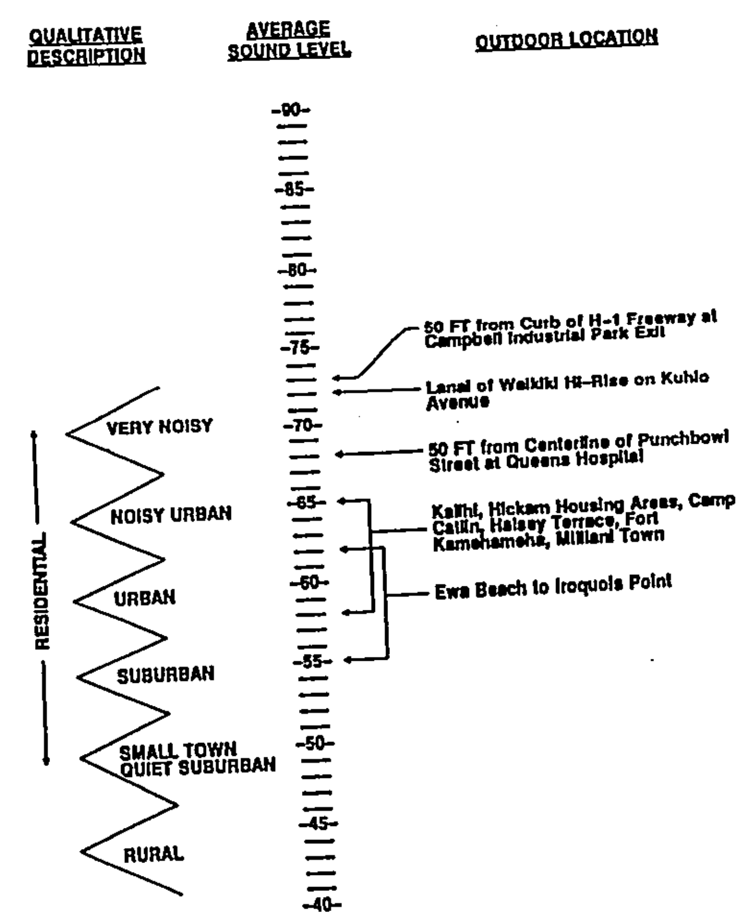


LAND USE COMPATIBILITY
WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL
AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED
(Source: American National Standards Institute S3.23-1980)

FIGURE 1

FIGURE 2

RANGE OF EXTERIOR BACKGROUND AMBIENT NOISE LEVELS



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

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 Ldn are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 Ldn.

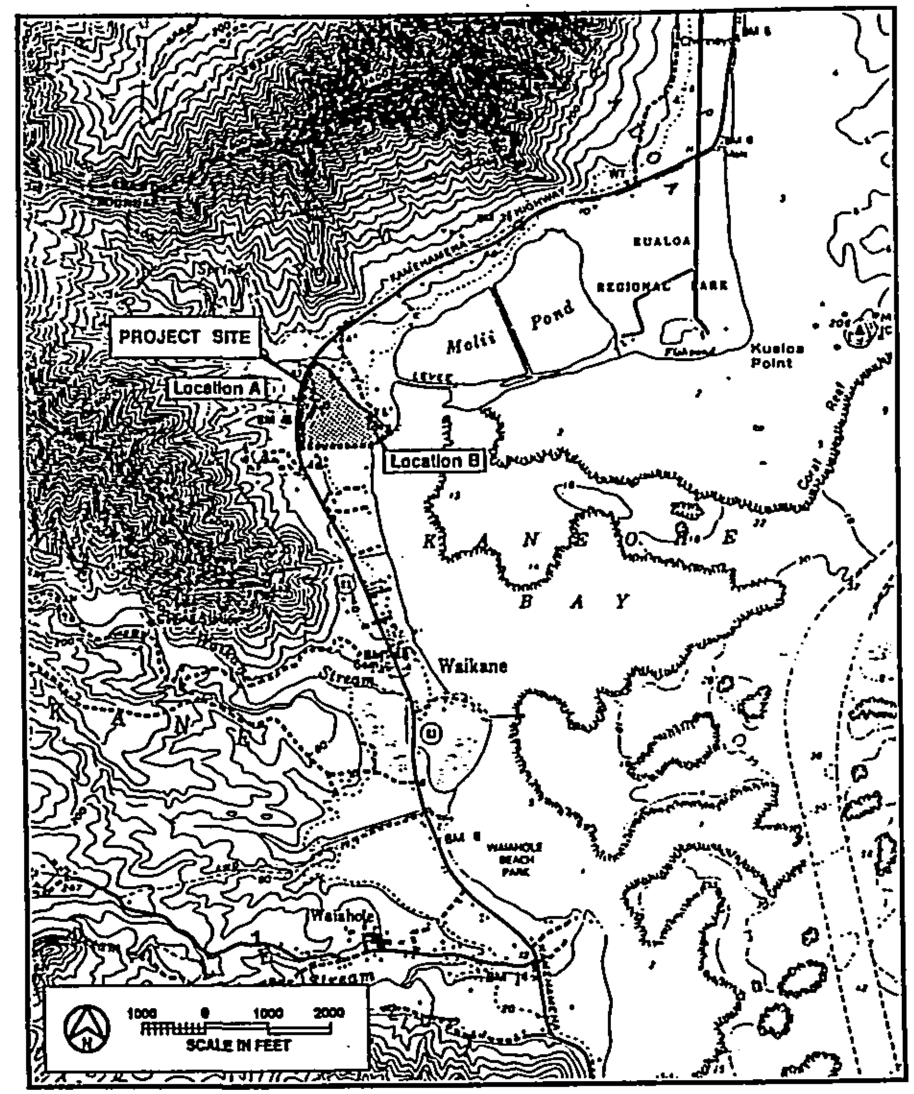
On the island of Oahu, the State Department of Health (DOH) regulates noise from on-site equipment and construction activities. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than Ldn (see Reference 4). For agricultural or industrial lands, the allowable limits are 70 dBA for daytime and nighttime periods along the project's property boundaries. Although they are not directly comparable to noise criteria expressed in Ldn, State DOH noise limits for residential, commercial, and agricultural/industrial lands equate to approximately 55, 60, and 76 Ldn, respectively.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and background ambient noise levels were measured at two locations in the project environs. The locations of the measurement sites are shown in FIGURE 3. Noise measurements were performed during December 1991 at Location 'A' along the highway fronting the project site as well as at Location 'B' at the northeast corner of the project site. Octave Band sound level measurements were also obtained of typical noise sources on the project site, such as pond aerators and spillways. The purpose of these Octave Band measurements was to provide additional data on the likelihood of aural detection of the future pond noise sources along the property boundaries of the project site.

Traffic noise calculations for the existing conditions (CY 1991) as well as noise predictions for the Year 1997 following completion of the project construction were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 5). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. Existing and future traffic volumes were obtained from the traffic study for the project (Reference 6). For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were 1.0 dB less than the 24-hour Ldn along each roadway segment. This assumption was based on the hourly variations of traffic volumes along Kamehameha Highway in the project area (see FIGURES 4 and 5).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic noise levels were calculated for future conditions with and without the proposed project. The forecasted changes in traffic noise levels from existing levels were calculated for both scenarios, and noise



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 3

FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAMEHAMEHA HWY. AT WAIAHOLE VALLEY RD. (JUNE 28-29, 1990)

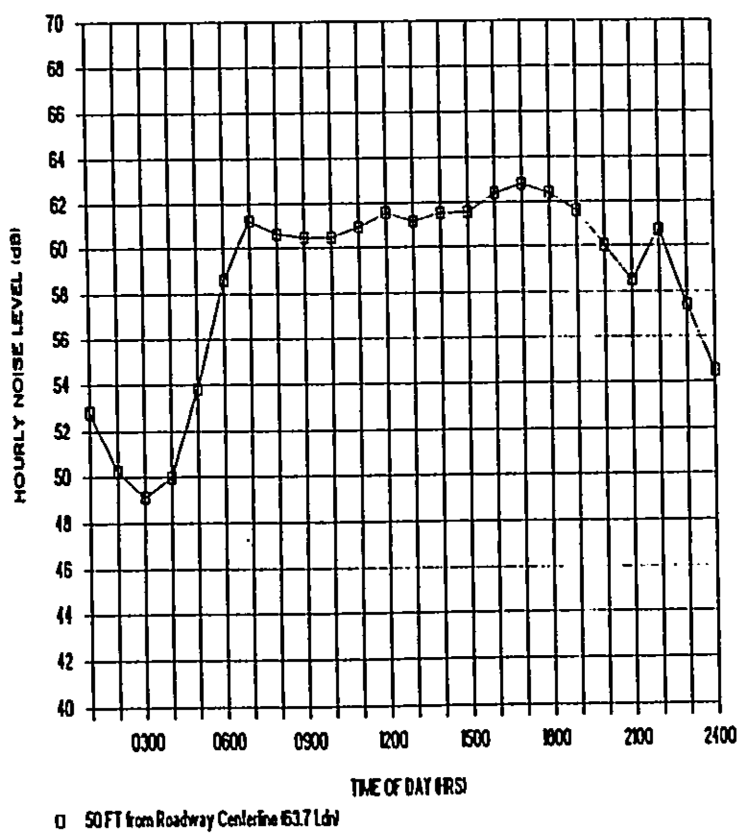
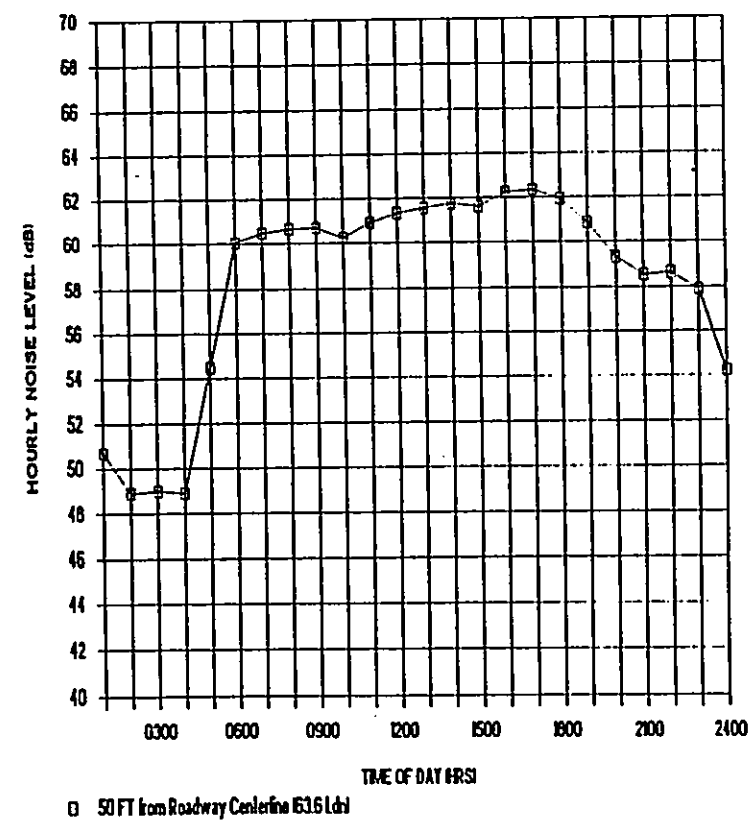


FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAMEHAMEHA HWY. AT OLD KUALOA SUGAR MILL (NOVEMBER 26-27, 1991)



impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation of possible traffic noise impacts was made.

Measurements of pond equipment noise levels were performed at the existing mariculture facility, which has larger ponds than will the proposed future facility. Sound level measurements of the larger 2 horsepower aerators which are currently used, as well as measurements of the smaller 1/2 horsepower aerators, which are planned to be used in the future ponds, were obtained. Sound level measurements of water spillway noise were also obtained. The results of these noise measurements were entered as inputs to the computer noise model which was used to develop noise level predictions for the proposed future mariculture facility. Calculations of average exterior noise levels from on-site pond equipment were performed. Predicted equipment noise levels were compared with existing background ambient noise levels, and potential noise impacts were then assessed. Recommended noise mitigation measures were also provided as required.

CHAPTER V. EXISTING NOISE ENVIRONMENT

The existing background ambient noise levels at the northeast corner of the project site near Location "B" (see FIGURE 3) are in the "Minimal Exposure, Unconditionally Acceptable" category at less than 55 Ldn. The results of the daytime and early morning background ambient noise measurements at Location "B" are shown in FIGURES 6 and 7, and TABLE 2. The early morning noise levels measured at Location "B" (FIGURE 7) were controlled by crickets. The Octave Band frequency components of the measured background ambient noise levels are shown in FIGURE 8. The peaking of the 46.2 dBA background noise level curve at 8,000 Hz (see FIGURE 8) resulted from the crickets.

Background ambient noise levels in the western or mauka portions of the project site are controlled by road traffic along Kamehameha Highway. Existing background ambient noise levels at the western portion of the project site are estimated to be less than 65 Ldn at 50 FT setback distance from the highway centerline, and are in the "Moderate Exposure, Acceptable" category. At approximately 181 FT setback from the highway centerline, traffic noise levels decline to 55 Ldn, and traffic noise levels are in the "Minimal Exposure, Unconditionally Acceptable" category.

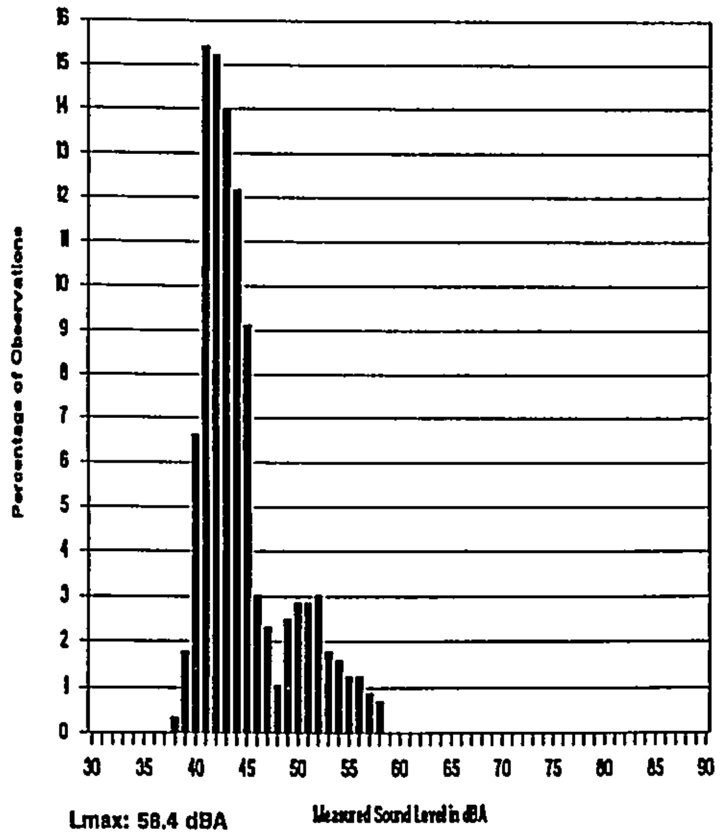
The results of the Octave Band measurements obtained for pond equipment as well as background ambient noise are shown in FIGURE 8. The primary noise sources at the existing ponds are electric motor driven pond aerators and water spillway noise. The high noise level (70 dBA at 12 FT) associated with a 2 horsepower aerator was attributable to worn or defective bearings. The 1/2 horsepower aerator was relatively quiet at 47 dBA when measured at 18 FT. The water spillway noise was similar to that of a small waterfall, and provided a natural masking noise source for the quieter aerators.

TABLE 2 presents the results of the existing traffic noise measurements and their comparisons with FHWA Highway Noise Model

FIGURE 6

HISTOGRAM OF A-WEIGHTED SOUND LEVELS AT LOCATION 'B' (1020 HRS TO 1035 HRS)

DATE: December 13, 1991 METER RESPONSE: Slow

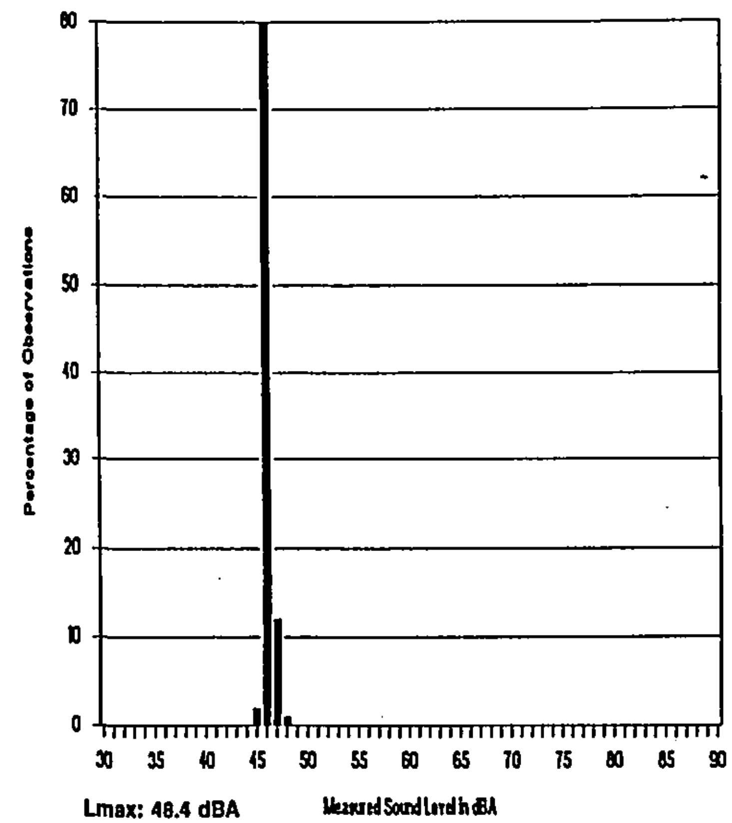


Lmax: 58.4 dBA
L10: 52.0 dBA
Leq: 46.8 dBA
Lmin: 38.4 dBA

FIGURE 7

HISTOGRAM OF A-WEIGHTED SOUND LEVELS AT LOCATION 'B' (0411 HRS TO 0413 HRS)

DATE: December 14, 1991 METER RESPONSE: Slow



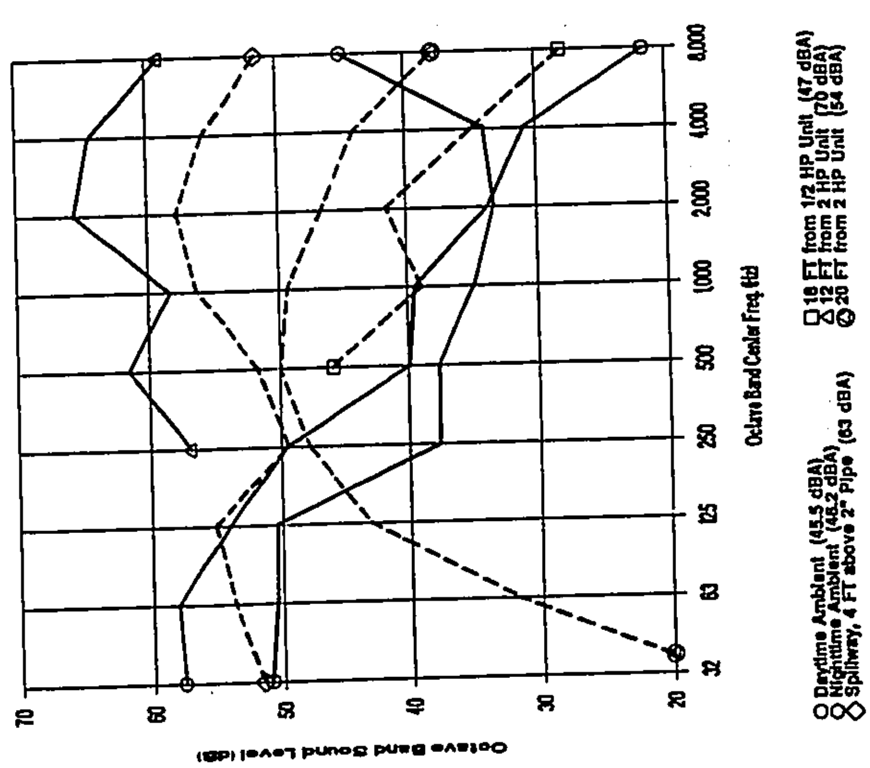
Lmax: 48.4 dBA
L10: 47.0 dBA
Leq: 46.1 dBA
Lmin: 45.1 dBA

TABLE 2

NOISE MEASUREMENT RESULTS

Location	Time of Day (HRS)	Ave.Speed (MPH)	—Hourly Traffic Volume— Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
A. 50 FT from Centerline of Kamehameha Highway at Kaawa Residence. (12/11/91)	1530 TO 1630	45	902	43	26	62.1	62.1
B. Near Northeast Corner of Project Site. (12/13/91)	1020 TO 1035	N/A	N/A	N/A	N/A	46.8	N/A
B. Near Northeast Corner of Project Site. (12/14/91)	0411 TO 0413	N/A	N/A	N/A	N/A	46.1	N/A

FIGURE 8
OCTAVE BAND SOUND
LEVEL MEASUREMENT RESULTS



predictions. Results of the calculations of existing (CY 1991) traffic noise levels during the PM peak hour period are shown in TABLE 3. The results of the calculations apply at 50 FT distance from the centerlines of the various roadway sections shown in the table. Calculated setback distances from these roadways to the existing 60, 65, and 70 Ldn contours are shown in TABLE 4. The traffic noise levels shown in the tables only apply when unobstructed line-of-sight conditions exist to the roadways. These conditions would generally occur at short (50 to 100 FT) distances to a roadway, within any flat, open space along the roadway, and at distant, but elevated locations above the roadway. The existing traffic noise levels shown in the tables should be reduced by 3 to 5 dB (or Ldn) if partial shielding (line-of-sight obstruction) exists between the roadway and the receptor location. If the receptor is located behind an obstruction (berm, hill, or building), the noise levels in the tables and figures should be reduced by 5 to 10 dB.

TABLE 3

COMPARISONS OF EXISTING AND FUTURE TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING PM PEAK HR. TRAFFIC:						
Kamehameha Hwy. @ Kaawa Residence	45	1,045	58.8	56.8	56.8	62.4
Kamehameha Hwy. North of Project	45	1,045	58.8	56.8	56.8	62.4
Kamehameha Hwy. South of Project	45	1,045	58.8	56.8	56.8	62.4
FUTURE PM PEAK HR. TRAFFIC WITH PROJECT:						
Kamehameha Hwy. @ Kaawa Residence	45	1,271	59.7	57.7	57.7	63.2
Kamehameha Hwy. North of Project	45	1,268	59.7	57.7	57.7	63.2
Kamehameha Hwy. South of Project	45	1,292	59.8	57.7	57.8	63.3

Note: (1) Assumed traffic mix of 93.0% autos, 4.5% medium trucks, and 2.5% heavy trucks and buses used for existing and future conditions.

TABLE 4

EXISTING AND FUTURE DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	60 Ldn SETBACK (FT) FUTURE	65 Ldn SETBACK (FT) EXISTING	65 Ldn SETBACK (FT) FUTURE	70 Ldn SETBACK(FT) EXISTING	70 Ldn SETBACK(FT) FUTURE
Kamehameha Hwy. @ Kaawa Residence	84	96	39	44	18	21
Kamehameha Hwy. North of Project	84	96	39	44	18	21
Kamehameha Hwy. South of Project	84	97	39	45	18	21

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be 1 dB greater than PM Peak Hour Leq.
(4) Setback distances are for unobstructed line-of-sight and soft ground conditions.

CHAPTER VI. FUTURE TRAFFIC NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 6 for CY 1997 with and without the proposed mariculture project. The future condition with the proposed project is expected to result in slightly greater traffic volumes along Kamehameha Highway south and north of the project. The future projections of project plus non-project traffic on the roadway sections which would service the project are shown in TABLE 3 for the PM peak hour of traffic. As indicated in TABLE 3, by CY 1997, traffic volumes on the roadway sections servicing the project are expected to increase by 21 to 24 percent due to both project and non-project traffic. Traffic noise levels are also expected to increase as a result of increased traffic volumes. The greatest increase in traffic noise of approximately 0.1 Ldn unit is expected to occur along the south section of Kamehameha Highway.

TABLE 4 summarizes the predicted setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadway sections servicing the project and attributable to both project plus non-project traffic by CY 1997. The setback distances in TABLE 4 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in TABLE 4, setback distances to the 65 Ldn contour of 44 to 45 FT from the centerline of Kamehameha Highway are predicted by 1997 if the project is implemented.

As shown in TABLE 5, the predicted increases in traffic noise due to project traffic along Kamehameha Highway are 0.1 Ldn and 0.0 Ldn south and north, respectively, of the proposed mariculture facility site. These levels of increase are considered to be insignificant, and are not expected to significantly alter the existing traffic noise levels along Kamehameha Highway.

TABLE 5

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 1997)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Kamehameha Hwy. @ Kaawa Residence	0.8	0.0
Kamehameha Hwy. North of Project	0.8	0.0
Kamehameha Hwy. South of Project	0.8	0.1

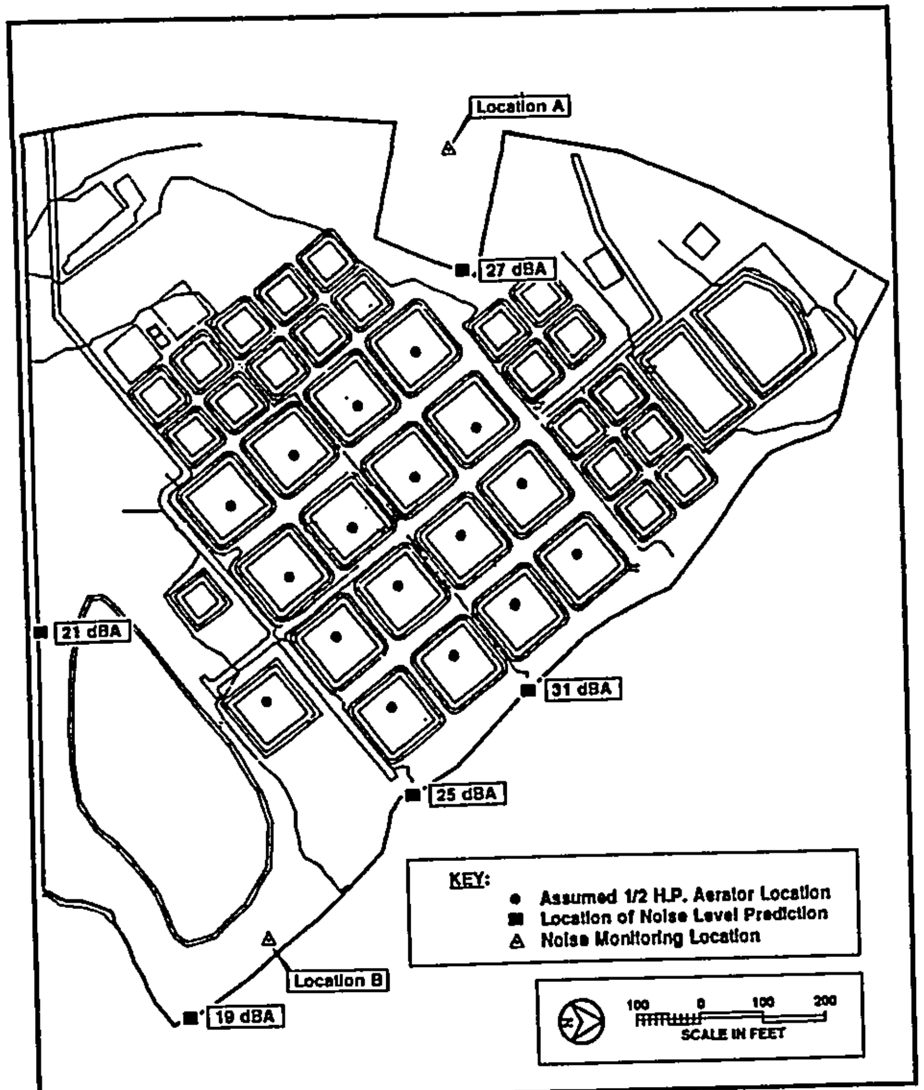
CHAPTER VII. PREDICTED NOISE LEVELS FROM ON-SITE POND EQUIPMENT

The proposed layout of the new ponds associated with this project is shown in **FIGURE 9**. The proposed ponds are smaller than the existing ponds, which are shown in **FIGURE 10**. Seventeen of the new ponds may require simultaneous nighttime use of 1/2 horsepower aerators during certain seasons of the year. The use of the existing 2 horsepower aerators would not be required due to the downsizing of the ponds. Also, an improved water pumping system for the ponds will also be implemented with the proposed project, which should minimize the requirements for use of the 1/2 horsepower aerators. The pumping system will incorporate the use of three each, 25 to 35 horsepower pumps. These pumps will be housed within a concrete building with silenced ventilation openings, and which is to be located near the shoreline.

With all 1/2 horsepower aerators operating, predicted noise levels along the project's boundary lines are shown in **FIGURE 9**. The noise levels from on-site pond equipment at the west, north, and south property lines are predicted to be less than 32 dBA, and below existing background ambient noise levels for the assumed locations of the 1/2 horsepower aerators shown in **FIGURE 9**. Noisy aerator bearings could possibly raise the predicted noise levels shown in **FIGURE 9** by 10 to 12 dBA. Even with all aerators operating with noisy bearings, property line noise levels are predicted to remain at or below existing background ambient noise levels of 45 to 46 dBA. For this reason, risks of adverse noise impacts from the 1/2 horsepower aerators are considered to be very low, particularly if the aerators are properly maintained. From **FIGURE 9**, the following conclusions were developed:

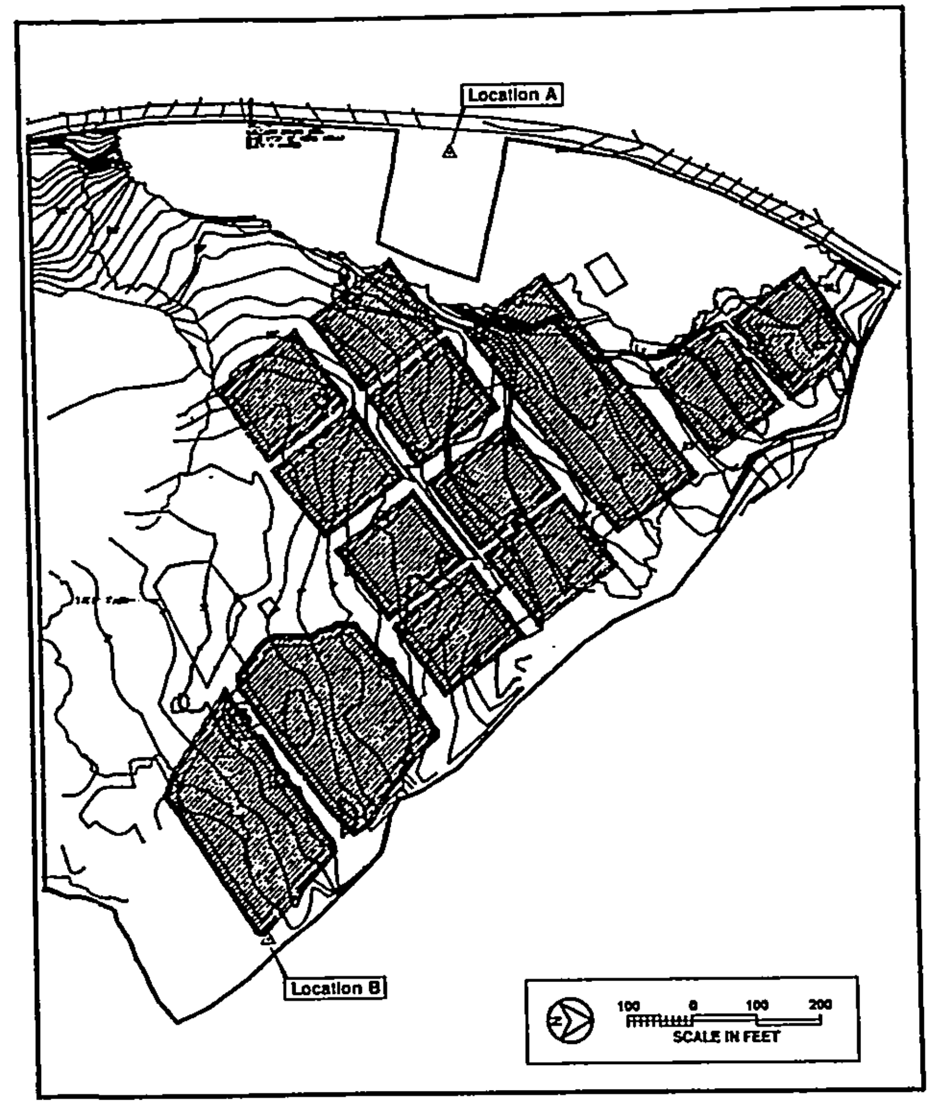
a. The State DOH noise limit of 70 dBA for Agricultural Districts will not be exceeded.

b. Pond equipment noise levels are not expected to exceed 55 Ldn at any of the surrounding noise sensitive properties, and as such, should be in the "Minimal Exposure, Unconditionally Acceptable" category.



PROPOSED NEW POND LAYOUT AND PREDICTED FUTURE NOISE LEVELS FROM 1/2 HP AERATORS

FIGURE 9



EXISTING POND LAYOUT

FIGURE 10

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

Traffic Noise. By CY 1997, traffic volumes in the project environs are expected to increase by approximately 0.8 Ldn as a result of non-project traffic. Project traffic is not expected to cause noticeable increases in traffic noise along the roadway sections north or south of the project site. The largest increases in traffic noise attributable to project traffic are expected to occur along Kamehameha Highway (see TABLE 5) south of the project site. Traffic noise levels along the south section of Kamehameha Highway are expected to increase by 0.1 Ldn as a result of project traffic. Because the increases in project related traffic noise levels are expected to be minimal, adverse traffic noise impacts from the proposed project are not expected to occur.

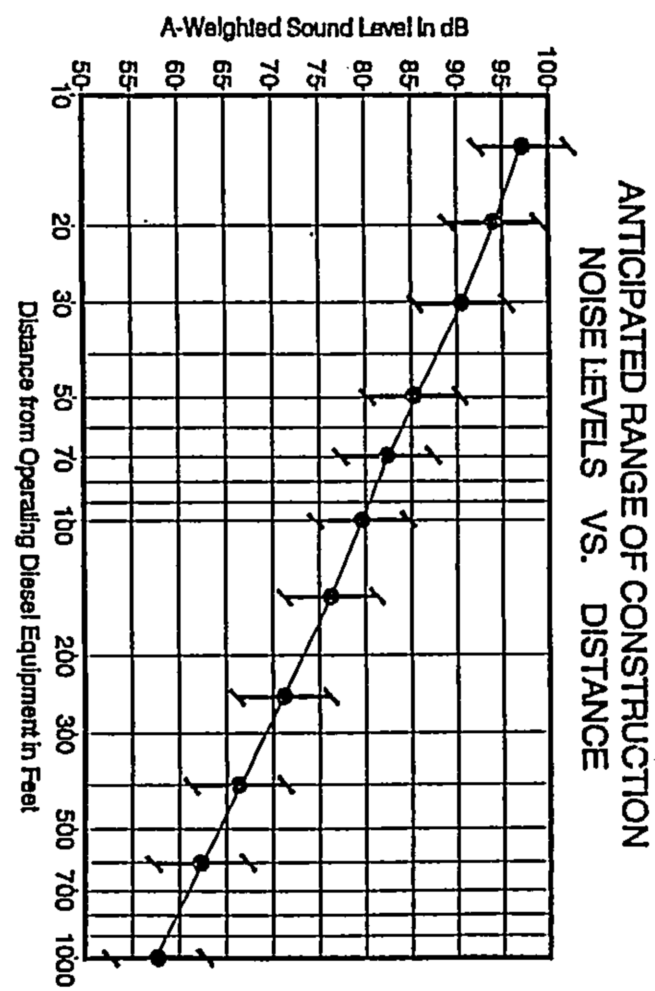
On-Site Pond Equipment Noise. The proposed 1/2 horsepower pond aerators should not create noise problems similar to those associated with the existing 2 horsepower aerators, particularly if they are properly maintained. The 1/2 horsepower units are significantly quieter (by 6 to 8 dBA) than a properly functioning 2 horsepower unit, and approximately 20 dBA quieter than a noisy 2 horsepower unit with faulty bearings. The proposed 1/2 horsepower aerators can and should be located with at least 100 FT buffer distance from any property line of the project site. With this buffer distance and with proper equipment maintenance, adverse noise impacts from the 1/2 horsepower aerators are not anticipated.

The waterfall noise at the pond spillways can be used to provide natural masking sounds around the facility. The spillway noise is not excessively loud, and is slightly louder (by 3 dBA) than the 1/2 horsepower aerators. In addition, the spillway noise components span the mid to high frequency bands which also coincide with the aerator noise spectrum characteristics (see FIGURE

8). Because of its natural sounding characteristics, spillway noise could be used as an effective masking source to further reduce the audibility and likelihood of noise complaints associated with the 1/2 horsepower aerators. In order to maximize the masking effectiveness of the spillways, they should be located on the opposite sides of the ponds from the aerator locations shown in FIGURE 9.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activities are shown in FIGURES 11 and 12. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (Reference 9), is another noise mitigation measure which can be applied to this project. TABLE 6 depicts the allowed hours of construction for normal construction noise (levels which do not



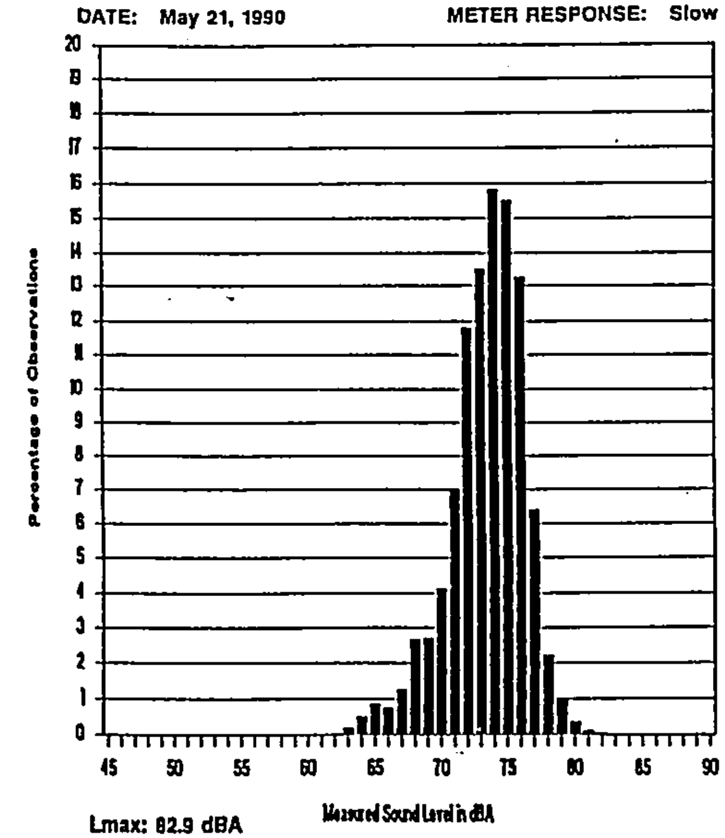
CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 11

FIGURE 12

TYPICAL NOISE LEVELS FROM
GRADING WORK AT 100 FT DISTANCE

DATE: May 21, 1990 METER RESPONSE: Slow

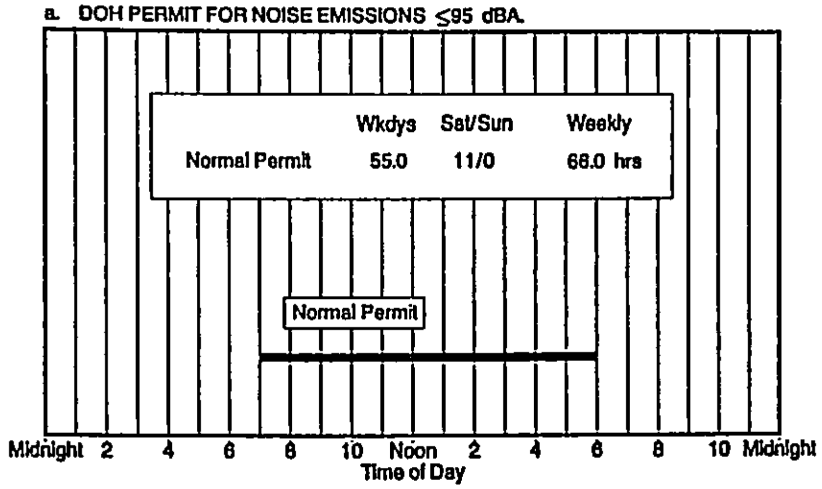


Lmax: 82.9 dBA
L10: 77.0 dBA
Leq: 74.7 dBA
Lmin: 63.0 dBA

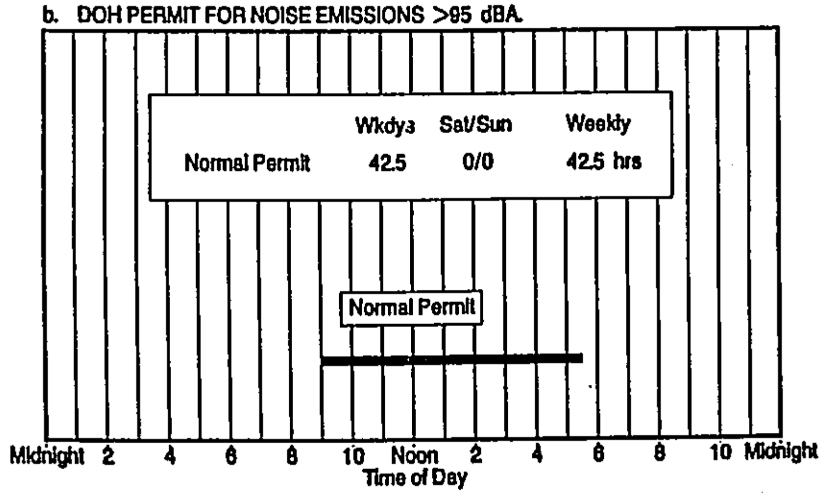
TABLE 6

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤95 dBA



b. DOH PERMIT FOR NOISE EMISSIONS >95 dBA



exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

APPENDIX A. REFERENCES

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

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

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

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

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

(6) Barton-Aschman Associates, Inc.; "Draft Traffic Impact Study for An Aquaculture Research Facility In Kaneohe, Hawaii;" February 1992; and Transmittal Dated February 28, 1992.

(7) 24-Hour Traffic Counts; Station C-29-B, Kamehameha Highway 1.9 Miles Northeast of Johnson Road (Old Sugar Mill); November 27, 1991; Hawaii State Department of Transportation.

(8) 24-Hour Traffic Counts; Station 30, Kamehameha Highway at Waiahole Valley Road; June 27, 1990; Hawaii State Department of Transportation.

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

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

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

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

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

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

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

Descriptor Nomenclature

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

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

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

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

Noise Impact

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

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

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

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

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

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

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

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

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

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

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

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

APPENDIX C

ARCHAEOLOGY STUDY

ARCHAEOLOGICAL INVENTORY SURVEY OF THE PROPOSED KUALOA OCEANIT MARICULTURE POND EXPANSION AREA, HAKIPU'U, KO'OLAUPOKO, O'AHU

by

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for
Oceanit Laboratories, Inc.

by

Cultural Surveys Hawaii

Revised June 1993
Appendix C Added December 1993

Abstract

In February of 1992 Cultural Surveys Hawaii conducted an archaeological inventory survey and test excavations on a 26 acre parcel of land in the *ahupua'a* of Hakipu'u, Ko'olaupoko District, O'ahu Island (TMK 4-9-01). This research consisted of a field reconnaissance, sub-surface testing, and historic background research for the proposed expansion of the University of Hawaii Mariculture Research and Training Center (MRTC). The project area comprises 26 acres and includes 13 acres of existing research buildings and mariculture ponds, as well as an extensive area of *hau* and mangrove swamp. The survey and test excavation were conducted to determine the presence or absence of prehistoric and historic sites in the project area and especially in the swamp land surrounding the existing pond infrastructure. No surface sites, or site remnants were located in or around the existing ponds, or in the area of proposed expansion. One site, 50-80-06-4492, was located on the property just *makai* of Kamehameha Highway and just north of the present driveway into the project area. Historic research indicates that the project area did contain extensive *lo'i* and rice paddies during the nineteenth century that are now buried under the present swamp. Systematic core sampling and analysis was recommended in the wetland areas designated for pond expansion.

Additional fieldwork, consisting of three backhoe-dug trenches, was conducted on 12/2/93. The trenching was done to record and collect representative soil stratigraphic samples within the area slated for pond expansion. The results of this additional field coring are presented in Appendix C of this report.

Acknowledgements

Cultural Surveys Hawaii wishes to thank Mr. Henry Kaawa for sharing his knowledge concerning the history of the project area and Hakipu'u *ahupua'a* in general, and for his information on the lifestyle of the people of Hakipu'u. Fieldwork was conducted by the authors, Mr. Ed Duncan and Ms. Julie Borra. Insight into report preparation was provided by David Shideler M.A and Doug Borthwick B.A. Historic background research for the report was provided by Mrs. Helen Wong-Smith M.A.

We also wish to thank Mr. Bob Bourke of Oceanit Laboratories Inc. and Dr. Tom Dye at the Hawaii State Historic Preservation Office for facilitating our research.

Backhoe services were provided by Mr. George Sebring, who also shared his knowledge of the project area as over a number of years he has conducted thousands of feet of trenching for MRTC.

Glossary

A-horizon	-a soil layer characterized by the accumulation of organic matter at the ground surface
Ahu	-heap, pile, collection, mass, altar, shrine; a traplike stone enclosure made by fishermen for fish
Ahupua'a	-a traditional Hawaiian land unit extending from the mountain to the sea
Ali'i	-chief, chiefess, nobility
Apana	-a smaller division of a Land Commission Award
Archaeological feature	-the discrete remains of post activity preserved in the ground
Artifact	-any object made by man
B-horizon	-a subsurface soil layer characterized by clay accumulation
C-horizon	-a subsurface soil layer which is minimally modified parent material of soil formation
Carbonate	-Calcium carbonate
cmbs	-centimeters below soil surface
Flake	-a piece of stone struck from a larger piece
Hale	-house
Hammerstone	-a stone used for percussion flaking or driving
Historic	-in Hawaii, the period after the landing of (post contact) Captain Cook in 1778.
'ili	-a small land unit, a subdivision of an ahupua'a
in situ	-the place of original deposition
kihapai	-small land division, garden plot

loko	-fishpond.
lo'i	-a wetland taro field
makai	-towards the sea
mauka	-towards the mountains
midden	-faunal and floral remains from archaeological deposits, usually food remains
ohana	-a kin group of extended families
pedogenic	-related to soil forming processes
pedogenic carbonate	-naturally occurring carbonate precipitated in a soil horizon
profile	-the vertical section of the ground
soil texture	-describes the size of the mineral grains in soil
soil structure	-describes the aggregates of soil particles
stratigraphic boundary	-the contact between two distinct strata
stratum	-a visually distinct layer of sediment
volcanic glass	-a structureless cooled lava which occurs naturally in lava flows and was used by Hawaiians as small cutting tools.

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I. Introduction

In February of 1992 Cultural Surveys Hawaii undertook background research, archaeological inventory survey, and test excavations for Oceanit Laboratories, Inc. on a parcel of land located in Hakipu'u *ahupua'a*, Ko'olaupoko, O'ahu, T.M.K. 4-9-01 (Figs. 1, 2, and 3). The project area consists of 26 acres of the University of Hawaii Mariculture Research and Training Center (MRTC) (Fig. 4).

Fieldwork was conducted in February of 1992 with the aim of identifying and locating any historic or prehistoric surface archaeological sites within the project boundaries. Test excavation was then carried out in three areas in an attempt to locate and describe any subsurface features and to provide general stratigraphic information concerning the subject parcel. This information was used to formulate a scope of work for further mitigation of specific areas through systematic core sampling and analysis.

Additional subsurface testing (backhoe trenching) was conducted in a grass-covered swampy area where a hand test unit (Test Unit #2) could not be completed satisfactorily due to the waterlogged soil conditions. The results of the additional testing, which consisted of three backhoe trenches, is presented in Appendix 3 of this report.

II. Scope of Work

The basic scope of work undertaken was to perform an inventory survey consisting of a surface survey, test excavations, and historical review to mitigate impact of the proposed Kualoa Oceanit Mariculture pond expansion on potential archaeological sites.

Fieldwork was conducted in February 1992 with the aim of identifying and locating any historic or prehistoric surface archaeological sites within the project boundaries. Test excavation was then carried out in three areas in an attempt to locate and describe any subsurface features and to provide general stratigraphic information concerning the subject parcel. This information was used to formulate a scope of work for further mitigation of specific areas through systematic core sampling and analysis (See Appendix C for Additional fieldwork).

The scope of work undertaken by Cultural Surveys Hawaii and agreed upon by Dr. Tom Dye of the State Historic Preservation Division includes the following:

1. A complete ground survey of the entire project area for the purpose of site inventory. All sites would be located, described, and mapped with evaluation of function, interrelationships, and significance. Documentation will include photographs and scale drawings of selected sites and complexes. All sites will be assigned State site numbers.

2. Limited subsurface testing to determine depth and quantity of cultural materials within archaeological sites and to obtain datable samples for chronological information if none is available for sites in the immediate area from previous studies.

3. Research on historic and archaeological background, including search of historic maps, written records, Land Court Awards, and Native Testimony. This research will focus on the specific area with general background on the *ahupua'a* and district and will emphasize settlement patterns.

4. Preparation of a survey report which will include the following:

   a. A topographic map of the survey area showing all archaeological sites and site areas;
   b. Description of all archaeological sites with selected photographs, scale drawings, and discussions of function;
   c. Historical and archaeological background sections summarizing prehistoric and historic land use as they relate to the archaeological features;
   d. A summary of site categories, evaluating their significance in an archaeological and historic context;
   e. Recommendations based on all information generated which will specify what steps should be taken to address potential impact of development on archaeological resources such as data recovery (excavation) and preservation of specific areas. These recommendations will be developed in consultation with the landowner and the State and County agencies.

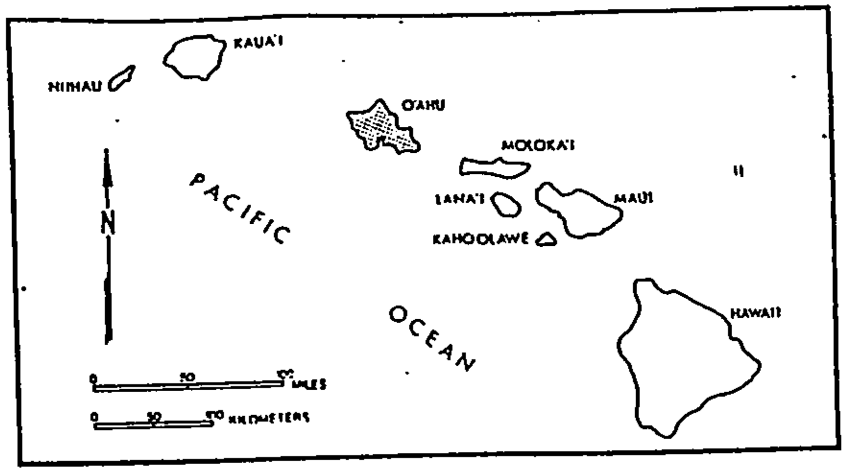

Fig. 1 State of Hawai'i

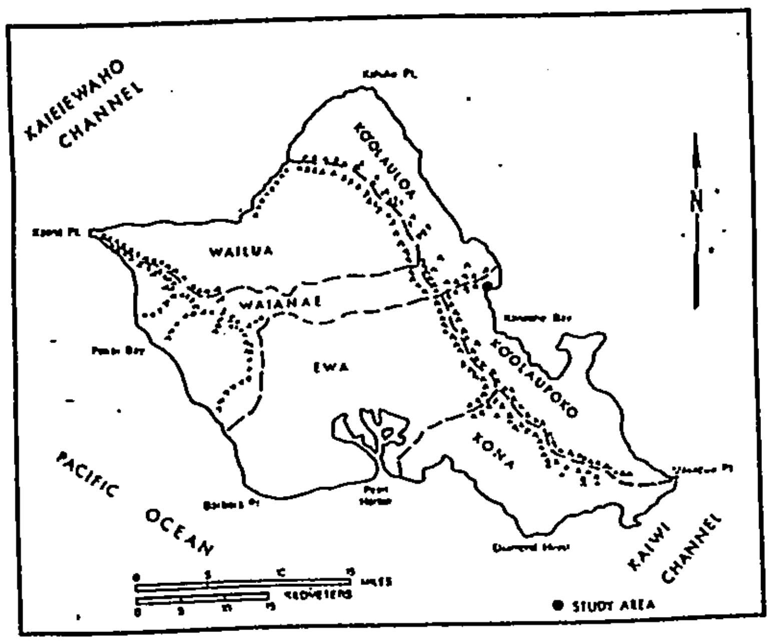

Fig. 2 O'ahu Island Location Map

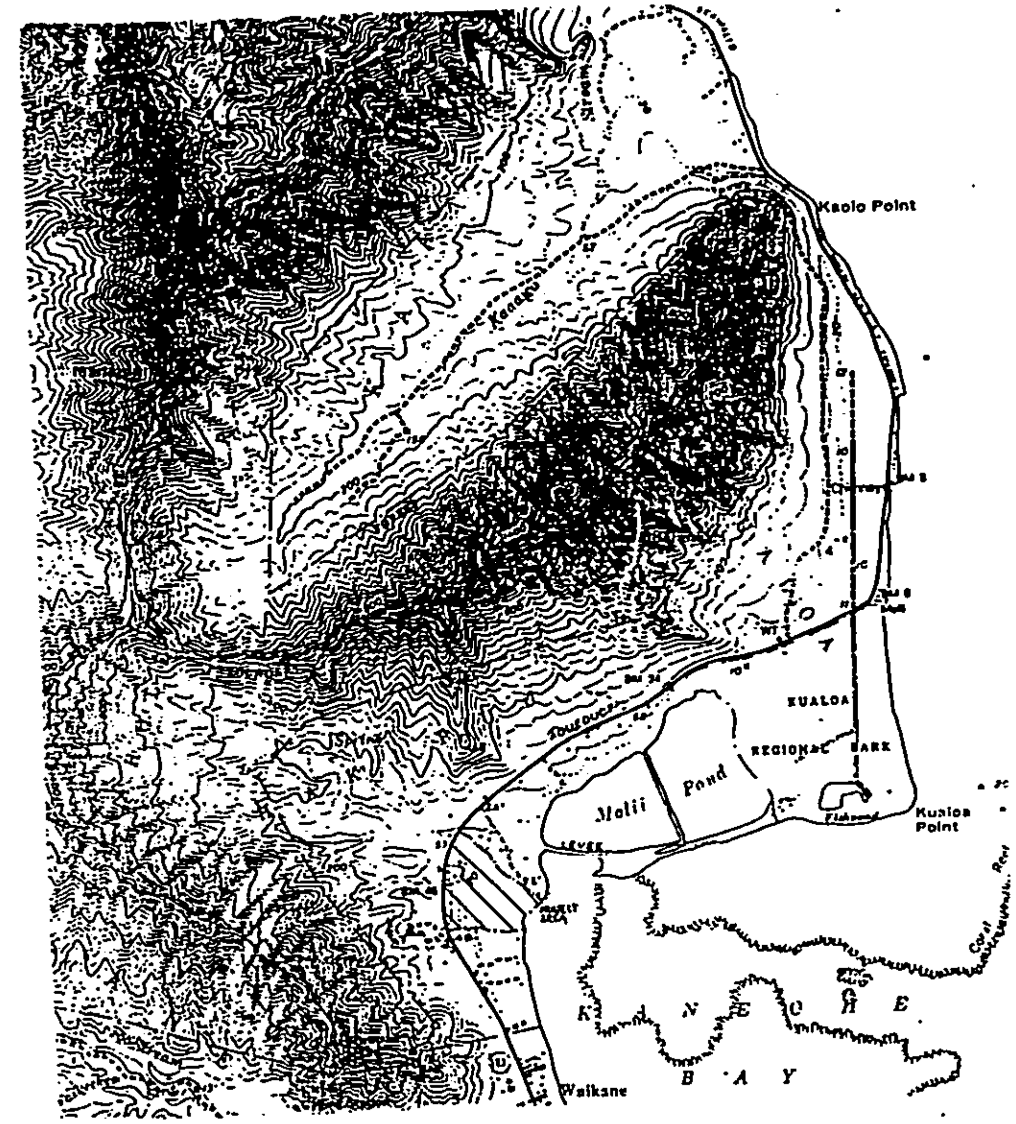

Fig. 3 U.S.G.S. 7.5 Minute Map, Hakipu'u, Koolaupoko, O'ahu

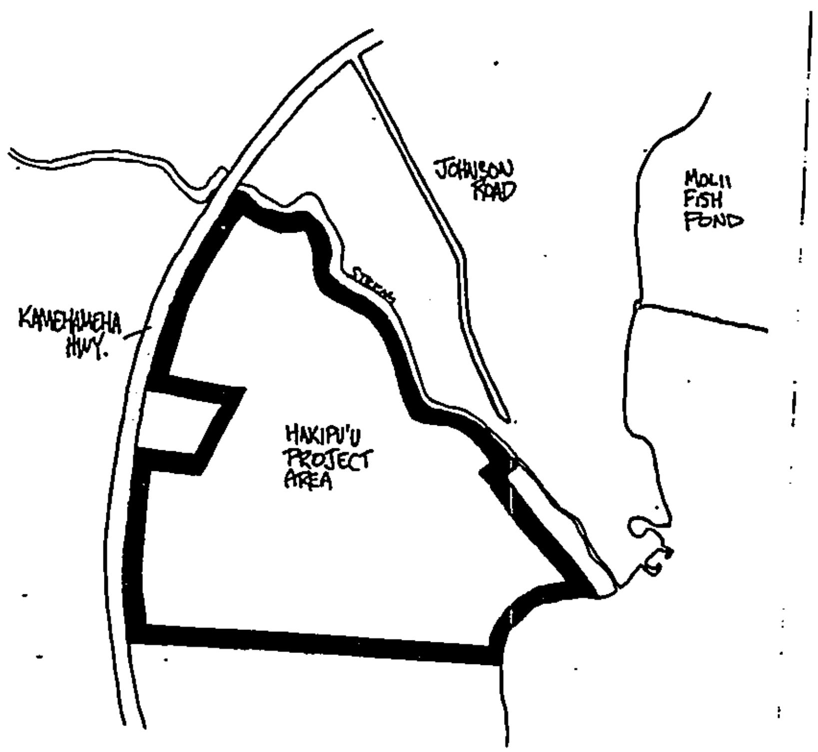

Fig. 4 Project Area Map, Hakipu'u, Ko'olaupoko, O'ahu

III. Project Area Description

Hakipu'u is a small *ahupua'a* that stretches from Kane'ohe Bay (to the east), to the top of the Ko'olau mountains (to the west), and from Waikane *ahupua'a* (to the south), to the top of a ridge line (containing Pu'u Kanehoalani) that extends from the Ko'olau out towards Mokoli'i Island (Chinaman's Hat) and to Kualoa *ahupua'a* (to the north). The top of the ridge line demarcates both Ka'aawa and Kahana *ahupua'a* and also the border between the districts of Ko'olauloa and Ko'olaupoko.

