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OFC. OF ENVIRONMENTAL
QUALITY CONTROL
JOHN WAIHEE
GOVERNOR

August 4, 1989

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

Dear Mr. Hayashida:

Based upon the recommendation of the Office of Environmental Quality Control, I am pleased to accept the Final Environmental Impact Statement for the Waialua-Kahuku Regional Water System Improvements, 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 whether the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under 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 proposing agency to weigh carefully whether the societal benefits justify the environmental impacts which will likely occur. These impacts are adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis of the proposed action.

With kindest regards,

Sincerely,

John Waihee
JOHN WAIHEE

cc: Dr. Marvin T. Miura

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**WAIALUA - KAHUKU REGIONAL
WATER SYSTEM IMPROVEMENTS**

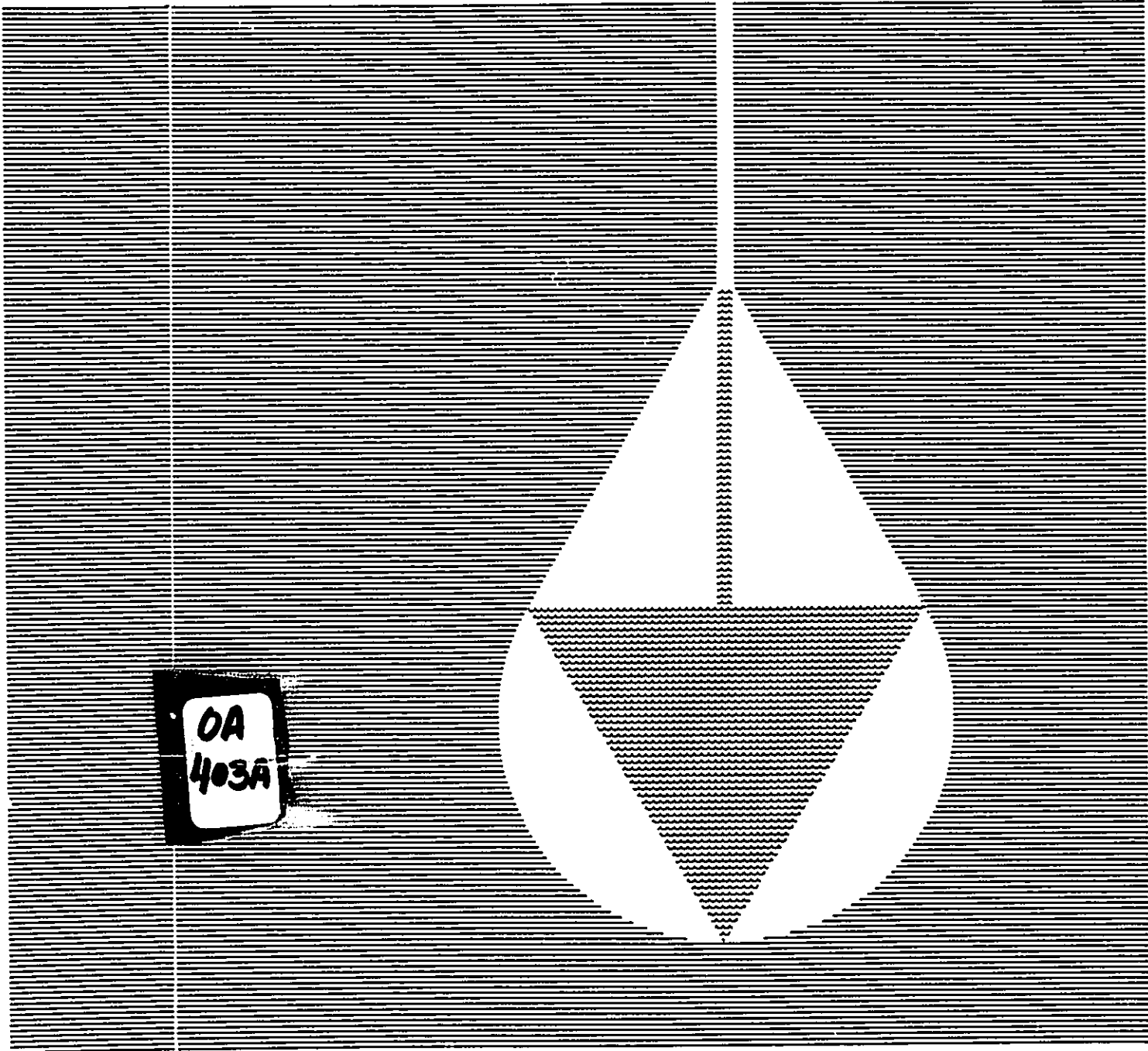
FINAL ENVIRONMENTAL IMPACT STATEMENT

prepared for:

BOARD OF WATER SUPPLY CITY & COUNTY OF HONOLULU

prepared by:

WILSON OKAMOTO & ASSOCIATES



DUPLICATE

Edna Wasgrew

~~Printed name due 03/29/91~~

CITY AND COUNTY OF HONOLULU
BOARD OF WATER SUPPLY
FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR
WAIALUA - KAHUKU
REGIONAL WATER SYSTEM IMPROVEMENTS

THIS ENVIRONMENTAL DOCUMENT IS SUBMITTED

PURSUANT TO CHAPTER 343, HRS

PROPOSING AGENCY: Board of Water Supply
City & County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

ACCEPTING AUTHORITY: Governor, State of Hawaii

Board Members:

Donna B. Goth, Chairman
John K. Tsui, Vice Chairman
Sister M. Davilyn Ah Chick, O.S.F.
Edward Y. Hirata
Alfred J. Thiede
Ernest A. Watari
Maurice H. Yamasato



KAZU HAYASHIDA
Manager and Chief Engineer

Date: 9/29/88

PREPARED BY: WILSON OKAMOTO AND ASSOCIATES, INC.
Planners, Engineers, Architects
Honolulu, Hawaii

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PREFACE

This environmental document is prepared pursuant to requirements of Hawaii Revised Statutes, Chapter 343, and the Environmental Impact Statement Rules.

This document discloses environmental impacts related to water facility proposals presented by the City and County of Honolulu Board of Water Supply. A group of proposed actions are treated as a single action pursuant to the Department of Health's Title 11, Chapter 200, "Environmental Impact Statement Rules".

I. SUMMARY

I. SUMMARY

PROPOSING AGENCY: Board of Water Supply, City and County of Honolulu

PROPOSED PROJECT: Regional Water System Improvements at Waialua and Kahuku, Hawaii

I. PROPOSED ACTION

This environmental document addresses various proposed Board of Water Supply (BWS) projects located within the Waialua-Kahuku Water Use District on the Island of Oahu. These projects include development of new water sources and transmission and storage facilities. This environmental document may be accepted in whole or in part, to fulfill requirements of Chapter 343, Hawaii Revised Statutes, for the individual water improvement facilities described herein. For those projects which may require further disclosures, addendum material may be supplied through preparation of supplemental environmental impact documents.

The following summarizes the proposed water system improvements.

Source Development: Wells will be developed to provide potable water for domestic use. Facilities associated with well development include the well, pump, control building and required transmission lines to connect the new source to the existing water system.

Reservoirs: Proposed reservoir facilities will increase the overall storage capacity of the system to meet projected needs and provide a more reliable supply of water within the affected service area. The added storage capacity will enhance the capability of the water system to meet peak demands or emergencies.

Transmission Lines: Proposed transmission mains will increase transmission capacities to meet projected need and provide redundancy in the distribution system. Redundancy increases the reliability of the system.

II. THE REGIONAL ENVIRONMENT

The proposed water facility improvements are within the 140 square miles delineated by the Waialua-Kahuku District in the northwest sector of Oahu. Bordering the shoreline, the district extends eastward from Kaena Point to Kaiaka Bay, then northeast past Waialua and Waimea Bays, to Kahuku Point and continues southeast to Kahuku Town. Inland, the district is bounded by the crest of the Waianae Range on the west, the Waialua-Wahiawa Judicial District boundary on the south, and the crest of the Koolau Range and Malaekahana Valley at its eastern extent. The economy of the region is based primarily on agriculture and tourism.

The District is large enough to encompass diverse physical characteristics represented by soil and rock types, topography, flora and fauna. The EIS document, therefore, provides detailed descriptions of environmental parameters to fully describe the range of local environments.

III. RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

The proposed water system improvements are supportive of and in compliance with applicable State and County plans, policies, and controls. These include the following:

- A. Hawaii State Plan
- B. State Functional Plans
- C. State Department of Health - Drinking Water Program
- D. State Exploratory Well Program
- E. City and County of Honolulu - General Plan
- F. City and County of Honolulu - Development Plan
- G. City and County of Honolulu - Oahu Water Plan
- H. State Land Use Classification
- I. City and County of Honolulu - Land Use Ordinance
- J. Coastal Zone Management
- K. Special Management Area
- L. Waialua Ground Water Control Area
- M. Department of the Army Permit

IV. REGIONAL IMPACTS

Regional impacts addressed in the EIS include those associated with water system, hydrology, water quality, flood hazard, population, public facilities, economy, displacement and stream and wetland environments. Potential impacts which will be closely monitored by the BWS are those of source development upon stream and wetland environments. Sustainable yields of basal water sources will not be adversely impacted by proposed source developments.

From a long-range planning standpoint, the proposed improvements will accommodate future growth, in keeping with the City and County of Honolulu's General Plan.

V. LOCAL ENVIRONMENTAL IMPACTS

Impacts at individual project sites are described generally in the EIS and are primarily construction related. Temporary construction related impacts are those associated with noise, dust, exhaust emissions, traffic, and other unavoidable nuisances.

VI. ALTERNATIVES

The following alternatives to source development are addressed in the EIS:

- A. No action
- B. Increase pumpage at existing BWS sources
- C. Development of surface water sources
- D. Desalting
- E. Resource conservation

VII. OTHER CONSIDERATIONS

- A. These improvements will help meet the projected water supply needs of the Waialua-Kahuku District and, if excess water is available, such excess is proposed for conveyance to the Waianae District.
- B. The long-term productivity of the basal aquifer is not anticipated to be adversely affected, as the anticipated drafts of sources within the Waialua Ground Water Control Area will be within DLNR-established sustainable yields for the Area.
- C. Development of the proposed water facility improvements would require irretrievable commitments of labor, material, and monies.

II. INTRODUCTION

II. INTRODUCTION

In keeping with its objectives of preparing for, and meeting anticipated consumer demands for potable water, the Honolulu Board of Water Supply (BWS) is proposing the development of new water sources and transmission and storage facilities in the Waialua-Kahuku Water Use District on the Island of Oahu.

The group of projects proposed include nine (9) sources with one or more new wells with associated storage and transmission facilities, one major transmission main which is independent of source development, and one new reservoir. These proposed individual water facility projects are treated as a single action towards meeting environmental impact statement requirements of Chapter 343, Hawaii Revised Statutes (HRS). This consolidation of various projects into a single action serves to increase public understanding of the context in which the individual projects have been proposed. More significantly, this approach streamlines the research and presentation of facts and findings as required by Chapter 343.

The following are the proposed individual projects:

- o Hanakaoe Well
- o Kawaihapai Well
- o Kawaihoa Well
- o Kawela Well
- o Mokuleia Well I
- o Opana Well
- o Ukoa Wells
- o Waialua Well II
- o Waimea Well
- o Mokuleia-Makaha Transmission Main and Reservoir

Prior to the preparation of this document, an environmental assessment (negative declaration) had been completed for the Waialua Well II and an environmental assessment (negative declaration) for the Mokuleia Well I was published on March 23, 1986 by the Office of Environmental Quality. Information and data from these previously completed documents are incorporated herein, as related to these projects.

Toward satisfying the requirements of Chapter 343, HRS, the information and data presented herein is intended to be comprehensive, reflecting physical, environmental, and socio-economic conditions and impacts from a broad regional context, as well as from an individual project standpoint.

This environmental document may be accepted in whole or in part, to fulfill requirements of Chapter 343, HRS for the individual water improvement facilities. For those projects which may require further disclosures, supplemental environmental impact studies and assessments may be prepared. Projects which are not implemented in the near-term may require supplemental assessments if, over the period of time prior to construction, physical, environmental, and socio-economic conditions change significantly from those presented herein.

III. THE PROPOSED PROJECT

III. THE PROPOSED PROJECT

A. PROJECT BACKGROUND

1. Water Use Districts

For administrative and planning purposes, the BWS divides the Island of Oahu into seven water use districts. These districts are identified as Honolulu, Windward, Waialua-Kahuku, Wahiawa, Pearl Harbor, Ewa, and Waianae.

The proposed water facility improvements are within the 140 square miles delineated by the Waialua-Kahuku District in the northwest sector of Oahu. Bordering the shoreline, the district extends eastward from Kaena Point to Kaiaka Bay, northeast past Waialua and Waimea Bays, to Kahuku Point and then southeast to Kahuku Town. Inland, the district is bounded by the crest of the Waianae Range on the west, the Waialua-Wahiawa Judicial District boundary on the south, and the crest of the Koolau Range and the Malaekahana Valley at its eastern extent. The Waialua-Kahuku District is coextensive with census tracts 99 through 101. The portion of the district which is within the Waialua Judicial District has been designated as the Waialua Ground Water Control Area by the State Board of Land and Natural Resources (BLNR).

2. Water System Parameters

a. General

The BWS is the primary supplier of potable water for most urbanized uses in the City and County of Honolulu. It is the second largest water developer and produces approximately one-fourth of Oahu's supply. In addition to the BWS, the military, private industry, agriculture and other private users develop water for their own consumption. Agricultural activities utilize more than half of all water developed, as shown in Table 1. Only a small fraction of water developed by the BWS is used for agriculture.

According to BWS projections of population and per capita consumption rates for the year 2000, an average of about 5.1 million gallons a day (mgd) will be needed to satisfy demand in the Waialua-Kahuku District. This represents a 120 percent increase over the 1980 daily average of 2.31 million gallons. Table 2 presents actual and projected water demand between the years 1970

TABLE 1
TOTAL WATER SUPPLY
OAHU 1980

Water Source Developer	Quantity (mgd)	Utilized (percentage)
Agriculture	262	57%
Board of Water Supply	130	28
Military	28	6
Industrial and Other Private Use	<u>41</u>	<u>9</u>
	462 mgd	100%

Adapted from: Oahu Water Plan, 1982.

TABLE 2
ACTUAL AND PROJECTED WATER DEMAND, 1970-2000

Year	TOTAL DAILY DEMAND (mgd)		CONSUMPTION PER CAPITA (gpcd)	
	Waialua- Kahuku District	Total Oahu	Waialua- Kahuku District	Total Oahu
1970.....	1.46	111.46	174	200
1971.....	1.64	114.97	186	199
1972.....	1.84	120.48	196	198
1973.....	1.98	126.86	191	200
1974.....	2.00	121.59	188	187
1975.....	2.26	134.59	209	203
1976.....	2.41	137.75	216	203
1977.....	2.51	136.99	222	197
1978.....	2.41	132.07	210	187
1979.....	2.52	133.53	215	184
1980.....	2.31	130.09	194	177
1985.....	2.90	141.40	199	181
1987				173
1990.....	3.70	155.50	204	186
1995.....	4.50	169.60	209	192
2000.....	5.10	181.00	214	198

Adapted from: Oahu Water Plan, 1982.

and 2000 for the Waialua-Kahuku District and the Island of Oahu in terms of total daily demand and consumption per capita. Actual demand data is broken down on a yearly basis from 1970 to 1980 while projected demand is estimated at five year intervals from 1985 to 2000.

Water supply actually used in the fiscal year ending June 30, 1984 from all sources in the Waialua-Kahuku District is summarized in Table 3.

b. Waialua-Kahuku Water System

The existing BWS Waialua-Kahuku District water system includes a single, integrated system extending from Kawela to Waialua, and a separate system servicing Kahuku (see Figures 1a, b, and c). Privately operated systems are not considered a part of the BWS' system.

c. Kawela-Waialua System

The Kawela-Waialua system extends from the Turtle Bay Resort on the east, to Crozier Drive on the west. Within this system, existing 16-inch, 12-inch and 8-inch transmission mains serve the area between the Turtle Bay Resort and Weed Junction. Major service to the Waialua area is by 16-inch and 12-inch mains.

Water storage for this system is comprised of a series of seven reservoirs. The total storage capacity of these reservoirs is 6.3 million gallons, as shown in Table 4.

Water for the Kawela-Waialua system is supplied by five pumping stations having a well capacity of 7.6 mgd, as shown in Table 5. The mean daily pumpage for these sources is 2.83 mgd.

These wells distribute water through two subsystems of the Kawela-Waialua system. The Pupukea-Waialua subsystem encompasses the area from Pupukea to Waialua, and is served by the Haleiwa and Waialua Wells. The Kawela-Sunset Beach subsystem encompasses the Sunset Beach to Turtle Bay Resort region and is served by the Waialea and Sunset Beach Wells. The three Pupukea reservoirs as well as the Haleiwa and Waialua reservoirs provide storage for the Pupukea-Waialua subsystem while the Kawela and Sunset Beach reservoirs serve the Kawela-Sunset Beach subsystem.

TABLE 3

WAIALUA-KAHUKU DISTRICT WATER SUPPLY, 1985

Pumped Sources	Preserved Use ^{1/} (mgd)	Actual Use ^{2/} (mgd)	Sustainable Capacity ^{3/} (mgd)	Reserve ^{4/} (mgd)
<u>Kahuku Area</u>				
Kahuku Wells	--	0.30	1.00	0.70
Waialeale Well I	--	0.27	0.50	0.23
Waialeale Well II	--	0.44	0.70	0.26
Sunset Beach Well	--	<u>0.01</u>	<u>0.10</u>	<u>0.09</u>
Subtotal	--	1.02	2.30	1.28
<u>Waialua Area</u>				
Haleiwa Wells ^{5/}	1.00	0.53	1.00	0.47
Waialua Wells ^{5/}	<u>1.73</u>	<u>1.58</u>	<u>2.00</u>	<u>0.42</u>
Total	2.73	3.13	5.30	2.17

^{1/}The quantity of water which is reserved for water users certified to have existed at the time Waialua became a Ground Water Control Area.

^{2/}Fiscal year 1984-1985.

^{3/}The rate at which water can be withdrawn from a specific source site, such as a well or shaft, without unduly impairing source utility.

^{4/}Difference between sustainable capacity or preserved use and actual use.

^{5/}Within a designated Ground Water Control Area.





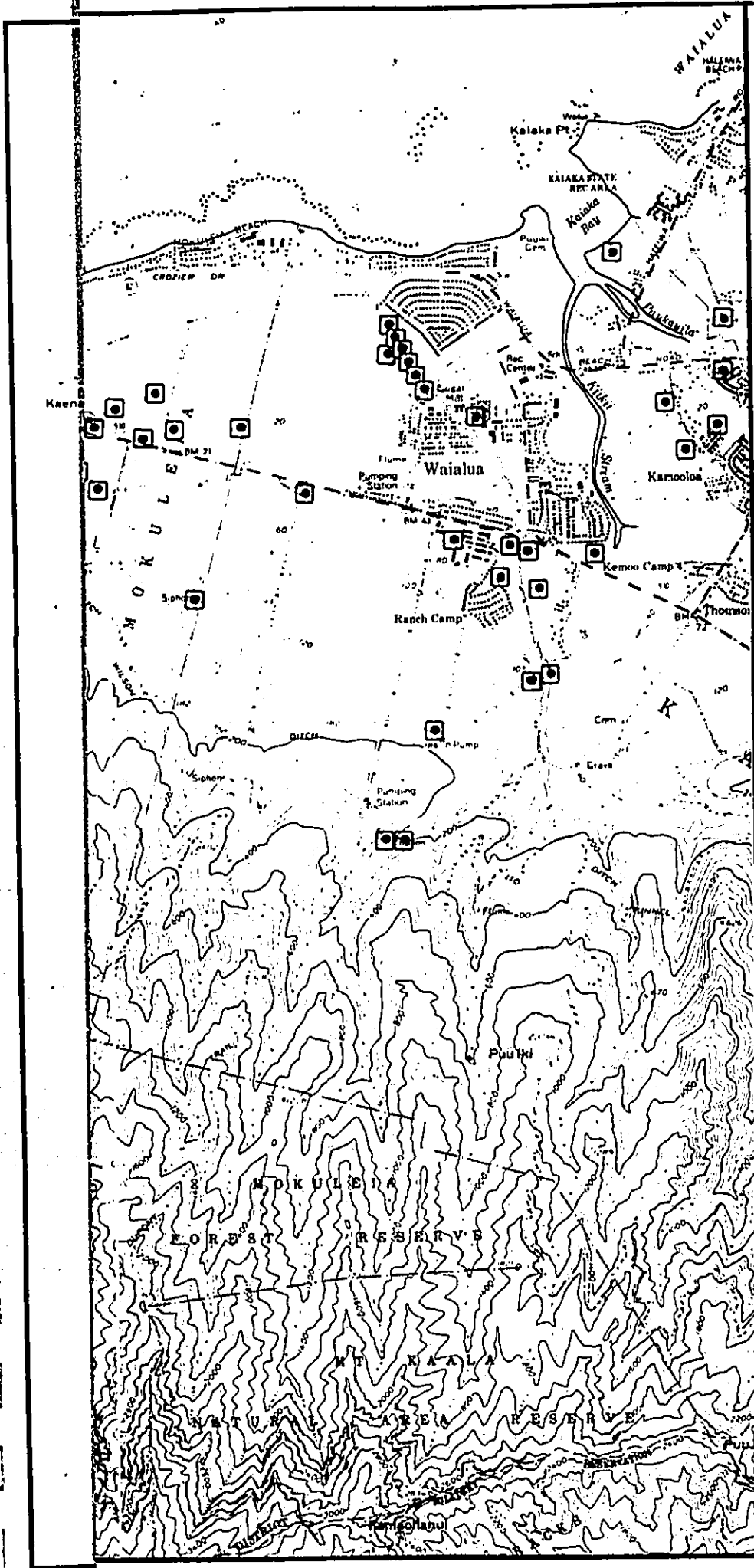
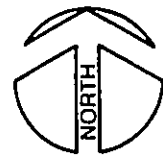


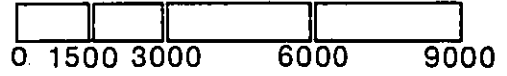
fig. 1a

Existing Well and Pump Locations

 Well and Pump Locations



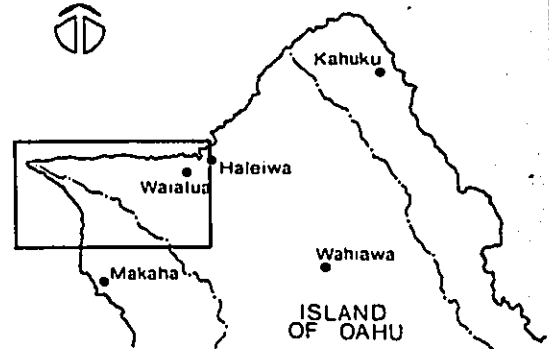
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WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS ENVIRONMENTAL IMPACT STATEMENT

prepared for:
 BOARD OF WATER SUPPLY
 prepared by:
 WILSON OKAMOTO & ASSOCIATES, INC.

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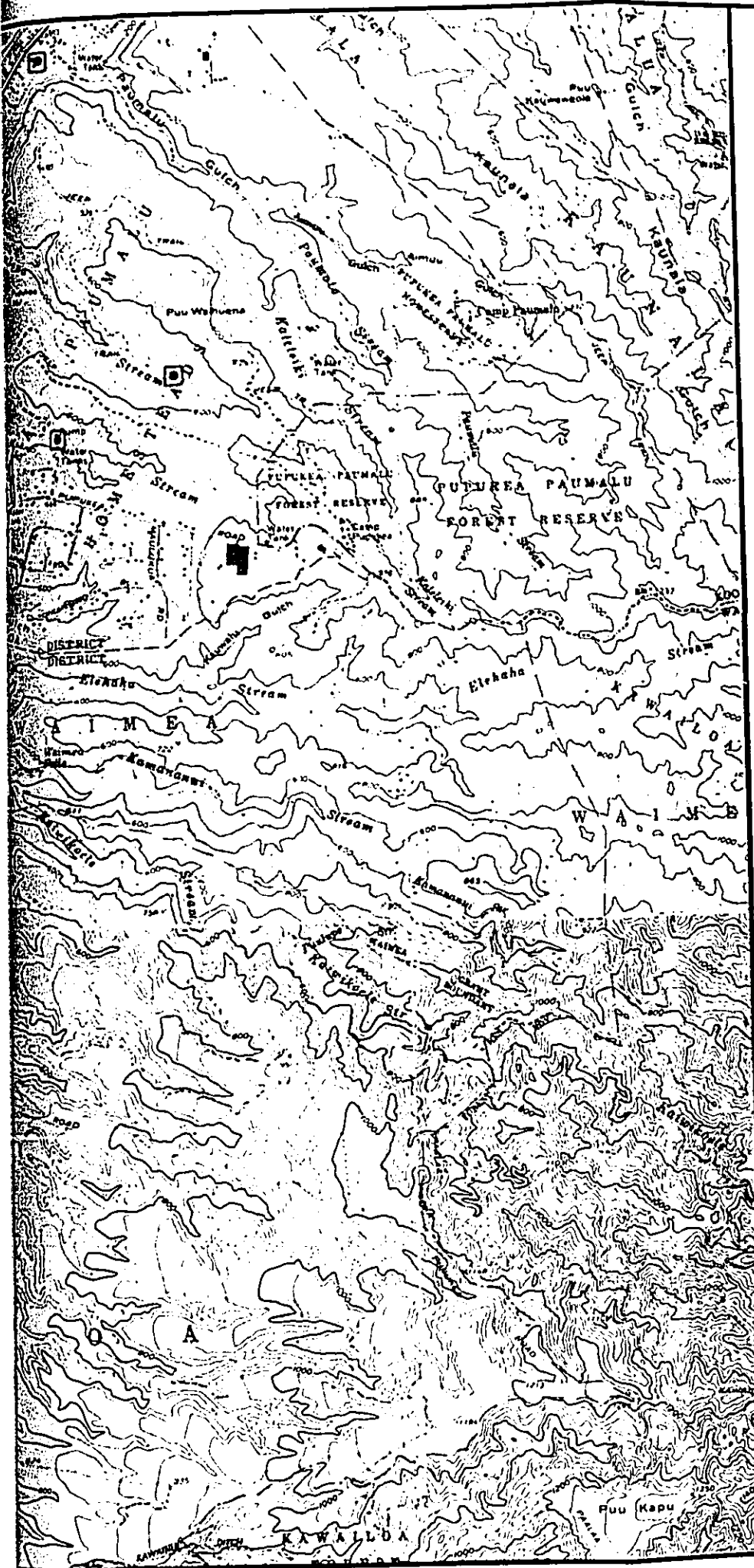
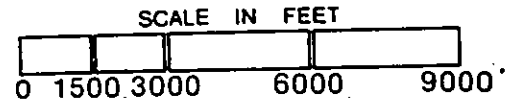
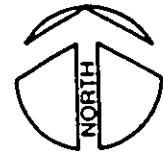


fig. 1b
**Existing Well
 and Pump
 Locations**

■ Well and Pump Locations



**WAIALUA-KAHUKU REGIONAL
 WATER SYSTEM IMPROVEMENTS
 ENVIRONMENTAL IMPACT STATEMENT**

prepared for
BOARD OF WATER SUPPLY
 prepared by
WILSON OKAMOTO & ASSOCIATES, INC.

KEY TO PLATE

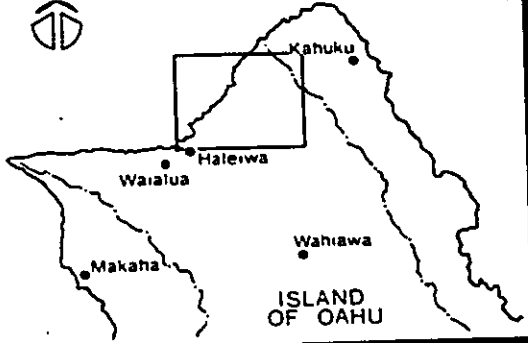
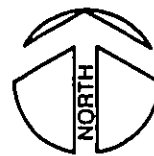
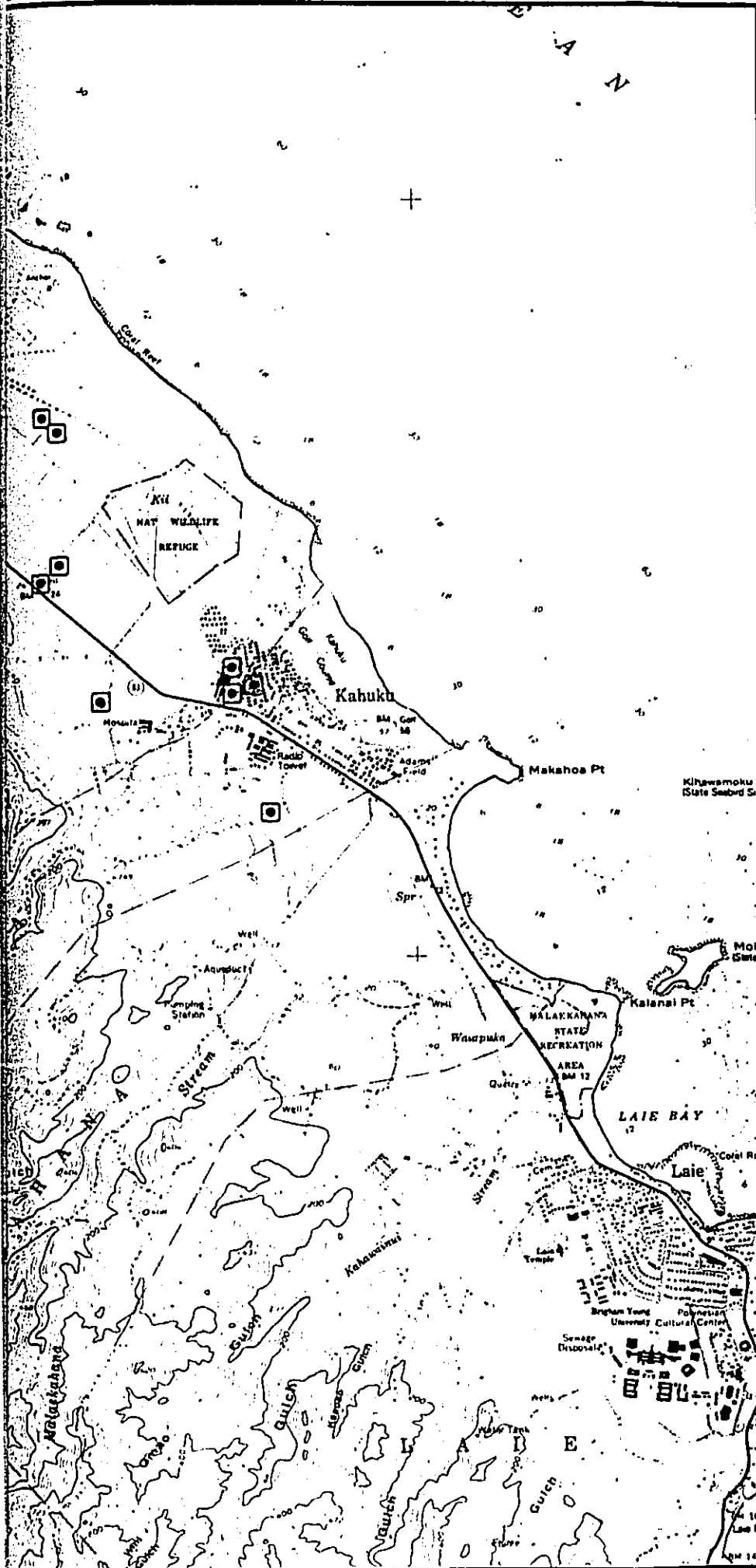




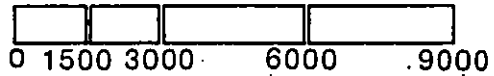
fig. 1c

Existing Well and Pump Locations

■ Well and Pump Locations



SCALE IN FEET



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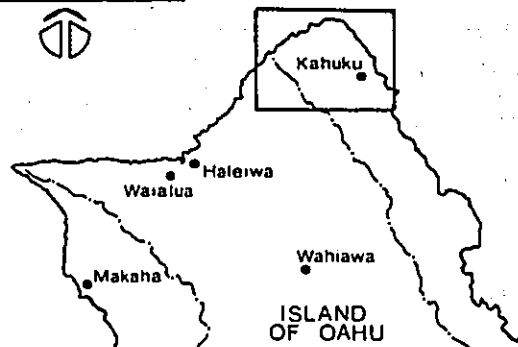


TABLE 4

KAWELA-WAIALUA RESERVOIRS

RESERVOIR	SPILLWAY ELEVATION	CAPACITY (mg)
Kawela	228	2.0
Sunset Beach	206	0.3
Pupukea	170	0.5
Pupukea	600	0.5
Pupukea	892	0.5
Haleiwa	225	1.0
Waialua	225	<u>1.5</u>
TOTAL STORAGE CAPACITY		6.3

Source: BWS Annual Report and Statistical Summary, 1983

TABLE 5

WELL CAPACITY AND MEAN DAILY PUMPAGE
FOR KAWELA-WAIALUA SYSTEM WELLS

WELL	WELL CAPACITY (mgd)	MEAN DAILY PUMPAGE (mgd) ^a
Sunset Beach	0.4	0.01
Waialeale I	0.5	0.27
Waialeale II	0.7	0.44
Haleiwa (2 wells)	2.0 ^b	0.53
Waialua (2 wells)	<u>4.0^c</u>	<u>1.58</u>
TOTAL	7.6	2.83

^a Fiscal year ending June 30, 1985

^b DLNR preserved use is 1.0 mgd.

^c DLNR preserved use is 1.73 mgd.

Source: BWS Annual Report and Statistical Summary, 1985

d. Kahuku System

The Kahuku system is an independent water system serving Kahuku Town. The water sources for this system are the two Kahuku Wells with a total capacity of 2.0 mgd. The combined mean daily pumpage from the wells is approximately 0.30 mgd. Storage for the system is provided by the Kahuku 228 Reservoir, with a capacity of 0.5 mg.

B. PROPOSED WATER SYSTEM IMPROVEMENTS

1. General

This section describes in generic terms, activities typically associated with the development of new water sources, reservoirs, and transmission lines. A more specific discussion of each of the proposed improvements is presented in Section III.B.2.

a. Water Sources

Pursuing a program to develop potable groundwater sources in suitable areas, the BWS proposes the development of new wells. Source development begins with a search for a suitable water source, as determined by the quality and quantity of water that can be produced over a sustained period. Exploratory wells are drilled at potential well sites to determine the yield and quality of new sources. If an exploratory well proves feasible for source development, the installation of production facilities can follow.

To develop exploratory wells into production wells, aquifer¹ testing is required to determine the aquifer parameters which, in turn, are used to determine system design and operation. Hence, until test pumping of exploratory wells is completed, descriptions of the proposed production facilities improvements can be only estimated.

A typical exploratory well for a modest source is a drilled hole about 16 inches in diameter. The depth of the well varies according to the ground elevation of the well site and the depth to the water table. Generally, if the intended source is a basal aquifer², the

¹ A water bearing formation of single or multiple layers.

² In basal aquifers, freshwater floats upon denser saline water.

exploratory well is drilled to a depth below sea level, as determined by head and the Ghyben-Herzberg relationship (see Section IV.A.2). Commonly, a 12-inch diameter steel casing is grouted into place before the well is drilled to its final depth. A series of aquifer tests follow to determine the sustained well capacity and water quality.

When an exploratory well has been tested and found to be suitable for domestic use, it can be developed as a production well. A typical production well facility will consist of the well and a permanent pump system, a control building, and necessary transmission lines to connect the new source to an existing water system. A standby well is sometimes drilled at the facility.

The control building typically measures 15 feet by 45 feet in floor size and contains three main rooms. One room houses the electrical control panel, flow recorder, and the pump controls. A second room stores chlorine cylinders and a third is for the chlorinator pumps and an air compressor. By separating these functions, the electrical equipment and controls would be protected should a chlorine leak occur. The control building and grounds are designed and landscaped for maximum visual compatibility with the local environment.

Transmission lines to connect a new source to the existing water transmission and distribution system are buried with a minimum cover of three feet.

If the water quality of an exploratory well does not meet acceptable standards for domestic water, but is within the allowable limits for irrigation, then it may be developed by other agencies or developers for use as a secondary source. Another option would be to dilute the water with potable water from another source, to produce a blend that would meet the State Drinking Water Standards. All BWS potable water sources meet Environmental Protection Agency (EPA) and State Department of Health (DOH) water quality standards. If developed as a secondary source for irrigation, the well system will typically include a well, pump, pump controls and connections to an existing or new irrigation system. The irrigation system would be totally separated from domestic water systems to prevent cross-connections that could degrade the domestic water system.

All wells proposed in the Waialua-Kahuku District will tap basal sources, although wells in the Kahuku area may supply water derived, in part, from dike leakage. All proposed water sources will be non-flowing basal wells.

b. Reservoirs

Water storage facilities enhance the capability of the water system to meet peak demands or emergencies in the service area.

In accordance with BWS standards, reservoirs are constructed of reinforced or prestressed concrete. Reservoirs are designed to meet either the maximum day consumption or the maximum day rate (average daily consumption x 1.5) plus fire flow, whichever is greater. When more than one reservoir serves the same system, the design is based on the combined capacity of those reservoirs.

Improvements typically associated with constructing a new reservoir include the following:

- 1) Minimum 12-foot wide paved access road.
- 2) Ten-foot wide perimeter road around the reservoir.
- 3) Site drainage system to accommodate excess water, including overflow from the reservoir.
- 4) Six-foot high perimeter security fencing.
- 5) Landscaping and irrigation.

c. Transmission Lines

Transmission mains convey water from the source to the service areas and provide redundancy in the distribution system. They are installed underground within roadway or pipeline easements or rights-of-way with a minimum ground cover of three feet (for six-inch diameter or larger pipes) and a maximum ground cover of eight feet. Transmission mains are sized to provide adequate flow and maintain adequate pressure during peak consumption periods.

Transmission main appurtenances include valves, manholes and valve boxes, and fire hydrants.

2. Individual Project Descriptions

The following is a project profile for each of the proposed water facility improvements. The type of improvement proposed, location, land ownership, estimated yield and surrounding land uses are described (see Figures 2a, b and c).





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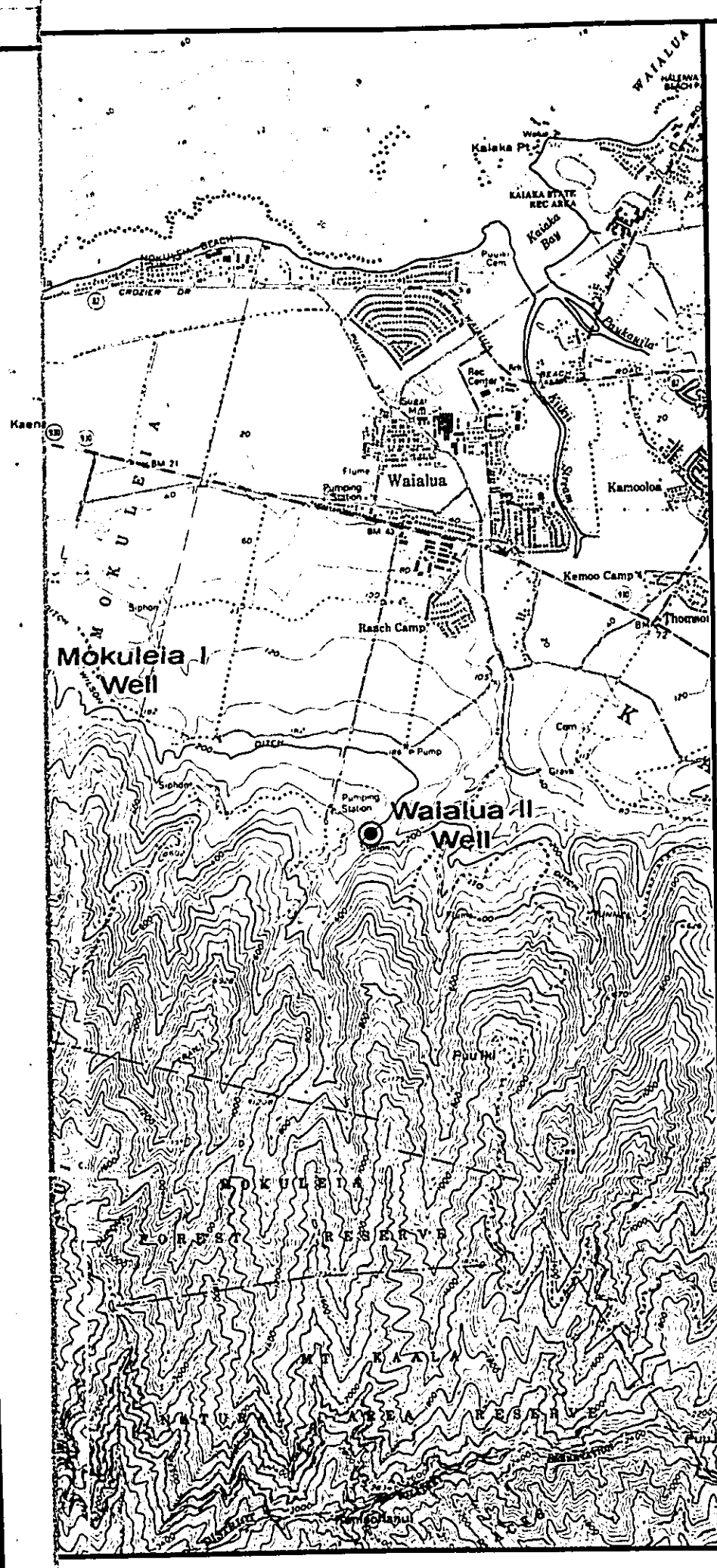
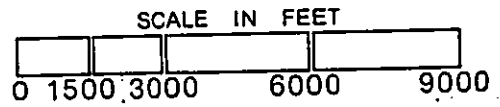
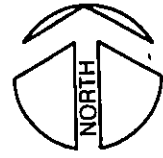



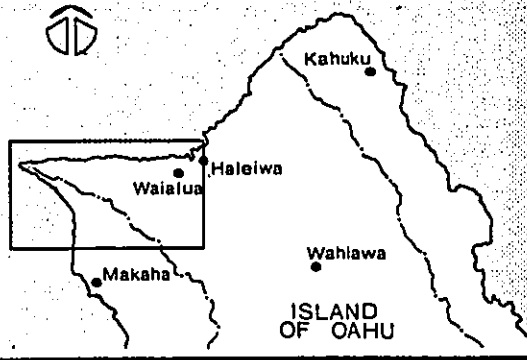
fig. 2a
**Proposed
 Water System
 Improvements**



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 ENVIRONMENTAL IMPACT STATEMENT**

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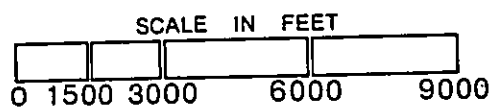
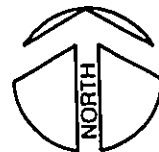
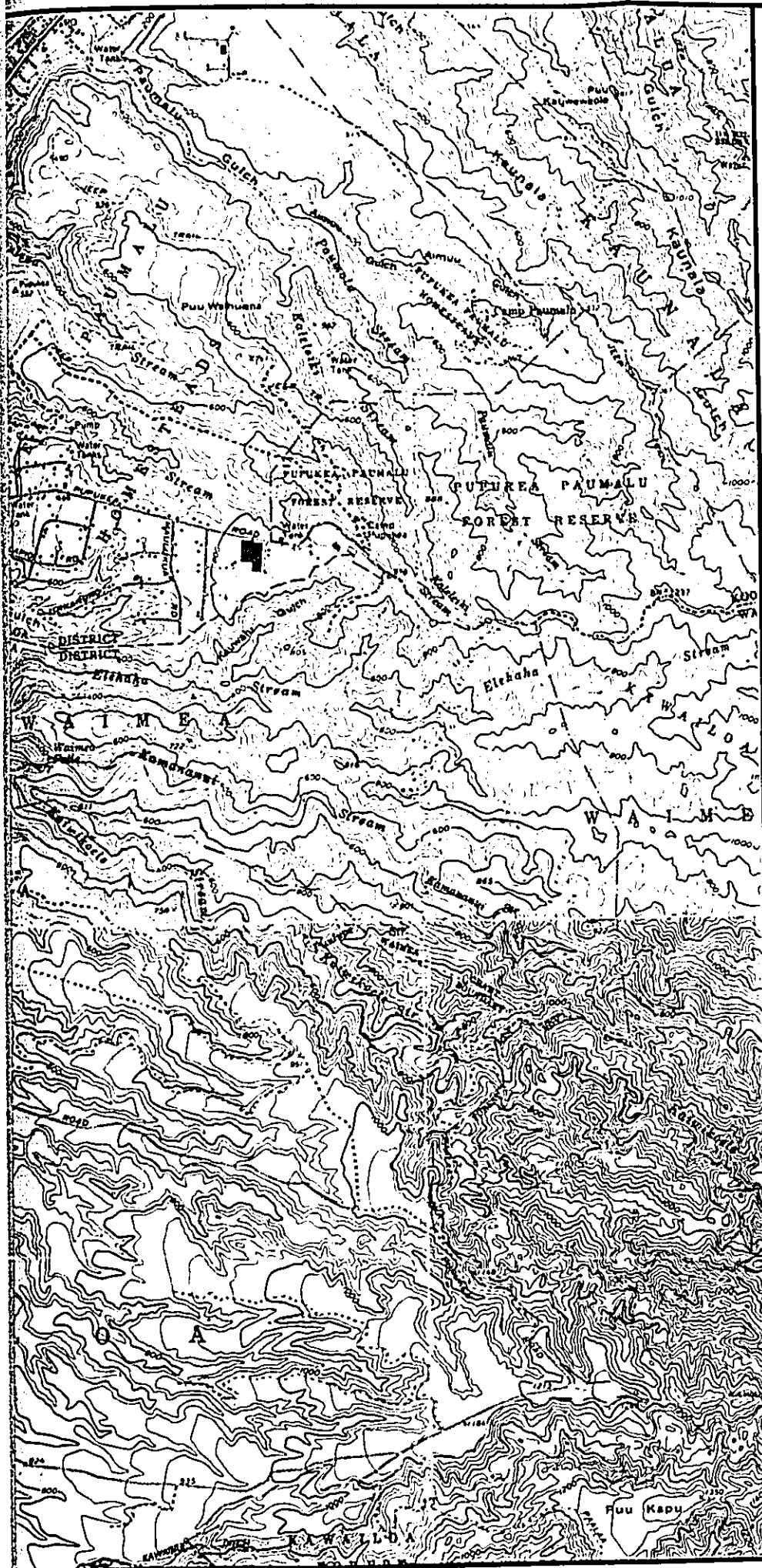
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fig. 2b
**Proposed
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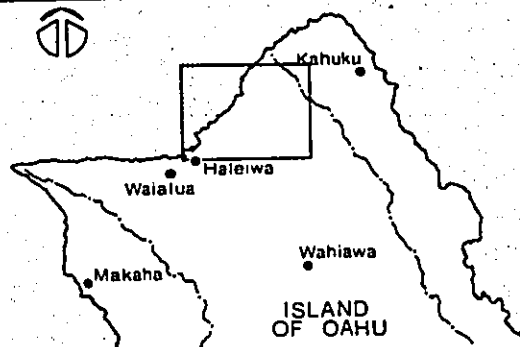
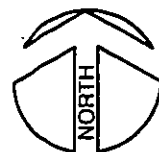
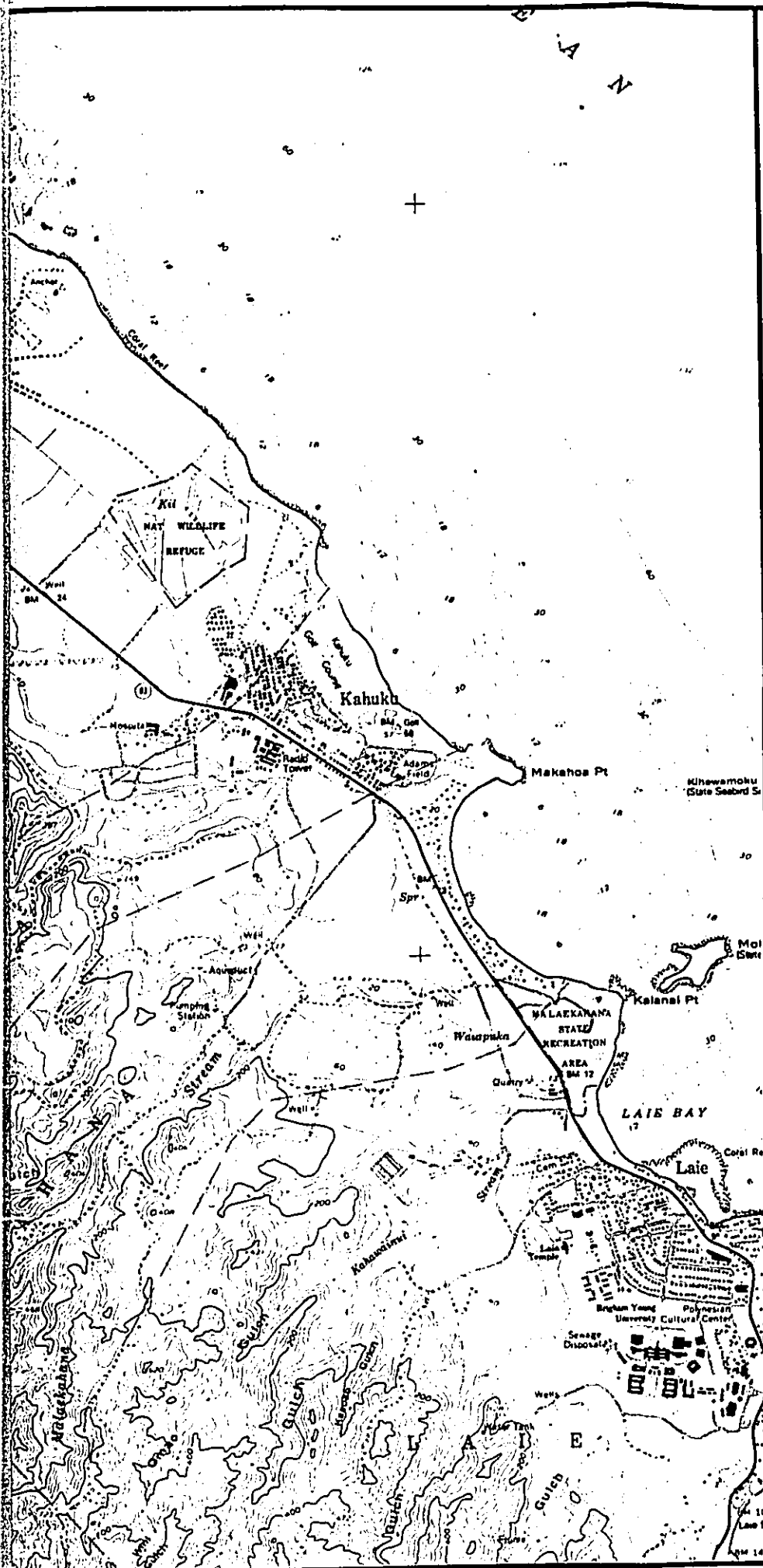


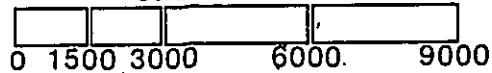


fig. 2c

Proposed Water System Improvements



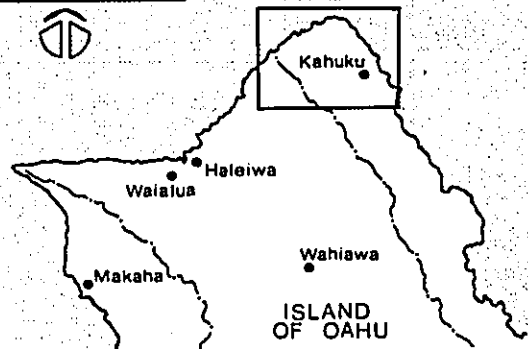
SCALE IN FEET



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a. Sources

(1) Hanakaoe Well

- o Location: Approximately one-half mile south of Kamehameha Highway in Kahuku, between Hoolapa Gulch and Kalaeokahipa Gulch.
- o Approximate Elevation: 200 feet
- o TMK: 5-6-05:2
- o Parcel Area: 27.4 acres
- o Owner: James Campbell Estate
- o Estimated Yield: 0.5 to 2.0 mgd
- o Surrounding Land Uses: Undeveloped and agricultural with U.S. Military Reservation in the vicinity.

(2) Kawaihapai Well

- o Location: Approximately one mile north of the Mokuleia Forest Reserve Boundary and one mile south of Farrington Highway in Mokuleia
- o Approximate Elevation: 300 feet
- o TMK: 6-8-02:6
- o Parcel Area: 1,023.7 acres
- o Owner: State of Hawaii
- o Estimated Yield: 0.5 to 2.0 mgd.
- o Surrounding Land Uses: Primarily agricultural

An alternate well site is located at an elevation of about 200 feet within the general vicinity.

(3) Kawaihoa Well

- o Location: Approximately 0.8 mile mauka of Kamehameha Highway and Kawaihoa Beach
- o Approximate Elevation: 412 feet
- o TMK: 6-1-06:1

- o Parcel Area: 2,050 acres
- o Owner: Bernice P. Bishop Estate
- o Estimated Yield: 0.1 to 1.0 mgd.
- o Surrounding Land Uses: Primarily agricultural; site is located in sugar cane

(4) Kawela Well

- o Location: Approximately one mile southwest of the Turtle Bay Resort and east of Kawela Stream in Kahuku
- o Approximate Elevation: 200 feet
- o TMK: 5-7-02:1
- o Parcel Area: 1,158 acres
- o Owner: James Campbell Estate
- o Estimated Yield: 1.0 to 1.5 mgd range
- o Surrounding Land Uses: The area south of Kamehameha Highway is in agriculture

(5) Mokuleia Well I

- o Location: Approximately one mile mauka of Farrington Highway
- o Approximate Elevation: 200 feet
- o TMK: 6-8-07:2
- o Parcel Area: 887.5 acres
- o Owner: Castle & Cooke, Inc.
- o Estimated Yield: 0.5 to 2.0 mgd with a sustainable capacity of 1.0 mgd.
- o Surrounding Land Use: Primarily agriculture; site is located in sugar cane
- o Access: Mount Kaala Road, which is used by the Federal Aviation Agency (FAA), Waialua Sugar Company and a Castle and Cooke lessee.

An Environmental Impact Assessment (Negative Declaration) for this project was published by the Office of Environmental Quality Control on March 23, 1986.

(6) Opana Well

- o Location: Approximately one mile south of Kawela Bay and west of Kawela Stream
- o Approximate Elevation: 120 feet
- o TMK: 5-7-02:1
- o Parcel Area: 1,559 acres
- o Owner: James Campbell Estate
- o Estimated Yield: 1.0 mgd.
- o Surrounding Land Uses: Primarily agricultural with U.S. Naval Reservation nearby.

Exploratory wells have been drilled and test pumping has been completed. Design considerations for the Opana Well are contained in Appendix A.

(7) Ukoa Wells

- o Location: East of Ukoa Pond, a wetland area, and south of the Kawaihoa Camp, approximately 0.8 mile mauka of Kamehameha Highway
- o Approximate Elevation: 180 feet
- o TMK: 6-2-09:1
- o Parcel Area: 81.1 acres
- o Owner: Bernice P. Bishop Estate
- o Estimated Yield: 0.25 to 0.5 mgd.
- o Surrounding Land Use: Agricultural and undeveloped land, and Ukoa Pond wetland area; site is located in sugar cane

(8) Waialua Well II

- o Location: South of Waialua, at the foot of Puu Iki on the northern slope of the Waianae Range, about 1.2 miles mauka of Waialua High School

- o Approximate Elevation: 200 feet
- o TMK: 6-7-02:4
- o Parcel Area: 184.1 acres
- o Owner: Macadamia Nut Co.
- o Estimated Yield: 1.5 mgd.
- o Surrounding Land Uses: Waialua Ranch Partners cattle-grazing lands, with sugarcane fields to the northwest and Mokuleia Forest Reserve and Mount Kaala to the south
- o Access: A dirt road extending from existing cane haul roads.

An exploratory well, originally designated as Mokuleia Well I, has been drilled and tested by the Department of Land and Natural Resources through their well drilling program. A Negative Declaration for the exploratory well was published on June 8, 1984.

The proposed project will also include the construction of a reservoir with probable capacity in the 0.5 to 1.0 mg range.

Design considerations for the Waialua II Well are contained in Appendix A.

(9) Waimea Well

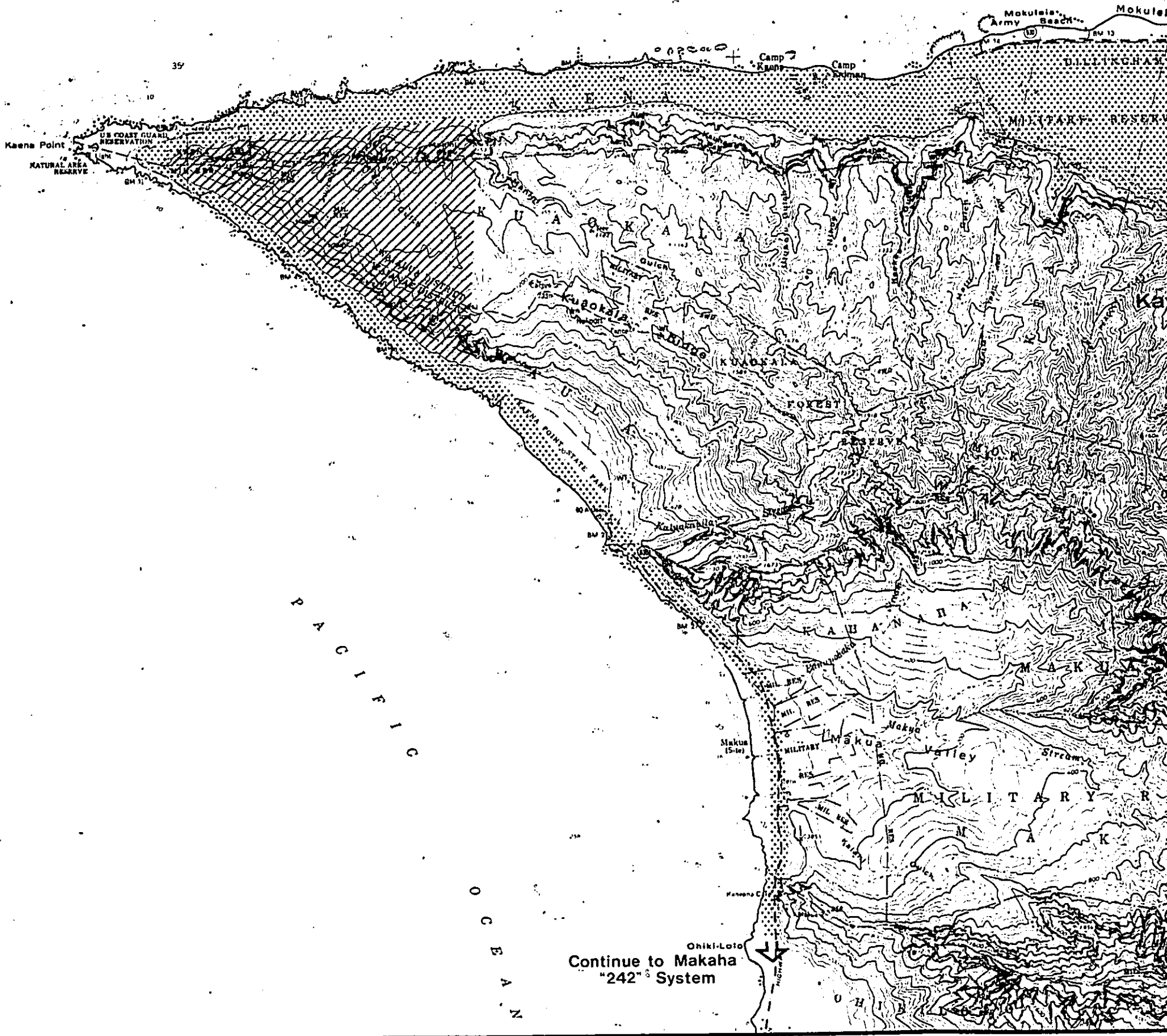
- o Location: More than one mile southeast of Waimea Bay
- o Approximate Elevation: 500 feet
- o TMK: 6-1-06:1
- o Parcel Area: 2,050 acres
- o Owner: Bernice P. Bishop Estate
- o Estimated Yield: 0.1 to 1.0 mgd.
- o Surrounding Land Uses: Primarily agricultural; site is located in sugar cane

b. Mokuleia-Makaha Transmission Main and Reservoir

A transmission main is proposed to convey surplus water from the Waialua-Kahuku District to the Waianae District, on the leeward side of Oahu (see Figure 2d). This transmission main is presently in the conceptual planning stage and more detailed engineering studies will be undertaken only if the availability of water in the Waialua-Kahuku District can be assured in quantities sufficient to economically justify the capital investment required to implement the water transfer. Existing and projected water needs for the Waialua-Kahuku District must be met before any inter-district transfer of water can be considered. The availability of water will partly be determined as the current BWS well drilling and testing program is implemented.

Also proposed in conjunction with the transmission main is a 2.0 to 6.0 million gallon reservoir or series of reservoirs (with pump stations) to facilitate the transfer of water from Waialua to Waianae. The reservoir(s) is proposed to be located between the 300-foot to 600-foot elevation on the Waialua-side of the Waianae Mountain Range. The specific elevation of the reservoir(s) would depend on the hydraulic profile of the transmission main. The reservoir(s) and pump stations would have to be situated to convey the water through the highest elevation of the transmission main, considering pipe energy losses. In this regard, three possible transmission main alignments are under review (see Appendix B):

- (1) Alternative 1: Along Farrington Highway in Waialua, continuing around Kaena Point along the "jeep trail" corridor, then along Farrington Highway on the Waianae-side of the island.
- (2) Alternative 2: Along Farrington Highway in Waialua, toward Kaena Point; tunneling through the Waianae Range to bypass Kaena Point, and continuing along Farrington Highway on the Waianae-side of the island.
- (3) Alternative 3: Along Farrington Highway in Waialua, toward Kaena Point; crossing over the Waianae Range to bypass Kaena Point, and continuing along Farrington Highway on the Waianae-side of the island.



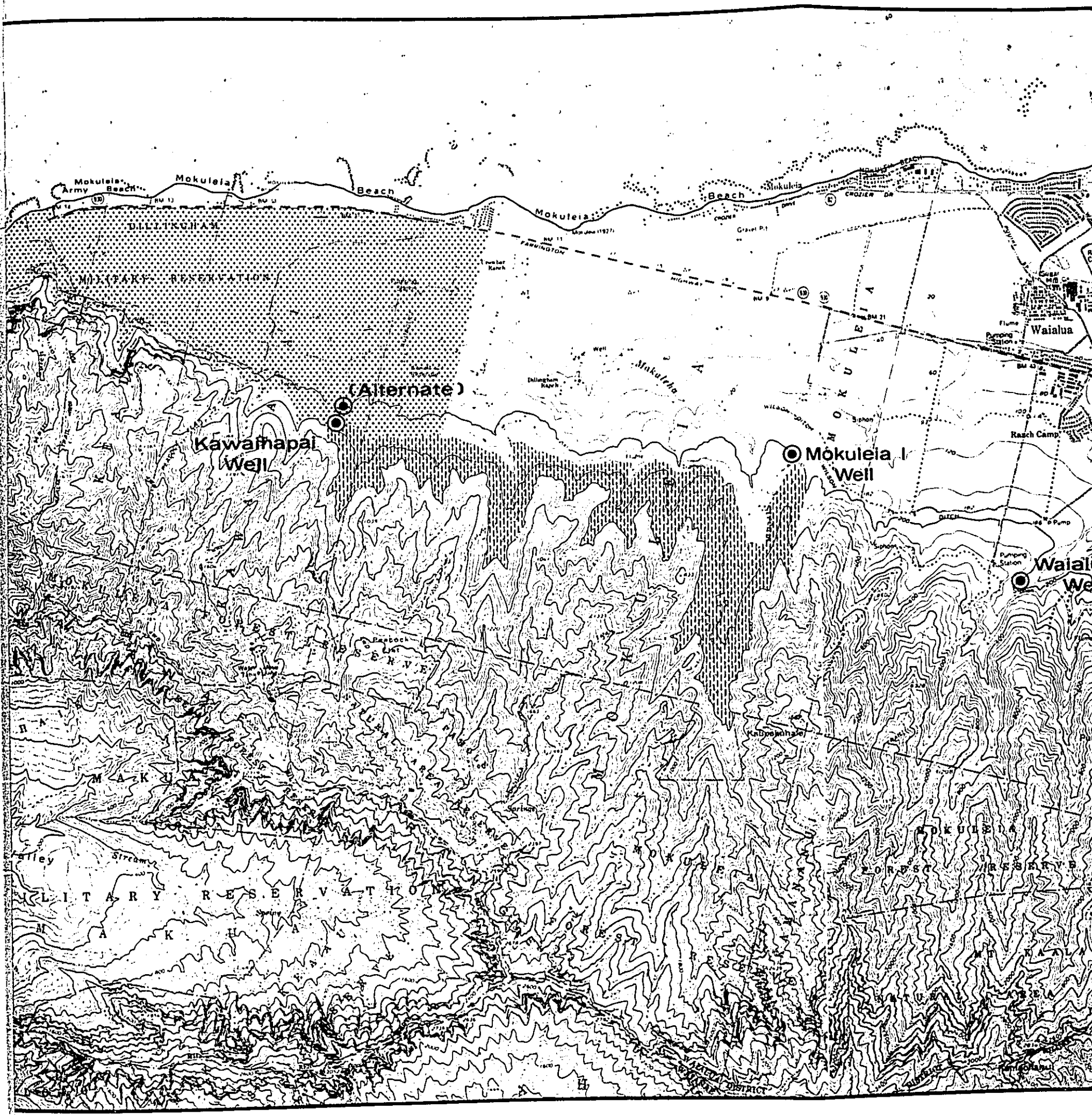
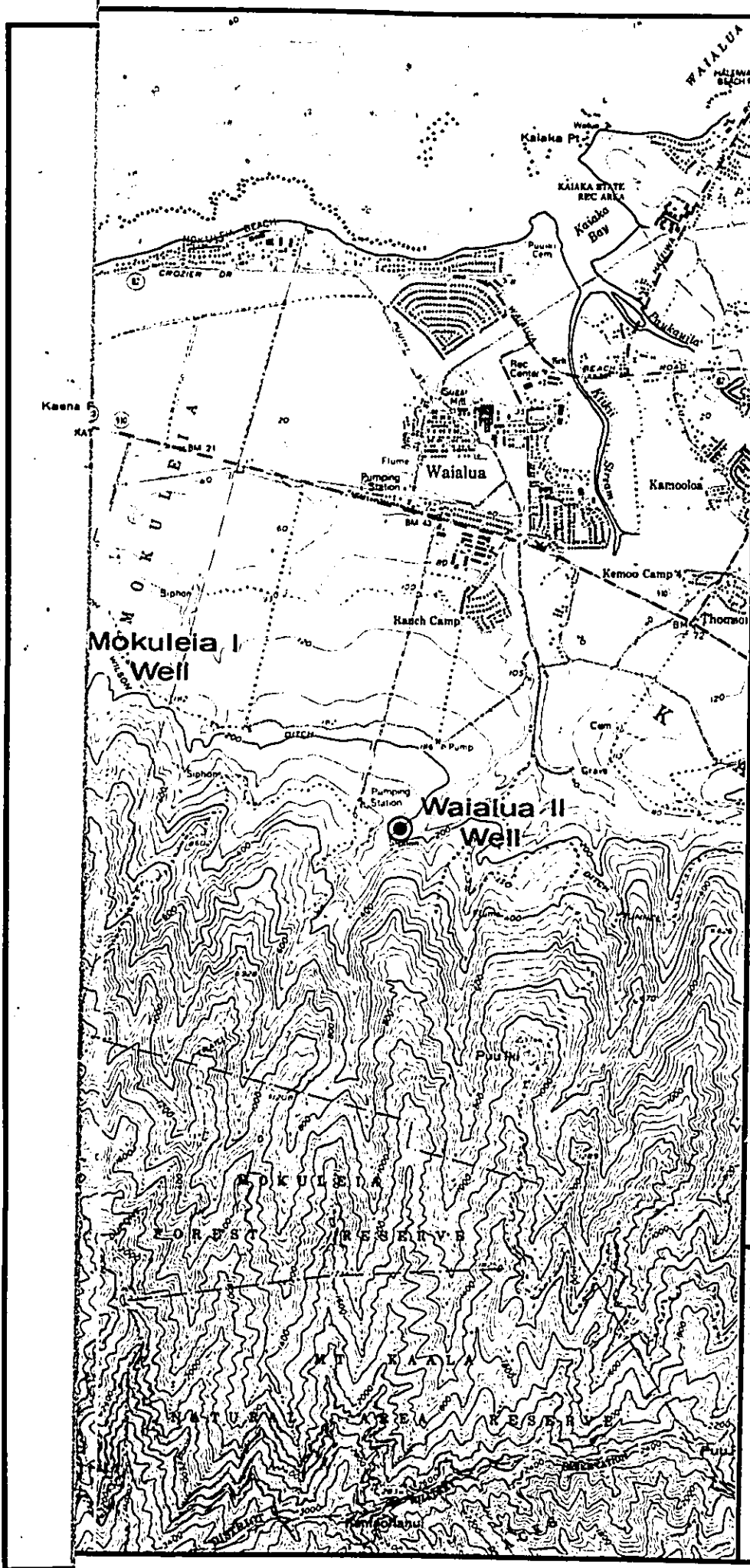
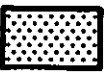


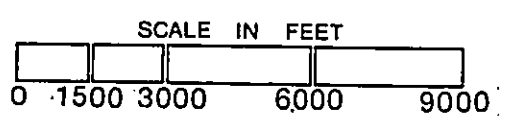


fig. 2d
**Proposed
 Water System
 Improvements**



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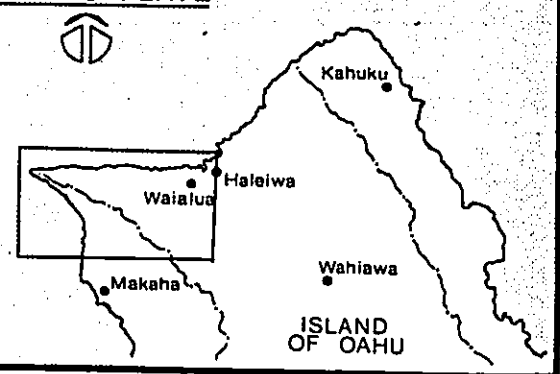
-  Mokuleia-Makaha Transmission Main (Farrington Highway Corridor)
-  Mokuleia-Makaha Transmission Main (Trans-Waianae Range Corridor)
-  Probable Location for Mokuleia-Makaha Reservoir (2.0 to 6.0 M.G.)



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It is estimated that these transmission alternatives would require a pipeline on an order of magnitude of 84,000 to 90,000 lineal feet to link the two districts. While the line size cannot be ascertained until the quantity of water available for transfer, if any, is determined, for planning purposes it is assumed that a 24-inch diameter pipe would meet system requirements.

Results of this preliminary analysis indicate that Alternatives 1 and 2 deserve further consideration and study. Alternative 3 is less favorable because of high energy costs required to pump water over substantial elevations.

C. COST ESTIMATES AND IMPLEMENTATION

The BWS six-year Capital Improvements Program (CIP) (1985 to 1991) includes the development of the Mokuleia I, Kawaihoa, and Waimea wells. The funding program and schedule for these three sources are shown in Table 6. Construction costs for the Opana Well and Waialua Well II are presented in Appendix A. All other proposed improvements for the Waialua-Kahuku District are long-range planning items which will be considered for implementation, as needs and water availability warrant. Order of magnitude cost estimates for sources not listed in the CIP are estimated to range from \$1.15 to \$5.06 million, excluding land acquisition costs.

A conceptual-level cost analysis for each of the three alternative transmission main alignments has been conducted to promote discussion and evaluation of the transmission main concept. Total estimated costs for Alternatives 1, 2 and 3 are \$29.0 million, \$33.4 million and \$31.1 million, respectively (see Appendix B).

TABLE 6
SIX-YEAR CIP FOR MOKULEIA I, KAWAILOA
AND WAIMEA WELLS

<u>PROJECT</u>	<u>TOTAL</u> <u>(\$000)</u>	<u>PRIOR</u> <u>APPRN</u>	<u>FY</u> <u>1986</u>	<u>FY</u> <u>1987</u>	<u>FY</u> <u>1988</u>	<u>FY</u> <u>1989</u>	<u>FY</u> <u>1990</u>	<u>FY</u> <u>1991</u>
MOKULEIA I								
Phase I - EIS	50	50	--	--	--	--	--	--
Phase II - Construction plans	118	--	--	--	--	118	--	--
Phase III - Land Purchase	267	--	--	--	--	--	267	--
Phase IV - Construction	2,904	--	--	--	--	--	2,904	--
TOTAL	3,339							
KAWAILOA WELL								
Phase I - EIS Construction Plans	20	--	--	--	--	20	--	--
	174	--	--	--	--	174	--	--
Phase II - Land Purchase	146	--	--	--	--	146	--	--
Phase III - Construction	3,197	--	--	--	--	--	--	3,197
TOTAL	3,537							
WAIMEA WELL								
Phase I - EIS; Test Well	20	--	--	--	20	--	--	--
	194	--	--	--	194	--	--	--
Phase II - Construction Plans	247	--	--	--	--	247	--	--
Phase III - Land Purchase	58	--	--	--	--	--	58	--
Phase IV - Construction	4,344	--	--	--	--	--	--	4,344
TOTAL	4,863							

Source: BWS Six-Year Capital Improvements Program, July 1, 1985 to June 30, 1991, 1985.

IV. THE REGIONAL ENVIRONMENT

IV. THE REGIONAL ENVIRONMENT

A. PHYSICAL ENVIRONMENT

Environmental characteristics described herein encompass the Waialua-Kahuku District, and to a limited extent, the portion of the Waianae District which would be traversed by the proposed transmission main improvement.

1. Geology

The Island of Oahu developed as lava flows from the Waianae volcanic shield on the west and the Koolau shield on the east coalesced to form a central plain known as the Schofield Plateau. The Waianae volcano subsequently became dormant and was deeply eroded before lava from the Koolau overlapped the eastern Waianae Range slopes. Features of both mountain ranges include amphitheater-headed valleys and spectacular cliffs. Eroded material from the Waianae and Koolau volcanoes form extensive alluvial and colluvial deposits in the lowlands.

a. Koolau Range

Approximately one-third of the land area of the Koolau shield is within the Kahuku area. The development of the Koolau shield is associated with the Koolau Volcanic Series, when fluid lava flowed down the flanks from northwest-trending fissures (northwest rift) generally aligned at right angles to the flows. The center of the Koolau caldera is located to the southeast, in the vicinity of Kailua.

Dikes formed when magma approached or reached the surface through fissures cutting older flows and subsequently solidified and cooled within the fissure when the eruption ceased. The northwest-trending dike complex (zone of fissures) is approximately 2.5 miles wide and extends along the crest of the Koolau Range for about 20 miles to the northwest, beginning near Kaneohe and ending near Kawela Bay. Dikes outcropping near Kawela are less concentrated and exhibit greater diversity in their trends.

The Koolau Range is composed mostly of basaltic lava of the Koolau Volcanic Series. The Honolulu Volcanic Series were later eruptions from much younger post-erosional vents which are concentrated in the southeastern end of the range and do not occur in the Kahuku area.

The lower reaches of valleys are underlain with talus and alluvium¹. The coastal plains consist of interbedded marine and terrestrial materials. Consolidated sand dunes, remnants of widespread calcareous sand deposits, which were once prevalent along the length of the entire northeast coast of Oahu, are located on the Kahuku coastal plain.

Alluvium and marine sediments of sand and coral overlie lava flows and confine the underlying artesian aquifers to the coastal plain extending west of the Anahulu River. The area between Anahulu River and Waimea River is essentially unconfined owing to the thinness and leakiness of the sediments. These coastal plain deposits are known locally as caprock.

b. Waianae Range

The Waianae Range is composed of basaltic lava from the Waianae Volcanic Series. Lava flows of the Waianae volcano are locally overlain by alluvium or weathered surfaces of younger flows originating from the Koolau Volcanic Series. A west-northwest trending dike-complex zone of the Waianae Range has been exposed by deep erosion west of the Waianae Range crest from Lualualei toward Kaena Point. Fewer dikes have been found on the east side of the range because erosion has progressed to a lesser degree.

Artesian aquifers underlying the coastal plain, which extends east from the vicinity of Haili Gulch (near Dillingham Airfield), are confined to lava flows which are overlain by terrestrial and marine sediments. These sediments are 200 feet thick in the Mokuleia area and 500 feet thick at Waialua.

2. Hydrology

The principal aquifers in the Waialua-Kahuku District are the basaltic lavas of both the Waianae and Koolau Volcanic Series. Ground water is transmitted and stored in open spaces within clinker, lava tubes, vesicles, imperfect flow contacts, and cooling cracks.

¹ Clay, silt, sand, gravel, or similar terrestrial material deposited by running water.

a. Types of Ground Water Bodies

There are several types of general ground water bodies on Oahu. The most important and extensive are the bodies of basal water that underlie most of the island. Caprock sources are also found on Oahu. Another type of water body is found between the sheetlike rock structures called dikes, which have solidified within the conduits of the rift zone. A less significant type of water body is perched water.

(1) Basal Water

Figure 3 illustrates the hydrology of basal water, which is derived from leakage from dike compartments and direct infiltration of rainfall over dike-free basalts and, in some areas, return irrigation water. Due to a difference in density, freshwater floats upon denser water of higher salinity. As a general "rule-of-thumb", the density ratio between freshwater and salt water is such that, theoretically, for each foot that the freshwater lens stands above sea level (i.e., for each foot of head), the lens extends 40 feet below sea level to a midpoint where salinity is half that of sea water. This relationship is known as the Ghyben-Herzberg principle. For example, if the freshwater head was found to be 20 feet above sea level, it can be reasonably estimated that the depth to the midpoint of the transition zone would be approximately 800 feet below sea level.

The amount of water in storage in a basal lens is significant. This characteristic permits draft rates in excess of the sustainable yield¹ during periods of high demand and low recharge, so long as there is compensation by reducing draft rates less than the sustainable yield during other periods. Recognizing the temporal pattern of draft, therefore, the sustainable yield of a freshwater lens is defined in terms of an average draft rate that will not cause harm to the lens.

¹ Sustainable yield is defined as the upper limit of the average rate of draft from a water resource that can be made using practicable technology and that can be sustained indefinitely without undue detrimental effects on the resource or water supplies that are or may be drawn from it.

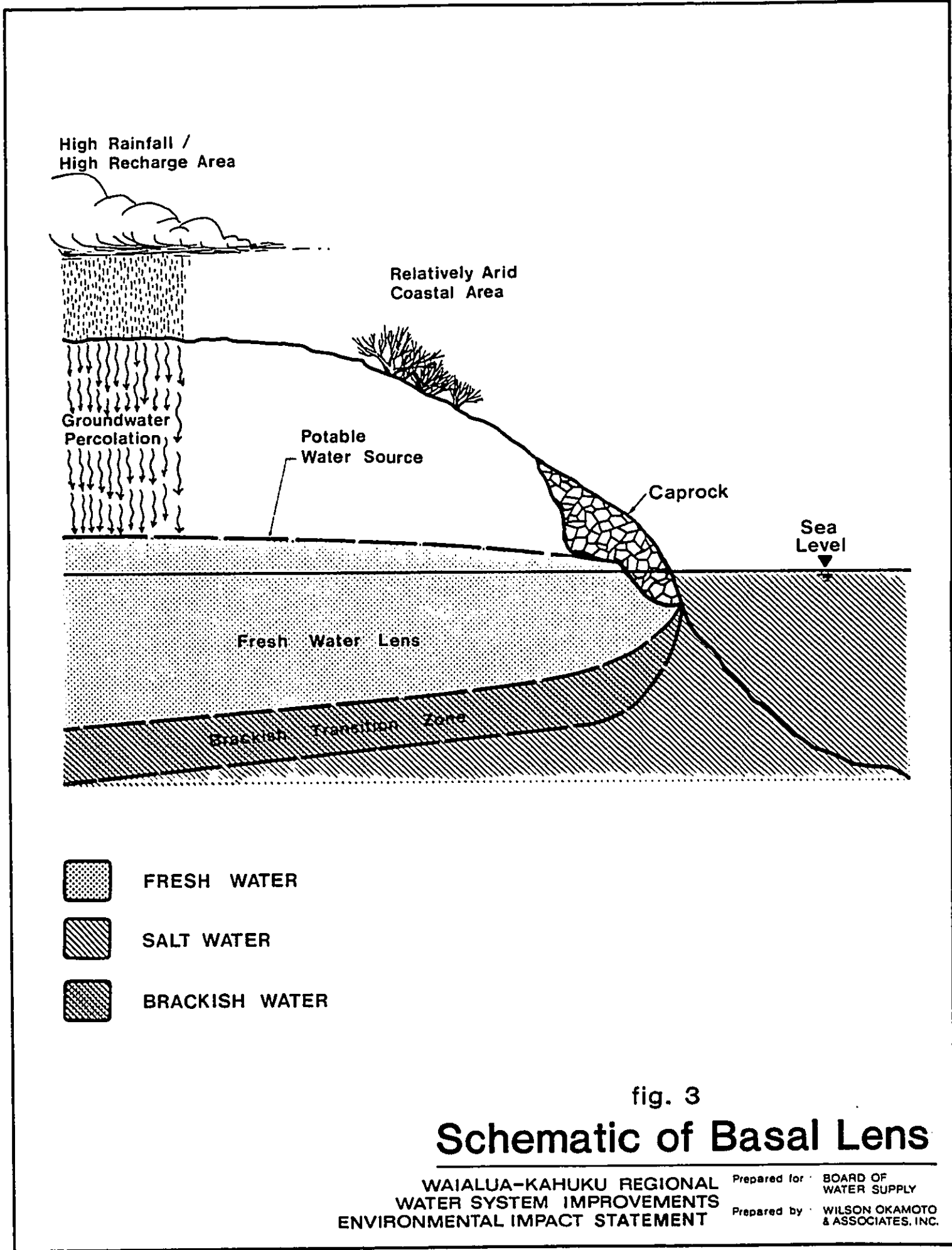


fig. 3

Schematic of Basal Lens

WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS ENVIRONMENTAL IMPACT STATEMENT

Prepared for: BOARD OF WATER SUPPLY
 Prepared by: WILSON OKAMOTO & ASSOCIATES, INC.

The sustainable yield of a freshwater lens is the difference (excess) of the amount of water which can be extracted from a lens minus the amount of outflow from the lens; i.e. the pumpage plus the outflow needed to keep the lens fresh.

(2) Caprock Water

In some coastal areas there is a relatively impermeable sediment sequence commonly called "caprock". This caprock barrier tends to restrict the seaward flow of freshwater and causes the thickness of the freshwater lens to be greater than it would if the caprock was absent. Depending upon the effectiveness of the caprock, the resulting lens could range from minor local thickening of a few feet to a relatively thick lens of several hundred feet. Caprock water is derived from local rainfall, return irrigation water and leakage of basal water bodies.

(3) Dike Water

Water impounded between relatively impermeable dikes in the mountains is called "dike water", or high-level water. Dikes are formed when molten magma intrudes and solidifies in conduits within the volcano's rift zone. These conduits may feed eruptions on the surface or may stay beneath the surface. Typically, they consist of nearly vertical slabs of dense, massive rock, generally a few feet thick, that can extend for considerable distances and cut across existing older lava flows. High level water impounded in permeable lavas occurring between dikes in the interior portions of Oahu is of excellent quality and is generally hydrologically distinct from the basal water found in dike-free areas. The water is not subject to saline contamination because of the high head of the water trapped between the dikes, distance from the sea, and low permeability of the dikes which inhibit the lateral flow of seawater. However, some water leaking through the dikes or overflowing, supplies the basal lens.

In many cases, dike-impounded water discharges at the ground surface where stream erosion has breached dike compartments. Once breached, the percentage of overall contribution to total stream flow depends on the head of the stored water, how deep the stream has cut into the high level reservoir, the permeability of the lavas between

dikes, the size of the compartments as well as connections to other compartments, and the amount of infiltration into the compartment that is breached.

(4) Perched Water

Ground water can be perched on top of layers of impermeable material such as dense volcanic rock, weathered and solidified ash, or clay-bearing sediments. Discharge of perched water sometimes occurs as springs where the perching member has been breached by erosion. Perched water supplies can be developed by tunnels or by constructing masonry chambers around spring orifices to collect flow and to prevent surface contamination.

b. Hydrology of the Waialua-Kahuku District

The basaltic lavas of both the Waianae and Koolau volcanic Series are the principal aquifers in the Waialua-Kahuku District. Major ground water bodies within this water use district are located within the Waianae Range, Koolau Range, Mokuleia area, Waialua-Haleiwa area, Kawaihoa area, Waimea-Kawela area, and Kahuku area.

(1) Waianae Range

Ground water is impounded at high levels by dikes in the central portion of the Waianae Range. The dikes in the Waianae Range have been mapped into two major rifts or dike complexes and one secondary rift. One rift trends west-northwest towards Kaena Point. The second trends southeast, outcropping mainly at Puu O Hulu kai and Puu Haleakala. The third system trends northeast toward Waialua and is a secondary rift zone radiating from the center of the former Waianae volcano (Stearns and Vaksvik, p. 78, 1935).

The amount of ground water impounded within the dike compartments depends on the porosity and permeability of the lava, the amount of rainfall, the area of recharge and the size of the compartment. In general, the marginal dike zone exposed on the north wall of Makaha Valley and to the northwest, toward Kaena Point, do not contain significant quantities of impounded water due to a small recharge area. Similarly, the dike compartments of the northeast rift zone are not expected to

contain significant quantities of developable water. However, a considerable amount of high-level ground water issues from the marginal dike zone which underlies the alluviated floor of Makaha Valley. Caldera-filling lava flows and lava flows outside the caldera have been intruded by widely spaced dikes. High level ground water is also present in the Waianae and Lualualei Valleys. Some of this ground water have been developed for agricultural and domestic uses. A component of Makaha Stream is direct runoff from the bog located at the summit of the Waianae Range, Mount Kaala.

Discharge of Waianae ground water reaches the sea as ground water flow in the Mokuleia area and Kaena subareas.