The project area is located in the central portion of the *ahupua'a* and is clearly demarcated on three sides: by Kamehameha Highway to the west (*mauka*), by Kane'ohe Bay to the east (*makai*), and by Hakipu'u Stream to the north. The southern boundary is overgrown by dense *hau* jungle and is demarcated by several rusted fence posts.

The project area is located near the northern edge of Kane'ohe Bay just south of Kualoa Ranch and Kualoa Park. Directly across the street from the entrance to the property is the Coral Kingdom, a popular tourist stop that is easily seen on the *mauka* side of Kamehameha Highway. Large mango trees, exotic bushes, and *hau* jungle hide the property from the street.

The project area consists of twenty-six (26) acres of land that are perceived as three distinct areas: 1) lawns, buildings, and pond infrastructure (50%); 2) dense *hau* thicket interspersed with large mangrove and *hàla* trees (25%); and 3) mangrove swamp and open, grassy, mud flats (25%).

Area 1, comprising 13 acres of the project area, consists of the existing mariculture pond areas, open lawns, and research buildings. This area has been extensively disturbed by bulldozer activity in the past during construction of the present mariculture ponds, and during the construction of the driveway and research facility buildings. Most of Area 1 is covered with mariculture ponds. The ponds were created by bulldozing up large berms of earth to form a series of interconnected rectangular basins. The rest of the area is covered with plants and large exotic and native trees such as mango, coconut, and *hau*, as well as various unidentified species of common bushes and vine. There is also a remnant of one historic structure, the mortuary house (CSH Site 1). The extensive disturbance of Area 1 during construction of the mariculture pond system and research buildings apparently destroyed any archaeological remains that may once have been present in Area 1.

Area 2, approximately 6.5 acres, is covered almost completely by dense *hau* jungle. There are also large mangrove and *hala* trees, and wild *taro* plants interspersed within the *hau* jungle. The *hau* jungle grows over an extensive swamp area that covers much of the undeveloped portion of the property. The swamp was formed by the low elevation of this portion of the property (at sea level or slightly above sea level). The swamp has obliterated at least three known historic sites, as reported by a local informant, Mr. Henry Kaawa, including an old Chinese house site, a Japanese well, and a historic culvert. No remnants of these sites were located during the field survey and it is probable that these sites no longer exist. The entire area is now dense swamp and, based on the size of the mangrove and *hau* trees, has probably been swamp for several decades.

Area 3 comprises the remainder (6.5 acres) of the project area and, based on a comparison of early photographs, has been overrun by mangrove and *hau* trees. This area is covered with large and small mangrove trees, *hau* jungle, and swamp grasses typically found in swamps and intertidal mud flats. Hakipu'u Stream runs through this area and forms a small delta at the point where it enters Kane'ohe Bay. Kane'ohe Bay shoreline is accreting in this area and has added considerably to the *makai* portion of the property. No remnants of a historic flood control canal were found in this area during the survey, although the remains of two small fishing boats were noted in the swamp mud of the delta. The mud in the delta portion of the swamp is quite deep (1 - 1.5 m.) and based on field testing, appears to be of marine origin. Therefore, no prehistoric, or historic terrestrial cultural mud layers are expected in the *makai* portion of Area 3.

IV. Survey Results

Cultural Surveys Hawaii surveyed the 26-acre parcel with the aim of locating all sites within the project area. The project area was divided into three areas: 1) the lawns, buildings, and existing pond infrastructure; 2) the dense *hau* thicket interspersed with large mangrove and *hala* trees in the southern portion of the parcel, and 3) *hau* and mangrove swamp fronting Kane'ohe Bay. Area 1 was surveyed by three archaeologists with the assistance of Mr. Henry Kaawa, a local resident who has lived in Hakipu'u most of his life. Mr. Kaawa contributed valuable information on the history of Hakipu'u and described several historic sites he thought were located within the study area: CSH Site 1, a historic house site foundation that he described as a "mortuary house" (Area 1); a Chinese house site located in the swamp (Area 3); a historic flood control culvert and a Japanese well within the *hau* swamp (Area 2).

CSH Site 1, the "mortuary house" was the only site that could be located during both the survey and excavation phases of work. Site 1 has been heavily impacted by the construction of Kamehameha Highway and little remains of the site.

Areas 2 and 3 were surveyed on foot by three archaeologists. Considerable effort was made to located the other two sites mentioned by Mr. Kaawa, but without success. If they still exist, which seems doubtful, they have been completely obliterated by Kane'ohe Bay shoreline accretion in this area.

Two long terraces were observed during the survey of Area 2. They are

located just *makai* of Kamehameha Highway in the south/southwest corner of the project area. The terraces appear to be remnants of Kamehameha Highway construction and were marked for test excavation.

V. Sites Within the Project Area

Only one site, CSH Site 1, could be located in the project area. The site is located (Fig. 5) just east (*makai*) of Kamehameha Highway on level ground and is surrounded by mango trees, various palms, coconut trees, and several other introduced species of trees and vines. The site was examined and recorded by Cultural Surveys Hawaii during field survey. Little remains of the site as it was heavily impacted by the construction of Kamehameha Highway. Roughly half of the site was destroyed with dirt, boulders, and other construction debris being piled over the remainder of the site.

The present site consists of a portion of the basement of a historical building that was constructed of cement. The remaining wall sections measure approximately 4.6 m. E/W (*mauka/makai*) by 3.2 m. N/S, with a height of .95 m. at the southwest corner. The basement is believed to have been used as a storage facility for deceased individuals before the modern road was constructed. Bodies were packed in salt and stored until they could be removed to Honolulu (Mr. H. Kaawa, personal communication). Mr. Kaawa reported that the house was inhabited until the modern highway was constructed (ca. 1929). Although several shards of glass and metal were noted near the site, extensive looting of the site's refuse dump by bottle collectors and recent and past bulldozer activity have disturbed much of the area, leaving little of value to determine the site's age, use, and length of habitation. However, based on the construction materials utilized and informant knowledge, it would appear that the site was used until ca. 1929

Fig. 5 CSH Site 1. The "Mortuary House." Hakipu'u, O'ahu

when it was abandoned due to the construction of Kamehameha Highway. Due to the destruction of much of the site Cultural Surveys Hawaii determined that the site is no longer significant (NLS).

VI. Excavation Results

After survey completion of the project area, a plan was formulated to test certain areas to ascertain the presence or absence of subsurface archaeological remains. Based on the survey results, three areas were chosen for test excavation (Fig. 6).

Unit One

Unit 1, a .50 m. by .50 m. test unit, was excavated near the bank of Hakipu'u Stream to test the area for cultural and/or agricultural remains. The unit was excavated in an area that closely corresponds to the original land surface of the project area before the mariculture research center ponds were constructed and is located adjacent to several of the ponds. Unit 1 was excavated approximately 7.0 m. from the banks of Hakipu'u Stream, in an flat area covered in California grass, with mango, banana, papaya, and *hau* trees. A profile of Unit 1 is included to show the stratigraphy of the soil in an undisturbed portion of the land surrounding Hakipu'u Stream (Fig. 7).

The surface of Unit 1 was covered with a thick layer of dead California grass. Directly beneath this was .03 m. to .05 m. of modern topsoil (Stratum I). Stratum I is classified as 7.5 YR 3/2 (dark brown), silty clay loam, and is composed of decayed organic matter and loose soil.

Stratum II, .05 m. to .10 m. below surface, consisted of thick dark brown alluvium. This layer contained only one piece of historic material, a fragment of rusted metal. Stratum II has numerous small roots, and small sub-angular

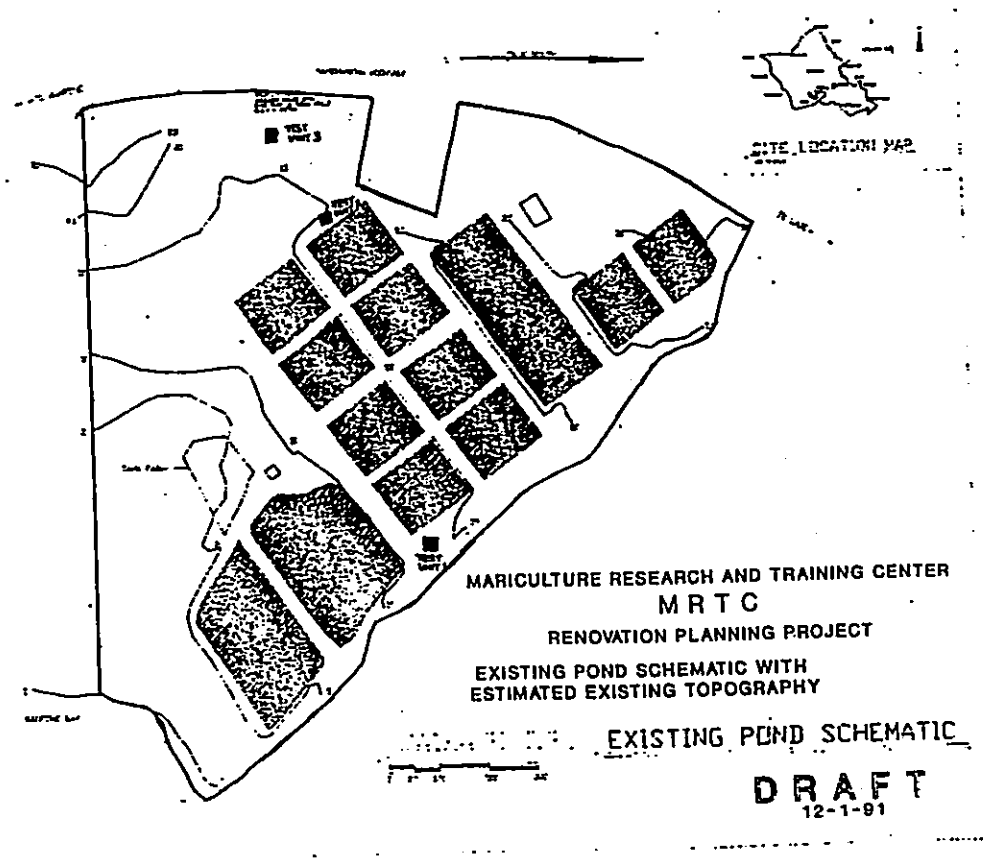

Fig. 6 Project Area Showing Test Units, Hakipu'u, Ko'olaupoko, O'ahu

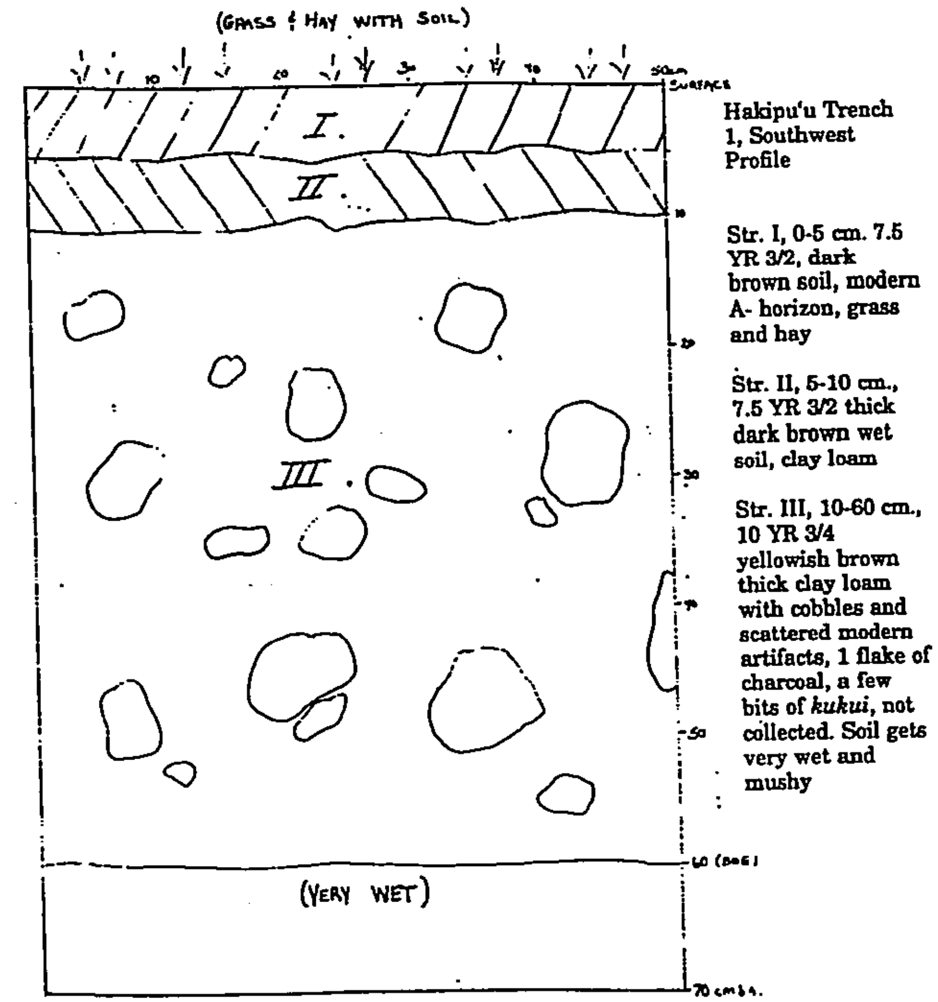

Fig. 7 Profile Record of Unit 1, Hakipu'u, Ko'olaupoko, O'ahu

pebbles and is classified as 7.5 YR 3/2 (dark brown) silty clay loam.

Stratum III, .10 m. to .60 m. (below surface) is classified as 10 YR 3/4 (dark yellowish brown) clay loam. This stratum contains numerous small water-worn pebbles and cobbles and appears to be disturbed or reworked alluvium from the recent channelization of Hakipu'u Stream. Several bits of white plastic, modern bottle glass, one fleck of charcoal, and numerous *kukui* nut shells (not collected) were noted in the soil of Stratum III. The presence of modern artifacts in Stratum III indicates that the alluvium was deposited within the last fifty years. At .60 m. the excavation was abandoned because the soil at the base of excavation, Stratum III alluvium, became waterlogged. No prehistoric artifacts or midden were observed in the excavation.

Unit Two

Unit 2 was excavated in a portion of Area 2 that will include construction of new ponds. This area appeared, from the surface, to be a large field of thick guinea grass and vines. However, upon excavation it was discovered that the area was completely waterlogged swamp land. Due to the extreme wetness of the soil, it was impossible to dig Unit 2. The unit immediately filled with water when excavation was attempted. Due to the difficulty imposed by the saturated soil of the unit, it was determined that a core sample would be of more use in determining whether there were any cultural remnants present in the area (See Appendix C).

Unit Three

Unit 3 was excavated in a terraced area just *makai* of the highway on a small hill that rises above the swamp. The two terraces run parallel to the highway just below (*makai*) a present-day *ti* farm owned by Kualoa Ranch. A unit was excavated in the lower terrace to determine if it was a deliberate construction that was utilized for agricultural purposes, or whether it was merely a result of bulldozing during the construction of the highway.

The lower terrace is approximately two meters above the swamp and is covered with numerous introduced plant species including a relative of the common gum tree and large cat's claw vines. The ground is exposed and appears to be composed of large peds and small cobbles of decomposing basalt of sterile clay loam.

Unit 3 contained only sterile Stratum III (C horizon) clay loam and was excavated to a depth of .40 m.. The soil was composed of large distinct peds combined with small pebbles and cobbles of decomposing basalt. Based on the excavation, it is probable that the terrace was formed by cut and fill construction techniques associated with Kamehameha Highway, and has no archaeological or cultural value. The soil in Unit 3 is classified as 10 YR 3/6 (dark yellowish brown) clay loam.

VII. Summary of Archaeological Research

Land Commission Awards (LCAs)

The main location (Area 1) where prehistoric and historic remains were expected was destroyed when the original mariculture ponds were put in, obliterating any remnants of prehistoric and/or historic habitation or agricultural sites. However, in the area of proposed pond expansion (the central portion of Area 2 and the *mauka* portion of Area 3), there were a number of Land Commission Awards which presumably contained former *lo'i*, and rice fields.

An examination E.D. Baldwin's 1907 map of Hakipu'u *ahupua'a* shows a total of 16 Land Commission Awards in the present project area (Fig. 8). Aside from LCAs 3068, 3061, and 6117, all of the Land Commission Awards in the project area are located in the *mauka* and northern section of the parcel. Any remnants associated with a majority of these Land Commission Awards were destroyed by the construction of the present mariculture ponds (Fig. 9). Only LCAs 5939, 10295, a portion of 3068, and 5979 (Mr. Kaawa's lot) were not impacted by the original mariculture pond construction. LCAs 5939, 10295, and 5979 lie outside of the proposed area of pond expansion and are located on a small bluff feature that is considerably higher in elevation than the surrounding area of proposed pond expansion. Therefore, they will not be impacted by the proposed pond expansion. However, LCA 3068 will be impacted by the proposed pond expansion (Fig. 10). This area now consists of swamp mud, soil, and dense *hau* jungle and could not be tested during fieldwork. However, core sampling would be

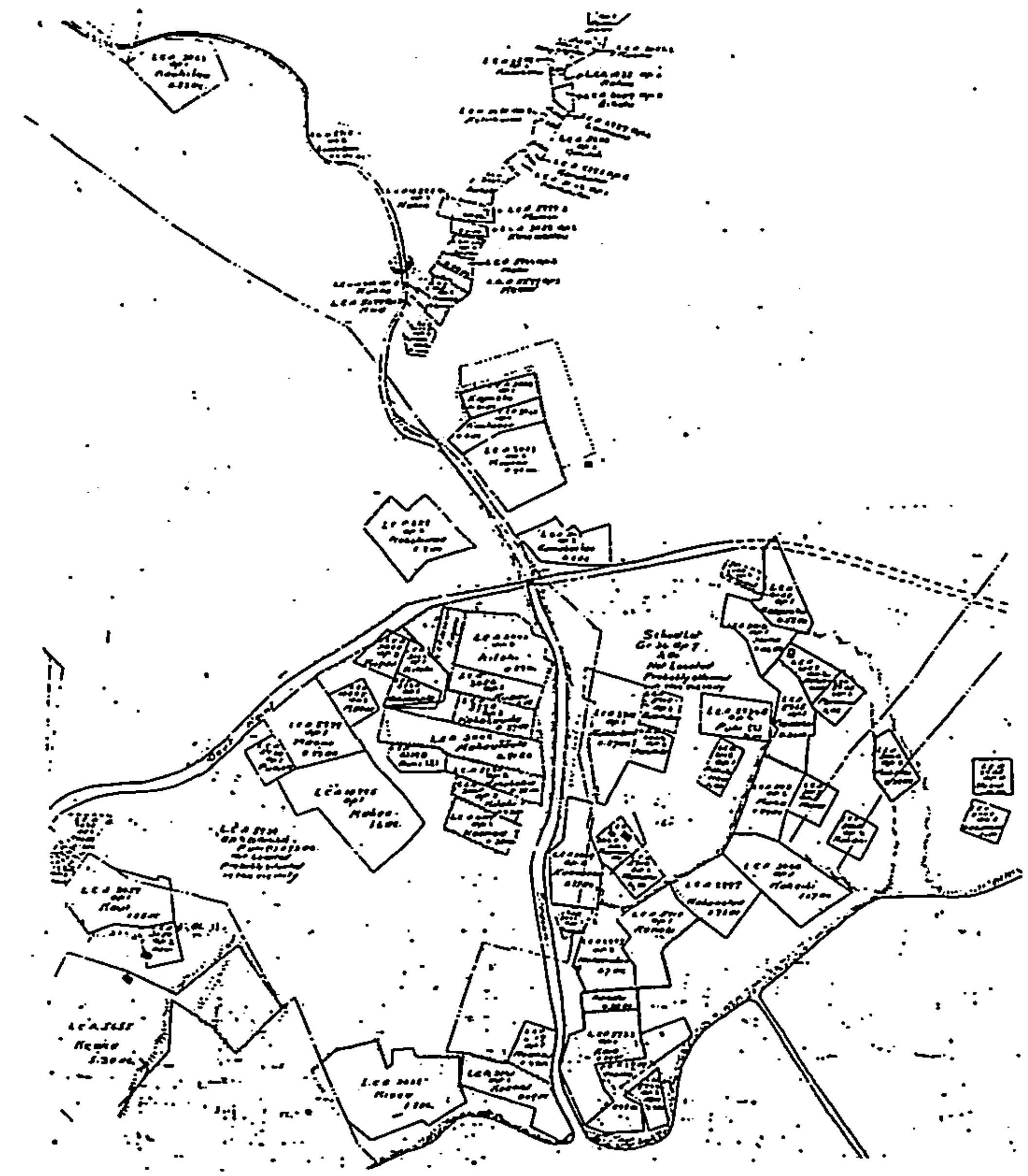

Fig. 8 Map of Land Commission Awards in Hakipu'u by Baldwin, 1907.

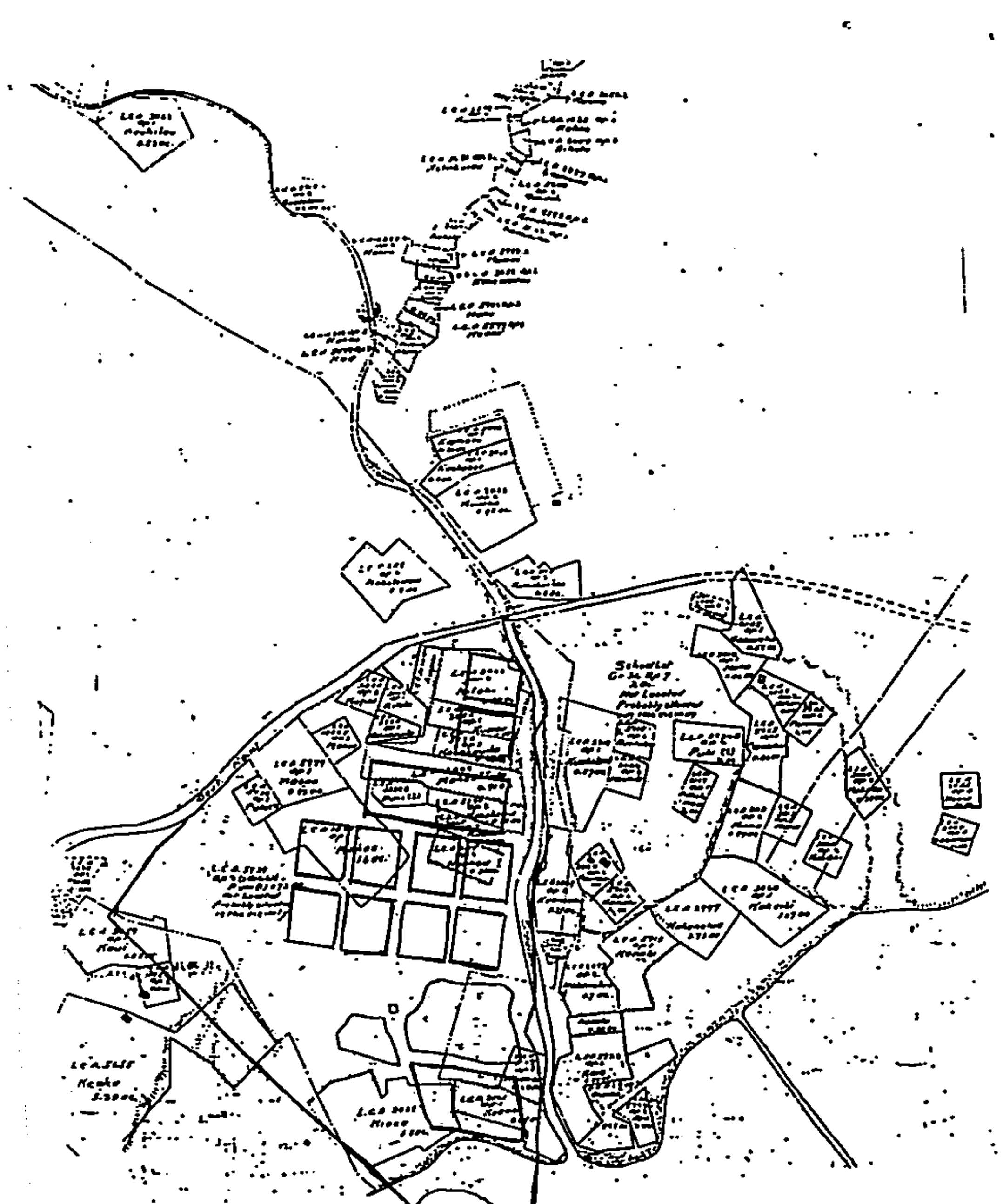

Fig. 9 Map of Land Commission Awards and Existing Ponds.

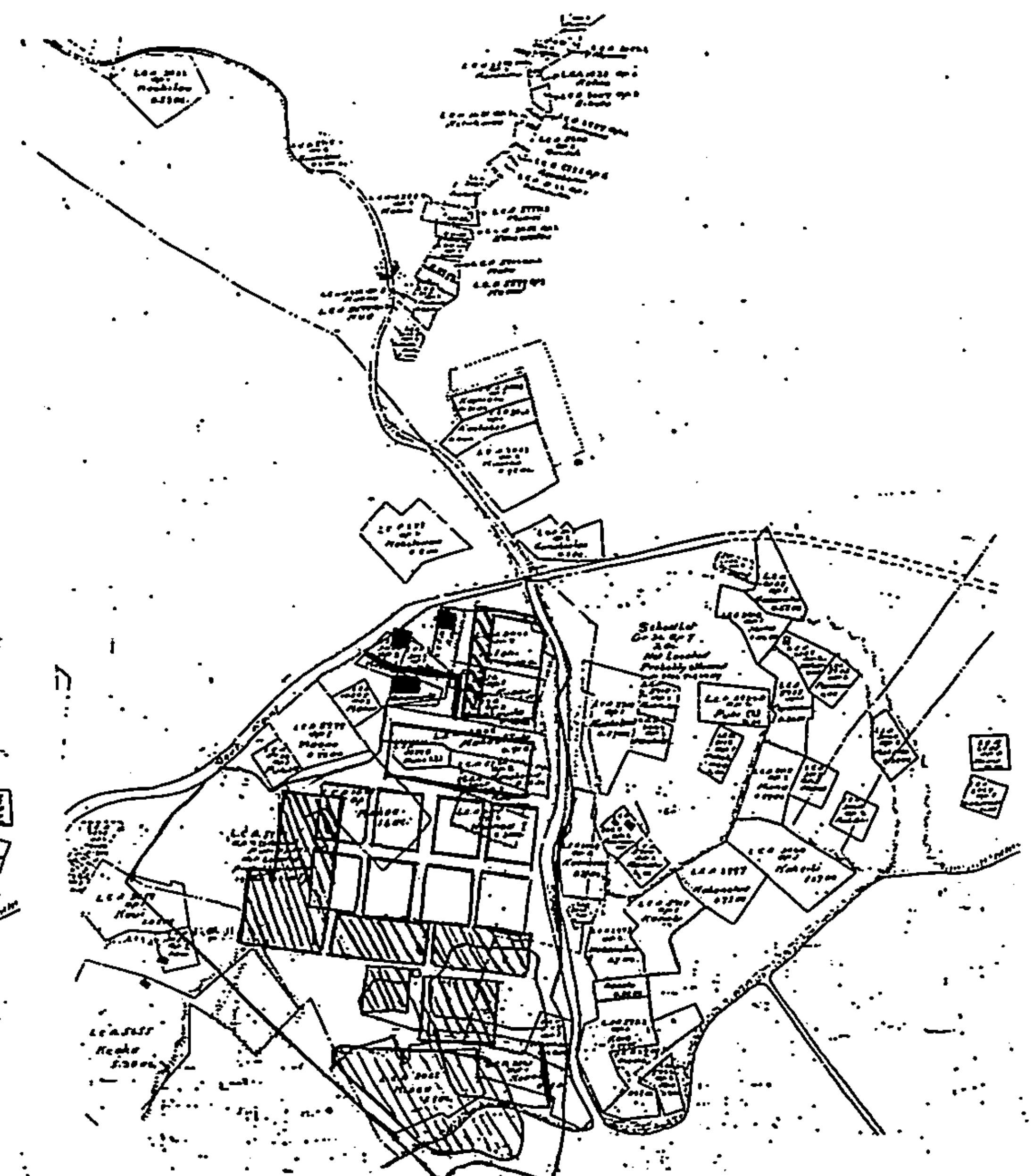

Fig. 10 Map of Land Commission Awards and Proposed Pond Expansion.

possible and should be carried out in the area of LCA 3068.

Archaeological Fieldwork

Little archaeological fieldwork has been conducted in Hakipu'u *ahupua'a* except on portions of Moli'i Fishpond. Moli'i Fishpond is often thought to be a part of Kualoa because it is included as a part of Kualoa Park, but it technically lies in Hakipu'u. The wall of the fishpond is, in fact, the dividing boundary between Kualoa and Hakipu'u. Some work has been done on the fishpond by the staff of archaeologists who worked at Kualoa Park as well as by Cultural Surveys Hawaii. However, no recent work has been conducted on the rest of the *ahupua'a*.

Moli'i Fishpond Coring

Cultural Surveys Hawaii was asked to put in several cores in the bottom of Moli'i Fishpond in June of 1987 (appendix B). A total of five cores were sunk into the sediments of the pond in association with a proposed boat dock construction project. The sample transect of the cores stretched from the shoreline out to a distance of 240 feet into the pond. An attempt was made to date the material taken from the five cores to determine the age of the fishpond. Of the four samples only one could be dated, a sample from core five, Stratum II (.24 m. to .56 m. below surface of the sediments). This sample represented six grams of shell material dating 5,950 +/- 160 years before present. This is obviously an anomalous date as it predates Hawaiian occupation in the Hawaiian Islands by thousands of years. The other samples could not be dated due to a lack of carbon for suitable dating purposes. The results of the research on Moli'i Fishpond are given in Appendix B.

VIII. Historic Background of Hakipu'u

The *ahupua'a* of Hakipu'u represented a self sufficient and autonomous social unit of the island of O'ahu. Each island was divided up into different districts. Each district was then divided into *ahupua'a*, or roughly pie-shaped, independent units of land that stretched from the ocean up to the top of the mountains. Each *ahupua'a* was largely autonomous from its neighbors and stretched from the ocean to the top of the mountains encompassing different physiographic zones. In this way each *ahupua'a* could utilize the different zones to grow, catch, or produce a wide variety of foods to support its resident population.

Although Hakipu'u is small in size, it was able to function as an independent and largely autonomous land unit because it contained two critical resources, a steady stream, and an abundance of marine resources (Kane'ohe Bay and Moli'i Fishpond).

The first significant resource is Hakipu'u Stream. Although the stream is listed as an intermittent flowing stream in a Department of Land and Natural Resources Report (Okamoto, W. and Assoc., p. 59), Mr. Kaawa insists that the stream is fed by up to fourteen artisan wells and flows year round. The stream was an important source of water for both drinking and agricultural purposes. The stream enabled the residents of Hakipu'u to utilize both small valleys and the swampland near the shores of Kane'ohe Bay for *lo'i*, or wetland *taro* cultivation.

The other major resources for the residents of Hakipu'u were Kane'ohe Bay and Moli'i Fishpond. Moli'i Fishpond, located on the northern edge of Hakipu'u *ahupua'a*, is one of the largest remaining fishponds on the island of O'ahu and is and raise large numbers of live fish for consumption and trade. By keeping a large number of fish in the ponds, the *konohiki* (or headman) could ensure that there would be a ready source of protein throughout most of the year. Although the pond was controlled by the *konohiki* of the *ahupua'a*, fish were shared with commoners in times of need.

Kane'ohe Bay was also a very important resource. Before it was dredged for navigational purposes in the mid-1900's, the bay consisted of an expansive fringing reef teeming with fish and other marine resources. Sheltered from rough seas, the bay was an ideal fishing ground for near-shore fishermen in small canoes.

IX. Settlement Patterns

A very important aspect of archaeological work involves trying to reconstruct, not only the sequential patterns for the individual sites within the area, but the overall pattern of communal life in general. A tentative reconstruction of land use patterns in Hakipu'u during the mid-1800's can be made by examining the Land Commission Award native testimonies and their location on the tax key map of Hakipu'u. It should be noted that, while a reconstruction of the settlement pattern in Hakipu'u during the mid-1800's applies only to that time period, the settlement pattern in prehistoric Hakipu'u was probably very similar to that of the early- to mid-1800's.

Forty Land Commission Awards were awarded in Hakipu'u following the Great Mahele in the mid-1800's. All 40 LCAs are listed on the state tax map of Hakipu'u *ahupua'a* (Zone 4, sec. 9) (Fig. 11). The tax map lists many small *apana* (each LCA lists several claim sections or *apana* awarded to a claimant) in the *ahupua'a* as well as large LCA awards, indicating that there were both agricultural parcels and habitation sites in Hakipu'u. This premise is corroborated by an examination of the native testimonies for each LCA. The testimonies indicate that there were both *apana* located in the valleys along Hakipu'u Stream for *lo'i* and the larger awards of land utilized for both habitation and/or agriculture.

By combining the information from each LCA testimony with the information on the tax map, it becomes apparent that there are three physiographic zones within the *ahupua'a*:

Zone 1) the mountainous Waiāhole Forest Reserve region; Zone 2) the area

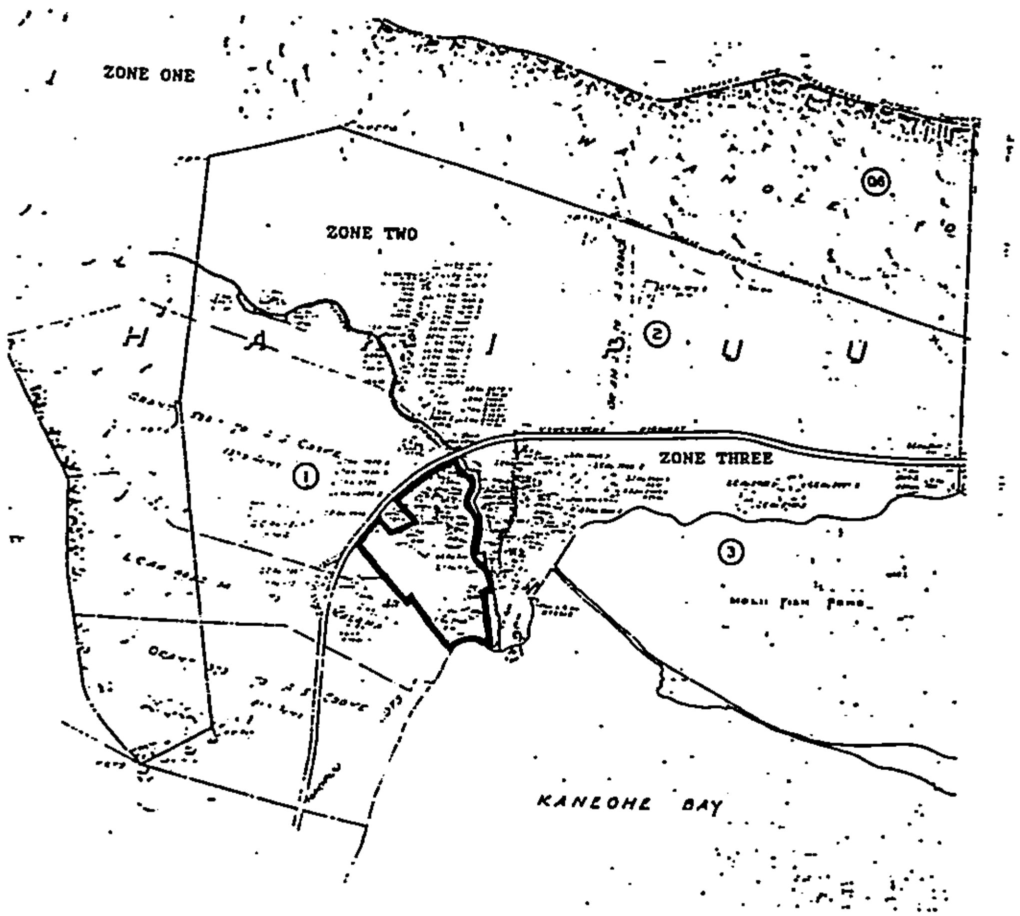

Fig. 11 Tax Map (Zone 4, Sec. 9) Showing Physiographic Zones One, Two, and Three in the Project Area (Bold Outline) in Hakipu'u, Ko'olaupoko, O'ahu (See Baldwin Map for LCAs)

of land *mauka* of Kam.:iameha Highway and *makai* of the Waiāhole Forest Reserve boundary line; and Zone 3) the area *makai* of the highway, including Moli'i Fishpond (See Fig. 11).

On the tax map there is only one LCA claim in Zone 1. This consists of a portion of LCA 4452 *apana* 14 for Hakipu'u *ahupua'a*, awarded to Queen Kalama by her husband, Kamehameha III. The vast majority of the zone consists of uninhabited mountainous forest land. There are probably prehistoric sites in this area and it is likely that this portion of the *ahupua'a* was utilized by prehistoric Hawaiians for hunting and gathering wild plants and animals. However, by the mid-1800's, no LCAs (aside from a portion of 4452) are listed in Zone 1.

Zone 2 makes up the portion of the ahupua'a that is *mauka* of Kamehameha Highway and *makai* of the Waiāhole Forest Reserve boundary. There are six roughly 1-acre *apana* listed in this zone, along with approximately thirty smaller *apana* (¼ acre or less) lining the banks of a small river valley that feeds into Hakipu'u Stream from the northwest. Based on their size and location, it is apparent that these *apana* were utilized for *lo'i*. This area lies outside of and *mauka* of the present project area.

The six larger *apana* in Zone 2 could have been used for habitation and/or agriculture. LCA 3063, for example, located along the upper banks of Hakipu'u Steam, is listed as having 19 *lo'i*, 1 *kula*, and 1 house site. The only relatively large LCA in Zone 2 is LCA 5725 (5.78 acres). This LCA probably contained both habitation and agricultural features. The LCA is separated from most of the other LCAs in Zone 2 and is not located along Hakipu'u Stream or one of its small tributaries as are the other LCAs in the zone. One property of interest in Zone 2, LCA 6118, located just *mauka* of Kamehameha Highway, is now the Coral Kingdom, a popular tourist stop.

Zone 3 has the highest density of large LCAs, small LCAs, and other cultural features of the three zones. Zone 3 is the area of swamp land that lies between Kane'ohe Bay and Kamehameha Highway. The zone was delineated by using Kamehameha Highway as an arbitrarily assigned boundary. The highway closely corresponds to an actual physiographic boundary between the drier, mountainous portion of Zone 2 and the wetter, swamp land of Zone 3. The highway skirts along the edge of the swamp and the foothills of Zone 2. Whereas Zone 2 contained almost entirely small LCA *apana* used as *lo'i* and/or *kula*, Zone 3 appears to have been utilized for a variety of purposes including, agriculture, habitation and mariculture (Moli'i Fishpond).

The vast majority of the LCAs in Hakipu'u are located in Zone 3 on either side of Hakipu'u Stream. The area to the north of Hakipu'u Stream (outside of the project area) contained a variety of LCAs that included both areas of habitation and *lo'i*, while the area to the south of the stream (Area 1 and part of Area 2) seems to have been predominantly utilized for *lo'i* and contained fewer habitation sites than the area to the north.

The project area consists of the portion of Zone 3 that lies to the south of Hakipu'u Stream and north of an arbitrary modern property line. There are approximately 16 whole, or partial LCAs in the project area. Of these, only the LCAs occupied by Mr. Kaawa still contain habitation structures. The rest of the LCAs, based on the informant interview, the Native testimonies on the LCAs, and through a physical inspection of the area, all seem to have been utilized as *lo'i* and

later as rice paddies. The descriptions of LCAs 10895, 3065, and 3008, for example, all indicate that they were used as *lo'i* and did not contain habitation sites. The same is true for the other testimonies that can be correlated with the LCAs in the project area. It is clear that the present project area was utilized during the mid-1800's as *lo'i* and later for rice paddies, and was never the site of extensive habitation or other cultural features. Many of the *lo'i* in the project area were used by Japanese rice farmers, and were destroyed when the modern mariculture ponds were constructed, however, *lo'i* may still be present in the *makai* and central portions of areas 2 and 3 and should be further tested using core sampling and analysis.

The area just north of the project area (on the north side of Hakipu'u Stream) was however, the site of most of the habitation features in Hakipu'u during this period. The native testimonies indicate that the LCAs on this side of the stream were used for both agricultural (*lo'i*) and as habitation sites. There were *lo'i* along the banks of the stream and on the *mauka* side of Moli'i Fishpond, and house lots along Johnson Road and down near the ocean at the mouth of the stream. Several houses are still being utilized along the road as are several *lo'i* near the banks of the stream.

Runoff from the *lo'i* fed Moli'i Fishpond with rich nutrients to feed the fish and other aquatic creatures in the pond. The Hawaiians often placed *lo'i* in the areas around a fishpond so that runoff water from the *lo'i* could be channeled into the fishponds.

The area on both sides of Hakipu'u Stream in Zone 3 was the focus of activity in Hakipu'u during the mid-1800's. The LCAs located within the project area were used predominantly as *lo'i*, while most of the habitation sites were located outside of the project area to the north of the stream and *makai* of Kamehameha Highway. Even today, most of the existing house sites are located on the north side of Hakipu'u Stream (aside from Mr. Kaawa's *kuleana* and several houses across the highway).

X. Summary

Cultural Surveys Hawaii performed a site inventory survey of a 26 acre parcel of land in Hakipu'u *ahupua'a* to determine whether or not there were any sites and/or cultural remains in the area.

Historic research, along with an informant interview, indicate that the project area previously contained *lo'i*, rice paddies, a flood control culvert, several house sites, and an old well. The entire 26 acres was surveyed on foot, but only one site could be located within the project boundaries (CSH 1, the "mortuary house"). No other sites were found in the project area due to their destruction by bulldozer activity and the accretion of Kane'ohe Bay's shoreline.

Test excavation was undertaken in the area proposed for mariculture pond expansion to determine the presence or absence of sub-surface remains. No sub-surface features or cultural remains were observed during test excavation. Due to the nature of the swamp land within areas 2 and 3 hand excavation was impossible and was limited to surface examination. Backhoe trenching was undertaken in an area of swamp presumed (based on historic evidence) to have contained former *lo'i* and rice paddies. No evidence of earthen embankments were observed. Only a homogeneous gleyed clay profile up to 10 feet thick was noted.

Hakipu'u has a very rich historical and legendary history and, with Kualoa, was a very important place to the prehistoric Hawaiians. There are many legends concerning both Hakipu'u and Kualoa, as well as myths about heroes who lived in this area in ancient Hawaii (see appendix A). Hakipu'u was also one of only three sacred places that were reserved for the *kahuna* of the king. Kualoa was reserved for the *ali'i* and is thought to have been one of the most sacred places on the island of O'ahu.

By the mid-1800's Kualoa and much of Hakipu'u had been purchased by foreigners (notably members of the Judd and Morgan family). Early pineapple, sugar cane, *poi*, and rice cultivation ventures were some of the earliest attempts to raise commercial crops in the islands and remain an important aspect of the history of O'ahu. For example, the remains of the first sugar mill built on O'ahu are located in Kualoa *ahupua'a* on Kualoa Ranch lands, just north of the project area.

Based on the above summary of the history of Hakipu'u, the following general considerations can be made on the project area.

1. Hakipu'u was an important part of the history of Hawaii as a sacred area reserved for the religious leaders, and as the home of mythical heroes such as Kahai, to whom even the greatest Hawaiian kings paid deference to.

2. Based on informant information, historic research, and an examination of the historic material concerning the division of land in the mid-1800's, a tentative reconstruction of the settlement pattern of Hakipu'u can be made.

3. The settlement pattern reconstruction indicates that the majority of people living in Hakipu'u lived near the banks of Hakipu'u Stream in the area of land *makai* of Kamehameha Highway and north of the present project area.

4. The construction of the original mariculture ponds and research facilities has destroyed much of the *lo'i* that once existed in the project area, especially in Area 1.

5. Mitigation involving systematic core sampling and analysis in what was once LCA 3065, and the other areas of proposed expansion, will provide important

data on the stratigraphy, time span, and land use of areas that are now buried under the swamp.

XI. Recommendations

No identifiable surface sites or subsurface cultural deposits were encountered during the project. However, historic background research indicated that there were sites and agricultural features present in the project area. Due to the encroachment of the modern swamp, any remnants of *lo'i* in Hakipu'u will only be found during systematic coring, or other major sub-surface testing. Analysis of core samples for radiocarbon dating, pollen analysis, and sedimentary deposition may add valuable information to the chronology of occupation in Hakipu'u. The cores may represent the only obtainable data on the chronology of occupation and land use in the Hakipu'u area and are an important archaeological resource that should not be ignored.

Due to the extreme difficulty of hand excavation in areas two and three Cultural Surveys Hawaii recommends mitigation, i.e. data recovery of systematic core sampling, and analysis of the cores, in the areas to be impacted by the proposed pond expansion, especially in the area that once consisted of LCA 3065.

It is further recommended that both Cultural Surveys Hawaii and the State Historic Preservation Division be notified should any sub-surface cultural remains be uncovered during construction of the proposed pond expansion.

XII. References

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APPENDIX A: Historical Documentary Research by Helen Wong-Smith

Appendix A: List of Figures

Historical Documentary Research

The *ahupua'a* of Hakipu'u is located in the district of Koolaupoko between the *ahupua'a* of Waikane to the south and Kualoa to the north. The name, which literally means, "hill broken", applies to the *ahupua'a* as well as a valley and a stream (Pukui 1974:35). The *ahupua'a* is made up of a small coastal plain facing a broad lagoon well guarded by an unbroken reef. There is one sizable stream, a swamp, and a hinterland of little valleys out of which flow small streams (Handy and Handy with Pukui 1972:442). Although often overshadowed by its more famous neighbor to the east, the *ahupua'a* of Kualoa, Hakipu'u is rich in its own right with pre-historic legends and myths. The fishpond of Moli'i which is usually identified with Kualoa Regional Park, falls within the boundaries of Hakipu'u (Tai Crouch pers. comm. 2/18/92). Moli'i Fishpond is listed on the National Register of Historic Places.

The nearly vertical ridge line inland of Hakipu'u and Kualoa is a section of the caldera rim of the extinct Ko'olau volcano, one of the two volcanoes that formed the island of O'ahu (Clark & Connolly 1975:3). The ridge's talus slopes flatten out quickly to form Kualoa Peninsula. Situated off Kualoa Point is Mokoli'i Island, a sea stack formerly a part of the Ko'olau rim (McDonald and Abbott 1970:199) also referred to as "Chinaman's Hat". The numerous geographic features on the ridge and Mokoli'i are the sources of many of the local myths. A photo taken in 1931 by Lt. Gen. O.S. Picher shows two men squidding from an outrigger (Fig. 1). The ridge descending from the highest point divides Kualoa from Hakipu'u. The rocks in the foreground are close to Mokoli'i Island and are part of a pond called Pili he'e, which was destroyed in 1868 (pers. comm. Tai Crouch 2/26/92).

TRADITIONS

The earliest legend in reference to Hakipu'u takes place during the era of Wakea and Papa, the progenitors of the Hawaiian race. While warring with Kumuhonua and his army, presumably human, a tidal wave and flood threatened Wakea and Papa. Wakea is saved after being swept into the sea by praying to Lono (Handy and Handy with Pukui:1972:522).

A detailed account of the tidal wave is found in another passage of Handy and Handy:

> They swam and swam in an effort to save themselves until they were almost exhausted. Kamo'awa, Wakea's kahuna, taught Wakea how to cup his hands together to represent a heiau, then he caught a humuhumunukunukuapua'a fish (a form of Kamapua'a or Lono, god of storm and rain) an stuck it head first into the cupped hands to represent a pig. Then the followers swam around Wakea in procession, dedicating the "heiau". As soon as this ceremony was finished, the sea washed them ashore on an island outside of Kahalu'u called Moku-Kapapa (ibid:449).

Figure 1 Squidding From Outrigger, c. 1931, Hawaii State Archives.

As a result of this event a heiau was built to Lono, who saved Wakea and Papa and Kualoa was set aside for the priests, "the Mo'o-kuauhau-o-Lono, or genealogical-line-of Lono" (Malo in Gunness 1987:15).

It is not surprising that legends associated with Hakipu'u are closely tied with those of Kualoa. Kualoa was considered to be the sacred land of Haloa, the son of Wakea and Papa (Clark & Connolly 1975:3). Kualoa is also the locale for one of the legends of Pele and her sister Hi'iaka. Hi'iaka killed a huge *mo'o*, or dragon, and the small island Mokoli'i off of Kualoa is part of his tail. His body became the foothills below the steep Kualoa cliffs. In another legend, Kamapua'a, half-man half-pig of O'ahu, hid from Pele in a hollow at Kualoa and later made the holes in the Kualoa ridge (ibid:4). There are many more legends associated with Kualoa, but for the purpose of this report, emphasis will be given to those associated with Hakipu'u.

The earliest legend specific to Hakipu'u takes place some two thousand years ago. It takes place in the valley where Kahai, a daring man, made his home. The legend tells of him sailing to distant lands to bring back to Hawai'i the seedlings of breadfruit trees and creating the first grove of breadfruit there in Hakipu'u Valley:

> It was a courageous deed, in those days of canoes, when seas were uncharted and men were guided by stars at night. Yet the daring Kahai went as far as Samoa, and when he returned, he told tales of the people, and planted some seeds.
>
> Among the seeds was the breadfruit tree, which the people planted in Hakipu'u. It brought food for the people and renown to Kahai.
>
> Many honors were given to Kahai. He was raised by the chiefs to their own kingly rank. And never again need he lower his sail--not for a chief nor a priest nor a king.
>
> Many more journeys were made by Kahai, and his fame continued for two thousand years. It is said that in 1795, when the conquering chief rounded the island, Kamehameha lowered his sail to show his respect for the daring Kahai - Raphaelson (Sterling and Summers 1978:186).

Pilahi Paki provides this legend as well, adding that Hakipu'u is a sacred valley and that Kamehameha I lowered his sails when passing the shores of Hakipu'u in honor of Kahai, goes by the name of Ke-awa-luku (Paki 1972). It may be that Hakipu'u received its status as a sacred valley from the residence of kahuna there. Native historian Samuel Kamakau cites Hakipu'u as one of the lands given to the kahuna:

> ...These lands belonged to the priests from ancient times down to that of Kahahana. In the time of Kahekili and Ka-lani-ku-pule, these were given to their kahuna and so also in the reign of Kamehameha I. - Moolelo o Kamehameha Kuokoa, Nov. 6, 1867 (Sterling and Summers 1983:184).