(2) Koolau Range

The major basal and dike-compartmented ground water aquifers in the Waialua-Kahuku District are the lavas of the Koolau Volcanic Series. The ground water in the district is stored in permeable layers of volcanic rock. The western boundary of the basal ground water body underlying the Koolau Range is approximately parallel with, and over 10 miles west of the Koolau Range crest. Dikes, in the central portion of the Koolau Range, impound ground water at high levels.

(3) Major Ground Water Reservoirs

Ground water recharge occurs primarily in the higher elevations where evapotranspiration is lower and rainfall is greater. As the ground water moves seaward, there are five areas where undeveloped ground water discharges to the ocean as diffuse coastal seeps, springs and submarine discharge. These discharge areas are identified in order from west to east as Mokuleia, Waialua-Haleiwa, Kawaihoa, Waimea-Kawela, and Kahuku.

(a) Mokuleia

A fresh basal ground water reservoir is located under the lower north slope of the Waianae Range from Waialua to Kaena Point. Ground water in the Mokuleia area originates from rainfall in the Waianae Range, the

Schofield Plateau area and deep percolation irrigation water known as return irrigation.

Alluvium along the coastal areas of Mokuleia partially confine ground water as it moves seaward. West of Mokuleia, the alluvium layer is thinner and less able to impede the flow of ground water to the ocean. Ground water also leaks into marine sedimentary material. A thin body of fresh to brackish water within permeable coralline limestone is located along the Mokuleia coastline. (Rosenau, Lubke and Nakahara, p. 26, 1971)

(b) Waialua-Haleiwa

An extensive freshwater body is located in dike-free Koolau lava flows from Waialua to Waialeale. Recharge from rainfall in the Koolau Range maintains this lens. The water body is divided into two segments near the coastline, the Waialua-Haleiwa and Kawaihoa, by thick alluvial fill and weathered bedrock (basalt) in the Anahulu River Valley. (Rosenau, Lubke and Nakahara, p. 27, 1971)

The movement of ground water in the Waialua-Haleiwa area occurs in a seaward direction, and is confined by a thick caprock sequence of marine and terrestrial sediments. Some ground water moves northwest to the Kawaihoa area.

(c) Kawaihoa

The Kawaihoa freshwater body is identified by a 6-foot difference in water level across the Anahulu River. High water levels are found near the Anahulu River with declining levels found to the northeast towards Waimea. A portion of ground water may move northeastward through or under the alluvium-filled Anahulu River valley, as indicated by the presence of high water levels south of the Anahulu River. (Rosenau, Lubke and Nakahara, pp. 28 and 29, 1971)

Free movement of ground water to the ocean is found in the Kawaihoa area due to a thin, or a lack of, confining caprock material. The discharge of water occurs from lava near the shoreline and through sedimentary material into a large coastal swamp located in the southwestern Kawaihoa area. The existence of freshwater springs offshore have been reported (Rosenau, Lubke and Nakahara, p. 29, 1971).

(d) Waimea-Kawela and Kahuku

Rainfall is responsible for the ground water recharge in the Waimea-Kawela and the Kahuku areas. The dike zone in this area of the District is approximately 2-1/2 miles wide and 10 miles long (within the confines of this district), and runs northwest or parallel to the crest of the Koolau Range toward Kawela Bay (Takasaki and Valenciano, pp. 26 and 27, 1969).

Dike water is especially significant in the Waimea-Kawela area although quantities present are undetermined. Basal water sources are of lesser significance in the Waimea-Kawela area due to higher saline concentrations which increase markedly with distance from the dike zone where leakage of dike water is not present. (Takasaki and Valenciano p. 54, 1969)

Natural occurrence of ground water flow in this lens is generally due to a thin caprock which allows considerable offshore leakage to occur. The basal water supply of most of the Kahuku area is fully developed.

3. Topography

The physiography of the Waialua and Kahuku areas is dominated by the Waianae and Koolau Ranges, respectively. Both mountain ranges are cut by many intermittent streams, forming ridges and gullies.

With the exception of long, narrow valleys and cliffs near the shoreline, the Kahuku area of the Koolau Range has retained the general shape of a volcanic shield at its last stage of growth.

The west side of the Koolau Range is broad and gently sloping. By comparison, the Waianae Range, especially its north and east sides, is steep, extensively gullied, and generally unsuitable for cultivation.

Slopes of 30 percent or more are found in the cliff and valley areas of the Waianae and Koolau Ranges. At valley heads and within lands bordering the coastal plains, steep slopes of 21 to 30 percent as well as flatter slopes of 11 to 20 percent are found. Lands on the coastal plains and mouths of valleys have relatively flat slopes of 10 percent or less. These areas include large coastal areas from Mokuleia Beach on the west, the entire Waialua area, and Kahuku on the northeast.

The area of the coastal plain (0 to 10 percent slope) from Camp Erdman on the east to Kaena Point on the west, as well as the coastline south of Kaena Point, is very narrow. The steep Waianae Range dominates this area of Oahu.

4. Climate

The climate of the Island of Oahu reflects Hawaii's location at the northern fringe of the tropics and the moderating influence of the Pacific High or anticyclone located to the northeast. Hawaii's climate is characterized by mild and equable year-round temperatures, moderate humidity, northeasterly tradewinds, marked differences in rainfall over short distances from orographic effects and infrequent severe storms.

The climate of the northern area of Oahu is characteristically mild with persistent northeast trade winds, and between 25 and 300 inches of rainfall annually. Humidity of the area is generally within the 60 to 80 percent range. The annual temperature range is relatively small with the difference between the coldest and warmest months averaging only 6.5°F. (Rosenau, Lubke and Nakahara, p.7, 1971)

The mean temperature and humidity near the town of Kahuku are 74.9°F and approximately 70 percent, respectively. The mean annual wind speed near Kahuku is slightly greater than 10 miles per hour (Takasaki and Valenciano, p. 11, 1969).

Average annual precipitation at Kahuku is 40 inches (State of Hawaii, Department of Planning and Economic Development,

1986). The greatest and least monthly rainfall of record are approximately 36 and 9 inches, respectively (University of Hawaii, Department of Geography, 1983).

The area of highest (mean annual) rainfall on Oahu is within the southeastern Kahuku area, near the crest of the Koolau Range. This area receives slightly more than 300 inches of rain per year. This high rainfall results from the rapid cooling of orographically lifted, warm, moist tradewinds. Thus, while rainfall near the crest of the Koolau range is heavy, it decreases rapidly downslope. The tradewinds are strongest during the summer, producing frequent upland showers. Rainfall along the coastline is more uniformly distributed and is produced by winter fronts and Kona storms.

The mean annual rainfall at Waialua is approximately 30 inches. Mean monthly temperatures at Waialua average 73.5°F. Wind speed at Mokuleia is usually within the 4 to 12 miles per hour range, from an easterly direction.

The Waianae Range receives much less rainfall than the Koolau Range even though Mount Kaala is 4,020 feet above sea level. The mean annual rainfall on the summit of the Waianae Range, Mount Kaala, is more than 100 inches per year. Mount Kaala is the highest point on Oahu.

5. Soils

Soil associations on the Island of Oahu are delineated on a general soil map by the U.S. Department of Agriculture, Soil Conservation Service (SCS). Intended for general planning purposes, a soil association is a landscape depicting a distinctive proportional pattern of soils. There are seven different soil associations within the Waialua-Kahuku District and the Waianae area.

The Lualualei-Fill land-Ewa association is located on fans and in drainageways of Oahu's western coastal plains, extending along the coast, approximately 2 miles southeast of Kaena Point, to Waianae. Formed of alluvium, this association consists of well-drained soils that have a fine or moderately fine textured subsoil or underlying material. It is representative of approximately 14 percent of Oahu soils.

The Rock land-Stony steep land association extends from Kaena Point along the western side of the Waianae Range. This association consists of steep to precipitous, well-drained to excessively drained, rocky and stony land. Approximately 15 percent of the Island of Oahu is comprised of the Rock land-Stony steep land association.

The mountainous areas and lower eastern slopes of the Waianae Range are composed of the Tropohumults-Dystrandeps association which is representative of about 8 percent of the soils of Oahu. This association consists of gently sloping to very steep, well drained, and fine to moderately fine textured soils. These soils are underlain by soft weathered rock, volcanic ash, or colluvium.

The Kaena-Waialua Association is located in drainageways, on coastal plains and talus slopes from Kaena Point to Kahuku. Comprising about 10 percent of Oahu soils, this association has the characteristic of having poorly to excessively drained soils with level and gentle slopes. These soils are formed in alluvium and have a fine to coarse textured subsoil or underlying material.

The uplands from Waialua to Sunset Beach consist of the Helemano-Wahiawa association. These soils are formed in material weathered from basalt and make up about 18 percent of the soils on the Island of Oahu. The association consists of deep, nearly level to moderately sloping, well-drained soils with a moderately fine to fine texture. The underlying subsoil is fine textured.

The Lolekaa-Waikane association is found on uplands, alluvial fans, and terraces of the Koolau Range. This association is composed of deep, nearly level to very steep, well-drained soils. These fine to moderately fine textured soils have a dominantly fine-textured subsoil. They occur on older alluvium and colluvial material derived from basic igneous rock. This association is representative of approximately 15 percent of the soils of Oahu.

The rough mountainous land-Kapaa association occurs on the Koolau Range between 1,000 feet and 3,000 feet elevations. Found in gullies and on narrow ridges, this association consists of very steep land broken by numerous drainageways. The soils are deep and well-drained with a fine or moderately fine textured subsoil. This association makes up about 20 percent of the Island of Oahu.

Specific soil types at sites for the proposed improvements are discussed in Section VII.B.

6. Water Quality

a. Ground Water

The proposed water system improvements will develop potable ground water for domestic use. The water must meet drinking water quality standards established by the

State Department of Health (DOH) as discussed in Section V.B.4. All BWS potable water sources meet DOH and Environmental Protection Agency (EPA) water quality standards.

b. Surface Water

In 1977, the U.S. Fish and Wildlife Service's Stream Channel Modification in Hawaii study classified perennial streams into one of four categories. The categories describe both the environmental quality and the appropriate use of the streams and are based on the State DOH water quality standards, as proposed in 1977. The four categories are:

(1) Pristine-Preservation

Streams with high environmental and biological quality. Intended uses for this category range from those involving no consumption, degradation, or modification, to special exploitive, but non-degrading uses.

(2) Limited Consumptive

Streams with moderate to high quality water or natural values, whose use is controlled to prevent excessive modification.

(3) Exploitive-Consumptive

Streams with moderate to low natural environmental-biological and/or water quality, including those which are well exploited, modified or degraded and are intended for water related recreational activities.

(4) Construct-Alter

Streams with low environmental and biological quality which may be restricted to the public for health or safety reasons.

There are 54 perennial streams recognized on the Island of Oahu. Twelve streams are located within the Waialua-Kahuku District.

Both Oio Stream near the Turtle Bay Resort and Makaleha Stream in Mokuleia have modified channels (see Table 7). The Oio and Makaleha Streams are categorized as Exploitive - Consumptive. Characteristics of streams within the Waialua-Kahuku District are presented in Table 8.

TABLE 7

SOME PHYSICAL CHARACTERISTICS OF STREAMS WITH
CHANNEL MODIFICATIONS WITHIN THE
MAIALUA-KAHUKU DISTRICT

Stream	Class <u>1/</u>	Length of Channel (km)		Alteration Features		Location	
		Total	Modified	Type <u>2/</u>	Date <u>3/</u>	Distance (km) <u>4/</u>	Elevation (m) <u>5/</u>
Oio Stream	I	10	2.0	2	1931, 1970	0	0
Makaleha Stream	C	23	1.3	2	1975	0	0

1/ C = continuous, I = interrupted.

2/ 1 = lined channel, 2 = vegetation removed - channel realigned, 3 = elevated culvert, 4 = revetment, 5 = blocked or filled-in channel, 6 = extended culvert.

3/ Year of earliest and most recent channel modification.

4/ Horizontal distance from mouth to lowest point of channel modification.

5/ Elevation of lowest modification.

Source: Stream Channel Modification in Hawaii, Part A: Statewide Inventory of Streams, Habitat Factors and Associated Biota, 1978.

TABLE 8
EXISTING STREAM - ECOLOGICAL CHARACTERISTICS

<u>Streams</u>	Anahulu	Kaukonahua	Makaieha	Makua	Ofo	Paukauia	Paumotu	Waimea	Kaunawaikaaia	Kawaihapa	Kawela	Pakulena
<u>Stream Characteristics</u>												
<u>Ecological Quality Status</u>												
Pristine-Preservation												
Limited Consumptive	X			X		X		X				X
Exploitive-Consumptive		X	X		X		X		X	X	X	
Construct-Alter												
<u>Stream Flow</u>												
Continuous	X	X	X			X		X				
Interrupted				X	X		X		X	X	X	X

Source: Stream Channel Modification in Hawaii, Part A: Statewide Inventory of Streams, Habitat Factors and Associated Biota, 1978.

None of the proposed improvements will be located within proximity to perennial streams, with the exception of the Waimea Well, which will be situated near a feeder tributary of the Waimea Stream.

7. Flood/Tsunami Hazards

Areas prone to flood hazards are delineated on the Federal Flood Insurance Rate Map (FIRM). Flood hazard areas (which include tsunami inundation areas) are categorized by the probability of hazard, based upon surveys prepared by the U.S. Army Corps of Engineers. Flood hazard zones encompassing the project sites are indicated in Section VII.B. All of the proposed well sites are located within Zone D, an area in which flood hazards are undetermined.

Development of water improvement facilities must comply with City and County of Honolulu Ordinance 80-62, regarding flood hazard areas.

8. Air Quality

The air quality of the Waialua-Kahuku area is comparatively better than that of the Honolulu area. An air quality study prepared for the Kuilima Resort Expansion Revised Environmental Impact Statement, estimated the peak hour concentration of carbon monoxide to be 9.3 mg/m^3 along Kamehameha Highway near Waimea in 1984.

As documented in Hawaii Air Quality Data for the Period of January 1982 - December 1984, the maximum one-hour carbon monoxide concentration at a Waikiki City monitoring station was as high as 12.0 mg/m^3 in 1984.

Additionally, atmospheric mercury distribution on Oahu between 1969 and 1974 was estimated in an environmental survey, the Kahuku Wind Energy Project Environmental Impact Statement, conducted for the Department of Land and Natural Resources. The mercury concentrations in the vicinity of Kahuku, Waimea, Waialua and Mokuleia were 0.08, 0.10, 0.40 and 0.08 ug/m^3 , respectively. In comparison, the mercury concentration near downtown Honolulu was estimated to be 0.91 ug/m^3 .

9. Agricultural Potential

a. Agricultural Lands of Importance

The State Department of Agriculture identifies agricultural lands of importance for the State of Hawaii. These lands are categorized into three groups. "Prime" agriculture lands have the soil quality, growing

season, and moisture supply needed to produce sustained high yields of crops economically, when treated and managed according to modern farming methods. "Unique" agricultural lands are those lands which have a special combination of soil quality, location, growing season, moisture supply, and are currently used to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods. Specialty crops such as taro or aquaculture development, for example, may have unique requirements which may not be desirable for traditional farm crops. "Other" important agricultural lands include agricultural lands which have not been rated "prime" or "unique" because they exhibit properties such as seasonal wetness, erodibility, limited rooting zone, slope, flooding or drought prone conditions which exclude them from the "prime" or "unique" categories. Nevertheless, they possess characteristics warranting their consideration as lands of statewide or local importance.

The Waialua-Kahuku District contains "Prime", "Unique", and "Other" agricultural lands. The agricultural land designations encompassing sites of the proposed improvements are identified in Section VII.B.

The proposed water system improvements are a compatible use within any agricultural land classification.

b. Land Study Bureau Detailed Land Classification Overall Productivity Ratings

The University of Hawaii Land Study Bureau has classified lands for overall suitability for agricultural use. Classification is indicated by a five-class productivity rating with A representing the class of highest productivity and E the lowest.

The Overall Productivity Ratings encompassing the well sites are indicated in Section VII.B.

10. Wetland Areas

A wetland area may be described as a "land area subject to periodic or permanent inundation during the growing season which causes the selection of a group or an association of plants that can tolerate the wet conditions" (U.S. Army, Engineer District, Honolulu, December, 1977). Recognized wetland values include, among others, performance of natural biological functions such as food chain production and habitat for a variety of aquatic and terrestrial species.

The U.S. Fish and Wildlife Service, for instance, has outlined certain areas within the State of Hawaii to protect endangered species. Within the Waialua-Kahuku region, Ukoa Pond and the Kahuku wetlands, including the James Campbell National Wildlife Refuge and Punahoolapa Marsh, have all been cited as wetlands of significance for protecting endangered waterbirds such as the Hawaiian stilt, coot, gallinule, and duck.

In addition to its value for supporting wildlife, wetlands are important in flood control as evidenced at Kawainui Marsh on Oahu and in improving water quality by removing and filtering certain pollutants.

In addition to those wetland areas noted above, wetlands within the Waialua-Kahuku District include Mt. Kaala, Dillingham Airfield, Haleiwa Wetlands, Waimea River, and Kalou Marsh. The wetland atop Mt. Kaala (elevation 4,000 feet), in the Waianae Range, is an upland bog. The bog occupies a poorly-drained, nearly level plateau.

Located in Mokuleia, the Dillingham Airfield Wetland consists of approximately 400 acres of land which is leased for cattle grazing. Heavy rains flood the extensive mudflats which are located within the primary grazing area.

The Haleiwa lowlands between Anahulu River and Kaukonahua Stream were developed for wetland agriculture in the early 1900's. Used primarily for rice and taro cultivation, there were over 150 separate water impoundments in this area before World War II. Currently, much of the area consists of residential developments and sugar cane fields. A few wetland areas remain such as a freshwater marsh near Haleiwa town and areas along stream banks and near irrigation canals. Loko Ea Pond, located north of the mouth of the Anahulu Stream was once connected to Ukoa Pond.

Ukoa Pond, listed as an essential habitat for endangered Hawaiian waterbirds, and its surrounding marshland are located approximately one mile northeast of Haleiwa, near Kawaihoa Beach. Water from this basal, spring-fed coastal marsh has been tapped and pumped for sugar cane irrigation. Additionally, part of the original marshland has been eliminated by the City's Kawaihoa Sanitary Landfill. Portions of the marshland are used for cattle grazing.

The Waimea River Wetland consists of a small estuarine marsh located on the lower reach of the Waimea River, near Waimea Bay. A sand dune at the mouth of the river offers some protection against wave action, however, the wetland is somewhat influenced by tidal action.

Kalou Marsh is located approximately two miles northeast of Sunset Beach. Once known as Kalou Fishpond, this site is listed in the Hawaii Register of Historic Places. A University of Hawaii Agricultural Experiment Station is located in the area, a portion of which is also utilized as pasture.

The Kahuku Wetlands consist of several wetland sites which were once part of an extensive marsh, located on coastal flatlands just northwest of Kahuku Town. The marsh, fed by springs, intermittent storm runoff, and ground water, has since been largely drained, filled, and converted to sugar production. The remaining wetlands includes Punahoolapa, Punamano and Kii Ponds, as well as a marsh along the abandoned Kahuku airstrip and a sewage infiltration reservoir at the Turtle Bay Resort Golf Course. In early 1977, the James Campbell National Wildlife Refuge was established by the United States Fish and Wildlife Service. The refuge encompasses both Kii and Punamano Ponds. The James Campbell National Wildlife Refuge and Punahoolapa Marsh are both listed as essential habitats for endangered Hawaiian waterbirds.

In addition to Ukoa Marsh and the Kahuku Wetlands, Crowbar Ranch Ponds, AmOrient prawn ponds, Haleiwa lotus fields and Waimea Falls Park are considered primary habitats for the recovery of endangered Hawaiian waterbirds in the Hawaiian Waterbirds Recovery Plan (U.S. Fish and Wildlife Service, September 1985). Proceeding from west to east, wetlands outlined in the National Wetlands Inventory maps for the District which are within one-half mile of proposed sources are described below and indicated on Figures 4a, b, and c:

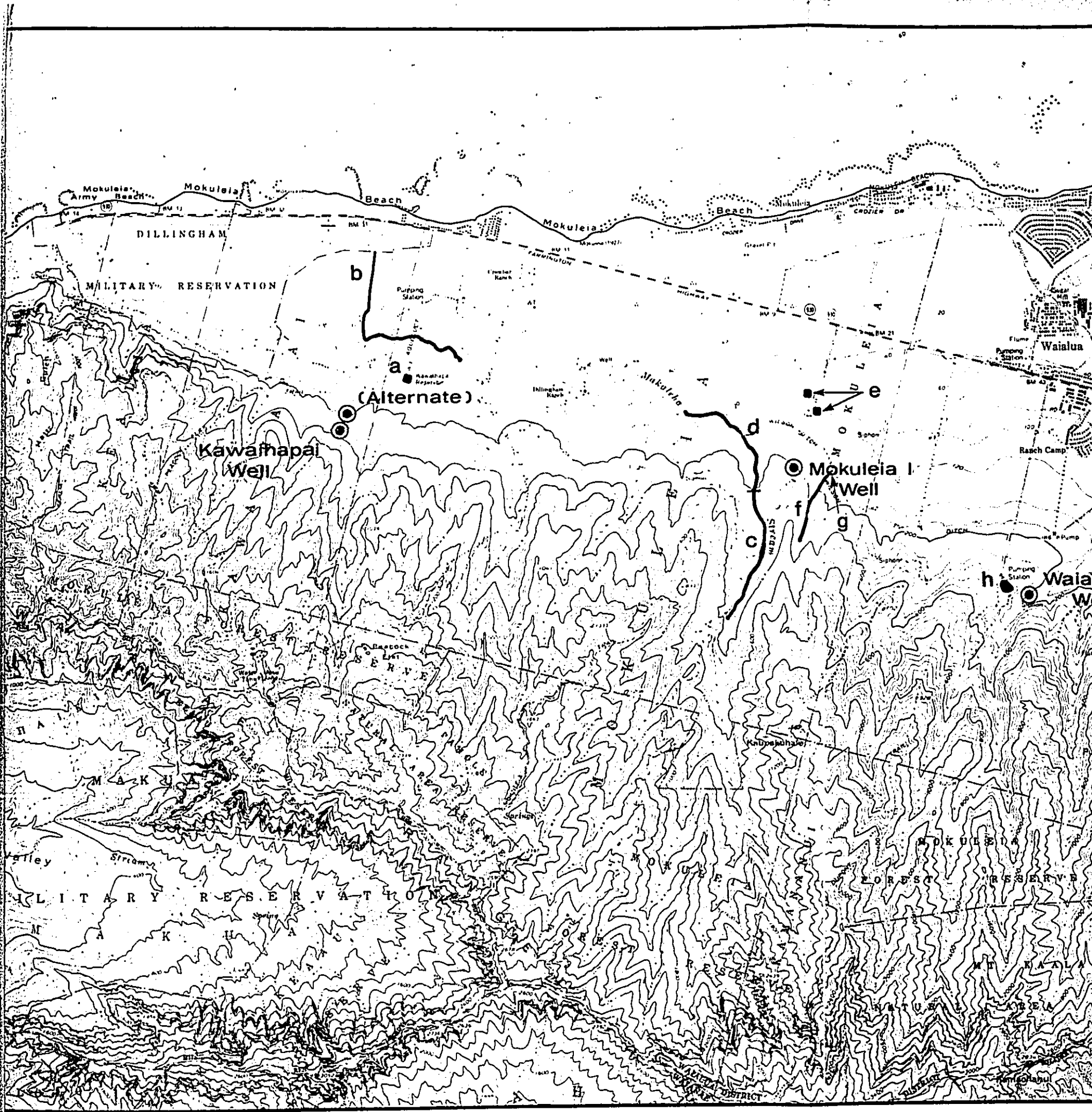
Kawaihapai Well:

- (a) Palustrine, Open Water/Unknown Bottom, Non-Tidal, Permanent, Diked/Impounded
- (b) Palustrine, Emergent, Persistent, Non-Tidal, Seasonal, Excavated

Mokuleia Well I:

- (c) Riverine, Intermittent, Streambed, Non-Tidal, Seasonal
- (d) Palustrine, Forested, Broad-leaved Evergreen, Non-Tidal, Temporary
- (e) Palustrine, Open Water/Unknown Bottom, Non-Tidal, Permanent, Diked/Impounded
- (f) Riverine, Intermittent, Streambed, Non-Tidal, Seasonal
- (g) Palustrine, Open Water/Unknown Bottom, Non-Tidal, Permanent, Diked/Impounded





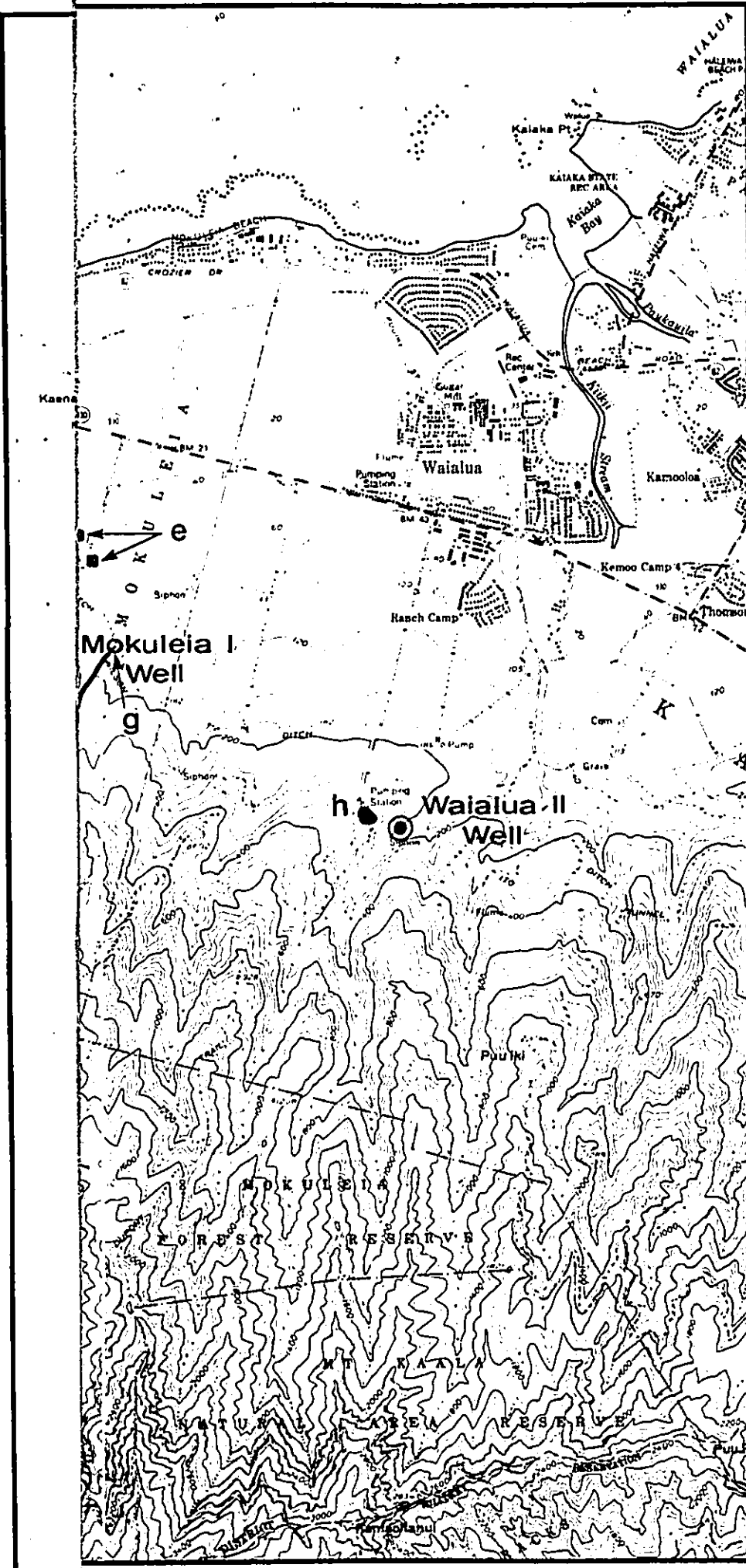


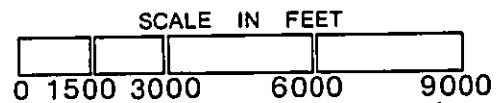
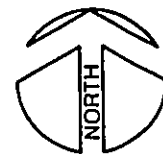
fig. 4a

Wetlands Located Within One-half Mile of the Proposed Sources

x Wetland
(described in text)

Note: Only a portion
of wetland streams
may be indicated.

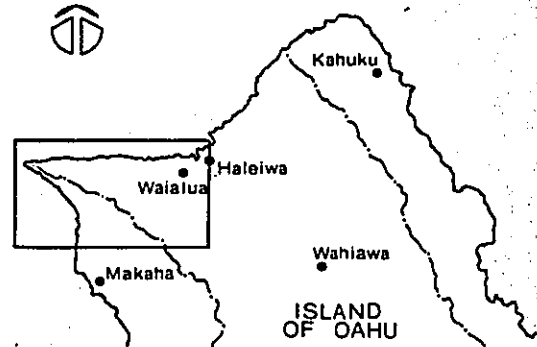
Source: U.S. Department
of the Interior,
National Wetlands
Inventory maps



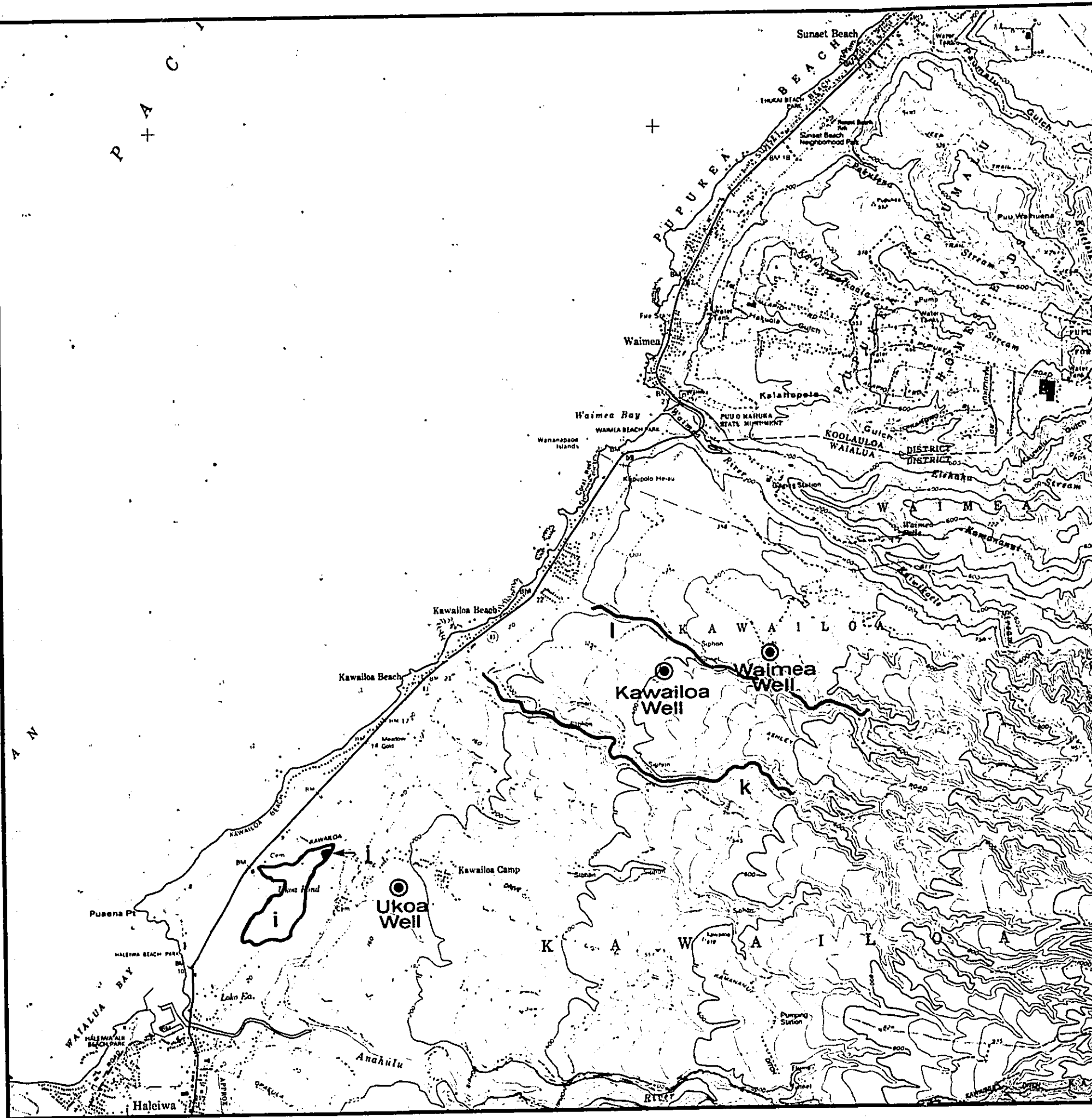
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WATER SYSTEM IMPROVEMENTS
ENVIRONMENTAL IMPACT STATEMENT

prepared for:
BOARD OF WATER SUPPLY
prepared by:
WILSON OKAMOTO & ASSOCIATES, INC.

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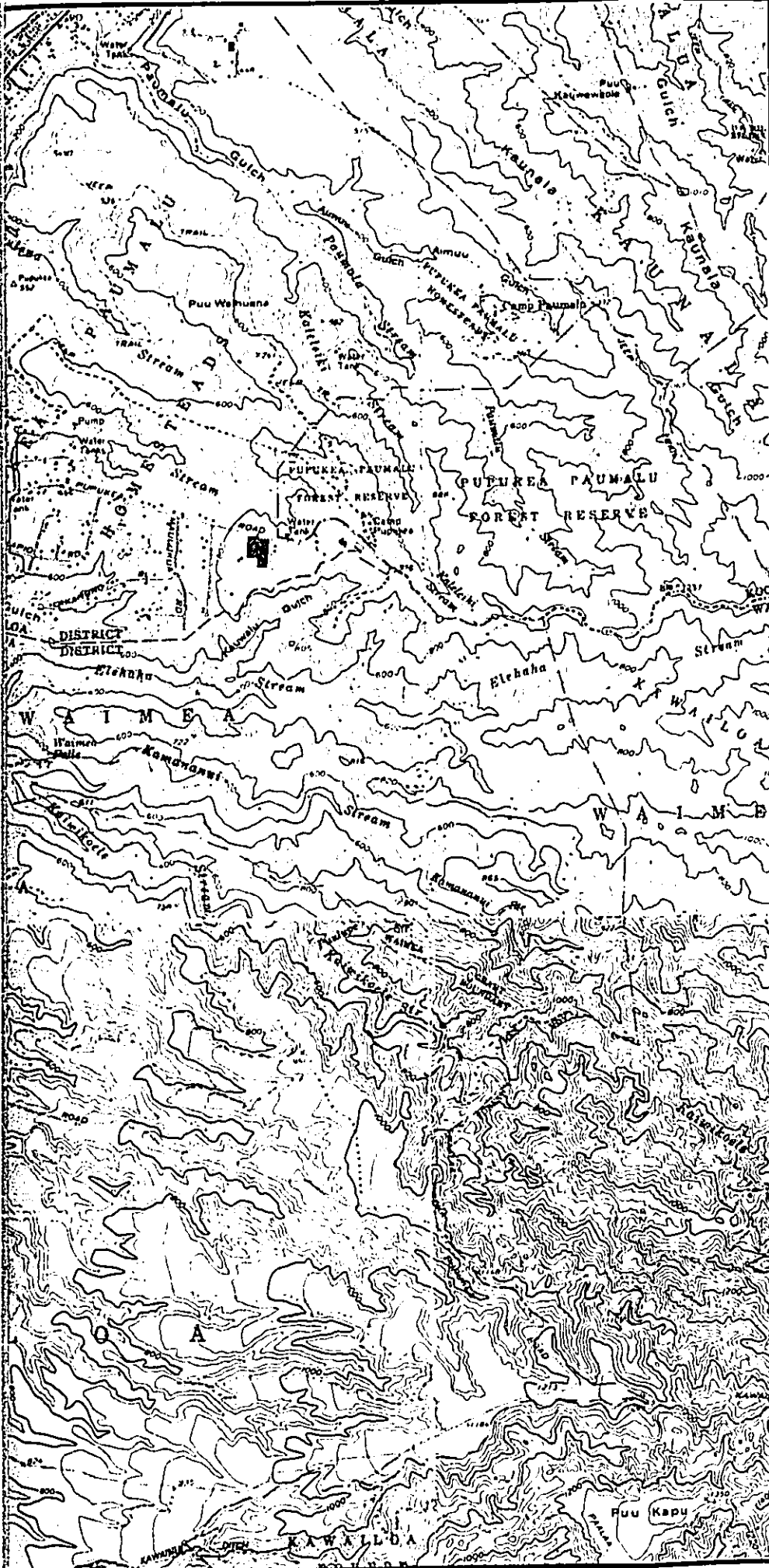
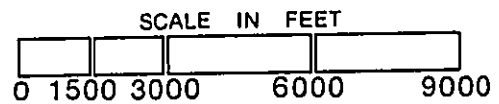
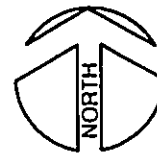


fig. 4b
**Wetlands
 Located Within
 One-half Mile
 of the Proposed
 Sources**

x Wetland
 (described in text)

Note: Only a portion
 of wetland streams
 may be indicated.

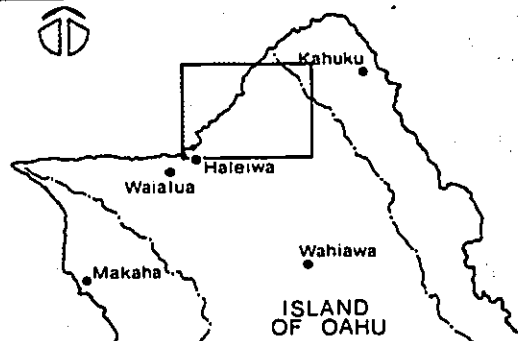
Source: U.S. Department
 of the Interior,
 National Wetlands
 Inventory maps



**WAIALUA-KAHUKU REGIONAL
 WATER SYSTEM IMPROVEMENTS
 ENVIRONMENTAL IMPACT STATEMENT**

prepared for:
BOARD OF WATER SUPPLY
 prepared by:
WILSON OKAMOTO & ASSOCIATES, INC.

KEY TO PLATE



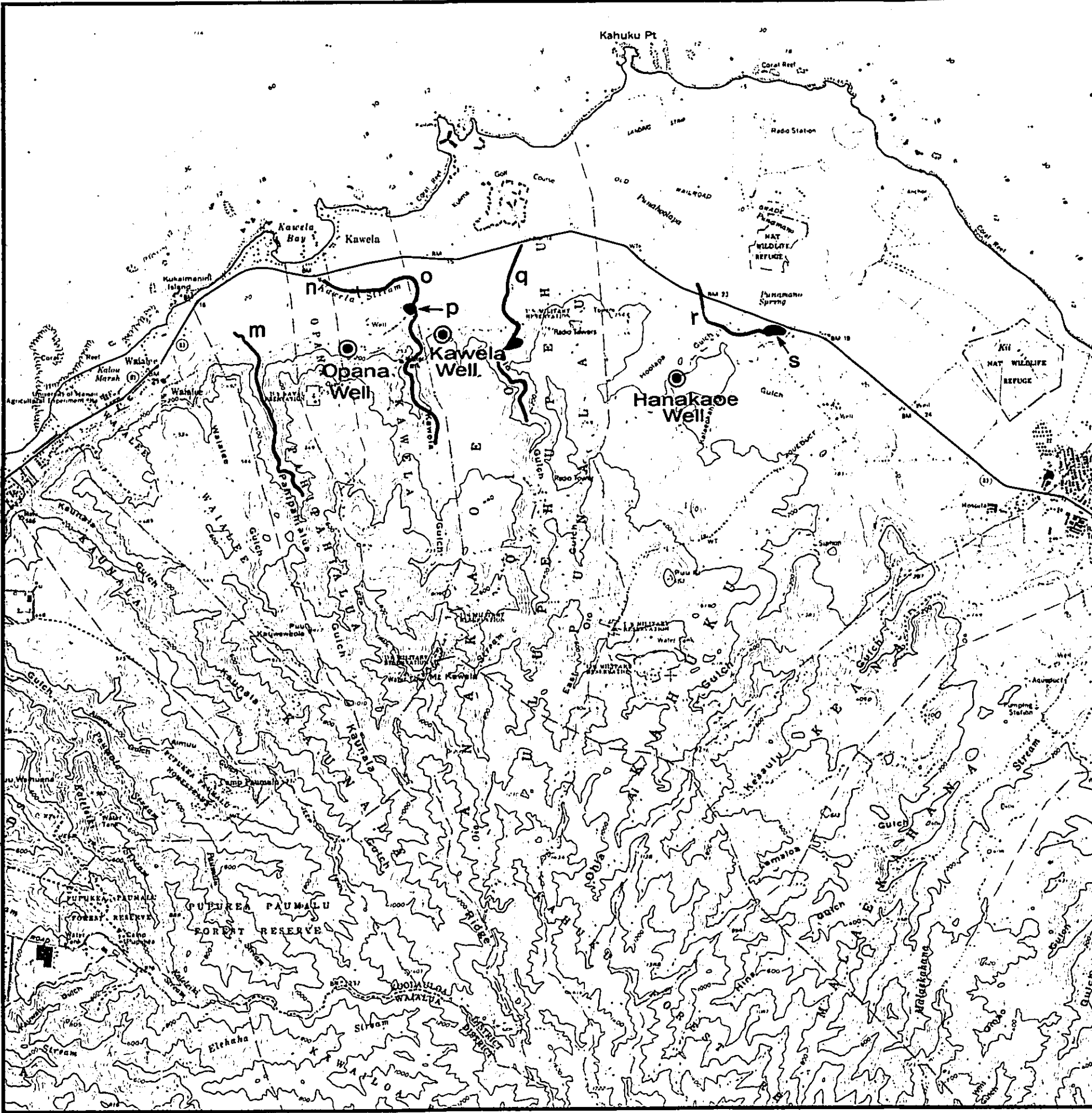
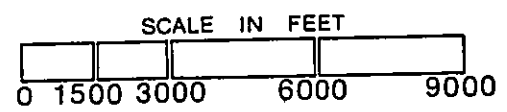
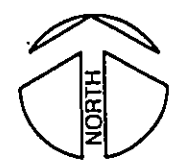
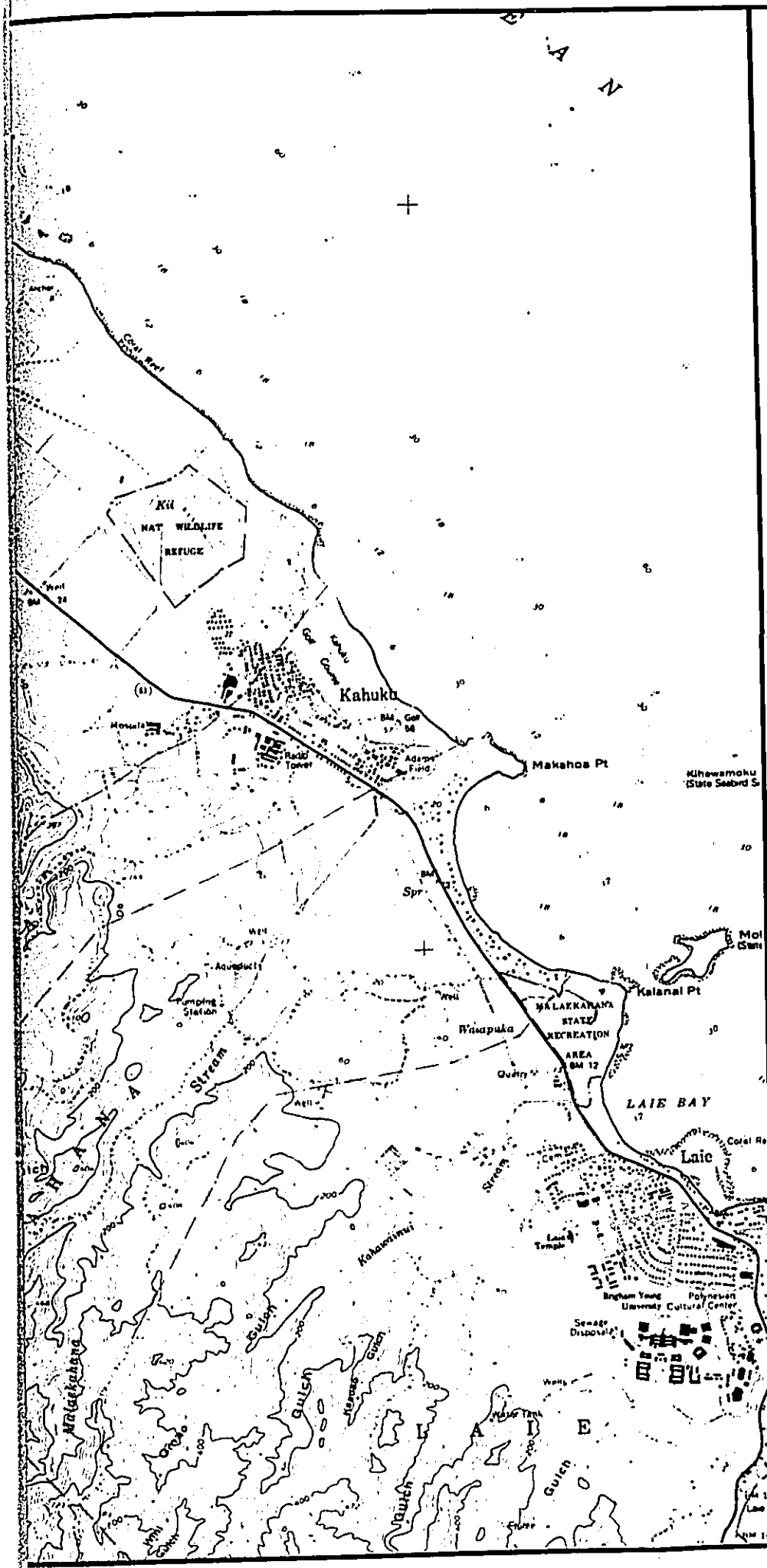


fig. 4c
**Wetlands
 Located Within
 One-half Mile
 of the Proposed
 Sources**

x Wetland
 (described in text)

Note: Only a portion
 of wetland streams
 may be indicated.

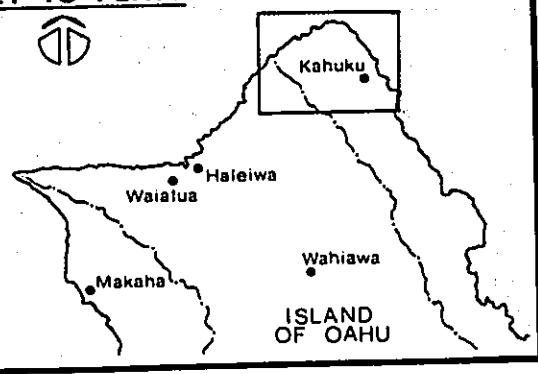
Source: U.S. Department
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Waialua Well II:

- (h) Palustrine, Open Water/Unknown Bottom, Non-Tidal, Permanent, Diked/Impounded

Ukoa Well:

- (i) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Emergent, Persistent, Non-Tidal, Seasonal
- (j) Palustrine, Open Water/Unknown Bottom, Non-Tidal, Permanent

Kawaihoa Well:

- (k) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Non-Tidal, Seasonal
- (l) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Non-Tidal, Seasonal

Waimea Well:

See (l) above

Opana Well:

- (m) Palustrine, Forested, Broad-leaved Evergreen, Non-Tidal, Seasonal
- (n) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Non-Tidal, Seasonal
- (o) Palustrine, Forested, Broad-leaved Evergreen, Non-Tidal, Seasonal
- (p) Palustrine, Open Water/Unknown Bottom, Non-Tidal, Permanent, Diked/Impounded

Kawela Well:

See (n), (o), (p) above

- (q) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Non-Tidal, Seasonal

Hanakaoe Well:

- (r) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Non-Tidal, Seasonal, Excavated
- (s) Palustrine, Scrub/Shrub, Broad-leaved Evergreen, Emergent, Persistent, Non-Tidal, Semipermanent, Partially Drained/Ditched

11. Archaeological/Historic Sites

At the time of Captain James Cook's arrival in the Hawaiian Islands, Hawaiian culture was heavily influenced by beliefs in the supernatural. Daily activities of building, planting, fishing and farming were vested with ceremonial ritual and dictated by regional monarchs.

This lifestyle was subsequently westernized by the arrival of European visitors. Contact with Europeans and Americans proliferated as merchant ships passed through the islands and missionaries arrived.

Remaining historical features evidence the unique evolution of the island's cultural heritage. In the Waialua-Kahuku District, there are many such features. Presented in Table 9 are those historic sites in the Waialua-Kahuku District which are listed on the Hawaii or National Historic Registers, and those which have been recommended to the National Register.

Archaeological reconnaissance surveys conducted at proposed project sites are contained in Appendix C and discussed in Section VII.B.

12. Flora

The coastal lowlands between Kaena Point and Kahuku receive 20 to 40 inches of rain a year. An association of lantana (Lantana camara L.) and koa haole (Leucaena leucocephala) shrubs thrives under these conditions and generally characterizes the flora of the area. Other prevalent vegetation include klu (Acacia farnesiana L.), panini (Opuntia megacantha), ilima (Sida fallax), and Natal redtop grass (Rhynchelytrum repens).

The predominant vegetation of the northeastern slopes of the Waianae Range, the Leilehua Plateau, and the northern slopes of the Koolau Range, below an elevation of 2500 feet, is an association of open guava forest and shrubs. Flora characteristic of this area include guava (Psidium guajava), koa haole (Leucaena leucocephala), lantana (Lantana camara L.), Spanish clover (Desmodium spp.), and Bermuda grass (Cynodon dactylon).

The prevalent vegetation at altitudes below 1500 feet on the slopes of the Waianae and Koolau Ranges, where annual rainfall is 60 inches or more, consists of closed guava forests with shrubs. Characteristic plants include guava (Psidium guajava), Boston fern (Nephrolepis exaltata bostoniensis), Hilo grass (Paspalum conjugatum), basket grass

TABLE 9
HISTORIC SITES IN THE WAIALUA-KAHUKU DISTRICT

SITE NAME	HAWAII REGISTER REGISTERED	NATIONAL REGISTER RECOMMENDED	NATIONAL REGISTER REGISTERED	TMK
Kupopolo Heiau	9/5/78	9/5/78	6/4/73	6-1-5:16
Puu O Mahuka Heiau	1/29/81	10/8/71	1966 NHL	5-9-5:68
Kalou Fishpond	1/30/81			5-8-1:15(por), 55
Burial Complex	1/17/72			6-1-5:16
Platform	5/10/71			5-8-2:1
Keahu O Hapuu Complex	1/17/72			6-1-1:1
Kahuku Habitation Area			9/11/72	5-6-3:10
Burial Platform			8/14/73	5-7-2:3
Greenfield Complex	11/15/71			6-8-7:1
Kalakiki Heiau	11/15/71			6-7-2:6
Waialua Habitation Area	11/15/71			6-7-4:1
Habitation and Agricultural Complex	11/15/71			6-7-4:1
Waialua Courthouse	2/20/79			6-6-9:23
Waialua School (Haleiwa Elementary School)	5/3/80	5/3/80	8/11/80	6-6-13:12(por)
Kawailoa Ryusenji Temple			11/21/78	6-1-5:1(por)

Source: Hawaii Register of Historic Places, June 1979, revised 5/21/80,
9/22/80, 9/14/81, 12/30/81, December 1987.

(Oplismenus hirtellus), false staghorn fern (Dicranopteris linearis), kukui (Aleurites moluccana) and hala (Pandanus odoratissimus).

A closed ohia lehua rainforest occupies the upper slopes of the Waianae and Koolau Ranges. Native Hawaiian flora characteristic of these areas are the ohia lehua (Metrosideros collina sub sp. polymorpha), hapuu tree fern (Cibotium spp.), and olapa (Cheirodendron trigynum).

Botanical surveys conducted at proposed project sites are contained in Appendix D and presented in Section VII.B.

13. Stream Fauna

The uniqueness of Hawaii's native stream fauna may be observed in its adaptation to the rocky, precipitous, freshet-flow nature of Hawaiian streams. All large native stream species, excluding insects, are diadromous (having marine larval development), indicative of invasion from the oceanic ecosystem and incomplete adaptation to freshwater life. Most species are endemic, though the number of species within a given taxon are few. Exotic species, however, dominate most streams.

Fauna found in many Oahu streams include the crayfish (Procambarus clarkii), indigenous goby (Awaous genivittatus), endemic goby (Awaous stamineus), and the wild guppy (Poecilia reticulata). Fauna prevalent in altered streams include the tilapia (Tilapia mossambica) and the swordtail (Xiphophorus helleri). The Chinese catfish (Clarias fuscus) and Tahitian prawn (Macrobrachium lar) are common in cleared-realigned channels. Toads (Family Bufonidae), and the bullfrog and wrinkled frog (Family Ranidae) occur on all the main Hawaiian Islands.

Stream fauna surveys were conducted in June, 1985 at Kamananui Stream and Ukoa Marsh for this regional EIS (see Appendix E). Kamananui Stream, the principal tributary of Waimea River, flows near the proposed Waimea Well and is the source of water for Waimea Falls, a popular tourist attraction. Kamananui Stream is perennial and characterized by strong, clear-flowing riffles and infrequent, deep pools. The aquatic survey found two native freshwater gobies (o'opu) in abundance. These are o'opu nakea, Awaous stamineus, and o'opu naniha, Stenogobius genivittatus. Other aquatic fauna observed include:

- o Macrobrachium lar or Tahitian prawn;
- o Muqil cephalus or mullet;

- o Poecilia mexicanus or shortfin molly;
- o Poecilia reticulata or guppy; and
- o Xiphophorus helleri or swordtail.

Aquatic fauna observed at Ukoa Marsh included Procambarus clarkii (crayfish), Xiphophorus helleri (swordtail) and Bufo marinus (Bufo toad).

14. Terrestrial Fauna

All of the proposed sites could provide habitats, or could be frequented by a variety of mammals known to exist in the region. These include feral pigs, feral cats, feral dogs, mongooses, rats and mice. Additionally, cattle may be found near several of the project sites.

Wild turkeys and peacocks may inhabit the north slope of the Waianae Range. A few wild goats may be found in the northern extent of the Waianae Range. The summit of the Waianae Range and the northern part of the Koolau Range, both wet areas, provide a favorable environment for wild pigs, many of which are hybrids of the wild Hawaiian pig and introduced breeds.

Insect life is abundant, and the control of the insect population is especially important in agricultural areas, such as Waialua and Kahuku. Trees and shrubs are inhabited by land snails of the genus Achatinella which are classified as endangered by Federal and State law.

Birds found in agricultural areas from Kahuku to Mokuleia include the cardinal, barred and spotted doves, mockingbird, golden plover, pueo, ricebird, house sparrow, ring neck pheasant, egret, sea birds and white eye. Birds found in the forest, shrubland and grassland near Kaena Point include all those mentioned above except the house sparrow.

Wetland areas provide habitats for several endangered waterbirds. These include the Hawaiian stilt which may be found feeding at the Haleiwa and Kahuku Wetlands. The Hawaiian coot has been regularly observed at the Kahuku Wetlands. The Hawaiian gallinule is common to Ukoa Marsh and Haleiwa. The Hawaiian duck has been observed at the Waimea River and Kahuku Wetlands. Kahuku is also a principle nesting area for the Black-crowned Night Heron which is not considered an endangered species. Native waterbirds observed at Ukoa Marsh during the aquatic survey included coots and stilts.

15. Stream Flow

Stream flow data compiled by the U.S. Geological Survey (USGS) provides flow data at specific points along individual streams. Water resources data are recorded for the following streams in the Waialua-Kahuku District (U.S. Geological Survey, 1988):

- o Kaukonahua Stream
- o Paukauila Stream
- o Waimea River

Stream flow data is summarized in Table 10. If information available at existing gaging station locations of major streams in the Waialua-Kahuku District is not suitable for relating source development to stream flow, the BWS would need to arrange for appropriate stream flow monitoring by the USGS for development of the proposed sources.

B. SOCIOECONOMIC ENVIRONMENT

1. Economy

The economy of the Waialua-Kahuku District is based primarily on agriculture and tourism. Large employers are the Turtle Bay Resort, Polynesian Cultural Center and Waialua Agricultural Company. The following sections discuss the local economies of communities within the Waialua-Kahuku District.

a. Kahuku

Kahuku is a small, rural town where agriculture and tourism are the major employment industries. Since the closing of Kahuku Sugar Plantation and Mill in the early 1970's, diversified agriculture has been steadily expanding. Construction of the Kahuku Agricultural Park is currently proceeding.

Tourist destination areas within the Koolauloa District providing major sources of employment are the Turtle Bay Resort, Polynesian Cultural Center, and the Mormon Temple.

Other sources of employment include Brigham Young University-Hawaii, retail goods and services, and government.

TABLE 10
STREAM FLOW DATA

STREAM	KAUKONAHUA	KAUKONAHUA	PAUKAULA	WAIMEA	WAIMEA
DESCRIPTION OF GAGING STATION	North fork above right branch, near Mahiawa	South fork at east pump reservoir, near Mahiawa	Opaaula Stream near Mahiawa	Kamananui Stream at Pupukea Military Road near Maunawai	Kamananui Stream at Maunawai
DRAINAGE AREA Square miles	1.38	4.04	2.98	3.13	12.36 (revised)
AVERAGE DISCHARGE (For N Years) cfs	16.4 (63 years)	21.2 (24 years)	13.4 (27 years)	10.2 (23 years)	17.0 (28 years)
1986 WATER YEAR* TOTAL DISCHARGE cfs	6190.86	7368.27	4869.75	2655.16	4476.52
1986 WATER YEAR* MAXIMUM DISCHARGE cfs	314	412	494	170	458
1986 WATER YEAR* MEAN DISCHARGE cfs	17.0	20.2	13.3	7.27	12.3
1986 WATER YEAR* MINIMUM DISCHARGE cfs	0.13	0.00	0.00	0.00	0.02

*October 1, 1985 to September 30, 1986

Adapted from: U.S. Geological Survey, Chinn, Salwyn S., Grace A. Tateishi and Johnson J.S. Yee, Water Resources Data, Hawaii and other Pacific Areas, Water Year 1986. Volume 1, U.S. Geological Survey Water-Data Report HI-86-1 prepared in cooperation with the State of Hawaii Department of Land and Natural Resources, Division of Water and Land Development and with other agencies, 1988.

b. Kawela, Waialeale, Sunset Beach, and Waimea

The communities of Kawela, Waialeale, Sunset Beach and Waimea are primarily residential. The University of Hawaii Agricultural Station and the COMSAT satellite receiving station are located along this stretch of the North Shore.

A scenic tourist destination, Waimea Falls Park, is located in Waimea Valley.

c. Haleiwa

The community of Haleiwa began as a business area for the Waialua Plantation and has now become the commercial center of the North Shore. Local employment is primarily in commerce, small shops, restaurants, banking, real estate and insurance. The community shopping area at Haleiwa attracts and employs persons from many communities along the North Shore.

d. Waialua

Waialua is an active plantation town, with its economy primarily dependent on sugar cultivation. The Waialua Sugar Company, Inc., conducts a successful sugar operation that employs 470 persons, many of whom are North Shore residents. The company actively cultivates approximately 10,500 irrigated and 1,500 non-irrigated acres of land.

2. Population

The majority of the State's population resides on the Island of Oahu. As the resident population of the State grew from 771,600 persons in 1970 to 968,900 persons in 1980, the City and County of Honolulu's resident population grew from 631,600 to 764,800 persons in the same period. (State of Hawaii, Department of Planning and Economic Development, 1986).

In 1980, the resident population of the Waialua-Kahuku District (census tracts 99.01 through 101) was 14,340 persons, a 13.2 percent increase over the 1970 resident population of 12,668 persons. There were a total of 4,340 households within the Waialua-Kahuku District in 1980.

Population statistics are used to predict the need for water so that appropriate measures may be taken to adequately accommodate this need. Tables 11 and 12 indicate the actual and projected populations served by the BWS on the Island of

TABLE 11
 ACTUAL AND PROJECTED POPULATION, 1970-2000,
 ISLAND OF OAHU

Year	Resident	De Facto	Served by BWS
1970.....	634,700	653,300	556,431
1971.....	654,400	675,100	578,974
1972.....	675,700	703,000	609,507
1973.....	693,400	728,300	635,540
1974.....	704,300	743,100	651,073
1975.....	714,300	752,800	661,506
1976.....	726,000	770,700	680,139
1977.....	733,800	783,600	693,772
1978.....	740,300	794,900	705,805
1979.....	754,000	814,000	725,638
1980.....	765,900	824,900	737,271
1985.....	803,800	866,000	781,100
1990.....	845,000	917,600	834,700
1995.....	885,800	965,700	882,300
2000.....	917,400	996,200	912,800

Source: Oahu Water Plan, 1982.

TABLE 12
 ACTUAL AND PROJECTED POPULATION, 1970 - 2000
 WAIALUA-KAHUKU DISTRICT

YEAR	RESIDENT	DE FACTO	SERVED BY BWS
1970 ¹	12,668	12,496	8,297
1970 ²	12,728	12,554	8,384
1971	13,025	12,868	8,815
1972	13,354	13,329	9,393
1973	13,610	14,204	10,385
1974	13,730	14,364	10,662
1975	13,833	14,421	10,836
1976	13,970	14,601	11,133
1977	14,029	14,652	11,301
1978	14,059	14,694	11,460
1979	14,235	14,814	11,697
1980 ¹	14,340	14,941	11,910
1980 ²	14,376	14,900	11,900
1985	15,686	17,123	14,623
1990	17,189	20,079	18,079
1995	18,754	23,453	21,453
2000	20,174	25,973	23,973

1 Relates to April 1 population for the years 1970 and 1980.

2 Relates to July 1 population for the years 1970 and 1980.

Source: Oahu Water Plan, 1982.

Oahu and the Waialua-Kahuku District for the years 1970 to 2000.

The City and County of Honolulu, Department of Housing and Community Development is presently developing approximately 173 residential units in the Kahuku Village housing project area. Water demand for this project is accounted for in the population projections for the area.

3. Public Services

Community facilities within the Waialua-Kahuku District are presented in Figures 5a, b and c.

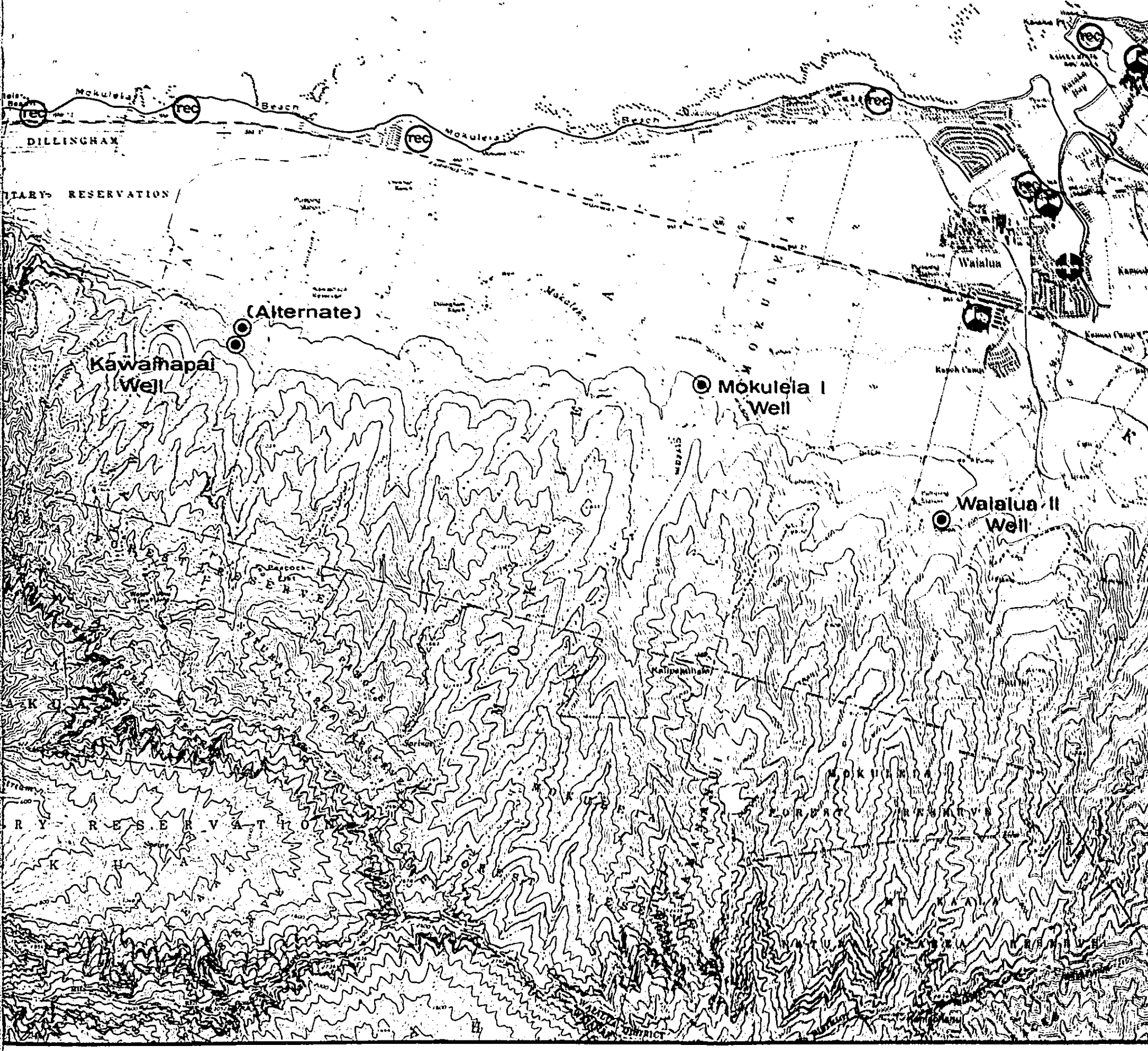
a. Sewer System

The Kahuku Sewage Treatment Plant is the only municipal sewage system serving the Kahuku area. The system, whose present method of effluent disposal is by means of injection wells, is designed to handle an average daily flow of 0.2 million gallons per day generated by the Koolauloa Housing Project, the Kahuku Hospital, the Kahuku School Complex and approximately 80 users in Kahuku Town. Upgrading the system to handle 0.4 million gallons per day is planned in consonance with the Koolauloa Housing Project. Approximately 170 households in Kahuku will continue to utilize their present individual cesspool systems.

The Waialua-Kahuku Districts, extending from Kaena Point to Waimea Bay is serviced primarily by individual household cesspools and small private treatment plants located within high density areas. As indicated in the Water Quality Management Plan for the City and County of Honolulu, (State Department of Health and City and County of Honolulu, December, 1980), there were about 1,993 cesspools in Waialua serving a population of approximately 6,776. The Paalaa Kai Sewage Treatment Plant, located along Oliana Street near Waialua Beach Road, serves the Paalaa Kai Housing subdivision in Waialua. This sewage treatment plant, whose present method of effluent disposal is by means of injection wells, is operated by the City and County of Honolulu as a temporary treatment facility. Average daily flow for this facility during the 1983 to 1984 period was 0.07 million gallons per day. The system is designed to handle 0.144 million gallons per day.

Plans to develop a 1.3 mgd wastewater treatment plant mauka of Kamehameha Highway on 20 acres of agriculture land owned by Campbell Estate is currently being





DILLINGHAM

LIARY RESERVATION

(Alternate)

Kawafapai Well

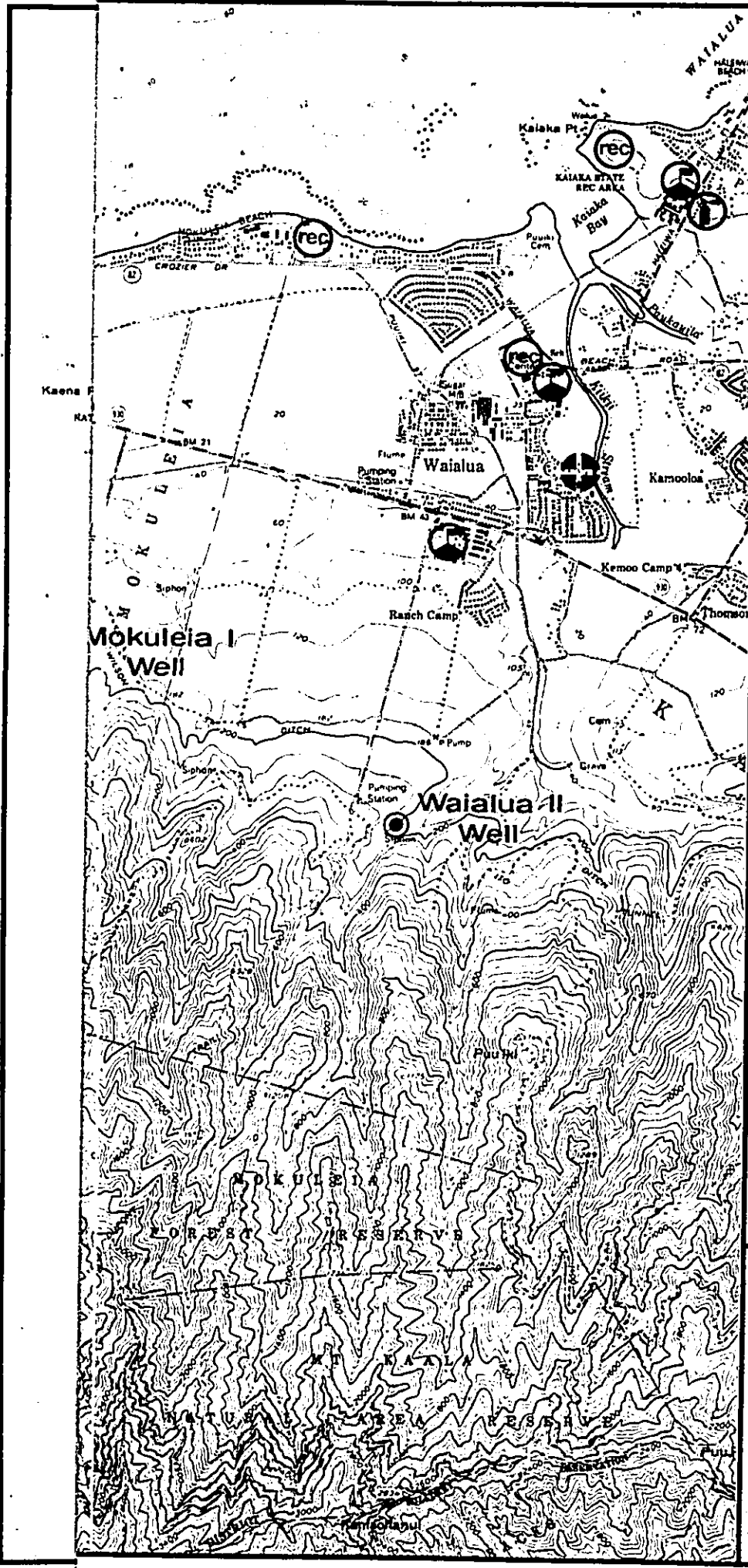
Mokuleia I Well

Wai' II Well

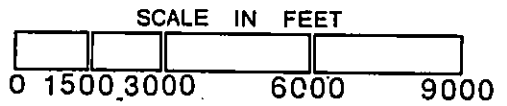
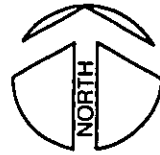
RY RESERVATION

DISTRICT

fig. 5 a
**Community
 Facilities within
 the Waialua -
 Kahuku District**



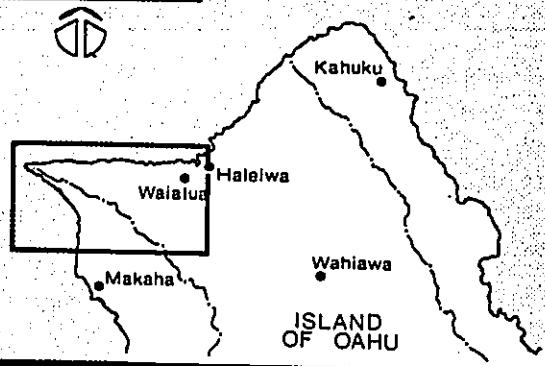
- Recreational Facilities
- Schools
- Fire Station
- Medical Facility



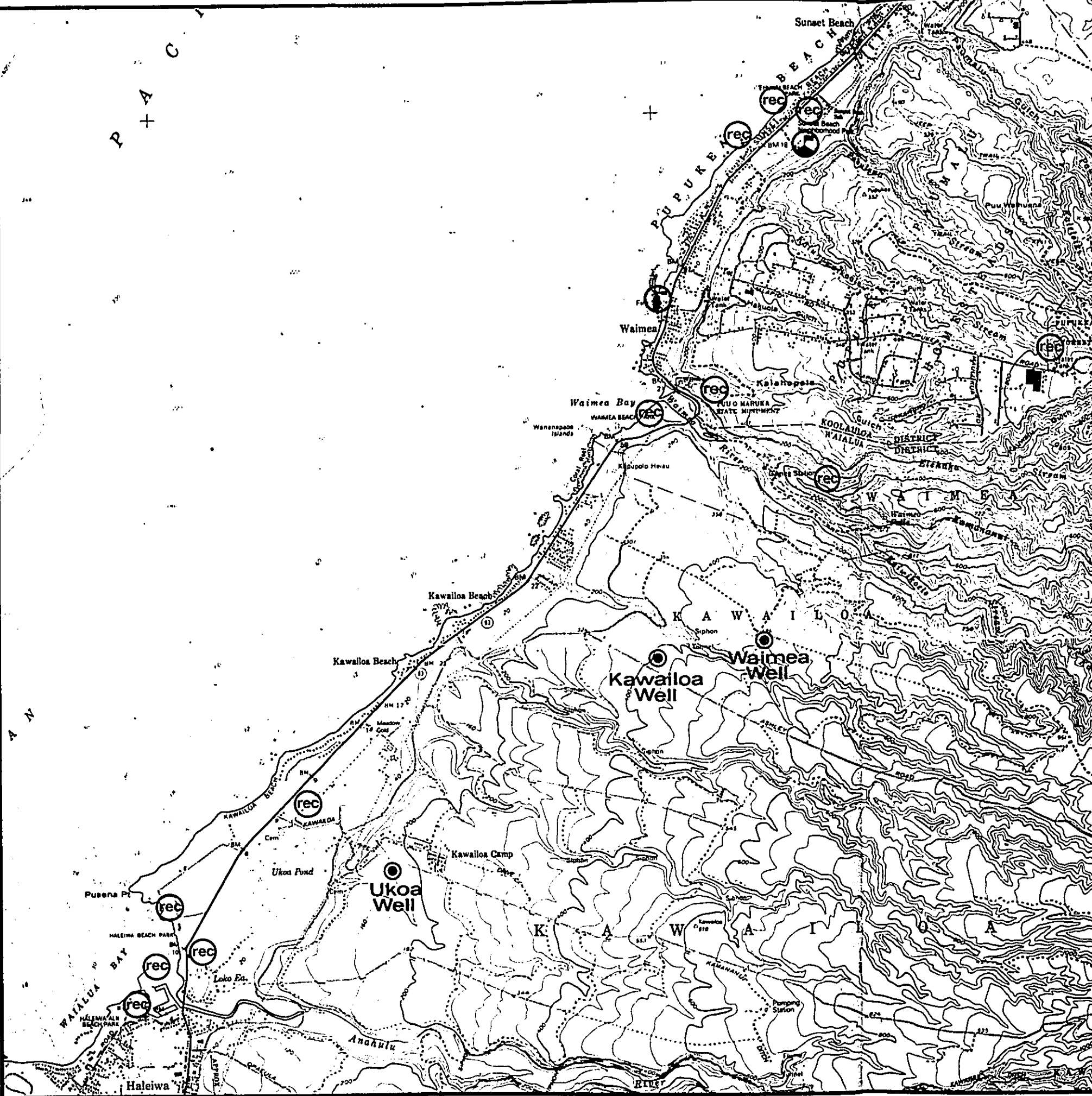
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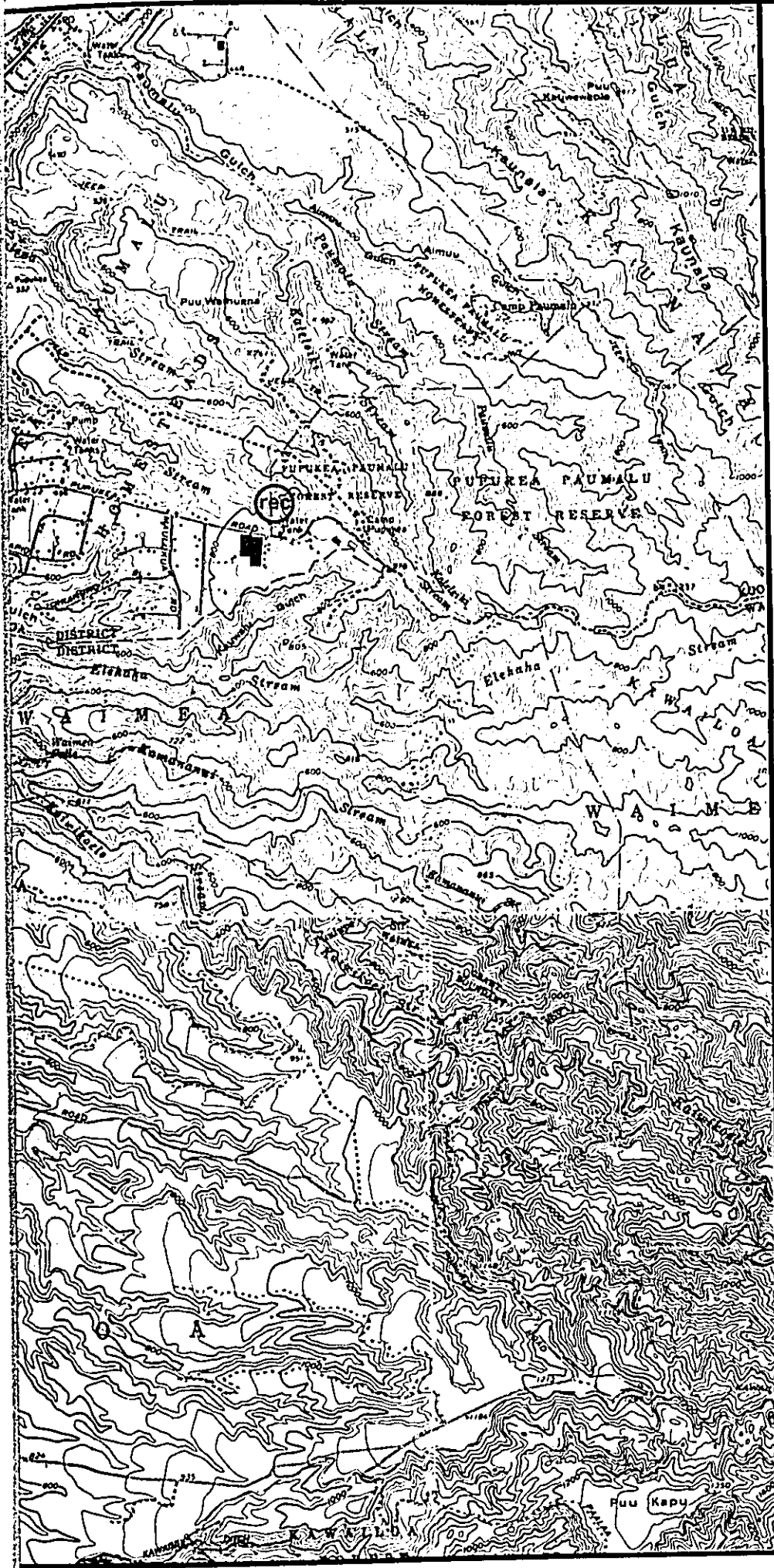



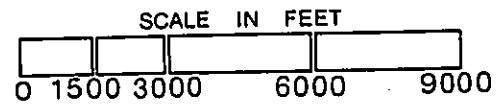


fig. 5b
**Community
 Facilities within
 the Waialua -
 Kahuku District**

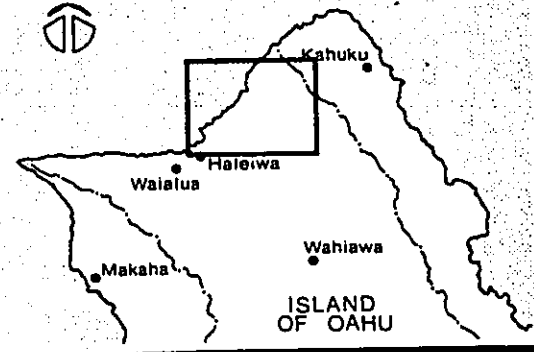
-  Recreational Facilities
-  School
-  Fire Station



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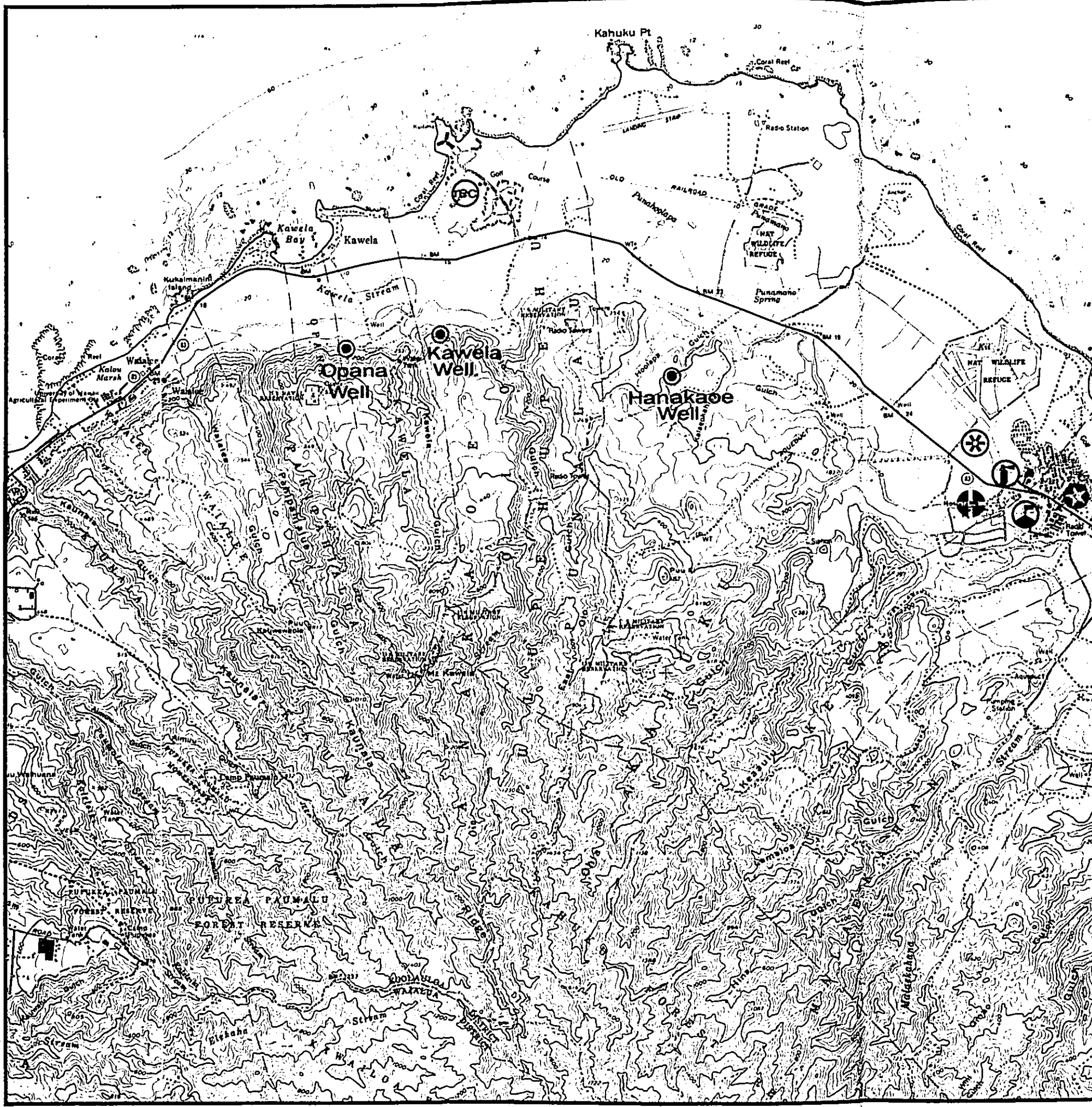
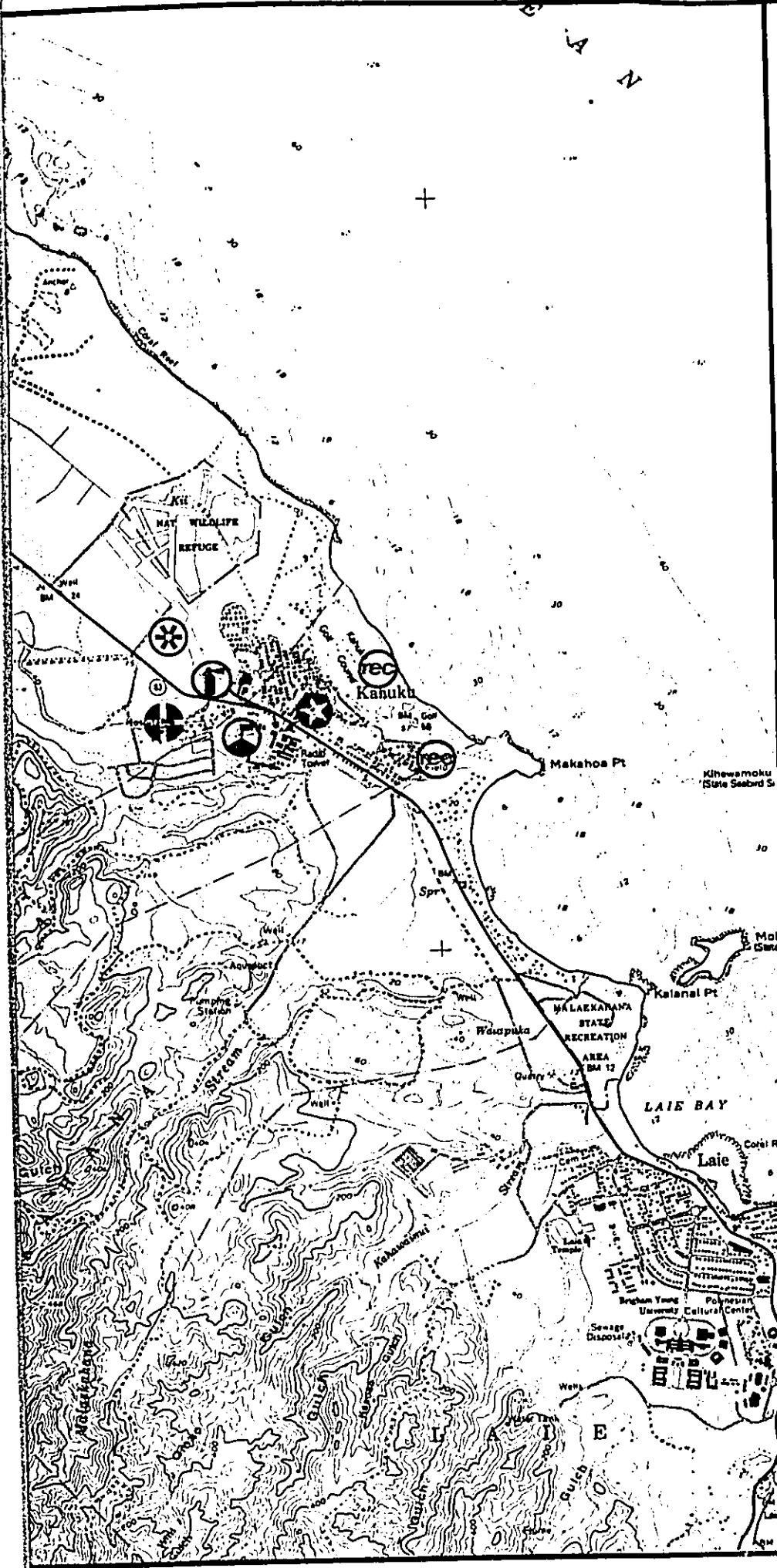
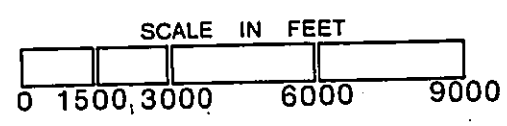
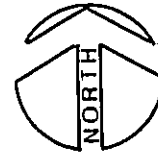


fig. 5c

Community Facilities within the Waialua - Kahuku District



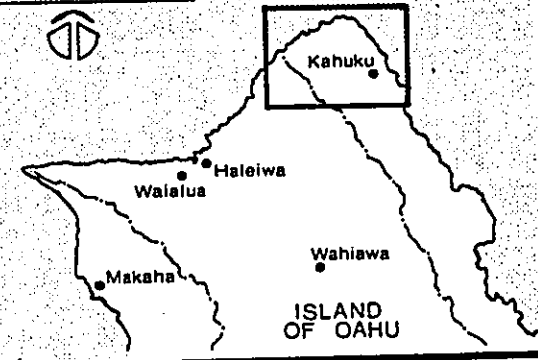
-  Police Station
-  Recreational Facilities
-  Schools
-  Fire Station
-  Health Care Services
-  Sewage Treatment Plant



WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS ENVIRONMENTAL IMPACT STATEMENT

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KEY TO PLATE



conducted by the Kuilima Corporation. Disposal of effluent as part of golf course irrigation will be within the "Pass Zone", in conformance with BWS Rules and Regulations.