Former curator of Kualoa Regional Park, Tai Crouch, recalls that he was told that Hakipu'u was reserved for the *kahuna* of the god Ku and that Kualoa was reserved for the *kahuna* of Lono (pers. comm. 2/18/92).

A legend provided by Abraham Fornander cites Hakipu'u as an famous place in regards to *'awa*:

> ...at a place called Hena; there is located a stone awa container and a stone awa cup. A man named Kapuna went there and drank some awa; and when he came home he was drunk and went to sleep, and died from the intoxication of the awa; and where he died there appeared two ridges; the ridges were joined in some place; those were the legs; there is also a small hill at the place; that was the head of the man. That place is known as Kapuna; this place is mauka of Hakipuu, Oahu. This place is also called Hena, where the awa is noted for its intoxicating quality - John Mana (Fornander vol II:610).

Another ridge formation identified in Hawaiian legend is near the high spur of the ridge line that divides Ko'olauloa and Koolaupoko, resembling a huge stalagmite, approximately 100 feet in height (McAllister 1985:168). This formation is referred to as a phallus, called the Nanahoa Stone, with its female counterpart being a stone on the wall of Moli'i fishpond which is named Kaluaua. This is the legend associated with the Nanahoa Stone:

> A keiki kapu (forbidden child) from Kahiki under the care of Kanehoalani. Not to look upon a woman until he was married, the reason being that they feared he had an animal nature.
>
> There was a girl born in Kahiki--born in the dark. Her father, groping about in the dark, mishandled her and she got huhu. For the girl was born and grew up in a single day. She left her home and came to Oahu. On the beach she landed and being very tired fell asleep on the pohuhue (beach morning glory vine). She left shortly after she was born and therefore she had no clothing. It was later that some women found her and covered her.
>
> The young man had been warned not to go far from his home, but to stay close to his kahu. That morning he disobeyed and came down the cliff part way. Looking down he saw the beautiful maiden. He stared and stared...and changed into the pohaku Nanahoa - Told by M.K. Pukui Aug.4, 1952 (Sterling and Summers 1978:185).

Hakipu'u was not without its dangers as seen in this next legend:

> Many a hapless Hawaiian who lived in the fertile valley of Hakipuu on the Windward side of Oahu lost his life to Kaupe. Hakipuu is still an excellent place to see Kaupe as a dog in the clouds hovering over the mountains....

Kaupe would lie in wait above the narrow valley until some fisherman returned home in the early morning hours or late in the evening. He would close down in his cloud form about the fisherman, lead him into a narrow place and there attack the man. - Taylor, Clarice (Sterling and Summers 1983:186).

Hakipu'u also had the nuisance of a shark that bit its people:

...a shark with one tooth, who nipped like a crab. He was known to all the *po'e kahiko*. He frequented the waters of Kahaloa at Waikiki, and Mokoli'i, at Hakipu'u and Kualoa, in the Ko'olaupoko. Malihini may be skeptical that he had only one tooth, but this was known to everybody...but this shark, called 'Unihokahi (One-toothed), had but one tooth...(Kamakau 1964:73).

Little is written of Hakipu'u's role during later years of Hawaiian history, but it is useful to study Kualoa's role during this period. Clark and Connolly provide the following in regards to Kualoa's importance to the Hawaiians:

The lands of Kualoa were considered to be the symbol of sovereignty and independence for Oahu, and were closely protected by the Oahu chiefs and priests. This is most clearly seen in the oral history tradition about the succession of Kahahana to the Oahu throne, and the attempt by King Kahekili of Maui to cheat him out of Kualoa and the *palaoa-pae* (whale ivory washed up along the Oahu coastline):

Shortly after his installation, Kahahana called a great council of the Oahu chiefs and the high-priest Kaopulupulu, and laid before them the demands of Kahekili regarding the land of Kualoa and the *palaoa-pae*. At first the council was divided, and some thought it was but a fair return for the kindness and protection shown Kahahana from his youth by Kahekili; but the high-priest was strongly opposed to such a measure, and argued that it was a virtual surrender of the sovereignty and independence of Oahu. Kualoa being one of the most sacred places on the island, where stood the sacred drums of Kapahuula and Kaahu-ulapunawai, and also the sacred hill of Kauakahi-a-Kahoowaha; and the surrender of the *palaoa-pae*, would be a disrespect to the gods; in fact, if Kahekili's demands were complied with, the power of war and of sacrifice would rest with the Maui king and not with Kahahana. He represented strongly, moreover, that if Kahahana had obtained the kingdom by conquest, he might do as he liked, but having been chosen by the Oahu chiefs, it would be wrong in him to cede to another the national emblems of sovereignty and independence. Kahahana and all the chiefs admitted the force of Kaopulupulu's arguments, and submitted to this advice not to comply with the demands of Kahekili (Fornander 1969 vol. II:218).

Numerous other writers have also reflected the feeling of sacredness for Kualoa. Raphaelson says that Kualoa has always been sacred soil, to which

the newborn children of the chiefs were brought to live and be trained in warfare and the ancient traditions of the Hawaiian chiefs. Kamakau referred to Kualoa as being a very sacred place of refuge in ancient times where people fled for protection if they had broken a tabu. Kualoa was also the place where sacrificial victims for religious rituals were drowned. Many authors say that all canoes passing seaward of Kualoa lowered their sails in acknowledgment of the nature of Kualoa as a sacred residence of chiefs (Clark & Connolly 1975:3).

Specifically to Hakipu'u is the line in a chant composed by Ka'ehu, a poet and hula instructor from Kaua'i. It refers to a part-white woman with whom he flirted. It is used in humor when referring to Hakipu'u:

E aha 'ia ana o Hakipu'u i ka palaoa lawalu 'ono a Ka'ehu?

What is happening to Hakipu'u, with dough cooked in ti leaves, of which Ka'ehu is so fond? (Pukui 1983:#248).

The following excerpts also make reference to Ka'ehu's fondness:

...Famed indeed is Hakipuu
For the sour-dough Kaehu is so fond of,
It is mixed with berry juices
And eaten with the very best poi.-Angus Coll. From M.P. No 28.

From thence to Hakipuu the place of the "dough cooked in wrappers, so much liked by Kaehu."-Angus Coll. Kuakoa, Sept. 18, 1896 (Sterling and Summers 1983:184).

Sites

Four *heiau* are identified in or near Hakipu'u. McAllister identified Niuolaa *heiau* being in Kualoa near the Hakipu'u boundary, although nothing remained of the site when he surveyed the area (1985:167). Rosamond S. Morgan, an informant to Sterling and Summers, doubted that such a site existed, "...as the Hawaiians regarded such places with superstition and thought it bad luck to build or live on them" (1983:181).

A *heiau* of the Pahulu family of Moloka'i is situated some six hundred feet away from the old sugar mill at Hakipu'u, in the water toward Mokoli'i (Beckwith 1970:108). The goddess Pahulu ruled the islands of Lana'i and Moloka'i before Pele arrived in the islands. When the prophet Lani-kaula of Moloka'i killed off Pahulu's people on Lana'i, the rest of her family moved to Moloka'i and O'ahu. They landed on the beach opposite Mokoli'i. Beckwith claims there is another *heiau* for Kane-hoa-lani near the old Judd place (ibid.).

The most extensive survey McAllister did of a Hakipu'u *heiau* is that of Puakea. In addition to a sketch with dimensions, (Fig. 2), McAllister's description provides the condition of the *heiau* in the early 1930's:

> A large three-terraced structure. Almost all of the stones have been removed for road building, but enough of the earth foundation and occasional walls remain to indicate its former size and features. The two lower terraces were probably open, though there are indications of a wall on the west side of the lowest terrace. The highest terrace appears to have been cut into the ridge, and was surrounded on three sides with high embankments faced with stones. The fourth side, overlooking the remainder of the structure, was open. The foundations of the walls which remain indicate their large size. They were faced on each side with 2-foot to 3-foot stones and a rubble fill. Frank Lealoha was told by the former natives that the earth elevation on the east side of the lower terrace was a lele used for human sacrifice. The small elevation in the back-center of the highest terrace was probably the site of the oracle tower. Thrum says that the heiau was "An ancient place of refuge to which is coupled the name of Kaopulupulu as supervising priest." This is the only mention of Kaopulupulu in connection with this heiau. After his retirement from the court of Kahahana, Kaopulupulu returned to "..his own estate in Waialua and Waimea."
>
> The lower terrace was planted in pineapple, but now is planted in grass. The upper terraces are covered with lantana and guava, with cow trails winding throughout (1985:169).

In regards to Puakea *heiau*, Tai Crouch adds that the stones of the *heiau* were used for cattle pens and that subsurface excavations would undoubtedly uncover more remains (pers. comm. 2/18/92).

The next site described by McAllister may have relating functions to Puakea *heaiu*. McAllister describes it as "Flexed burial Hakipuu":

> Portions of skeletal material were found protruding above the ground by A.F. Judd and reported. Upon excavation it was found to be a flexed burial with the distal portions of the femurs and the proximal portion of the tibiae, fibulae, and of one humerus exposed. The body had been placed in a sitting posture, facing toward the sea, which is approximately east, with the head bent between the knees. Consequently the skull was upside down, with the norma basilaris uppermost and the skull cap facing downward. The right arm had apparently been placed about the knees; the left doubled up behind the body. The site is on the side of a slope and had been exposed by erosion. The material was very fragile and in a poor state of preservation (1985:170).

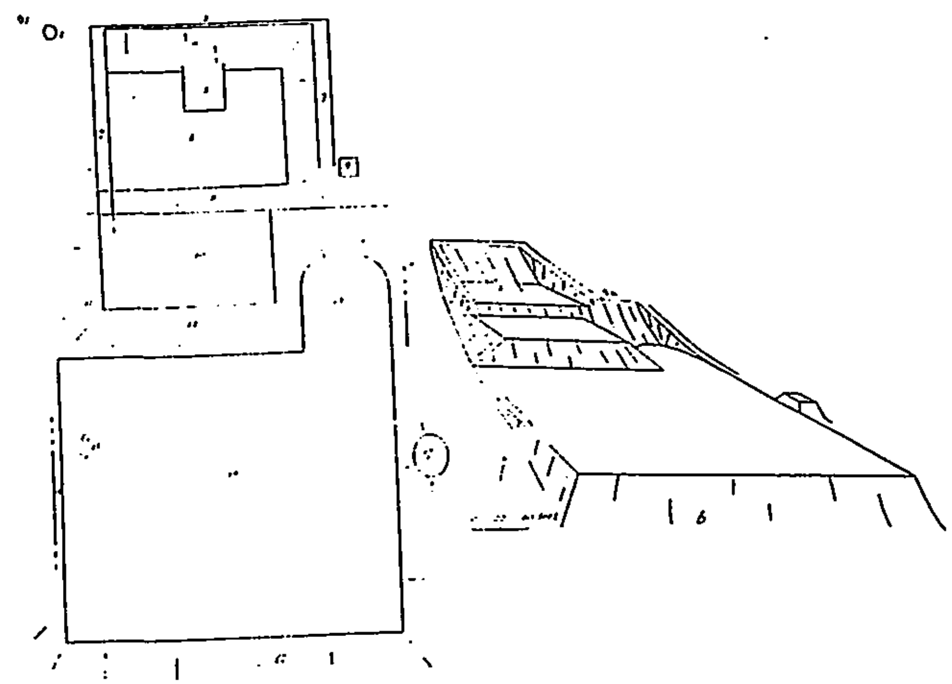


Figure 2 McAllister sketch of Puakea *heiau*.

David Malo describes this corpse arrangement:

> A rope was attached to the joints of the legs and then being passed about the neck was drawn taut until the knees touched the chest. The body was then done up in a rounded shape and at once closely wrapped in tapa and made ready for burial (Malo 1951:97).

Sepulture near the ocean fit in with the ceremony of purification conducted by a temple priest or *kahuna pule heiau*:

> The kahuna brought with him a dish filled with sea water, which also contained a sea moss called limu-kala and turmeric; and standing before the people who sat in a row, he prayed...
> The kahuna then sprinkled the water mixed with turmeric on all the people and the purification was accomplished, the defilement removed (Malo 1959:97).

Moli'i fishpond falls within the boundaries of the *ahupua'a* of Hakipu'u. According to Rosamond S. Morgan, it is a pre-historic fishpond, supposedly built by the menehunes (Sterling and Summers 1983:185). No other reference to its original construction to could be found during this research. McAllister gives the following physical description:

> Formed by inclosing [sic] a bay-like area covering 124 acres. The eastern portion of the wall is now a rather wide sand embankment with stone facings in narrow portions. The southwestern portion of the wall is narrower and of stone construction. The entire wall approximates 4000 feet in length. Just to the east is a smaller pond, now not used. The walls here are a sand embarkment with a stone wall on the sea side (1985:168).

Handy and Handy provide a description of Moli'i and its environs:

> ...partly enclosed to the east by the southernmost prong of Kualoa; and its lateral extent forms the upper, or northernmost, border of the great bay of Kane'ohe. Old *lo'i* areas once covered the swampy flats *makai* of the present Kamehameha Highway, and here as late as 1935 about a dozen *lo'i* were still cultivated along the Hakipu'u stream, with about the same number *mauka*. This area was quite extensive originally running for something more than a half mile southward from Moli'i Fishpond, and throughout the level land up along the stream. An interesting series of abandoned *lo'i* was noted filling a small valley bottom in an S curve from Moli'i Fishpond to a point up beyond the highway. This was formerly watered from Kailau Spring on the hillside above the fishpond. In 1935, a marshland patch just below the road to the southwest was being cultivated by an energetic Hawaiian using the old mounding method. It was the only swampy plantation of this type found on Oahu in the area survey of that year (Handy and Handy with Pukui 1972:443).

An aerial photo taken on October 2, 1930 shows Moli'i Fishpond (Fig. 3). The smaller fishpond in the foreground is Apua, which was formerly opened to the ocean (pers. comm. Tai Crouch 2/26/92). An earlier photo, taken in 1925, shows the nets used for Moli'i fishpond, in Hakipu'u proper (Fig. 4).

Moli'i Fishpond holds the distinction of being one of the few remaining commercially productive fishponds in Hawai'i. Sometime in the late 1920's or early 1930's, a portion along the eastern edge of the fishpond, a pig farm was established which continued until the 1950's (Gunness 1987:30). It was determined through cartographic sources and conversations with the operator of Moli'i Fishpond, Mr. George Uyemura, that there were at least three holding ponds associated with Moli'i (Clark and Connolly 1978:8).

In addition to Moli'i, another fishpond existed in the area. The following is from Clark and Connolly's research in regards to an offshore fishpond that is below the ocean surface:

> The wall was first noticed on the 1945 aerial photograph of Kualoa Park. It appeared as a dark shadow on the lighter-colored coral and sand reef;...The visible remnants of the fishpond wall, extending in a curve an area approx. 200 to 300 meters long by 40 meters wide, are what is left of the southernmost portion of the wall....
> It is believed that the fishpond was probably non-functional for approx. 100 years before its ultimate destruction, around A.D. 1850. Archival research and interviews with several long-time local residents of the area indicate that the structure was not built in historic times, or at least not after 1850 (the date of the arrival of the Judd family at Kualoa Ranch). Mention is made of the wall in a biographical story by Una Hunt Drage, relating an incident which took place in 1901. Marvin Fukumitsu, a local resident, and George Uyemura, operator of Moli'i Fishpond...both remember the wall in the ocean from their childhoods, as being that of an old broken-down basalt rock wall. Mrs. Ronald Morgan and Mrs. Mary Judd, past residents of Kualoa Ranch, also remember the wall and relate local legends of the area that tell of an unfinished fishpond wall that had supposedly been built by *menehune* but which was unfinished because the sun had risen before the structure was finished (1975:5-7).

Historic Land Use

During the reign of Kamehameha III, the Great Mahele took place. The Mahele separated and defined the undivided land interests of the King and the high-ranking chiefs and *konohiki* [*konohiki* originally referred to the person in charge of a tract of land on behalf of the king or chief. It is in the later statues that the chiefs or landlords were referred to as "*konohikis*" (Chinen 1958:vii and Chinen 1961:13)].

Figure 3 Moli'i and Apua Fishponds. October 2, 1930. Hawaii State Archives.

Figure 4 Hakipu'u Proper to North, c.1925, Hawaii State Archives.

More than 240 of the highest ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division. The first *mahele* was signed on Jan. 27, 1848 by Kamehameha III and Princess Victoria Kamamalu by her guardians Mataio Kekuanaoa and Ione Ii. The last *mahele* was signed by the King and E. Enoka on March 7, 1848 (Chinen 1958:16).

The *mahele* did not convey any title to any land. The chiefs and *konohiki* were required to present their claims to the Land Commission and to receive awards for the lands quitclaimed to them by Kamehameha III. Until an award for these lands was issued, title remained with the government. Because of the lack of surveyors at the time of the Mahele, the lands were divided by name only, with the understanding that the ancient boundaries would hold until a survey of such lands could be made in the future. Thus the Land Commission awarded lands to chiefs and *konohiki* by their names only. These awarded lands became known as Konohiki Lands (Chinen 1961:13).

In the will of Kamehameha III's he bequeathed Hakipu'u to his queen, to be held by her in fee simple (Privy Council Vol. 8 pg. 334). The *ahupua'a* of Hakipu'u was awarded to Queen Hakaleleponi Kapakuhaili Kalama under Claim No. 4452 (Privy Council vol. 9 pg. 149 and Interior Dept. Apr 26, 1854).

The Kuleana Act of 1850 permitted the Land Commissioners to issue awards to the farmers for houselots and gardens cultivated by them for their own subsistence only, providing the claimants had fulfilled all other legal requirements, such as making a written application before February 14, 1848, having two witnesses give sworn testimony regarding applicant's past occupation and use of the land for an extended period, and having no counter claims made by others (Kelly 1971:6). The parcels for house and garden purposes became known as *kuleana* (responsibility).

The *ali'i* and commoners had to file a claim to Quiet Land Titles with the Board of Commissioners, usually referred to as the Land Commission. When such a claim was filed, a Land Commission Award, (LCA) was assigned and upon payment of a fee, a Royal Patent was awarded (Erikson 1980:9).

Keaka X [This was for an acreage of 5.39 acres, one of the larger awards in Hakipu'u.]

LCA 3008 to Makaulaula (who was awarded 0.91 acres) 27 Dec 1847
To the Land Commissioners, Greeting: I hereby petition for my claim in the ku of Puukaluha, ahupua'a of Hakipuu, District 6, Division 2, Island of Oahu. There is one mo'o[1] and I have two lo'i[2] in this mo'o. Some were transferred

[1]The arable portions of ilis were divided into small tracts or fields called "Mo'os" or "Mo'oainas." A Mo'o was the division of land next less than an ili and was for the purpose of cultivation only. These mo'o were named, which were in reality field names.

to the lopas /tenants/, Nakane and Ohule; however, the right to this entire mo'o is mine, from Papa, and Nakane is below me.

LCA 3009 to Mana (Mana received his final award for 1.80 acres under LCA 3013) 23 Dec. 1847
To the Land Commissioners, Greetings: I hereby petition for my claim in the ahupua'a of Hakipuu, District 6, Division 2 Island of Oahu. There are two lo'i, which were from Kaanaana.

LCA 3054 to Kupau (who was awarded 0.88 acres) 24 Dec. 1847
...I hereby petition for my claim in the ku of Puukaluha, ahupua'a of Hakipuu...There are five lo'i and one kula[3]. The right was from Papa.

LCA 3059 to Kaui (who was awarded 1.30 acres) 22 Dec. 1847
...I hereby petition for my claim in the ku of Kaohewai, ahupua'a of Hakipuu...There are six lo'i, one kula and the right was from the konohiki in the year 1847.

LCA 3060 to Kakeiki (who was awarded 1.63 acres) 24 Dec. 1847
...I hereby petition for my claim in Hakipuu...There are fourteen lo'i in the ku of Lupehu, one kula, one houselot. The right was from Kamakahonu.

LCA 3062 to Kauhiliki (who was awarded 0.12 acre)
...I, an old woman, a widow and childless, hereby petition for my little claim at Kaohewai, a ku of Hakipuu. There is only one small lo'i, which was bequeathed to me by my deceased husband.

LCA 3063 to Kauhiilau (who was awarded 1.07 acre) 21 Dec 1847
...I hereby petition for my claim in the ahupua'a of Hakipuu...There are nineteen lo'i, one kula, one houselot. The right was from Hinau to Pakai, and from him to me;...

[For the same award, it is noted that Kauhilau is deceased]
Hakauila, sworn says, he knows the land of claimant in Hakipuu. It consists of 9 patches of kalo and 5 patches cultivated recently. The whole 14 patches form one piece, bounded on Kaneohe and Punaluu sides by a pali. Mauka by Heeia's land. Makai by a stream.
Claimant's house site in near the kalo land, and is separated from it by a watercourse. It is not enclosed. Claimant held the land from the time of Kamehameha I. He died lately leaving his land to his wife Opunui....

[2]Irrigated terrace, especially for taro, but also for rice.

[3]Plain, field, open country, pasture. an act of 1884 distinguished dry or kula land from wet or taro land.

LCA 3064 to Kaulahea (who was awarded 0.65 acre) 4 Jan 1848
Greetings: I hereby petition for my claim in the ku of Puakea, ahupua'a of Hakipuu...consisting of three lo'i. At Kualoa is a houselot and any planted trees. The right was to me from Kapiioho....

LCA 3065 to Kilohi (who was awarded 1.65 acre) 2 Jan 1848
...I hereby petition for my claim in the ku of Puukaluha,...I am the konohiki there, from Uilama, and also cultivate that land in three mo'o of the land. there is one kula....

LCA 5722 to Kaio (who was awarded 1.23 acres)
...I hereby petition for my land claim in the 'ili of the ahupua'a of Hakipuu...There are four lo'i, two house sites, one kula two fish pools. However, two lo'i adjoin in the 'ili of Kaohewai. The right was acquired in 1832.

LCA 5724 to Kahakauila (who was awarded 0.99 acre)
Greetings: I hereby petition for my claim in the 'ili of Puukaluha, ahupua'a of Hakipuu...There are five lo'i, one kula, one house lot. Two lo'i remain which are weed-grown. One mala[4] of 'awa adjoins the ahupua'a. From 1833, from Kapuaahiwa who gave the right, and from Kaiakoili, and when they died from Kamakahonu until this day on which I petition.

LCA 5979 to Maopo (who was awarded 1.21 acre)
...I hereby petition for my claim for land in the 'ili of Lupehu,...There are two lo'i, two kula and one house lot. In the ahupua'a are three lo'i adjoining the 'ili of Puukaluha. One lo'i adjoins Namakaokao. It is an ancient right of my kupuanas, from the konohiki, until myself, with no opposition from anyone.

LCA 6117 to Noanoa (who was awarded 0.67 acre)
...I hereby petition for my land claim in the 'ili of Puukaluha,...There are eleven lo'i, two mala of 'awa, three kula and one house site. Two lo'i are together in the ahupua'a. The right was acquired in 1840.

A reduced copy of a map that identifies the location of the *'ili* mentioned in some of the testimonies was procured from the State Survey Office (Reg. No. 22, Drawer 17, Number 26). Although the map has no date, it is evidently an early one, made by James Dillon, using chains as a measurement (Fig. 5).

The location of Land Commission Awards, as well as subsequent grants, are depicted on Baldwin's map of June 1907 (Fig. 6). The map shows a concentration of Land Commission Awards on the area *ma kai* of the government road alongside the major stream of Hakipu'u. There are also a substantial number of *kuleana* awards

[4]Garden, plantation, cultivated field.

ma uka near the stream. There are four parcels fronting Moli'i Fishpond, those of Kanalu, Heeia, Nokane and Kepaa (State Survey Office Reg. Map 2651).

The following references were gleaned from the State Archive in order to provide an overview of land transactions:

Interior Dept. 1847 Dec
Lands of the King as reported by C. Kanaina, shows, (inter alia;) Hakipuu, Island of Oahu.

Interior Dept Dec. 15, 1847
Lands of Kamehameha I as reported by M. Kekauonohi, shows, (*inter alia*;) Hakipuu, Koolau Poko, Oahu

Hakipu'u 17

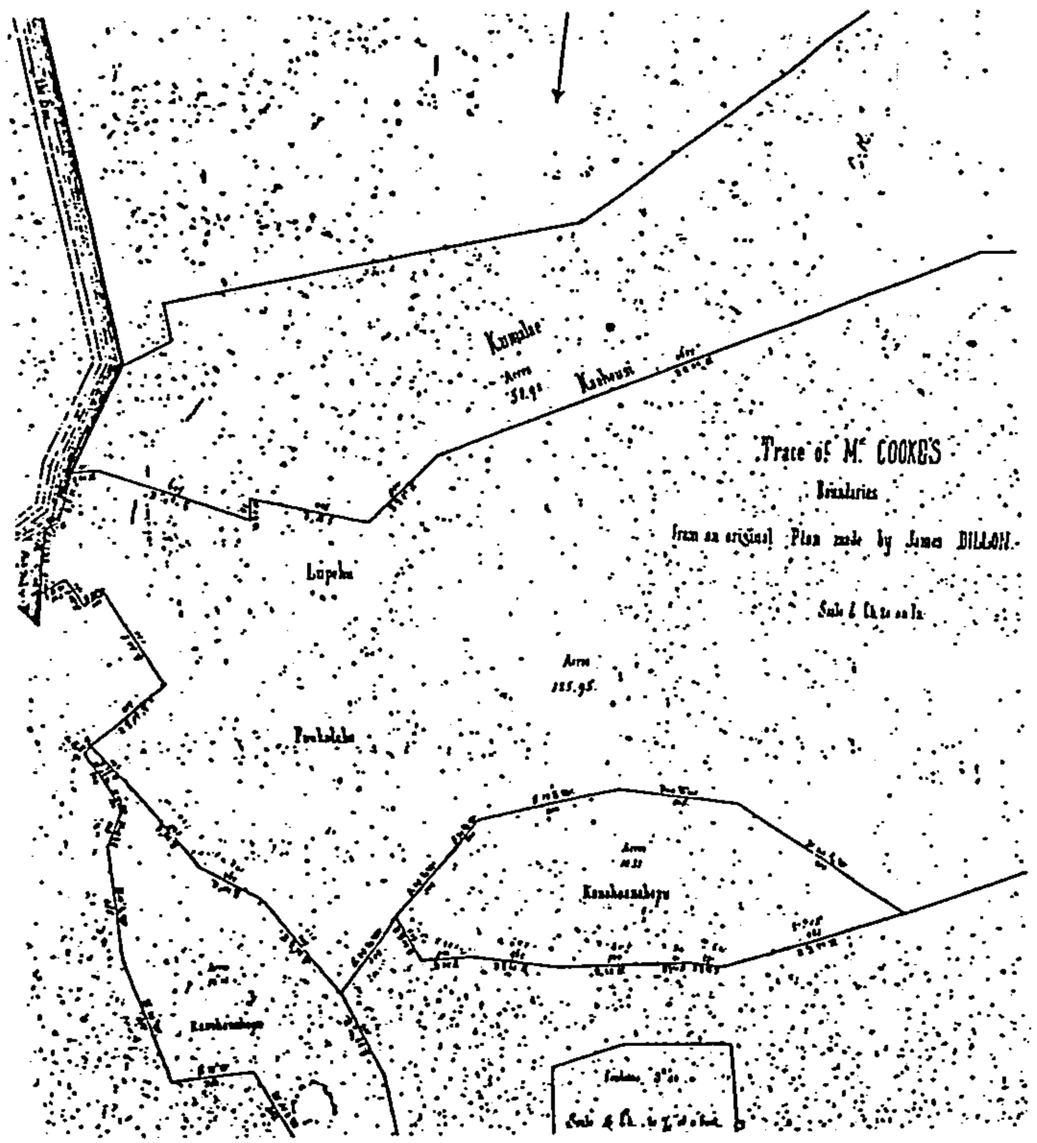


Figure 5 Map of the location of a portion of the *'ili* of Hakipu'u by J. Dillon.

Hakipu'u 18

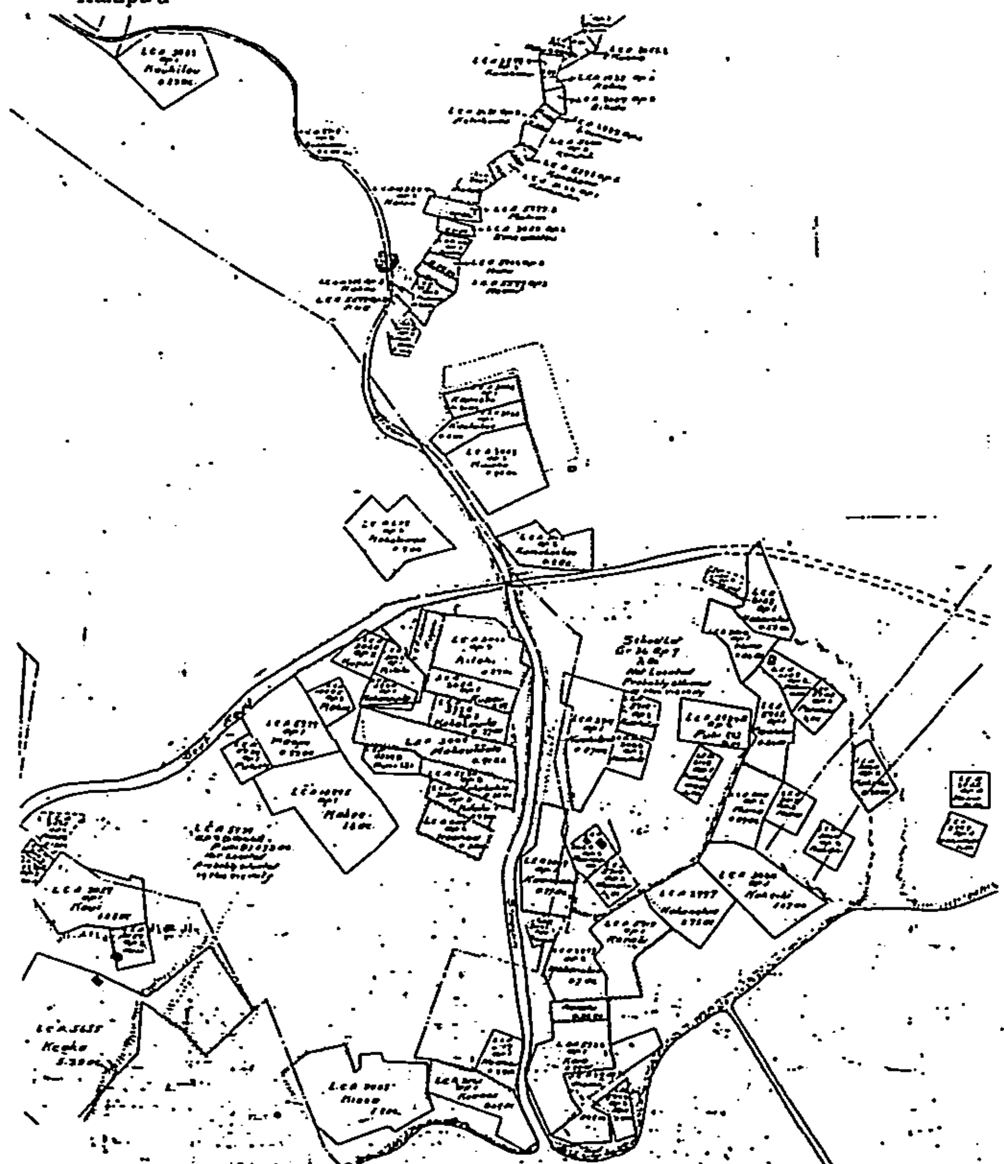


Figure 6 Map of Land Commission Awards in Hakipu'u by Baldwin, 1907.

Interior Dept Dec. 16, 1847
Lands of the king as reported by Iona Piikoi, shows (*inter alia;*) Hakipuu...

Interior Dept. Bk 2 pg 542 Feb. 13, 1850
In letter of the minister of Interior (by Goodale) to Kaneakalau. Government own no land in above named land.

Interior Dept Bk 15 pg. 107
In table of Konohiki lands, showing that the above land was awarded under Land Claim No. 4452 & that it has a sea coast frontage along the reef of miles.

Interior Dept Doc. No. 153
Letter from Kaneakalau to the Minister of Interior (John Ana) applying to purchase allodial title for 1/2 of the above land, in which he offers to pay $4 an acre for taro land & $1 for upland.

Interior Dept. Doc. No. 250
In list of lands sold by W.C. Parke, Adm. of the Est. of Chas. Kanaina, showing that the above ahupuaa was sold to C.H. Judd for $5,215. [Queen Kalama was adopted by Charles Kanaina.]

Interior Dept. Doc. 394
List of lands of H. Kalama as reported by Chas. Kanaina, shows, (inter alia) HAKIPUU, AHUPUAA, HONOLULU, OAHU, Voted on Aug. 28, 1850, that the Premier grant a Fee Simple Title.

Interior Dept Oct. 14, 1850
Application by A.S. Cooke, for 2 lots in above tract, granted. In memorandum made by Armstrong, attached to Resolution passed by Privy Council, on above date.

In a Reports Special Committee to the Privy Council, dated May 25, 1850:

"7. That of Mr. A.S. Cooke of Honolulu dated 22 March 1850 for about 300 acres of land, more or less, in the district of Hakipuu, Oahu, for which he thinks $5.00 per acre for taro land and $1.00 per acre for upland to be a fair price. He applies for the land on behalf of his children, also another application for a small piece of land between the Missionary Cattle Yard and Kainas place which he desire for pasturage for his horses, for which he offers at the rate of $30.00 per acre. Your Committee strongly recommend the application of Mr. Cooke."

Privy Council vol 6 pg.22
Re. granting A.S. Cooke's Appl. for 3 ilis in Hakipuu not to exceed 489 acres, but should the two lots fall short of 560 acres then said applicant can take the balance in Wahiawa. "Should the above together with the land you have

already bought in Pahalona fall short of 560 acres, you may take the balance in Wahiawa at $1 per acre; or you may relinquish the land for which you have applied in Hakipuu, ..."

Interior Dept. Feb. 18, 1853
In letter from J. Kalili to the Land Commissioner (Kekaulahao) informing that it is rumored that Kaio had fraudulently put in a claim for the kuleana of Nahapalie's brother in the above place - Asks that the said be returned to the rightful claimant, because Kaio is a rogue.

Interior Dept. Apr. 26, 1854
In copy of a list of lands granted to H. Kalama under Land Claim No. 4452 showing that the above ahupuaa is included in same as passed by the privy council on Aug. 29, 1850 & c.

Privy Council Vol. 3 pg. 484
Re. Appl. of Kaaiahua, Kekaheike & others for land Hakipuu, - Res. that it cannot be granted because the price is not adequate & the said lands are mixed up with others.

Interior Dept. Feb. 24, 1863
In letter from Chas. H.Judd & S.G. Wilder to Minister of Interior, applying for the lease of one half of the land formerly belonging to Kanehailua, in the above land Koolaupoko, for which no award has been granted by Land Commission Award or under the Act of August 24, 1860.

Interior Dept. Bk. 13 pg.80 Sept. 14, 1875
In letter from Minister of Interior to Attorney General, asking him to furnish this Dept. with a legal opinion in regard to the claim of Queen Kalama to the ahupuaas of Kaneohe, Kailua & the above ahupuaa which were received by the said Queen in a division made in 1848. That on the 26th of April 1854 an award was issued to Kalama for said ahupuaa & c.

Hist. & Misc. Kalakaua to Marshal Parke Parke Collection
Re. purchase certain pieces of land of Estate of Kanaina.

Hilo Dec 10-/80 "I have ordered Col. Judd to bid in the above tract for me" Use Kalakaua's share in said Estate up to $5000 to purchase same, "for Col. C.H. Judd."

Interior Dept. April 21. 1881 Interior Dept Kalakaua to Marshal Parke Parke Collection refers again to Kanaina Estate share to purchase the above land.

Hakipuu, School house at-
public Instruction 1896, Apr 22
A.F. Judd to Minister of Public Instruction

Desires to purchase the old school house at the above place Offers $20 for same, &c.

A map dated Feb. 1880 provides the location of the major grants in Hakipu'u (Fig. 7). It notes that: "The total area of the ahupuaa is 116.5 acres of which area there remains to the Kanaina Estate, 924.5 acres, comprising 10 acres of Rice land, the Fishpond of 124.5 acres and 790 acres of Grazing and Mountain Land (Reg. No 328).

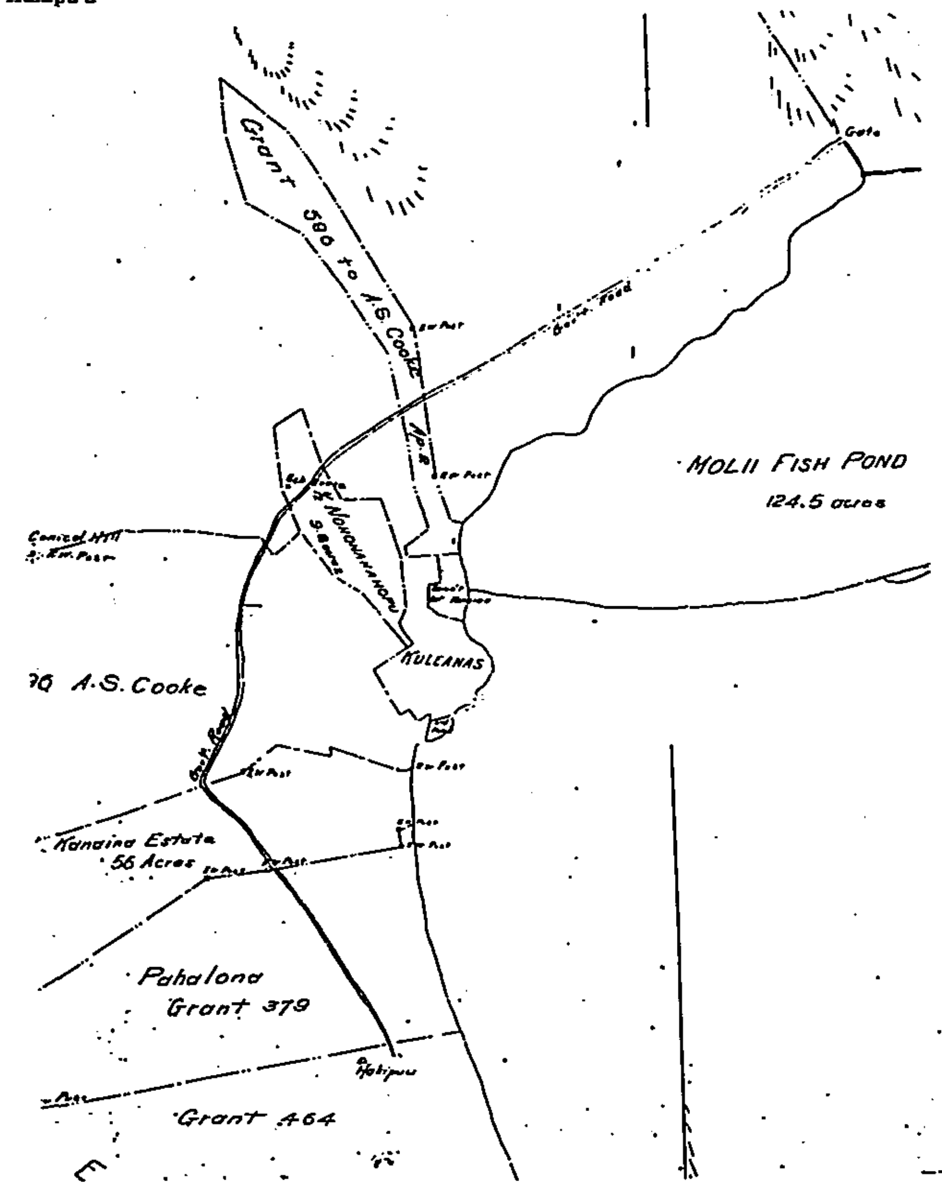


Figure 7 Major Grants in Hakipu'u, 1880.

Oahu Plantation and Kualoa Ranch (1850 to 1871)

Dr. Gerritt P. Judd, who had served as one of Kamehameha III's ministers and head of the Land Commission, purchased from the King for $1,300 "622 acres more of less and known as the land of Kualoa fist and second, also the...boundaries include all the sea or fishing grounds adjoining both said lands and the island called 'Mokolii'" (Bureau Liber 4:304-305). After a failed farming venture, Dr. Judd deeded Kualoa to his son Col. Charles H. Judd, who was also Kalakaua's Chamberlain, and his son-in-law Samuel G. Wilder in 1860 (Gunness 1987:29). Charles H. Judd purchased Hakipu'u for $5,215 from the estate of Charles Kanaina, (Kanaina had adopted Queen Kalama) (Interior Dept. Doc. No. 250). Great-great-grandson, John Morgan, the present day ranch mananger, relays, that Charles H. Judd did not have the ready cash for the purchase of Hakipu'u and had to ask Kalakaua to co-sign the loan (pers. comm. 2/28/92). The purchase was for the entire *ahupua'a* excepting the *kuleana* parcels. Later, Judd and Wilder applied for the lease of one half of the land formerly belonging to a native Hawaiian for which no award had been granted (Interior Dept. Feb. 24, 1863).

In a report of Kualoa Regional Park, Jo Lynn Gunness gives a detailed history of Kualoa Ranch's involvement in the Kualoa *ahupua'a*. She writes of Dr. Judd's first endeavors there:

> Beginning in 1850 Judd practiced diversified farming at Kualoa, growing among other things, corn, sweet potatoes and other garden vegetables, arrowroot, pineapples, melons, grapes, figs, mangoes, and peanuts. He also used part of the land for pasturage for his saddle and carriage horses....
>
> ...on May 16, 1855 Judd leased the farm to 88 Hawaiians. However, records show that Judd was not happy about the way they cared for the land (Gunness 1987:24)

After deeding Kualoa to his son Charles and son-in-law, Samuel, Kualoa was planted in sugar cane, a sugar mill was built just north of the Kualoa peninsula and *ma uka* of the Government road in Hakipu'u.

An optimistic report was made of the sugar plantation in 1865, when it was known as Oahu Plantation. An article reported that the machinery had previously been used by Union Planation in Makawao, Maui:

> ...Oahu Plantation...Including Kaawa [sic] it now consists of about four thousand acres....a beautiful field of cane growing, about two hundred acres in extent, with extensive mill buildings erected, and powerful machinery driven by steam....Like much of the land in this side of Oahu, the cane fields here consist of rich bottom-land, lying just above the level of high tide. So near the surface is the water, that the roots of the cane find moisture all the year around, reducing the risk of drought very much. The soil, like that of Lahaina,

> Waikapu and Wailuku, receives its deposits of rich alluvium from the mountains in the rear.
>
> Two spacious stone buildings, each 80 x 124 feet, located near the point, and beyond the dwelling about one mile, have been erected for the manufacture of sugar. The stone was brought from the foot of the mountain, only a few hundred yards inland, while the lime was burned from coral stone procured in the sea. The cost of this large and permanent building thus scarcely exceeds that of a wooden one....The entire crop this season will be between two hundred and fifty and three hundred tons, and during the present year the extent of the land put into cane, will be increased to about four hundred acres.
>
> About eighty laborers are employed on the estate...Mr. Cording also assured us that he had refused over one hundred applications for labor. This certainly indicates anything but a scarcity of labor....Near the Oahu Plantation mill, we found rows of neat little houses erected for the native workmen, many of whom are permanent residents on the estate, who find it for their interest to engage as laborers on it (Advertiser Feb 18, 1865 p.3 c.2).

Evidently, Dr. Judd was still very much involved with the Kualoa and Hakipu'u as we see in a memoir of his daughter Elizabeth Kinau Judd Wilder:

> Mrs. Wilder described how her husband and father erected the mill's company with their own hands. The mill was finished, fields were fenced and plowed up, and Chinese coolies were imported as laborers....By 1867 it became evident that the lands was too poor for cane, although it was 1871 before the venture was finally abandoned. The land was turned into a cattle ranch called for many years the Old Judd Ranch but more recently the Kualoa Ranch Co (Star-Bulletin Apr. 24, 1971 B16 c1).

After the sugar plantation failed, Dr. Judd repurchased the Kualoa land from Wilder on Dec. 19, 1870 for $15,042 (ibid.).

In an in-depth history of the sugar mill in Hakipu'u, T.T. Waterman provides this story regarding the mill stack:

> The mill stack, built of lime mortar, and imported brick, was erected in part by S.M. Wilder himself, who swarmed up on the staging and wielded the trowel, because his Hawaiian workmen of those days did not like to climb so far above the solid ground (<u>Paradise of the Pacific</u> Sept. 1934:2).

The Wilder Mill, was known by the name of "Wili-ka-a-i" due to a Hawaiian workman who had one eye. As he shoveled dirt he followed each spadeful with his good eye and at night had a twisted neck and yelled "Wili-ka-a-i", thus the others gave this name to the mill (Advertiser Sept. 1, 1866).

In an article regarding the mill's remains, the author writes:

[the planation] was not altogether a success in the 60's, due to many obstacles, transportation, labor and infrequent rainfalls....The ruins show how solid and pretentious was this mill so many decades ago...A child fell into one of the sugar boiling vats in the late 1860's and died of his injuries" (Advertiser May 17, 1927 p6).

According to Gunness, it was Wilder's 9-year-old son who fell into the vat (1987:29). A photo of the remains of the mill was taken in 1920 as is exhibited in Fig. 8.

When dismantling the mill, it was discovered upon detaching two old iron centrifugal machines from their foundation, that the stones on which the centrifugal rested were old cane crushers, used to grind cane, of a foreign rock (Paradise of the Pacific Sept. 1934:2). The stones, or rollers weighed upward of a ton a piece, shaped by the original maker out of diorite, somewhere near Canton, China. Such cane crushers had not been used in Hawai'i since the 1830's and one of them had been made into a base for a flagpole. This antiquated mill was reconstructed at the Hawaii Sugar Planters Association (HSPA) Experimental Station on Keeaumoku Street (Fig. 9). The mill was moved in 1976 to the new location of the Experiment Station which is also the locale of the HSPA Headquarter, at 99-193 Aiea Heights Drive (pers. comm. HSPA Librarian 2/24/92).

Kualoa Ranch (1871 to Present Day)

As mentioned above, ranching activities replaced sugar in the 1871 at Kualoa Ranch under the direction of Charles Judd. A map dated Oct. 3, 1878 entitled "Hakipu'u and Kualoa Coastline" indicates that a large coastal section of Hakipu'u was planted in rice (Fig. 10).

Gunness writes of ranching activities in Kualoa:

> In 1916 the Morgan family[5] built a small bathhouse on the south beach of Kualoa Point between 'Apua and Moli'i Ponds. Built with stone walls, this building is still standing today, next to the park offices and approximately 122 meters back from the beach (1987:29).

According to Tai Crouch, this bathhouse sits on the border of the *ahupua'a* of Hakipu'u and Kualoa (pers. comm. 2/18/92).

Gunness reports that when the U.S. Army took over Kualoa Ranch during World War II, among major land alterations in Kualoa, including an airstrip, cement "pillboxes" along the coast and the eastern edge of Moli'i Pond, were constructed (1987:30). In 1957 the Morgan family built a home near the southeast corner of Moli'i

[5]A descendant branch of the Judd family and present owners of Kualoa Ranch.

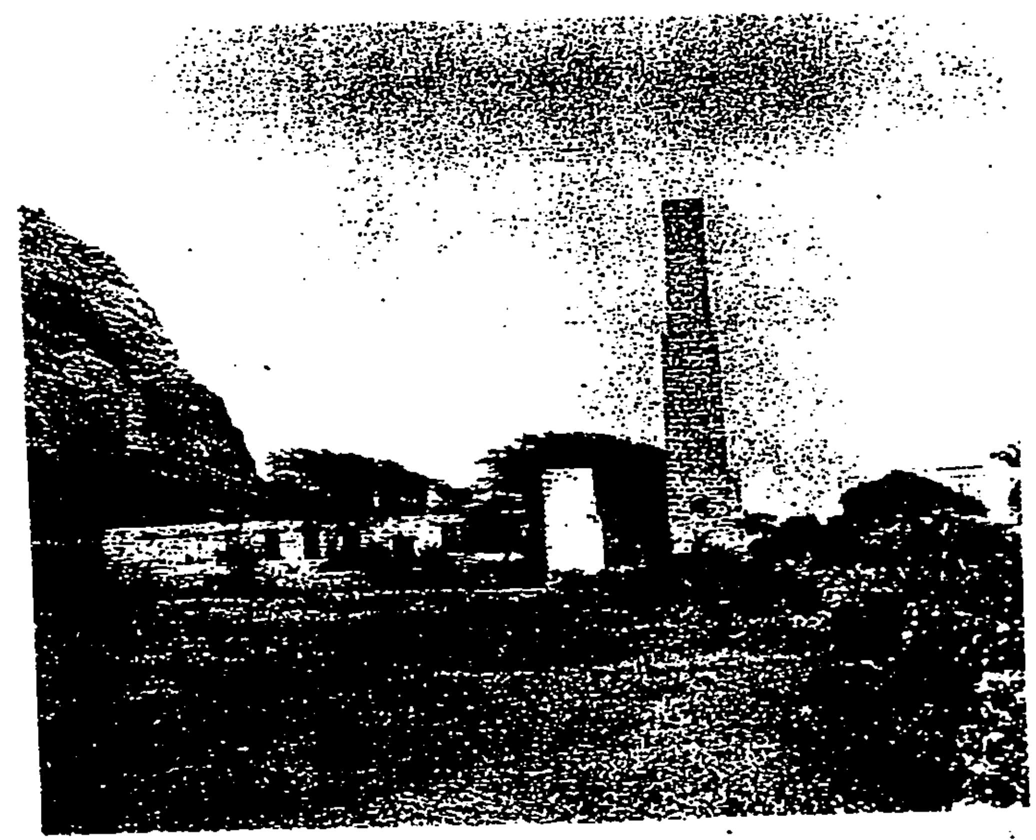
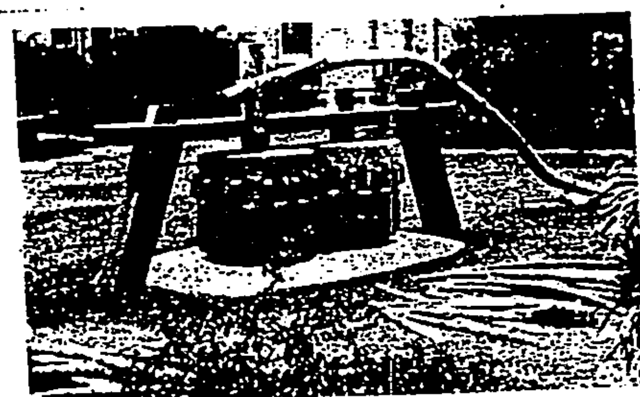


Figure 8 Kualoa Sugar Mill, c.1920, Hawaii State Archives.



Done! The Swanzy Sugar Mill ready for business. The cane in the photograph is the first cane to go through the mill in one hundred years, or thereabouts.

Figure 9 Reconstruction of the Swanzy Sugar Mill, Paradise of the Pacific, 1934.

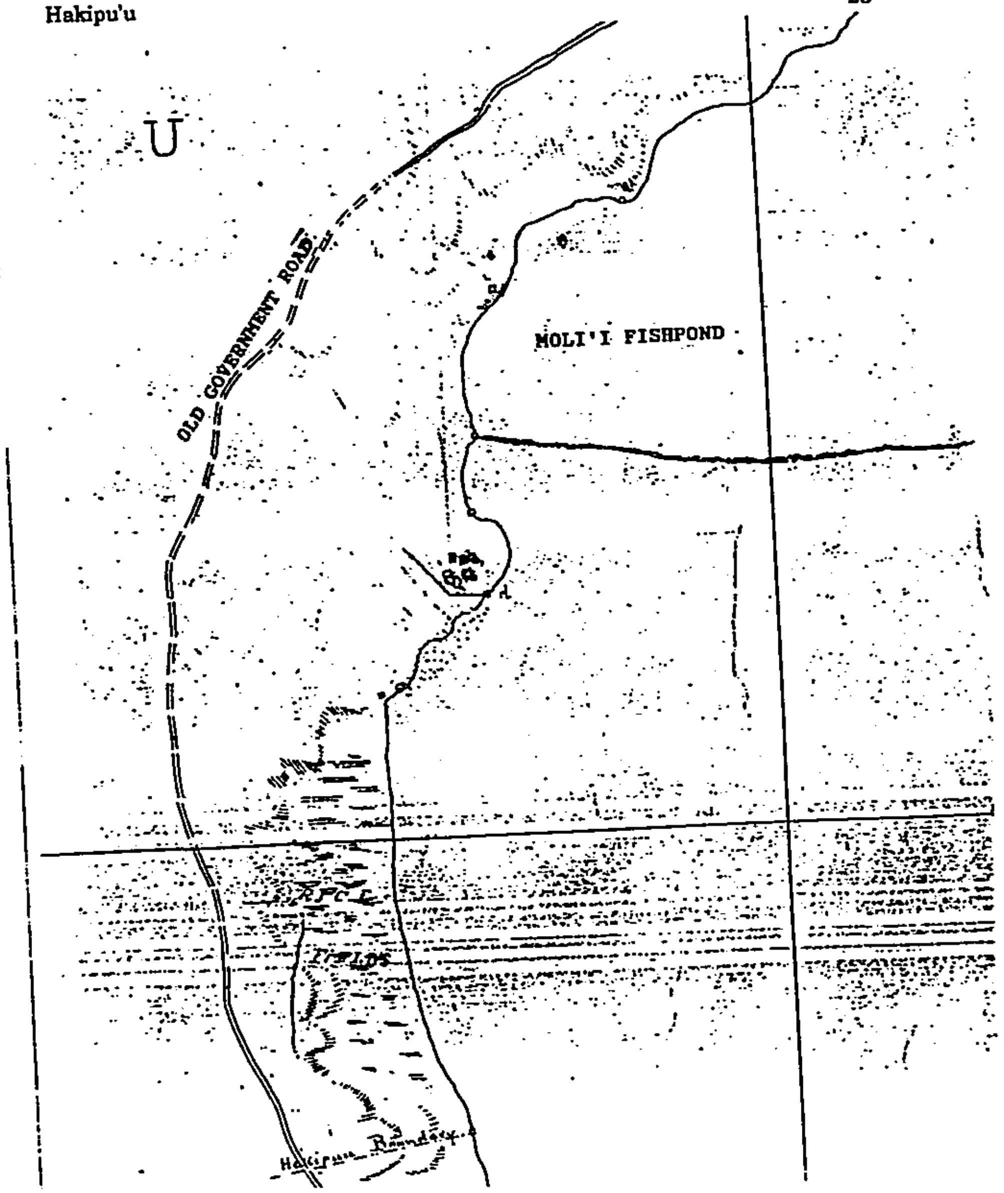


Figure 10 Hakipu'u and Kualoa Coast Line Map, J. F. Brown, 1878.

Pond, just to the south of the stone bathhouse. This house would later become the main office of Kualoa Park (*ibid.*)

When the City and County of Honolulu began condemnation proceedings in Kualoa in order to establish Kualoa Park, which would eventually cover an area of 154 acres in total, the following article provided an overview of the land as well as the dispute the City and County had with the Ranch:

> ...Kualoa Ranch, which has opposed giving up its land since the proposal was first made in 1962, is expected to take the issue of the price to court. It will argue that the area has prime resort possibilities and is worth much more than the city is offering.
>
> The 73.4 acres include four acres of Mokolii Island (Chinaman's Hat). The state normally has title to all offshore islands, but this island is owned by the ranch....
> The remainder of the area is forested with interesting growth. Some of the land is now being farmed and some is given over to the grazing of horses. The beach along the inner shore is a little better and swimming is good. Several sand bars stretch into Kaneohe Bay from this area (Advertiser July 3, 1966 p.6 c.3).

INFORMANT INTERVIEW

Mr. Henry "Hanalei" Kaawa, a *kama'aina* of Hakipu'u was interviewed on two occasions. On February 20, 1992 by Cultural Surveys Hawaii archaeologists working on the project and on February 26, 1992, by the author. The following is an edited summary of the latter interview.

Mr. Kaawa was born in Hakipu'u in 1929. He claims *konohiki* rights to parcels and water rights which descend to him from his mother's family. Both sides of his family received Land Commission Award parcels in Hakipu'u. His mother, Agnes K. Aukai Kaawa was a descendant of Heeia, who was at one time the *konohiki* of Hakipu'u.

On February 26, Mr. Kaawa used copies of Reg. Map 328 and Reg. Map 2651 to relate changes in the *ahupua'a*. According to Mr. Kaawa, Kualoa Ranch had no involement with Hakipu'u. Kamehameha III and Queen Kalama's interest where confined to the area in which the park is located. Hakipu'u was a private place, reserved for and by the *konohiki*. During Territorial time, the gate that had formerly kept others out was removed to allow the Ranch to come into Hakipu'u [see Reg. Map 328 for the location of the gate]. Reg. Map 2651 shows "Kaaawa" as having holdings in Hakipu'u which is erroneous. According to Mr. Kaawa, it should read Kaawa. Mr. Kaawa's *ohana* had parcel located both *ma uka* and *ma kai* in Hakipu'u.

On Reg. Map 2651, the most *ma uka* LCA parcel is that of 2955 to Heeia, the *konohiki* at the time. Mr. Kaawa stresses that the enclosure that is located in apana

2 (for 0.62 acres) is not a *heiau* as often suspected. The structure was a shelter for those times they had to stay overnight while working on the *lo'i*. They were not allowed to work up there during the war due to marshall law. An area abutting apana 2 (0.15 acres), was destroyed by bulldozers c. 1947. The string of LCA to the right of the stream, run up a small valley, and were used for *lo'i*.

Mr. Kaawa claims that the section marked as apana 2 of A.S. Cooke's Grant 596 is the home of the white owl. He saw the last one when he was 6 years old, when his uncle, Henry Mokoomaili Aukai, who was a fisherman, had a place up there. Mr. Aukai had two *aumakua*, the owl and the shark.

Mr. Kaawa was told by a Mr. Joe Roberts that there were three *poi* factories in the vicinity, including one in Kualoa c.1939. Mr. Kaawa remembers the *poi* factory in Hakipu'u as he ran into it with a truck when he was a kid. The Hakipu'u *poi* factory's cement foundation is still there by the shore (outside of the project area).

When Mr. Kaawa was young he lived with his grandfather at Moli'i pond. The pond was operated by a Japanese man who allowed his grandfather to partake in the pond's resources. The orange tree indicated on Reg. Map 2651 is still there.

Mr. Kaawa claims that the section next to the Coral Kingdom, on the Kualoa side, is his family's land and has put up homemade signs indicating thus. A bridge was built over stream in 1929. This is the *konohiki* land that he claims and he says that the maps are in error. Mr. Kaawa bases all of his claims on a personal geneology that starts with his mother and traces ancestors back. The papers include genealogy as well as parcels in their holding, including Mokoli'i. He claims that the surveyor working for the government changed the map to hide the facts.

SUMMARY AND CONCLUSIONS

Based on the number of legends, archaeological features, and historic references it is evident that Hakipu'u *ahupua'a* was utilized extensively in both prehistoric and historic times. This is expected due to its rich resources; with its fertile soil and abundant water resources, and with the immense Moli'i Fishpond as one of its ocean resources.

Based on the LCA information (native registers and foreign testimonials) it is clear that individual LCA's contained both inland apana as well as apana near the shoreline. This shows a settlement pattern that utilized the resources of both zones of the *ahupua'a* by the same *'ohana*. It appears from testimonies and the local informant, that the *ma uka* parcels were used for agricultural purposes only, the vast majority in taro cultivation. Whenever, houselots are mentioned, they are located *ma kai* of the government road, on the delta plain. Although taro cultivation in the uplands is no longer being conducted, the last *lo'i* was abandoned by Mr. Kaawa's family in 1989, the remains of *lo'i* terraces are still evident. Pictures of such *lo'i* terraces were taken by the author on her hike with Mr. Kaawa and are included with this archaeoligist's report.

Since Charles H. Judd's acquisition of the bulk of Hakipu'u, the *ahupua'a* has been subject to uses determined by Kualoa Ranch. Such uses included, grazing and pineapple and sugar cane agriculture. Although there were many *kuleana* parcels, the last reference to an individual working the land in a traditional manner was during the 1930's. This is probably due to a number of factors which are common with Hawaiian land tenure. Two factors are most likely; residents moving to urban centers for salaried employment when subsistence and barter systems became more difficult with modern society, and the increased involvement of Kualoa Ranch in the *ahupua'a*. The bulk of the usable land in the *ahupua'a* is controlled and utilized by Kualoa Ranch for their cattle and recreation activities, excepting for a few remaining parcels occupied by such *kama'aina* residents as Mr. Kaawa.

Hakipu'u holds the distinction as being an *ahupua'a* that still retains its fertile land and rich marine resources. Couple this with its rich heritage of legendary places and figures, and it is truly an *ahupua'a* to be recognized on its own merit, not just as the neighbor of Kualoa.

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APPENDIX B: Kualoa Coring Results

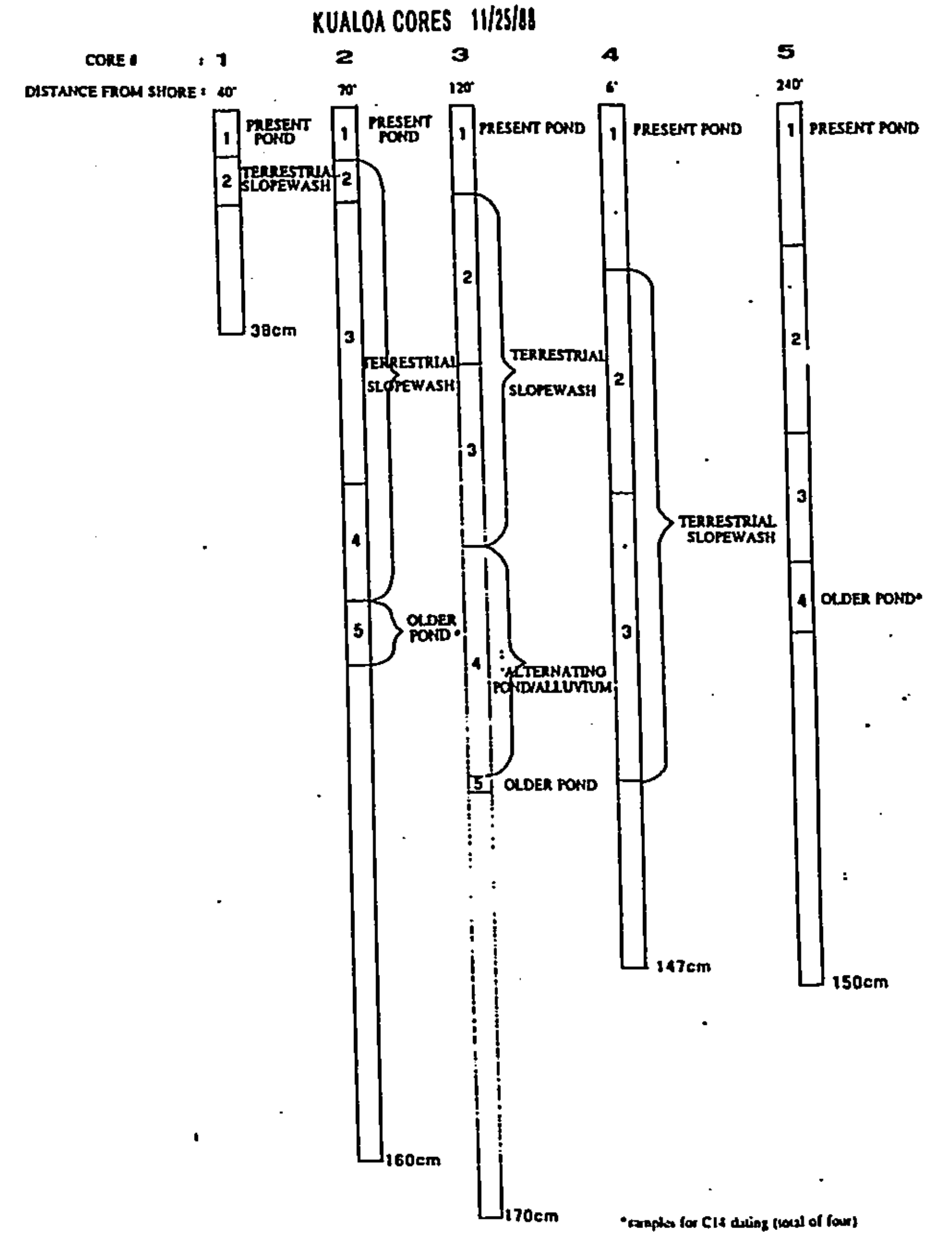

Table I: Stratigraphic Descriptions of Cores Taken from Moli'i Fishpond

Unit Horizon	Depth cm	Color - Dry	Color - Wet	Texture	Consistency Dry	Consistency Wet	Plasticity	Ca.+	Boundary	Boundary	Special Features
					Core 1						
Core 1 I	0-8	10 YR 5/2 greyish brown	10 YR 4/2 dark greyish brown	sandy loam	slightly hard	not sticky	non plastic	Slight effervescence			pebble-sized mud balls. mod. fishpond
Core 1 II	8-16	10 YR 5/3 brown	10 YR 4/3 dark brown	sandy clay loam	hard	slightly sticky	slightly plastic	Slight effervescence	--	--	iron staining pebble-sized mud balls terrestrial slopewash
					Core 2						
Core 2 I	0-9	10 YR 4/2 dark greyish brown	10 YR 3/2 very dark greyish brown	sandy clay loam	hard	slightly sticky	slightly plastic	None	--	--	shell and coral fragments - mod. fishpond
Core 2 II	9-16	10 YR 4/4 dark yellowish brown	10 YR 4/4 dark yellowish brown	silt loam		slightly sticky	slightly plastic	None	--	--	well sorted silt - slopewash
Core 2 III	16-64	mottled 10 YR 4/3 dark yellowish brown to 10 YR 7/6 yellow	--	sandy clay loam	hard	slightly sticky	slightly plastic	None	--	--	mottling iron stained lenses. yellow clay balls - slopewash

Table I: Stratigraphic Descriptions of Cores Taken from Moli'i Fishpond

Unit Horizon	Depth cm	Color - Dry	Color - Wet	Texture	Consistency Dry	Consistency Wet	Plasticity	Ca.+	Boundary	Boundary	Special Features
Core 2 IV	64-84	10 YR 8/6 yellow to 10 YR 8/3 very pale brown	--	clay loam	hard	slightly sticky	slightly plastic	None	very abrupt	--	mottled alternating lenses of yellow and very pale brown - slopewash
Core 2 V*	84-95	10 YR 3/2 dark brown	--	clay	very hard	very sticky	plastic	None			uniform color - clay probably varved, highly organic fishpond mud v. few sand grains
					Core 3						
Core 3 I	0-15	10 YR 5/2 greyish brown		sandy clay loam	hard	sticky	plastic	slight effervescence			Crepid w/ shells Brachydontis, other small shell frags. modern pond sediments
Core 3 II	15-44	10 YR 5/4 yellowish brown with 10 YR 7/6 yellow mottles		sandy loam	slightly hard	slightly sticky	slightly plastic	none			Some red mottles, soft weathered lava, pebbles laterite? slopewash alluvium
Core 3 III	44-76	10 YR 5/3 brown		sandy loam with soft weathered pebbles	slightly hard	slightly sticky	slightly plastic	none			more silt than above slopewash alluvium - pebble-sized soft lava

Table I: Stratigraphic Descriptions of Cores Taken from Moli'i Fishpond

Unit Horizon	Depth cm	Color - Dry	Color - Wet	Texture	Consistency Dry	Consistency Wet	Plasticity	Ca.+	Boundary	Boundary	Special Features
Core 3 IV	76-114	10 YR 4/2 dark greyish brown with 10 YR 5/6 yellowish brown		clay alternating with sandy clay	hard	sticky	plastic	none			finely bedded alternating layers of yellow slopewash alluvium and organic clay
Core 3 V	114-117	10 YR 3/2 very dark greyish brown		clay, finely bedded	very hard	very sticky	very plastic				organic clay pond sediments
Core 4											
Core 4 I	0-28	10 YR 5/1 grey		sandy loam, plentiful shells	weakly coherent	slightly sticky	slightly plastic	strongly effervescent			Talina ragosa shells, plentiful Brachydontis, fishpond sediments
Core 4 II	28-66	10 YR 4/2 dark greyish brown to 10 YR 6/4 light yellowish brown		sandy clay loam with clay beds	slightly hard	slightly sticky	slightly plastic	none			Alternating clay and soft pebble, slopewash

Table I: Stratigraphic Descriptions of Cores Taken from Moli'i Fishpond

Unit Horizon	Depth cm	Color - Dry	Color - Wet	Texture	Consistency Dry	Consistency Wet	Plasticity	Ca.+	Boundary	Boundary	Special Features
Core 4 III	66-115	10 YR 7/2 light grey to 10 YR 7/6 yellow		sandy clay loam	slightly hard	slightly sticky	non plastic	none			Contains soft weathered lava, pebbles, slopewash alluvium
Core 5											
Core 5 I*	0-24	10 YR 5/2 greyish brown		sandy loam	weakly coherent	non sticky	non plastic	strongly effervescent			Many bi-valves & Gastropod shells 10-20% shell frags. Cochlea punctata bivalve, favartia garrettii Trochus intextus, fishpond sediments
Core II*	24-56	10 YR 4/2 dark greyish brown		sandy loam with fewer shell frags than Str. I	weakly coherent	non sticky	non plastic	strongly effervescent			Fewer shell frags. more grey silt than above 5-10% shells, 1 whole Brachydontis, fishpond sediments
Core 5 III	56-78	10 YR 5/2 greyish brown to 10 YR 6/8 brownish yellow		sandy clay loam with lava pebbles	hard	slightly sticky	slightly plastic	none			Slopewash alluvium with brown clay alluvium

Table I: Stratigraphic Descriptions of Cores Taken from Moli'i Fishpond

Unit Horizon	Depth cm	Color - Dry	Color - Wet	Texture	Consistency Dry	Consistency Wet	Plasticity	Ca.+	Boundary	Boundary	Special Features
Core 5 IV*	78-90	10 YR 3/2 very dark greyish brown		clay	extremely hard	very sticky	very plastic				Terrestrial ponded clay sediments, probably fined bedded

+Carbonate * Samples collected for dating

APPENDIX C: Additional Subsurface Testing Results

On Nov. 17th 1993 an on-site planning discussion concerning backhoe testing was conducted with Mr. George Sebring. The purpose of the meeting was to decide on the best method of trenching within the swampy area with the aim of recovering representative soil samples. Additionally, Mr. Sebring, who had conducted extensive trenching throughout the MRTC project area, was queried as to soil conditions and general stratigraphy of the area, about any buried rock walls, trash pits, and Hawaiian artifacts, etc.

Mr. Sebring's trenching included some 3000+ linear feet (Fig. 1) and ranged from 2 to over 9.5 feet deep. Mr. Sebring is an experienced backhoe operator who is also an amateur bottle collector. He is aware of the possibility of unearthing trash pits and/or Hawaiian artifacts at the MRTC project. He was in fact surprised not to have unearthed any such items. Mr. Sebring, while mapping out the trenching he conducted on a 1:30' scale map of MRTC. (See Fig. 1), iterated that no buried walls, trash pits or artifacts were ever encountered.

General stratigraphic information as related by Mr. Sebring for the existing ponds area include clay loam soil increasingly wet with depth, and at a depth of 3 - 5 feet basalt boulder, cobbles, pebble, gravel with flowing fresh water referred to as the "underground stream." Stratigraphy at the shoreline includes relatively recently mucky clay over beach sand, then the clay loam layer (same as) at ponds overlying the gravel of the underground stream.

Based on our survey, review of historic photos (Kaneohe Library) and Mr. Sebring's information, it is strongly suggested that the taro *lo'i* and later rice paddies had earthen embankments, not rock walls. The highway, MRTC pond construction, and related earth-moving has altered stream and other runoff in the project which has increased alluviation and caused area-specific stagnation (i.e. marsh area) which accounts for the "relatively recent mucky clay" along the southern side and the shoreline portion of the project area.

To recover a representative soil sample profile an agreed-upon methodology consisted of trenching to allow water to drain away from the specific sample area. Samples of specific strata would then be procured by hand and/or backhoe. The location would be in the vicinity of the previously uncompleted Test Trench 2 (Fig. 2). The excavation is set up to specifically recover soil samples for immediate perusal and archiving for possible later analysis (pollen, etc.).

Backhoe excavations were undertaken on 12/2/93. These trenches were dug (Fig. 3) into the grassy swamp area south of the existing ponds. Trench 1 was the most *mauka* (west) unit with Trench 3 the most *makai* (east). The trenches average 3 meters in length and 1 meter wide. A total of nine soil samples were

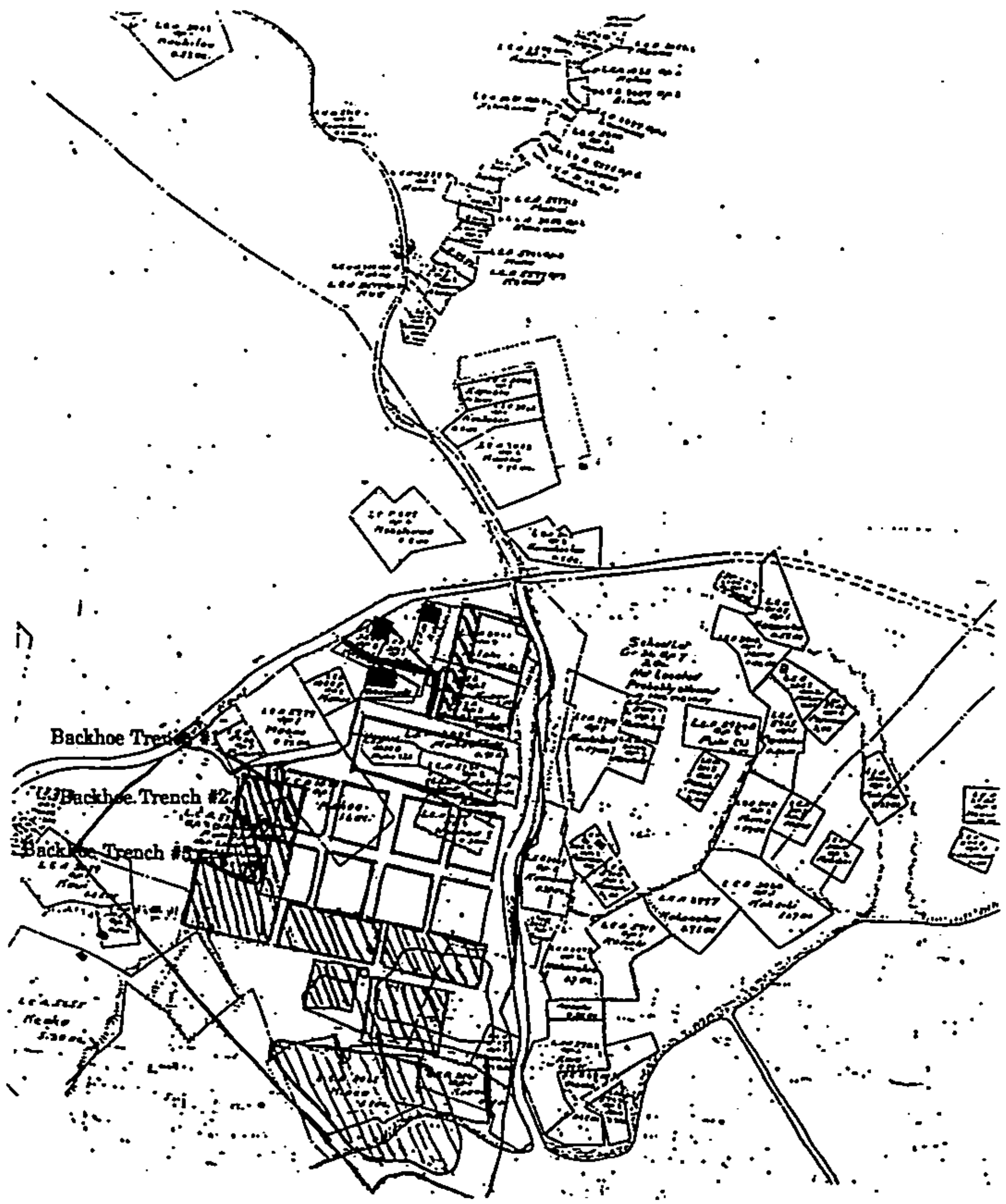

Fig. 1 Map of Land Commission Awards and Proposed Pond Expansion

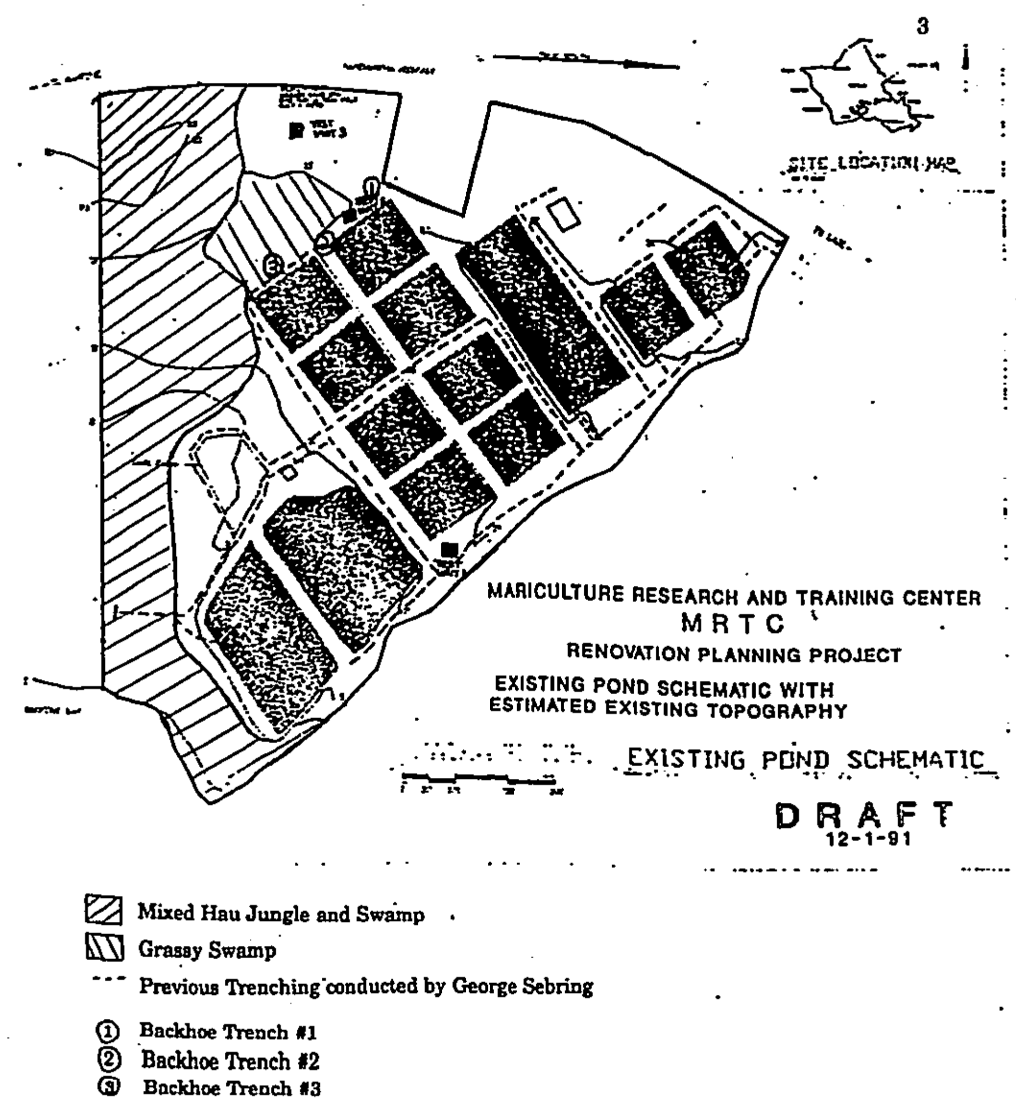

Fig. 2 Project Area Showing Existing Ponds and Related Buildings and Test Unit Locations

obtained, four from Trench 1, three from Trench 2, and two from Trench 3 (See accompanying soil sample catalog).

Trench 1 was excavated in an area reported (H. Kaawa) to be the location of a spring and/or well. Trench 1 was the only trench of the three which actually exhibited a definable stratigraphic profile. Five Strata, I, II, III, IV, and V were observed with samples taken from II, III, IV, and V. Stratum I consists of very dark brown (10 YR 2/2) clay loam matrix in the existing grass mat. Stratum II consists of dark yellowish brown (10 YR 3/4) clay loam with 0-5% basalt gravel. Stratum III is also dark yellowish brown clay loam but is mottled (7 YR 4/6 strong brown) throughout. Stratum IV is clay loam predominantly strong brown (y YR 4/6) in color but mottled with gley clay balls that are gray in color (N 5/). Stratum V is clay, predominantly dark gray in color (N 4/), but mottled throughout with clay loam and decomposing rock mixture which is strong brown in color (7 YR 4/6).

The stratigraphy exposed in Trench 1 represents a soil profile increasingly wet with depth. The gley-colored sediments in Strata IV and V indicate fluctuation in the water level, with Stratum V being consistently submerged. Additional evidence is the increasing clay content with depth below surface as Stratum V is designated clay, not clay loam. No cultural material (i.e. midden or artifacts) other than modern trash on the surface and some in Stratum I, was in Trench 1. Also there was no stratigraphic evidence of *lo'i* (ponded taro field) at the Trench 1 Location.

The stratigraphy exposed in backhoe Trenches 2 and 3 was quite different from Trench 1's stratigraphy (Fig. 4-6). Both Trenches 2 and 3 profiles are entirely waterlogged clay from top to base of excavation (3 meters below surface). Colors ranged from black (10 YR 2/1) to very dark gray (5 YR 3/1) with a high percentage of organic material throughout. At 2.5 meters below surface in Trench 2 portions of tree trunks were encountered. The orientation (parallel to ground surface) of the trunks, as well as being only partially decomposed, is suggestive that the tree remains are from bulldozed land clearing. Based on these observed characteristics and informant knowledge (H. Kaawa) a sequence of present swamp development can be posited.

The development of the existing mariculture ponds necessitated bulldozer land clearing. The debris from the land clearing, at least in part, was pushed to the southern side of the project area, then earthen embankments were created for the ponds. The pond development has thus exacerbated swamp development by dramatically slowing drainage to the ocean. This model of swamp development is further reinforced by H. Kaawa and G. Sebring, both of whom indicated "recent muck" covering areas both along the shoreline and in the area of the expanding *hau* "jungle."

Fig. 3 Grassy Swamp with *Hau* Jungle in Background (Existing Ponds to Left)

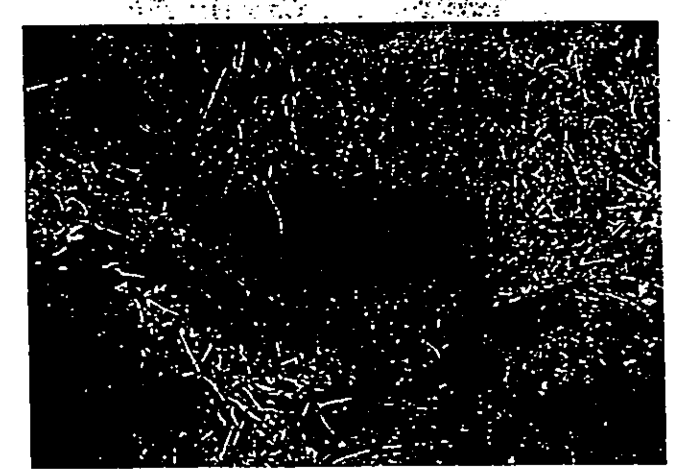

Fig. 4 Mucky Clay below Grass Mat

Fig. 5 West Face of Backhoe Trench 2

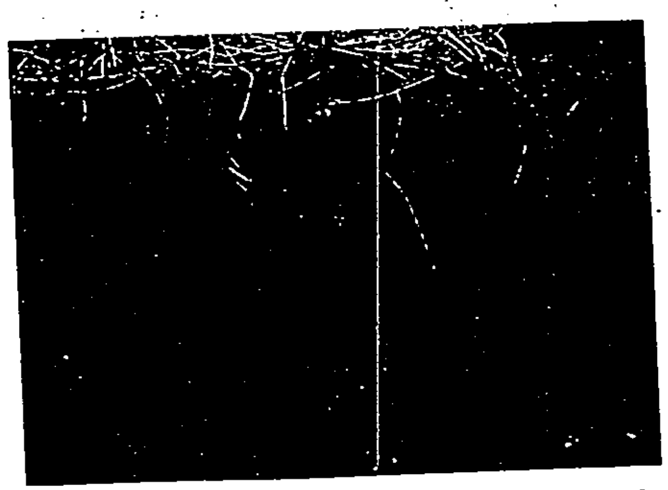

Fig. 6 West Face of Backhoe Trench 2 Showing Muck and Decaying Organic Debris at Base

Based on the accumulation of evidence (survey, testing, informant knowledge, historic background), it is presumed that if *lo'i* existed in the present swamp area(s) that they have been inundated with up to 3+ meters of spongy clay muck. Though the thickness of the much (3+ meters) appears to argue for a much longer time period of its accumulation, a mitigation program to address this model could answer archaeological and environmental questions (See recommendation section of the survey report).

Table 2: Soil Samples Catalog

CULTURAL SURVEYS HAWAII SOIL SAMPLES CATALOG					
Project: Hakipu'u Mariculture Research and Training Center					
Location	Date	Stratum	Depth (cm.)	Weight (g.)	Munsell color & Description
Backhoe Trench 1	12/2/93	II	7-20	1015.9	10 YR 3/4 clay loam
Backhoe Trench 1	12/2/93	III	20-35	874.2	10 YR 3/4; mottled 7 YR 6/6 clay loam
Backhoe Trench 1	12/2/93	IV	35-55	845.8	7 YR 4/6; mottled N5/ clay loam
Backhoe Trench 1	12/2/93	V	55-75	930.9	N4/; mottled 7 YR 4/6 clay (water 65-70)
Backhoe Trench 2	12/2/93		15-25	3308.5	10 YR 1/2; mottled 10 YR 6/8 clay
Backhoe Trench 2	12/2/93		140-170	2989.9	5 YR 3/8 clay
Backhoe Trench 2	12/2/93		250-300	2146.1	5 YR 3/1 clay
Backhoe Trench 3	12/2/93		80-100	2628.1	10 YR 2/2 clay
Backhoe Trench 3	12/2/93		50-70	2117.8	5 YR 3/1 clay

APPENDIX D

BOTANICAL STUDY

BOTANICAL SURVEY

LARGE SCALE POND RESEARCH, TRAINING AND DEMONSTRATION FACILITY

KUALOA, O'AHU, HAWAI'I

by

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Honolulu, Hawai'i

Prepared for: Oceanit Laboratories, Inc.

January 1992

INTRODUCTION

The proposed large scale pond research, training and demonstration facility will be located on the 26 acre University of Hawaii's Mariculture Research Training Center (MRTC) at the extreme north-west corner of Kane'ohe Bay. The site was originally a commercial aquaculture farm, Aquatic Farms, Inc. Renovations of the facility will tentatively include creating a system of smaller experimental ponds, new tank facilities, new salt and freshwater systems, one (or more) new laboratories, office facilities, and on-site visiting student facilities.

Vegetation on the 26 acre project site consists primarily of well-maintained lawns and landscape plantings surrounding the aquaculture ponds, office building, maintenance area, and along the highway. Unimproved areas support a dense tangle of hau thickets, thick mats of California grass, mixed forests, and a stand of mangrove.

Field studies to assess the botanical resources on the subject property were conducted on 24 January 1992. The primary objectives of the survey were to: 1) describe the major vegetation types; 2) inventory the flora; and 3) search for threatened and endangered plant species protected by Federal and State endangered species laws.

SURVEY METHODS

Prior to the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps, proposed new pond schematic map, and a very recent black and white aerial photograph were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points.

A walk-through survey method was used. Notes were made on plant distribution and associations, substrate types, drainage, exposure, topography, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium and for comparison with the most recent taxonomic literature.

The grounds of the existing MRTC facility are fairly well-maintained while most of the undeveloped portions of the site are covered by thickets of hau, mangrove, mixed forest, or California grass. These undeveloped portions of the property were surveyed more intensively as rare species are more likely to occur in such situations.

DESCRIPTION OF THE VEGETATION

The MRTC site falls within the coastal zone vegetation. In many places in Hawai'i, especially on the island of O'ahu, the native coastal plant communities have been severely altered by humans and replaced by introduced or alien species (Fosberg 1972; Cuddihy and Stone 1990). The MRTC site was probably cultivated by the Hawaiians, given its proximity to the Moli'i Fishpond and other important areas such as Kualoa. Today adjacent parcels are still used to grow taro. The existing large ponds on the site were part of the commercial aquaculture farm which originally occuppied the 26-acre parcel.

A maintained, landscaped area surrounds the ponds and buildings, while the unmaintained or unimproved area occurs as a wide to narrow band around the developed portions of the property. A more complete description of these two areas follows; a checklist of the plant species inventoried on the property is presented at the end of the report.

Maintained Area

Grassy lawns fill in the area around the ponds and buildings. The lawns are composed of a mixture of different grasses and weedy herbs. Hilo grass (*Paspalum conjugatum*) is the most abundant of the grasses while others such as Bermuda grass or manienie - (*Cynodon dactylon*), carpet grass (*Axonopus fissifolius*), seashore paspalum (*Paspalum vaginatum*), and Glenwood grass (*Sacciolepis indica*) are common to occasional. Scattered through the lawns are a number of low-growing, weedy species such as Spanish clover (*Desmodium incanum*), sensitive plant or puahilahila (*Mimosa pudica*), hairy spurge (*Chamaesyce hirte*), Asiatic pennywort or pohekula (*Centella asiatica*), yellow wood sorrel (*Oxalis corniculata*), and nutgrass (*Cyperus rotundus*). Around the margins of ponds and drainage ditches, plants which prefer a wetter environment are found; these include *Leptochloa uninervia*, California grass (*Brachiaria mutica*), primrose willow or kamole (*Ludwigia octovalvis*), marsh purslane (*Ludwigia palustris*), honohono (*Commelina diffusa*), jungle rice (*Echinochloa colona*), barnyard rice (*Echinochloa crus-galli*), and green kyllinga (*Kyllinga brevifolia*). Aquatic plants observed in ponds and ditches include *Azolla filiculoides*, water hyacinth (*Eichhornia crassipes*), and hihiawai (*Ceratopteris thalictroides*). Seaward of the tank farm is a drainage ditch with a small taro (*Colocasia esculenta*) patch and water lily (*Nymphea* cf. *rubra*) pond.

Clumps of different banana cultivars (*Musa* X *paradisiaca*) and coconuts (*Cocos nucifera*) are found throughout the lawn areas.

Where the MRTC site borders Kamehameha Highway, near the office and maintenance buildings, is a grove of large trees, 70 to 80 ft. tall, which include monkeypod (Samanea saman), mango (Mangifera indica), Caribbee royal palm (Roystonea oleracea), Java plum (Syzygium cumini), and Paraserianthes falcataria. Beneath the taller tree layer are plantings of banana, coconut, cassava (Manihot esculenta), papaya (Carica papaya), ti (Cordyline fruticosa), and several other ornamental species. This dense growth of vegetation provides a buffer (visual and noise screen) between the facility and the busy highway traffic.

Unmaintained/Unimproved Area

Along the southwest corner of the property is a large, open grassy area dominated by California grass (Brachiaria mutica), from 3 to 6 ft. high. Scattered throughout the dense mat of California grass are plants of candle bush (Senna alata) and primrose willow (Ludwigia octovalvis). Locally common and forming small pacthes are Job's tears (Coix lachryma-jobi) and umbrella plant (Cyperus alternifolius). Where there are small mounds of soil, shrubs of koa-haole (Leucaena leucocephala) and Pluchea symphytifolia occur. Around the margins of this grassy area are plants of honohono (Commelina diffusa), maile-pilau (Paederia scandens), maunaloa (Canavalia cathartica), and Wedelia trilobata.

Makai (east) of the California grass dominated area is a dense thicket of hau (Hibiscus tiliaceus) up to 20 ft. tall. A few large trees of Java plum (Syzygium cumini) stand above the thicket on its inland side, while a few trees of mangrove (Rhizophora mangle) are found on its seaward side. Basically, there is very little vegetation under this dense hau thicket and litter, mud, and foul-looking water are the prominent features. Only along the edges of the thicket or on areas with fill land, such as along the trail through the hau to Kane'ohe Bay, are there other plant species such as California grass, hairy sword fern (Nephrolepis

multiflora), milo (Thespesia populnea), coconut (Cocos nucifera), and false kamani (Terminalia catappa).

Fronting Kane'ohe Bay, on the northeast corner of the property, is a dense mangrove thicket. Like the hau thicket, there is very little vegetation under the tangle of mangrove plants.

A mixed forest is found bordering the stream along the north boundary. Java plum is the most commonly occurring tree, although kukui (Aleurites moluccana) forms a fairly-large stand closer to the highway. Other tree species occurring here are monkeypod (Samanea saman), African tulip (Spathodea campanulata), and hau. Where the tree cover is open, California grass forms a dense ground cover. Where the tree canopy is closed and the ground below more heavily shaded, as under the kukui trees, basket grass and water-worn cobbles are a more characteristic feature.

DISCUSSION AND RECOMMENDATIONS

The majority of the site is landscaped and maintained. The undeveloped/unmaintained area supports California grass, hau, and mangrove dominated wetlands as well as a mixed forest along the small stream to the north. The wetland areas are of particular interest to regulatory agencies.

With the exception of hau, which is probably indigenous, the dominant components of the vegetation on the project site are introduced or alien plant species. Of a total of 129 species inventoried during the field studies, 115 (89%) are introduced, 9 (7%) are originally of Polynesian introduction, and 5 (4%) are indigenous, i.e. native to the Hawaiian Islands and elsewhere. No endemic species, i.e. native only to the Hawaiian Islands, were found. No officially listed threatened and endangered plants (U.S. Fish and Wildlife Service 1989) occur on the site; nor are there any plants proposed or candidate for such status (U.S. Fish and Wildlife Service 1990) on the subject property. All of the species found on the MRTC site can be found in similar habitats throughout the islands.

There is very little of botanical interest or concern on the MRTC site and the proposed renovations of the facility will not have a significant negative impact on the botanical resources.

As to landscaping, it is recommended that more plants of Polynesian introduction and native species be incorporated into the landscaping plans for the renovated facility. The site already has a number of different banana cultivars and small groves of coconut trees. The additional material could include breadfruit or 'ulu (*Artocarpus altilis*), milo (*Thespesia populnea*), more banana and taro cultivars, mountain apple (*Syzygium malaccense*), kamani (*Calophyllum inophyllum*), hala (*Pandanus tectorius*), etc.

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PLANT SPECIES LIST -- Aquaculture Facility, Kualoa, O'ahu

A checklist of all those vascular terrestrial and aquatic plant species inventoried during the field study is presented below. The plants are divided into three groups: Ferns and Fern Allies, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux (1984); the flowering plants, Monocots and Dicots, are in accordance with Wagner _et al_. (1990) for the native and naturalized introduced species while the cultivated taxa follow St. John (1973).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   I = indigenous = native to the Hawaiian Islands and also elsewhere throughout the Pacific
   P = Polynesian = plants originally of Polynesian introduction prior to Western contact (1778); not native
   X = introduced or alien = all those plants introduced to the islands intentionally or accidentally after Western contact; not native.
4. Distribution, presence (+) or absence (-), of a particular species within each of two areas on the project site (see text for discussion):
   M = Maintained Area
   U = Unmaintained Area

Scientific name	Common name	Status	Distribution M	U
FERNS AND FERN ALLIES				
AZOLLACEAE (Water Fern Family)				
Azolla filiculoides Lamk.	azolla	X	+	-
NEPHROLEPIDACEAE (Sword Fern Family)				
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X	+	+
PARKERIACEAE (Parkeria Family)				
Ceratopteris thalictroides (L.) Brongn.	hihiawai, palai-kahawai	X	+	-
POLYPODIACEAE (Common Fern Family)				
Phymatosorus scolopendria (Burm.) Pic.-Serm.	laua'e, lauwa'e	X	+	+
PSILOTACEAE (Whisk Fern Family)				
Psilotum nudum (L.) Beauv.	moa, pipi	I	+	+
THELYPTERIDACEAE (Downy Woodfern Family)				
Christella parasitica (L.) Levl.	woodfern, oakfern	X	+	+
FLOWERING PLANTS				
MONOCOTS				
AGAVACEAE (Sisal Family)				
Cordyline fruticosa (L.) A. Chev.	ti,ki	P	+	+
Pleomele marginata (Lam.) N. E. Brown	money plant	X	+	-
AMARYLLIDACEAE (Amaryllis Family)				
Crinum asiaticum L.	spider plant	X	+	-

Scientific name	Common name	Status	Distribution M	Distribution U
NYMPHAEACEAE (Water Lily Family)				
Nymphea cf. rubra Roxb ex Salisb.	water lily (cultivar)	X	+	-
PANDANACEAE (Screwpine Family)				
Pandanus tectorius S. Parkinson ex Z.	pandanus, hala	I	-	+
POACEAE (Grass Family)				
Axonopus fissifolius (Raddi) Kuhlm.	carpet grass	X	+	-
Brachiaria mutica (Forssk.) Stapf	California grass, Para grass	X	+	+
Chloris barbata (L.) Sw.	swollen finger grass, mau'ulei	X	+	-
Chloris divaricata R. Br.	star grass	X	+	-
Chloris radiata (L.) Sw.	radiate finger grass	X	+	-
Coix lachryma-jobi L.	Job's tears	X	-	+
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	+	-
Digitaria spp. (2)	crabgrass	X	+	-
Echinochloa colona (L.) Link	jungle rice	X	+	-
Echinochloa crus-galli (L.) P. Beauv.	barnyard grass	X	+	-
Eleusine indica (L.) Gaertn.	wire grass	X	+	-
Leptochloa uninervia (K. Presl.) Hitchc. & Chase		X	+	-
Oplismenus hirtellus (L.) P. Beauv.	basket grass, honohono kukui	X	-	+
Paspalum conjugatum Bergius	Hilo grass, mau'u Hilo	X	+	+
Paspalum vaginatum Sw.	seashore paspalum	X	+	-
Sacciolepis indica (L.) Chase	Glenwood grass	X	+	-
Setaria palmifolia (J. Konig) Stapf	palm grass	X	-	+
Sporobolus indicus (L.) R. Br.	West Indian dropseed, smutgrass	X	+	+
PONTEDERIACEAE (Pickerel Weed Family)				
Eichhornia crassipes (Mart.) Solms	water hyacinth	X	+	+
ZINGIBERACEAE (Ginger Family)				
Alpinia mutica Roxb.	small shell ginger	X	+	-
Alpinia purpurata (Vieill.) K. Schum.	red ginger, 'awapuhi 'ula'ula	X	+	-

Scientific name	Common name	Status	Distribution M	Distribution U
ARACEAE (Aroid Family)				
Alocasia cucullata (Lour.) G. Don	Chinese taro	X	+	+
Alocasia macrorrhiza (L.) Schott	'ape, apii	P	+	+
Colocasia esculenta (L.) Schott	taro, kalo	P	+	-
Dieffenbachia seguine (Jacq.) Schott	dumb cane	X	+	-
Epipremnum pinnatum (L.) Engl.	taro vine	X	+	+
Monstera sp.	monstera	X	+	-
ARECACEAE (Palm Family)				
Caryota sp.	fishtail palm	X	-	+
Cocos nucifera L.	coconut, niu	P	+	+
Livistona chinensis (Jacq.) R. Br. ex Mart.	Chinese fan palm	X	+	+
Roystonea oleracea (Jacq.) O. F. Cook	Caribbee royal palm	X	+	+
COMMELINACEAE (Spiderwort Family)				
Commelina diffusa N. L. Burm.	honohono	X	+	+
CYPERACEAE (Sedge Family)				
Cyperus alternifolius L.	umbrella plant, 'ahu 'awa haole	X	-	+
Cyperus rotundus L.	nutgrass	X	+	-
Fimbristylis littoralis Gaud.		X	+	-
Kyllinga brevifolia Roth.	green kyllinga, kili'o'opu	X	+	+
Kyllinga nemoralis (J. R. Forster & G. Forster) Dandy ex Hutchinson & Dalziel	white kyllinga, kili'o'opu	X	+	-
Pycreus polystachyos (Rottb.) P. Beauv.		I	+	-
MUSACEAE (Banana Family)				
Musa X paradisiaca L.	banana, maia	P	+	+

Scientific name	Common name	Status	Distribution M	Distribution U
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	+	+
Sonchus oleraceus L.	sow thistle, pualele	X	+	+
Synedrella nodiflora (L.) Gaertn.	nodeweed	X	+	+
Vernonia cinerea var. parviflora (Reinw.) DC.	little ironweed	X	+	-
Wedelia trilobata (L.) Hitchc.	wedelia	X	+	+
Youngia japonica (L.) DC.	oriental hawksbeard	X	+	+
BIGNONIACEAE (Bignonia Family)				
Jacaranda mimosifolia D. Don	jacaranda	X	+	-
Spathodea campanulata P. Beauv.	African tulip tree	X	+	+
BRASSICACEAE (Mustard Family)				
Cardamine flexuosa With.	bittercress	X	+	-
BUDDLEJACEAE (Butterfly Bush Family)				
Buddleia asiatica Lour.	dog tail, huelo 'ilio	X	-	+
CARICACEAE (Papaya Family)				
Carica papaya L.	papaya, mikana	X	+	+
CARYOPHYLLACEAE (Pink Family)				
Drymaria cordata (L.) Willd. ex Roem.	drymaria, pipili	X	+	+
COMBRETACEAE (Indian Almond Family)				
Terminalia cattapa L.	tropical almond, false kamani	X	-	+
CONVOLVULACEAE (Morning Glory Family)				
Ipomoea alba L.	moon flower, koali pehu	X	-	+
Ipomoea triloba L.	little bell, pink bindweed	X	+	-
CUCURBITACEAE (Squash Family)				
Momordica charantia L.	wild bittermelon	X	-	+

Scientific name	Common name	Status	Distribution M	Distribution U
DICOTS				
ACANTHACEAE (Acanthus Family)				
Ruellia prostrata Poir	ruellia	X	+	-
Ruellia sp.	ruellia	X	+	-
Thunbergia fragrans Roxb.	white thunbergia	X	-	+
AMARANTHACEAE (Amaranthus Family)				
Achyranthes aspera L.		X	-	+
Alternanthera sessilis (L.) DC.	sessile joyweed	X	+	-
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X	+	+
Amaranthus viridis L.	slender amaranth, pakai	X	+	-
ANACARDIACEAE (Mango Family)				
Mangifera indica L.	mango, manako	X	+	+
APIACEAE (Parsley Family)				
Centella asiatica (L.) Urban	Asiatic pennywort, pohekula	X	+	-
ARALIACEAE (Ginseng Family)				
Schefflera actinophylla (Endl.) Harms	octopus tree	X	+	+
ASTERACEAE (Sunflower Family)				
Ageratum houstonianum Mill.	maile hohono	X	+	+
Bidens alba var. radiata (Schultz-Bip.) Ballard ex Melchert	white-flowered beggar's tick	X	-	+
Bidens pilosa L.	Spanish needle, beggar's tick	X	+	+
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	+	-
Eclipta alba (L.) Hassk.	false daisy	X	+	+
Emilia fosbergii Nicolson	pualele	X	+	+
Pluchea indica (L.) Less.	Indian fleabane	X	-	+

Scientific name	Common name	Status	Distribution M	Distribution U
MALVACEAE (Mallow Family)				
Hibiscus tiliaceus L.	hau	I?	+	+
Sida rhombifolia L.	Cuba jute	X	+	+
Thespesia populnea (L.) Sol. ex Correa	milo	I?	-	+
MELASTOMATACEAE (Melastoma Family)				
Clidemia hirta (L.) D. Don	Koster's curse	X	+	+
MORACEAE (Mulberry Family)				
Ficus microcarpa L. f.	Chinese banyan	X	-	+
MYRTACEAE (Myrtle Family)				
Psidium guajava L.	guava, kuawa	X	+	+
Syzygium cumini (L.) Skeels	Java plum	X	+	+
ONAGRACEAE (Evening Primrose Family)				
Ludwigia octovalvis (Jacq.) Raven	primrose willow, kamole	P?	+	+
Ludwigia palustris (L.) Elliott	marsh purslane	X	+	-
OXALIDACEAE (Wood Sorrel Family)				
Averrhoa carambola L.	star fruit, carambola	X	+	-
Oxalis corniculata L.	yellow wood sorrel, 'ihi 'ai	P?	+	+
Oxalis corymbosa DC.	pink wood sorrel, 'ihi pehu	X	+	-
PASSIFLORACEAE (Passion Flower Family)				
Passiflora edulis Sims	passion fruit, liliko'i	X	-	+
Passiflora laurifolia L.	yellow granadilla, yellow water lemon	X	-	+
PLANTAGINACEAE (Plantain Family)				
Plantago major L.	broad-leaved plantain, laukahi	X	+	-

Scientific name	Common name	Status	Distribution M	Distribution U
EUPHORBIACEAE (Spurge Family)				
Aleurites moluccana (L.) Willd.	kukui, tutui	P	+	+
Chamaesyce hirta (L.) Millsp.	hairy spurge	X	+	-
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X	+	-
Chamaesyce hyssopifolia (L.) Small	spurge	X	+	-
Codiaeum variegatum (L.) Bl.	croton (cultivars)	X	+	-
Macaranga mappa (L.) Müll. Arg.	bingabing	X	+	+
Manihot esculenta Crantz	cassava, tapioca	X	+	-
Phyllanthus debilis Klein ex Willd.	niruri	X	+	+
FABACEAE (Pea Family)				
Albizia lebbeck (L.) Benth.	siris tree, women's tongue	X	+	-
Caesalpinia decapetala (Roth) Alston	wait-a-bit, cat's claw, Mysore thorn	X	-	+
Canavalia cathartica Thouars	maunaloa	X	+	+
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	+	-
Desmodium incanum DC.	Spanish clover, ka'imi	X	+	+
Leucaena leucocephala (Lam.) de Wit	koa-haole	X	+	+
Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb.	sensitive plant, sleeping grass, pua hilahila	X	+	+
Paraserianthes falcataria (L.) I. Nielsen		X	+	-
Samanea saman (Jacq.) Merr.	monkeypod	X	+	+
Senna alata (L.) Roxb.	candle bush	X	-	+
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	kolomona	X	+	+
LAMIACEAE (Mint Family)				
Hyptis pectinata (L.) Poit.	comb hyptis	X	+	-
Indet. sp.		X	-	+
LAURACEAE (Laurel Family)				
Persea americana Mill.	avocado, alligator pear	X	+	-

Scientific name	Common name	Status	Distribution M	Distribution U
PORTULACACEAE (Purlane Family)				
Portulaca oleracea L.	pigweed, 'akulikuli kula	X	+	-
RHIZOPHORACEAE (Mangrove Family)				
Rhizophora mangle L.	American mangrove, red mangrove	X	-	+
RUBIACEAE (Coffee Family)				
Morinda citrifolia L.	noni	P	-	+
Paederia scandens (Lour.) Merr.	maile pilau	X	+	+
SOLANACEAE (Nightshade Family)				
Capsicum frutescens L.	chili pepper, nioi	X	+	-
Solanum mauritianum Scop.	pua nana honua	X	+	-
STERCULIACEAE (Cacao Family)				
Melochia umbellata (Houtt.) Stapf	melochia	X	+	-
ULMACEAE (Elm Family)				
Trema orientalis (L.) Blume	gunpowder tree, charcoal tree	X	+	-
VERBENACEAE (Verbena Family)				
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain	X	+	+

APPENDIX E

AVIFAUNA STUDY

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT MARICULTURE RESEARCH AND TRAINING CENTER, KUALOA, OAHU

Prepared for

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by

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28 February 1992

INTRODUCTION

The purpose of this report is to summarize the findings of a one day (25 February 1992) bird and mammal field survey of approximately 26 acres located at Mariculture Research and Training Center (MRTC), Kualoa, Oahu (Fig. 1). Also included are references to pertinent literature as well as unpublished faunal reports.

The objectives of the field survey were to:

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

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

3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened".

4- Suggest what changes, if any, may occur in bird and mammal populations at this site as a result of the proposed development.

GENERAL SITE DESCRIPTION

Figure One indicates the property surveyed for birds and mammals. Much of the site is covered in aquaculture ponds, lawns and a variety of introduced plants. Hakipuu Stream borders the property. A dense stand of Hau (_Hibiscus_ _tiliaceus_) and Red Mangrove (_Rhizophora_ _mangle_) occur on the makai and Kaneohe sides of the site. Coastal mudflats and patches of California Grass (_Brachiaria_ _mutica_) provide additional habitats. The proposal for this property includes removal of some forested patches and the creation of new wetland habitat which will serve to treat aquaculture effluent.

Weather during the field survey was clear and warm. Winds were light 0-5 mph.

STUDY METHODS

Field observations were made with binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity. At various locations eight minute counts were made of all birds seen or heard (Fig. 1). Between these count (census) stations any unusual observations of bird were also noted. These data provide the basis for the relative

(estimated) abundance figures given in this report (Table 1, 2). Published and unpublished reports of birds known from similar habitat were also consulted in order to acquire a more complete picture of the possible species that might be expected (Shallenberger 1977; Conant 1981; USFWS 1981; DLNR 1986, 1987, 1988; Prat et al. 1987; Hawaii Audubon Society 1989; Bruner 1991a, 1991b). Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative (estimated) abundance and distribution.