A central wastewater treatment plant is also being planned for the Waialua-Haleiwa Sewerage District which will eventually eliminate the Paalaa Kai wastewater treatment plant and 17 private sewage treatment plants and cavitettes. An ocean outfall alternative for the disposal of the effluent is being considered in addition to reuse the effluent for sugar cane irrigation and injection wells.

b. Transportation System

Facilities for ground transportation in the Waialua-Kahuku District include a highway system, smaller collectors and local roadways. The area from Kahuku to Waialua and south to Wahiawa is serviced primarily by Kamehameha Highway. Farrington Highway extends west from Waialua to approximately one mile past Camp Erdman, near Kaena Point.

The City and County of Honolulu Department of Transportation Services operates a municipal bus system which serves the entire Island of Oahu.

Air service on Oahu is centered primarily at the Honolulu International Airport. It is the only commercial airport on Oahu and provides both passenger and cargo services. The Dillingham Air Field located near Mokuleia is operated as a general aviation field by special arrangements with the Air Force.

Most shipping activity is now concentrated in Honolulu Harbor, the only commercial deep draft harbor on Oahu. Dredging work has been completed, however, for the State's deep draft harbor at Barbers Point, a joint Federal/State project. The Barbers Point Harbor will meet the long range harbor needs of Oahu and will allow for future growth of the Statewide harbor system. In the project area, the Haleiwa Small Boat Harbor provides boat moorages and launching lanes.

c. Electrical and Telephone Systems

Electrical and telephone services in the Waialua-Kahuku District are provided by the Hawaiian Electric Company and Hawaiian Telephone Company, respectively. Both companies are headquartered in Honolulu.

Long electrical service line extensions will be required to service most of the proposed facilities. There are no existing or planned electrical transmission facilities in the Waialua-Haleiwa area.

d. Health Care Services

Health care services in the Waialua-Kahuku area are available through the Kahuku Community Hospital and the Waialua Clinic. The Kahuku Community Hospital is a 26-bed facility with 24-hour emergency service. The Waialua Clinic is one of three Medical Arts Clinic, Inc. facilities on Oahu.

e. Police and Fire Protection

A police substation in Kahuku is located adjacent to the Kahuku High and Elementary School complex, and the Kahuku Fire Station. It is manned by about 40 officers and is open for the North Shore area and walk-in "across the counter" services. The station serves the communities from Laie to Kaena Point.

Fire protection is provided by the Kahuku, Sunset Beach and Waialua/Haleiwa Fire Stations.

f. Educational Facilities

Five public schools serving the Waialua-Kahuku District are the Waialua Elementary School (K-6), Waialua Intermediate and High School (7-12), Haleiwa Elementary School (K-6), Sunset Beach Elementary School (K-6), and Kahuku High and Elementary School (K-12).

g. Parks and Recreational Facilities

Various Federal, State, County and private recreational facilities are located within the Waialua-Kahuku District, offering a range of recreational opportunities. Table 14 presents a summary of existing recreational resources within the District.

The City and County of Honolulu, Department of Parks and Recreation anticipates the addition of two parks and deletion of one park within the North Shore area before the end of 1988. The proposed Kahuku District Park will be a 15 acre facility located adjacent to Kahuku High School. Also proposed is the Waialea Beach Park which will be a 7 acre facility located along the northeast extent of Kaunala Bay, makai of the University of Hawaii's Agricultural Experiment Station. Adams Field in Kahuku town is proposed for abandonment.

TABLE 13

RECREATIONAL RESOURCES OF THE WAIALUA-KAHUKU DISTRICT

CITY AND COUNTY OF HONOLULU, DEPARTMENT OF PARKS & RECREATION

Adams Field
Ehukai Beach Park
Haleiwa Alii Beach Park
Haleiwa Beach Park
Haleiwa Regional Park
Kamananui Playground
Kahuku Golf Course
Mokuleia Beach Park
Pupukea-Sunset Beach Park
Sunset Beach Neighborhood Park
Waialua Recreation Center
Waimea Bay Beach Park

STATE DEPARTMENT OF LAND AND NATURAL RESOURCES - DIVISION OF FORESTRY

Kealia Trail
Mokuleia Crossover
Mokuleia Trail
Peacock Flat Trail

STATE DEPARTMENT OF LAND AND NATURAL RESOURCES - DIVISION OF STATE
PARKS AND HISTORIC SITES

Kaiaka Point State Recreation Area
Puu O Mahuka State Park

STATE DEPARTMENT OF TRANSPORTATION

Haleiwa Small Boat Harbor

UNITED STATES DEPARTMENT OF DEFENSE

Mokuleia Army Beach
Mokuleia Beach

QUASI-PUBLIC ORGANIZATIONS

Camp Harold R. Erdman
Camp Pupukea

PRIVATE INDIVIDUALS OR ORGANIZATIONS

Cannon Pony Club
Turtle Bay Country Club
Mokuleia Polo Farm
Puuiki Beach Park
Waimea Falls Park

Source: Adapted from State of Hawaii, Department of Land and Natural Resources, State Recreation Plan, January 1980.

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V. RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

V. RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

A. PLANS

1. Hawaii State Plan

The Hawaii State Plan, prepared in accordance with Chapter 226, Hawaii Revised Statutes, as amended, is the basis of a statewide planning system that establishes an overall theme, describes goals, objectives, and policies, and identifies priority directions for all plans and programs of the State of Hawaii. The proposed project is consistent with the following State Plan objective:

"Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities."

The proposed improvements are also consistent with the following State policies promoting achievement of the above water facility systems objective:

- o Coordinate development of land use activities with existing and potential water supply.
- o Support research and development of alternative methods to meet future water requirements well in advance of anticipated needs.
- o Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use.
- o Support water supply services to areas experiencing critical water problems.
- o Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.

2. State Water Resources Development Functional Plan

The State Water Resources Development Plan, one of twelve State Functional Plans, implements the goals, objectives, and policies of the Hawaii State Plan with respect to the development, utilization, and preservation of the State's water resources. The proposed water system improvements are consistent with the following Plan objectives and policies:

- o Maintain the long-term availability of freshwater supplies, giving consideration to the accommodation of important environmental values.
 - Promote sound watershed and aquifer management practices.
 - Manage surface drainage areas and ground water aquifers to prevent contamination of sources of water supply.
 - Seek a balance among developmental and environmental values in the planning, evaluation, permitting, and construction of water resources projects.
- o Assure adequate municipal water supplies for planned urban growth.
 - Promote the planning and development of new water supplies, giving priority support to areas experiencing critical water problems.
- o Assure the availability of adequate water for agriculture.
 - Preserve water for existing beneficial agricultural uses and provide additional irrigation water where needed by further development of existing surface and ground water sources and improvements to diversion, storage, and transmission facilities.

3. State Health Functional Plan

The State Health Functional Plan, also one of the twelve State Functional Plans, provides for the maintenance of a clean and healthful environment, as well as adequate health care services, benefits, and facilities. With respect to water resources, the State Health Functional Plan complements the State Water Resources Development Functional Plan in the following areas:

- o Administer a permit program for surface and ground water discharges.
- o Erosion and sediment control.
- o Ensure that all public water systems meet drinking water standards.
- o Use of treated effluent for irrigation.

- o Construction of water treatment facilities.
- o Operation of the environmental impact statement process.
- o Establishment of an instream flow management system.

The proposed improvements will be consistent with all applicable rules and regulations relating to the State Health Functional Plan.

4. City and County of Honolulu - General Plan

The General Plan for the City and County of Honolulu specifies long-range objectives reflecting desired conditions for the people of Oahu, and policies which will facilitate the attainment of these objectives. The framework provided by the General Plan addresses all aspects of public health, safety and welfare.

The proposed water system improvements would facilitate implementation of the General Plan by providing a system which will adequately meet the anticipated water needs of the projected population in the North Shore and Kahuku portion of the Koolauloa Rural areas as identified in the General Plan. The proposed facilities will maintain a high level of service within the water system and will help Oahu continue to be a desirable place to live and visit.

5. City and County of Honolulu, Board of Water Supply - Oahu Water Plan

The Oahu Water Plan establishes plans, policies, and priorities for providing water, within the guidelines of the City and County General Plan. The plan is prepared by the BWS, which is mandated by law to provide for the growing consumer demand on Oahu to the extent of available water resources.

Water use planning objectives of the BWS include the following:

- o Manage its ground water sources to insure preservation of the aquifers for the benefit of future generations, in perpetuity.
- o Achieve optimum utilization of the existing water supply in order to minimize the need for developing additional potable ground water sources and alternate sources.

- o Investigate, prepare for, and in a timely manner, develop additional potable ground water sources and alternative sources requiring treatment, to meet anticipated consumer demands.
- o Insure that growth in consumer demand will be compatible with available water supply.

The proposed improvements will implement the Oahu Water Plan.

B. LAND USE POLICIES AND PROGRAMS

1. State Land Use Classification

The State Land Use Law regulates land uses through a land classification system intended to accommodate growth and development, while protecting the natural resources. All lands are classified by the State Land Use Commission as either Urban, Rural, Agricultural, or Conservation, with consideration given to the General Plans of the respective Counties.

All of the proposed well developments are situated upon Agricultural lands in which the City has been delegated authority to grant special permits for certain land uses. Development of the proposed water system improvements would be permitted in Agricultural zoned areas.

2. City and County of Honolulu - Development Plans

Eight separate Development Plans for the Island of Oahu present relatively detailed schemes to implement and accomplish the objectives and policies of the General Plan with respect to development. Planned land uses and public facilities are shown on maps, with an indication of the sequence in which public facilities will be developed.

The Waialua-Kahuku District is addressed in both the Koolauloa and North Shore Development Plans, and includes portions of the Kahaluu-Kahuku and North Shore Rural areas as identified in the General Plan. The General Plan prescribes limited growth in both areas to a level which essentially maintains the 1980 proportion of the islandwide population.

The Koolauloa Development Plan area comprises the northern half of Oahu's windward coast. The ridgeline of the northern end of the Koolau Range forms its western boundary. The residential community of Kahuku lies within this area.

The North Shore Development Plan area extends from Waialeale Gulch near Kawela Bay to Kaena Point. The communities of Haleiwa, Waialua and Mokuleia are within this area.

The Development Plan Public Facilities Maps (DP/PF) designate proposed facilities which are intended to meet the growth objectives of the Development Plans by providing adequate facilities to accommodate existing and projected needs. Prior to construction, all proposed public facilities must be designated on the appropriate Development Plan Public Facilities Map.

The proposed water system improvements are consistent with the objectives of the Development Plans, and will provide for the projected water needs in these Development Plan areas. Presently, of the eleven water facility improvements being proposed, only three are in conformity with the DP/PF maps, namely - Mokuleia I Well, Kawaihoa Well, and Waimea Well. The remaining seven water facility improvements listed below will require amendments to the appropriate DP/PF map (North Shore or Koolauloa):

- o Hanakaoe Well
- o Kawaihapai Well
- o Kawela Well
- o Opana Well
- o Ukoa Well
- o Waialua Well II
- o Mokuleia-Makaha Transmission Main and Reservoir

Public Facilities Map amendments will be initiated for the proposed facilities.

3. City and County of Honolulu - Land Use Ordinance

In accordance with the City's Land Use Ordinance, public facilities such as the proposed water system improvements, are permitted uses in all zoning designations. The proposed well sites are within either the AG-1 Restricted Agricultural District or the AG-2 General Agricultural District. The City's zoning does not extend into the State Land Use Conservation District.

4. State Department of Health - Drinking Water Program

All potable water sources must be approved by the Department of Health (DOH) to assure safe drinking water quality standards as prescribed by Section 29-Use of New Sources of Raw Water for Public Water Systems, Chapter 20 - Potable Water Systems, Title 11, State Department of Health

Administrative Rules in accordance with Federal requirements under the Safe Drinking Water Act (42 USC 300).

5. State Exploratory Well Drilling Program

The State Exploratory Well Drilling Program is administered by the State Department of Land and Natural Resources (DLNR). The program funds the development of new water source facilities, including the drilling of exploratory wells. If the exploratory wells produce adequate yields, they are then converted into production wells. The operation and management of the wells then falls under the jurisdiction of the County Government. If these wells are constructed and turned over to the BWS on a "ready to serve" basis, the wells' sustainable capacity would be "credited" towards the State for State funded projects which require a water commitment from the County.

The location of potential well sites is determined through a coordinated effort between the DLNR and the County water supply agencies (the BWS for the City and County of Honolulu).

The proposed facilities to be constructed under this program include the development of one exploratory well at the Waialua Well II site.

6. Waialua Ground Water Control Area

The Board of Land and Natural Resources (BLNR) is responsible for protecting the ground water resources of the State. Based upon hydrological factors, the BLNR establishes "sustainable yields" which represent the upper limit of the average rate of draft from a water resource, that can be made using practicable technology and that can be sustained indefinitely without undue detrimental effects on the resource or water supplies that are or may be drawn from it (i.e., increasing seawater intrusion into the aquifer).

If it becomes evident that the resource is threatened by present or projected withdrawals, the BLNR may designate an area as a "Ground Water Control Area" and establish appropriate measures to regulate water development and draft.

In 1981, in response to concerns regarding diminishing reserves of developable ground water and threats to water quality at developed sources, the BLNR designated the Waialua portion of the Waialua-Kahuku District as a Ground Water Control Area (GWCA) under authority of Chapter 177, HRS, and Chapter 166 of Title 13, Administrative Rules entitled "Rules for the Control of Ground Water Use in the State of Hawaii".

Limitations on water use are established at two levels: sustainable yields for each BLNR ground water control area, and specific limits for each water source site. During designation of the GWCA, existing water uses were certified and an inventory of water sources was established. This information was used to determine the existing water uses to be preserved (preserved use) and the draft to be allowed. As indicated in the Oahu Water Plan, the Waialua GWCA had an estimated sustainable yield of 100 mgd and a 1979 draft of 71 mgd.

Subsequent to the establishment of the GWCA, development of new sources and expansion of preserved use sources have been managed by the BLNR through issuance of Water Withdrawal and Use Permits. This "permitted use" and the "preserved use"¹ represent the total water use authorized by the BLNR.

The amount of water the BLNR can allot for future water use within each subarea without degrading the aquifer resource, is the difference between the sustainable yield and the sum of preserved and permitted uses. As such, approximately 17 to 19 mgd can be developed before achieving the upper limit of withdrawal established by the BLNR. The BLNR has not established preserved use limitations upon gravity systems such as developed tunnels and springs.

Prior to designation of the GWCA's, the BWS controlled well drilling and draft on Oahu. The BWS still controls well drilling and draft in non-designated areas on Oahu.

C. ENVIRONMENTAL CONTROLS

1. Department of the Army Permit

The Department of the 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 permit is required for all work within waters of the United States, including ocean and coastal waters, inland and tidal waters, tidal ponds, fishponds, rivers, streams and adjacent wetlands; perched wetlands, and intermittent streams.

¹ A quantity of water for which water use rights have been approved by the BLNR by a permitting process.

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, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people.

For those projects involving stream crossings and wetland areas, applications for a Department of the Army Permit will be submitted.

2. Hawaii Coastal Zone Management Program

The Hawaii Coastal Zone Management Program (HCZMP) is administered by the State Department of Business and Economic Development (DBED). The HCZMP has established objectives and policies relating to the protection of recreational, historic, scenic and open space resources as well as coastal ecosystems, in the State's coastal zone, which includes all lands and waters in the State except forest reserves. Also addressed are economic uses, protection against coastal hazards, and management of development.

The DBED is charged with conducting a continuing review of the administration of the HCZMP and of the compliance of State and County agencies. The proposed water facility improvements further the HCZMP objective for economic uses by providing "improvements important to the State's economy in suitable locations." The proposed developments are not inconsistent with other HCZMP objectives.

The DBED's HCZMP responsibilities also includes the review of federal programs, permits, licenses and development proposals for consistency with the program. Such a review would not be required, however, since the proposed BWS water system improvements do not involve Federal permits or approvals.

3. State Conservation District Use Application

The Department of Land and Natural Resources (DLNR) administers all land uses within the State Conservation District. Lands within this District are considered worthy of protection and preservation to ensure optimum long-term benefits for its inhabitants.

The Mokuleia-Makaha Transmission Main (Farrington Highway Corridor) will traverse both Conservation and Agricultural lands. Portions of the corridor encroaching in Conservation lands will require a Conservation District Use Permit administered by the State Board of Land and Natural Resources. The Mokuleia-Makaha Transmission Main (Trans-Waianae Range Corridor) alternative is situated upon Agricultural lands, except the portion of the corridor within the Waianae District, which is situated upon Conservation lands. The portion in the Conservation District would require a Conservation District Use Permit. The probable site for the 2.0 to 6.0 mg reservoir lies within lands designated Agricultural.

4. State Water Code

The State Water Code, Chapter 174C of Hawaii Revised Statutes, provides for maximum beneficial use of the waters of the State for purposes such as domestic uses, aquaculture uses, irrigation and other agricultural uses, power development, and commercial and industrial uses. Provisions are made for the protection of Hawaiian rights, fish and wildlife, the maintenance of ecological balance and scenic beauty, and the preservation and enhancement of waters of the State.

The State Water Code provides for the protection of instream uses. The BLNR approved interim Instream Flow Standards for Windward Oahu on July 30, 1987. Windward Oahu consists of the Koolauloa and Koolaupoko districts. The western boundary of Windward Oahu is defined by the Koolau Range crest and Waimea Stream. The Opana, Kawela and Hanakaoe Wells which are within Windward Oahu, and the Waimea Well which could affect a tributary of Waimea Stream, will be subject to the interim Instream Flow Standards for the area. All BWS projects must comply with requirements that may be imposed by the State Water Code and Instream Flow Standards.

5. Special Management Area

The City and County of Honolulu, Department of Land Utilization (DLU) regulates development in Oahu's Special Management Area (SMA) which is established along the shoreline and extends from a few hundred feet to over a mile inland in some areas. All development in the SMA requires a permit that must be approved by the City Council in consideration of the HCZMP objectives, policies and SMA permit guidelines. However, installation of underground utilities and appurtenant above-ground features less than 4 feet in height along existing corridors are exempt from the SMA requirements (SMA Ordinance No. 84-4, as amended).

The proposed water facility improvements will not be located within the Special Management Area, with the possible exception of portions of the Mokuieia-Makaha Transmission Main around Kaena Point. In addition to applying for an SMA permit, the BWS will pursue appropriate measures to mitigate or minimize anticipated adverse impacts on the SMA should the transmission main be developed.

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VI. REGIONAL IMPACTS

VI. REGIONAL IMPACTS

This section describes potential impacts that are anticipated in areas beyond the immediate vicinity of the individual project sites, and cumulative impacts which may result from the combined effects of individual projects. Individual projects may or may not contribute to one or more of these effects. General construction impacts of water system improvements upon local environments are discussed in Chapter VII.

A. WATER SYSTEM

The proposed water system improvements are intended to meet projected water demands of a population on which the City and County of Honolulu General Plan, the Koolauloa Development Plan and the North Shore Development Plan are based. The proposed projects will help meet these demands while maintaining a high level of service within the water system.

All water needs of the Waialua-Kahuku District will be met before exportation of water to other water use districts will be considered. If water becomes available in quantities justifying the development of an inter-district transmission system, it would be directed to the Waianae District to help satisfy the projected needs in that district.

B. HYDROLOGY

Development of the proposed water source facilities is not anticipated to adversely impact the quality of the basal aquifer. The expanded yield in the Waialua Ground Water Control Area would be within the DLNR sustainable yield for basal water sources for the Area. Development of the proposed water storage and transmission facilities is not expected to affect ground water recharge.

One of the alternatives being considered for transporting water from the Waialua-Kahuku District to the Waianae District is the Mokuleia-Makaha Transmission Main tunnel through the Waianae Range. Since the Waianae Range is intruded by many dikes which trap ground water, tunnel construction could disrupt the integrity of the impounded water compartments. To minimize impacts on ground water resources, the tunnel route under investigation is one which evidences insignificant impounded dike water. The tunnel can also be designed to collect and transport ground water that may be encountered should dike compartments be breached during tunnel construction. Should the BWS proceed with this project, supplemental environmental studies would be conducted to consider specific hydrologic impacts.

Development of the proposed facilities may affect the stream flows of perennial streams or water levels in wetlands in proximity to the sites (see Section VI.I). As the proposed projects are implemented, the BWS will contract with the U.S. Geological Survey to monitor the potentially affected streams for such effects. Stream flow and wetland monitoring will also be conducted in coordination with the U.S. Fish and Wildlife Service and the State Department of Land and Natural Resources. Additional ground water investigations will be conducted, as appropriate, to determine the relationship between the water sources of the wetlands and basal aquifers.

C. WATER QUALITY

The proposed water system improvements will not adversely impact the quality of ground water resources as the increased draft will be within DLNR sustainable yield limits.

With respect to the quality of water supplies which will be developed, there is a possibility of contamination from cesspool seepage, residual agricultural waste matter or pesticides. Mitigative measures that may be implemented include closure of the source or treating the water before distribution by aeration, activated carbon, or other acceptable treatment technology.

The BWS will monitor the quality of domestic water to ensure that it is safe to drink in conformance with the State's Safe Drinking Water Regulations. Approval from the State Department of Health (DOH) must be obtained before any new drinking water source may be used. All BWS potable water sources meet DOH and Environmental Protection Agency (EPA) water quality standards.

D. FLOOD HAZARDS

None of the proposed projects are located within an area where flood hazards have been determined. To mitigate the possibility of flooding in these areas, the proposed projects will, if necessary, be designed to minimize adverse impacts in accordance with criteria established under the National Flood Insurance Program and other established guidelines for construction in flood prone areas.

E. POPULATION

In accordance with the BWS Oahu Water Plan, the proposed water system improvements are intended to meet the anticipated needs of the population projected by the Department of Business and Economic Development (DBED). Consequently, the proposed projects will be consistent with the growth objectives of the City and County of Honolulu General Plan.

F. PUBLIC FACILITIES

The proposed water improvements are not anticipated to have direct cumulative impacts upon existing public facilities, with the exception of the municipal water system.

Changes in the existing service requirements of public facilities are determined by provisions in the City and County Development Plans to meet desired land use and density objectives. Thus, the proposed improvements are among various public facility improvements intended to accommodate these objectives.

G. ECONOMY

The development of the proposed water system improvements will have both short and long-term economic benefits. In the short term, the proposed improvements will provide temporary economic benefits in the form of construction expenditures and employment opportunities. These effects will last for the duration of construction, after which the facilities will be operated and maintained by the BWS.

The cost to operate and maintain the new facilities may result in increases in water rates. However, without the proposed water system improvements, the long-term development in all sectors of the island's economy will be constrained.

The provision of adequate water supplies is essential to support further economic growth. The proposed facilities are intended to provide for such development, as indicated in the Development Plans.

H. DISPLACEMENT

None of the proposed improvements will displace existing uses with the exception of a few acres of sugarcane. The proposed facilities will be sited to minimize impacts to the site and surrounding lands. Selection of alternative sites could also minimize potential adverse effects.

I. STREAM AND WETLAND ENVIRONMENTS

The development of water sources may impact stream and wetland environments. The degree of impact to stream flow or wetland water sources will depend on whether the well is directly or indirectly tapping the same body of water.

Reduction of flow may modify the stream or wetland ecosystem or the surrounding environment. A decrease in stream flows or wetland water levels may either reduce or induce growth of riparian vegetation which in turn may be perceived as a negative aesthetic impact.

Resulting changes in the physical and chemical nature of the habitats may potentially impact aquafauna and terrestrial biota dependent upon riparian vegetation including wetland plants, endangered waterbirds, migratory waterbirds and shorebirds. Since the magnitude of any stream flow or wetland level reduction can only be determined during long term pumpage, the BWS will monitor stream flow and wetland water levels during the pumping test of the exploratory wells to determine the immediate effects, if any, of the source development. The BWS will coordinate stream flow and wetland monitoring with the U.S. Geological Survey, U.S. Fish and Wildlife Service, and the State Department of Land and Natural Resources to assure that water levels are not adversely affected by source development. To determine the relationship between the water sources of the wetlands and basal aquifers, additional ground water investigations will be conducted as appropriate. However, if it is found that a BWS water source has a detrimental impact on stream or wetland environments, mitigative measures available include the reduction or termination of pumping from the source. Potential areas of concern are Ukoa Pond, which is a spring-fed wetland environment in the vicinity of the Ukoa Well Site, and the Waimea Stream, whose feeder tributary lies in the vicinity of the Waimea Well Site. Other possible wetland areas of concern are the Punahoolapa, Punamano and Kii Ponds, located near the Hanakaoe Well. It is noted that supplemental environmental impact documents will discuss environmental impacts to wetlands in more detail.

The State Water Code and Instream Flow Standards should ensure that stream flows and wetlands are preserved. All BWS projects must comply with requirements that may be imposed under these regulations, such as stream flow monitoring and wetland water level monitoring. The Opana, Kawela and Hanakaoe Wells which are within Windward Oahu, and the Waimea Well which could affect a tributary of Waimea Stream, will be subject to the interim Instream Flow Standards approved for Windward Oahu. While stream flow standards have not been established for the remainder of the Waialua-Kahuku District, should such standards be established in the future, the BWS will conform to them.

It is not known to what extent a hydraulic connection exists between basal aquifers in Windward Oahu. In this regard, several hypotheses regarding the relationship between the development of the Opana, Kawela and Hanakaoe Wells, and the sustainable yield for the Kahuku area are available. Because the static heads of coastal wells gradually decline in a northwesterly direction from about 22 feet at Punaluu to about 10 feet at Kahuku, one hypothesis is that beginning north of Punaluu Stream, most basal ground water moves northward beneath the coastal plain and discharges into marshes and springs between Kahuku town and Kahuku Point. (Mink, 1982) Under this hypothesis, there is a single basal aquifer extending from Punaluu Valley to Kahuku Point known as the Koolauloa Basal Aquifer. If this hypothesis is correct,

then ground water in the Koolauloa Basal Aquifer flows in all directions from areas of high hydraulic potential to areas of low potential. Assuming hydraulic integrity, long term excessive pumping of wells in any part of the aquifer could adversely affect the static head and yield of wells in other parts of the aquifer. Another implication of this hypothesis is that basal ground water between Kaluanui and Laie can be developed by wells in Kahuku and/or Punaluu.

Other than differentials in the static heads of coastal wells, which could be accounted for by reduced rainfall towards Kahuku, there is no evidence that the Koolauloa Basal Aquifer is completely hydrologically continuous between Punaluu and Kahuku. Another hypothesis is that most basal ground water in Koolauloa slowly leaks through coastal caprock rather than flowing to Kahuku through and beneath sedimentary fill material in Kaluanui, Kaipapau, Malaekahana, and numerous smaller stream valleys. Even if caprock is only poorly permeable, substantial quantities of ground water still could seep into the 30 square miles of caprock between Punaluu and Kahuku. (Lao, 1983) As evidence that basal water may seep into caprock, an exploratory BWS alluvial well (Punaluu Well IV) shows developable yields of 0.5 mgd. If this hypothesis is correct, then basal ground water between Punaluu and Kahuku would behave more as if it were compartmentalized between stream valleys (as is the case in Leeward Oahu) than as if it were part of a continuous aquifer. Another implication of this hypothesis is that it is not possible to develop basal ground water between Kaluanui and Laie with wells in either Punaluu or Kahana.

There is insufficient data at this time to resolve the extent to which valley fill caprock limits movement of fresh basal ground water across Kaluanui, Kaipapau, and other stream valleys. However, there is some evidence for a continuous Koolauloa Basal Aquifer. In 1961, a 4-day pump test of Kahuku Plantation Well 398 (DOWALD No. 3354-02) near the mouth of Kaluanui Valley at a rate of 4.3 mgd produced a slight drawdown in the static head of Plantation Well 401 (DOWALD No. 3654-04) which is 1,000 feet to the east, and observation Well 396 (DOWALD No. 3654-02) which is 2,500 feet to the north. (U.S. Department of the Interior, Geological Survey, 1969) Similarly, after a brief shutdown, the BWS Punaluu wells were pumped at rates of 483 to 888 gallons per minute (gpm) for about 4 hours in June 1983, and produced a slight drawdown in Well 401 (DOWALD No. 3654-04) which is about a mile to the northwest, but not in the exploratory Kaluanui Well (Board of Water Supply, Revised Environmental Impact Statement for the Kaluanui Wells, 1984). A possible explanation for this drawdown is that Well 401 (DOWALD No. 3654-04) is not in the same hydraulic area as the exploratory Kaluanui Well. This strongly suggests that Well 401 is in the Punaluu area as shown by the pumping records.

VII. IMPACTS OF WATER SYSTEM IMPROVEMENTS UPON LOCAL ENVIRONMENTS

VII. IMPACTS OF WATER SYSTEM IMPROVEMENTS UPON LOCAL ENVIRONMENTS

A. GENERAL CONSTRUCTION IMPACTS

Development of the proposed water system improvements will have short-term construction-related impacts on noise levels and air and visual qualities of the local environment. These unavoidable impacts can generally be regarded as nuisances which will be apparent for the duration of construction, depending upon the extent and phasing of the proposed developments. Construction activities will be scheduled during daylight hours, Monday through Friday.

Noise levels will be elevated during construction hours by the operation of construction equipment, including vehicles required to haul various materials to and from the site. It shall be the contractor's responsibility to minimize construction noise impacts by complying with Title 11 of the State Department of Health's Administrative Rules, Chapters 42 and 43. In this regard, the contractor will maintain mufflers and other noise attenuating equipment as well as comply with any conditions imposed on noise permits by the Noise and Radiation Branch of the State Department of Health.

Ambient air quality is expected to be temporarily degraded as a result of dust and vehicular emissions generated during the installation and construction of transmission lines, reservoirs and control buildings. Airborne dust will be controlled with appropriate dust control measures, such as water spraying and sprinkling while vehicular emissions will be minimized through proper equipment maintenance. It shall be the contractor's responsibility to minimize air quality impacts through compliance with Title 11, State Department of Health Administrative Rules, Chapter 60.

Other construction-related impacts include the alteration of existing land forms through earthwork operations and the displacement of existing flora and fauna. The displacement of existing flora and fauna is not anticipated to be a significant impact as there are no known threatened or endangered species at the project sites.

Site preparation/grading activities will be kept to a minimum and, as required, will be conducted in compliance with applicable State and City and County regulations. Additionally, all work in the vicinity of known historic or archaeological sites will be coordinated with the State Historic Preservation Officer. Archaeological survey data is documented in Section B of this Chapter. Construction of transmission lines through the lowlands to connect new water sources to the existing water system should

be monitored by an archaeologist to ensure that any sub-surface agricultural remains encountered in those areas are not destroyed without first being studied. If archaeological resources such as human bones, stone artifacts, shell midden, charcoal deposits, stone walls, abandoned lo'i or petroglyphs are uncovered during construction, work will be suspended and the State Historic Preservation Office notified. Should these resources be determined significant, a number of mitigative measures are available. These include preservation of the site and the relocation of proposed improvements; salvage excavation and continuation of proposed projects; or continuation of proposed projects with no further studies. Subsequent development activities by the BWS will be coordinated with the Preservation Officer. It is noted that additional archaeological surveys may be conducted as supplemental environmental documents are prepared.

During development of well sites and reservoirs, construction equipment will use public roads, as necessary, to haul away surplus excavation material and import materials required for construction of the proposed facilities. The increased traffic from construction vehicles will be insignificant, but may cause minor inconveniences to area residents for the duration of construction. Development of transmission mains will require more extensive road use during excavation and installation of water lines. Therefore, diversion of traffic may be required for limited periods of time. Detour plans will be developed as necessary, and coordinated with the appropriate government agencies during the design phase of the individual projects.

Connection of the proposed water system improvements to existing facilities may require temporary disruption of service. Affected users will be notified in advance of such disruption by the contractor or the BWS. Long electrical service line extensions will be required to service most of the proposed facilities. There are no existing or planned electrical transmission facilities in the Waialua-Haleiwa area.

Residents of the area will be apprised of pending construction by the BWS or the contractor. The contractor will be required to use proper traffic control devices necessary to insure minimum inconvenience and maximum safety to roadway users.

The short-term economic impact resulting from construction includes the provision of jobs to local construction workers. Local material suppliers and retail businesses may also benefit from the increased activities.

Relatively few adverse impacts are anticipated during operation of the facilities. Transmission mains will have negligible impacts, once installed. Storage facilities may have visual impacts, however, these effects could be mitigated through appropriate design standards and landscaping. The operation of source

facilities may conflict with existing land uses at some sites, hence alternate sites may be considered. Well pumps will generate noise, but these effects can be attenuated, as necessary, in populated areas.

Since some of the source projects could affect nearby stream or wetland environments, stream flow rates and wetland water levels will be monitored by the BWS in coordination with the U.S. Geological Survey, U.S. Fish and Wildlife Service and the State Department of Land and Natural Resources. Should the stream or wetland environments be adversely affected by a reduction in flow or water level, respectively, the BWS will take appropriate action by reducing or terminating pumpage from the implicated source.

B. IMPACTS UNIQUE TO EACH PROJECT

This section summarizes development considerations, potential impacts and administrative requirements unique to each of the proposed water facility improvements. A descriptive profile of each proposed improvement and project site is presented in Section III.B.2.

Developmental considerations include land use designations associated with the State Land Use District, City and County Development Plan, and City and County Zoning, as well as flood hazard identification, soil type, vegetative cover, archaeological resources and Land Study Bureau Detailed Land Classification Overall Productivity Ratings. Further discussion of developmental considerations as related to each land use designation is presented in Sections V.B.1, V.B.2 and V.B.3. Data for flood hazards are provided in symbolic form (refer to Section IV.A.7. for a discussion of flood hazard zones). All soil classifications were obtained from the Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii. The discussion of vegetation at the project sites is abstracted from the Waialua-Kahuku Regional EIS Botanical Survey (see Appendix D). Archaeological information is abstracted from Appendix C, Waialua-Kahuku Regional Water System Improvements Archaeological Surveys at Proposed Well Locations. Land Study Bureau Detailed Land Classification Overall Productivity Ratings were obtained from the Detailed Land Classification-Island of Oahu.

The proposed projects will have both beneficial and adverse environmental impacts in the long-term and short-term. Most of the anticipated adverse impacts are short-term impacts, associated with construction activities. These construction-related impacts will be incurred at all of the proposed project sites, to some degree, as discussed in Chapter VI and Section A of this Chapter.

Among the administrative requirements necessary to implement the project are permits, approvals, and interagency coordination. The

requirements for each project varies, depending upon the type of facility proposed and its site location.

1. Hanakaoe Well

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-1, Restricted Agricultural
- (4) Flood Zone: D
- (5) Agricultural Lands of Importance: None
- (6) Soil: PeF Paumalu silty clay, 40 to 70% slopes. Developed in old alluvium and colluvium from basic igneous rock. Used for pasture.
- (7) Vegetation: Due apparently to extensive topographic and vegetational modification, the vegetation of the area is generally atypical of the region. Vegetation at the site consists mostly of a mosaic of scrubby koa-haole, grasses and smaller shrubs, and eroding soils. Species of grass common to the site include bermuda grass, rhodes grass, large crabgrass and buffelgrass.
- (8) Archaeology: The field inspection revealed no historical or archaeological remains in the area.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: E

b. Potential Impacts - Short-term construction-related impacts.

c. Administrative Requirements

- (1) Negotiation with Campbell Estate for use of the site for well development as they intend to use remaining water resources available in the Kahuku area.
- (2) DOH approval of the well for domestic use.
- (3) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.

- (4) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (5) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
- (6) Construction-related permits and approvals.

2. Kawaihapai Well and Alternate

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-2, General Agricultural
- (4) Flood Zone: D
- (5) Agricultural Lands of Importance: None
- (6) Soil: rRK Rock land. Main characteristics are rock outcrops and very shallow soils. Used for pasture, wildlife habitat and water supply.
- (7) Vegetation: Guinea grass is the dominant species at the project site. Other significant components of the vegetation are browsed shrubs of Koa-haole between 4 and 5 feet in height and small kiawe trees up to 20 feet tall. Small numbers of cocklebur, false mallow, comb hyptis, fuzzy rattle-pod, bitter herb, klu, ageratum, spiny amaranth, large crabgrass, cow pea and honohono are found in vicinity of the site. The botanical survey area may not encompass the entire Kawaihapai Well Alternate Site vicinity.
- (8) Archaeology: The field inspection revealed no historical or archaeological sites. The archaeological reconnaissance survey area may not encompass the entire Kawaihapai Well Alternate Site vicinity.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: E

b. Potential Impacts - Short-term construction-related impacts.

c. Administrative Requirements

- (1) Coordination with the State of Hawaii for use of the site for well development.
- (2) DLNR Water Withdrawal and Use Permit.
- (3) DOH approval of the well for domestic use.
- (4) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
- (5) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (6) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
- (7) Construction-related permits and approvals.

3. Kawailoa Well

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-1, Restricted Agricultural
- (4) Flood Zone: D
- (5) Agricultural Lands of Importance: Prime
- (6) Soil: WaB. Wahiawa silty clay, 3 to 8% slopes. Developed in residuum and old alluvium from basic igneous rock. Used for sugarcane, pineapple and pasture.
- (7) Vegetation: The Kawailoa Well Site is located in sugar cane fields near a cane haul road. The cane fields are devoid of other species except along the verges and roadways where small numbers of nut sedge, fir-leaved celery, bur clover, sow thistle, garden spurge, pua-lele, slender amaranth, prostrate spurge, goosegrass, rhodes grass, Panama grass and Bermuda grass were observed.

- (8) Archaeology: The field inspection revealed no archaeological or historical remains at the site.
 - (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: B
- b. Potential Impacts - Short-term construction-related impacts.
- c. Administrative Requirements
- (1) Negotiation with private landowner for use of the site for well development.
 - (2) DLNR Water Withdrawal and Use Permit.
 - (3) DOH approval of the well for domestic use.
 - (4) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
 - (5) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
 - (6) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
 - (7) Construction-related permits and approvals.

4. Kawela Well

- a. Developmental Considerations
- (1) State Land Use District: Agricultural
 - (2) City Development Plan: Agriculture
 - (3) City Zoning: AG-1, Restricted Agricultural
 - (4) Flood Zone: D
 - (5) Agricultural Lands of Importance: None
 - (6) Soil: WkB Waialua silty clay, 3 to 8% slopes. Developed in alluvium from basic igneous rock. Used for sugar cane, truck crops and pasture.

- (7) Vegetation: Vegetation at the Kawela Well site, situated on a lower slope of a bluff, can be described as a koa-haole-guinea grass-paragrass scrub with emergent Christmas berry. Approximately 30 percent of the vegetative cover is provided by koa-haole, 10 to 18 feet in height. Guinea grass and paragrass form an almost complete herb layer which is 3 to 7 feet in depth.
- (8) Archaeology: The field inspection revealed no archaeological or historical remains at the site.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: E

b. Potential Impacts

- (1) Short-term construction related impacts.

c. Administrative Requirements

- (1) Negotiation with private landowner for use of the site for well development.
- (2) DOH approval of the well for domestic use.
- (3) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
- (4) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (5) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
- (6) Construction related permits and approvals.

5. Mokuleia Well I

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-1, Restricted Agricultural
- (4) Flood Zone: D

- (5) Agricultural Lands of Importance: Prime
- (6) Soil: EaC Ewa silty clay loam, 6 to 12% slopes. Developed in alluvium derived from basic igneous rock. Used for sugarcane and pasture.
- (7) Vegetation: The Mokuleia Well I site is located in a sugar cane field. Vegetation found in the surrounding area include sugar cane, keawe, Java plum, guava, lantana, ironwood and California grass (Board of Water Supply, Environmental Impact Assessment for Mokuleia Exploratory Well, 1986.)
- (8) Archaeology: An archaeological reconnaissance was not conducted at the project site. However, as the site is cultivated in sugar cane, any surface remains have been previously disturbed. Should any unforeseen archaeological or historical artifact be encountered during construction, all work will be stopped and the State Historic Preservation Office will be notified.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: C

b. Potential Impacts

- (1) Short-term construction related impacts.
- (2) Possible visual impact.

c. Administrative Requirements

- (1) Negotiation with private landowner for use of the site for well development.
- (2) DLNR Water Withdrawal and Use Permit
- (3) DOH approval of the well for domestic use.
- (4) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
- (5) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (6) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.

- (7) Construction-related permits and approvals.
6. Opana Well (Design considerations are presented in Appendix A)

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-1, Restricted Agricultural
- (4) Flood Zone: D
- (5) Agricultural Lands of Importance: None
- (6) Soil: KanE Kaena very stony clay, 10 to 35% slopes. Developed in alluvium and colluvium from basic igneous rock. Used for pasture and urban development.
- (7) Vegetation: The flora found at the Opana Well site consists of Christmas berry-koa-haole-guinea grass scrub typical of the region. About 70 percent cover is provided by an upper canopy consisting exclusively of 10 to 20 feet tall shrubby Christmas berry, and 6 to 10 feet tall koa-haole. The herb layer is dominated by guinea grass approximately 3 feet in height.
- (8) Archaeology: The field inspection revealed no archaeological or historical remains at the site.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: E

b. Potential Impacts

- (1) Short-term construction related impacts.
- (2) Possible visual impact of reservoir.

c. Administrative Requirements

- (1) DOH approval of the well for domestic use.
- (2) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.