Scientific names used herein follow those given in Hawaii's Birds (Hawaii Audubon Society 1989); Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987); Mammal Species of the World (Honacki et al. 1982) and List and Summary of the flowering plants in the Hawaiian Islands (St. John 1973).

RESULTS AND DISCUSIION

Resident _Endemic_ (_Native_) _Land_ _Birds_:

No endemic land birds were recorded on the survey. The Short-eared Owl or Pueo (_Asio_ _flammeus_ _sandwichensis_) is the only endemic land bird that may likely occur in this area (Pratt et al. 1987). Pueo are listed as endangered species on Oahu by State of Hawaii Division of Forestry and Wildlife. They forage in pastures, agricultural fields and forests. The up slope ranch lands may contain Pueo. This species may at times forage around the ponds at MRTC.

Resident Endemic (Native) Waterbirds:

The following endemic and endangered waterbirds were recorded on the survey: Black-necked Stilt (Himantopus mexicanus knudseni); American Coot (Fulica americana alai) and Common Moorhen (Gallinula chloropus sandvicensis). These endangered species were observed throughout the various wetlands associated with this site. Table 1 shows the number of stilt, coot and moorhen recorded on the morning and afternoon census of the property as well as data from 1989 and 1990 collected by the State of Hawaii Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife. DLNR reports (1986, 1987, 1988) also provide data from which to evaluate the importance of these wetlands for waterbirds. In addition Shallenberger (1977), USFW (1981) and Conant (1981) give information on waterbirds in Windward Oahu.

Migratory Indigenous (Native) Birds:

Migratory shorebirds winter in Hawaii between the months of August through May. Some juveniles will stay through the summer months as well (Johnson and Johnson 1983). Of all the shorebirds species which winter in Hawaii the Pacific Golden Plover (Pluvialis fulva) is the most abundant. Plover prefer open areas such as

exposed intertidal reef, rocky shorelines, mud flats, lawns, plowed fields and pastures. They arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April (Johnson et al. 1981). Johnson et al. (1989) have also shown that plover are extremely site-faithful on the wintering grounds and most establish foraging territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years (Johnson et al. 1989).

Nine plover were recorded on the morning survey and 13 on the afternoon census. Eight Ruddy Turnstone (Arenaria interpres) and one Wandering Tattler (Heteroscelus incanus) were also observed. These common migrants utilize mudflats and shallow ponds. Migratory ducks such as Northern Pintail (Anas acuta) and Northern Shoveler (Anas clypeata) may also occur at this site (Shallenberger 1977; DLNR 1986, 1987, 1988). No migratory waterfowl, however, were found on this survey.

Resident Indigenous (Native) Birds:

Several Black-crowned Night Heron (Nycticorax nycticorax) were tallied on the survey (Table 1). Bo Alexander (MRTC employee) reported (pers. comm.) that over 100 night heron may occur on the property when the ponds are drawn down to harvest prawns. This species is the only native waterbird that is not listed as endangered.

Night Heron have probably increased in abundance in recent years as a result of the statewide development of the aquaculture industry (Hawaii Audubon Society 1989).

Resident Indigenous (Native) Seabirds:

No nesting seabirds were observed on the property. The presence of predators renders this site unsuitable for nesting or roosting seabirds. Great Frigatebird (*Fregata minor*) are known to take fresh water from the open ponds in Kawainui Marsh (Conant 1981) and may do so on occasion at this site.

Exotic (Introduced) Birds:

A total of 14 species of exotic birds were recorded during the field survey (Table 2). The most abundant birds were: Red-vented Bulbul (*Pycnonotus cafer*), Common Myna (*Acridotheres tristis*), Nutmeg Mannikin (*Lonchura punctulata*) and Common Waxbill (*Estrilda astrild*).

Based on the location and type of habitats found on the property as well as information provided in Pratt et al. 1987 and Hawaii Audubon Society 1989, the following exotic species may also occur at this site: Common Barn Owl (*Tyto alba*), Hwamei (*Garrulax canorus*) and Chestnut Mannikin (*Lonchura malacca*).

Feral Mammals:

Small Indian Mongoose (*Herpestes auropunctatus*) and feral cats

were observed. No trapping was conducted in order to assess the relative abundance of mammals.

Records of the endemic and endangered Hawaiian Hoary Bat are sketchy, however, the species has been reported from Oahu (Tomich 1986; Kepler and Scott 1990). No bats were found on this survey.

CONCLUSION

A brief field survey such as this one can provide only a limited perspective of the wildlife which utilize the area. The number and relative abundance of each species may vary throughout the year due to available food resources and reproductive success. Species which are migratory will quite obviously be found only at certain times during the year. Exotic species sometimes prosper only to later disappear or become a less significant part of the ecosystem (Williams 1987; Moulton et al. 1990). Thus only long term studies can provide a comprehensive view of the bird and mammal populations in a particular area. Nevertheless some general conclusions related to bird and mammal activity at this site can be drawn. The following comments summarize the findings of this survey .

1- All major habitats on the property were visited and census stations were distributed so as to provide a reasonable sample from which relative estimates of bird populations could be derived.

2- The endemic waterbirds found on the survey have long been known to occur in this region (Shallenberger 1977; DLNR 1986, 1987, 1988). The wetlands at this site are censused for waterbirds by DLNR Division of Forestry and Wildlife. The number of waterbirds recorded on the most recent 1989, 1990 DLNR surveys and this one day census reveal some variation. These differences are likely due to several factors: survey methods, weather and water level conditions, reproductive success, vegetation cover and distrubance.
The Oahu population of the endemic Hawaiian Owl or Pueo is listed by the State of Hawaii as an endangered species. This bird was not recorded on the survey. Pueo, however, do forage in wetlands and may on occasion occur in this area.

3- The numbers of migratory shorebirds recorded on this survey were comparable with data gathered on other surveys in similar habitat (Bruner 1991a, 1991b).

4- The property supports the typical array of exotic birds one would expect in this type of environment on Oahu. No unusual or unexpected species were recorded.

5- A trapping program would be required in order to obtain more

definitive data on mammals. Feral mammal observations were comparable with similar habitat surveyed elsewhere on Oahu (Bruner 1991a, 1991b). The Hawaiian Hoary Bat was not recorded at this site but is known from Oahu.

6- The aquaculture ponds provide foraging and nesting habitat for native waterbirds. The adjoining hau thickets are of less value. The conversion of these densely vegetated patches to open usable wetlands should result in an increase in the number of waterbirds on this property. The loss of this second growth forest of hau and grass is of minor importance compared to the value the additional wetland habitat will provide for the native waterbirds.

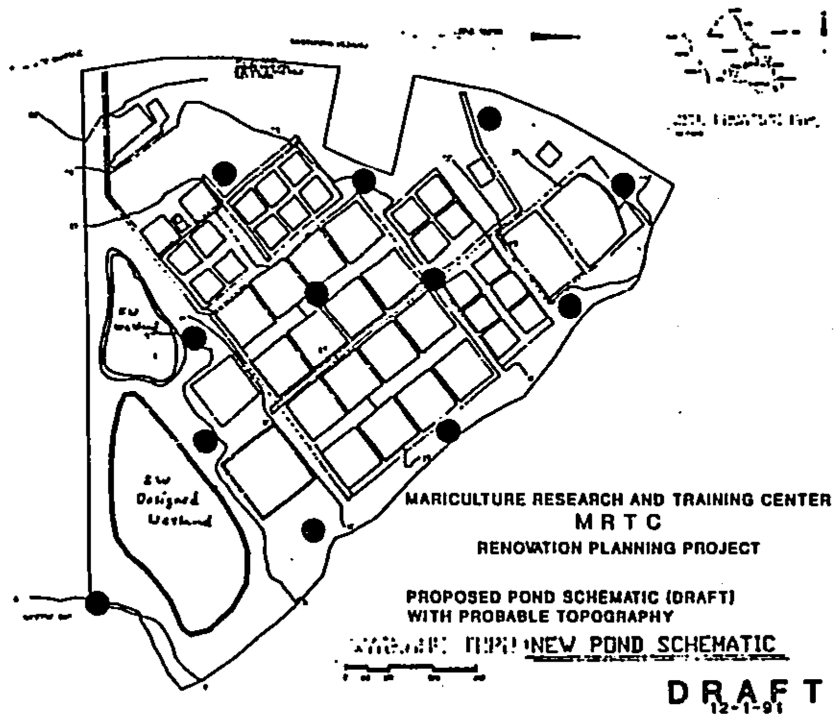

Fig. 1. Location of faunal survey of the MRTC site, Kualoa, Oahu. Solid circles indicate where census (count) stations were taken.

TABLE 1

Summary of census data for waterbirds at MRTC, Kualoa, Oahu. Morning (am) and afternoon (pm) counts are given along with data from 1989, 1990 collected by State of Hawaii DLNR Division of Forestry and Wildlife (data courtesy of Dr. Carol Terry DOFAW).

COMMON NAME	SCIENTIFIC NAME	AM COUNTS	PM COUNTS	1989 DLNR	1990 DLNR
American Coot	Fulica americana alai	15	9	18	7
Common Moorhen	Gallinula chloropus sandvicensis	6	9	0	0
Black-necked Stilt	Himantopus mexicanus knudseni	4	3	0	5
Black-crowned Night Heron	Nycticorax nycticorax	8	6	5	2

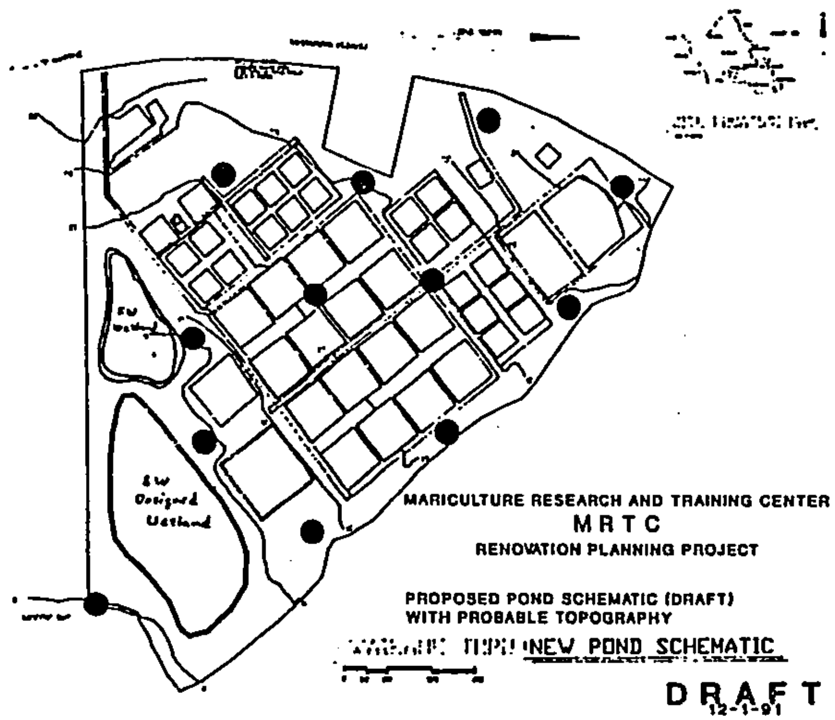

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TABLE 2

Exotic (introduced) birds recorded at MRTC, Kualoa, Oahu.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Cattle Egret	Bubulcus ibis	R = 9
Spotted Dove	Streptopelia chinensis	C = 8
Zebra Dove	Geopelia striata	C = 9
Common Myna	Acridotheres tristis	A = 12
Red-vented Bulbul	Pycnonotus cafer	A = 15
White-rumped Shama	Copsychus malabaricus	U = 4
Northern Cardinal	Cardinalis cardinalis	C = 6
Red-crested Cardinal	Paroaria coronata	C = 7
Japanese White-eye	Zosterops japonicus	C = 9
Nutmeg Mannikin	Lonchura punctulata	A = 14
Common Waxbill	Estrilda astrild	A = 18
House Finch	Carpodacus mexicanus	C = 8
House Sparrow	Passer domesticus	R = 3
Java Sparrow	Padda oryzivora	R = 2

*(see page 13 for key to symbols)

KEY TO TABLE 2

Relative (estimate) abundance = Number of times observed during survey or average number on eight minute counts in appropriate habitat.

A = abundant (ave. 10+)

C = common (ave. 5-10)

U = uncommon (ave. less than 5)

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

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APPENDIX F

MRTC CONCEPTUAL WATER SUPPLY SYSTEM & MARINE ENVIRONMENTAL ASSESSMENT

Oceanit Laboratories, Inc.
coastal & environmental engineering services • research & development

APPENDIX F

MARICULTURE RESEARCH AND TRAINING CENTER

CONCEPTUAL WATER SUPPLY SYSTEM AND MARINE ENVIRONMENTAL ASSESSMENT

Prepared for:
UNIVERSITY OF HAWAII
INSTITUTE OF MARINE BIOLOGY

AND

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT

January 1993

Century Square 1188 Bishop Street, Suite 2512, Honolulu, Hawaii 96813
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I. INTRODUCTION

A. BACKGROUND

The University of Hawaii's Mariculture Research and Training Center (MRTC) is an existing aquaculture facility located on the windward side of Oahu at the extreme northwest corner of Kaneohe Bay and adjacent to Hakipu'u Stream (see Figure I-1).

The facility currently includes a laboratory, office and housing buildings, and 12 ponds. Existing infrastructure includes fresh and salt water wells, water distribution and water quality monitoring systems, a small hatchery building, a pump house, 30 culture tanks ranging in size from 4 to 25 feet in diameter and 4 concrete raceways. All ponds are supplied with electricity and PVC plumbing to provide fresh and/or salt water.

The State of Hawaii Department of Land and Natural Resources in cooperation with the University of Hawaii proposes to renovate the entire facility to create more, but smaller ponds while establishing support facilities to include an office/classroom/laboratory building, a maintenance facility, a hatchery, and housing for students and caretaker. The proposed uses include expansion of most of its present education and research facilities, as well as a new role as the center for networking with research sites on other Hawaiian Islands.

Oceanit Laboratories, Inc. was contracted to provide a preliminary water system design and a marine environmental assessment as part of the renovation of the MRTC.

B. OBJECTIVES

The objectives of this study are to:

- provide a conceptual design for a seawater and fresh water delivery system
- provide a workable schematic pond layout design
- propose a method for disposal of pond effluent
- provide an assessment of the existing nearshore marine environment
- predict the probable impact of the project on the nearshore marine environment

C. SYSTEM CONCEPT

The re-designed water system will provide both clean seawater and fresh water to 39 ponds, a hatchery, and laboratory facilities (see Figure I-2). Seawater will be obtained from Kaneohe Bay while fresh water will be pumped from wells at sites to be determined. After circulation to ponds or the hatchery, water will be drained through

3

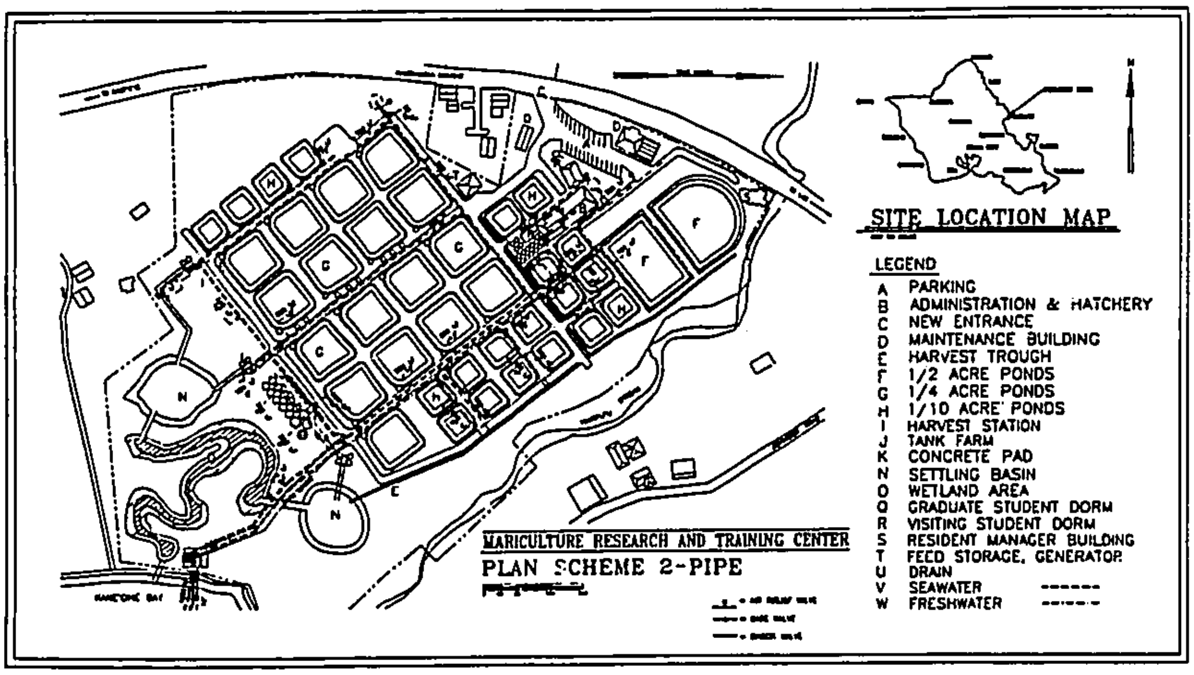

FIGURE I-2 WATER DISTRIBUTION SYSTEM

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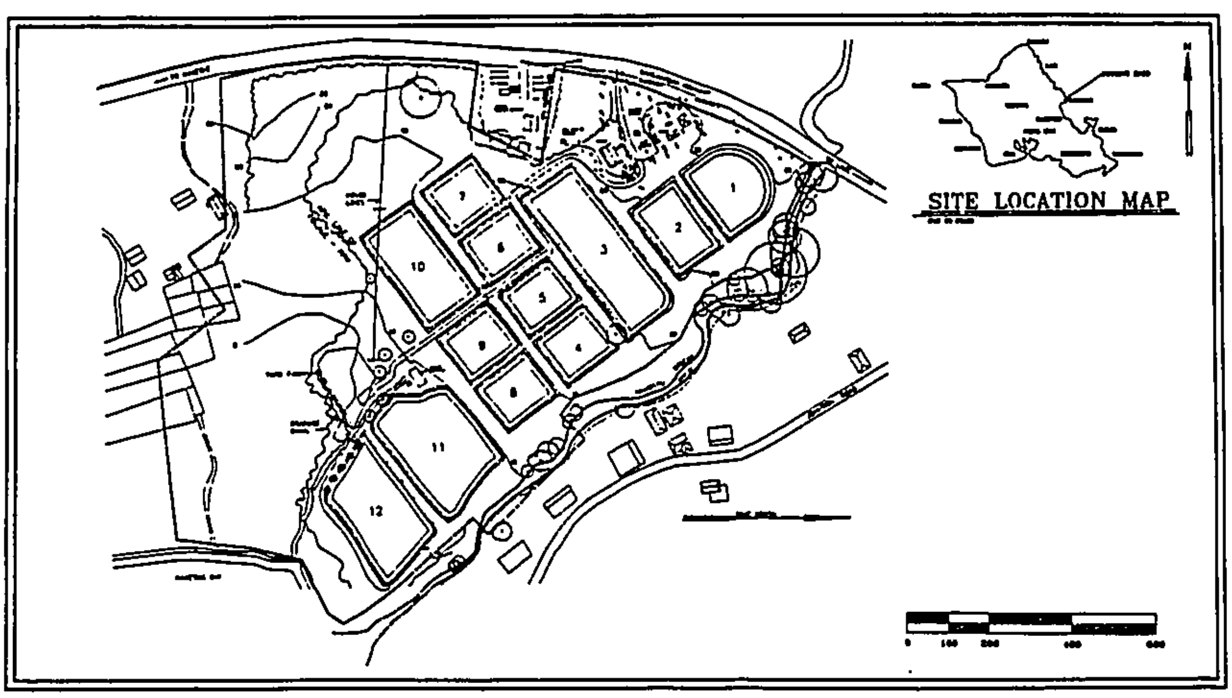

FIGURE I-1 EXISTING SITE CONDITIONS

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harvest stations and then to a designed marsh where nutrients and sediment will be removed (see Figure I-3). Clean water from the marsh will be returned to Kaneohe Bay. A properly functioning marsh should obviate the need for other water treatment.

The proposed seawater system consists of an offshore intake, pumping facility, and a buried pipe distribution system. The fresh water system consists of wells, pumps, and distribution system. The drainage system uses both buried pipes and open channels leading from the ponds to the harvest stations and designed marsh. The MRTC marsh will be the first designed salt water marsh in Hawaii.

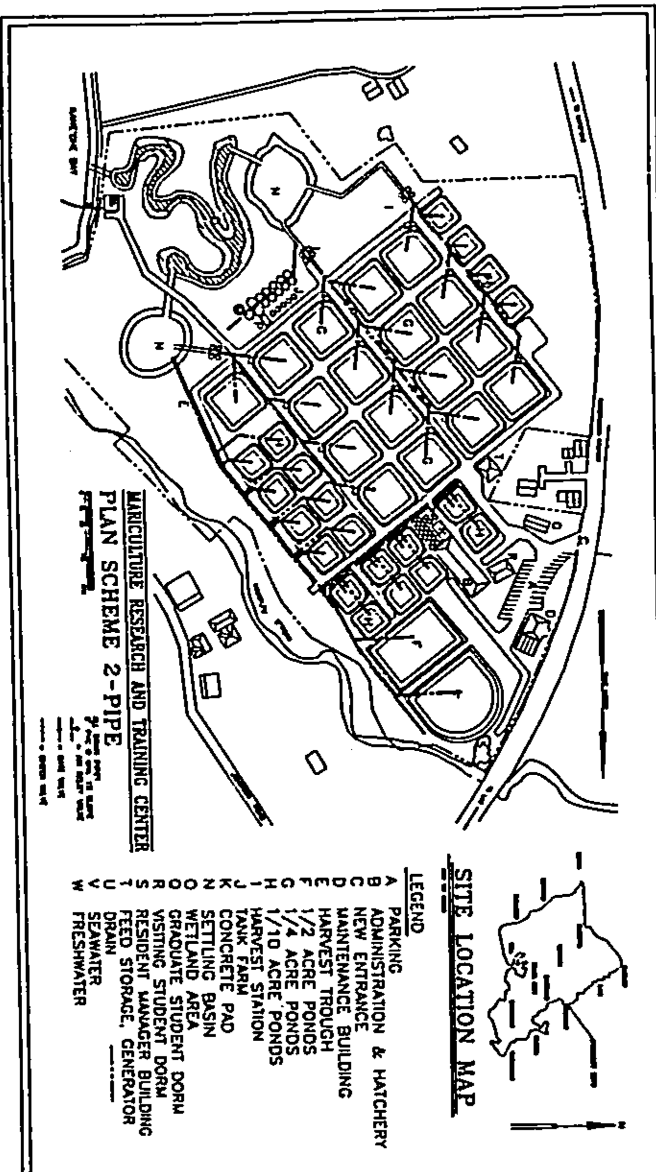

FIGURE I-3 DRAINAGE SYSTEM

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II. WATER SUPPLY SYSTEMS

A. FRESH WATER SYSTEM

1. Requirements

The following are the fresh water requirements for MRTC as specified by the University of Hawaii Institute of Marine Biology (U.H. 1992):

- The sediment load should be low.
- There should be little fluctuation in availability due to periodic flood or drought.
- The projected fresh water requirement is 500 gpm average flow with a maximum of 1000 gpm.
- The fresh water flow profile is shown in Figure II-1.
- The development and pumping of the fresh water system should not affect the water in Hakipu'u Stream.

In addition, city tap water will be required in all buildings and at each group of tanks.

2. System Concept

Fresh water is available as ground water or from Hakipu'u Stream, which runs adjacent to the MRTC facilities. Water from Hakipu'u Stream is used for agriculture by residents living near the stream; therefore, use by MRTC could cause conflict. Reducing flow in Hakipu'u Stream could also affect aquatic species that inhabit the stream. Groundwater from wells appears to be the best source of fresh water.

The availability of ground water at MRTC has not been studied in detail; however, OLI analyzed the ground water supply based on information in the literature (OLI,1992). Findings show that there may be both shallow and deep aquifers underneath MRTC. An evaluation of the possible shallow aquifer reveals that there is insufficient recharge to supply 500 gpm continuously. Actual recharge is estimated at 25 gpm. The deep aquifer has much greater potential for producing the required flow of fresh water; however, there are no wells on site or in the adjacent valley and, therefore, no means of verifying water availability without a hydrologic study and test wells. We recommend two or three wells drilled to the 100-foot depth to obtain 500 gpm of fresh water. A hydrological study including at least two test wells, should be completed to confirm these findings.

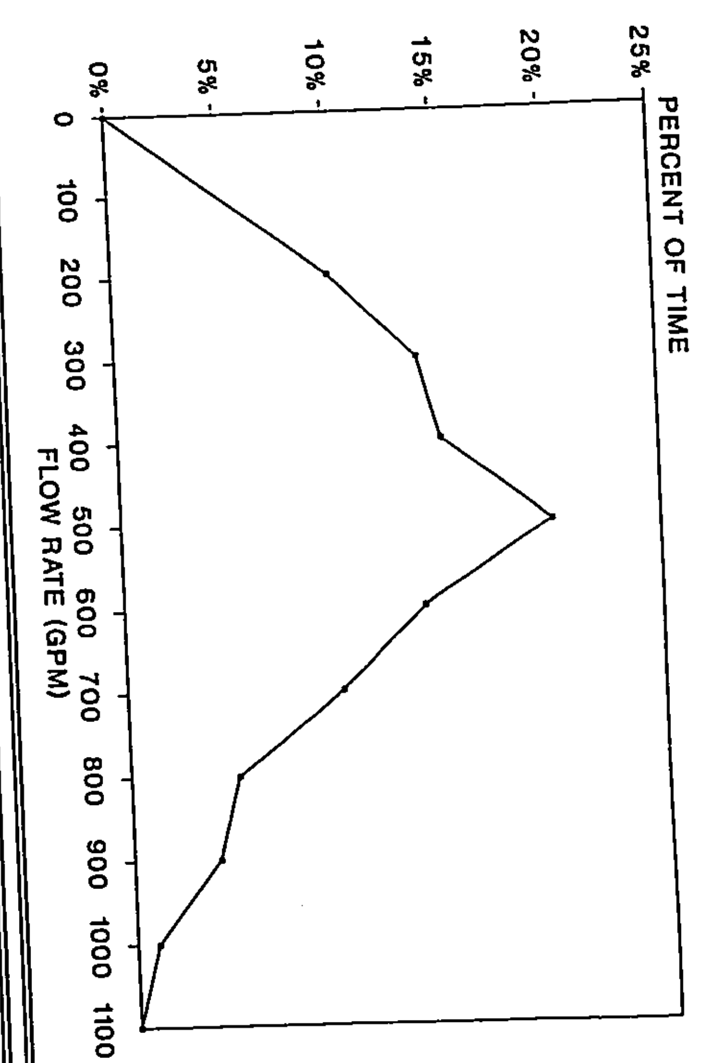

FIGURE II-1
FRESHWATER FLOW REQUIREMENTS

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3. Subsystem Design

a. Well

Conventional water wells would be used. The number of wells, their locations, and depths should be determined after performing a suitable hydrologic study of the area.

b. Pump

Each well will have a pump. Pump size and type depends on well size, location, and depth. Vertical turbine type or other suitable pumps will be used. To control noise and reduce weather effects, the pumps will be enclosed in small pump houses. Pump houses will be constructed so as to support a hoist from roof members for periodic removal and maintenance of the pump and motor.

c. Distribution

The fresh water distribution system, in general, parallels the seawater system except for ponds 1 and 2, which are fresh water only (see Figure I-2). Fresh water will be pumped to all ponds and the hatchery through buried polyvinylchloride (PVC) pipes ranging from 15 inches to 6 inches in diameter. Water will be supplied to each pond through an above-ground manifold with valves to control flow.

4. Installation/Construction

Trenches will be excavated throughout the facility large enough to contain fresh water and seawater pipes as well as electrical and instrumentation conduits. Trenches will be backfilled and planted with vegetation. The PVC pipe will be assembled and laid using accepted industry standards.

5. Operation

The operating methods and procedures will depend on the number, location, and capability of the wells and pumps. The system will be capable of 24 hour operation at desired flow rates and emergency flushing if required. Each pond will have manual flow control valves.

B. SEAWATER SYSTEM

1. Requirements

The seawater requirements as stated in the Project Development Report (U.H. 1992) are the following:

a. The basic criterion is to obtain ambient, offshore Kaneohe Bay water (approximate salinity of 34 ppt).

b. The projected seawater requirement is 1,000 - 1,200 gpm average flow rate with a maximum flow rate of 2,000 gpm.

c. The majority of the water should be filtered to eliminate particles and suspended solids of 50 microns or larger. If a cost effective method (e.g., sand filtration) can reliably eliminate smaller particles, we would prefer even finer filtration. The water flowing to the hatchery, 100 gpm, should be filtered secondarily to 5 microns.

d. The incoming water should be free of fish and other macro-organisms and preferably free of fouling organisms.

e. Mineral and heavy metal content should be at normal seawater levels. The intake pipe should be situated so as to avoid any point-discharge pollution sources.

f. If the well intake is an open water intake, then it should be screened or sand-filtered to prevent uptake of organisms, with auxiliary systems available onshore to screen and filter more finely as required for specific uses.

g. The flow rate profile is given in Figure II-2.

h. A breakdown of the tankage and flow requirements is shown in Table II-1.

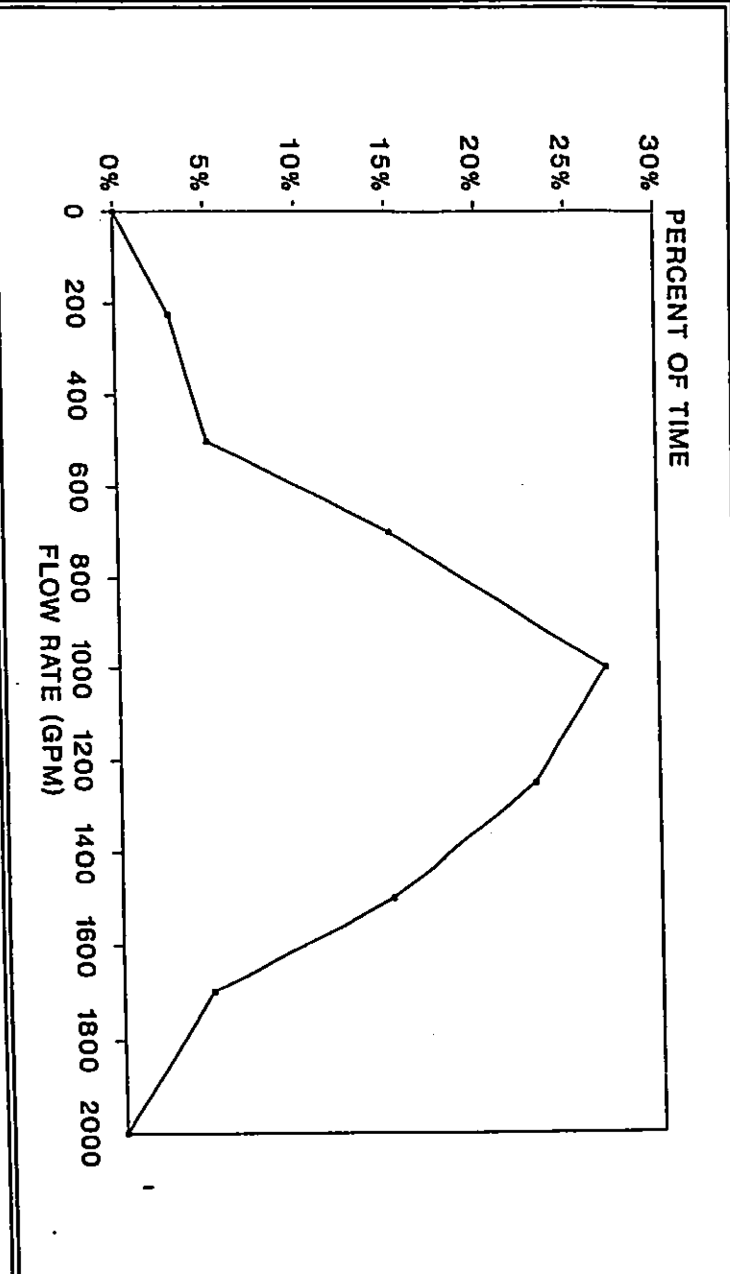

FIGURE II-2
SEAWATER FLOW REQUIREMENTS

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TABLE II-1
TANK FLOW REQUIREMENTS

TANK SIZE	NUMBER OF TANKS	INDIV TANK VOL (GAL)	TOTAL VOLUME (GAL)	FLOW VOL/DAY (%)	FLOW RATE (GPM)
1/2 Acre (2000 m2)	2 - 3	490,000	1,470,000	15	100 fresh 50 salt
1/4 Acre (1000 m2)	16	245,000	3,920,000	20	550
1/10 Acre (400 m2)	16+	100,000	1,600,000	25	300
Tank Farm					
24' Dia	4	11,300	45,000	100-300	
18' Dia	26	6,400	165,000	100-300	
12' Dia	65+	2,800	184,000	100-300	
Totals - Tank Farm			400,000		250
Hatchery					50-100
		Total Flow	Normal Operation		1,200 gpm
			Maximum Flow		2,000 gpm

from: Project Development Report, U.H. 1992

ASSUMPTIONS/NOTES:

(1) Two of the 1/2 acre ponds (ponds 1 & 2) will be receiving fresh water only. Therefore, a salt water flow of 50 gpm is projected for pond 11, the remaining 1/2 acre pond.

(2) The tank farm is not likely to be operating at 100 percent turnover per day with all 106 tanks running. Most likely, the 16 harvest tanks would be used infrequently. Therefore, assume 50 percent of the calculated flow rate (≈200 gpm) for normal operation.

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(3) Maximum flow rate is based on all ponds and tanks operating as listed above and, in an emergency situation, four of the 1/4 acre ponds being flushed at 50 percent per day.

(4) As a backup calculation - allow for normal flow rate of 30 percent turnover per day for full capacity. This allows for some tanks/ponds to be at 50 - 70 percent turnover/day while the rest of the farm is at 20 percent.

(5) Have the ability to fill one acre of ponds in 24 hours plus normal operation on the rest of the farm (approximately 1600 gpm).

2. System Concept

Two options were considered in selecting a seawater source. One was to pump saltwater from Kaneohe Bay through an offshore intake and pipeline. The other was to use saltwater wells drilled near the shoreline. Saltwater wells have drawbacks that make them undesirable for aquaculture use. Shallow wells frequently have low salinity, especially after heavy rainfall. Deep wells reach ancient seawater that contains high levels of dissolved minerals. These minerals can foul pipes and pumping equipment and are also detrimental to some aquaculture uses.

Relatively clean seawater with salinity similar to open ocean water can be obtained from Kaneohe Bay if the intake is properly located. The intake must be far enough below the surface to avoid fresh water during rainstorms and far enough off the bottom to avoid pumping silty water. An intake located 1500-1800 feet offshore in the vicinity of Hakipu'u Sandbar meets these criteria (see Figure II-3). An open water intake could be placed in the channel adjacent to the sandbar (see Figure II-4); however, filtered seawater can be obtained by burying the intake in the sandbar (see Figure II-5). Alternatively, incoming seawater can be filtered by commercially available filter systems that can be designed to the desired filter size.

To transport the seawater ashore, a pipeline would be laid between the intake and an on-shore pumping station. To prevent damage from boats or storms, the pipeline must be buried in the seafloor sediment. Multiple pipes give redundancy and permit efficient handling of both average and maximum flow rates. Multiple pumps must also be used for redundancy.

On-shore distribution to the various ponds and hatchery requires a system of both buried and above-ground pipes with the necessary manifolds and valves to control flow rates.

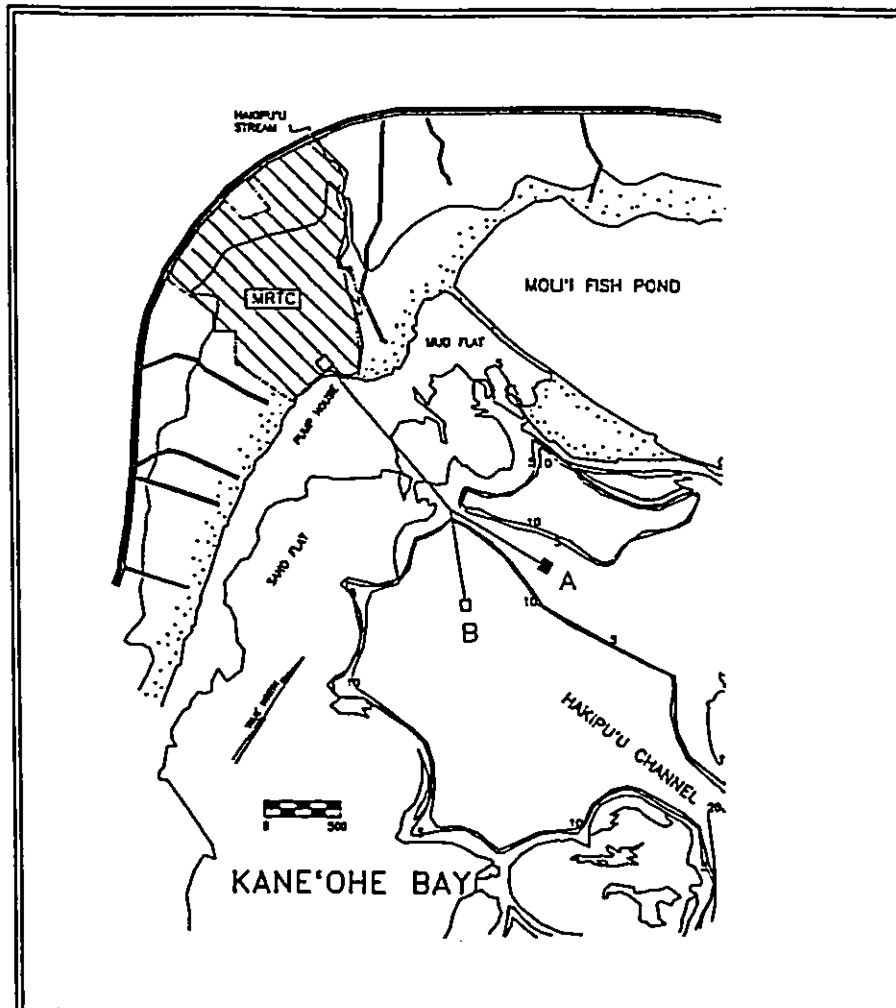

FIGURE II-3 SEAWATER INTAKE LOCATIONS
A BURIED INTAKE, B OPEN WATER INTAKE

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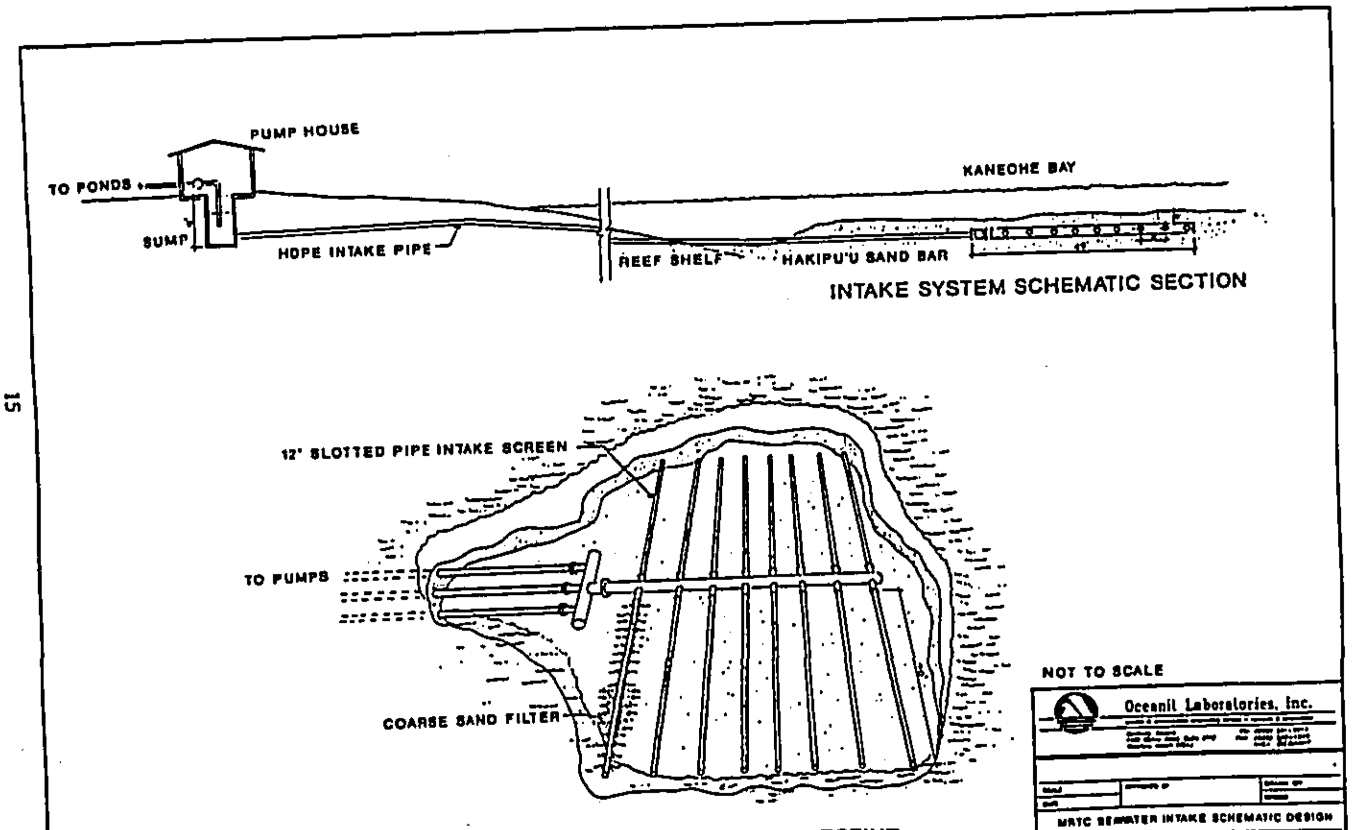

FIGURE II-5
BURIED INTAKE CONCEPT

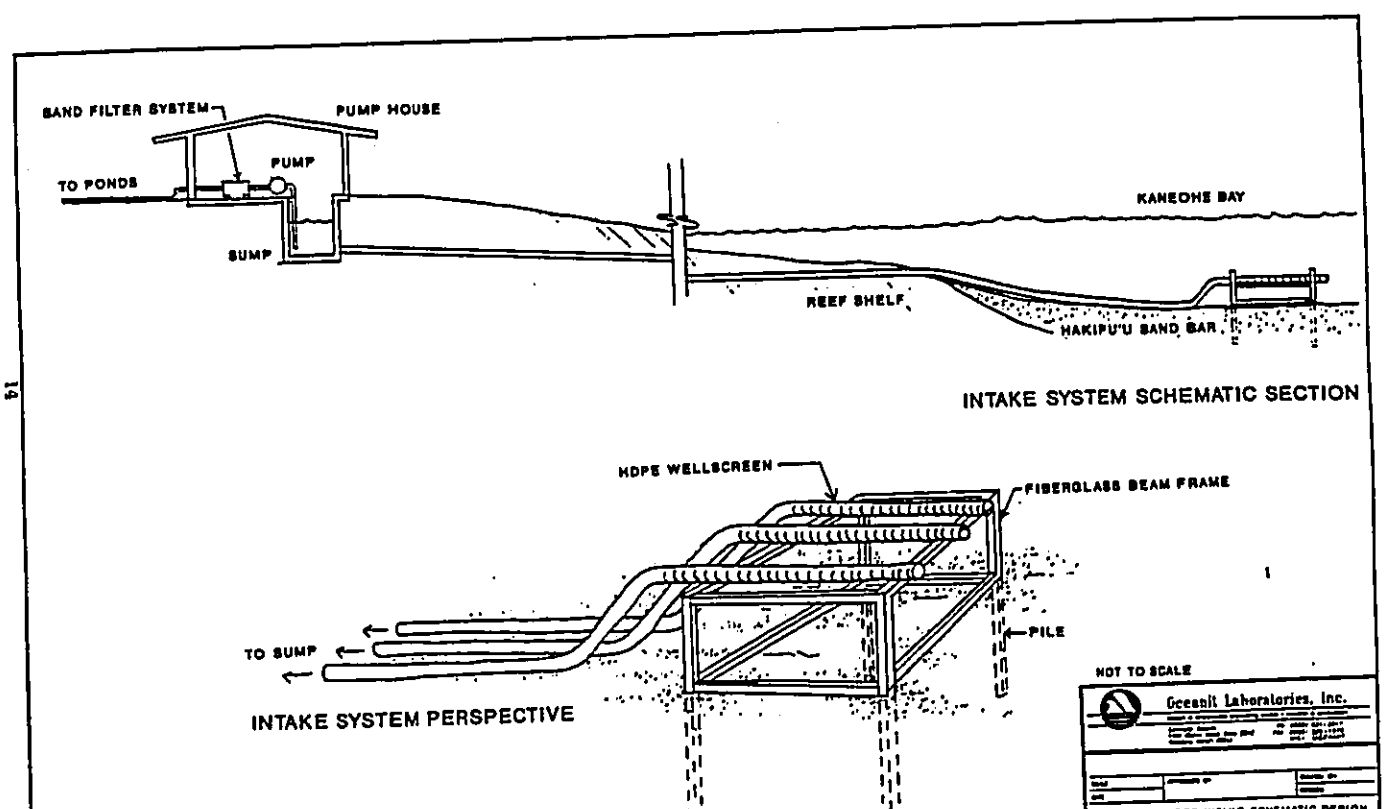

FIGURE II-4
OPEN WATER INTAKE CONCEPT

3. Subsystems Design

a. Intake

Intake design depends on whether the water is filtered through sand offshore or with an on-shore filter system. An intake buried in Hakipu'u Sandbar is similar in concept to a water well. Water is pumped through the sand, then through a gravel filter, and finally through a well screen into the intake pipes. As shown in Figure II-4, the intake is installed as a horizontal gallery in the sand bar. To place a horizontal intake in the sandbar, approximately four feet of sand must be excavated to form a trench. The intake screen is then placed in a filter bed of sand/gravel and covered with sand. Commercially available well screens made of high density polyethylene (HDPE) can be used to construct the gallery. The filter layers would be coarse coral sand.

Approximately 600 feet of slotted HDPE pipe would be necessary to handle the 2000 gpm maximum flow requirement. Sixteen 40-foot sections of 12-inch diameter slotted pipe would be connected to a 24-inch diameter collection pipe as shown in Figure II-4.

The alternative open-water intake would consist of slotted pipe fastened to a frame held in place on the bottom by piles. Slot sizes on this intake would be larger than the buried intake since their purpose is to screen out larger forms of marine life rather than to act as a filter for micro-organisms. An open-water intake would be installed in the 17-foot channel adjacent to Hakipu'u Sandbar.

Three 12-inch diameter HDPE intake pipes will transport water to the on-shore pumping station. Each pipe has an efficient capacity of 1000 gpm giving the system excess capability that may be needed during cleaning, or if damage or blockage occurs to one of the pipes, or for future requirements.

b. Pumps

Continuous flow of seawater up to 2000 gpm will be required. Seawater must be pumped from the offshore intake approximately 6 to 14 feet below sea level to the top of the MRTC property, approximately 35 feet above sea level. A total required pumping head of 60 feet is estimated to achieve desired flow rates and overcome pipe losses. Seawater from the intake pipes will gravity feed into a sump where it will be pumped to the ponds. The sump must be large enough to handle the required flow and to act as a surge chamber when flow rates are changed. The sump also must be deep enough to allow sufficient intake submergence below lowest tide levels.

Three pumps rated at 700 gpm are needed to meet flow requirements and provide backup during maintenance. Maintenance costs can be reduced by using all pumps the same size and type. Either horizontal centrifugal or vertical turbine pumps can be used for this application. A vertical type may be necessary because of the required depth of the sump, approximately 12-15 feet below sea level. Pumps will be operated in parallel to give a range of flow rates. Since the pumps operate at constant speed, excess flow will be bypassed back to the sump or to the drainage system. A header tank will be installed at the upper portion of MRTC to maintain system pressure and moderate flow surges.

Pumps, motors, and control equipment will be enclosed in a pump house built above the sump. A schematic of the pumping system is shown in Figure II-6. A backup emergency generator will be required to maintain flow during power failures. Pump materials must be corrosion resistant and non-toxic to pond marine life. Potential materials include stainless steel, coated cast iron, or fiberglass. A list of possible pump types and manufacturers is given in Table II-2. Hoists installed within the pumphouse will be used to remove motors and pumps for annual servicing.

TABLE II-2
SEAWATER PUMPS

PUMP MANUFACTURER/SUPPLIER	PUMP CHARACTERISTICS
Worthington	various designs
Demming/Berkley Engineering	cast iron, belzona coating
Gould Pumps, Inc.	vertical turbine
Fybroc	fiberglass construction
Peerless	stainless steel

c. Filters

Two filter options are available, burying the intake in a sandbar or using commercially available sand filters. Burying the intake provides a relatively maintenance free filter but requires designing and installing a gallery as described above. Commercial sand filters permit close control of material sizes in the incoming water with filtering particles to 50 microns well within their capability. Various flow rates can be accommodated by combinations of filter elements. One type of filter system is shown in Figure II-7. The system designed would require eight filters of the type shown in Figure II-7.

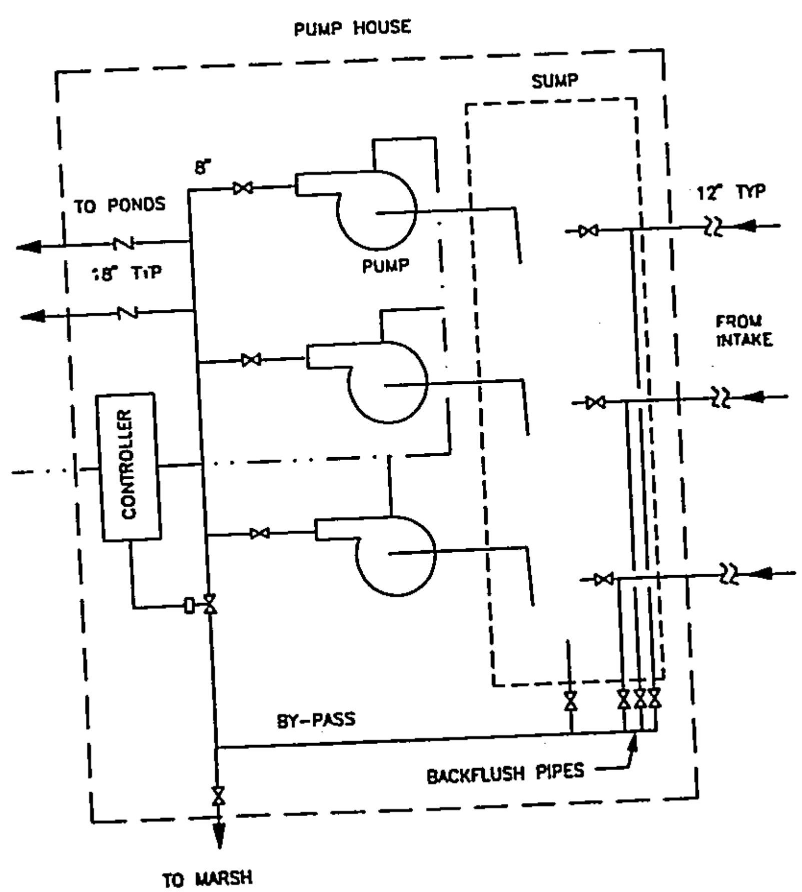

FIGURE II-6 SEAWATER PUMPING SYSTEM SCHEMATIC

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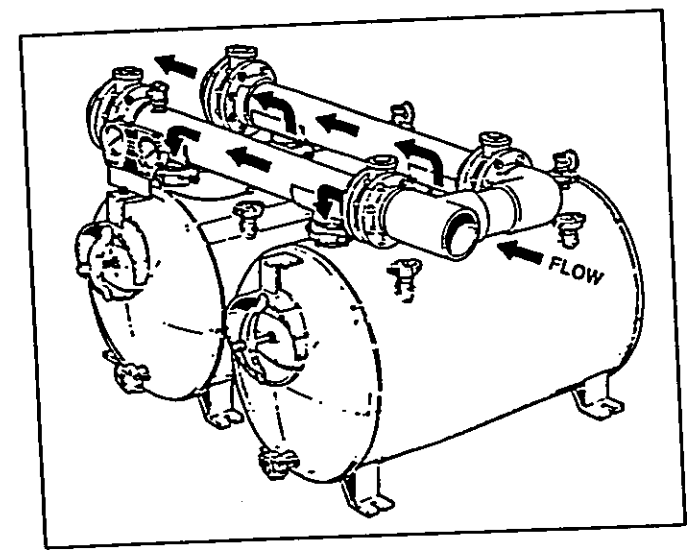

TYPICAL ON-SHORE SEAWATER FILTER UNIT
FROM: ENVIRONMENTAL PRODUCTS DIVISION

FIGURE II-7 SAND FILTRATION SYSTEM

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

d. Distribution and Drainage

Seawater will be distributed to the ponds and hatchery through buried PVC pipe (see Figure I-2). Each pond will have an above-ground manifold with flow control valves, shown conceptually in Figure II-8. Pipe diameters vary from 18 inches at the pump house to 6 inches at the ponds.

The ponds will empty through removable standpipe drains to either a buried PVC pipe or a concrete channel (see Figure II-9). The 1/4 acre ponds will have 8-inch diameter drains and the 1/10 acre ponds will have 6-inch diameter drains. Each pond will contain two drains, one at the center and one near the corner where flow control valves and auxiliary tank are located. The drains will empty into harvest stations on the lower part of the property. The harvest stations will then empty into the settling ponds and marsh.

4. Installation/Construction

An excavation 85-feet long, 50-feet wide, and 4-feet deep will be dredged in Hakipu'u Sandbar for the intake gallery. The excavation will cover less than one percent of the total surface area of the sandbar. This excavation will require dredging equipment capable of working in less than three feet of water. Parts of the intake gallery will be assembled on shore and transported to the excavation by boat. Final assembly will be done underwater. The gallery will be installed with a gravel filter surrounding the intake screens, and the excavation will be backfilled with the previously dredged sand. After backfill, the sandbar will be returned to essentially its original appearance.

The three HDPE intake pipes will be assembled on shore. Sections of HDPE pipe are welded together to make a continuous string with few couplings. Concrete anchors will be fastened to the pipes at pre-calculated intervals. The pipes will be filled with air, floated into position, and sunk by releasing the air and filling the pipes with water. When the pipes are in position on the bottom, they will be jetted into the bottom until covered with sediment to protect them from storm or boat damage. The on-shore sections of the intake pipes will be placed in a trench to the sump at the pump house.

There are several options for constructing the sump. It can be a pre-cast or cast-in-place concrete box or a pre-fabricated fiberglass tank. The sump will be buried at a selected location near the shoreline. The pump house will be constructed above the sump. A conceptual drawing of the sump and pump house are shown in Figure II-10.

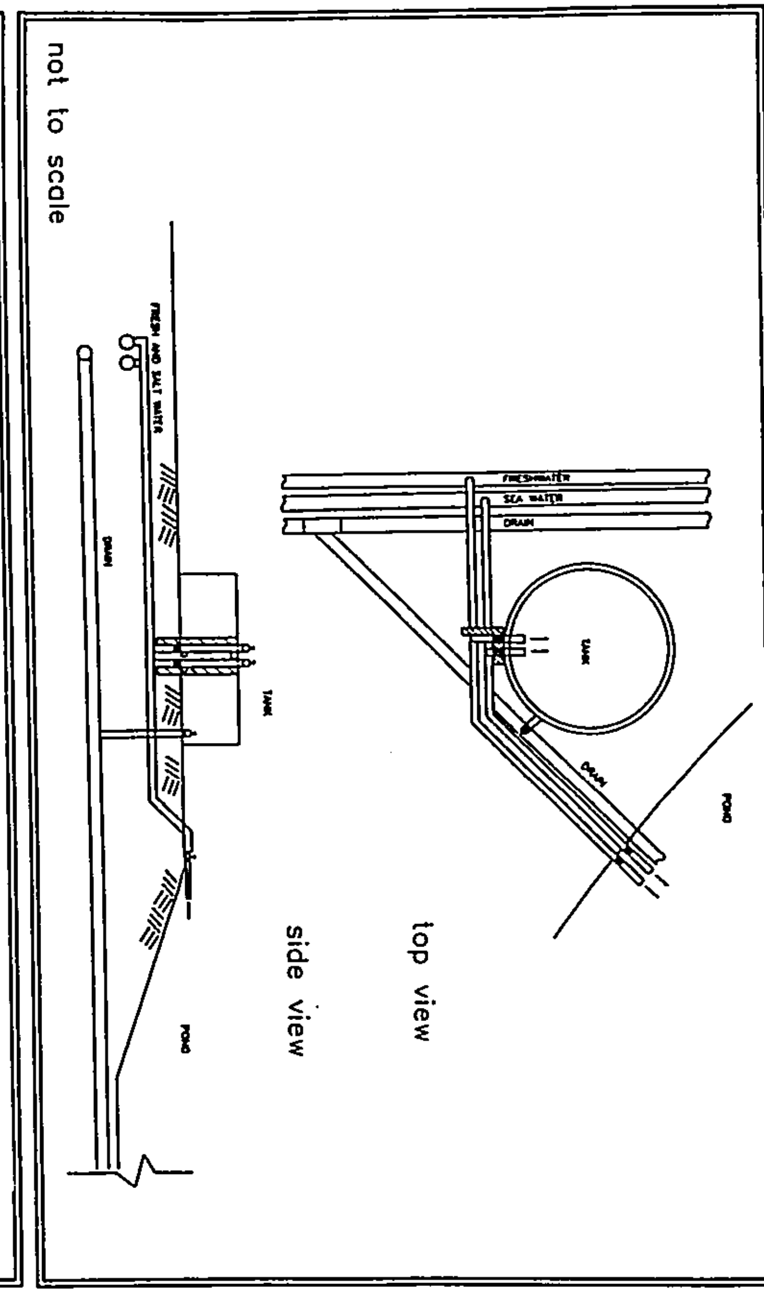

FIGURE II-8 POND PIPING AND FLOW CONTROL

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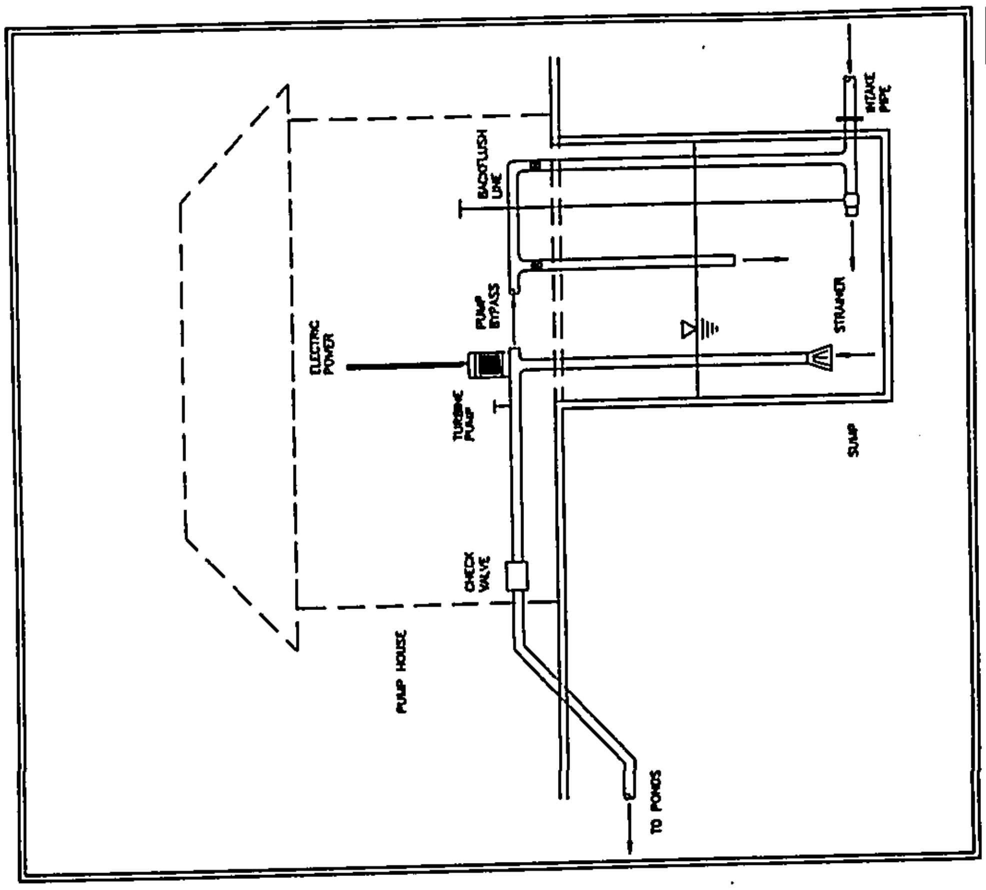

FIGURE II-10 SUMP AND PUMP HOUSE CONCEPT

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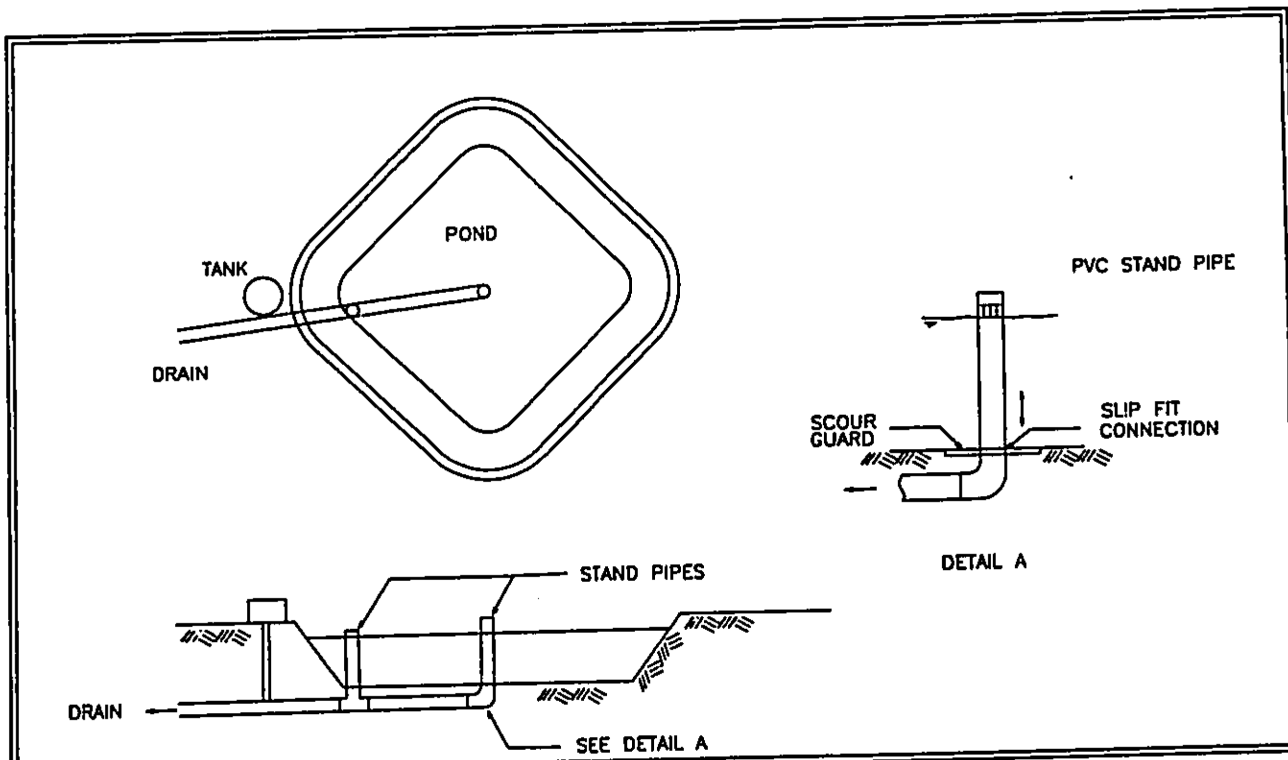

FIGURE II-9 POND STAND PIPE DRAIN

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5. Operation

Seawater will be pumped continuously to provide flow to the ponds and hatchery. Flow can be controlled in three ways including valves at the ponds, running one to three pumps, or by changing the bypass flow. Proper control will result in maximum pump efficiency and operating life. Pumps and bypass valves will be controlled in the pump house by an automatic system to regulate flow conditions and prevent overpressure in the distribution pipes. Although the intake pipes will be plumbed to allow backflushing, under normal operating conditions, there should be no need to backflush or perform maintenance of the buried portions of the intake at the sandbar.

III. PONDS

A. REQUIREMENTS

The pond requirements summarized from the Project Development Report (U.H. 1992) are as follows:

1. Pond Construction
   a. Ponds should have slopes graded with a 3-to-1 slope.
   b. The pond bottom should slope toward the center drain so that the ponds can be drained completely.
   c. The depth of the ponds should be adjustable to a maximum of four feet with an additional one foot to the top of the berm.
   d. The sides and bottom of the ponds should be stabilized to prevent erosion and maintain the slope of the bottom.
2. Plumbing
   a. Salt and fresh water lines should run to each pond.
   b. Each pond will have a center drain and an individual drain pipe that will discharge into either a drain channel or a harvest station.
   c. An additional drain, located in a corner of the pond and connected to the center drain will be used for water level control.
3. Number of Ponds
   a. Three half-acre ponds.
   b. Sixteen one-quarter acre ponds.
   c. Sixteen or more one-tenth acre ponds.

B. SYSTEM CONCEPT

The current configuration of 12 ponds will be changed into 16 quarter-acre and 20 tenth-acre ponds plus 2 fresh water ponds and 1 half-acre pond (see Figure I-1). Two existing fresh water ponds will remain essentially unchanged except for repairs and new piping. The smaller ponds will better meet the needs of the research and training mission of MRTC.

C. SUBSYSTEMS DESIGN

Each pond will have fresh and salt water supply and drainage systems as described in Chapter II and shown in Figures II-8 and II-9.

D. INSTALLATION/CONSTRUCTION

Ponds will be constructed by excavating and filling the existing pond sites to the desired configuration. Heavy equipment such as bulldozers and scrapers will be required for this work. By working within the existing topography, no new fill material should be needed. Ponds will be five feet deep to the top of the berm with working water depth of four feet. Pond banks will be graded to a 1:3 slope and protected from erosion by coral riprap or other soil stabilization methods.

E. OPERATION

Operation of the ponds will depend on the research and training programs used at MRTC. Except ponds 1 and 2 on the upper part of the property, all ponds are designed for both fresh and salt water use. Ponds 1 and 2 will be used for fresh water only to avoid contamination of Hakipu'u Stream. Normal operation will require either periodic or continuous water flow into a pond. Water level will be controlled by overflow stand pipes. To harvest species in a pond, the stand pipe will be removed allowing both animals and water to drain through harvest stations where the animals will be removed. Effluent water will then flow into the marsh treatment system described in the next section.

IV. MANAGED AQUACULTURE RECLAMATION SYSTEM HABITAT (MARSH)

A. REQUIREMENTS

Proposed renovations to the MRTC include upgrading both aquaculture water supply systems to allow for a freshwater source of 500-1000 gpm and a saltwater intake of 1000-2000 gpm. Combined, this is expected to generate an average flow of 0.5 to 1.75 million gallons per day (mgd) of combined fresh and marine waters. Current plans indicate that this volume will be provided by on-site freshwater well(s) and seawater from a 17-foot natural channel within Kaneohe Bay approximately 1800 feet offshore. After the water has passed through an aquaculture pond, tank, or aquarium, it must be returned to the environment. Large volumes of aquaculture wastewater must be returned , Kaneohe Bay. Effluent water will be of variable salinity and will contain pond plankton and aquaculture waste products that could adversely impact the bay's ecosystem if released directly into the bay. There is additional concern that chemicals used for aquaculture operations and scientific studies could be released into the bay. The system must adapt well to various qualities of aquaculture effluent and provide economically achievable effluent treatment prior to discharge into Kaneohe Bay.

B. SYSTEM OPTIONS

Several options considered for an effluent treatment system but not selected are summarized as follows:

- Direct discharge into deep Kaneohe Bay or open ocean through a long effluent pipe. This option requires a very large, costly pipe and is likely to get resistance from environmental groups.
- Use an injection well on-site to dispose aquaculture effluent. An injection well would probably not function adequately considering the low porosity of the alluvial fan materials underlying the site. Injected fluids do not disappear and may reach surface waters in the nearshore area.
- Pump effluent into Moli'i fishpond. The lease with Koolau farms reserves the right to pump waste water from the site into the adjacent Moli'i fish pond. Technically this would be an acceptable solution for MRTC. However, the impacts (positive or negative) on the fishpond are difficult to predict and would cause an unacceptable level of uncertainty.
- Filter all effluent water to meet acceptable standards. Direct filtration and biological treatment of effluent would be both costly and technically intensive.

Additional discussions of aquaculture effluent treatment technologies have been reviewed by Pruder (1992) and Van Gorder (1991). The solution proposed here is a designed wetland Managed Aquaculture Reclamation System Habitat (MARSH). Waste water from the aquaculture facility would pass through the MARSH where particulate matter and nutrients would be removed to the greatest practical degree before the water flows back into Kaneohe Bay.

C. SYSTEM CONCEPT

There are several aquaculture research facilities in the United States where waste water from ponds flows directly into adjacent pre-existing salt marshes. At the University of South Carolina, Waddell Mariculture Research and Development Center effluent flows into a Spartina grass marsh. Although the grass within 10 to 15 feet appears taller and thicker than surrounding grasses, the impact seems to be limited to a very small area within the vast Spartina grass marsh community in the vicinity of the facility's outfall. A problem with this outfall is that the constant flow of effluent has followed the path of least resistance and cut a bypass channel to the open estuary. (Steve Hopkins, Waddell Manager Pers. communication). Unfortunately, for comparison purposes, there are no marshgrass species similar to Spartina in Hawaii or the tropical Pacific. A designed wetland in Hawaii must be dependent upon endemic species including both terrestrial and aquatic species. Although there are few saltmarsh adapted terrestrial plants in Hawaii, the number of possibly useful macro-algae species is extensive.

Natural wetlands function to covert biological wastes and chemicals, thereby impacting the quality of water flowing through the wetland. Although the mechanisms of this change are neither simple (or well understood in some cases), this capability is known to be a function of vegetation type, water flow rate, and wetland complexity. A wetland may serve as a source, sink, or transformer of water-borne sediments and biological wastes. These functions vary greatly between wetland types, and may be maximized or minimized through appropriate design of created wetlands. These facts are utilized in the creation of constructed wetlands designed for advanced treatment of sewage effluent from residential areas. Such systems are designed to handle nutrient loads at substantially higher levels than would be expected from an aquaculture facility. There are many examples of successful designed wetlands created to handle freshwater domestic waste (Tennessee Valley Authority, 1991; EPA, 1988).

There are few examples of wetland waste control systems that operate under brackish or salt water conditions. Research was done on a pilot scale in the early 1970's (Ryther, et al 1973; Ryther, et al 1975; Mann and Ryther, 1977) where domestic sewage from a waste water processing plant (tertiary treated to 20mg/L total dissolved nitrogen and 6 mg/L total dissolved phosphorous) was diluted 75 to 90 percent with seawater. This mixture was then passed through a series of raceways and ponds where nutrient extraction occurred through algal growth, plankton culture, and interaction with

sediments. Aquaculture animals such as lobster, oysters and fish were included in a polyculture system to utilize the single celled algae and other lower invertebrates grown in this process. This system was able to accomplish a reduction of biochemical oxygen demand (BOD) and nitrogen levels by 90 percent during impoundment for 4 to 10 days (Ryther, 1983). Saltwater marsh systems are currently being used to treat municipal waste from small coastal communities such as in Arcata, California (Hammer, 1989). Such systems require much land, are very intensive, and may not necessarily provide the type of treatment required for the MRTC facility. Aquaculture effluent is much more benign (lower dissolved and particulate matter, and free from human pathogenic organisms) than domestic sewage effluent. Treatment systems for aquaculture effluent should not necessarily emulate domestic sewage treatment systems.

Highly advanced saltwater treatment techniques utilizing designed ecosystems as filters and transformers of water impurities have developed for use in aquaria. These aquarium systems, up to 120,000 gallons in size, operate in the almost total absence of water exchange while maintaining water of sufficient quality to support delicate fish and invertebrate life. Large experimental aquarium systems (mesocosms) have been built to model energy flow and nutrient dynamics in estuaries and other ecosystems (Adey & Loveland, 1991). These experimental systems are on the order of a hundred times smaller than our proposed MARSH. However, the dynamics and nutrient absorbing capacities of these small systems indicate that saltwater estuary ecosystems with a high dependency on nutrient uptake by algae probably have a greater potential for nitrate absorption than comparable fresh water wetlands.

There is currently a great deal of discussion world-wide in the aquaculture industry concerning the problem of aquaculture waste water. State and Federal environmental water quality laws were conceived to control effluent from industrial and municipal waste polluters. Potential pollution from aquaculture effluent is not considered a serious threat to the environment by the EPA due to the relatively benign quality and low volume of effluent. However, laws intended to protect the environment from domestic and industrial pollution often foster unnecessary restrictions on aquaculture facilities. One proposed solution is to minimize or eliminate any effluent from shore-based aquaculture, relying totally on water quality management within the ponds, polyculture, and recycling of water (Ryther, 1983; Hopkins, Pers. communication). Another proposed solution is to modify water quality laws thereby allowing effluent to enter coastal waters. The final solution to this dilemma probably lies somewhere in-between these two viewpoints. Effluent from aquaculture facilities should be allowed by modified regulations, but should also undergo a reasonable degree of treatment to protect the environment. The MARSH proposed here provides an ideal system which can be experimentally manipulated to yield effluent water of the highest possible quality with little or no adverse impact on the nearshore marine environment (see Figure IV-1).

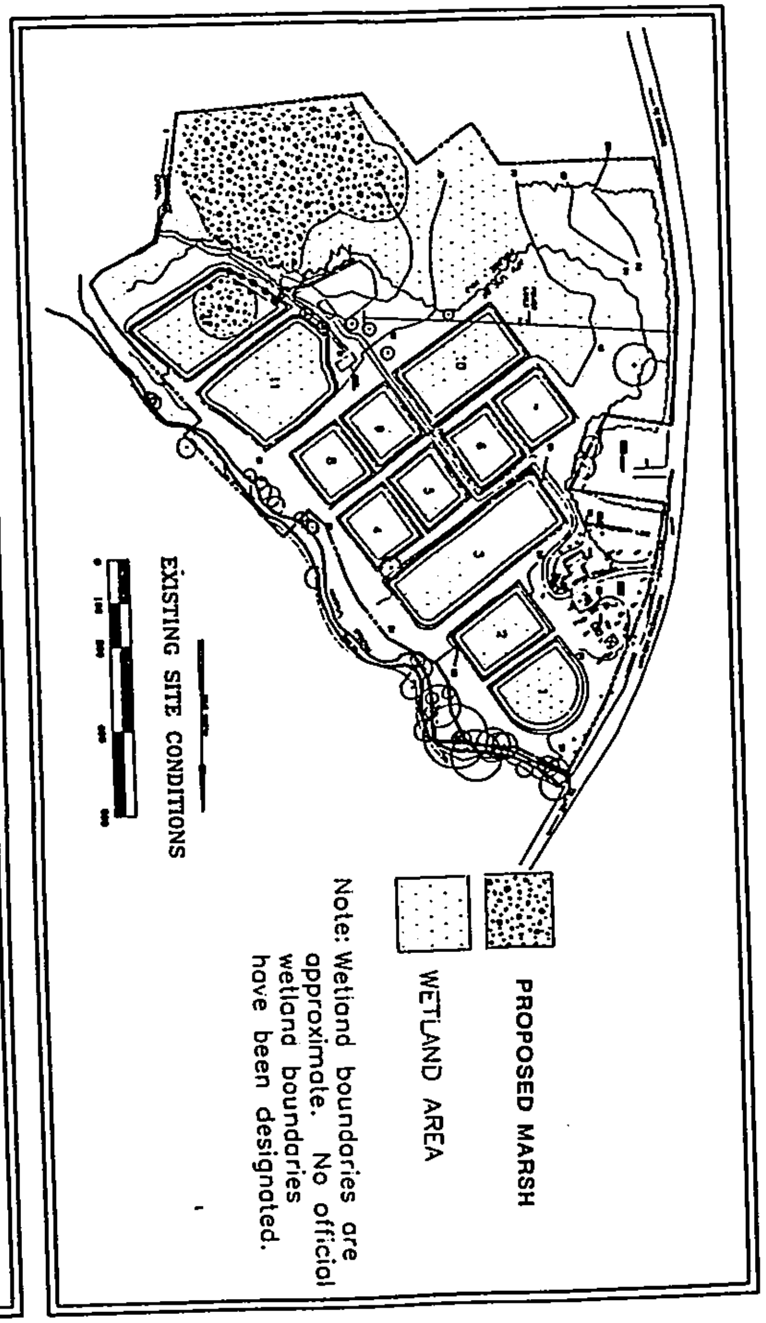

FIGURE IV-1 AREA OF PROPOSED MARSH IN WETLAND

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D. MARSH DESIGN

The proposed MARSH is composed of a settling basin, a series of channels and an expanse of "tidal" area supporting a community of algae, vascular plants, and invertebrates. Water passing through the MARSH can be adjusted for depth, flow rates and residence times by means of dikes and weir gates. The maximum volume of the MARSH at it's highest level will be approximately 600,000 gallons with a residence time (at 1200 gpm) of approximately 8 hours. Minimum residence time is about 5 hours with the system operating on total flowthrough. Dissolved nutrients within the effluent stream will be controlled by adsorption to the marsh soils and by biological action with the plants and invertebrates within the MARSH.

1. General Site Description

The site for proposed MARSH construction encompasses approximately 2.5 acres (1.0 hectare) of land along the western border (Kaneohe side) between the shoreline and the existing hatchery tank farm (see Figure IV-1). This area is currently covered by California Grass (40%), Hau jungle (35%), mangrove (20%), and a few miscellaneous trees and palms. Due to growth density, the area was visually surveyed from the periphery only. Examination without borings or intrusion into these areas indicates that the ground water level is within 18 inches of the surface. Therefore, most of the area may be classified as an existing wetland in accordance with the U.S. Army Corps. of Engineer's Wetlands Delineation Manual (Environmental Laboratory, 1987). No official classification or delineation of wetlands in this general area has been conducted.

The entire 2.5 acres rests upon an alluvial fan deposited by Hakipu'u Stream. Soils in the area consist of a relatively thin layer of decomposed vegetative matter mixed with fine clay and silt resulting from periodic flood events from Hakipu'u Stream. The underlying substrate is layered with stream sediments, cobble, sand and silt; as is typical of alluvial fans. This soil type is extremely hydroscopic but not very permeable. Analyses of subsurface sheet flow indicates that freshwater flow through the ground to the ocean is approximately 20 gallons per day per linear foot of property line. This fresh water forms a lens overlying denser salt water and percolates into the bay through sediments near the shoreline.

The relative value of marshlands can be addressed using an approach developed for temperate marshes entitled Wetland Evaluation Technique (WET) (Adamus et al, 1987). The WET technique values a wetland according to the functions expressed in Table IV-1.

TABLE IV-1
HAKIPU'U/MRTC SHORELINE WETLAND VALUATION

FUNCTION	VALUE	FUNCTION	VALUE
Ground water recharge	Low	Ground water discharge	Med
Flood storage	Low	Shoreline anchoring	High
Nutrient retention	High	Food chain support	Low
Fishery habitat	Low	Endangered species	Low
Wildlife habitat	Low	General diversity	Low
Waterfowl habitat	Med	Active recreation	Low
Passive recreation	Low	Heritage value	Low

The table above indicates the existing shoreline wetland has a relatively low value for recreation or as a bird refuge and provides minimal positive input to the nearshore fisheries resources. The highest value of the existing wetland is as a shoreline protection buffer, limiting erosion from flooding or large waves, and capturing silt and nutrients from periodic flood events.

2. Water Quality Considerations

The anticipated quality of effluent water depends to a large extent on the type of aquaculture. In a study of effluent water quality from aquaculture farms in Hawaii (Zieman, [CTSA] 1990), a wide range of physical and chemical water quality parameters were correlated to the type of animal being cultured. For example, effluent from marine shrimp culture operations exhibited very high turbidity but relatively low phosphate levels whereas effluent from tilapia farms was comparatively clear, but had high phosphate levels. MRTC will rarely, if ever, be growing one species, nor will the facility grow crops at commercially intensive levels. Therefore, the quality of the effluent stream should be better than a commercial farm of comparable size. For planning purposes we have estimated an average "worst case" effluent water quality condition based upon data from all combined species grown commercially as listed in the CTSA report. These figures form the basis of design calculations for the MARSH and are shown in Table IV-2.

A summary of water quality geometric means related to the MRTC site are listed in Table IV-2. The designed percent efficiency of the MARSH for each constituent is based on using figures for the worst case scenario pond effluent. The table also shows the percent removal required to return the effluent to the quality of the receiving water. A more complete discussion of water quality methods and results is contained in Section V-4 of this report.

TABLE IV-2
WATER QUALITY VALUES FOR WATER BODIES ASSOCIATED WITH MRTC AND REQUIRED MARSH NUTRIENT REMOVAL EFFICIENCY

PARAMETER	STATE WET STANDARD	INFLOW WATER	POND EFFLUENT	HAKIPU'U STREAM	RECEIVING WATERS	% REMOVAL TO MEET STANDARDS
TOTAL NITROGEN (ug/l)	200	135.8	500***		160	60-68%
AMMONIA N. (ug/l)	6		120***	9.4*	10.5 \5.36**	93-96%
NITRATE & NITRITE (ug/l)	8	1.2	300***	54.5*	0.7 \ 3.1**	99-99.7
TOTAL PHOSP. (ug/l)	25	15.1	300***		15.1	95%
O-PHOSPHORUS (ug/l)	NA	5.6	50***	6.04*	5.1 \ 3.3**	89-93%
N.F.R. (mg/l)			50	9.2	6.2	NA
TURBIDITY (ntu)	1.5	1.82	25***		1.52	94%

Measured values are geometric mean of single day nearshore samples from current study.
*- Values from Water Res. Res. Cntr Tech Report No.31
**- geometric mean of year-round nearshore samples from Atkinson (unpublished) study.
***- Calculated "worst case" values from aquaculture pond survey report (Zieman, et.al., 1990).

a. Sediment Control Basins

Two sediment control basins will be constructed just seaward from the lowest ponds. Each basin will be circular with a diameter of approximately 80 feet and a 10-foot depth at the center (see Figure IV-2). The basin sides will have a 1:4 slope yielding a pond almost conical in cross section. The sloped walls of the sediment control basins should be reinforced either with pond liner material or plastic grating down to a depth of at least four feet to prevent erosion. At a flow rate of 600 gpm, the pond water will have a residence time of

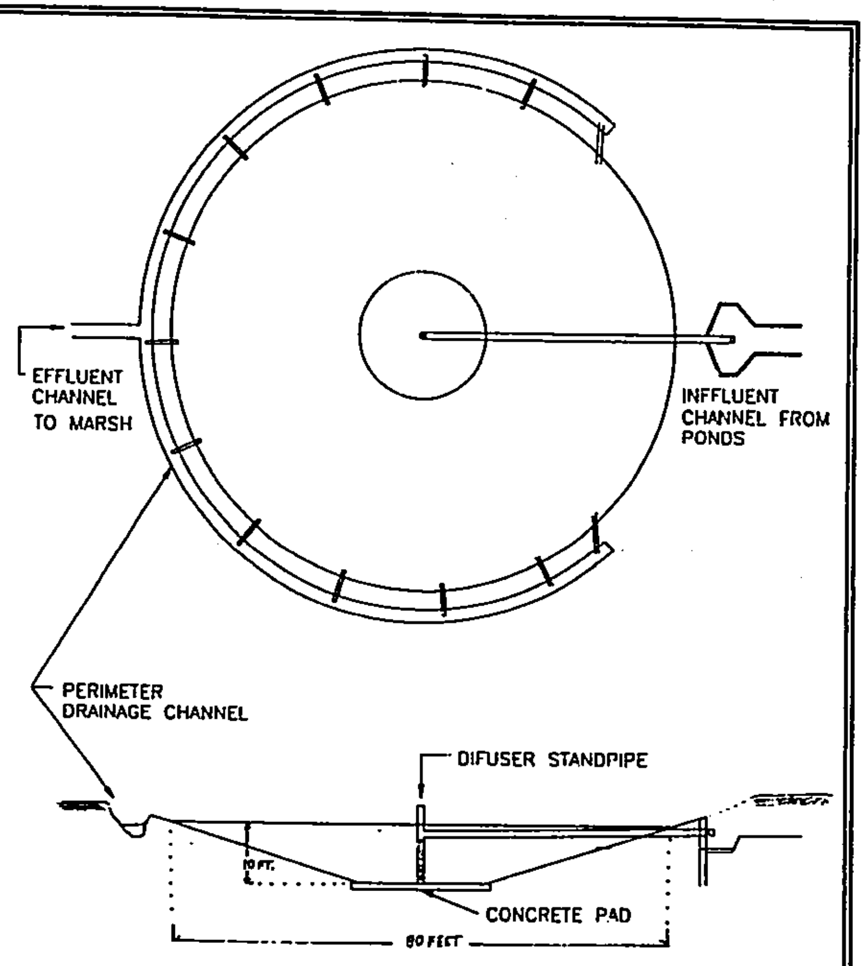

FIGURE IV-2 SETTLING BASIN

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approximately 4 hours. These basins will receive water directly from the ponds via harvest boxes or the harvest trench paralleling Hakipu'u Stream. The water will enter at the center of the pond through a perforated standpipe and drain around the perimeter through surface drain pipes. The drain pipes will direct clarified water into a trough surrounding the basin leading to the MARSH.

The causative agents responsible for pond effluent turbidity vary widely with the type of practiced aquaculture and the bloom stage of the pond. As a working estimate, it may be assumed that roughly half of the suspended solids are inorganic (mostly silica and diatom tests) and half are organic. Of the organic portion roughly half is detrital complex and half is phytoplankton.

Under normal operations aquaculture ponds are excellent settling basins. Effluent from the ponds (except during harvest operations) is normally skimmed off the pond surface through stand pipes and will contain suspended solids with a great resistivity to settling.

The settling basin will allow large particles (particularly during harvest operations) and a portion of the organic fecal material and diatom tests to settle thereby reducing the sediment and BOD load on the MARSH. Settled materials must be removed annually from the basin using a sludge pump. To improve the efficiency of this maintenance procedure, the center of the settling basin should have a concrete pad bottom. The basin can be stocked with salinity-tolerant predatory fishes such as papio to control passage of aquaculture fish or invertebrates from the pond system.

Increased control of floatable detritus and phytoplankton turbidity could be attained by polyculture of various plants and animals within settling basins. The primary goal of this polyculture would be for effluent particulate matter control, and would differ from polyculture practiced with economic gain as the primary goal. Under fresh water operation, the use of water hyacinth with its fine root system would provide excellent particulate filtration. Freshwater carp or tilapia are also known for their ability to strip solids from the water.

When operated under salt water mode, additional particle filtration can be achieved through the polyculture of oysters or other filter feeders suspended in the water path within the settling basin. Oysters placed in the water stream at sufficient density can effectively strip 90 percent or more of the suspended organic matter from pond effluent. To be efficient at stripping, oysters should be stocked at a high density and would not be expected to have a rapid growth rate. The oysters produce capsulized fecal matter which will settle in the basin, and dissolved nutrients which would pass on to the MARSH. Other aquaculture species including milkfish and tilapia could also contribute to particulate matter control in this system. The mix and stocking density of these fish will require careful management over time to achieve the best results.

b. MARSH channel function and design

The central channel of the MARSH proposes finished grade slopes from 0'0" MSL to +0'6" over it's 1,350-foot length (see Figure IV-3). The bottom and sides of the 2-foot deep, 8-foot wide central channel should be lined with rock to prevent erosion and provide a solid base for algae holdfasts. A practical method to achieve a rock lining is to use large gravel or small rock held together in a wire cage to form a large, brick-like "gabion". The wirecase can be made off-site to specific sizes. They are then installed on site, filled with rock and sealed. Grade will slope to the central channel from the base of a perimeter dirt berm encircling the marsh at a height of 4 feet MSL. An area at least 20 feet to either side of the central channel should be provided for wetland plant propagation.

Water level in the marsh will be controlled at the ocean end by a reinforced dam with a concrete lined spillway and a weir gate with an overflow level of 3 feet. The gate may be closed to allow the MARSH to fill to it's designed height of 3 feet. At this height the MARSH channel will achieve it's maximum residence time (5 hours) and water will flow over the weir into Kaneohe Bay. When the weir is completely opened at a flow rate of 1200 gpm, water level in the bottom of the central channel should regulate itself to a depth of about 12 inches and a speed of 0.3 feet per second.

The MARSH may also operate on a pulsed-flow basis. Automatic timed control of weir gate height will allow water in the MARSH to flow only on a falling tide, thereby speeding it's return to open waters. The rate of mixing would increase and minimize any impact on the nearshore environment. Operating in a pulsed mode, the flow into the bay would be zero during 6 hours of rising tide and then increase to about 3000 to 4000 gpm for the first 3 to 4 hours of falling tide. During the 5th and 6th hours of falling tide, flow would slow to ambient levels and then stop completely when the weir gate was closed automatically at low tide.

The weir will be adjacent to the pumphouse facility. During construction, a single 12-inch pipe will be installed below grade between the pumphouse sump and the MARSH side of the weir. This valved pipe may serve as a means to recirculate a portion of the MARSH filtered water through the facility for re-use. This pipe would provide the alternative of using a pump to run effluent water through one bank of filters before discharge, or the possibility of pumping the effluent to another site for re-use.

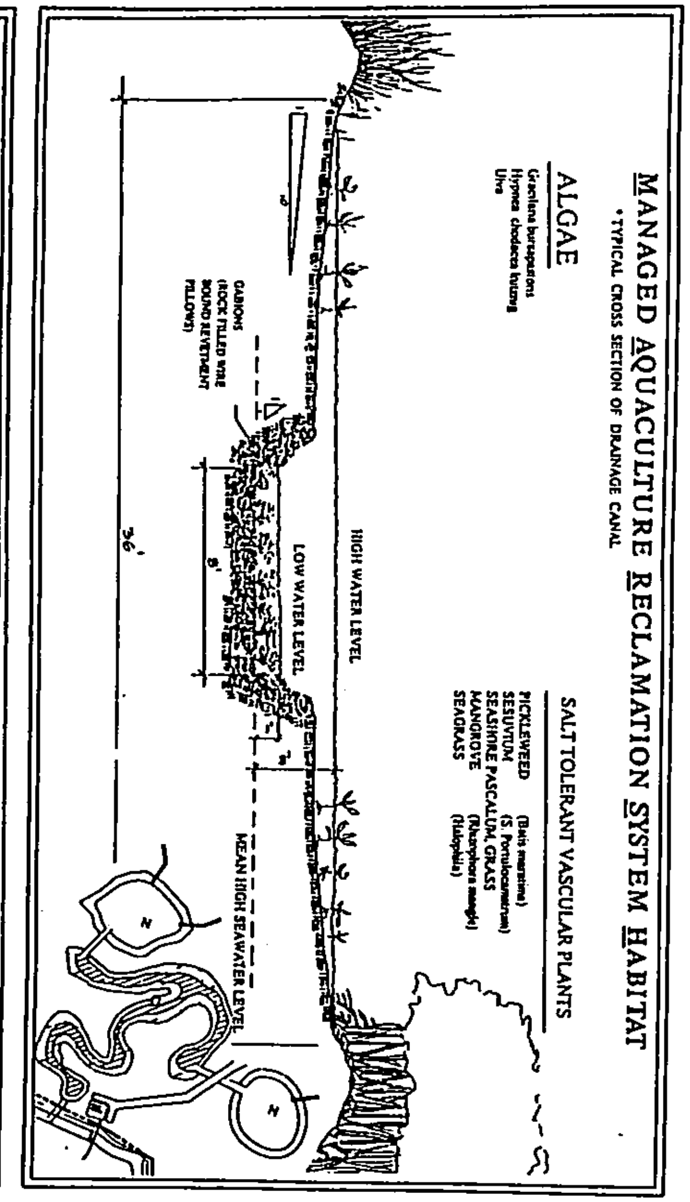

FIGURE IV-3 MARSH CHANNEL CROSS SECTION

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Although the total length of the channel should be about 1000 feet, its orientation and course may vary depending upon specific site characteristics orperformance variable options. A single, meandering, 1,350-foot long channel is displayed in both Scheme I and Scheme II plans (see Figure I-1). This design may be modified significantly during construction (dependent upon site considerations) without significantly altering performance characteristics. An alternate design (see Figure IV-4) is more costly to construct, but offers flow control options that allow the system to be managed with greater flexibility. The alternate design would enable managers to control water flow and planting characteristics within each cell, thereby maximizing control over water quality output. In addition, the alternative design could provide the control necessary to conduct experiments on wetland ecology and nutrient cycling.

In the event of a flood from Hakipu'u Stream, the MARSH will be protected by it's slightly raised grade and access road levee to the pumphouse. The only portal through this levee will be a 24-inch conduit from one of the two settling ponds. In the event of a 100-year storm, all drains from all ponds fill to capacity and all ponds will fill to overflowing. Sheet flow will cascade from one level of ponds to the next, eventually ending up in the MARSH system. The weir and concrete spillway should be designed to accommodate this flow rate at a weir height of 3 feet above mean sea level.

c. Marsh Vegetation

The primary function of the MARSH is to remove potentially harmful levels of nutrients and other wastes from aquaculture effluent. To achieve this goal the system must exhibit long-term stability with a robust capacity to absorb effluent pulses. Stability in natural systems is generally achieved through biological diversity. Diversity in the MARSH system will be maximized through the use of a variety of terrestrial and marine plants. This vegetation will be planted in a 20-foot wide border to either side of the central channel, or within the channel itself (in the case of the algae). The species of plants used and their density and position in the MARSH will depend upon the mode of operation of the MARSH and the plant's response to effluent (particularly salinity) conditions. The control channel of the MARSH will offer growth holdfasts and constant water coverage for a variety of algae species. However, if the MARSH is operated under "full" depth mode, the algae could obviously be grown in the shallow border to either side of the channel. As initially conceptualized, the border areas will be planted with land based vascular plants with high salinity tolerance. The various attributes of algae and salt tolerant vascular plants are discussed in the section below.

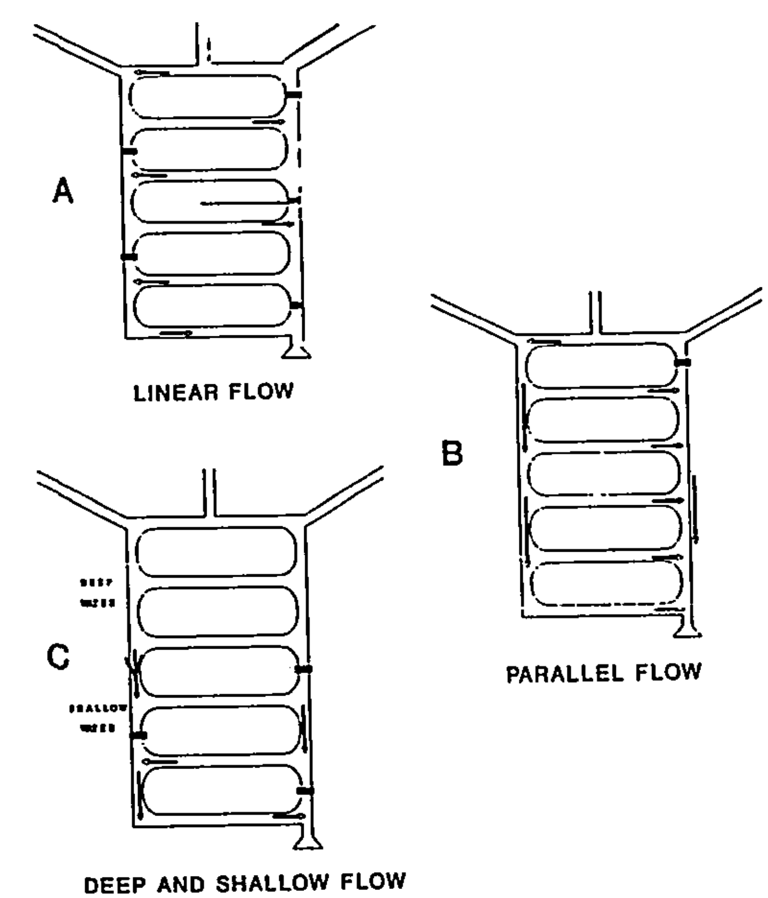

FIGURE IV-4 MARSH ALTERNATE CHANNEL FLOW SCHEMATIC

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(1) Marine Algae

Marine algae have gained much attention recently in Hawaii aquaculture because of their rapid growth, relative ease of culture and a good market price. Research effort has been directed towards the growth and harvest of tropical macro-algae to yield various carrageen and agar products of commercial value. Other research has centered on the use of algae to strip nutrients from municipal waste. In general, studies show that the growth rate of certain types of algae is limited by temperature, nutrient concentration, water movement and ambient light. Different species of algae have differing optimum growing conditions, and also vary in their capacity and efficiency for striping nutrients from the water. The ideal mix of algae in the system will evolve as a function of cultivation efficiency, nutrient removal efficiency, and ease of system harvest and maintenance.

Research on the nutrient uptake capacity of macroalgae has shown that several genera have a remarkable capacity for nutrient uptake and growth (Laws, personal communication; Lapointe and Ryther, 1978; Atkinson & Bilger,1991). Researchers in Florida passed water at controlled nutrient levels and at different flow rates over macroalgae cultures (Lapointe and Ryther,1978, 1979). Success of the experiments has led these researchers to create a conceptual design for the use of algae beds as a filter for experimental recirculating water system (Hanisak, personal communication). The ability of algae to uptake nutrients is positively correlated (within limits) to the nutrient concentrations, water flow rate, ambient light, temperature, and absence of fouling organisms. Each algae species has different growth and nutrient uptake characteristics making it possible to customize a sequential algae bed system to match expected effluent water quality characteristics.

The remarkable ability of algae to extract nutrients from water has been used in the design of algae "scrubbers" for closed circuit aquaculture systems. In these devices algae are grown on high surface area plates (such as corrugated roofing) with rapid water movement over the culture provided by pumps or motors. The rapid water movement serves to keep the system well oxygenated and to increase the diffusion efficiency of nutrients across the water/plant cell wall interface. In the MARSH system the algae will remain on fixed substrate with water movement provided by gravity flow from the ponds to the ocean.

Calculations and assumptions used in the design of the MARSH algae bed system, based on the work of several researchers, are detailed in Table IV-3. These calculations, derived with the assistance of Dr. Marlin

TABLE IV-3
MARSH AREA CALCULATIONS

CALCULATIONS OF NUTRIENT UPTAKE BY A MIXED ALGAL TURF TO YIELD AREA ESTIMATES FOR DESIGN OF A MARSH SYSTEM

STEADY GROWTH MODEL

ASSUME C:N RATIO = 18:1 C:P RATIO = 500:1
GROSS PRODUCTIVITY OF MIXED ALGAE REEF = 2 moles C / m^2 - day
NET PRODUCTIVITY = = 1.41 mole C / m^2 - da
= 79.5 mmole [N] / m^2 - day
= 7.6 gr [N] / m^2 - wk
= 1.1 gr [N] / m^2 - day

EFFLUENT NUTRIENT CONCENTRATIONS

	ug/l	mmol/m^3
NH4	120	8.6
NO3	300	21
PO4	50	1.6
TN	500	35
TP	300	21

(NH4, NO3) > INORGANIC [N] = 29.6 or 30 = 30 mmole [N] / m^3

AT A FLOW RATE OF 1200 GPM THIS YEILDS

(1200 gal/min * 3.31 l/gal * 60 min/hr)/ 1000 l/m^3 = 275 m^3 affluent / hr
275 m^3/hr * 30mmol [N] / m^3 = 8250=8.25 mole [N] / hr = 2772 gr [N]/da
(2772 gr[N]/da) / 1.1 gr[N]/m^2-da = 2500 m^2 of algae
= 150 m^2
= 1000m x 2.5m

KINETIC MODEL : Based on maximizing uptake by providing an optimum flow

Optimum flow rate =~10 cm/sec at a depth of 33 cm
At 1200 gal/min = 4560 l/min = 76 l/sec or 76 dm^3/sec
Vol = 76 dm = h * w * l = (3.3 dm)*(w)*(1 dm)
width of channel (w) = 76/3.3 = 23dm = 2.3 meters =~7.5 feet

Stanton number (Stm) is a "constant" that denotes the efficiency of uptake at a given flow rate. Stm is defined as

$$Stm = h\left(\frac{\ln Cb}{\ln Cbo}\right)/L$$

Where: h = water height (depth) = .33 m
L = length of flow
Cb = nutrient uptake = 78.5 mmole [N]/m^2-da
Cbo = nutrient input conc. =~ 30 mmole/m^3

At a flow rate of 10 cm/sec Stm =~ $5 \cdot 10^{-4}$
Solving the equation for L:

$$L = .33 \cdot \left(\frac{\ln(78.5)}{\ln(30)}\right) / 5 \cdot 10^{-4}$$

= 846 meters long by 2.5 meters wide
= 300 meters long by 7.5 meters wide

Atkinson of the University of Hawaii Institute of Marine Biology, indicate that a single shallow flowing algae bed channel about 8 feet wide and 2700 feet long (or 28 feet * 1000 ft = 28,000 ft2 = 2/3 acre) should be adequate to extract inorganic nutrients in aquaculture effluent from the MRTC site. These calculations are based upon the concept that flowing water over an algae coated surface improves the nutrient uptake rate.

The calculations do not take into account any nutrient uptake by other animals, plants or soil within the MARSH system, and are therefore considered to be conservative estimates. In the MARSH design presented here, an 8-foot wide channel with a length of only 1350 feet is proposed. This is about half the length suggested by the calculations shown in Table IV-3. However, the wide shallow borders to either side of the central channel should adequately compensate for the additional necessary uptake.

Algae will be grown in and harvested from the central trough of the marsh. Harvest rates are estimated to be approximately 250 pounds of wet algae per week. Rapid (0.3 ft/sec) water flow in the channel twice a day would serve to minimize epiphytic growth and maximize nutrient uptake rates. Excess algae may be harvested from a small boat in the 8-foot wide channel at high water using manual or mechanical harvesters. Alternatively, a stationary harvester could be mounted at the ocean end of the channel to effectively remove any floating algae from effluent waters. Algae harvested from the MARSH could be re-used as fish feed, or dried and composted on site. Composted algae may be sold or used on site as a soil conditioner.

There are many potentially useful species of algae that could be grown in the MARSH system. Three representative species are discussed below:

- Gracilaria spp. (Ogo, Limu Manauea) is commercially grown for sale as edible seaweed. Nitrogen uptake rates of Gracilaria average about 7.6 grams of nitrogen per meter square per week (Laws, personal communication). This figure forms the basis of calculations in Table IV-3. The algae has the ability, however, to quickly absorb and store much larger amounts of nutrients. Gracilaria is easily harvested, and if washed out to the open bay during harvest and flushing operations, are not anticipated to have negative impacts.

- Ulva (Limu Palahalaha, sea lettuce) is easily recognizable by bright green, broad, cellophane-like leaves. Often growing on rocky outcroppings where stream or groundwater enters the ocean, this

seaweed has the capacity to remove trace amounts of nutrients from seawater. It is also easily harvested and is not anticipated to pose a significant pollution problem if small amounts enter the bay in outflowing water. Harvested and processed ulva would probably make a good soil conditioner, but the methods and economics of this process have not been examined.

- Enteromorpha (Limu 'ele'ele) forms fine, dark green or black hair-like colonies attached to the substrate or growing over other algae. Enteromorpha is often found in areas where fresh water with high nutrient content enters the ocean.

(2) Vascular Land Plants

The MARSH system will not rely totally on algae for nutrient removal. To maintain stability, the system will also incorporate salt-tolerant rooted vascular plants. These plants will be rooted in a 20-foot wide border to either side of the central channel. A schematic cross section of the channel is shown in Figure IV-3. The plants will absorb nutrients directly and also provide increased surface area for attachment of various epiphytic algae, invertebrates, and bacteria which add to the system's nutrient removal process.

To properly engineer a plant-based treatment system, information on growth rate and nutrient content (proximate analyses or C:N:P ratio) of the plants is useful. Unfortunately, the availability of hard information concerning the growth rate or proximate content of tropical salt-tolerant plants is very limited. With the exception of mangrove, growth rate and content data on salt-tolerant Hawaiian wetland plants is limited to qualitative statements. The following list of salt-tolerant wetland species are candidates for inclusion in the MARSH.

- Mangrove (Rhizophora mangle) forests are dominant along tropical shorelines. Mangroves of many species are known to play an important role in coastal shoreline hydrodynamics, preventing erosion and acting as a nutrient sink for land-based nutrient sources. In addition, they often provide habitat for many invertebrates and juvenile fishes.

  Nutrient uptake in a mangrove forest is accomplished through direct absorption by mangrove (and other) plants by precipitation and complexing within the soil substrate, and by primary and secondary uptake through the biological food web. Studies suggest that the growth of tropical mangrove forests are limited by the availability of Nitrate (N) and Phosphate (P). Artificial enrichment of mangrove forests either experimentally with fertilizer, guano, or sewage indicates that the growth rate of fertilized mangroves increases significantly by approximately 30 percent. Other studies have shown that the actual N and P concentrations within the mangrove tissues also increase with fertilization (see Table IV-4).

TABLE IV-4
MANGROVE COMPOSITION UNDER
FERTILIZED AND CONTROL CONDITIONS

MANGROVE	NUTRIENT	STEM (% wt)	LEAF (% wt)
UNFERTILIZED	Phosphate	0.05	0.1
	Nitrate	0.5	1.0
FERTILIZED	Phosphate	na	0.17
	Nitrate	na	2.04

Unfertilized mangroves ingestion rate of nitrogen is between 150 kg and 250 kg (N) per hectare per year. This estimate is based upon measured mass increase and proximate analyses of mangrove plant tissue. With fertilized growth, it has been estimated (Boto, 1991) that the 30 percent growth rate increase and 100 percent tissue nutrient content increase is estimated to increase the nutrient uptake of a mangrove forest to about 300 kg (N) and 30 kg (P) per hectare per year. Increased growth rate promotes an increase in leaf litter. In a mature forest, most leaf litter is recycled through the biological web although a portion of this waste is carried out to sea with the tides.

Potential problems with mangrove include its ability to spread quickly, invading the habitat of other plant species, and the difficulty of harvesting this plant which can reach heights of over 45 feet. In addition, growth of mangrove should be limited to maintain open water space for waterbirds.

- Indian Fleabane (Pluchea indica) is a facultative wetland species also occurring in non-wetland areas. This woody plant is moderately tolerant to high salt soils and tends to form thickets up to six feet high at the upper dry borders of marshlands. The thick

areal root system of this plant tends to capture and build up soil from runoff. This upland plant also tends to encroach on marshlands and is not conducive to nesting wetland bird species. Because of it's sturdy nature this plant can also be difficult to control or harvest. With a rather short life span, this plant tends to die back unpredictably leaving a dead woody thicket.

- Pickleweed (Batis maritima) is an obligative wetland species tolerant to relatively high salinities. Pickleweed forms a low dense mat, grows all year round and is easily maintained. In the Oceanic Institute's aquaculture wastewater settling pond, pickleweed forms an almost monoculture growth in the effluent system. Pickleweed is also abundant in the high salinity waters of the Nu'u Pia fish ponds on the Kaneohe Bay Marine Corps Air Station. Young shoots and seeds of pickleweed are highly nutritious and are eaten by several species of water birds. Pickleweed has a very high water content and displays rapid growth rate.

- Ditchgrass (Ruppia maritima) is an indigenous obligative wetland plant with moderate salt tolerance. Ditchgrass may be used to line and stabilize the banks of both settling ponds and channels leading to the MARSH. These plants are normally completely submerged.

- Akulikuli (Sesuvium portulacastrum) is an indigenous facultative wetland plant. Growth rate of akulikuli has not been measured but is reportedly greater than pickleweed. This plant could be used as a temporary planting between pickleweed clumps. This plant tends to grow well for a while and then die back, which would gives pickleweed room for expansion.

- Bulrush (Bolboschoenus maritimus) is an indigenous obligative wetland species with a high salt tolerance. Growth rate of bulrush is generally rapid.

- Seashore Paspalum (Paspalum vaginatum) is a facultative wetland species that typically forms low dense mats and emergent clumps in wetland areas. It can also form extensive meadows in saltwater coastal marshes and may cover marsh areas from which mangrove has been cleared. Easy to maintain and normally tolerant to moving water, Paspalum prefers areas where brackish water flows into the ocean such as areas along the Punalu'u coast of the Big Island.

- Water Hyssop (Bacopa maritima) is often found along banks and in water in association with Bulrush. It forms a low creeping mat and is moderately tolerant to high salinities.

- Seagrass (Halophila hawaiiana) is an obligate marine wetland plant. Seagrass beds are not common in Hawaii, but they do exist in certain areas such as abandoned coastal fishponds. Seagrass is a rapidly growing species that may be used to stabilize marine wetland shorelines. Transplantation techniques for this species are still being developed.