- (3) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (4) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
- (5) Construction-related permits and approvals.

7. Ukoa Wells

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-1, Restricted Agricultural
- (4) Flood Zone: D
- (5) Agricultural Lands of Importance: Prime
- (6) Soil: LaB Lahaina silty clay, 3 to 7% slopes. Developed from basic igneous rock. Mainly used for sugarcane and pineapple.
- (7) Vegetation: The Ukoa Wells are situated in a sugar cane field. The area is devoid of other plant species with the exception of nut sedge.
- (8) Archaeology: The field inspection revealed no archaeological or historical remains at the site.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: A

b. Potential Impacts

- (1) Short-term construction related impacts.
- (2) Possible impact to Ukoa Pond, a spring environment. Wetland monitoring will be coordinated with the U.S. Geological Survey, U.S. Fish and Wildlife Service, and the State Department of Land and Natural Resources.
- (3) Possible visual impact to nearby residences.

c. Administrative Requirements

- (1) Negotiation with private landowner for use of the site for well development.
- (2) DLNR Water Withdrawal and Use Permit.
- (3) DOH approval of the well for domestic use.
- (4) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
- (5) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (6) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
- (7) Construction related permits and approvals.

8. Waialua Well II (Design considerations are presented in Appendix A)

a. Developmental Considerations

- (1) State Land Use District: Agricultural
- (2) City Development Plan: Agriculture
- (3) City Zoning: AG-1, Restricted Agricultural
- (4) Flood Zone: D
- (5) Agricultural Lands of Importance: None
- (6) Soil: KpE Kemoo silty clay, 20 to 35% slopes. Developed from basic igneous rock. Used for pasture.
- (7) Vegetation: The slopes of the ravine near which the Waialua Well II is located are dominated by koa-haole, Java plum, ironwood and swamp mahogany. Vegetation at the bottom of the ravine also includes guinea grass and Christmas berry. Flora found along the secondary access road to the site include false mallow, 'uhaloa, spiny amaranth and

beggar's tick. The understory of the ravine include vegetation such as pluchea, lion's ear, bitter melon, cocklebur and lantana.

(8) Archaeology: As the well site has already been developed, no further archaeological work is required. However, the presence of large stone mounds located next to the existing well were noted. The transmission line route should be designed to avoid these mounds.

(9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: E

b. Potential Impacts

(1) Short-term construction-related impacts.

c. Administrative Requirements

(1) DLNR Water Withdrawal and Use Permit.

(2) DOH approval of the well for domestic use.

(3) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.

(4) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.

(5) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.

(6) Construction-related permits and approvals.

9. Waimea Well

a. Developmental Considerations

(1) State Land Use District: Agricultural

(2) City Development Plan: Agriculture

(3) City Zoning: AG-1, Restricted Agricultural

(4) Flood Zone: D

(5) Agricultural Lands of Importance: Prime

- (6) Soil: WaC Wahiawa silty clay, 8 to 15% slopes. Developed in residuum and old alluvium from basic igneous rock. Used for sugarcane and pineapple.
- (7) Vegetation: The Waimea Well site is located in a weedy portion of a sugar cane field. Common weedy species include nut sedge, spiny amaranth, lion's ear, ageratum, fuzzy rattle-pod and pua-lele. Common grasses found at the site are guinea grass, goosegrass and Panama grass. Other vegetation include 1 to 2 feet tall koa-haole shrubs and bur clover. With the exception of flora found at a nearby gulch, this site is completely surrounded by sugar cane.
- (8) Archaeology: The field inspection revealed no historical or archaeological remains at the site.
- (9) Land Study Bureau Detailed Land Classification Overall Productivity Rating: B

b. Potential Impacts

- (1) Short-term construction-related impacts.
- (2) Possible impact to flow of a tributary of Waimea Stream. Stream flow monitoring will be coordinated with the U.S. Geological Survey, U.S. Fish and Wildlife Service, and the State Department of Land and Natural Resources.

c. Administrative Requirements

- (1) DLNR Water Withdrawal and Use Permit.
- (2) DOH approval of the well for domestic use.
- (3) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
- (4) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
- (5) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
- (6) Construction-related permits and approvals.

10. Mokuleia-Makaha Transmission Main

- a. Developmental Considerations - Developmental considerations are uncertain at this time as the exact alignment of the proposed main is unknown.
- b. Potential Impacts - Impacts to specific environs cannot be assessed at this time as the exact alignment of the proposed main is unknown. Should development of the main be pursued, anticipated impacts for all three alternative routes discussed in Chapter III and Appendix B would, for the most part, be construction-related. Additionally, impounded water compartments may be affected as discussed in Section VI-B.
- c. Administrative Requirements
 - (1) Coordination with DLNR for a possible Conservation District Use Application.
 - (2) Fulfillment of the Department of the Army Permit, if necessary.
 - (3) CZM Federal Consistency Review to be coordinated with the Department of Business and Economic Development, if necessary.
 - (4) Coordination with the Department of Land Utilization on SMA Permit requirements for the construction of access roads, if within the SMA boundary.
 - (5) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
 - (6) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
 - (7) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
 - (8) Construction-related permits and approvals.
 - (9) Coordination with landowners.

11. Mokuleia-Makaha Reservoir (To be developed in conjunction with proposed Mokuleia-Makaha Transmission Main)
- a. Developmental Considerations - Developmental considerations are uncertain at this time as the exact location of the proposed reservoir is unknown.
 - b. Potential Impacts - Impacts to specific environs cannot be assessed at this time as the exact location of the proposed reservoir is unknown. Should development of the reservoir be pursued, impacts will be primarily construction-related.
 - c. Administrative Requirements
 - (1) Coordination with DLNR for a possible Conservation District Use Application.
 - (2) Fulfillment of the Department of the Army Permit, if necessary.
 - (3) CZM Federal Consistency Review to be coordinated with the Department of Business and Economic Development.
 - (4) Coordination with the Department of Land Utilization on SMA Permit requirements for the construction of access roads, if within the SMA boundary.
 - (5) Telephone and electrical service needs will be coordinated with Hawaiian Telephone Company and Hawaiian Electric Company, respectively.
 - (6) All health-related impacts applicable to the Administrative Rules of the Department of Health (DOH) will be coordinated accordingly with DOH.
 - (7) Plans involving access road connections and use of rights-of-way within the State highway system will be coordinated with the Department of Transportation, Highways Division.
 - (8) Construction-related permits and approvals.
 - (9) Coordination with landowners.

VIII. ALTERNATIVES

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A. ALTERNATIVES

1. No Action

Under the no action alternative, existing pumpage rates would be maintained and no new water sources would be developed in the Waialua-Kahuku District. If no new water sources are developed to meet projected demands within the Waialua-Kahuku District, then the long-term development and growth of the District may be constrained. Moreover, inasmuch as the BWS is considering the conveyance of excess water to the Waianae District, the no-action alternative would preclude the potential for satisfying projected need in that district as well.

2. Increase Pumpage at Existing BWS Sources

Limitations on allowable draft, set by the Board of Land and Natural Resources (BLNR) has constrained BWS water development to levels below BWS' estimates of sustainable capacity.

The BWS estimated sustainable capacity represents the average rate at which water could be withdrawn from a specific source without deterioration of water quality.

Because the pumping capacity at existing BWS source facilities exceeds the draft allowed by the BLNR, it is possible to increase the amount of developable water without development of new water source sites. To accomplish this the BLNR must issue Water Withdrawal and Water Use Permits to allow the BWS to increase drafts at specific source sites.

The sustainable yield, total allowed draft and reserve are indicated in Table 14. The BWS' total pumping capacity and unused pumping capacity is 9.6 and 7.16 mgd, respectively.

3. Surface Sources

There are approximately five (5) continuous stream systems in the Waialua-Kahuku District. These streams could serve as a source of potable surface water. Dams, reservoirs and diversion structures would be required, in addition to sufficient land area for the improvements.

TABLE 14
GROUND WATER RESOURCE AND SOURCE DEVELOPMENT CONSTRAINTS
(All units mgd)

	Subareas					Total
	Waialua	Mokuleia	Kawailoa	Sunset Beach Waialeale	Kahuku (Malae-Kahana-Opana)	
Sustainable Yield	60*	20*	10*	(2-3)***	(10)***	102-103
Total Allowed Draft**	51.612	7.753	5.960	N/A	N/A	65.325
BWS Sources	1.73	0.00	0.00	0.34	0.37	2.44
Private Sources	1.502	4.673	0.43	0.01	9.8	16.415
Waialua Sugar Co.	48.38	3.08	5.53	--	--	56.99
Reserve				1.65-2.65	-0.17	1.48-2.48
BWS Pumping Capacity	6.0	0.00	0.00	1.6	2.0	9.6
BWS Unused Pumping Capacity	4.27	N/A	N/A	1.26	1.63	7.16

* Established by the Board of Land and Natural Resources as that amount of water which may be developed without degrading the source.

** This amount includes "preserved use" and "permitted use". The "preserved use" is the certified existing BWS use based on average daily pumpage. "Permitted use" is an additional amount of water (over and beyond the "preserved use") which the BLNR has approved for development by the BWS. The "allowed draft" cannot exceed the "sustainable yield."

*** BWS estimate

N/A Not applicable

Source: Board of Water Supply, 1986.

There are problems associated with the development of surface water sources; for instance, an open system poses greater liabilities to the BWS as it is more prone to unauthorized entry and possible contamination. Water quality and quantity would also fluctuate greatly between "wet" and "dry" periods.

4. Desalting

The use of desalted sea or brackish water for potable use is not a new technology, however, it is very expensive. Desalting is usually implemented when there are no other fresh water sources available (i.e., desert countries or areas with no ground water).

The development of a seawater or brackish water source will involve many governmental permits and could result in significant environmental impacts, especially in the vicinity of the seawater intake and brine disposal sites. Development of a brackish water well could cost as much as a freshwater well, excluding the desalting expense.

B. CONSERVATION

The BWS is undertaking a program of water conservation consisting of resource conservation (water exchange), and conservation by the consumer which will help to preserve Oahu's valuable water supplies.

1. Resource Conservation (Water Exchange)

As competition for ground water resources grows, the BWS is emphasizing optimal resource utilization. This includes the concept of water exchange. Water exchange is a conservation method that matches the quality of the water to its best use. An example of this is the use of Oahu's best water for potable uses and lower quality water for other uses such as golf course, medial strip and landscape irrigation.

The BWS' highest priority for source development includes only potable sources. The BWS, therefore, has no immediate plans to develop secondary water sources within the Waialua-Kahuku District.

2. Resource Conservation (Reuse of Water)

The reuse of water will also amplify the resource base. An example is the use of treated wastewaters for sugar cane irrigation. The water used for crop irrigation can also supplement ground water recharge in certain areas. In such an approach, however, care must be taken to apply the water in suitable areas to avoid adverse effects on potable ground water resources.

3. Water System Conservation (Conservation by Consumers)

Water system conservation targets losses during the transmission and distribution of water. By metering water entering the system and water consumption, the BWS can account for its water supplies. To shorten BWS's response time in initiating system repairs, a leak detection program was initiated in 1976. Other benefits arising from this monitoring program include identifying poor soil conditions, detaining the need for changes in construction materials, establishing construction standards and practices, and determining the need for pipe replacements.

In the event of power and/or mechanical failures, it is BWS policy that any disruption to water service should be minimized. Therefore, any breaks or other damages to the system are repaired as quickly as possible. The water system is designed for reliability and, where possible, multiple sources are interconnected to provide back-up service in emergencies. Properly managed, the system is designed to minimize the severity and duration of emergencies.

Consumer conservation is fostered through various means. Public involvement is encouraged through dissemination of information. This is exemplified by meetings held with school officials, classes for children, discussions with the public and notices in the daily newspapers.

In 1978, amendments to Chapter III of the BWS rules and regulations provided for progressively restrictive measures as ground water levels decline. These measures include voluntary conservation measures, mandatory irrigation restrictions and water allotments, and restricted use of water depending on the ground water level. Also, to promote consumer conservation, the Plumbing Code was revised to require the installation of household water saving devices for all new and replacement plumbing work. The code requires water flow control devices on faucets and valves, low volume flush toilets, and recirculation of cooling water in all new construction.

IX. PROBABLE ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

IX. PROBABLE ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Although construction-related impacts will be unavoidable, they will be of temporary duration, occurring only during installation of the proposed facilities. Appropriate measures will be taken to minimize adverse effects.

Most of the project's anticipated long-term adverse impacts can be mitigated. However, the commitment of land area to the proposed use cannot be avoided. Utilization of these lands may preclude options for future development at some sites.

X. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES
OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND
ENHANCEMENT OF LONG-TERM PRODUCTIVITY

X. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF
MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF
LONG-TERM PRODUCTIVITY

The proposed water facility improvements will develop additional water sources and improve the existing municipal system. Development of additional sources is required to meet the projected needs of the Waialua-Kahuku District and accommodate desired growth rates as expressed by the City and County of Honolulu's General Plan. If excess water in the Waialua-Kahuku District becomes available and inter-district conveyance is determined to be economically feasible, a transmission main is proposed for the purpose of conveying the excess water to the Waianae District on the leeward side of the Island of Oahu.

The long-term productivity of the basal aquifer in the Waialua Ground Water Control Area is not anticipated to be adversely affected, as the anticipated draft for the Area will be within the DLNR-established sustainable yields.

XI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

XI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Development of the proposed water facility improvements, as proposed, would require irretrievable commitments of labor, material, and monies.

Lands upon which development occurs may be reclaimed if it becomes desirable to do so.

XII. UNRESOLVED ISSUES

XII. UNRESOLVED ISSUES

Regional Environmental Impact Statement

This environmental document considers and assesses various proposed water system improvement projects as a single action. This consolidation of individual projects into a single action is intended to streamline the research and presentation of facts and findings in conformance with Chapter 343, Hawaii Revised Statutes.

This "regional" approach to environmental impact assessment facilitates discussion of the cumulative effects of the proposed improvements. However, additional details may be required to more fully disclose potential impacts of individual projects. The BWS will, therefore, prepare supplemental environmental impact statements, as necessary, prior to the implementation of individual water system improvements.

Stream and Wetland Environments

The development of water sources may impact stream and wetland environments. The degree of impact to stream flow or wetland water sources will depend on whether the well is directly or indirectly tapping the same body of water.

Mokuleia-Makaha Transmission Main and Reservoir

The Mokuleia-Makaha Transmission Main and Reservoir system is proposed to facilitate the transfer of surplus water from the Waialua-Kahuku District to the Waianae District. The alignment and size of the transmission main, and the location and size of the reservoir(s) are still unresolved.

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

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

FEDERAL AGENCIES

Soil Conservation Service
U.S. Department of Agriculture
P. O. Box 5004
Honolulu, Hawaii 96850

Engineering Division
U.S. Army Engineer District,
Honolulu
Department of the Army
Building 230
Fort Shafter, Hawaii 96858

Office of Environmental Services
Fish and Wildlife Service
U.S. Department of Interior
P. O. Box 50167
Honolulu, Hawaii 96850

U.S. Geological Survey
Division of Water Resources
U.S. Department of Interior
P. O. Box 50166
Honolulu, Hawaii 96815

District Planning Office
U.S. Department of Transportation
United State Coast Guard
Commander, Fourteenth Coast
Guard District
300 Ala Moana Boulevard
Honolulu, Hawaii 96850

U.S. Army Support Command Hawaii
Attention: Environmental
Management Office
Fort Shafter, Hawaii 96858-5000

Commander, Naval Facility
Command Pacific Division
U.S. Department of the Navy
Pearl Harbor, Hawaii 96860

STATE AGENCIES

Department of Accounting and
General Services
State of Hawaii
P. O. Box 119
Honolulu, Hawaii 96810

Department of Agriculture
State of Hawaii
P. O. Box 22159
Honolulu, Hawaii 96822-0159

Department of Defense
Office of the Adjutant General
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Department of Health
State of Hawaii
P. O. Box 3378
Honolulu, Hawaii 96801

Department of Land and Natural
Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

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

Office of Hawaiian Affairs
Kawaiahao Plaza Suite 100
567 S. King Street
Honolulu, Hawaii 96813

STATE AGENCIES - (Continued)

Department of Business and
Economic Development
State of Hawaii
P. O. Box 2359
Honolulu, Hawaii 96804

Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Environmental Center
University of Hawaii
Crawford 317
2250 Campus Road
Honolulu, Hawaii 96822

Water Resources Research Center
University of Hawaii
Holmes Hall 283
2540 Dole Street
Honolulu, Hawaii 96822

Office of Environmental Quality
Control
State of Hawaii
465 South King Street, Room 104
Honolulu, Hawaii 96813

Department of Business and Economic
Development
Housing Finance and Development
Corporation
P. O. Box 17907
Honolulu, Hawaii 96817

Hawaii Housing Authority
1002 No. School Street
Honolulu, Hawaii 96813

CITY & COUNTY OF HONOLULU AGENCIES

Department of General Planning
City and County of Honolulu
650 S. King Street, 8th Floor
Honolulu, Hawaii 96813

Department of Land Utilization
City and County of Honolulu
650 S. King Street, 7th Floor
Honolulu, Hawaii 96813

Department of Parks and Recreation
City and County of Honolulu
650 S. King Street, 9th Floor
Honolulu, Hawaii 96813

Department of Transportation
Services
City and County of Honolulu
650 S. King Street
Honolulu, Hawaii 96813

Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Department of Housing & Community
Development
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Fire Department
City and County of Honolulu
1455 S. Beretania Street, Room 305
Honolulu, Hawaii 96814

Police Department
City and County of Honolulu
1455 S. Beretania Street
Honolulu, Hawaii 96814

Building Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

GOVERNMENT OFFICIALS

Senator Gerald T. Hagino
7th Senatorial District
State Capitol, Room 205
Honolulu, Hawaii 96813

GOVERNMENT OFFICIALS - (Continued)

Representative Joseph P. Leong
14th Representative District
State Capitol, Room 309
Honolulu, Hawaii 96813

Councilmember Randall Y. Iwase
Council District I
Honolulu Hale
Honolulu, Hawaii 96813

Councilmember Gary Gill
Council District VI
Honolulu Hale
Honolulu, Hawaii 96813

UTILITY COMPANIES

Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96840-0001

Hawaiian Telephone Company
P. O. Box 2200
Honolulu, Hawaii 96841

The Gas Company
P. O. Box 3379
Honolulu, Hawaii 96842

Oceanic Cablevision
2669 Kilihau Street
Honolulu, Hawaii 96819

NEIGHBORHOOD BOARDS

North Shore Neighborhood Board
No. 27
P. O. Box 607
Haleiwa, Hawaii 96712

Koolauloa Neighborhood Board
No. 28
c/o Hauula Satellite City Hall
54-010 Kukuna Road
Hauula, Hawaii 96717

ORGANIZATIONS & INDIVIDUALS

James Campbell Trust Estate
James Campbell Estate
828 Fort Street
Honolulu, Hawaii 96813

Bernice P. Bishop Trust Estate
Trustees of the Bernice P. Bishop
Estate
P. O. Box 3466
Honolulu, Hawaii 96801

Castle and Cooke, Inc.
P. O. Box 2990
Honolulu, Hawaii 96802

Mokuleia Homesteads
333 Queen Street, Suite 605
Honolulu, Hawaii 96813

Waialua Ranch Partners
66-214 Farrington Highway
Waialua, Hawaii 96791

Life of the Land
250 South Hotel Street, Room 211
Honolulu, Hawaii 96813

Mr. Gary Andersen, Conservation
Chair
Sierra Club
Honolulu Executive Committee
P. O. Box 11070
Honolulu, Hawaii 96828

Outdoor Circle
200 N. Vineyard Boulevard
Honolulu, Hawaii 96817

John Zapotocky
Pacific Tower, Suite 1010
1001 Bishop Street
Honolulu, Hawaii 96814

Engineers-Surveyors Hawaii, Inc.
Building No. 6, Suite No. 1
1020 Auahi Street
Honolulu, Hawaii 96814

XIV. ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
COMMENTS AND RESPONSES

XIV. ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
COMMENTS AND RESPONSES

This section presents letters of comments received on the Environmental Impact Statement Preparation Notice (EISPN) and the BWS' responses to these comments. The following is a list of agencies and organizations commenting on the EISPN. Substantive comment letters and the respective response letters are reproduced in this section.

<u>Name</u>	<u>Date of Comment</u>	<u>Date of Response</u>
<u>FEDERAL AGENCIES</u>		
Department of the Army, U.S. Army Engineer District, Honolulu	07/17/86	08/04/86
Department of Interior, Fish and Wildlife Service	07/28/86	08/11/86
Department of Interior, U.S. Geological Survey	07/16/86	08/01/86
<u>STATE AGENCIES</u>		
Office of Environmental Quality Control	06/28/86	08/11/86
Department of Health	07/11/86	07/21/86
Department of Transportation	07/07/86	07/21/86
<u>CITY & COUNTY OF HONOLULU AGENCIES</u>		
Department of General Planning	07/24/86	08/22/86
Department of Land Utilization	07/31/86	08/11/86
Department of Public Works	07/08/86	07/14/86
<u>UTILITY COMPANIES</u>		
Hawaiian Electric Co., Inc.	07/31/86	08/18/86
Hawaiian Telephone Company	08/10/86	06/24/86
<u>OTHER ORGANIZATIONS</u>		
Engineers-Surveyors Hawaii, Inc.	04/28/86	05/21/86
The Estate of James Campbell	04/21/86	05/20/86
John Zapotocky	03/12/86	03/19/86



861788

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

RECEIVED
BOARD OF WATER SUPPLY

JUL 21 1 34 PM '86

MGR
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ME

July 17, 1986

REPLY TO
ATTENTION OF:

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

August 4, 1986

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

Dear Mr. Hayashida:

Thank you for the opportunity to review and comment on the EIS for Waialua-Kahuku Regional Water System Improvements, Oahu. The following comments are offered:

- a. A Department of the Army permit is required for specific project improvements (such as waterlines crossing streams or through wetlands and reservoirs or well site developments in wetlands) in waters of the U.S. and adjacent wetlands.
- b. The flood hazards have been addressed on page IV-18 of the report covering the regional environment. All the proposed well sites are located within Zone D, an area of undetermined, but possible flood hazards.

Sincerely,

Kisuk Choung
Kisuk Choung
Chief, Engineering Division

Mr. Kisuk Choung
Chief, Engineering Division
U. S. Army Engineer District,
Honolulu
Building 230
Fort Shafter, Hawaii 96858
Dear Mr. Choung:

Subject: Your Letter of July 17, 1986 on the Environmental Impact Statement Preparation Notice for the Waialua-Kahuku Regional Water System Improvements

Thank you for commenting on the environmental document for the proposed water system improvement projects.

We will apply for a Department of the Army Permit for those projects involving stream crossings and wetland areas.

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

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates



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BOARD OF WATER SUPPLY
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United States Department of the Interior
FISHERY AND WILDLIFE SERVICE
100 ALA MOANA BOULEVARD
P O BOX 50167
HONOLULU, HAWAII 96850

of these habitats may change. Subsequently, serious adverse impacts upon the distribution of wetland plants, and populations of endangered waterbirds, migratory waterfowl and shorebirds might follow.

Because the proposed actions may have a significant impact upon important fish and wildlife resources, the Service recommends that an Environmental Impact Statement (EIS) be prepared. We would be happy to assist you in preparing the fish and wildlife impact analysis portion of the EIS.

We appreciate this opportunity to comment.

Sincerely yours,

Ernest Kosaka
Ernest Kosaka
Project Leader
Office of Environmental Services

cc: NMFS - WPPD
HDFAW
HDAR
EPA, San Francisco

Thank you for requesting our early review of the subject EIA. My staff has evaluated the document and offers the following comments for your consideration.

General Comments

The Service's principal concerns regarding the proposed water developments involve wetland habitats, endangered waterbirds, and native stream fauna. Specifically, the James Campbell National Wildlife Refuge, and Punahoolapa Pond in Kahuku and Ukoa Pond near Kanihala together harbor all four species of endangered Hawaiian waterbirds and a host of migratory waterfowl and shorebirds. Both areas are listed as "essential habitat" in the revised Hawaiian Waterbirds Recovery Plan (Sept. 1985).

Specific Comments

Page IV-25. The paragraph describing Ukoa Pond should include a reference to the importance of this wetland to endangered waterbirds.

Page IV-26. Similarly, the paragraph concerning Kahuku wetlands should be expanded to explain the importance of the James Campbell National Wildlife Refuge and Punahoolapa Pond to populations of endangered Hawaiian waterbirds.

Page VI-2. The discussion of project-related effects upon hydrology should address the potential draw down of groundwaters in wetlands adjacent to the well sites, specifically Ukoa Pond/Marsh and the Kahuku wetlands. If necessary, additional groundwater investigations should be conducted to accurately determine the relationship between the water source(s) for these wetlands and basal groundwaters. If well operation may lower groundwater levels or otherwise affect the hydrology of Ukoa Pond and the Kahuku wetlands, the physical and chemical nature



Save Freely and You Serve America!

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

August 11, 1986

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AUG 13 1986

WILSON OKAMOTO & ASSOCIATES

Mr. Ernest Kosaka
Office of Environmental Services
Fish and Wildlife Service
U.S. Department of the Interior
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

Subject: Your letter of July 28, 1986 on the Environmental
Impact Assessment for the Waialua-Kahuku Water
System Improvements

Thank you for commenting on the environmental assessment for
the proposed water system improvement projects and offering
your assistance in preparing the fish and wildlife impact
analysis.

Our consultant, Wilson Okamoto and Associates, will be
contacting you on the fish and wildlife impact analysis.

We will include a discussion on the importance of Ukon Pond
and Kohuku wetlands as well as any project related impacts on
these sensitive areas.

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

Very truly yours,

KAZUO HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates



United States Department of the Interior
Geological Survey

Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96815

July 16, 1986

RECEIVED
DIVISION OF WATER SUPPLY
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Ref

Mr. Kazu Hayashida - July 16, 1986

Mr. Kazu Hayashida
Manager and Chief Engineer
Honolulu Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Subject: Waialua-Kahuku Regional Water System Improvements
Environmental Impact Assessment (EIA)

Attached are comments by my staff on the subject Environmental Impact Assessment. The principal reviewer was Kiyoshi Takasaki.

Our review comments follow:

Page	Paragraph	Line	Remarks
III-3	b	All	Why "Regional" when it is "District" everywhere in the report.
Fig. 1a.	-	All	Not clear. Does the Waialua-Kahuku Water System include the Kahuku and other private water systems?
Fig. 1b.	-	All	Pumping and flowing wells in map should be shown so that reader can better assess any impact to the ground-water body or bodies being tapped.
Fig. 1c.	-	All	ditto
IV - 3	2	All	Only the alluvium and marine sediments overlying Waianae lavas should be described here. Sediments underlying the Koolau lavas should be described in IV - 2.

Page	Paragraph	Line	Remarks
IV - 3 (cont'd)	2	All	Where is Haiki Gulch? The sediments underlying the Mokuleia area are thicker than those underlying the Waialua area, that is 500 and 200 feet, respectively.
IV - 3	3	All	Ground-water bodies or reservoirs occurring in Waianae lavas should be discussed separately from those occurring in Koolau lavas.
IV - 8 to IV - 10			Ground-water occurrence, reservoirs and flows in Koolau lavas and in Waianae lavas should be discussed separately-- to make for easier reading.

We thank you for the opportunity to review the subject document.

Sincerely,

Joseph D. Camp
Joseph D. Camp
Acting District Chief

9

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August 1, 1986

Mr. Joseph D. Camp
Page 2

August 1, 1986

Mr. Joseph D. Camp
Acting District Chief
Water Resources Division
Geological Survey
U.S. Department of the Interior
P. O. Box 50166
Honolulu, Hawaii 96815

Dear Mr. Camp:

Subject: Your letter of July 16, 1986 on the Environmental
Impact Assessment for the Waialua-Kahuku Regional
Water System Improvements

Thank you for commenting on the environmental document for the
proposed water system improvement projects.

In response to your comments we offer the following:

1. The term "Regional" was used since the document incorporates projects in both Waialua-Kawela Water District and our Kahuku Water District. Each district's water system is independent of the other; therefore, the term "Regional" refers to the area served by separate water system districts.
2. The narrative describing the service area of the two water systems will be revised to indicate that no private water systems are involved.
3. A map showing existing wells will be included in the Draft Environmental Impact Statement (EIS).
4. The discussion on the geology of the Koolau and Waianae Ranges will be separated as suggested in your letter.

5. Halli Gulch is located inland of the old Dillingham Quarry in Mokuleia. (See attached map.)
6. The Draft EIS will be revised to show that the sediments at Mokuleia is thicker than those at Maialua.
7. The groundwater bodies in the Waianae lavas will be discussed separately from those in the Koolau lavas.

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

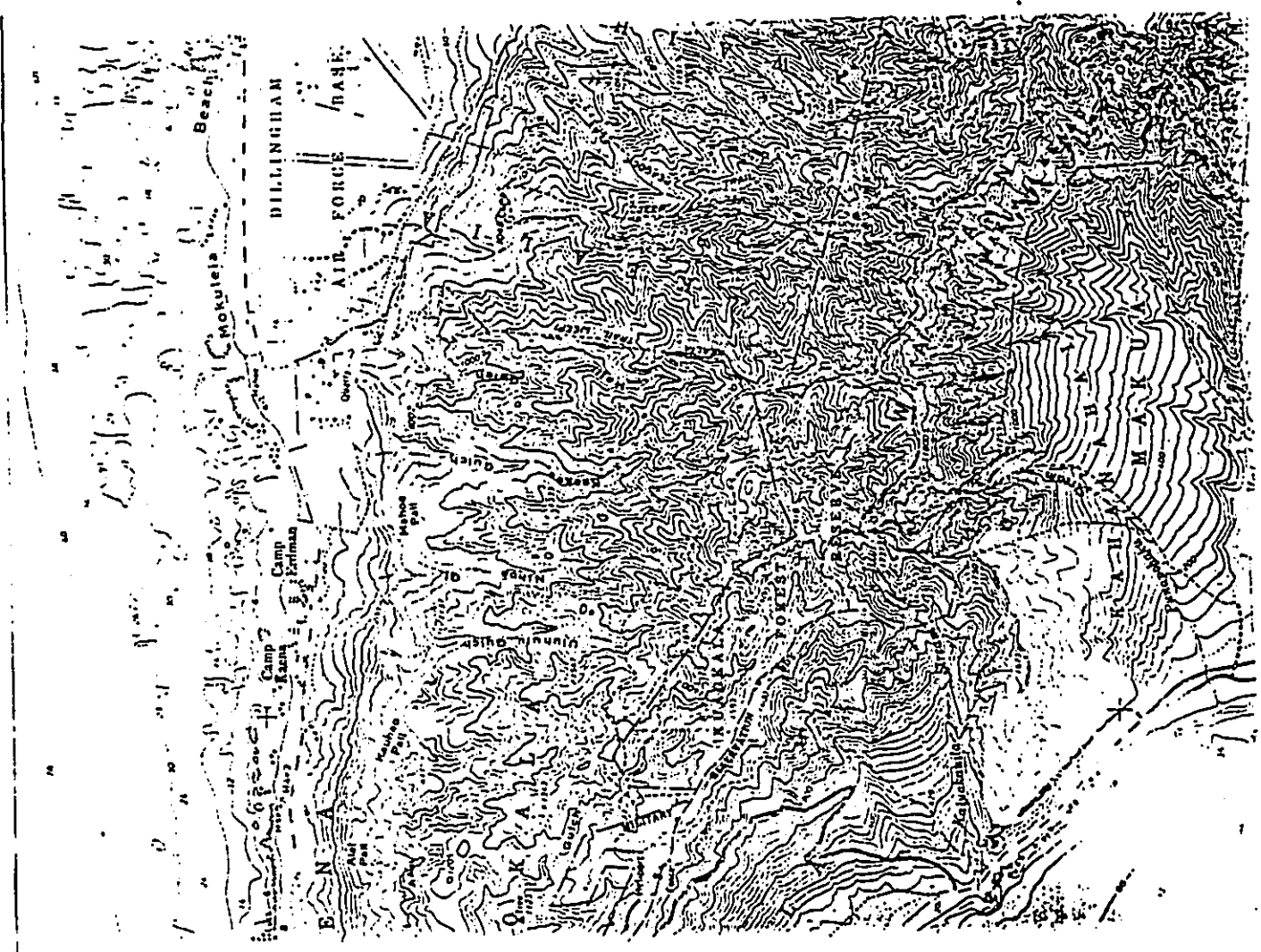
Very truly yours,


KAZU HAYASHIDA
Manager and Chief Engineer

Attachment

cc: Wilson Okamoto & Associates

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

MGR
P/E

LESLIE S. MATSUMURA
DIRECTOR

IN REPLY, PLEASE REFER TO
EPMSO



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STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3218
HONOLULU, HAWAII 96801

July 11, 1986

July 21, 1986

MEMORANDUM

To: Mr. Kazu Hayashida, Manager & Chief Engineer
Board of Water Supply, City & County of Honolulu

From: Deputy Director for Environmental Health

Subject: Environmental Impact Assessment (EIA) for Waialua-Kahuku Regional Water System Improvements

Thank you for allowing us to review and comment on the subject EIA. On the basis that the project will comply with all applicable Administrative Rules, please be informed that we do not have any objections to this project.

We realize that the statements are general in nature due to preliminary plans being the sole source of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review.

JAMES K. IKEDA

Mr. James K. Ikeda
Deputy Director
Environmental Health
State of Hawaii
Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Ikeda:

Subject: Your letter of July 11, 1986, on the Environmental Impact Assessment for the Waialua-Kahuku Regional Water System Improvements

Thank you for reviewing the environmental assessment for the proposed water system projects.

We will comply with all applicable Administrative Rules of the Department of Health.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates
(with incoming letter)

9

GEORGE F. ABTOSHI
GOVERNOR

RECEIVED
OFFICE OF THE SUPERVISOR
JUL 14 11 43 AM '86



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
808 PUNCHBOUL STREET
HONOLULU HAWAII 96813

July 7, 1986

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:

Waialua-Kahuku Regional Water System Improvements
Environmental Impact Assessment (EIA)

We have no objections to the proposed water system improvements as described in the subject EIA.

However, we would be interested in any contemplated access road connection to our State highway system. In such cases, all plans for work within the State highway right-of-way will need to be reviewed and approved by the Highways Division.

Thank you for this opportunity to provide comments.

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Director of Transportation

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

By: *Wayne J. Yamasaki*
WAYNE J. YAMASAKI
DIRECTOR

DEPUTY DIRECTORS
JOHN THOMAS SIMLADA, P.E.
WALTER T. HO
CHRISTOPHER D. SOON
ADAM D. VINCENT

WHERE REFER TO
STP 8-1434



COPY

July 21, 1986

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JUL 23 1986

WILSON OKAMOTO & ASSOCIATES

Mr. Wayne J. Yamasaki, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Yamasaki:

Subject: Your letter of July 7, 1986 on the Waialua-Kahuku Regional Water System Improvement Environmental Impact Assessment

Thank you for reviewing the environmental assessment for the proposed water system projects.

We will coordinate plans involving access road connections and use of right-of-ways within the State highway system with your Highways Division.

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

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates
(with incoming letter)

COPY



BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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DEPT 510
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LETITIA N. UYEHARA
DIRECTOR
TELEPHONE NO.
544-8313

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STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 SOUTH KING STREET, ROOM 104
HONOLULU, HAWAII 96813

GEORGE A. HAYASHIDA
DIRECTOR

August 11, 1986

June 28, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental
Quality Control
State of Hawaii
465 South King Street, Room 104
Honolulu, Hawaii 96813

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:

Subject: Waialua-Kahuku Regional Water System
Improvements Environmental Impact Assessment

We would appreciate some discussion on the effects of well development on nearby streams. We would like to see the Board of Water Supply maintain a level of pumping which will retain minimum stream flow necessary to support stream fauna.

Thank you for allowing us the opportunity to review this assessment.

Sincerely,

Letitia N. Uyehara

Letitia N. Uyehara
Director

Subject: Your letter of June 28, 1986 on the Waialua-Kahuku Regional Water System Improvements Environmental Impact Assessment

Thank you for commenting on the environmental assessment for our proposed water system improvements projects.

We will address the impacts to streamflow and stream fauna from applicable well development projects in the Draft Environmental Impact Statement.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates

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 30 OF WATER SUPPLY
 DEPARTMENT OF GENERAL PLANNING
 CITY AND COUNTY OF HONOLULU JUL 30 AM '86
 550 SOUTH KING STREET
 HONOLULU, HAWAII



DONALD A. CLEGG
 CHIEF PLANNING OFFICER
 DEPARTMENT OF GENERAL PLANNING

JB/DGP 7/86-8948

July 24, 1986

MEMORANDUM
TO: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
 BOARD OF WATER SUPPLY
ATTENTION: LARRY WHANG
FROM: DONALD A. CLEGG, CHIEF PLANNING OFFICER
 DEPARTMENT OF GENERAL PLANNING
SUBJECT: WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS
 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
 YOUR MEMORANDUM DATED JUNE 26, 1986

We have the following comments for your consideration.

- Of the eleven (11) water-facility improvements being proposed as shown on page II-1 of the EIA, only three (the Hokuleia I Well, the Kawailoa Well, and the Waiamea Well projects) are in conformity with the Development Plan Public Facilities (DP/PF) Map.

The eight proposed improvements which we have listed below presently are not depicted on either the North Shore or Koolauloa DP/PF Maps and, therefore, will require amendments to the appropriate DP/PF Map:

- | | |
|-----------------|--------------------------------|
| Hanakaoo Well | Waialua Well II |
| Kawaihapai Well | Hokuleia-Waianae Transmission |
| Kawela Well | Main |
| Opana Well | Mokuleia-Kaena Point Reservoir |
| Ukoa Well | |

Kazu Hayashida
 July 24, 1986
 Page 2

2. Section 2.1 of Ordinance No. 86-68 (see attached) which was in effect June 12, 1986 states:

"For publicly funded facilities required to be shown on the public facilities map, a project shall be designated as proposed funding (within 6 years), before construction and land acquisition funds may be budgeted. In addition, no funds may be budgeted for projects shown by the site undetermined symbol until the site location is specified on the map. Designation on the map is not required for the budgeting of planning and engineering funds."

With Ordinance No. 86-68 now in effect, we would suggest that the Board of Water Supply program its activities accordingly so that no unnecessary delays are created because of nonconformity with the public facilities maps.

If there are any questions on Ordinance No. 86-68 or on filing of the amendment applications, you may call Gary Okino of my staff at 527-6067.

3. The discussion on "Wetland Area" on pages IV-24 to IV-26 might be expanded to indicate that wetlands, as a natural resource, provide vital nesting and rearing habitat for endangered waterfowl species.

For example, within the Waialua-Kahuku districts, the U.S. Fish and Wildlife Service has delimited certain areas for the protection of endangered waterbirds. These include the following:

- Ukoa Marsh
- Haleiwa lotus field
- Crowbar Ranch Ponds near Dillingham Field
- James Campbell National Wildlife Refuge (Kii and Punamano Units)

See attached maps prepared by the USF&WS.

Aside from its biological value in supporting wildlife populations, wetlands also offer a natural form of flood control and play a major role in the recharging of groundwater supplies, and help to maintain water quality. We feel these valuable assets need to be mentioned in the EIS.

Handwritten notes at top of page: "5/13/86" and "Hayashida 7/24/86".

Handwritten mark resembling a stylized 'G' or '9'.

4. The new Kahuku Fire Station was officially dedicated on February 23, 1985, and dedication ceremonies for the Kahuku Police Substation were held on May 3, 1986.
The discussion relating to "Police and Fire Protection" on pages IV-41 to IV-42 should be modified to present up-dated information.
5. Depending on its location, the proposed transmission line around Kaena Point may be subject to the requirements of SMA Ordinance No. 84-4. (See attached SMA map.)
6. The proposed 2.0 to 6.0 m.g. reservoir may require approval of a Conservation District Use Application from the Board of Land and Natural Resources.
7. Table 6 (page III-22) shows the funding schedule (amounting to \$4.9 million) for construction of the Mokuleia I. Kawailoa and Waimea Well improvements.
While the remaining proposals are indicated to be still in the conceptual stage, some indication of the dollar amount that will be required to implement these facilities would be helpful.
If federal funds will be expended in assisting the development of these facilities, that also should be indicated.
8. Re the "General" section on page III-2, line 6, agricultural activities utilize not produce, more than half of all water developed, as shown in Table 1.

Attach.

Donald Clegg
DONALD A. CLEGG
Chief Planning Officer

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



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BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

Mr. Donald A. Clegg
Page 2

August 22, 1986

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AUG 26 1986

August 22, 1986

WILSON OKAMOTO & ASSOCIATES

TO: DONALD A. CLEGG, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR MEMORANDUM OF JULY 24, 1986 ON THE
ENVIRONMENTAL IMPACT ASSESSMENT FOR WAIALUA-KAIUKU
REGIONAL WATER SYSTEM IMPROVEMENTS

Thank you for commenting on the environmental document for our
proposed water system improvement projects.

In response to your comments, we offer the following:

1. Amendments to the DP/PF Map will be submitted for those projects not depicted on either the Koolauloa or North Shore DP/PF Maps.
2. No funds will be budgeted for projects not on the appropriate DP/PF Maps in compliance with Ordinance No. 86-68.
3. A more detailed discussion on "wetland" areas will be included in the Draft Environmental Impact Statement (EIS).
4. Updated information on "Police and Fire Protection" will be included in the Draft EIS.
5. The siting of the reservoir and transmission main conveying excess water to the Waianac area has not been determined. The need for a possible SNA Permit or CDUA permit for the projects will be included in the Draft EIS.

(6) Estimated construction costs for the conceptual projects will be included as available in the Draft EIS.

7. The word "produce" on line 6 on page III-2 will be replaced with the word "utilize" in the Draft EIS.

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

for KAZU HAYASHIDA

cc: Wilson Okamoto & Associates

COPY



BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

MEMO
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WATER SUPPLY
JUL 31 11 29 AM '86

861861

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
840 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 533-4131



FRANK F. ASH
DIRECTOR

JOHN P. WHALEN
DIRECTOR

LU7/86-3872 (BWH)

August 11, 1986

RECEIVED
AUG 13 1986

WILSON OKAMOTO & ASSOCIATES

TO: JOHN P. WHALEN, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR MEMORANDUM OF JULY 31, 1986 ON THE ENVIRONMENTAL ASSESSMENT FOR THE WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS

July 31, 1986

MEMORANDUM

TO : KAZU HAYASHIDA, MANAGER & CHIEF ENGINEER
BOARD OF WATER SUPPLY

FROM : JOHN P. WHALEN, DIRECTOR

SUBJECT : WAIALUA - KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS
ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

We have reviewed the document and have the following comments and suggestions:

1. Public Services - Sewerage System (p. IV-38):
For your information, the Kullima Development Corporation has plans to develop a 1.3 mgd wastewater treatment plant mauka of Kamehameha Highway on 20 acres of agricultural land owned by Campbell Estate.
2. Policies and Controls - (p. V-9):
The relationship to the Development Plan (DP) Public Facilities Map should be noted.
3. Special Management Area (SMA) - (p. V-11):
Installation of underground utility lines and appurtenant above-ground features less than four feet in height along existing corridors is not considered "development" under the SMA Ordinance No. 84-4, as amended, and are therefore exempt from SMA requirements.

Thank you for the opportunity to comment. If there are any questions, please call our Environmental Affairs Branch at 527-4077.

Frank F. Ash
for JOHN P. WHALEN
Director of Land Utilization

JPM:s1
03328

Thank you for commenting on the environmental document for the proposed water system improvement projects.

In response to your comments, we offer the following:

1. We will note that Kullima Development Corporation's plans to develop a 1.3 mgd wastewater treatment plant on Campbell Estate lands in the Draft EIS.
2. The relationship to the Development Plan Public Facilities Map will be included in the discussion on "Policies and Controls."
3. We will indicate that the installation of underground utilities and appurtenant above-ground features less than four feet in height along existing corridors is exempt from SMA requirements under SMA Ordinance No. 84-4, as amended.

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

Very truly yours,

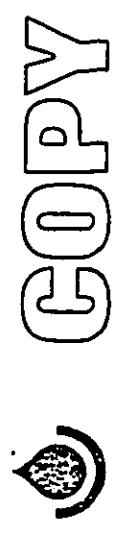
Kazu Hayashida
KAZU HAYASHIDA

cc: Wilson Okamoto and Associates

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

BOARD OF WATER SUPPLY
 CITY AND COUNTY OF HONOLULU



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RUSSELL L. SMITH, JR.
 ENV 86-148

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 JUL 16 1986

July 14, 1986

WILSON OKAMOTO & ASSOCIATES

July 8, 1986

MEMORANDUM

TO: MR. KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
 BOARD OF WATER SUPPLY

FROM: RUSSELL L. SMITH, JR., DIRECTOR AND CHIEF ENGINEER
 DEPARTMENT OF PUBLIC WORKS

SUBJECT: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR
 WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS

TO: RUSSELL L. SMITH, JR., DIRECTOR AND CHIEF ENGINEER
 DEPARTMENT OF PUBLIC WORKS

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
 BOARD OF WATER SUPPLY

SUBJECT: YOUR MEMORANDUM OF JULY 8, 1986 ON THE ENVIRONMENTAL
 IMPACT ASSESSMENT FOR THE WAIALUA-KAHUKU REGIONAL WATER
 SYSTEM IMPROVEMENTS

We have reviewed the subject Environmental Impact Assessment and have the following comments.

1. The existing Kahuku WHTP and Paalaa Kai WHTP are described in the EIA. The present method of effluent disposal at both plants is by means of injection wells.
2. A central WHTP in Mokuleia is being planned for the Waialua-Maleiwa Sewerage District which will eventually eliminate the Paalaa Kai WHTP and 17 private STPs and cavitates. An ocean outfall alternative for the disposal of the effluent is being considered in addition to reuse of the effluent for sugar cane irrigation and injection wells.

Thank you for your comments on the environmental document for the proposed water system improvements in the Waialua to Kahuku area. We shall note your comments in the draft environmental impact statement. If you have any questions, please contact Lawrence Whang at 527-6138.

cc: Wilson Okamoto

[Signature]
 For KAZU HAYASHIDA

[Signature]
 RUSSELL L. SMITH, JR.
 Director and Chief Engineer

Q

HAWAIIAN ELECTRIC COMPANY, INC. PO BOX 2150 HONOLULU, HI 96801
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July 31, 1986

Mr. Kazu Hayashida
July 31, 1986
Page 2



Bonnie Mungel Ph.D. PE
Manager
Environmental Improvement
HEI CONSULTING

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:

Subject: Waialua-Kahuku Regional Water System Improvements
Environmental Impact Assessment (EIA)

We have reviewed the above subject EIA and have the following comments:

1. If any of these exploratory wells are found to be suitable for domestic use, it is then converted into a production well. A typical production well installation will include a control building which will require electrical service.
2. It should be pointed out that a typical production well installation will be connected to the existing water system by water transmission lines. Hence, the construction of these water lines may be in close proximity to the overhead electrical lines serving the production well installation. Therefore, the following HECO notes are to be included as part of the final construction plans:
 - a. The existence and location of HECO's overhead facilities are as shown on the plans. The Contractor is to exercise extreme caution when the excavation and construction crosses or is in close proximity to overhead facilities and is to maintain 13'-0" clearance for his equipment while working close to and/or under the overhead facilities.
 - b. The Contractor is to comply with the directions of the State of Hawaii Occupational Safety and Health Law (DOSH).

- c. When excavation is adjacent to or under existing structures or facilities, the Contractor is responsible for properly sheeting and bracing the excavation and stabilizing the existing ground to render it safe and secure from possible slides, cave-ins and settlement, and for properly supporting existing structures and facilities with beams, struts or underpinning to fully protect it from damage.
 - d. Should field conditions and/or construction procedures require that the project will be in close proximity to HECO overhead lines, the Contractor is to contact W. Okudara at 455-7022 a minimum of 72 hours in advance.
 - e. Should it become necessary, any work required to relocate HECO facilities shall be done by HECO. The Contractor shall be responsible for all costs and coordination.
 - f. The Contractor shall be liable for any damages to HECO's facilities.
 - g. The Contractor shall report any damages to HECO's facilities to the HECO Trouble Dispatch at phone number 548-7961.
3. Upon request for electrical service to well sites, we would follow normal procedures in providing same.
 4. None of the well sites appear to be within the State Conservation District, thus no prior DLMR approvals should be required for overhead service lines.

Sincerely,

Bonnie Mungel



Q

A Hawaiian Electric Industries Company



18

August 10, 1986

RECEIVED

WATER RESOURCES DIVISION

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

Dear Mr. Hungor:

Subject: Your letter of July 31, 1986 on the
Environmental Impact Assessment for the
Kalahele-Kalahele Water System Improvement

Thank you for commenting on the environmental impact
assessment for the proposed water system improvement projects.

We will include the HECO notes specified in your letter as
part of the final construction plans.

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

Very truly yours,

Lawrence Whang

KAZU HAYASHIDA
Manager and Chief Engineer

TO:ln
cc: K. Hayashida
Engineering Branch
L. Whang

86-1892

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



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HAWAIIAN TELEPHONE
613

6/10/86

RECEIVED
PP OF WATER SUPPLY
JUN 18 12 00 PM '86

June 10, 1986

PK

Mr. Kazu Hayashida
Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Waialua-Kahuku Regional Water System
Environmental Impact Assessment

As requested, we have reviewed the Environmental Impact Assessment for the Waialua-Kahuku Regional Water System Environment and find that the projects to construct nine well stations, transmission main, and reservoir should not have any adverse environmental effect on our existing facilities.

Upon request, Hawaiian Telephone will work with the Board of Water Supply to ensure that telecommunication services to the involved areas are provided on a timely basis.

If you have any questions, please call Nelson Yrizarry at 834-6222.

Sincerely,

T. Yoshiooka
Tom Yoshiooka
Engineering Manager
Land & Buildings

cc: Nelson Yrizarry

PO BOX 2200 • HONOLULU, HAWAII 96841 • TELEPHONE (808) 537-7111 • CABLE TELHAWAII

June 24, 1986

RECEIVED
JUN 26 1986

WILSON OKAMOTO & ASSOCIATES

Mr. Tom Yoshiooka
Engineering Manager
Hawaiian Telephone
P. O. Box 2300
Honolulu, Hawaii 96841

Dear Mr. Yoshiooka:

Subject: Your Letter of June 10, 1986 on the
Environmental Impact Assessment for the
Waialua-Kahuku Regional Water System

Thank you for commenting on the environmental document for our proposed water system improvement projects and for offering your cooperation in providing telecommunication services.

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

Very truly yours,

Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates

12 10 11 12 00 PM '86

THE ESTATE OF JAMES CAMPBELL

RECEIVED
BY THE BOARD OF WATER SUPPLY

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mer
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DCP
S/S
P/E

April 21, 1986

Mr. Kazu Hayashida
Board of Water Supply
630 S. Beretania Street
Honolulu, Hawaii 96843
Hawaii

Dear Mr. Hayashida:

Maialua-Kahuku Regional Water System Improvements EIA

Thank you for the copy of the subject report. Our response is directed to the proposed Hanakaoe Well at Kahuku. We feel that it is not consistent with our Management Guide to the Water Resources of the Kahuku Water Management Area (copy attached), as the area in the vicinity of the well is in agriculture and utilizing water from the aquifer. The available sustainable yield for the area extending from Haleakaha to Kaunala is described in Appendix 2 of the report. The proposed well allocations will limit the Estate's affective use of portions of the land presently in agriculture.

Should you wish to discuss this matter, please call me.

Very truly yours,

Samuel L. Keala, Jr.
Manager, Engineering/
Construction Services

SLK/bk
Encl.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

May 20, 1986

Mr. Samuel L. Keala, Jr.
Manager, Engineering/Construction
Services
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813-4380

Dear Mr. Keala:

Subject: Your letter of April 21, 1986 on the Environmental Impact Assessment Preparation Notice for the Maialua-Kahuku Regional Water System Improvements

Thank you for your comments on the environmental document for the water system projects planned within the Maialua-Kahuku area.

The proposed Hanakaoe Well is only in the conceptual stage and the Board has no plans to pursue this source in the near future. Siting of the Hanakaoe Well was made where maximum utilization of the available potable water resources could be attained and no adverse impacts would occur to existing wells in the area.

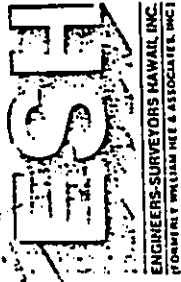
We will note in the draft environmental impact statement (EIS) Campbell Estates' present intent to use the remaining water resources available in the Kahuku area. All projects in the EIS will be coordinated with the land owners at the time we decide to proceed with any specific project.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates



RECEIVED
BOARD OF WATER SUPPLY
APR 30 11 55 AM '86

WILLIAM YEE & ASSOCIATES, INC.
ENGINEERS-SURVEYORS
1020 ALAHI STREET
HONOLULU, HAWAII 96813
(808) 531-3116 (HONOLULU)
(808) 985-6281 (KAHAKULA)

Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96813

SUBJECT: EIA FOR WAIALUA-KAHUKU REGIONAL
WATER SYSTEM IMPROVEMENTS

Gentlemen:

Thank you for the opportunity to review and comment on the draft EIA for the subject project.

Our client, Mokuleia Development Corporation is presently in the midst of planning a development of its lands, which cover approximately 2,900 acres. Unfortunately, we cannot be specific at this time re: the type of development and the amount of water required.

Our preliminary estimate of water demand for the development varies from two to three million gallons per day (peak demand).

We would appreciate your inclusion of this development in your analysis for water demand within the subject region. We should be able to provide more information on the proposed development within the next two months.

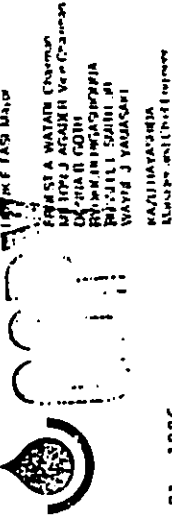
Should you require further information, please call me or members of my staff at 531-3116.

Very truly yours,
ENGINEERS-SURVEYORS HAWAII, INC.

William B. C. Ilee
Its President

cc: Tim Yee
B. Okuda

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96813



May 21, 1986

Mr. William B. C. Ilee, President
Engineers-Surveyors Hawaii, Inc.
Building No. 6, Suite No. 1
1020 Alahi Street
Honolulu, Hawaii 96814

Dear Mr. Ilee:

Subject: Your Letter of April 28, 1986 on the Environmental
Impact Assessment for the Waialua-Kahuku Regional
Water System Improvements

Thank you for commenting on the environmental document for the proposed water system facilities planned for the North Shore areas.

We acknowledge your client's proposed development and their projected water demands.

Your client's land is located in the State Department of Land and Natural Resources (DLNR) designated ground water control area. All water development projects in this area will be coordinated with the land owners and DLNR when we decide to proceed with any specific project.

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

Very truly yours,
Kazu Hayashida
KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates

April 28, 1986
DEP 510
PIE

P-14416

John Zapotocky, Consultant

Pacific Tower, Suite 1010
1001 Bishop Street
Honolulu, Hawaii 96813
(808) 533-2929


March 12, 1986

Mr. Lawrence Whang
Board of Water Supply
City and County of Honolulu
630 S. Beretania Street
Honolulu, Hawaii 96813

Dear Mr. Whang:

Subject: EIS Prep Notice for Waialua-Kahuku Regional Water System Improvements

I would like to get more information on what is being proposed for the North Shore Area. Please send me any information that is available on these projects. I would also like to get a copy of the draft EIS when it becomes available. Thank you for your assistance on this matter.

Sincerely,

John Zapotocky

MAR 14 1 15 PM '86

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

March 19, 1986

RECEIVED
MAR 24 1986

Mr. John Zapotocky
Pacific Tower, Suite 1010
1001 Bishop Street
Honolulu, Hawaii 96813

WILSON OKAMOTO & ASSOCIATES

Dear Mr. Zapotocky:


Subject: Your letter of March 12, 1986 on the Environmental Impact Statement (EIS) Preparation Notice for Waialua-Kahuku Regional Water System Improvements

Thank you for your interest in our proposed water development projects along the North Shore.

The enclosed copy of our environmental assessment includes our planning proposals for the North Shore area. If you wish to comment on the report, please send your comments to us by April 15, 1986.

Your name has been added to our consulted parties list and a copy of the Draft EIS will be sent to you when it becomes available.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Enclosure

cc: Wilson Okamoto & Associates
Office of Environmental Quality Control

9

XV. DRAFT ENVIRONMENTAL IMPACT STATEMENT COMMENTS AND RESPONSES

XV. DRAFT ENVIRONMENTAL IMPACT STATEMENT
COMMENTS AND RESPONSES

This section presents letters of comments received on the Draft Environmental Impact Statement (DEIS) and the BWS' responses to these comments. The following is a list of agencies and organizations commenting on the DEIS. Substantive comment letters and the respective response letters are reproduced in this section.

Name	<u>Date of Comment</u>	<u>Date of Response</u>
<u>FEDERAL AGENCIES</u>		
Department of Interior, Fish and Wildlife Service	11/13/87	12/18/87
<u>STATE AGENCIES</u>		
Department of Agriculture	11/10/87	12/02/87
Department of Land and Natural Resources	10/23/87	10/30/87
Department of Land and Natural Resources, State Parks, Outdoor Recreation and Historic Sites Division	10/19/87	10/26/87
University of Hawaii, Environmental Center	10/08/87	11/04/87
<u>CITY & COUNTY OF HONOLULU AGENCIES</u>		
Department of General Planning	11/09/87	12/01/87
Department of Housing and Community Development	10/26/87	11/09/87
Department of Land Utilization	11/13/87	12/11/87
Fire Department	11/09/87	11/25/87
Police Department	09/21/87	09/30/87
<u>UTILITY COMPANIES</u>		
Hawaiian Electric Co., Inc.	09/15/87	09/29/87
Hawaiian Telephone Company	10/15/87	10/26/87
<u>NEIGHBORHOOD BOARD</u>		
Koolauloa Neighborhood Board No. 28	No Date	12/23/87
<u>PUBLIC INFORMATIONAL MEETING</u>		
Haleiwa Gym	10/07/87	--



United States Department of the Interior
 FISH AND WILDLIFE SERVICE
 300 ALA MOANA BOULEVARD
 P. O. BOX 50157
 HONOLULU, HAWAII 96810

RECEIVED
 May 16 10 37 AM '87
 Room 6307
 NOV 13 1987

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

Re: Draft Environmental Impact Statement for the Waialua-Kahuku
 Regional Water System Improvements Project, Oahu

Dear Dr. Miura:

We have reviewed the referenced Draft Environmental Impact Statement (EIS) and offer the following comments for your consideration.

General Comments

Our primary concerns with the proposed water system improvements in the Waialua-Kahuku area are the following:

- a. Potential adverse impacts from groundwater withdrawal on wetland and stream habitats for endangered Hawaiian waterbirds and native stream fauna.
- b. Potential impacts to candidate endangered plant species at Keena Point from the construction of a transmission main from Hokuieia to Makaha.

Specific Comments

a. Mokuieia-Makaha Transmission Main and Reservoir. Page III-14. A portion of Keena Point is within the Hawaii Natural Area Reserves System. Several candidate endangered plant species are found within this reserve. Potential impacts of routing the transmission main through or near this Natural Area Reserve should be discussed in the Final EIS. We recommend that this aspect of the project be coordinated with Department of Land and Natural Resources, Natural Area Reserves Commission.

b. Wetland Areas. Page IV-16. In addition to Ukoo Marsh and the Kahuku wetlands (including the James Campbell National Wildlife Refuge and Punahoolapa Marsh), Crowbar Ranch Ponds,

AmOrient prawn ponds, Haleiwa lotus fields, and Waimea Falls Park are considered primary habitats for the recovery of the endangered Hawaiian waterbirds (Hawaiian Waterbirds Recovery Plan, September 1985). In addition to these wetlands, several other wetlands are outlined in the National Wetlands Inventory maps for the Kahuku, Waimea, Haleiwa, and Keena quadrangles. These maps are available for review in our office or with the Department of Land and Natural Resources, Division of Forestry and Wildlife.

c. Stream Fauna. Page IV-20. Based on Figure 2b, Proposed Water System Improvements, it appears that Kaiwikoale Stream, a tributary to Waimea River, is closest to the proposed Waimea Well. It is not clear from this section or Appendix C whether this tributary was surveyed for stream fauna. It may be appropriate to conduct an aquatic fauna survey of this stream if discharge may be reduced by the proposed Waimea Well.

d. Hydrology. Page VI-2-4. This section states that the proposed wells may reduce the discharge of perennial streams and water levels in wetlands. This section also states that the Board of Water Supply will monitor streamflow and wetland water levels during the pumping test of the exploratory wells to determine the "immediate effects" of well development.

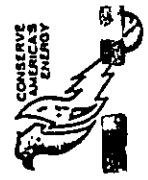
Short-term pump tests may be inadequate to identify potential short-term and long-term reductions in streamflow or wetland water levels. Long-term pump tests may be needed to confidently determine potential impacts of groundwater withdrawal on streamflow and wetland water levels.

Summary Comments

We recommend that the Final EIS include the following:

a. A detailed description of the program to monitor short-term and long-term reductions in streamflow and wetland water levels associated with well pumping. In addition, groundwater investigations to identify the water sources for the Punahoolapa, and Ukoo marshes to determine if these wetlands would be affected by the proposed well development should be conducted. We ask that the Service be apprised of the results of the monitoring studies.

b. A description of candidate endangered plants and a discussion of potential impacts to these plants from the construction of a transmission main along Keena Point.



Save Energy and You Serve America!

c. National Wetlands Inventory maps showing the location of wetlands in the Waialua-Kahuku area that may be affected by well pumping.

We appreciate the opportunity to comment.

Sincerely,



Ernest Kosaka, Field Supervisor
Office of Environmental Services
Pacific Islands Office

cc: BMS
DLNR
RM



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December 18, 1987

Mr. Ernest Kosaka
Page 2
December 18, 1987

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WILSON OKAMOTO & ASSOCIATES

Mr. Ernest Kosaka
Fish and Wildlife Service
U. S. Department of the Interior
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

Subject: Your Letter of November 13, 1987 to the Office of Environmental Quality Control on the Draft Environmental Impact Statement (EIS) for the Waialua-Kahuku Regional Water System Improvements

Thank you for commenting on the environmental document for our proposed water system projects.

The Waialua-Kahuku Draft EIS is an assessment of our long-range water plans which include source, storage, and transmission facilities. Many of the projects are still in the conceptual stage. All the projects have common objectives; therefore, we felt that a regional EIS with the subsequent preparation of supplemental EIS's should give the public a more comprehensive overview of the Board's objectives instead of EIS's prepared for individual projects.

Supplemental EIS's will address the environmental concerns and problems associated with the projects. You will be given the opportunity to review and comment on them, including the Mokuia-Makaha transmission main and reservoir project if we decide to proceed with this project.

The State Water Code and Instream Standards should ensure that streamflows and wetlands are preserved. All of our projects must be in compliance with these regulations. Your concerns on long-term monitoring of streams, reductions to streamflow, and lowering of wetland water levels will be addressed in the applicable supplemental EIS's.

A list of other wetlands in the region that may be affected by our proposed projects will be included in the revised EIS.

A description of our proposed streamflow and wetland water level monitoring program will be included in the revised document.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates

JOHN WAIHEE
GOVERNOR



SUZANNE D. PETERSON
CHAIRPERSON, BOARD OF AGRICULTURE

DEPUTY TO THE CHAIRPERSON

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

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

November 10, 1987

MEMORANDUM

To: Dr. Marvin T. Miura, Director
Office of Environmental Quality Control

Subject: Draft Environmental Impact Statement (DEIS) for
Waialua-Kahuku Regional Water System Improvements
Board of Water Supply (BWS)
THK: Zones 5 and 6 Waialua-Kahuku, Oahu

The Department of Agriculture has reviewed the Draft EIS and has the following comments to offer. We did not previously receive a copy of the EIS Preparation Notice on which to comment.

The BWS proposes to test and develop new potable water sources and construct the necessary transmission and storage facilities within the Waialua to Kahuku region. Nine new well locations are being considered, all of which are located in the State Agricultural District. Five of the sites are located on marginal agricultural lands. The other four sites -- Kawailoa, Hokuleia, Ukoa and Waimea -- are in the edge of sugarcane fields, although the Waimea site may be fallow or abandoned (DEIS pages VII-6 to VII-13). There appear to be a few discrepancies in the descriptions of these sites in different sections of the DEIS (see pages III-10 to 13 and VII-3 to 13 with respect to the uses of the sites and surrounding land uses).

The DEIS does not include the Land Study Bureau Detailed Land Classification Overall Productivity Ratings for the subject sites, nor does it discuss the State Agriculture Functional Plan along with the other State Plans that are supportive of, or may be impacted by, potable water development. The DEIS also does not acknowledge the Kahuku Agricultural Park (under construction) and the commitment by Campbell Estate of 1.98 MGD

Dr. Marvin T. Miura
November 10, 1987
Page -2-

to the State and the Kahuku Farmers' Association for this project. The water draft figures for the Kahuku subarea in Table 14 of the DEIS are considerably less than those shown in Table 4 of the Revised EIS for the Kahuku Agricultural Park, and yet show a negative reserve of - 0.17 MGD. The draft of the proposed Opana, Kaweia, and Hanakao wells appears to range from 2.5 to 4.5 MGD and would exceed the sustainable yield for this subarea.

The Department of Agriculture does not foresee any major impacts on agricultural lands due to the small areas affected by the well sites and the selection of sites to minimize impacts (page VI-3). However, there may be an adverse impact on existing and committed water sources in the Kahuku subarea.

Thank you for the opportunity to comment.

Suzanne D. Peterson

SUZANNE D. PETERSON
Chairperson, Board of Agriculture

cc: Mr. Lawrence Whang, BWS

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December 2, 1987

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WILSON OKAMOTO & ASSOCIATES

Ms. Suzanne D. Peterson
Chairperson, Board of Agriculture
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Ms. Peterson:

Subject: Your letter of November 10, 1987 on the Draft EIS
for the Maialus-Kahuku Regional Water System
Improvements

Thank you for commenting on the environmental document for our
proposed water system projects.

We offer the following in response to your comments:

1. We will correct discrepancies between information presented on pages III-10 to 13 and pages VII-3 to 13.
2. The Overall Productivity Ratings from the Land Study Bureau's Detailed Land Classification will be included in the "Developmental Considerations" in Chapter VII.
3. The Kahuku Agricultural Park will be acknowledged in Chapter IV, The Regional Environment.
4. Additional information will be provided in the Final EIS explaining the differences between our estimate of the sustainable yield in the Kahuku area and the yield appearing in the Kahuku Agricultural Park EIS.

Ms. Suzanne D. Peterson
Page 2

December 2, 1987

5. The relationship between the development of the Opana, Kawela, and Hanakoa Wells and the sustainable yield for the Kahuku area will be discussed in the Final EIS.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 631
HONOLULU, HAWAII 96809

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

LIGHT R. SURGALAT
MEMBER

AGRICULTURE DEVELOPMENT
PROGRAM
AQUATIC RESOURCES
CONSERVATION AND AFFAIRS
CONSTRUCTION AND AFFAIRS
NATURAL RESOURCES DEVELOPMENT
CONSTRUCTION AND AFFAIRS
LAND MANAGEMENT
STATE PLANS
WATER AND LAND DEVELOPMENT

10 11 12 13 14 15 16 17 18 19

DOC. NO.: 1596E
FILE NO.: 88-104

-3

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

Dear Dr. Miura:

SUBJECT: Draft Environmental Impact Statement (EIS),
Waialua-Kahuku Water System Improvements

Thank you for the opportunity to review the EIS cited above.
We offer the following comments:

Aquatic Resources Concerns:

From an aquatic resource standpoint, we have no objection to the proposed domestic water development projects, provided that the monitoring studies are conducted and streamflows and wetland water levels are not adversely altered. We trust that the proposed mitigation measure of reducing or terminating pumpage will be instituted immediately should reduction in streamflow or wetland water levels occur.

Water and Land Development Concerns:

The Honolulu Board of Water Supply (BWS) recognizes the Department of Land and Natural Resources (DLNR) jurisdictional interests and has adequately addressed them in a general way in the Draft EIS. We anticipate that as individual projects are initiated in accordance with the regional development plan proposed in the EIS, the BWS will have complied with DLNR's water-related control programs which include, in part, the following requirements:

1. Apply for permits for:
 - the use of water in designated water management areas;
 - the alteration of stream channels;

Dr. Marvin T. Miura

- 2 -

DOC. NO.: 1596E

- the construction of stream diversion works; and
 - the drilling of wells and the installation of well pumps.
2. Complying with streamflow standards to protect valuable instream uses.
 3. Assuring the consistency of proposed developments with the Hawaii Water Plan and the State Water Quality Plan.

Thank you for your consideration of our concerns.

Very truly yours,

William W. Paty
WILLIAM W. PATY, Chairperson
Board of Land and Natural Resources

cc: Mr. Lawrence Whang, BWS

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



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October 30, 1987

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WILSON OKAMOTO & ASSOCIATES

Mr. William W. Paty, Chairperson
Board of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

Subject: Your letter of October 23, 1987 to the Office of
Environmental Quality Control on the Draft EIS for
the Maialua-Kahuku Water System Improvements

Thank you for commenting on the environmental document for our
proposed water system projects.

We will coordinate streamflow and wetland monitoring with you
to assure that water levels are not adversely affected by our
projects. Mitigative measures will be instituted if
streamflows or wetland water levels are adversely affected.

Also, as individual projects are initiated, we will comply
with the requirements of your agency.

If you have any questions, please contact Lawrence Whang at
537-6138.

Very truly yours,

KAZUO HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto

JOHN WILKIE
Assistant Secretary



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 622
HONOLULU, HAWAII 96809

October 19, 1987

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

Dear Mr. Miura:

SUBJECT: Review of Draft EIS -- Waialua-Kahuku Regional
Water System Improvements
Waialua-Kahuku, Oahu

Our office has reviewed this Draft EIS, and we have several
comments.

With respect to Table 9, page IV - 19, which lists the Historic
Sites in the Waialua-Kahuku District, we find that the list
used was the one last revised in 1981. There have been three
more archaeological districts added within the area since then.

Of somewhat more serious import, however, is the fact in
assessing impacts, we note that the Kawahapai Well and
Alternate site may not have been completely surveyed. We are
concerned about the many archaeological sites which have been
reported but not formally recorded in this area. We believe
that there is a high probability that well site construction
and attendant road and transmission line installations may
destroy significant historic sites in this area. This
situation should be rectified by completing the archaeological
survey, identifying sites and assessing significance. Specific
plans to mitigate adverse effects to any significant sites
should be presented in the Final EIS.

100/100

WILLIAM W. FAYT, CHAIRPERSON
Board of Land and Natural Resources

LIBERT E. LANGOLF
SECRETARY

AGRICULTURAL DEVELOPMENT
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CONSERVATION AFFAIRS
CONSTRUCTION AND
RECONSTRUCTION
PLANNING AND DESIGN
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

Dr. Marvin T. Miura
Page 2
October 19, 1987

We also note that under "General Construction Impacts" (page VI
- 1), monitoring of construction of transmission lines through
the lowlands is specified. It is not apparent that corridors
for these pipelines have been selected for all the wells. Such
corridors should undergo archaeological survey to determine if
significant sites are present. This should occur well before
construction. After the survey results are available, then it
should be determined whether monitoring is an appropriate
mitigation measure or not.

Thank you for the opportunity to comment on this Draft EIS.

Sincerely,

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

cc: Mr. Lawrence Whang, Board of Water Supply

9

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



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Mr. Ralston Nagata
Page 2

October 26, 1987

October 26, 1987

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OCT 28 1987

WILSON OKAMOTO & ASSOCIATES

Mr. Ralston Nagata
State Parks Administrator
and Deputy State Historic
Preservation Officer
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Nagata:

Subject: Your Letter of October 19, 1987 on the Draft
Environmental Impact Statement for the
Maialua-Kahuku Regional Water System Improvements

Thank you for your comments on the environmental document for
our proposed water system improvement projects.

A walk-through archaeological survey was made for the
Kawaihapai Well and alternate sites. However, a detailed
survey was not made since a definite site has not been
selected. Should we decide to pursue developing this source,
a detailed archaeological survey will be conducted and the
archaeological report will be submitted for your review. It
is premature to conduct a thorough survey as the tentatively
selected site may be moved to a location outside the limits
of the previous survey. A supplemental environmental
document will be prepared for the project and the
archaeological impacts and mitigative measures will be
discussed in the document.

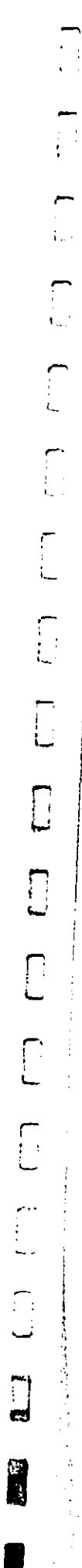
Regarding actual pipeline corridors, we will consider
conducting archaeological surveys along the pipeline
alignments for the various projects as they are programmed
into our capital improvement budgets.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates





University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7381

File 10/27/80

October 8, 1987
RE: 0472

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

Dear Dr. Miura:

Draft Environmental Impact Statement (EIS)
Waialua-Kahuku Regional Water System Improvements
Waialua-Kahuku, Oahu

The above cited document proposes the improvement and construction of
numerous water development projects in the Waialua-Kahuku Regional Water
District. The proposed improvements include new wells, reservoirs,
transmission lines, and support facilities. This review was prepared with
the assistance of Paul Ekern, Agronomy and Soils; P. Bion Griffin,
Anthropology; Edwin Murabayashi, Henry Gee and Yu-Si Fok, Water Resources
Research Center; Frank Peterson, Geology and Geophysics; and Steven Armann,
Environmental Center.

General Comments

The purpose of an EIS is to describe a proposed action and to fully
disclose the environmental effects of that action. The Waialua-Kahuku
Regional Water System Improvements Draft EIS describes the proposed systems
but does not identify or evaluate the potential environmental impacts of
the action. In this regard the document more closely resembles a planning
information document. Substantive amendments and revisions are needed to
assure that the content requirements of an EIS are met. Acceptance of the
EIS should be deferred until these revisions have taken place. Examples
of topics requiring additional attention include but are not limited to the
following:

Waialua-Kahuku Water System (p. III-4)

Figures 1a, b, and c delineate the locations of existing Board of Water
Supply wells. However, no indication of pumping rates or water quality
characteristics, is provided. A summary table of each figure is needed

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Office of Water Resources Research Center

AN EQUAL OPPORTUNITY EMPLOYER

Dr. Harvin T. Miura

-2-

October 8, 1987

that indicates the pumping rate, volume, use, and primary water quality
characteristics for each well. A similar set of figures and descriptive
characteristics for injection wells in the Waialua-Kahuku region should
also be included in the EIS.

Climate (p. IV-9, 10)

The 1969 study for rainfall in Kahuku is outdated. The EIS should
refer to current rainfall statistics and trends.

Water Quality (p. IV-11)

The impact and potential for agricultural pollution to the ground-water
must be discussed, and mitigation plans need to be identified to avoid a
repeat of the water contamination problems which have occurred in Milliani
Town. Furthermore, no consideration has been made for the probable demise
of the Waialua Sugar Company and the consequent impacts on water needs and
availability of supply. The Draft EIS should discuss the present
groundwater recharge volume from Waialua Sugar Company and the potential
effects to this recharge volume due to non-agricultural use.

Appendix C

The archaeological survey as presented in Appendix C seems adequate.
We do suggest, however, that care be taken in the case of the Kawaihapai
Well Alternate Site since the entire area was not inspected (p. VII-5).

Thank you for the opportunity to comment on this document. We hope
that our comments will be helpful.

Yours truly,

Jacquelin N. Miller
Jacquelin N. Miller
Associate Environmental Coordinator

cc: Lawrence Whang, BWS

- L. Stephen Lau
Paul Ekern
Y.S. Fok
Henry Gee
P. Bion Griffin
Edwin Murabayashi
Frank Peterson
Steven Armann



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November 4, 1987

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WILSON OKAMOTO & ASSOCIATES

Ms. Jacquelin N. Miller
Associate Environmental
Coordinator
Environmental Center
2550 Campus Road,
Crawford 317
Honolulu, Hawaii 96822

Dear Ms. Miller:

Subject: Your Letter of October 8, 1987 to the Office of
Environmental Quality Control on the Draft EIS for
the Waialua-Kahuku Regional Water System Improvements

Thank you for your comments on the environmental document for
our proposed water system projects.

We offer the following in response to your comments:

1. Existing Wells: The pumping rates for our wells are noted in Table 3. The general water quality characteristics will be included in the Final EIS for AWS wells. However, pumping rates and water quality of private wells and injection wells may be obtained from the individual owners.
2. Climate: The Draft EIS will be revised to refer to current rainfall statistics and trends.
3. Water Quality: On page 111-2, we note that there is a possibility of pollution from residual agricultural waste matter or pesticides. The water quality will be monitored to assure conformance with the State's Safe Drinking Water Regulations. Mitigative measures that may be implemented include closure of the source or treating the water before distribution by aeration, activated carbon, or other acceptable treatment technology.

Ms. Jacquelin N. Miller
Page 2

November 4, 1987

4. Waialua Sugar Company: There is no definite indication that Waialua Sugar Company will be going out of business. However, should Waialua Sugar Company close its operations, the availability of any surplus water will be determined by the State Water Resources Management Commission.

We do not know of any study estimating the amount of groundwater recharge from Waialua Sugar Company's irrigation practices.

5. Additional archaeological surveys will be made, and supplemental environmental documents will be prepared as required by Chapter 343 when specific projects are programmed into our Capital Improvements Program budget.

The EIS is an environmental assessment of our proposed long-range plan. There are common regional elements among all the projects; therefore, we feel that a regional EIS with supplemental EIS's on individual projects is more appropriate.

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

Very truly yours,

for KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates

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

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

2/1/87



FRANK P. FAR
-11004

DONALD A. CLEGG
CHIEF PLANNING OFFICER
GENE CONNELL
DEPUTY CHIEF PLANNING OFFICER

JM/RH/DGP 8/87-2972

December 1, 1987

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WATER RESOURCES & UTILITIES

November 9, 1987

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

Dear Dr. Miura:

Matalua-Kahuku Regional Water System Improvements DEIS

The Department of General Planning has reviewed the subject Draft EIS and has to offer the following comment:

Supplemental environmental studies should be conducted if Alternative 1 or 3 of the Mokuia-Makaha Transmission Main is implemented. Discussion of the environmental impacts appears limited since the exact alignment of the transmission main has not yet been determined; and the transmission main alternatives may affect the environmental quality of the Kaena Point area.

Thank you for the opportunity to review this Draft EIS.

Donald A. Clegg
DONALD A. CLEGG
Chief Planning Officer

cc: Lawrence Whang, Board of Water Supply

TO: DONALD A. CLEGG, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: KAZU HAYASHIDA
MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF NOVEMBER 9, 1987 ON THE DRAFT EIS FOR
THE MATAIUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS

Thank you for commenting on the environmental document for our proposed water system projects.

We will be preparing supplemental EIS's for most of our proposed projects, including the Mokuia-Makaha transmission main.

If you have any questions, please contact Lawrence Whang at 527-6130.

cc: Office of Environmental Quality Control
Yinsen Okamoto & Associates

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
450 SOUTH KING STREET
HONOLULU, HAWAII 96813
PHONE: 533-4181

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October 26, 1987

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

Dear Dr. Miura:

Subject: Draft Environmental Impact Statement
Maialua-Kahuku Regional Water System Improvements

Thank you for the opportunity to review and comment on the draft EIS for the Maialua-Kahuku regional water system improvements, Oahu.

The Department of Housing and Community Development is presently in the midst of developing approximately 173 new units on 56 acres of land in the Kahuku Village housing project area. Our preliminary estimate of water demand for this proposed development is 115,000 gallons per day (single family unit = 400 gallons per unit). We would appreciate your inclusion of this proposed project in your analysis for water demand within the subject region.

Sincerely,

Robert Okamoto
MIKE MOON
Director

cc: Board of Water Supply
(Lawrence Whang)

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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October 26, 1987

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

Dear Dr. Miura:

Subject: Draft Environmental Impact Statement
Maialua-Kahuku Regional Water System Improvements

Thank you for the opportunity to review and comment on the draft EIS for the Maialua-Kahuku regional water system improvements, Oahu.

The Department of Housing and Community Development is presently in the midst of developing approximately 173 new units on 56 acres of land in the Kahuku Village housing project area. Our preliminary estimate of water demand for this proposed development is 115,000 gallons per day (single family unit = 400 gallons per unit). We would appreciate your inclusion of this proposed project in your analysis for water demand within the subject region.

Sincerely,

Robert Okamoto
MIKE MOON
Director

cc: Board of Water Supply
(Lawrence Whang)

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
450 SOUTH KING STREET
HONOLULU, HAWAII 96813
PHONE: 533-4181

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October 26, 1987

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

Dear Dr. Miura:

Subject: Draft Environmental Impact Statement
Maialua-Kahuku Regional Water System Improvements

Thank you for the opportunity to review and comment on the draft EIS for the Maialua-Kahuku regional water system improvements, Oahu.

The Department of Housing and Community Development is presently in the midst of developing approximately 173 new units on 56 acres of land in the Kahuku Village housing project area. Our preliminary estimate of water demand for this proposed development is 115,000 gallons per day (single family unit = 400 gallons per unit). We would appreciate your inclusion of this proposed project in your analysis for water demand within the subject region.

Sincerely,

Robert Okamoto
MIKE MOON
Director

cc: Board of Water Supply
(Lawrence Whang)

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NOV 10 1987

WILSON OKAMOTO & ASSOCIATES

TO: MICHAEL H. H. MOON, DIRECTOR
DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

FROM: KAZU HAYASHIDA
MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF OCTOBER 26, 1987 TO THE OFFICE OF ENVIRONMENTAL QUALITY CONTROL ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE MAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS

Thank you for commenting on the environmental document for our proposed water system projects.

We will note your intent to develop 173 new units in the Kahuku Village housing project area. Water demand for your project is accounted for in the population projections for the area.

For your information, our consumption guideline for single-family dwellings is 500 gallons per unit per day.

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

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates

Robert Okamoto



DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 522-4212



FRANK P. FAI
DIRECTOR

November 13, 1987

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

Dear Dr. Miura:

Draft Environmental Impact Statement (EIS)
Maialua - Kahuku Regional Water System Improvements

The Department of Land Utilization (DLU) has reviewed the Draft EIS and offers the following comments and questions:

1. Special Management Area (SMA)

It appears that the proposed water facilities will not be located within the SMA except possibly for portions of the Mokuleia - Hakaha Transmission Main around Kaona Point. An SMA permit will be required unless the installation falls into the exempt category of underground facilities with appurtenant above-ground features less than four feet in height along existing corridors. If a SMA permit is required, a supplemental EIS will be required detailing the specifics of the Mokuleia - Hakaha Transmission line.

2. Wetland Environment

Punahouliapa Pond, Kii Pond, and Ukoa Pond may be affected by the drawdown of groundwater caused by the new wells and the resultant lessening of ground water seepage into the ponds. While the exact magnitude of the impact is undeterminable at this point in time, it is still appropriate to have some

Dr. Marvin T. Miura, Director
Page 2

discussion of the possible degree to which the ponds may be affected, rather than simply noting this as an unresolved issue.

3. Mitigation

If drawdown of groundwater caused by well pumpage causes a decrease in water levels at Punahouliapa Pond, Kii Pond, or Ukoa Pond, what mitigative measures will be taken?

Thank you for the opportunity to comment. If you have any questions regarding our response, please call Bennett Mark of our staff at 527-5038.

Very truly yours,

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

JPH:sl
1445B

cc: Lawrence Whang, BWS

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JOHN P. WHALEN
DIRECTOR

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BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



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DEC 15 1987

December 11, 1987

WILSON OKAMOTO & ASSOCIATES

TO: JOHN P. WHALEN, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF NOVEMBER 13, 1987 TO THE OFFICE OF
ENVIRONMENTAL QUALITY CONTROL ON THE DRAFT EIS FOR
THE WAIALUA-KAHUKU WATER SYSTEM IMPROVEMENTS

Thank you for commenting on the environmental document for our proposed water system projects.

We offer the following in response to your comments:

1. Most of our projects are conceptual in nature and supplemental EIS's will be required, including one for the Mokuleia-Makaha transmission main. Should we decide to pursue this project, an application for a SHA Permit will be submitted to your department.
2. The impacts that our projects may have on wetland environments are unresolved. The supplemental EIS's for proposed well projects will cover the environmental impacts on wetlands in more detail. Your department will be given the opportunity to review those supplemental EIS's.
3. Pumpages from wells affecting water levels in wetland areas, may be regulated to mitigate the problem. We will be coordinating our monitoring efforts with the appropriate Federal and State agencies.

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

cc: Office of Environmental Quality Control
Wilson Okamoto

P-639/87
cc

HONOLULU FIRE DEPARTMENT
1455 S. Deretania Street, Room 305
Honolulu, Hawaii 96814

November 9, 1987

Dr. Marvin I. Iiura, Director
Office of Environmental Quality Control
100 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Iiura:

SUBJECT: Waialua-Kahuku Regional Water Systems Improvement
Environmental Impact Statement (EIS)

We have reviewed the subject EIS and have no objections to the proposed project. Fire protection facilities and service is considered adequate. We request timely notification of construction activities which may affect emergency response by fire apparatus, once the proposed project has started.

Thank you for the opportunity to comment on this subject. If you have any questions, please contact Battalion Chief Kenneth Hara of our Administrative Services at 943-3838.

Sincerely,

FRANK K. KAHOHANOHANO
Fire Chief

FRK/KAH:sd

cc: Mr. Lawrence Whang
Board of Water Supply

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

November 25, 1987

RECEIVED
NOV 30 1987

WILSON OKAMOTO & ASSOCIATES

TO: FRANK K. KAHOHANOHANO, FIRE CHIEF
FIRE DEPARTMENT

FROM: KAZU HAYASHIDA
MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF NOVEMBER 9, 1987 TO THE OFFICE
OF ENVIRONMENTAL QUALITY CONTROL ON THE DRAFT
EIS FOR THE WAIALUA-KAHUKU REGIONAL WATER SYSTEM
IMPROVEMENTS

Thank you for commenting on the environmental document for our proposed water system projects.

We will keep you informed of our construction activities along major highways which may affect emergency responses by your department.