V. MARINE ENVIRONMENTAL SURVEY AND IMPACTS

A. INTRODUCTION

This portion of the study describes the nearshore marine environment and assesses potential impacts to the marine environment fronting the MRTC property from the proposed project development. The biological history and relevant scientific literature concerning Kaneohe Bay was reviewed, and field trips were made for collection of marine biological, water quality, and physical oceanographic data. This information was reviewed, consolidated, and interpreted with respect to possible impacts from the proposed project.

B. METHODS

Background information was obtained through a search of relevant published literature including scientific research reports, previous environmental assessments, historic charts, and discussions with residents and fishermen familiar with the area. Unpublished water quality data were extracted from a larger data set supplied by Dr. Marlin Atkinson of the University of Hawaii Institute of Marine Biology with funding from the UH Sea Grant Program in coordination with the State's Main Hawaiian Island Marine Resource Investigation study.

Three field trips collected information on sediment depth in the reef-back area, water depth, water quality, and to conduct a biological assessment of the area. Sample sites are shown in Figure V-1. The methods utilized a combined quantitative and qualitative approach to define the nearshore existing community biotypes in the nearshore environment. Data from these field trips was used to plan the best course of development while minimizing impact from that development. The survey is not designed to collect sufficient quantitative data to act as a base line from which to measure future environmental changes. Such a survey (or yearly surveys) may be required as a condition of the National Pollution Discharge Elimination System (NPDES) permit.

1. Water Quality

Water quality samples were taken at seven stations (top and bottom) from the shallow nearshore to the deep bay ship channel (see Figure V-1). Insitu salinity, temperature and conductivity measurements were made with a salinometer (Beckman RS3-5 portable salinometer). Dissolved oxygen was measured in situ using a YSI oxygen meter (model 57). Turbidity measurements were performed with a laboratory nephelometer (Turner Nephelometer). Non-filterable residue was determined by filtration through pre-weighed 5 micron glass filters. Nutrient values, including total nitrogen, nitrite plus nitrate, total phosphorous and orthophosphate were determined with an auto-analyzer (Technicon Auto-analyzer II).

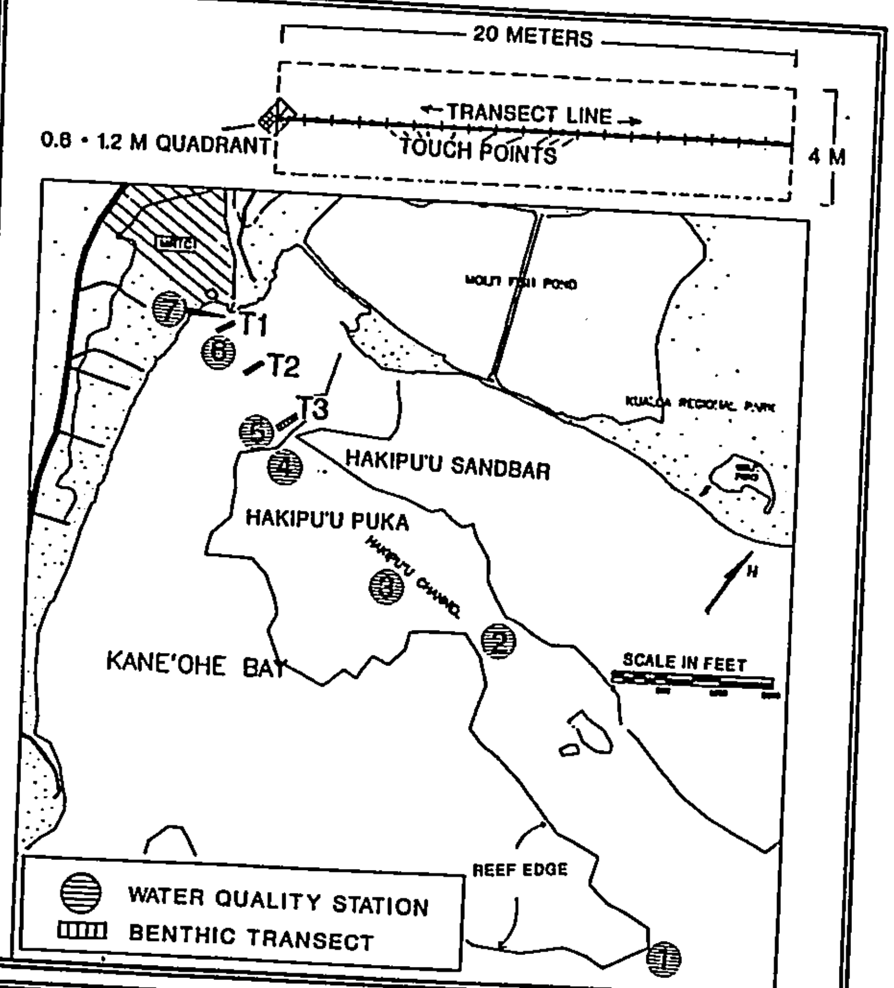


FIGURE V-1 TRANSECT(T) AND WATER QUALITY SITES

Mariculture Research and Training Center

2. Currents

Surface current direction and speed were estimated using a drogue tethered to an anchor with a known length of line. The direction of drift and distance from the anchor after a known time interval yielded current vectors which were then compared to previously published reports (see Figures V-7 and V-8).

3. Marine Life Assessment

The marine life survey combined both qualitative and quantitative methods to achieve an overall view of the marine environmental characteristics of the area. Three 4 x 20-meter transects were laid out parallel to shore over the reef-flat area at approximately 60 meters from shore, 150 meters from shore, and at the edge of the reef, about 250 meters from shore (see Figure V-1). All fish within the 4 x 20 meter transect were noted by a diver using mask and fins as the transect line was being deployed. All macroinvertebrates within the transect were counted and classified to genus and species where possible. No attempt was made to count species that were cryptic, tend to hide under rocks or burrow into the substrate. A single 0.96 square meter quadrant placed at a random location (i.e. thrown from the surface) on the bottom marked the beginning of each transect. Each quadrant is divided into 24 (20 cm x 20 cm) grids. The percent cover within the quadrant of hard substrate, sand and mud, rubble, algae, and coral was visually estimated by the diver. Touch point analyses of these same variables was done to characterize the bottom at 0.5 meter intervals along the 20 meter transect (see Figure V-1). Each quadrant was photographed at a visual field scale of 1/4 meter or smaller due to poor visibility.

The area surrounding each transect was viewed by the diver to assure that the transect was representative of the general area. Additional qualitative observations were made along the reef edge about 100 meters each side of the reef edge juncture with Hakipu'u Sandbar, and also on Hakipu'u Sandbar itself. Substrate core samples (radius 8 cm, depth 20 cm), centered at one designated corner of the meter square quadrant, were taken in the field and stored in zip-loc bags for analyses in the lab. Samples were cut down to about 3 kilograms each and passed through a series of sieves (13 mm, 6mm, 3mm, 1.5mm). Sediments captured by each sieve were weighed and any animals isolated were identified to Family.

C. RESULTS

1. Water Quality

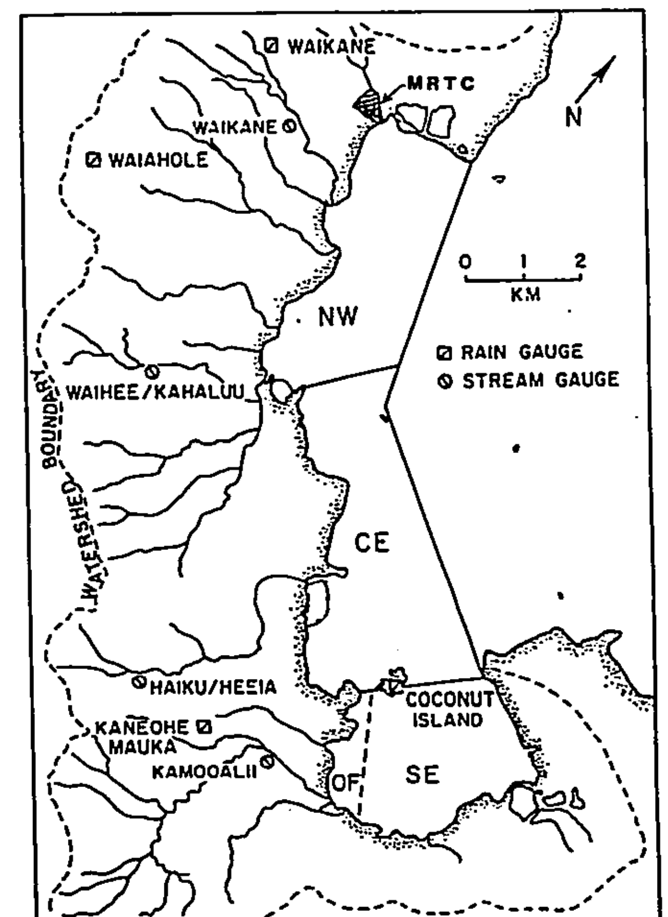
Water quality data analyzed are from the northern quadrant of Kaneohe Bay. Northern Kaneohe Bay has been identified as a transition zone between the pristine open ocean waters and the estuary-like conditions existing in the south bay (see Figure V-2)

Water quality results for the seven OLI field survey stations are displayed in Table V-1 and Figure V-3. Physical water quality parameters (temperature, salinity, turbidity) from these stations are represented as a graphical cross section through the bay from the MRTC shoreline to the deep bay in Figure V-4.

TABLE V-1
WATER QUALITY IN KANEOHE BAY FRONTING THE MRTC FACILITY
October 29, 1991

SAMPLE SITE	NO3/2 ug[N]/l	TOTAL N ug[N]/l	O-Phos ug[P]/l	TOTAL P ug[P]/l	TURB (NTU)	NFR mg/l	SAL ppt
1 Top (MIDBAY)	7	123	4	7	0.44	3.5	33.20
1 Bot	2	101	6	13	1.0	4.2	35.50
2 T	<1	123	6	13	1.5	5.0	35.38
2 B	<1	169	6	30	4.6	8.0	35.65
3 T	<1	127	5	11	1.3	3.5	35.10
3 B	2	191	7	31	4.1	14.3	35.1
4 T	<1	154	4	10	2.0	4.2	35.15
4 B	<1	118	5	20	3.0	7.3	35.58
5 T	<1	140	5	12	1.5	5.0	35.20
5 B	<1	144	5	10	1.8	6.3	35.40
6	<1	177	5	16	0.5	6.3	34.18
7 (STREAM)	3	255	7	31	-	9.2	34.0
G.MEAN	<1 (0.9)	121.5	5.33	15.1	1.9	7.1	34.95

Kaneohe Bay Sewage Diversion Experiment—Smith, Kimmerer, Laws, Brock, Walsh



V-2 KANEOHE BAY BATHYMETRIC SECTIONS

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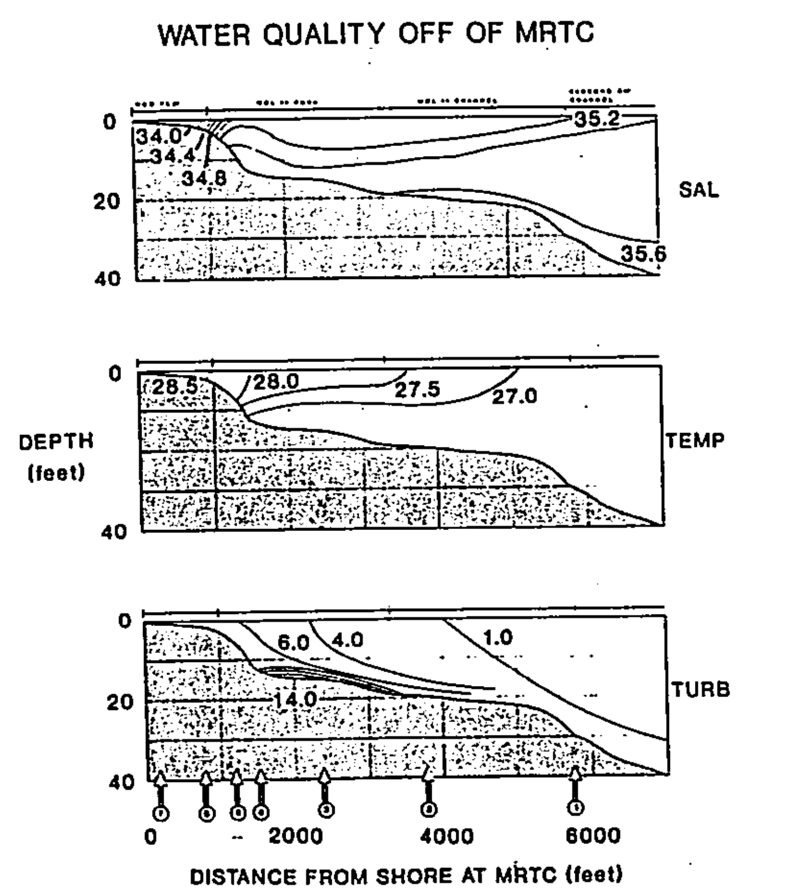

FIGURE V-3 WATER QUALITY CROSS SECTION

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Additional water quality data were extracted from a larger data set compiled by Dr. Marlin Atkinson of the University of Hawaii Institute of Marine Biology under funding by the University of Hawaii Sea Grant Program as a part of the State of Hawaii's Main Hawaiian Island Marine Resource Investigation studies. These data were collected over a period of one year from surface waters at many sites throughout the bay. The data extracted here are from approximately twelve sites in the north bay fronting the MRTC facility. The data have been further divided into one set of nearshore stations and a second set of "offshore" (generally reef edge) stations as shown in Figure V-4. The data are presented in tabular form in Tables V-2a and V-2b, and graphically represented in Figures V-4 through V-8. Figure V-5 displays surface salinity isobaths at various times throughout the year in the north bay. Figure V-6 displays the nearshore data set compiled using log-normal statistics to show probable variability of nearshore (receiving) waters adjacent to MRTC.

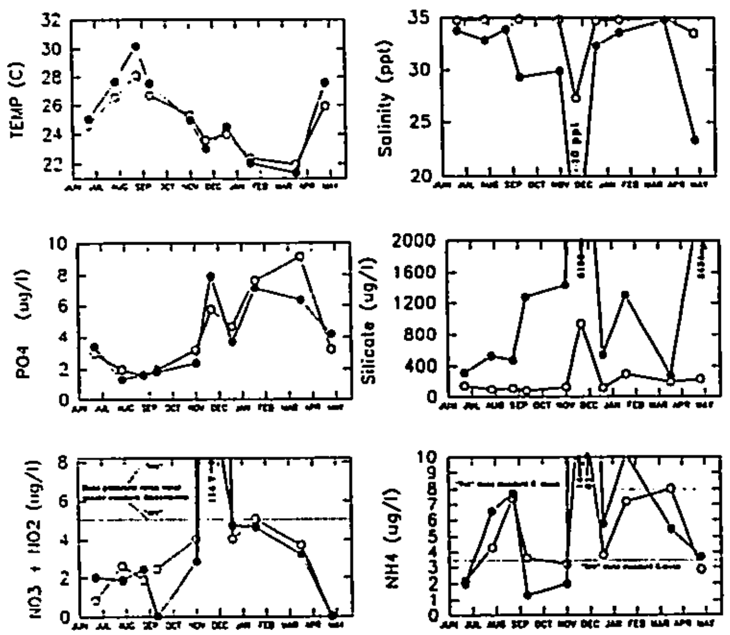
2. Currents

Currents within the bay are affected by tides, wind, proximity to ocean channels and bottom topography. Currents in the south bay are generally circular, clockwise, forming a relatively stable water-cell with slow exchange rates. In the north bay, currents are influenced primarily by the wide open channel which allows free exchange of tidal flow. In the North Bay a fairly consistent nearshore current flows parallel to the shore north of the bay and enters the bay around Kualoa Point bringing water from the open ocean into the bay. A summary of current direction after Bathen (1978) is shown for incoming and outgoing tides in Figure V-7. Current direction and speed measured on October 29, 1991 are shown in Figure V-8.

3. Marine Life Assessment

The seaward edge of the MRTC project site is lined with a mangrove thicket at the high water mark. The beach adjacent to the mangroves consists of fine sand mixed with dark mud and is fairly firm, footprints sinking only 1 to 2 centimeters. There were no signs of burrows and no bird footprints on the mud surface. At the time of the survey, the alluvial fan of Hakipuu Stream had been extended at least 30 meters beyond the beach and was colonized by seedling mangroves, 20 to 50 centimeters in height. The stream exited through one principle and one minor stream mouth on the south (Kaneohe side) of the newly built delta with flow running obliquely parallel to the shoreline. The mud bottom around the stream mouth is very soft with footprints sinking 10 to 20 centimeters. Between 50 and 100 juvenile fishes all less than 5 centimeters in length including mullet (<u>Mugil</u> spp.), tilapia (<u>Oreochromis</u> spp.) and aholehole (<u>Kulia sandvicensis</u>) were noted in and around the stream mouth.

North Kaneohe Bay Water Quality



North Kaneohe Bay water quality showing variation with season and proximity to the shore. Nearshore samples (—●—) were taken on the reef flat fronting Hakipuu valley within about 100 meters (300 feet) from shore. Off shore samples (—○—) taken in more central bay areas over reef flats or deep water. Approximate sample locations shown in FIG V-4. Data extracted from a larger data set compiled by Dr. M. Atkinson, UH Institute of Marine Biol. with support of the UH Sea Grant Program.

FIGURE V-4 NORTH KANEOHE BAY WATER QUALITY

MARICULTURE RESEARCH AND TRAINING CENTER | Oceanit Laboratories, Inc.

	STATION	TEMP. (C)	PO4 ug/l	PO4 (uM)	NO3 & NO2 ug/l	NO3 & NO2 (uM)	NH4 ug/l	NH4 (uM)	SI ug/l	SI (uM)	SALINITY (o/oo)
20 JUNE 1990 OFF-SHORE	10	26.60	4.34	0.14	4.36	0.29	17.92	1.28	120	4.29	34.8603
	14	26.60	3.41	0.11	2.26	0.16	0.98	0.07	224	8.00	34.5606
	12	26.40	2.17	0.07	0.01	0.30	0.70	0.05	169	6.05	34.6734
	41	26.60	3.10	0.10	2.94	0.21	3.50	0.25	126	4.49	34.8553
	42	26.70	2.17	0.07	1.40	0.10	0.98	0.07	109	3.90	34.8529
	GEO.MEAN	26.58	2.93	0.09	0.88	0.06	2.11	0.15	144	5.15	34.76
NEAR-SHORE	7	25.10	2.17	0.07	1.82	0.13	2.38	0.17	142	5.07	34.7153
	13	24.90	5.27	0.17	2.24	0.16	1.68	0.12	716	25.56	33.0015
	GEO.MEAN	25.00	3.38	0.11	2.32	0.16	2.00	0.14	319	11.38	33.85
25 JULY 1990	16	26.90	2.17	0.07	2.94	0.21	2.80	0.20	89	3.18	34.9344
	10	26.70	1.86	0.06	2.24	0.16	3.50	0.25	195	6.95	34.7175
	11	27.20	3.10	0.10	17.22	1.23	5.46	0.39	161	5.76	34.8628
	14	26.00	2.17	0.07	2.52	0.18	9.24	0.66	50	1.79	35.0044
	15	26.00	2.17	0.07	2.52	0.18	8.96	0.64	33	1.19	34.9792
	12A	26.60	0.93	0.03	0.42	0.03	1.40	0.10	189	6.75	34.6015
	GEO.MEAN	26.56	1.95	0.06	2.59	0.19	4.29	0.31	98	3.50	34.85
	7	27.60	0.93	0.03	0.42	0.03	7.28	0.52	222	7.94	34.1358
	13	27.70	1.86	0.06	8.40	0.60	5.88	0.42	1212	43.27	31.7916
	GEO.MEAN	27.65	1.32	0.04	1.88	0.13	6.54	0.47	519	18.54	32.96
22 AUG. 1990	16	28.10	1.86	0.06	2.80	0.20	6.02	0.43	128	4.58	35.1072
	10	28.10	2.17	0.07	1.12	0.08	9.66	0.69	187	6.68	34.8686
	11	28.10	1.24	0.04	0.70	0.05	3.22	0.23	176	6.30	34.8695
	14	27.90	1.86	0.06	3.64	0.26	8.82	0.63	64	2.29	35.2940
	15	27.70	1.86	0.06	3.22	0.23	20.44	1.46	38	1.34	35.1796
	12A	28.70	0.93	0.03	1.82	0.13	4.76	0.34	192	6.87	34.8727
	GEO.MEAN	28.10	1.59	0.05	1.90	0.14	7.37	0.53	112	3.99	35.04
	7	29.60	1.24	0.04	3.22	0.23	9.94	0.71	256	9.14	34.7784
	13	30.90	2.17	0.07	1.82	0.13	6.02	0.43	861	30.74	33.1299
	GEO.MEAN	30.19	1.64	0.05	2.42	0.17	7.74	0.55	470	16.78	33.94
9 SEPT. 1990	10	26.70	4.96	0.16	2.80	0.20	7.56	0.54	166	5.92	34.7376
	14	26.70	1.86	0.06	1.82	0.13	3.64	0.26	59	2.10	34.9180
	15	26.40	1.24	0.04	1.12	0.08	1.26	0.09	32	1.15	34.9961
	16	26.40	0.93	0.03	1.12	0.08	3.64	0.26	43	1.53	34.9027
	11	27.40	2.17	0.07	12.88	0.92	4.76	0.34	192	6.87	34.8112
	12A	26.60	2.17	0.07	2.52	0.18	3.64	0.26	112	4.31	34.9110
	GEO.MEAN	26.70	1.92	0.06	2.43	0.17	3.60	0.26	81	2.91	34.88
	7	27.80	0.93	0.03	0.01	0.00	0.42	0.03	1360	48.57	28.8118
	13	27.60	1.24	0.04	1.12	0.08	5.60	0.40	1165	41.62	30.0384
	17	27.40	2.17	0.07	0.01	0.00	1.54	0.11	1331	47.54	29.2378
	18	27.40	4.34	0.14	0.01	0.00	0.84	0.06	1245	44.48	-
	GEO MEAN	27.55	1.82	0.06	0.04	0.00	1.32	0.09	1275	45.54	29.36
30 OCT. 1990	10	25.60	2.79	0.09	3.64	0.26	2.66	0.19	172	6.16	34.9772
	11	25.50	3.72	0.12	10.64	0.76	2.94	0.21	267	9.54	34.6331
	12	25.40	3.72	0.12	4.34	0.31	3.22	0.23	312	11.13	34.5249
	14	24.70	2.79	0.09	2.38	0.17	2.94	0.21	45	1.59	34.9366
	15	25.10	3.10	0.10	1.96	0.14	3.50	0.25	45	1.59	34.9968
	16	25.40	2.79	0.09	5.60	0.40	4.06	0.29	156	5.57	34.9239
	GEO.MEAN	25.28	3.13	0.10	4.05	0.29	3.19	0.23	128	4.58	34.83
	7	25.00	1.86	0.06	3.36	0.24	3.22	0.23	1731	61.83	29.2830
	13	25.10	2.17	0.07	9.94	0.71	2.94	0.21	885	31.61	32.4318
	17	24.80	1.86	0.06	1.96	0.14	0.28	0.02	1676	59.86	29.1799
	18	24.80	4.03	0.13	0.98	0.07	6.16	0.44	1644	58.85	28.8896
	GEO MEAN	24.92	2.35	0.08	2.83	0.20	2.01	0.14	1634	51.22	29.91

TABLE V-2a HIMB WATER QUALITY DATA

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	STATION	TEMP. (C)	PO4 ug/l	(uM)	NO3 & NO2 ug/l	(uM)	NH4 ug/l	(uM)	Si ug/l	(uM)	SALINITY (o/oo)
20 NOV. 1990											
OFF-SHORE	10	23.5	7.44	0.2400	90.02	6.4300	13.54	0.9700	1213	43.3300	29.1773
	11	23.6	6.82	0.2200	84.98	6.0700	4.62	0.3300	848	30.0100	30.7348
	12	23.1	4.03	0.1300	101.64	7.2600	36.68	2.6200	2966	105.9600	19.9643
	14	24.7	6.82	0.2200	13.44	0.9600	6.72	0.4800	72	2.5800	34.0771
	16	23.3	4.65	0.1500	80.50	5.7500	22.26	1.5900	1759	62.8100	25.0513
	15	23.3	5.58	0.1800	70.42	5.0300	24.36	1.7400	1842	65.7900	25.0332
	GEO.MEAN	23.61	5.75	0.19	42.44	4.44	14.25	1.02	944	33.71	27.33
NEAR-SHORE	7	23.1	6.82	0.2200	102.76	7.3400	43.12	3.0800	4402	157.2350	14.7511
	13	23.0	13.32	0.4200	129.22	9.2300	88.76	6.3400	5638	201.3500	
	17	23.0	5.58	0.1800	113.82	8.1300	59.64	4.2600	5334	190.3750	10.4485
		23.03	7.91	0.26	114.76	8.20	61.11	4.37	5166	184.50	12.63
17 DEC. 1990											
	10	24.1	5.58	0.1800	7.70	0.5500	4.34	0.3100	117	4.1700	34.8148
	11	24.2	5.27	0.1700	12.04	0.8600	2.66	0.1900	128	4.5700	34.7996
	12	23.8	4.34	0.1400	5.04	0.3600	4.06	0.2900	262	9.3400	34.3820
	14	24.0	6.20	0.2000	1.68	0.1200	5.46	0.3900	43	1.5400	35.0977
	15	24.1	4.34	0.1400	1.68	0.1200	4.06	0.2900	72	2.5800	34.8734
	16	23.9	3.10	0.1000	3.36	0.2400	2.94	0.2100	211	7.5500	34.2801
	GEO.MEAN	24.02	4.60	0.15	4.05	0.29	3.81	0.27	118	4.20	34.71
	7	24.3	2.17	0.0700	1.40	0.1000	1.96	0.1400	406	14.5100	33.3748
	13	24.6	5.58	0.1800	31.50	2.2500	26.32	1.8800	1130	40.3500	29.8909
	17	24.5	4.03	0.1300	2.38	0.1700	3.78	0.2700	334	11.9300	34.1234
	GEO MEAN	24.47	3.65	0.12	4.72	0.34	5.90	0.41	535	19.12	32.41
17 JAN. 1991											
	10	22.5	7.44	0.24	5.74	0.41	6.16	0.44	303	10.82	34.6461
	11	22.5	7.44	0.24	9.66	0.69	6.44	0.46	888	31.72	34.6672
	12	22.4	7.44	0.24	7.42	0.53	7.14	0.51	956	34.14	34.7101
	14	22.2	7.44	0.24	2.80	0.20	8.96	0.64	136	4.85	33.2152
	15	22.2	8.37	0.27	2.32	0.18	7.98	0.57	99	3.54	35.3083
	16	22.5	7.75	0.25	5.74	0.41	6.86	0.49	214	7.65	34.7631
	GEO.MEAN	22.38	7.64	0.25	5.05	0.36	7.20	0.51	301	10.75	34.81
	7	22.1	6.51	0.21	3.22	0.23	8.68	0.62	1646	58.77	33.7304
	13	22.0	7.75	0.25	11.06	0.79	12.60	0.90	601	21.46	33.6717
	17		7.13	0.23	2.80	0.20	9.66	0.69	2220	79.29	33.5676
	GEO MEAN	22.05	7.11	0.23	4.64	0.33	10.18	0.73	1300	46.42	33.66
15 MAR. 1991											
	10	21.7	9.30	0.30	5.32	0.38	9.38	0.67	191	6.81	34.8343
	11	22.1	7.13	0.23	3.22	0.23	5.46	0.39	225	8.32	35.3773
	11B	-	18.91	0.61	3.50	0.25	19.04	1.36	225	8.02	35.2809
	12	22.1	5.58	0.18	3.22	0.23	4.34	0.31	209	7.46	35.3458
	GEO MEAN	21.95	9.15	0.30	3.73	0.27	8.07	0.58	200	7.14	35.01
	912	21.4	6.20	0.20	3.22	0.23	5.46	0.39	235	8.40	34.7942
	912B		6.51	0.21	3.22	0.23	5.46	0.39	329	11.75	34.7726
	GEO.MEAN	21.40	6.35	0.20	3.22	0.23	5.46	0.39	278	9.93	34.78
24 APR. 1991											
	10	25.4	3.10	0.10	0.01	0.00-	1.68	0.12	178	6.35	36.1003
	10	25.6	3.10	0.10	0.01	0.00	1.68	0.12	178	6.35	36.1003
	11	26.4	3.41	0.11	3.08	0.22	5.74	0.41	167	5.96	33.9337
	12	26.1	3.10	0.10	0.01	0.00	4.06	0.29	571	20.38	32.1610
	GEO MEAN	25.92	3.17	0.10	0.05	0.00	2.85	0.20	234	8.37	33.56
	17	28.2	4.34	0.14	0.01	0.00	2.38	0.17	3005	107.31	21.2761
	1221	27.0	4.03	0.13	0.01	0.00	5.74	0.41	1971	70.39	25.7168
	GEO.MEAN	27.59	4.18	0.13	0.01	0.00	3.70	0.26	2434	86.91	23.39
MAKIPLU STREAM											
	15 MAR	-	7.44	0.24	30.94	2.21	5.04	0.36	14264	509.40	0.0933
	21 MAR		6.51	0.21	126.74	8.91	21.56	1.54	11961	427.17	0.1544
	26 APR		4.03	0.13	27.86	1.99	0.70	0.05	11179	399.26	0.1675
	20 NOV		6.82	0.22	42.18	3.07	7.56	0.54	9031	322.54	0.1019
	GEO MEAN		6.04	0.19	54.32	3.89	4.90	0.35	11456	409.14	0.14

TABLE V-2 b HIMB WATER QUALITY DATA

MARICULTURE RESEARCH AND TRAINING CENTER

Oceanit Laboratories, Inc.

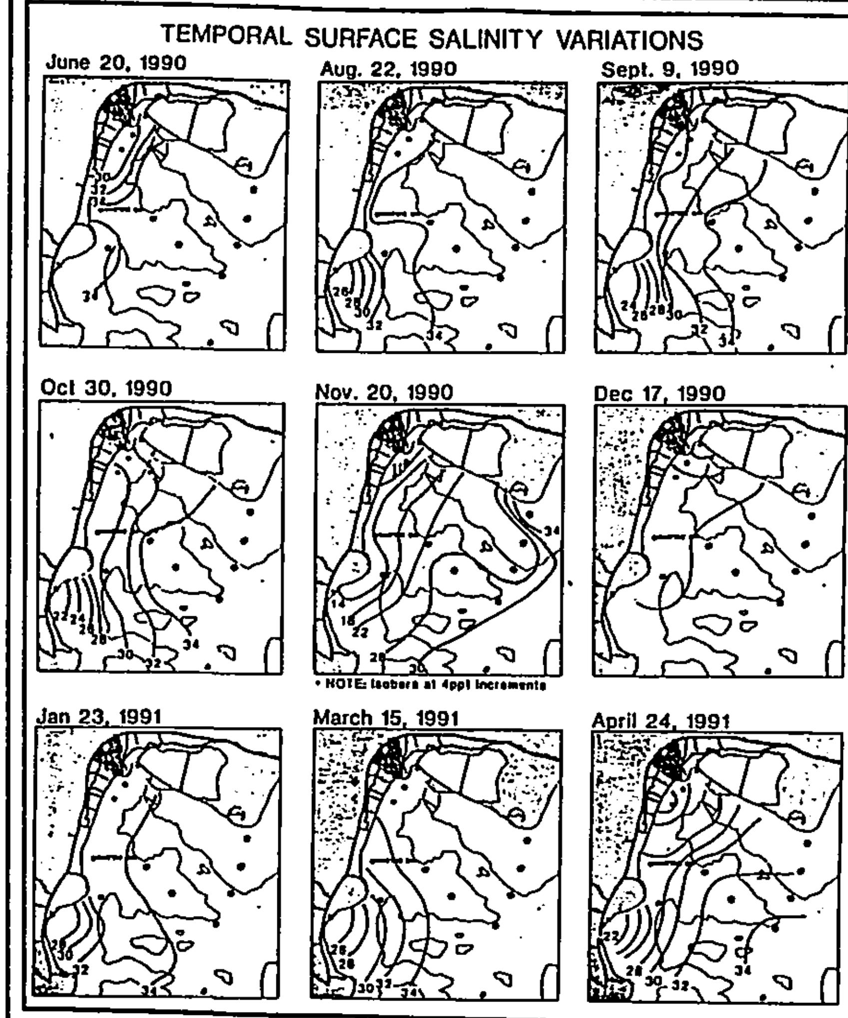

FIGURE V-5 NORTH KANEOHE BAY SURFACE SALINITY

MARICULTURE RESEARCH AND TRAINING CENTER

Oceanit Laboratories, Inc.

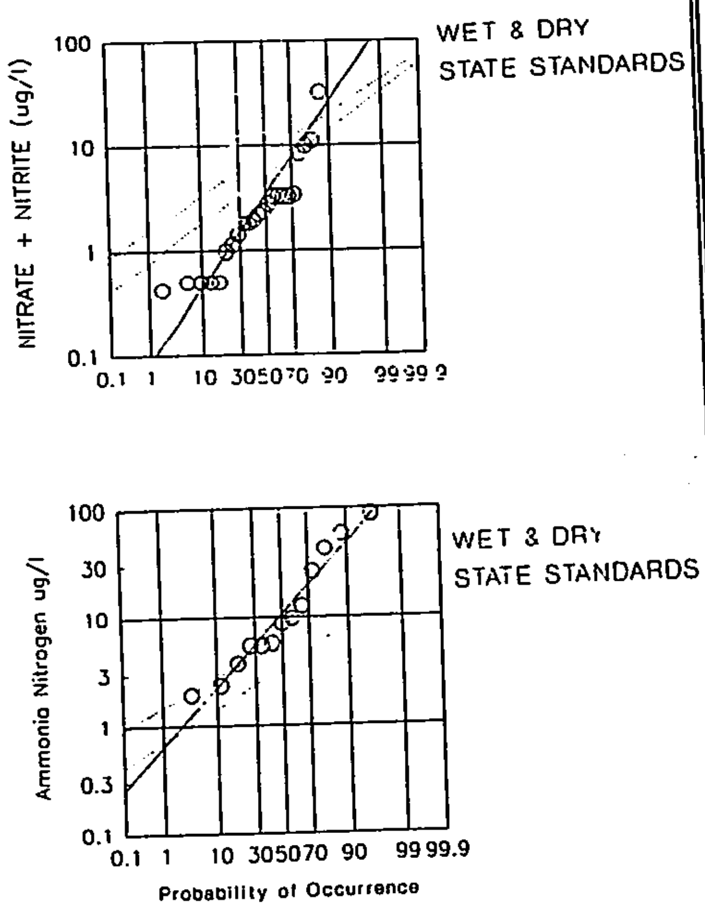

FIGURE V-6 WATER QUALITY LOG-NORMAL STATISTICS

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

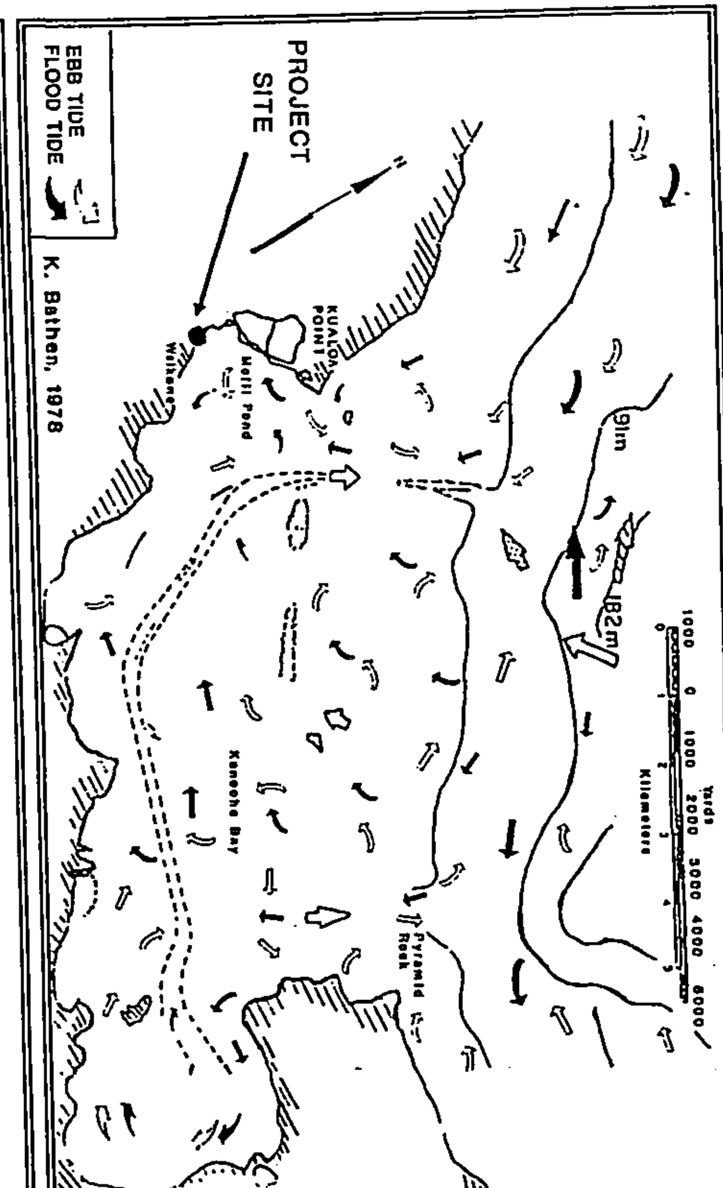

FIGURE V-7 KANEOHE BAY CURRENTS

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

coastal & environmental engineering services • research & development

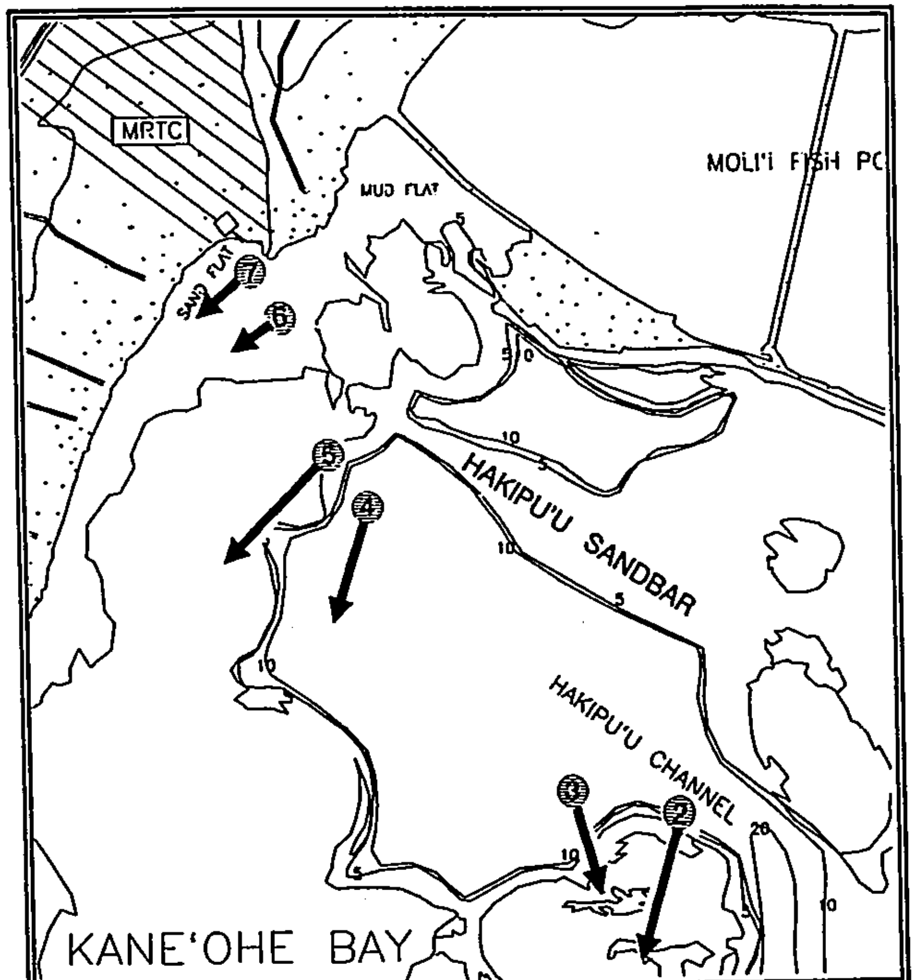

FIGURE V-8 MEASURED CURRENTS
1/4" = 1FT/MIN.

Mariculture Research and Training Center

Oceanit Laboratories, Inc.

Transect #1 was located approximately 60 meters offshore and about 30 meters off the Hakipuu Stream alluvial fan deposits. Water depth was 25 to 40 centimeters. The substrate within the quadrant was 100 percent sand and mud with 15 active burrows noted within the square. No fish or macroinvertebrates were seen. No attached algae were present in the entire 4m x 20m transect, although several loose clumps of the algae Acanthophora spicifera were seen loose on the surface. Just outside the transect area clumps of exposed rock or debris were covered with algae, primarily Padina sp. and A. spicifera.

In a 2,790 gram subsample of the substrate, a single 2.5 cm polychaete was found along with two bivalve shell fragments and a single unoccupied 3mm gastropod shell. Rubble and large grained sand was 90 percent grey stone of land origin.

Transect #2 was located approximately 150 meters from the beach in water approximately 1 meter deep. The area was fairly uniform with sandy mud overlaying rubble, approximately 50 percent exposed. The rubble appeared to be made up primarily of fragments of coral (Porites compressa). The exposed rubble provided excellent substrate for macro-algae growth. Three principle species of algae A. spicifera (50%), the green Caulerpa sertularioides (25%), and Padina sp.(15%), along with lesser amounts of Dictyota acutiloba and Gracilaria sp. were noted. No fish, corals or macroinvertebrates were noted along the 4m x 20m transect line, although it is probable that a number of small invertebrates were hidden in the algae mat.

The substrate sample consisted of about half coral rubble and half terrigenous stone. One rock had an attached mollusk (mussel). Two large (1.5 cm) intact but dead gastropod shells were recovered along with many (30-60) whole shells and shell fragments in the 3mm to 6mm size range. Two polychaete worms were recovered.

Transect #3 was located along the upper edge of the reef dropoff in about 2 meters of water and extended near its juncture with Hakipu'u Sandbar to the south towards Kaneohe. The substrate consisted of 20 percent rubble, 25 percent small dead coral heads, and 55 percent sand. Three damsel fish (Dascyllus albisella) and two small butterflyfish (Chaetodon miliaris) were noted associated with one dead Porites coral head. Two small (3 cm diameter) colonies of Pocillopora damicornis were noted on large rubble. No other fish or macroinvertebrates were seen along the 4m x 20m transect. Macro-algae cover was limited to a very fine, thin mat covering exposed substrate. Only small isolated colonies of A. spicifera, and Padina spp. were noted.

Qualitative observations along approximately 100 meters of reef edge south of Hakipu'u Sandbar show a habitat similar to transect #3. The slope of the 2 meter deep reef edge increases to about 35 to 40 degrees and falls rapidly to a depth of about 5 meters and again levels out on the bottom of the basin. For purposes of this report, this finger of deep bay is called "Hakipu'u Puka". There are occasional live coral heads, predominantly Porites compressa and Pocillopora damicornis, on the reef edge and slope, but these are the exception and occurred in random isolated clumps spaced 2 to 5 meters apart. The substrate sample from this site had a relatively large component of shell fragments and coral rubble although no live mollusks were found. Six polychaetes were found in the sample.

At the bottom of Hakipu'u Puka visibility approached zero. The mud substrate was so black and soft that determining where the boundary layer between water and substrate was difficult. Ninety-eight percent of the substrate sample from this site passed through a 1.5 mm screen, and 93 percent passed through a 0.1mm screen.

Qualitative observations along the reef edge immediately north of Hakipu'u Sandbar show dramatically different conditions than those seen to the south (transect #3). In this area the reef edge is defined by a ridge of large live and dead finger coral heads (Porites compressa). Some cubic meter sized coral heads had broken and fallen down the ledge slope. A few feather duster worms (Sebellastarte sanctijosephi) were noted, approximately one for every 2 meters along the reef edge. Miscellaneous sponges were also common, particularly on the underside of overhanging coral heads. Fish were fairly abundant, particularly one-spot damselfish (Dascyllus albisella), and small brown snapper (Lutjanus fulvus). Other fish including butterfly fish (C. ornatissnus, C. trifasciatus, C. miliaris, C. lunula, and one C. reticulatus), small schools of juvenile parrot fish (Scarus spp.) and several unidentified surgeon fish were noted.

Qualitative observations on the top and sides of Hakipu'u Sandbar showed no indication of solid substrate or macroalgae growth. Although there are probably fish and sand dwelling invertebrates associated with the sandbar, none were seen during casual observation.

D. DISCUSSION

1. General, Kaneohe Bay

Hawaii's geographic isolation, relatively small land mass, and its position at the border of tropical/sub-tropical waters limits marine species diversity and standing biomass. The nearshore ecosystem of windward Oahu's waters are characterized by a moderate species diversity, overall low biomass and rapid nutrient recycling.

Kaneohe Bay is a partially enclosed embayment on the northeast coast of Oahu, and fully exposed to the onshore tradewinds. The mean tide range is about 62.6 cm (2 feet) with a maximum range of 112 cm (3.8 feet). The bay stretches about 12.5 kilometers along the windward coast of Oahu from Kualoa Point to Kaneohe MCAS, although the inner maximum length of the bay approaches 18 kilometers. The breadth

of the bay from the barrier reef to MRTC is about 4 km. The total surface area at mean sea level (MSL) is 31 km^2 (11,360 acres). The total volume of the bay is 266,000,000 cubic meters. The floor of the bay is generally deep (>10 m) lagoon (46% of area) or shallow reef flat or shoal (33% of area), with relatively little of the bay at intermittent depths. While the mouth of the bay is wide, two-thirds of its length is restricted by a barrier reef of sand, shoal reef and coral rubble.

The entire bay is classified as a weakly developed estuary with terrestrial influences of freshwater, sediment and nutrients. It is the largest estuary in the State of Hawaii. Both estuarine and coral reef environments are found within the bay's boundaries, locations for these diverging ecosystems being primarily a function of water circulation patterns and their proximity to terrestrial inputs. Three general areas are evident; (1) the offshore coral/sand reef ecosystem has a predominantly marine influence (34% of total area, average depth 1.8 m), (2) the inshore lagoon (46% of total area, average depth 16 m), and (3) the inshore shoal reef and mudflats (20% of total area, average depth 1 meter).

Historically, the reef flat area of the bay was the site of more than 30 active fish ponds whose walls accounted for 30 percent of the total shoreline. Only seven fish ponds are still in existence, and only the Moli'i fish pond adjacent to the project site is currently in production. The remaining six inactive ponds have undergone various degrees of physical structural degradation and are often clogged with the thick, fine brown silt and clay deposits from streams entering the bay. (Note: Heeia pond is currently undergoing renovation to become active.)

2. Bathymetry and Substratum Formation

In general, the bathymetry and substratum formation of the bay follows the divisions stated above: (1) the offshore coral/sand reef ecosystem (coral/sand reef, average depth 1.8 m), (2) the inshore lagoon (average depth 16 m, mud bottom), and (3) the inshore shoal reef and mudflats (average depth 1 m, sand & mud flat). The deep lagoon area is typified by a thick muddy floor and isolated irregular coral patch reefs rising abruptly to within 1 meter of the surface. The lagoon floor consists of grey mud, coral rubble, and fine coral sand. The proportion of non-calcareous material in the lagoon sediments increases with proximity to the shore where basalt mineral clays with higher organic content predominate as a consequence of land erosion sediments.

The inner bay is classified into three contiguous bathymetric sections (see Figure V-2); the southeast (southbay) basin, the northwest (northbay) section and the central area. The southeast basin is surrounded on three sides by land with a high population density and is moderately isolated hydrographically due to a fairly persistent counter-clockwise eddy. The central and north-west sectors are considered somewhat as a transition zone between the outer barrier reef/oceanic conditions, and the south basin. The south bay has the least exchange with the open sea, is fairly deep with few patch reefs, and has three major streams inputting freshwater and nutrients. The north basin has the largest channel to the open sea, the greatest tidal exchange volume, a large number of patch reefs, and the largest number (7) of major streams inputting fresh water.

Approximately 50 km of the bay's shoreline boundary is typified by a fringing reef flat extending outward several hundred meters offshore. While the steep face of these fringing reefs is usually lush with coral reef growth, the landward reef flat often resembles a mud-flat ecosystem with encroaching mangroves at the shoreline. Estuarine conditions are strong within these areas. The ratio of fresh to salt water at stream mouth areas show considerable seasonal variation. The inner-bay fringing reefs have a prominent component of land-derived mud, sand and rubble, with a higher standing crop of algae.

3. Water Quality

Kaneohe Bay has been subjected to widely fluctuating environmental impacts from man's activities during the past century. Man has been responsible for introducing large amounts of nutrients and sediments into the bay through construction, agricultural run-off, dredging and sewage disposal. The last major sugar cane field in the bay's watershed ceased operations shortly after the sewage was diverted from the bay in 1977. The recovery of the bay has been documented primarily through the Hawaii Institute of Marine Biology (HIMB) (Pacific Science 35(4): Oct. 1981).

One of the most destructive (but "natural") elements changing the character of the Bay's living reefs has been fresh water floods and resultant siltation. The majority of coral reef animals cannot survive long in water of reduced salinity or high turbidity. During major storms, runoff into the bay is sufficient to form a layer of potentially-lethal fresh water several feet thick over the reefs. Even during minor storms, silt can coat corals and other invertebrates, blocking out sunlight or physically smothering them under a mud blanket. Periodic catastrophic flooding of the bay has markedly affected diversity on the coral reefs, with only fresh-water tolerant species able to successfully colonize the reef within the upper 1 to 2 meters of the surface.

As an aid to help regulate and maintain the quality of surface waters in the state, the Department of Health has prepared a "Water Quality Plan". This plan stipulates the quality of water that should be maintained for various classes of water around the State. The geometric mean water quality state standards (wet season) are shown in Table IV-2, and displayed for comparative purposes (wet and dry season standards) in Figures V-3 and V-6. Bay waters offshore of MRTC are classified pursuant to Chapter 54, Title 13, Water Quality Standards for marine waters as Class AA. The

State of Hawaii Water Quality Plan states that:

> "It is the objective of this class that these waters remain in their pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-caused source or actions. Uses to be protected in this class of waters are activities such as oceanographic research, aquaculture, conservation of coral reefs and wilderness, and compatible recreation."

Water quality in the nearshore areas is affected markedly by input from land runoff through Hakipu'u Stream and probably Moli'i fishpond. Inshore water quality often exceeds Class AA standards for water quality set by the State Department of Health.

4. Currents

Published and measured data show that currents are predominantly long-shore from Kualoa point to Hakipu'u Stream while bringing fresh seawater (and Kualoa beach sand) into the bay (see Figure V-3 and V-4). This seawater then joins waters of Hakipu'u Stream and Moli'i Pond effluent and appears to flow to the open bay through or over one of the deep channels sculpted into the reef edge.

5. Marine Life Assessment

The marine environmental survey suggests that Kaneohe Bay fronting MRTC may be divided into the following community biotypes:

- Mangrove swamp and stream mouth
- Back-reef sand and mud flat
- Reef edge
- Hakipu'u Sandbar
- Deep bay basin

a. Hakipu'u Stream courses through a mangrove swamp. This mangrove swamp serves to physically protect the coastline from erosion, but offers limited biological habitat. Mangrove tends to colonize the newly built-up alluvial fan deposits from Hakipu'u Stream thereby accelerating the extension of the stream mouth delta into the bay.

b. The back reef sand and mud flat biotype fronting the facility extends about 250 meters out to the reef edge. This area is strongly affected by the stream and terrestrial influences nearest the shore. No coral growth was noted on the mud and sand flat. Significant macroalgae population on the sand/mud flat suggests the presence of a higher level of nutrients than would typically be expected in Class AA waters. The back-reef flat ranges from a muddy beach fronting the mangroves out to the sandy reef edge in about 2 meters of water.

c. The reef edge directly fronting MRTC is unusual in that it is almost totally lacking in coral cover. Other sections of the reef edge, to the north of Hakipu'u Sandbar, display typical extensive coral growth.

Normally, the reef edge in Kaneohe Bay is an almost vertical drop with close to 100 percent coral cover. The reef edge to the south (Kaneohe side) of the Hakipu'u Sandbar is almost totally devoid of live coral for at least 100 meters (300 feet). Along this reef edge the bottom slope merely increases and falls to the flat mud floor of Hakipu'u Puka. Fish density along this length of reef edge was low, probably due to the lack of habitat cover. To the north (Kualoa side) of Hakipu'u Sandbar, the reef edge supports a 50 percent (estimated) coverage growth of live coral. The coral is almost exclusively made up of colonies of finger coral (Porites compressa) that form large hemispherical colonies in the bay. Numerous butterfly fish, juvenile parrot fish, surgeonfish, damselfish, and snappers were seen on this portion of the reef.

d. Hakipu'u Sandbar was created by sand deposits eroded from Kualoa Point and carried by wave action and prevailing currents along the coast. The sand on the surface of the bar is primarily calcareous and is essentially the same grain size distribution as sands from Kualoa beach. The top of the sandbar is very flat at a depth of approximately 2 feet at mean tide level. The edges of the sandbar slope at an angle of approximately 30 degrees down to the bottom of the bay mud. Hakipu'u Sandbar itself offers little habitat except for sand burrowing species. Because the surface of the sandbar is not stable due to wave and current action, there is no macro-algae growth on the sandbar. Although no fish or invertebrates were seen, it is probable that the sandbar provides habitat for certain wrasses, flatfish, and others.

e. The bottom of Hakipu'u Puka, on both sides of Hakipu'u Sandbar, consists of deep, silty, black mud. This mud, typical of bay bottom sediments through out Kaneohe Bay, consists of an accumulation of terrigenous silts mixed with plankton and fish derived sediments. About 93 percent of a grab sample of the surface sediment from Hakipu'u Puka had a grain size smaller than 100 microns (one hair width). No macroscopic living organisms were recovered from the four liter sample.

E. IMPACT ASSESSMENT

Any development of coastal property carries with it the potential to impact the adjacent marine environment. The proposed MRTC renovation includes laying pipes in a trench across the mud-flat and possibly burying an intake in Hakipu'u Sandbar to draw water from Kaneohe Bay. The water will return to the bay after passing through the aquaculture ponds and MARSH. The aquaculture ponds reconfiguration involves extensive grading and extension of new ponds into existing wetland areas. Each of these actions has potential to impact the marine environment.

1. Intake System

Trenching of the sand and mud flat from the shoreline to the reef edge will destroy habitat directly in line with trenching. The quality of the habitat, however, is such that significant long-term damage should be negligible. Sand, mud and rubble removed from the trench will be replaced to protect the pipes. Algae colonization over the pipes should be fairly rapid and the surface will regain it's natural appearance. During construction a silt plume will be created. Current studies in the area indicate that the plume will be carried parallel to shore and out into the bay. Because nearshore sediments include a higher percentage of fines, the silt plume from nearshore trenching will be more significant than off-shore trenching. The bay is adapted to periodic inundation with silt during storms from seven streams entering this area of the bay. Because there are no live coral reefs or other significant habitat along the proposed pipeline trench, there should be no direct significant long-term impact from this action.

There are two proposed inlet sites for the pipeline. The open water inlet within Hakipu'u Puka would be raised on a platform above the mud bottom. This inlet should not have any adverse impact on the environment as long as it is sufficiently screened to prevent entrapment of small fish. The second option involves laying a network of slotted pipes several feet beneath the Hakipu'u Sandbar surface. Because of the constantly shifting nature of the sandbar surface, there should be no long term impact to the faunal ecology over and within the sandbar.

There are several unknown factors involved with using the sandbar as a filter. The fate of materials filtered out by the sand is unclear. If waters over the sandbar filter contain 5 mg/l of solids that will be filtered, this translates to approximately 33 kilograms of sediment per day or about 12 metric tons per year. This is not a large load for a filter of this size. The large portion of this sediment is probably organic in nature and would be subject to biological degradation. Whether this material would remain in the sandbar and its long-term impact on the sandbar is unknown.

2. Distribution and Pond Systems

Impact from construction and operation of the ponds and MARSH system upon terrestrial plants and animals is discussed in the EIS and in EIS Appendices D and E.

Short-term impacts to the marine environment are primarily related to siltation from runoff during construction of the ponds and facilities. Although, as discussed above, the nearshore communities are somewhat adapted to periodic silt-laden runoff resulting from Hakipu'u Stream, it would be prudent to minimize this impact through the use of siltation ponds. It is recommended that the MARSH and settling basins be constructed before any ponds are built. This will allow the MARSH to act as silt and runoff control devices, and will also allow a period of time for clean salt water to be pumped through the MARSH allowing algae and plants to become established in the system.

a. Floodwater Flow

Grading and construction of the new ponds and MARSH will impact sheet flow of flood waters on the facility. In the proposed pond layout, the ponds closest to Hakipu'u Stream will be moved away from the stream to provide a wider flood plain for the stream. The lined drainage channel paralleling the stream will protect the ponds from flood erosion and help to channel flood waters down to the lower portion of the property where the land will be leveled to receive flood waters. This is seen as a positive impact.

With the exception of one settling pond, the entire MARSH is outside of the floodwater delta to be leveled by the State of Hawaii Hakipu'u Stream Flood Control Improvements (Job 9-OF-J) flood water control project. The final grading plan of that project consists essentially of leveling all the existing pond 12 and the lower portion of pond 11. The language of the contract states that the grade will be returned to the pre-1976 level as determined by a 1975 survey map. One of the two settling ponds is planned for construction in this area. Because the settling pond will not have raised berm walls, its existence will not impede the flow of flood waters across the flood plain.

The raised roadbed (4') extending from the lowest ponds to the pump house would prevent Hakipu'u Stream flood waters from entering the Marsh, except through the 24-inch conduit leading from one settling basin. In addition to providing access to the pumphouse, this roadbed will also support the main saltwater lines from the pumps to the ponds.

b. Dependent Water-Bird Habitat

The new ponds and MARSH will be extended into existing wetland. These wetlands include areas of California Grass, Hau and Mangrove jungle. In total, these habitats will be reduced by about 50 percent on the site. A survey of birds resident on the site was made by Dr. P. Bruner (see Appendix D of the EIS) His conclusions are summarized here for completeness. These existing jungles, however, provide very limited habitat for important waterbird species and provide no recognizable habitat for any important fisheries species.

The proposed MARSH will have an overall positive impact on waterbird habitat. The open water areas created will not be cultured or subject to frequent harvest operations that typically disturb waterbirds around aquaculture ponds. Depending upon the final design and operation of the MARSH, open water areas could be relatively small (8' x 1000') with a rapid flow speed (0.3 ft/sec), or large (40' x 1000') with a minimal flow speed (0.3 ft/min), or they could vary between the two on a 6-hour cycle. Depending upon costing and final design, islands which act as safe nesting areas could be an integral part of the MARSH design.

Open wetland, with shallow water and appropriate low-lying foliage would promote use of the MARSH by shorebirds and other waterfowl. Removal of the relatively tall existing wetland jungle would enable waterfowl to establish flight patterns from the sea directly to the land. This is important if successful waterfowl breeding occurs in the MARSH or upper pond areas, because it allows feeding or escape access of on-site waterfowl to the adjacent open waters of Kaneohe Bay. Control of canopy height within the MARSH would preserve this flight path allowing escape lanes for waterbirds, fleeing Night Herons or predators.

Several plants proposed for the MARSH system would also serve as food to water fowl. The low growing wetland plants could provide protective habitat and possible nesting areas for birds. In addition, the anticipated stock of invertebrates that should thrive in the MARSH would provide an easily available source of food to birdlife.

c. Impact of pumps on ambient noise levels

Electric water pumps of the general size and type specified in chapter II of this report are not considered to operate above ambient noise levels. However, due to the concern about noise expressed by neighbors, the pump house will be designed to baffle any noise produced by pumps to within acceptable levels.

3. Effluent System

a. Undesirable Species Introduction

The aquaculture research facility has a potential for introduction of undesirable species to the environment from experimental studies. This facility, like other University research facilities, will hold experimental populations of a variety of species. Experiments will occur in aquaria and small tanks, as well as larger earthen ponds. Economically and scientifically important aquaculture species will include a mix of non-indigenous and indigenous organisms. The process of sustaining a viable aquaculture industry (as with the agriculture industry) will necessitate the introduction of new species. Escape of species is an import consideration for constructing and operating this facility.

There are numerous University and State of Hawaii guidelines and rules regulating the use of live specimens. Any aquaculture species used during investigations at the site will follow the internal and public review and approval procedures established by the State Department of Agriculture (DOA). Species selected for research at MRTC must meet the approval of DOA and experimentation must adhere to any conditions (e.g., containment engineering) placed on a permit. This process will manage the risk of unwanted introduction of non-indigenous species. As part of the review process, panels of experts will advise the DOA on biological and environmental impacts and potential risks arising from introductions.

Reducing the potential for organisms to escape from the facility has been considered in the conceptual engineering design of the facility. Moreover, loss of experimental species, indigenous and non-indigenous, is an unwanted result both from scientific, as well as environmental perspectives. The University will adhere to strict management and control procedures for the facility. For example, screens on all drains, predatory fish in the MARSH settling basin, 24-hour security at the facility, and periodic surveys of the MARSH and near-shore communities will be implemented.

The MARSH system, through which all effluent flows, will act as a direct barrier by virtue of its shallow channels, dense algae and plant mats, and barrier gate weirs. However, there is also the potential for animals or plants grown or established within the MARSH to become a constant source of recruitment to the bay. The extent of impact depends upon the species recruited. With endemic fish species or desirable algae species, additional recruitment would not be perceived as an adverse impact. However, if escaped organisms that are not currently of the Kaneohe Bay community, there could be cause for concern. Native predatory species introduced into the MARSH could act as an effective

filter for aquaculture species attempting escape through the MARSH. Regular cropping of the excess biomass and retention of a sustaining population or biomass would be prudent management of the MARSH.

b. Coral Reef Habitat

Water quality impacts from the proposed renovation will be dependent upon the functional efficiency of the MARSH system. Potential impacts to coral reefs fall into several categories (EPA, 1983; Carpenter & Maragos, 1989):

- Oxygen consumption

  The possibility of occasional discharge of water from the facility with low dissolved oxygen levels during early morning hours, may be regarded as a potential problem from aquaculture sites. Tropical marine systems are adapted to high environmental oxygen levels. Hakipuu Stream and Molii fishpond already introduce water with increased biological oxygen demand into this section of Kaneohe Bay. Although dissolved oxygen measurements do not indicate any present problems, it is remotely possible that additional nutrient loads or low oxygen water could exacerbate conditions to the detriment of local coral populations. The potential for release of low oxygen waters from the facility is minimized by the nutrient absorbing capacity, wide surface area and water current agitation within the MARSH system. The prevailing nearshore current and rapid mixing in the shallow nearshore waters of Kaneohe Bay also serve to minimize this potential threat.

- Sedimentation

  Various coral species are more, or less, sensitive to impact from silt. Sedimentation can cause damage to corals through light deprivation, enhanced bacterial growth, direct smothering, and long-term energy drain for sediment removal from the colony surface. Corals in Kaneohe Bay are tolerant to a relatively high amount of "natural" sedimentation from the surrounding watershed. Sediment load from the MARSH system is expected to be below background turbidity levels within the inner bay and is not expected to impact corals in the area.

- Chemicals

  Aquaculture pond management and experimental tank studies may require occasional use of chemicals. Any chemicals or wastes originating from the laboratories are to be disposed of through a separate drainage sewer system and are not perceived as a threat to the bay through the

MARSH. These chemicals range from common organic and inorganic fertilizers to feed ingredients and additives (e.g., binders and hormones) to disease treatment and prophylaxis (e.g., lime and copper sulfate). The use of chemicals in ponds is extremely restricted, primarily owing to the large volumes and cost involved. Further, aquaculture management practices do not allow for exposure of food organisms to many chemical compounds. Within the United States, very few chemicals or prophylaxis drugs are allowed to be used in the commercial growout or larval hatchery phases without stringent U.S. Food and Drug Administration approval. This facility will follow those guidelines.

In the laboratory, small aquaria or experimental tanks, chemicals may be used with greater frequency. The amount used is normally so small that it is insignificant relative to the effluent in the marsh. All chemicals used will be disposed by approved methods. As a University research facility, the use of stringent and potential environmentally hazardous chemicals is strictly controlled. The MARSH system is a biotic filter and environmental sink for potential chemicals used within the facility. The organisms in the MARSH should be able to tolerate diluted effluent coming from the aquaculture facility. MARSH systems in general are reported to have a substantial ability to absorb various chemicals (pesticides and heavy metals). Regular harvesting and removal of excess biomass or benthos from the MARSH would serve to prevent any bioaccumulation within the MARSH.

- Nutrification

Additional nutrients actually promote coral growth in areas conducive to coral growth with rapid water movement (Krock, pers communication). But in areas of low surge such as Kaneohe Bay, algae growth often exceeds coral growth, overgrowing and smothering coral colonies. The MARSH is a plant-based system designed to extract inorganic nutrients from the water. In this process, however, complex organic nutrients will be released into the water through biodegradation of plant materials, plankton, and metabolic products from MARSH inhabitants. Regular maintenance of the MARSH system by cropping of excess biomass will control potential nutrification impact.

c. Potential for noxious odors

Unpleasant odors are commonly associated with sewage processing facilities and with natural marsh lands. The methane or hydrogen sulphide smell associated with sewage plant operation is a product of anaerobic digestion of waste products. However, the MARSH is designed to be aerobic through the use of

shallow beds, fluctuating water level and rapid water flow rate. If the MARSH were allowed to run at its full level for longer than several months, substrate sediments may become anaerobic. If the water level were then dropped again exposing the sediments, then methane and hydrogen sulfide gasses could escape into the air at detectable levels. However, under normal operating conditions, the production of noxious odors from the MARSH system will be less than from the existing wetland. Unless the system is overloaded with anaerobic sediments from a fouled pond, it should not emit noxious fumes.

d. MARSH habitat for mosquitos, rats or other undesirable species

The production of nuisance animals from the MARSH system is anticipated to be less than from the existing wetland. The MARSH system will not provide extensive foliage canopy habitat for rodents. The water systems will not harbor standing or stagnant water which could provide habitat for mosquitos or other nuisance animals.

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APPENDIX G

GROUNDWATER STUDY

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APPENDIX G

MRTC GROUNDWATER STUDY

Prepared for:
Department of Land and Natural Resources
Division of Water and Land Development

NOVEMBER 1992

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EXECUTIVE SUMMARY

The Mariculture Research and Training Center (MRTC) is an existing aquaculture facility located at the northwest corner of Kaneohe Bay. The proposed action will create more, but smaller ponds, and develop support facilities to include an office/classroom/laboratory building, a maintenance facility, a hatchery, and dormitories for graduate students and caretaker. Proposed upgrades of the MRTC will require an increase in demand for fresh water.

Average fresh water requirements for the facility are estimated to be 500 gallons per minute or 720,000 gallons per day. Although Hakipuu Stream runs adjacent to the project site, this resource will not be taped for the expanded facilities because of its present use for irrigation in neighboring agricultural plots.

Groundwater in the region was investigated as an alternate source of fresh water. Water for the MRTC may be obtained from two sources; the local/shallow aquifer or the deep, Koolau-Dike Aquifer. Water within the shallow aquifer will not support the 500 gallons per minute (GPM) flow requirement due to its small recharge area. However, the Koolau-Dike Aquifer, which originates in the Koolau Range, contains large amounts of water. The potential to tap this water body is high as the project site lies above this aquifer.

There are no existing deep wells in Hakipuu Valley. However, existing wells in adjacent valleys all tap sources within the Koolau-Dike Aquifer. Because this deep aquifer is a dike complex of unpredictable structure, a hydrogeological investigation of the region, including the project site, is recommended to determine capacity and location of potential fresh water well(s).

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I. INTRODUCTION

A. BACKGROUND

The University of Hawaii's Mariculture Research and Training Center (MRTC) is an existing aquaculture facility located at the northwest corner of Kaneohe Bay on the windward side of Oahu. Hakipuu Stream runs adjacent to the project site.

The Department of Land and Natural Resources proposes to renovate the entire facility to create more, but smaller ponds, and develop support facilities including an office/classroom/laboratory building, a maintenance facility, a hatchery, and dormitories for students and caretaker.

B. OBJECTIVES

Proposed upgrades of the existing facility will constitute an increase in demand for fresh water. Current demand for aquaculture fresh water is approximately 100 gallons per minute (GPM). Fresh water requirements after facility renovation are estimated to be between 200 and 900 GPM. Initial estimates indicate that an average use of approximately 500 GPM or 720,000 gallons per day (GPD) is reasonable for a research facility with 7¼ acres worth of pond area operating with fresh water flow. The additional 400 GPM requirement above the average is to provide for emergency pond flushing. The cost to obtain fresh water and results of a hydrogeological survey will determine final fresh water quantity requirements.

This report looks into the availability of groundwater in the Hakipuu Valley for MRTC as it is considered to be the primary source for the fresh water. Because Hakipuu Stream water is used for irrigation in neighboring agriculture plots, the present quantity of stream water can not yield the projected MRTC requirement of fresh water. Groundwater, however, is considered to be abundant beneath the project site. Water for the MRTC facility may be obtained from either the local (shallow) aquifer or the deep aquifer. Both possibilities are investigated in this report.

C. SITE DESCRIPTION

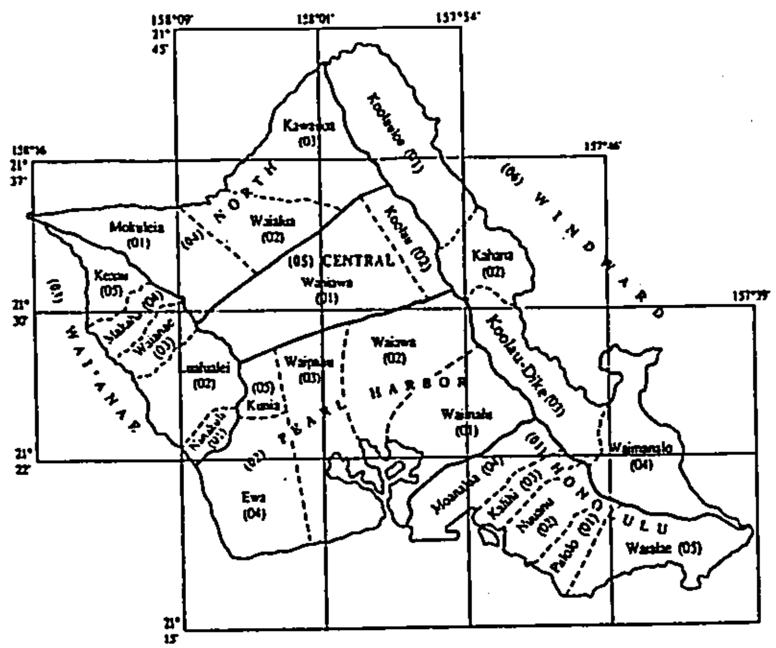
The MRTC facility is located on the coastline alluvial fan of Hakipuu Valley. A major portion of the watershed lies mauka of the facility across Kamehameha Highway. Most of the 28.3-acre project site consists of unconsolidated noncalcareous deposits overlaying Koolau basalt. A portion of project site abutting the highway is consolidated noncalcareous deposits (Stearn, 1939).

The project site is on a slight slope at the bottom of the alluvial fan. The altitude ranges from 35 feet at Kamehameha Highway and slopes down to sea level. Groundwater locally recharged by rainfall in the area is assumed to flow towards the

the valley that could potentially affect groundwater flow.

Hakipuu Valley lies on the Koolau-Dike Aquifer Complex, which is a deep, large water body spread over the windward area (see Figure 1). This aquifer is confined at the coast by caprock and contains artesian water (Takasaki, 1969). A typical cross section of the windward side of the Koolau Range aquifer system is shown in Figure 2. Stream flow into this system is typically from dike springs. However, due to the characteristics of the old alluvial valley and from on-site observations, the facility may sit on a two layered aquifer. The upper layer is a local aquifer or shallow aquifer, while the lower layer is part of the deep aquifer complex described above. The Koolau-Dike Aquifer will be referred to in this report as the deep aquifer. Because of the low elevation, soil type and proximity to sea level, the water table is quite high near the surface of the project site. The water level ranges from approximately ten feet below the surface at the highest point to ground level at several locations around the site. The water table of the shallow aquifer (upper layer) is close to the surface of the ground. As a result of groundwater seepage into the streambed, water volume increases in Hakipuu Stream as one moved seaward.

The local/shallow aquifer is probably not confined and its source is limited to local rainfall. The Hakipuu Stream is a discharge from this aquifer. This aquifer lies on top of the salt water due to the proximity of the site to the coast. The amount of water to be extracted from this aquifer without adverse effects on the environment can be estimated by calculating the water budget for Hakipuu Valley.



(01) AQUIFER IDENTIFICATION NUMBER

(Mink and Lau, 1990)

FIGURE 1. LAYOUT OF AQUIFER SECTORS FOR OAHU

MRTC GROUNDWATER STUDY

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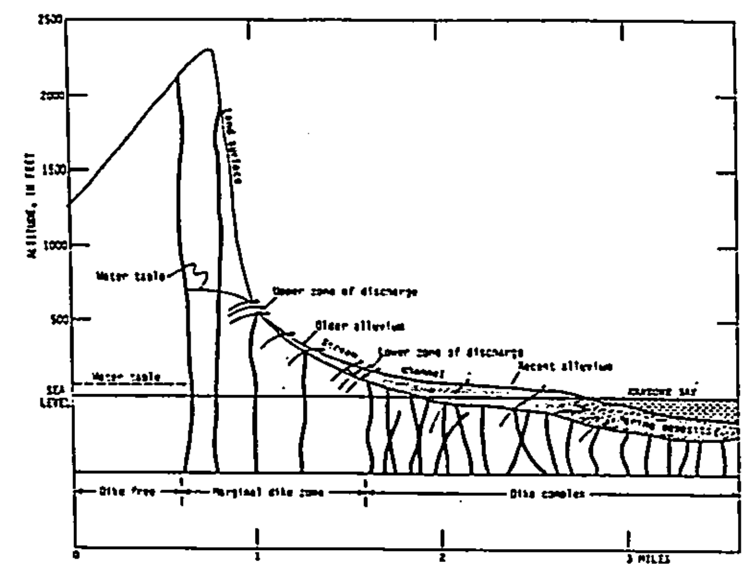

FIGURE 2. TYPICAL CROSS SECTION OF KOOLAU RANGE, WINDWARD SIDE

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II. METHODS

A. LOCAL/SHALLOW AQUIFER

The potential groundwater recharge rate was estimated by calculating the water budget for Hakipuu Valley. Recharge rate is the amount of water input to groundwater within the region. When discharge of groundwater is greater than recharge, depression of groundwater storage and other adverse environmental impacts may occur.

1. Recharge Area

The subsurface groundwater flow direction is assumed to be perpendicular to topographic contour lines. The area of direct recharge into the project site was determined based on groundwater flow lines (see Figure 3). The groundwater flows down to areas of lower elevation, then discharges as surface water or into a stream. Groundwater flow that crosses into the stream is not factored into the water budget calculations as Hakipuu Stream will not be used as a fresh water source for the project.

2. Recharge Rate of the Site

Mean annual regional groundwater recharge of the shallow aquifer was obtained from the water balance equation as follows:

Recharge = Rainfall - Direct runoff - Evapotranspiration

Annual rainfall, runoff/rainfall ratio, and annual pan evaporation data were obtained from a report by Shade (1991). A pan coefficient of 1 was recommended to estimate potential evapotranspiration. This yields a mean annual evapotranspiration rate of approximately 60 inches.

Mean annual runoff water was subtracted from rainfall to yield the amount of surface water available for groundwater recharge. This number does not reflect flood conditions during rain storms.

Maximum possible pumping rate from the local aquifer was estimated using the recharge volumes obtained from the water budget analysis.

B. DEEP AQUIFER

Investigating the potential of the deep aquifer (Koolau-Dike Aquifer) as a source of fresh water consisted of interpreting existing data from federal (United States Geological Survey, Well Log. Eyer, 1992.), and county (Kawata, 1992) agencies and

several publications (Board of Water Supply, 1989. United State Geological Survey, 1985. Miyamoto et al, 1986. Stearn, 1939. Takasaki et al, 1969. Fetter, 1988. Stearn and Vaksuik, 1938.) Information from these reports was integrated as they apply to the specific area of Hakipuu Valley.

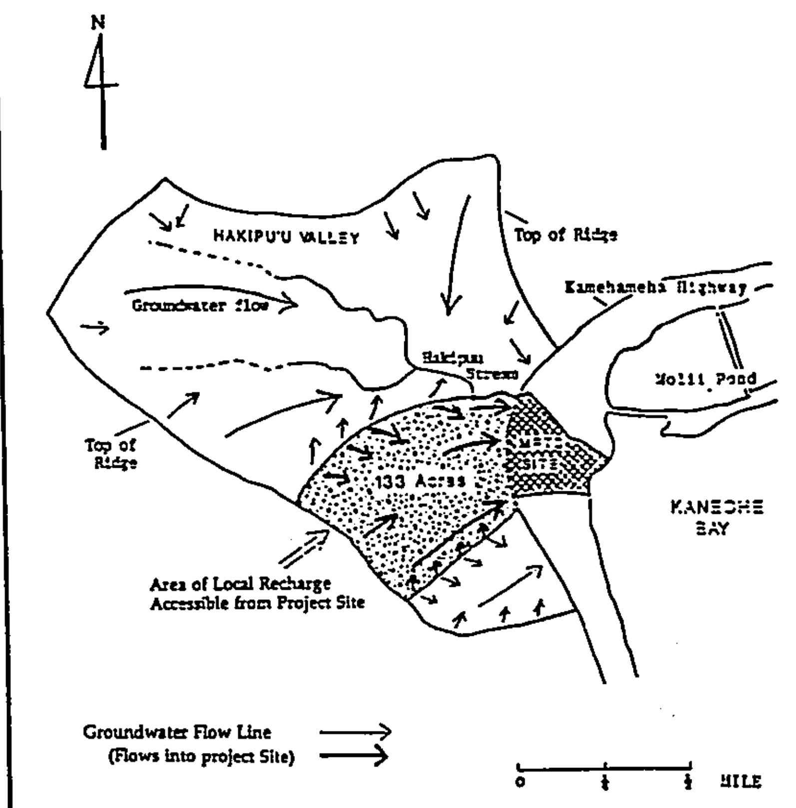

FIGURE 3. LOCAL RECHARGE BOUNDARY

MRTC GROUNDWATER STUDY

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III. RESULTS

A. DIRECT RECHARGE (LOCAL/SHALLOW AQUIFER)

Mean annual rainfall, pan evaporation and runoff data are given in Table 1.

TABLE 1.
ANNUAL CLIMATE DATA (Shade, 1991)

	RAINFALL in/yr	PAN EVAPORATION in/yr	RUNOFF PERCENT	RECHARGE
Maximum Rate[1]	90	65	9 %	16.9
Minimum Rate	60	35	9 %	19.6
Weighted Average[2]	70	60	9 %	3.7

The total recharge area within Hakipuu Valley is 133 acres (5.8×10^6 ft^2 [see Figure 3]). The project site boundary facing groundwater flow is 1,770 feet long. By utilizing these numbers and the weighted average of rainfall/evaporation rate, mean annual average recharge rate per unit area was determined to be between 3.7 and 19.6 inches per year (1.4 to 7.4×10^7 gallons per year). This yields a mean recharge volume of 27 to 143 gallons per minute (GPM) over the local recharge area for the project site. Therefore, the total mean flow rate of the shallow aquifer onto the project site across the entire 1,770 feet long boundary is only 27-143 GPM. Only a fraction of this amount may be extracted from the aquifer without adverse impact on the shallow groundwater regime, due to anticipated depression of groundwater storage. It is evident that the shallow aquifer cannot provide the minimum 200 GPM requirement for the facility.

B. WELL DRILLING (DEEP AQUIFER)

Because the availability of shallow fresh groundwater is very limited on-site,

[1] Rainfall rate and evaporation rate do not correspond. Generally, low evaporation rate occurs at high rainfall rate area.

[2] Weighted average based on spatial distribution of individual event.

groundwater from the deep aquifer should be considered as a possible source.

Deep wells (120-200 feet) could tap the deep aquifer as evidenced by wells of this depth in adjacent valleys. There are no existing wells within Hakipuu Valley. Table 2 lists existing wells in neighboring areas. Figure 5 shows the approximate location of these wells and other natural features. The wells all tap sources within the Koolau-Dike Aquifer.

1. Water Body Boundary

Based on soil distribution and topographic features, valleys within the Koolau-Dike Aquifer area are geologically similar. Volcanic rock structures within the Koolau-Dike Aquifer are generally very permeable due to their porous structure. Some dikes below the ridge of Puu Ohulehule, at the southern end of Hakipuu Valley, may change groundwater flow direction and may impede local recharge. There are no known dikes at the northern end of the valley except at higher elevations. Therefore, it is likely that the deep aquifer is continuous along the coastal area under ridges perpendicular to the coast. The potential to tap the deep aquifer is discussed in the next section.

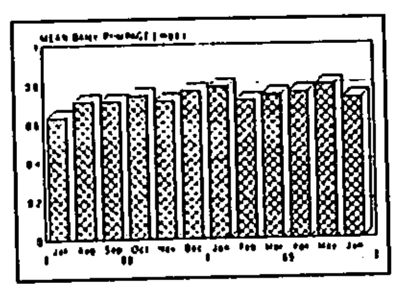
2. Existing wells

Pumpage and drilling records of existing wells may be used to approximate the potential pumpage and depth of a new well. The following is information gathered from our investigation.

- As shown in Table 2, wells in adjacent Waikane Valley (No. 1 to 5) were dug for domestic use. Those wells vary from 120 feet to 197 feet below sea level with casings 28 to 90 feet deep. Well locations are shown in Figure 5.

- The well in Kahana Valley (No.7) supplies water for the Board of Water Supply (BWS). The mean daily pumpage from these wells are 0.73 million gallons per day (MGD) (BWS, 1989), which is approximately equivalent to the MRTC

FIGURE 4.
MEAN DAILY PUMPAGE
OF KAHANA WELL



requirement of 0.72 MGD. Figure 4 shows the monthly distribution of pumpage for the Kahana well. The Kahana well, located two valleys distant from the project site, draws water from the Koolau-Dike Aquifer (Miyamoto, 1986). A determination has not been made as to whether drawdown of the Kahana well is affecting the aquifer storage or whether water remains available to fulfill the MRTC requirement for fresh water. Further study is recommended.

- Two wells in Waihee Valley (not shown) are utilized by BWS as an alternate water source for Kualoa Regional Park and the north Kaneohe area when Kahana Well is not operable. The current pumpage of Waihee Wells is minimal (BWS, 1989).

TABLE 2.
EXISTING WELLS AROUND HAKIPUU AREA

No.	USGS#	Alt. ft.	W.tab ft.	Wldep ft.	Cadp ft.	Use	Status	Owner	Year	Dia. in.
-	3285001	27	NO WATER	40	6	--	D	E LEE	1943	10
-	3285002	30	NA	60	48	D	W	YEE & CHING	1947	8
1	3285003	32	18.9	120	28	U	U	L WONG	1949	8
2	3285004	19	9.2	180	62	D	W	J AKIMA	1949	8
3	3285005	25	19.3	197	62	U	U	O PADEKEN	1949	8
4	3285006	27	7.9	191	66	U	U	H KANESHIRO	1949	8
5	3285007	13	7.3	160	90	U	U	D NG	1949	8
6	3325101**	11	--	500	--	I	W	F SWANZY	1896	--
7	3335201	11	5.0	441	177	D	W	FOSTER ES.	1932	16
-	3345201	6	8.6	163	50	U	U	BISHOP ES.	1937	12
-	3345301	70	18.1	530	433	P	W	BWS.HON.	1974	16
-	3345307	62	17.7	560	180	P	W	BWS.HON.	1974	16
8	3335301	35	18.0	520	274	P	W	BWS.HON.	1973	16
9	3335302	94	24.6	521	321	P	W	BWS.HON.	1973	16
10	3335303	101	119.7	600	240	P	W	BWS.HON.	1973	16
11	3335304	101	87.5	600	300	P	W	BWS.HON.	1973	16
-	3275102	192	--	348	62	P	W	BWS.HON.	1972	12
-	3275103	198	--	343	144	P	W	BWS.HON.	1972	12

Usage
D Domestic
U Unused
I Irrigation
P Public

Status
D Destroyed
W Withdrawal
U Unused

Alt. = Altitude
W.lev. = Water level above mean sea level (MSL)
Wldep = Well depth
Cadp = Casing depth. (For casing materials, refer individual well log.
Dia. = Diameter

** This well taps in KAHUKU aquifer.
-- Indicates data lost/unreported.

SOURCE: MIYAMOTO, 1986.

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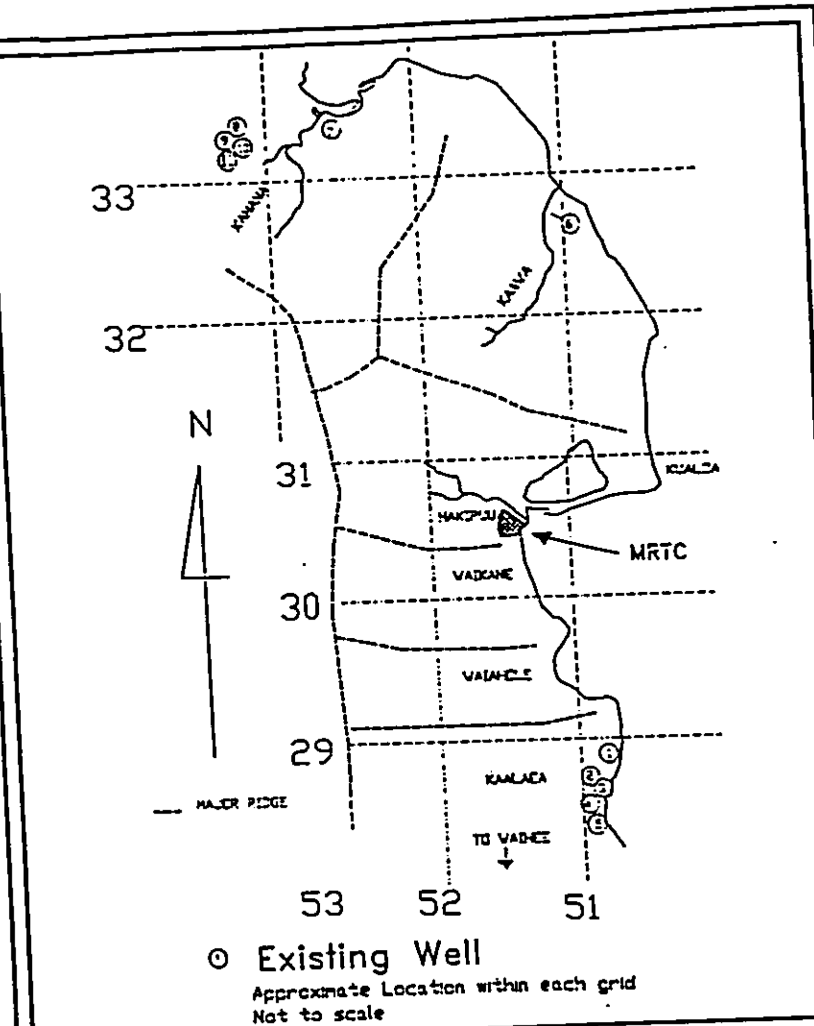

FIGURE 5. EXISTING WELL LOCATIONS

MRTC GROUNDWATER STUDY

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IV. RECOMMENDATIONS

The projected MRTC fresh water requirement cannot be obtained from the shallow aquifer without causing adverse impacts to the local, shallow water regime and Hakipuu Stream.

Our investigation indicates that 500 gallons per minute of fresh water can be obtained from the deep aquifer, also known as the Koolau-Dike Aquifer. However, there is no data available for Hakipuu Valley to estimate the depth wells must be drilled, and the amount of pumpage available per well to fulfill the fresh water requirement. Therefore, a hydrogeological investigation, including at least two on-site test wells, is recommended to estimate the water source potential of Hakipuu Valley.

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APPENDIX H

ENGINEERING REPORT

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APPENDIX H

MARICULTURE RESEARCH AND TRAINING CENTER
KUALOA, OAHU, HAWAII

PRELIMINARY ENGINEERING REPORT

Prepared for:
State of Hawaii
Department of Land and Natural Resources
Division of Water and Land Development

January 1993

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I. INTRODUCTION

This report addresses the planning and preliminary engineering concepts for redevelopment of the Mariculture Research and Training Center of the University of Hawaii, at Kualoa, Oahu, Hawaii. Engineering activities (grading, construction, drainage, and runoff) and infrastructure requirements (power, potable water supplies, communication facilities, and solid and wastewater disposal) are discussed in this report. Existing conditions, potential impacts, and mitigative measures to be undertaken are also discussed. Operational needs (fresh and salt water supply), circulation and disposal of used pond water are discussed in Appendix F.

A. SITE CONDITIONS

The University of Hawaii's Mariculture Research and Training Center (MRTC) is located on the windward side of Oahu at the extreme northwest corner of Kaneohe Bay and adjacent to Hakipuu Stream (see Figure 1). The Department of Land and Natural Resources - Division of Water and Land Development proposes to renovate the existing facility to facilitate technological advances in aquaculture. The 28.3 acre site is leased from Kualoa Ranch, Inc. and is defined by Tax Map Key 4-9-01:parcels 11,12,19,31,32 and portions of 14 and 18.

The site is bounded on the west by Kamehameha Highway, and on the east by the Kaneohe Bay shoreline. Hakipuu Stream acts as the boundary on the north, while the south boundary consists of taro farms and residential parcels. The property slopes at a steep angle at the southern end from the highway to the existing ponds. The highway abuts the west side of the property and is relatively flat. The strip of land between the seaward ponds and the shoreline is low lying and marshy most of the year.

B. PROPOSED FACILITIES

The proposed facilities consist of a hatchery, an office, a laboratory, and maintenance facilities and will also provide accommodations for a manager, graduate students and visiting researchers.

The aquaculture facilities will consist of 2 half-acre ponds, 17 quarter-acre ponds and 20 tenth-acre ponds. The dikes for the ponds will be of earthen construction with a bank slope of 1:3. One tank farm consisting of 10 to 20-foot diameter circular tanks is included in addition to the ponds. Inflow, outflow and salinity of the water in each pond will be controlled independently. Ponds will be supplied with water from both fresh and salt water distribution systems. Fresh water is recommended to be obtained from a well(s) drilled sufficiently inland from the shoreline. Salt water will be obtained

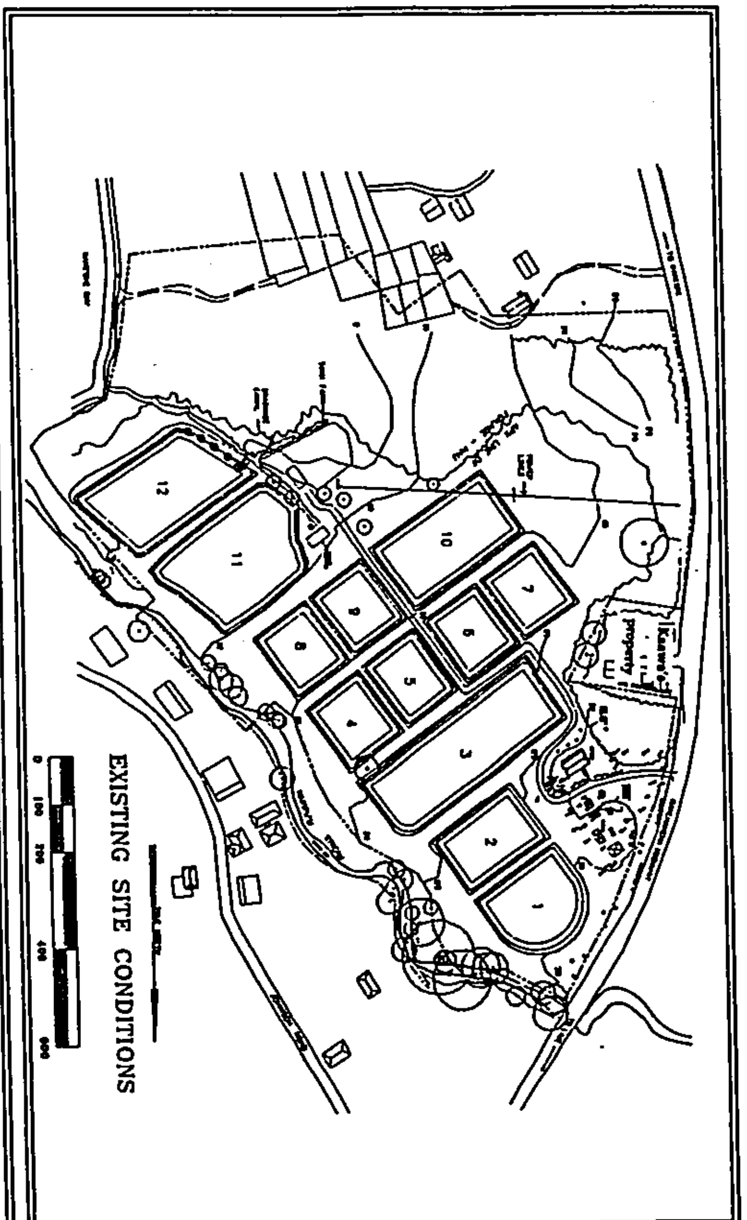

FIGURE 1. EXISTING SITE SCHEME

Mariculture Research and Training Center

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from Kaneohe Bay. Pipelines, channels and pumping equipment will be installed for both water distribution and disposal of used water. Each pond will have a central outflow pipe connecting to one of several harvest stations. The harvest stations will direct water through a common channel to settling basins and a designed effluent disposal marsh.

Pond effluent will be discharged into the settling basins to remove particulate matter and then directed to a marsh designed to further remove particulate matter and a major fraction of nutrients. The spent effluent will eventually be discharged into Kaneohe Bay.

II. DRAINAGE, RUNOFF AND CONSTRUCTION ACTIVITIES

Engineering concepts for drainage and runoff, particularly during construction of the proposed renovation of MRTC, are discussed in this section.

Topography at the site varies from +45 feet (MSL) Mean Sea Level at Kamehameha Highway on the west boundary to sea level at Kaneohe Bay. The slope of land from the highway to the existing ponds varies from 3 to 10 percent, and is steepest at the southern boundary. The remaining land is below +15 feet MSL and is currently terraced for pond construction. Low lying land outside of the ponds is water saturated most of the time. The area is subject to 10-year floods as noted in Figure 2.

A major portion of the project area consists of ponds at present and does not contribute to runoff. The balance area has adequate vegetative cover to prevent build-up of high water velocities. The average annual rainfall is about 55 inches, most of it occurring during the rainy season (November to March). Average ratio of runoff to rainfall is 0.09, or about 5 inches. Runoff water from the existing parking lot and office building drains into pond 3 which is located just down slope. Runoff reaching Kamehameha Highway upgradient of the site is directed through a storm drain into Hakipuu Stream. Most of the storm water runoff from Mr. Kaawa's yard flows into pond 7 (see Figure 1). Runoff from the vegetated area by the southern boundary flows down into the low lying water-logged area. The capacity of the ponds are sufficiently large to accommodate runoff into the ponds without overflowing.

A. GRADING, CONSTRUCTION ACTIVITIES AND MITIGATION

Trenching for building foundations, excavation of ponds and wetlands, and construction of dikes to contain water will involve earthwork over much of the project. Some short-term environmental impacts are anticipated from these activities.

Clearing, grubbing and grading will be accomplished in phases to limit the extent of land exposed at any given time. Fugitive dust generated during construction will be mitigated through compliance with the State of Hawaii Department of Health Rules and Regulations (Chapter 43, Section 10) which stipulates that control measures be employed to reduce fugitive dust. Primary dust control consists of frequent spraying of loose soil areas with water.

An erosion control plan designed to prevent erosion of sloped areas and sedimentation of adjacent areas must be approved by Department of Public Works (City and County of Honolulu) and adhered to during the grading activities. Construction methods used shall comply with all applicable City, State and Federal regulations and standards. The contractor will take all necessary steps to control erosion and dust during the grading and construction phase.

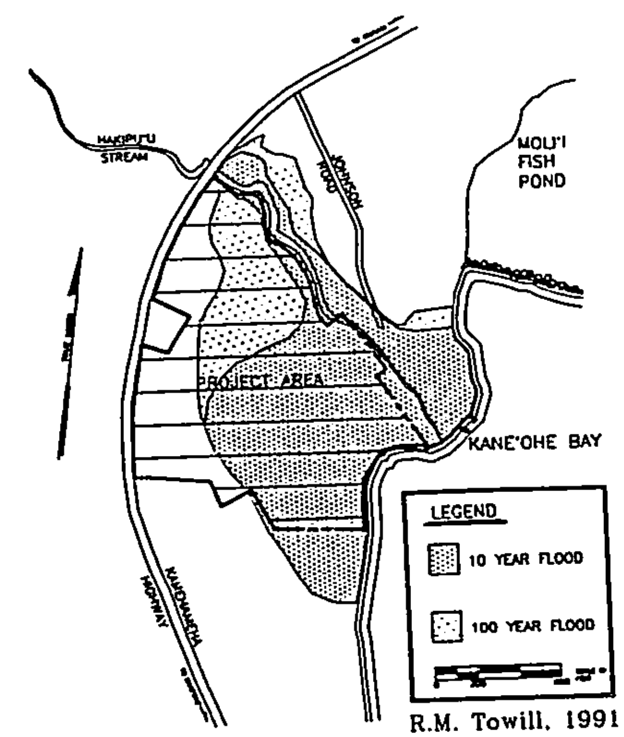

FIGURE 2. FLOOD ZONE MAP

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Other negative impacts from construction activity shall be mitigated by several measures. All slopes will be planted with appropriate vegetation as soon as grading is completed. All equipment on-site shall be provided with mufflers and operated only during normal working hours.

B. DRAINAGE ALTERATIONS FROM DEVELOPMENT

Two alternate layout schemes were developed for the MRTC. Both plans essentially provide the same structures, but the position and orientation of the buildings and the ancillary facilities relative to the mariculture ponds are varied. These alternatives are shown in Figures 3 and 4.

The total water area and pond elevations are the same in both alternatives. Both schemes include the pond effluent disposal system which clarifies and de-nutrifies effluent from the ponds before discharge into Kaneohe Bay. The total area of exposed water in the proposed MRTC renovation is greater than that of the existing scheme. Overall runoff volume in the lower area is reduced due to trapping of more rain water in ponds. An increase in buildings and paved areas in both alternatives is expected from the present configuration. Construction of the parking lots and other structures in the higher vegetated area will cause a slight increase in runoff. Most site runoff will flow into the ponds where it will pass through the pond stand pipe drains and into the effluent marsh. Should an extremely high rainfall cause the ponds to overflow, water will cascade down to lower level ponds and eventually into the effluent marsh.

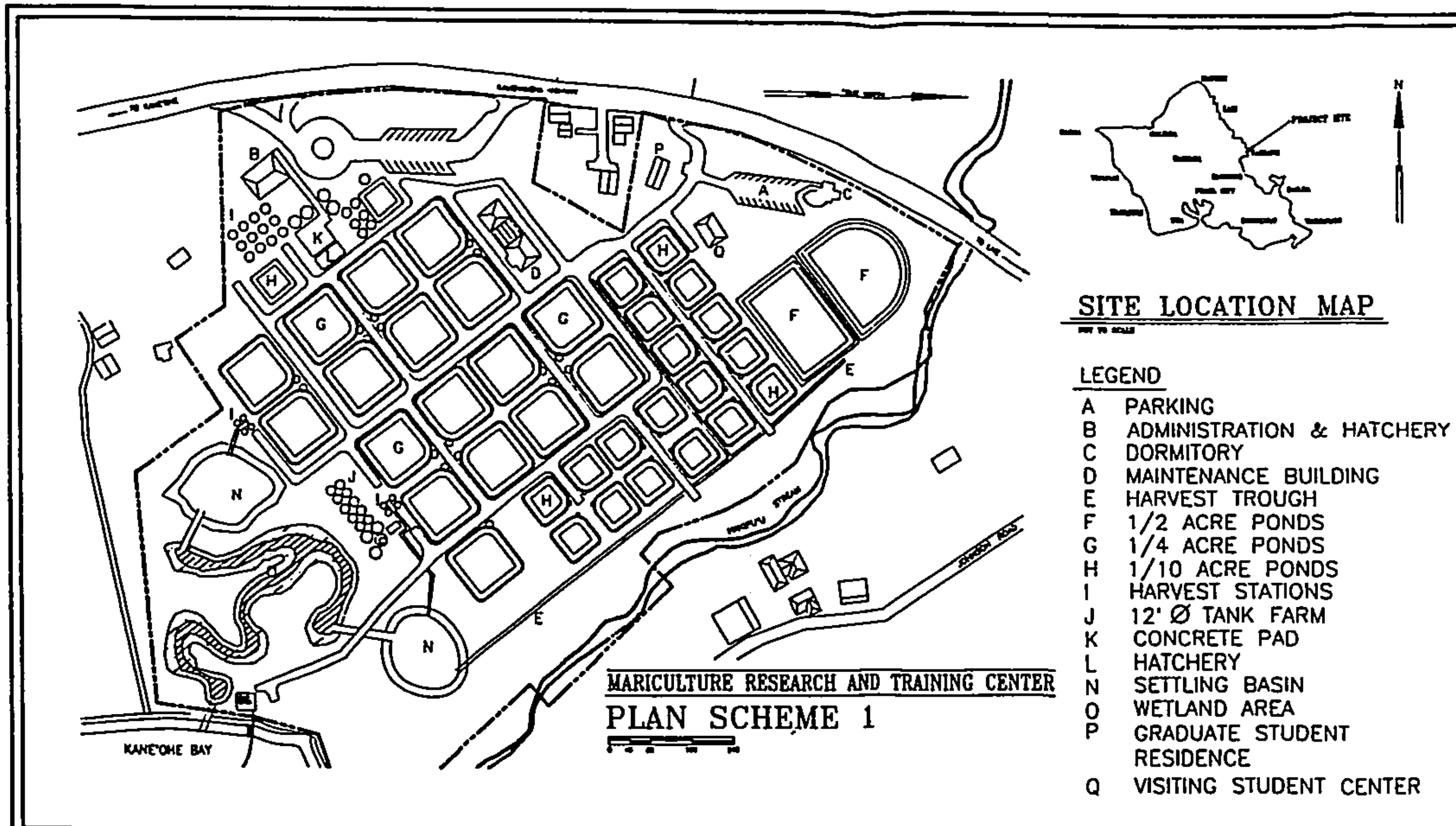

FIGURE 3. FACILITY LAYOUT – SCHEME 1

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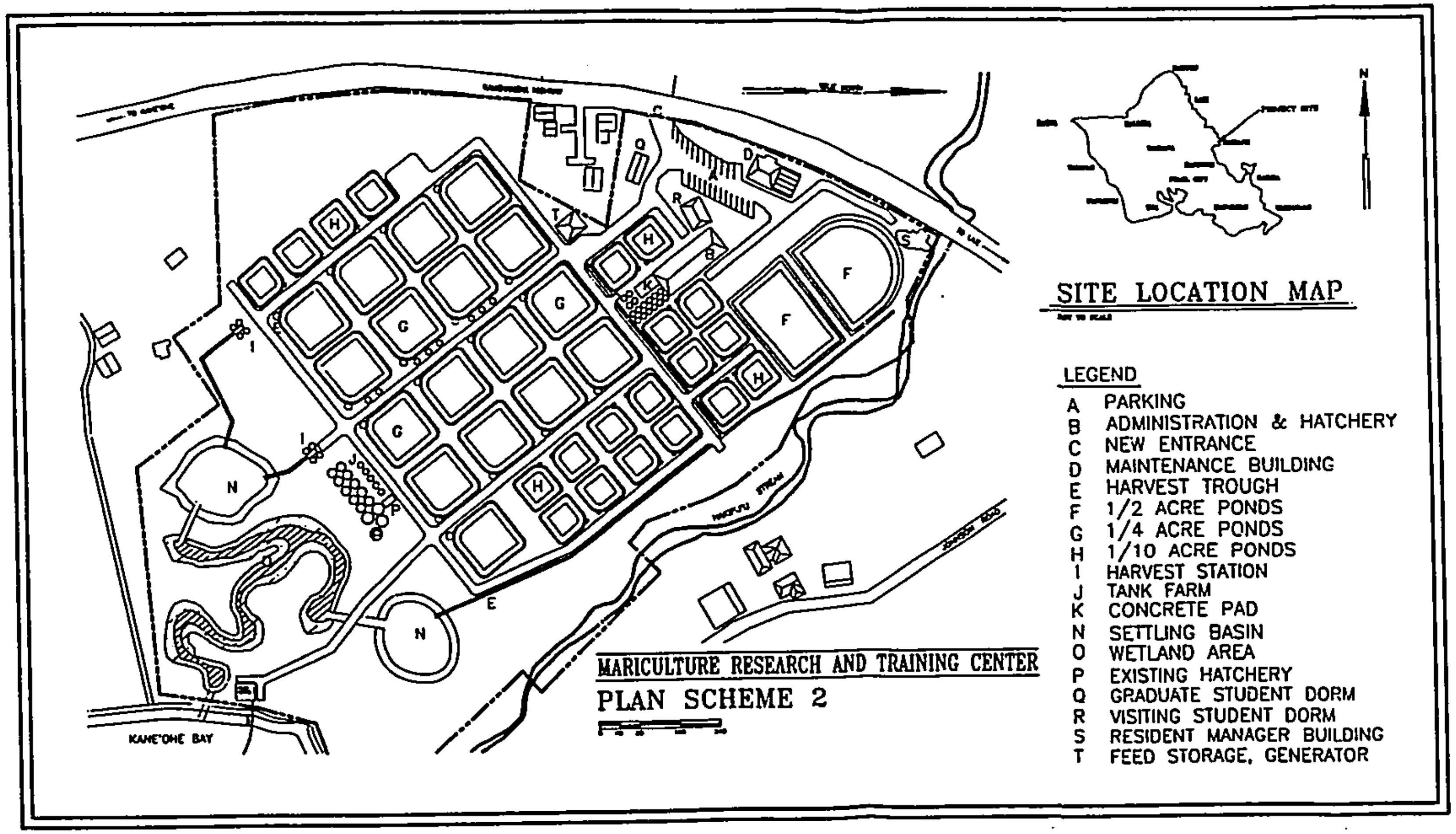

FIGURE 4. FACILITY LAYOUT – SCHEME 2

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III. INFRASTRUCTURE

A. POTABLE WATER SUPPLY

Existing facilities, which require potable water, include the office, the workshop and the resident manager's house. Potable water is supplied by a 30-inch water main under Kamehameha Highway. Two water lines connect the facility to the water main; 1-inch and 2-inches in diameter. The 2-inch line is disconnected. The water demand, prior to renovation, is approximately 600 gallons per day.

The proposed renovation will require potable water for the main building, dormitory, hatchery, resident manager's home, and maintenance buildings. The projected maximum daily demand for potable water is approximately 2,000 gallons. According to the City and County of Honolulu Board of Water Supply, the present capacity of the water main is sufficient to accommodate this additional requirement. There will be no use of public city water for aquaculture.

The facility will connect to the 30-inch main through a 2-inch pipeline. One-inch lines will connect the dormitory, office and maintenance building to the 2-inch supply line. Significant impacts on the existing water supply system in the area are not anticipated due to only a slight increase in demand.

Fresh water needs and sources for aquaculture and the hatchery are discussed in Appendix G - Groundwater Study.

Salt water requirements and the proposed supply scheme are found in Appendix F - Conceptual Water Supply System and Marine Environmental Assessment along with a complete discussion of the designed marsh effluent disposal system or Marine Aquaculture Reclamation System Habitat (MARSH).

B. ELECTRICITY AND TELEPHONES

Hawaiian Electric Company feeder lines are located along Kamehameha Highway. Existing power demand is composed of lighting and domestic requirements for the office and for operating fresh and salt water pumps. At present, a 37 KVA transformer supplies electricity to the site.

The proposed facility will require an average power supply of about 60 KVA with both water systems running at average capacity. Hawaiian Electric Company officials have stated that the existing infrastructure facilities can handle up to 60 KVA without modifications. However, any additional load would require upgrading of the transformer. Since peak loads may be in excess of the present capacity of the system, installation of a higher capacity transformer is anticipated. Action will be taken with

Hawaiian Electric Company to upgrade the power supply in order to mitigate any impacts to other users.

Of the six telephone lines connected to the facility, five are used. An increase in telephone connections is not anticipated. Two telephone lines to the office and one line each to the dormitory, managers office, hatchery, and maintenance office will be provided in the new facility.

C. SEWAGE AND SOLID WASTE DISPOSAL

There is no connection at present to the main sewer system. Sewage and wastewater is disposed into a septic tank.

A greater amount of sewage from the proposed facility is anticipated due to increased numbers of workers, researchers and students living in the dormitories. A small sewage treatment facility capable of handling the anticipated sewage load will be incorporated into the final design.

Solid waste from the site is collected by the City and County of Honolulu. At present, disposal facilities are limited. Excess and large waste material is transported to the Kapala land fill by MRTC employees.

The amount of solid waste generated at the site will increase by about 50 percent upon completion of development. Existing methods of disposal are anticipated to be used after the renovation.