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

cc: OPOC
Wilson Okamoto and Associates

Nov 10 2 44 PM '87

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POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU

1915 SOUTH BERETAMA STREET
HONOLULU, HAWAII 96813 - AREA CODE (808) 943-3111

FRANK F. FASI
MAYOR



DOUGLAS G. GIBB
CHIEF
HARREN PEREIRA
DEPUTY CHIEF

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

OUR REFERENCE SS-LK

September 30, 1987

September 21, 1987

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

Dear Dr. Miura:

Subject: Waialua-Kahuku Regional Water System Improvements

We have reviewed the Environmental Impact Statement (EIS) for the above proposal and have no objections to the proposed improvements.

We concur that during the construction phases of the project, adequate measures be developed to expedite traffic flow and insure the safety of roadway users.

Sincerely,

DOUGLAS G. GIBB
Chief of Police

cc: Mr. Lawrence Whang

TO: DOUGLAS G. GIBB, CHIEF OF POLICE
POLICE DEPARTMENT

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF SEPTEMBER 21, 1987 TO THE OFFICE OF ENVIRONMENTAL QUALITY CONTROL ON THE WAIALUA - KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS

SEP 23 3 00 PM '87

Thank you for commenting on the Draft EIS for our proposed water system projects.

Traffic control measures will be implemented according to the applicable Federal, State, and City regulations that will expedite traffic flow and insure the safety of roadway users.

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

KAZU HAYASHIDA

cc: OEQC
Wilson Okamoto & Associates



Director Murgus, Ph.D., PE.
Albany
Environmental Department
(809) 548 6880

P. 705/C7 J
ENV 2-1
JN/G

September 15, 1987

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

Dear Dr. Miura:

Subject: Waialua-Kahuku Regional Water System Improvements
Environmental Impact Statement (EIS)

We have reviewed the above subject EIS and have the following comments:

1. On July 31, 1986, HECO submitted comments on the Environmental Impact Assessment for the project to Mr. Kazu Hayashida (i.e., Manager of Board of Water Supply) which addressed HECO's concerns pertaining to the construction procedures in close proximity to our facilities (See attached copy). It does not appear that these comments were addressed in the EIS.
2. Almost all of the water well sites are a considerable distance from our service lines and therefore will require long service line extensions to provide electric service. This should be mentioned in the subject EIS.
3. There are no existing or planned transmission facilities in the Waialua-Haleiwa area.

Sincerely,

Banner Murgus

Attachment

cc: Mr. Lawrence Whang
Board of Water Supply

AmHEI Company

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HAWAIIAN ELECTRIC COMPANY, INC. - HAWAIIAN ELECTRIC COMPANY, INC. - HAWAIIAN ELECTRIC COMPANY, INC.

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July 31, 1986

Mr. Kazu Hayashida
July 31, 1986
Page 2



Division Manager, P.O. PE
1000
Environmental Department
1000-518-5100

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:

Subject: Haiialua-Kahuku Regional Water System Improvements
Environmental Impact Assessment (EIA)

We have reviewed the above subject EIA and have the following comments:

1. If any of these exploratory wells are found to be suitable for domestic use, it is then converted into a production well. A typical production well installation will include a control building which will require electrical service.
2. It should be pointed out that a typical production well installation will be connected to the existing water system by water transmission lines. Hence, the construction of these water lines may be in close proximity to the overhead electrical lines serving the production well installation. Therefore, the following HECO notes are to be included as part of the final construction plans:
 - a. The existence and location of HECO's overhead facilities are as shown on the plans. The Contractor is to exercise extreme caution when the excavation and construction crosses or is in close proximity to overhead facilities and is to maintain 13'-0" clearance for his equipment while working close to and/or under the overhead facilities.
 - b. The Contractor is to comply with the directions of the State of Hawaii Occupational Safety and Health Law (DOSH).

- c. When excavation is adjacent to or under existing structures or facilities, the Contractor is responsible for properly sheeting and bracing the excavation and stabilizing the existing ground to render it safe and secure from possible slides, cave-ins and settlement, and for properly supporting existing structures and facilities with beams, struts or underpinning to fully protect it from damage.
- d. Should field conditions and/or construction procedures require that the project will be in close proximity to HECO overhead lines, the Contractor is to contact W. Okudara at 455-7022 a minimum of 72 hours in advance.
- e. Should it become necessary, any work required to relocate HECO facilities shall be done by HECO. The Contractor shall be responsible for all costs and coordination.
- f. The Contractor shall be liable for any damages to HECO's facilities.
- g. The Contractor shall report any damages to HECO's facilities to the HECO Trouble Dispatch at phone number 548-7961.
3. Upon request for electrical service to well sites, we would follow normal procedures in providing same.
4. None of the well sites appear to be within the State Conservation District, thus no prior DLNR approvals should be required for overhead service lines.

Sincerely,

Banner Mungo



Q

A Division of Hawaiian Electric Company

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU



COPY

September 29, 1987

RECEIVED
OCT 02 1987

Dr. Brenner Mungler
Manager, Environmental Department
Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96840-0001

WILSON OKAMOTO & ASSOCIATES

Dear Dr. Mungler:

Subject: Your letter of September 15, 1987 to Dr. Marvin Miura of the Office of Environmental Quality Control on the Draft Environmental Impact Statement (EIS) for the Waialua-Kahuku Regional Water System Improvements.

Thank you for commenting on the Draft EIS.

Our response to your comments on the environmental assessment is appended to the Draft EIS on the reverse side of your letter. We indicated that we will include the HECO notes as part of our final construction plans.

We will inform our consultant to expand the section on electrical and telephone service (p. IV-28) to indicate that long service line extensions will be needed to service most of the proposed facilities. We will also indicate that there are no existing or planned electrical transmission facilities in the Waialua-Haleiwa area.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates

7-255/11
KOOAULOA NEIGHBORHOOD BOARD NO. 28
The Hon. Harold G. Fong, Mayor
84-310 KUKUNA ROAD
MAUOLA, HAWAII 96717



Dr. Marvin T. Mura, Director
Office of Environmental Quality Control
465 South King St. Room 104
Honolulu, Hawaii 96813

Subject: Koolauloa Neighborhood Board #28's comments on the EIS for
the Maialuna-Kahuku Regional Water System Improvements.

Dear Dr. Mura:

The Koolauloa Neighborhood Board thanks you for the opportunity to review the above mentioned EIS. The Board has both specific and general comments to make.

Specific Comments:

Page I - 3, VII, Other Considerations A.

The estimated need for the area covered by the EIS by the year 2000 is described as 5.1 mgd per day. The current sustainable yield within the area is 5.3 mgd per day. The additional sustainable yield proposed for development is 5.45-11.5 mgd per day bringing the total for the area up to 10.75-16.8 mgd per day or 2 to 3 times that necessary for the community. Therefore the Board questions the stated need to develop these resources to meet future area needs. While the Board is not necessarily opposed to water development targeted for other areas of the island we would appreciate it if the Board of Water supply were more open and honest about its intent to maximize development of windward water sources for transmission to other areas. The Board further feels that the BMS is not responsive to the water needs of the project area by not recognizing that it is an agricultural area and that some future allocation of water over and above residential use water should be factored into their equation that assures that all water development on the windward side is not allocated out to residential development in other areas to the detriment of the long term viability of agriculture in the windward area.

Page III - 14, b.

The discussion of a transmission line in this EIS is another indication that the major reason for this proposed water development

is to ship the water resources developed out of the area. We are not sure why the transmission line is mentioned at this time as it will require its own EIS when and if it is developed. However, since the BMS has discussed it here the Board would like to know when a decision would be made to proceed or not proceed and how this decision would be made. What does BMS considered to be an appropriate amount of surplus water to justify the transmission line and what are the likely cost of such a proposal. The Board has the same questions regarding the reservoir which is also mentioned at this time.

Pages IV - 15 and 16, 9.

The BMS here discusses the location of "Prime", "Unique", and "Other" agricultural lands within the district. However they limit their comments to the fact that development of water resources is a compatible use within any agricultural land classification. The Board would like to see a discussion and an estimate of what amount of water is necessary to keep these land in economic production till the year 200 and beyond.

Page VI - 3, I.

The discussion here is of a possible decrease in stream flow which may induce the growth of riparian vegetation which in turn may be perceived as a negative aesthetic impact. The Board proposes to you that in an area noted for its flash floods that allowing or creating a situation which allows the streams to become overgrown is not an aesthetic impact but is a definite threat to life and property. The communities within the area are known as flood areas, lives are just yearly in flash floods. The Board would argue that any future water development should not impact the streams to the extent that they are allowed to fill in with vegetation.

Page IX - 1, IX.

The statement here is that most of the long term impacts are mitigable. The Board would like to see a program that deals with mitigation of the possible long term impacts on stream flows and the potential loss of agricultural land from cultivation due to lack of water availability.

Page XII - 1, Stream and Wetland Environments

How is BMS going to monitor this impact and what actions will they take if it is found that their wells are having a detrimental impact on streams and wetlands.

XIV. Environmental Impact Statement Preparation Notice Comments and Responses

Neighborhood Board # 28 would support the deletion of the Hanakooe Well at Kahuku based on the Board's long standing concern for the continued viability of agricultural lands and the letter from Campbell Estate, dated April 21, 1986, noting the adverse impact of this well on the agricultural uses on their property in the area.

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Aquatic Survey

The Neighborhood Board enforces the need to protect our streams and in particular agrees with the consultant the Kananani Stream should be given special attention.

General

The Neighborhood Board would like to see a program of agricultural water setasides developed as was done for Waialeale and Waianalo. We are willing to work with BKS and our legislators to achieve such a program and will be contacting them soon. We would not like to see extensive water development for the area approved without proper mechanism in place or in development to deal with our agricultural and stream flow concerns. Both of these issues impact on the long term health and welfare of the area in question.

Concerning stream besides the things previously mentioned would like to see baseline data on all impacted streams and a mandated minimum flow that sustains the current agricultural usage of the streams as well as the ecosystems involved. We do not feel we are unreasonable to ask that if the area's water is to be developed to meet other Waianae's needs that the needs of the area be adequately addressed and taken care of PRIOR to approval of such a development program. As previously mentioned Waianae has in place a agricultural water setaside our area does not! The Board would also like to urge BKS to become much more active with its water conservation programs as an alternative to massive water development.

Once again thank you for this opportunity to comment. If you have any questions feel free to contact me at 521-6768.

Sincerely,

Dee Dee Letts
Chair Water and Transportation
Committee
Neighborhood Board #28

cc: Mr. Lawrence Whang
Senator Jimmy Wong
Senator Gerald Hupino
Representative Rep Bellinger
Representative Joseph Leong
Councilmember David Kahana
Councilmember Randall Iwase
Mr. William Paly, Director DLNR
Mr. Paul Schwind, DWA
North Shore N.B. #27

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Ms. Dee Dee Letts
Page 2
December 23, 1987

We do not have an exclusive right to undeveloped water resources in the Waialua-Kahuku area. Governmental agencies or the public, such as those engaged in farming, may develop any of the potential sources mentioned in the EIS.

We also offer the following responses to your comments as they relate to the regional EIS:

1. We will continue to develop ground water until it becomes economically and environmentally unfeasible. Only surplus water from the Waialua-Kahuku sources will be exported to Honolulu.
2. The State has paid for the development of some new water sources which are integrated into our system. Water from these State sources are reserved for State projects and to designated agricultural users.
3. Water is available on a "first come, first served" basis. Everyone has an equal opportunity to obtain water from our systems, including agricultural users.
4. All consumers are being encouraged to conserve water. Conservation measures, such as rate restructuring and retrofitting of plumbing fixtures, will enhance conservation but will not provide enough water to meet projected demands. Other alternative sources of water, including desalting of seawater and brackish water, may still need to be developed to meet future demands.

The City and County of Honolulu, including the Board of Water Supply, will be preparing a comprehensive County water use plan as required by the new Water Code. The plan will address the water needs of all activities, including agriculture. Future water development projects will have

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December 23, 1987

Ms. Dee Dee Letts
Koolauloa Neighborhood Board No. 28
c/o Haula Satellite City Hall
54-010 Kukuna Road
Haula, Hawaii 96717

Dear Ms. Letts:

Subject: Your letter (No Date) to the Office of Environmental Quality Control on the Draft EIS for the Waialua-Kahuku Regional Water System Improvements

Thank you for your comments on our EIS.

The Waialua-Kahuku Regional Draft EIS is an assessment of our long-range water plans which include source, storage, and transmission facilities. Many of the projects are still in the conceptual stage. Since all the projects have common objectives, we felt that a regional EIS followed with supplemental EIS's should give the public a comprehensive overview of the Board's future plans instead of EIS's for individual projects.

Supplemental EIS's will address environmental concerns associated with the individual projects. You will be given the opportunity to review and comment on them. Where we find obvious environmental problems with certain projects, those projects will be dropped from our long-range plans.

The State Water Code and Instream Flow Standards should ensure that streamflows and wetlands are preserved. All of our projects must comply with requirements that may be imposed under these regulations, such as streamflow monitoring and wetland water level monitoring.

PUBLIC INFORMATIONAL MEETING

SUBJECT: City and County of Honolulu
Board of Water Supply
Maialua-Kahuku Regional Water System Improvements
Environmental Impact Statement Public Presentation

**PERSONS
PRESENT:** Mr. and Mrs. William Paty

State Department of Land
and Natural Resources
and Neighborhood Board
No. 27

Mr. Wilbert Kishinami

Mr. George Hiu
Mr. Larry Khang
Mr. Chester Lao
Mr. Gary Okamoto
Mr. Denis Shiu
Mr. Earl Matsukawa
Ms. Nam Hamaguchi

Maialua Community
Association

BMS
BMS
MOA
MOA
MOA
MOA

INFORMATION ITEMS:

The public informational meeting was held at the Haleiwa Gym (66-434 Kamehameha Highway) and commenced at 7:45 PM.

The presentations by Mr. Khang and myself are attached hereto as Attachments 1 and 2, respectively. The presentations have been recorded.

The following concerns were expressed during the informal question-and-answer period following the presentations (responses to questions are noted in parentheses):

o How long will it take to determine the availability of excess water?

(The availability of excess water will be determined as sources are developed. Availability is dependent on the number of exploratory wells drilled, and the data on the quality and quantity of water obtained from the pumpage tests of the exploratory wells.)

It is noted that if excess water is available, it may not necessarily be transported to the Maianae District. Water could possibly be exported to another district. It could also be imported. In planning the exportation of water, the Board of Water Supply would consider those areas where

growth is projected. The quantity of local growth (i.e., agriculture, resort) would also determine water needs. If the transmission main corridor is developed, flow could be reversed to import water. Water use districts could "share" excess water and support each other.

It is also noted that an exact value for the sustainable yield of the Maialua Ground Water Control Area has not been determined.)

o Regarding cost estimates for the transmission main alternatives, is tunnelling through the Maianae Range less costly than crossing over the Maianae Range? Is a transmission main around Kaena Point the least costly of the three alternatives?

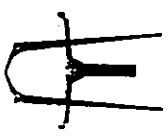
(A transmission main around Kaena Point has been estimated to be the least costly of the three transmission main alternatives. Tunnelling through the Maianae Range is the most costly of the three transmission main alternatives.)

o Can groundwater contained in the Maianae Range strata be developed?

(There is a question as to the amount of groundwater which is available for development. For example, a quantity of water is reserved for current water users. A substantial quantity of this preserved use is used for sugarcane production. For example, approximately 2.5 mgd is used by the Maialua Sugar Company. Other preserved uses total less than 3 mgd. A permitted use is an additional amount of water (over and beyond the preserved use) for which the Board of Water Supply has received approval for development.

As a range of estimates is available for the sustainable yield within the Maialua Ground Water Control Area, the total amount of water which may be developed in the Maianae Range strata is undetermined. While estimates indicate that 7 to 17 mgd may be developed, the amount of water of the quality desired which could be developed may not be near the upper value of this range.)

The Board of Water Supply noted that it is their goal to service the public. In this respect, the exportation and importation of water among districts will support the needs of the districts involved. For example, excess water could be transported to the



WILSON
OKAMOTO
& ASSOCIATES

2539-02
Public Informational Meeting
Page 4
October 7, 1987

The Board of Water Supply noted that water used for sugarcane production is generally higher in chloride content (as high as 1000 ppm) and is, therefore, not considered acceptable for drinking water which complies with a Board of Water Supply administrative limit of 160 ppm.

- o Are test wells successful?
(While a 5-day pumping test is conducted, results may not be indicative of a well's potential. Ideally, a well's sustainable capacity should be determined through experience, and day to day observations over an extended period.)
- o All well sites are within agricultural or undeveloped lands, consequently, no major impacts are anticipated (No major adverse impacts of developing the proposed improvements are anticipated with the possible exception of the Ukoa Well. Development of this source could possibly reduce water levels in Ukoa Pond, resulting in impacts to this wetland environment.)
- o Consumer water usage and conservation was discussed.

The public informational meeting adjourned at 9:15 PM.

Mami Hamaguchi
Mami Hamaguchi, Planner and Civil Engineer

cc: Mr. Larry Whang
Mr. Chester Lao

Attachments

WILSON
OKAMOTO
& ASSOCIATES

2539-02
Public Informational Meeting
Page 3
October 7, 1987

Waianae District if needs are determined to be greatest in this area. The Board of Water Supply is also considering the development of desalted sea or brackish water.

- o When would such development be initiated (i.e., in the year 2000 or later)?
(The Board of Water Supply hopes to accommodate future growth. Service to existing consumers is provided, and then planning for future consumers' needs is conducted. Locating potential water sources for use by future consumers is ongoing. While a previous projection may have indicated that water supply could be inadequate in the year 2000, water will be available to service the future population.)
- o Are there estimates of available water (total sustainable yield) within the District?
(The State Department of Land and Natural Resources estimates are about 60 mgd for the Kalahele area, 20 mgd for the Mokulele area and 10 mgd for the Kawaihoa area.
It is noted, however, that as more sources are developed, the probability of developing reliable, high yield new sources decreases. The most reliable water sources have already been developed. Current efforts to develop new sources may involve well sites with marginal or less reliable potential for producing the quantities of water which could be obtained at older well sites.)
- o How many exploratory wells have been drilled within the District?
(Of the proposed projects, the Opana and Kalahele II (formerly designated Mokulele I) exploratory wells have been drilled. Additionally, an exploratory well has been drilled at the Turtle Bay Resort. Three wells have also been drilled at Mokulele Ranch. The State Department of Land and Natural Resources will determine the volume of water which can be withdrawn from these three wells.)
- o Has test boring been conducted?
(Yes, test boring has been conducted at the exploratory well sites.)

GOOD EVENING EVERYONE:

MY NAME IS LARRY KHANG.

I AM IN CHARGE OF THE ENVIRONMENTAL SECTION, BOARD OF WATER SUPPLY, CITY AND COUNTY OF HONOLULU.

ON BEHALF OF THE BOARD OF WATER SUPPLY, WE WISH TO THANK THE WAIALUA COMMUNITY ASSOCIATION FOR ALLOWING US TO HOLD THIS INFORMATIONAL MEETING IN THEIR MEETING HALL. THE ASSOCIATION'S PRESIDENT, GABY CASSART, AND ASSOCIATION'S SECRETARY, PUA, ARE HERE TONIGHT. GABY AND PUA, PLEASE STAND AND BE RECOGNIZED. THANK YOU. WE ALSO WISH TO THANK THE REST OF YOU FOR JOINING US AT THIS INFORMATIONAL MEETING ON OUR WAIALUA-KAHUKU REGIONAL ENVIRONMENTAL IMPACT STATEMENT.

WE WOULD LIKE TO RECOGNIZE OUR ELECTED OFFICIALS AND BOARD MEMBERS WHO ARE PRESENT WITH US TONIGHT. IF THERE IS ANY OTHER ELECTED OFFICIAL PRESENT WHO HAS NOT BEEN INTRODUCED, WILL YOU PLEASE STAND AND INTRODUCE YOURSELF TO THE GROUP.

WE ALSO WISH TO INTRODUCE MEMBERS OF THE BOARD OF WATER SUPPLY WHO ARE AVAILABLE AS RESOURCE PEOPLE FOR TONIGHT'S MEETING.

WE ALSO HAVE WITH US THOSE PERSONS WHO HELPED PREPARE THE EIS PREPARATION NOTICE AND THE DRAFT EIS. THEY WILL SHORTLY BE INTRODUCED.

WE DO HAVE A SIGN-UP SHEET AND A FORM FOR ANY QUESTIONS OR STATEMENTS YOU MAY WISH TO MAKE TONIGHT. IF THERE IS ANYONE WHO HAS NOT SIGNED IN OR HAS NOT OBTAINED A FORM TO ASK A QUESTION OR MAKE A STATEMENT, PLEASE RAISE YOUR HANDS. THANK YOU. FOR THOSE OF YOU WHO RAISED YOUR HANDS, PLEASE GET THE ATTENTION OF THE PERSON THAT WILL BE CIRCULATING AMONG YOU WITH THE SIGN-IN SHEET AND FORMS.

TONIGHT'S INFORMATIONAL MEETING IS ON THE BOARD OF WATER SUPPLY'S PROPOSED LONG-RANGE PROGRAM IN THE WAIALUA-KAHUKU DISTRICT. LET ME EMPHASIZE "PROPOSED" BECAUSE UNTIL WE INVESTIGATE EACH PROJECT IN DETAIL, THE PROJECTS PROPOSED IN THE EIS REPRESENT ONLY OUR CONCEPTION OF WHAT OUR LONG-RANGE PROGRAM MIGHT BE. THE OBJECTIVES OF THIS MEETING ARE THERE AS FOLLOWS:

1. TO INFORM YOU OF THE BOARD OF WATER SUPPLY'S LONG-RANGE PLAN OR IDEAS AS PRESENTED IN THE REGIONAL EIS;
2. TO CLARIFY ANY ISSUES IN THE EIS;
3. TO RECEIVE YOUR INPUTS AS TO WHAT ELSE MAY BE ADDRESSED IN THE EIS; AND
3. TO MAINTAIN COMMUNICATIONS WITH YOUR COMMUNITY.

WE'RE HOPING TO HAVE AN ACTIVE QUESTION-AND-ANSWER PERIOD AFTER THE PRESENTATION BY THE CONSULTANTS. YOUR CONCERNS TONIGHT WILL BE ADDRESSED IN THE FINAL EIS. ALTHOUGH THE DRAFT EIS WAS PUBLISHED IN THE AUGUST 23, 1987 OFFICE OF ENVIRONMENTAL QUALITY CONTROL BULLETIN, WE REQUESTED OEQC TO EXTEND THE COMMENT PERIOD FROM ONE MONTH, FROM THE DATE OF PUBLICATION, TO NOVEMBER 15, 1987. WE URGE THOSE WITH ANY CONCERNS TO SEND IN YOUR WRITTEN COMMENTS ON THE DRAFT EIS. THE LAW NOT ONLY REQUIRES THE FINAL EIS TO ADDRESS YOUR CONCERNS BUT ALSO REQUIRES THE COMMENTS AND RESPONSE LETTERS TO BE INCLUDED IN THE FINAL EIS. BY SENDING IN YOUR WRITTEN COMMENTS, THE CONCERNS OF AN INDIVIDUAL OR ORGANIZATION WILL BE RECOGNIZED IN THE FINAL EIS.

ONE KEY POINT WE WOULD LIKE TO EMPHASIZE TONIGHT IS THAT OUR PROPOSED PROJECTS ARE JUST IDEAS. THESE PROPOSED OR POTENTIAL SOURCES ARE LOCATED ON LAND OWNED BY OTHERS. WE HAVE NO PRIOR RIGHTS TO THESE POTENTIAL SOURCES. THEY CAN BE DEVELOPED BY OTHERS, SUCH AS PRIVATE PARTIES OR GOVERNMENT, IF THEY HAVE USE FOR THE WATER BEFORE WE ARE READY TO USE IT. IF WE FEEL THAT WATER IS STILL AVAILABLE WHEN WE ARE READY TO PROCEED WITH THE PROJECT, WE WILL ASSESS THE PROJECT AND IF NEED BE, PREPARE A SUPPLEMENTAL EIS.

THE NEXT PORTION OF THIS MEETING WILL BE A PRESENTATION ON THE DRAFT EIS AND A QUESTION-AND-ANSWER PERIOD. I WOULD LIKE

-3-

TO INTRODUCE THE FOLLOWING PERSONS FROM OUR CONSULTANT, WILSON, OKAMOTO AND ASSOCIATES:

1. GARY OKAMOTO, VICE PRESIDENT
2. EARL MATSUKAWA, PROJECT MANAGER AND DIRECTOR OF PLANNING
3. DENIS SHIU, DIRECTOR OF CIVIL ENGINEERING
4. NAMI HAMAGUCHI, PLANNER AND CIVIL ENGINEER

NAMI HAMAGUCHI WILL BE MAKING THE FOLLOWING PRESENTATION AND HANDLING THE REST OF THE MEETING. NAMI.

-4-

8MS MAIALUA-KAHUKU REGIONAL DRAFT EIS PRESENTATION

Good evening ladies and gentlemen, members of the Board. Mr. Earl Matsukawa and Mr. Denis Shiu are the project manager and civil engineer for this project, respectively, at Wilson Okamoto & Associates. If there are any questions after the presentation we would be happy to try and answer them.

The Draft Environmental Impact Statement has been prepared for the Maialua-Kahuku Water Use District. This District extends eastward from Kaena Point to Kahuku, Inland, the District is bounded by the Maianae Range, the Maialua-Hahione Judicial District boundary, and the Koolau Range and Maiaekahana Valley. (See Location map)

The Draft EIS document addresses various proposed Board of Water Supply projects located within this large district. Collectively, these water system improvements will help to meet the Maialua-Kahuku District's water requirements for the future. From a long-range planning standpoint, the proposed improvements will accommodate future population growth, in keeping with the City and County of Honolulu's General Plan, and the Koolauloa and the North Shore Development Plans. The projects will meet the projected water supply needs of the Maialua-Kahuku District and, if excess water is available, such excess may be conveyed to the Maianae District.

Water requirements for the Maialua-Kahuku District in the year 2000 are expected to reach 5.1 million gallons per day (mgd) which compares to a 1985 demand of 2.9 mgd. Currently, water for the District is provided by the Board of Water Supply through a system extending from Kawela to Maialua, and a separate system servicing Kahuku. Approximately 3.1 million gallons of water per day is provided by the Board of Water Supply systems.

A regional EIS approach was taken so that the cumulative impacts of all proposed projects taken together could be addressed. In addition to regional impacts, the EIS also addresses the local (site) impacts associated with each of the source, transmission and storage facility projects. The EIS document may be accepted in whole, or in part, to fulfill the requirements of Hawaii Revised Statutes Chapter 343 and EIS Rules. The Board of Water Supply, in progressing through a planning and design phase for each of these projects would need to evaluate or environmentally assess the projects and, at that point, may determine that supplemental environmental impact statements are required.

The Draft EIS is available for review at the following public libraries:

- o State Main Library.
- o Hamilton Library.
- o the Kaimuki, Kaneohe, Pearl City, Hilo, Maui and Lihue Regional Libraries.
- o the Kahuku Community-School and
- o Maialua Libraries.

In meeting anticipated consumer demands for potable water, the Board of Water Supply is proposing the development of three types of improvements which are new water sources, storage, and transmission facilities.

Basically, the physical features of source development would involve drilling of exploratory wells and test pumping of these wells. If the wells are acceptable in terms of quality of water and yield, the exploratory well would be converted to a production facility. A production facility basically consists of a permanent pump and control building, and a transmission main which would tie the source to the existing Board of Water Supply pipeline.

A second category of improvement is reservoir or storage facilities. This would involve providing storage tanks which will increase the overall storage capacity of the system to meet projected needs, and provide a more reliable supply of water and fire protection within the District. Also, reservoirs would help to meet additional peak demands or help to meet demands during emergency situations such as power outages.

The third category of improvements would be transmission mains. Mains would provide additional transmission capacity to meet projected need as well as facilitate or improve reliability of operations for transmission.

Proposed Improvements

These three types of improvements are included in the proposed projects. You have with you, in the handouts passed out earlier, a series of maps which show the proposed projects. These maps are identical to the maps posted up front.

The proposed projects include 9 sources, each of which consist of one or more new wells with associated storage and transmission facilities. All wells proposed in the Maialua-Kahuku District will tap basal sources, although wells in the Kahuku area may supply water derived in part from dike leakage. All proposed water sources will be non-flowing basal wells. Proceeding from west to east within the District, the first new proposed source is the Kawahapa Well.

(see FIGURE 2A)

Kawahapa Well

This well is located in an agricultural area about 1 mile north of the Mokuiea Forest Reserve boundary and 1 mile south of Farrington Highway.

This source is estimated to yield 0.5 to 2.0 mgd

The well would be situated at an elevation of approximately 300 feet.

An alternate well site is located to the north, at an elevation of about 200 feet.

Mokuleia I Well

The second source is the Mokuleia I Well which is located approximately 1 mile mauka of Farrington Highway in an area planted in sugarcane at an elevation of about 200 feet.

This source would provide about 0.5 to 2.0 mgd, with a sustainable capacity of 1.0 mgd. Sustainable capacity is defined as the rate at which water can be withdrawn from a specific source site, such as a well or shaft, without unduly impairing source utility.

An environmental impact assessment in the form of a negative declaration for this project was published by the Office of Environmental Quality Control on March 23, 1986.

Maiailua II Well

The third source, the Maiailua II Well, is located south of Maiailua at the foot of Puu Iki on the northern slope of the Maianae Range, about 1.2 miles mauka of Maiailua High School. This site is surrounded by cattle-grazing lands and sugarcane fields. The Mokuleia Forest Reserve and Mount Kaala are located to the south.

An exploratory well, located at an elevation of about 200 feet, has been drilled and tested by the Department of Land and Natural Resources through their well drilling program. A negative declaration for the exploratory well was published on June 8, 1984.

This source is estimated to provide 1.5 mgd

The Maiailua II Well project will also include the construction of a reservoir with a probable capacity in the 0.5 to 1.0 mg range.

(see FIGURE 28, proceeding north)

Ukoa Well

The Ukoa Well would be located east of Ukoa Pond, a wetland area, and south of Kawailoa Camp, about 0.8 mile mauka of Kamehameha Highway. The site would be situated at an elevation of about 180 feet in undeveloped land.

The Ukoa Well is estimated to yield 250,000 to 0.5 million gallons per day (gpd)

Kawailoa Well

The Kawailoa Well would be located at an elevation of about 412 feet, approximately 0.8 mile mauka of Kamehameha Highway and Kawailoa Beach in an agricultural area.

This source is estimated to yield 100,000 to 1.0 million gpd

Maimea Well

The Maimea Well would be located about 1 mile mauka of Maimea Bay at an elevation of approximately 500 feet. Surrounding land uses are primarily agricultural.

This source would provide about 100,000 to 1.0 million gpd

(see FIGURE 2C, Kahuku area)

Opama Well

The Opama Well is located about 1 mile mauka of Kawela Bay and west of Kawela Stream. Elevation of the site is about 120 feet and surrounding land uses are mostly agricultural. A U.S. Naval Reservation is nearby.

Exploratory wells have been drilled and test pumping completed.

The Opama Well is estimated to yield 1.0 mgd

Kawela Well

The proposed Kawela Well will be located about 1 mile southwest of the Turtle Bay Resort and east of Kawela Stream. This area, south of Kamehameha Highway, is used for agriculture.

The well would be located at an elevation of about 200 feet and would yield between 1.0 and 1.5 mgd

Hanakaoe Well

Finally, the ninth source proposed for the District is the Hanakaoe Well. This source would be located between Hoolapa and Kalaeokahipa Gulches in Kahuku, about one-half mile mauka of Kamehameha Highway. The land uses surrounding the site are undeveloped lands and agricultural lands. A U.S. Military Reservation is located nearby.

The well would be located at an elevation of approximately 200 feet and is estimated to provide 0.5 to 2.0 mgd

It is important to note that the portion of the District within the Maialua Judicial District which extends from Kaena Point to Maimea (See Location Map) has been designated as the Maialua Ground Water Control Area by the State Board of Land and Natural Resources. The Board of Land and Natural Resources has established water withdrawal limits for the District. Some estimates have indicated that up to 20 mgd can be developed before achieving the upper limit of withdrawal established by the Board of Land and Natural Resources. The upper limit of withdrawal indicates the amount of water which can be withdrawn without unduly degrading the groundwater resource. The proposed source development will respect the limits imposed by the Ground Water control designation. Therefore, no adverse impacts to the aquifer in terms of yield as well as quality are anticipated.

Mokuleia-Makaha Transmission Main and Reservoir

In addition to source development, one major transmission main which is independent of source development, and one new reservoir are proposed. These facilities are the Mokuleia-Makaha Transmission Main and Reservoir. As shown on FIGURE 2D, only probable areas are indicated for alignments and locations of these facilities as these projects are in the conceptual planning stage. Possible transmission main corridor areas are noted in orange and green. Probable reservoir location is noted in blue.

The transmission main is planned to convey surplus water from the Maialua-Kahuku District to the Maianae District. The proposed transmission main could connect the Board of Water Supply system in Maialua to the Makaha "242" system. More detailed engineering studies would be undertaken only if sufficient quantities of excess water in the Maialua-Kahuku District are available to justify the water transfer. Importantly, existing and projected water needs for the Maialua-Kahuku District will be met before any inter-district transfer of water is considered.

Together with the transmission main, a 2 to 6 mg reservoir, or series of reservoirs (with pump stations) is proposed to facilitate the transfer of water. The reservoir or reservoirs would be located between the 300 and 600 feet elevation on the Maialua-side of the Maianae Range (noted in blue on the figure). The reservoir(s) and pump stations would have to be situated to convey the water through the highest elevation of the transmission main. In this respect, three possible transmission main alignments are being considered:

1. The first alternative transmission main corridor would be along Farrington Highway, continuing around Kaena Point along the "Jeep trail" corridor, then along Farrington Highway on the Maianae-side of the island. Alternative 1 is shown in green on FIGURE 2D and is titled the Farrington Highway Corridor.
2. The second alternative transmission main corridor is similar to the first alternative. The difference between the two is that the second alternative proposes a tunnel through the Maianae Range near Kaena Point, but bypassing Kaena Point. This alternative transmission main corridor is also indicated as the Farrington Highway Corridor on FIGURE 2D.
3. The third alternative transmission main corridor would follow a similar alignment along Farrington Highway as the other two alternatives, shown in green, with one major difference. This alternative, indicated as the Trans-Maianae Range Corridor on FIGURE 2D in orange, proposes an alignment which would cross over the Maianae Range somewhere within this area.

Of the three Mokuleia-Makaha Transmission Main alternatives, preliminary analysis indicates that Alternatives 1 and 2 deserve further consideration and study. Alternative 3 is less favorable because of high energy costs required to pump water over substantial elevations.

I would now like to discuss regional impacts of the proposed projects. These are potential impacts that are anticipated in areas beyond the immediate vicinity of the individual project sites, and cumulative impacts which may result from the combined effects of individual projects.

With respect to the quality of water supplies, the Board of Water Supply will monitor the quality of domestic water to ensure that it is safe to drink. Approval from the State Department of Health must also be obtained before any new drinking water source may be used.

None of the proposed projects are located within an area where the possibility of flooding has been determined. If necessary, the projects will be designed in accordance with established guidelines for construction in flood prone areas.

The development of the proposed water system improvements will have economic benefits. In the short term, the proposed improvements will provide temporary economic benefits in the form of construction expenditures and employment opportunities. The cost to operate and maintain the new facilities may result in increases in water rates. However, without the proposed water system improvements, the long-term development in all sectors of the island's economy will be constrained as the provision of adequate water supplies is essential to support further economic growth.

None of the proposed improvements will displace existing uses with the exception of a few acres of sugarcane. The proposed facilities will be sited to minimize impacts to the site and surrounding lands. Selection of alternative sites could also minimize potential adverse effects.

Impacts to stream and wetland environments are not anticipated, with the possible exceptions of Ukoa Pond, which is a spring-fed wetland environment near the Ukoa Well site, and the Maimea Stream, whose tributary is located in the vicinity of the Maimea Well site. The amount of any stream flow or wetland level reduction, however, can only be determined during long term pumping. Therefore, the Board of Water Supply will monitor streamflow and wetland water levels during the pumping tests of exploratory wells. Should a water source have a detrimental impact on stream or wetland environments, the Board of Water Supply will reduce or terminate pumping from the source.

With respect to regional hydrology impacts, development of the proposed water storage and transmission facilities is not expected to affect ground water recharge. However, supplemental environmental studies of potential hydrological impacts of the Mokuleia-Makaha Transmission Main tunnel through the Maianae Range would need to be conducted if the Board of Water Supply proceeds with this project.

Development of the proposed projects will also result in general construction impacts upon local environments. Primarily, noise levels, and air and visual qualities of the local environment will be affected. These short-term impacts will be experienced only during construction and can generally be regarded as nuisances.

Noise levels will be elevated during construction hours by the operation of construction equipment, including vehicles required to haul various materials to and from the site. Ambient air quality is expected to be temporarily degraded as a result of dust and vehicular emissions generated during the installation and construction of transmission lines, reservoirs and control buildings.

Other construction-related impacts include the alteration of existing landforms through earthwork operations and the displacement of existing flora and fauna. This is not anticipated to be a significant impact as there are no known threatened or endangered species at the project sites.

If archaeological resources are uncovered during construction, work will be suspended and the State Historic Preservation Office notified.

The increased traffic from construction vehicles may cause minor inconveniences to area residents for the duration of construction. Development of transmission mains will require more extensive road use during excavation and installation of water lines. Therefore, diversion of traffic may be required for limited periods of time.

Connection of the proposed water system improvements to existing facilities may require temporary disruption of service. Affected users will be notified in advance of such disruption. Residents of the area will also be apprised of pending construction.

Relatively few adverse impacts are anticipated during operation of the facilities. Transmission mains will have negligible impacts, once installed. Storage facilities may have visual impacts, however, these effects could be mitigated through appropriate design standards and landscaping. The operation of source facilities may conflict with existing land uses at some sites, hence alternate sites may be considered. Well pumps will generate noise, but these effects can be attenuated, as necessary, in populated areas.

Impacts of developing the Mokulele-Makaha Transmission Main and Reservoir cannot be assessed at this time due to the uncertainty of alignment and siting. Should development of these projects proceed, however, impacts are anticipated to be primarily construction-related, with the exception of the tunnel through the Maianae Range mentioned previously.

Before I close, I would like to briefly summarize project costs and implementation. The Board of Water Supply's 6-year Capital Improvements Program (CIP) includes the development of the Mokulele I, Kawailoa and Waimea Wells. Construction of the Mokulele I Well is proposed in 1990, and the Kawailoa and Waimea Wells are proposed to be constructed in 1991. Total costs of developing these sources are estimated at about \$3.5, \$3.2 and \$4.9 million for the Mokulele I, Kawailoa and Waimea Wells, respectively. Construction costs of the Opana Well and Matalua II Well are estimated at approximately \$2.5 and \$4.7 million, respectively. All other proposed improvements for the District are long-range planning items which will be considered for development as needs and water availability warrant. For those sources not listed in the CIP, order of magnitude cost estimates range from about \$1.0 to \$4.6 million, not including costs for land acquisition.

A conceptual level cost analysis for the three Mokulele-Makaha Transmission Main alternatives has been developed. These costs are \$26.0, \$30.2 and \$28.3 million for Alternatives 1, 2 and 3, respectively. The cost of a 6 mg reservoir is included in these estimates.

This concludes my presentation. If there are any questions, we would be happy to try and answer them.

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XVI. REFERENCES

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XVIII. APPENDICES

- A. Design Considerations for the Opana Well and Waialua Well II
- B. Cost Evaluation of Mokuleia-Makaha Transmission Main and Reservoir
- C. Archaeological Surveys at Proposed Well Locations
- D. Botanical Survey
- E. Aquatic Survey of Kamananui Stream and Ukoa Marsh
- F. Opana Well Pumping Tests
- G. Waialua Well II Pumping Test

A. DESIGN CONSIDERATIONS FOR THE
OPANA WELL AND WAIALUA WELL II

APPENDIX A
DESIGN CONSIDERATIONS FOR THE
OPANA WELL AND WAIALUA WELL II

I. INTRODUCTION

This appendix discusses requirements for integrating production wells at Opana and Waialua (II) into the existing BWS system. This disclosure of system components and functions is intended to facilitate identification and evaluation of potential environmental impacts and mitigative measures.

II. OPANA WELL

The project site is located at an elevation of about 120 feet, approximately one mile south of Kawela Bay and west of Kawela Stream. The Opana Well is located about one third mile northeast of a U.S. Naval Reservation, in an agricultural area, adjacent to Kawela Camp Road (the private access road to the Kawela Reservoir). Access can be provided by Kawela Camp Road and a connecting plantation or limited access road located to the east.

The Opana exploratory well has been drilled and pumping tests have been completed. Aquifer tests indicate a sustainable capacity of 1.0 MGD. A second Opana Well has been drilled. Test pumping data are provided in Appendix F.

A. EXISTING SYSTEM

The Kawela Reservoir and the Sunset Beach Reservoir provide for the storage needs of the Kawela, Sunset Beach and a portion of the Pupukea systems. The two Waialeale Wells and the Sunset Beach Well are the sources for these systems.

The problems associated with the existing system are two-fold: (1) the Kawela Reservoir cannot be completely filled; and (2) the Sunset Beach Well shows elevated chloride levels during sustained pumping.

The Kawela Reservoir cannot be completely filled because of an elevation difference with the Sunset Beach Reservoir. The Kawela Reservoir, with a capacity of 2.0 MG and a spillway elevation of 228 feet can be filled to approximately 500,000 gallons. If the Kawela Reservoir is filled to higher levels, the Sunset Beach Reservoir will overflow (at an elevation of 206 feet).

The existing Sunset Beach reservoir lacks the capacity (300,000 gallons) to supply fire flows required by the Sunset Beach Elementary School. The problem is compounded by a small waterline size (8-inch) that causes excessive pressure losses during fire flows. A line booster was installed in Pupukea to compensate for the small Sunset Beach Reservoir and the small

waterline, during fire flows. The booster is normally not in operation and a valve at the booster is normally closed.

B. PROPOSED "OPANA" IMPROVEMENTS

To alleviate the problems associated with the existing Kawela-Sunset Beach system, the following improvements are suggested:

- o Construct new Sunset Beach Reservoir with 228 feet spillway elevation.
- o Remove existing Sunset Beach Reservoir from service.
- o Replace pumps at Waialeale Wells and Sunset Beach Well with higher head pumps.
- o Convert Opana Well to a production well.
- o Install new valves to separate Sunset Beach and Kawela systems.
- o Use Sunset Beach Well as a standby source.

The concept of the proposed system is to divide the Kawela-Sunset Beach system at the Waialeale Wells. The Opana Well will feed into the Kawela Reservoir, which would service the Turtle Bay Resort and Kawela areas. The Waialeale Wells would feed the Sunset Beach Reservoir, which would feed the Sunset Beach and Pupukea areas.

Proposed system improvements are shown in Figure A-1 and are discussed below.

- Construct New Sunset Beach Reservoir with 228-foot Spillway Elevation

The proposed reservoir would replace the existing reservoir. The existing reservoir is planned to be deactivated. The 228-foot spillway elevation for the proposed Sunset Beach Reservoir will assure reservoir system compatibility, thereby enabling full utilization of the Kawela Reservoir. The Waialeale and Sunset Beach Wells would need to be equipped with higher head pumps to fill the proposed reservoir which is located at a higher elevation than the existing reservoir.

- Convert Opana Well to a Production Well

Implementation of the production well at Opana will provide an additional source yield of 1.0 MGD to the BWS

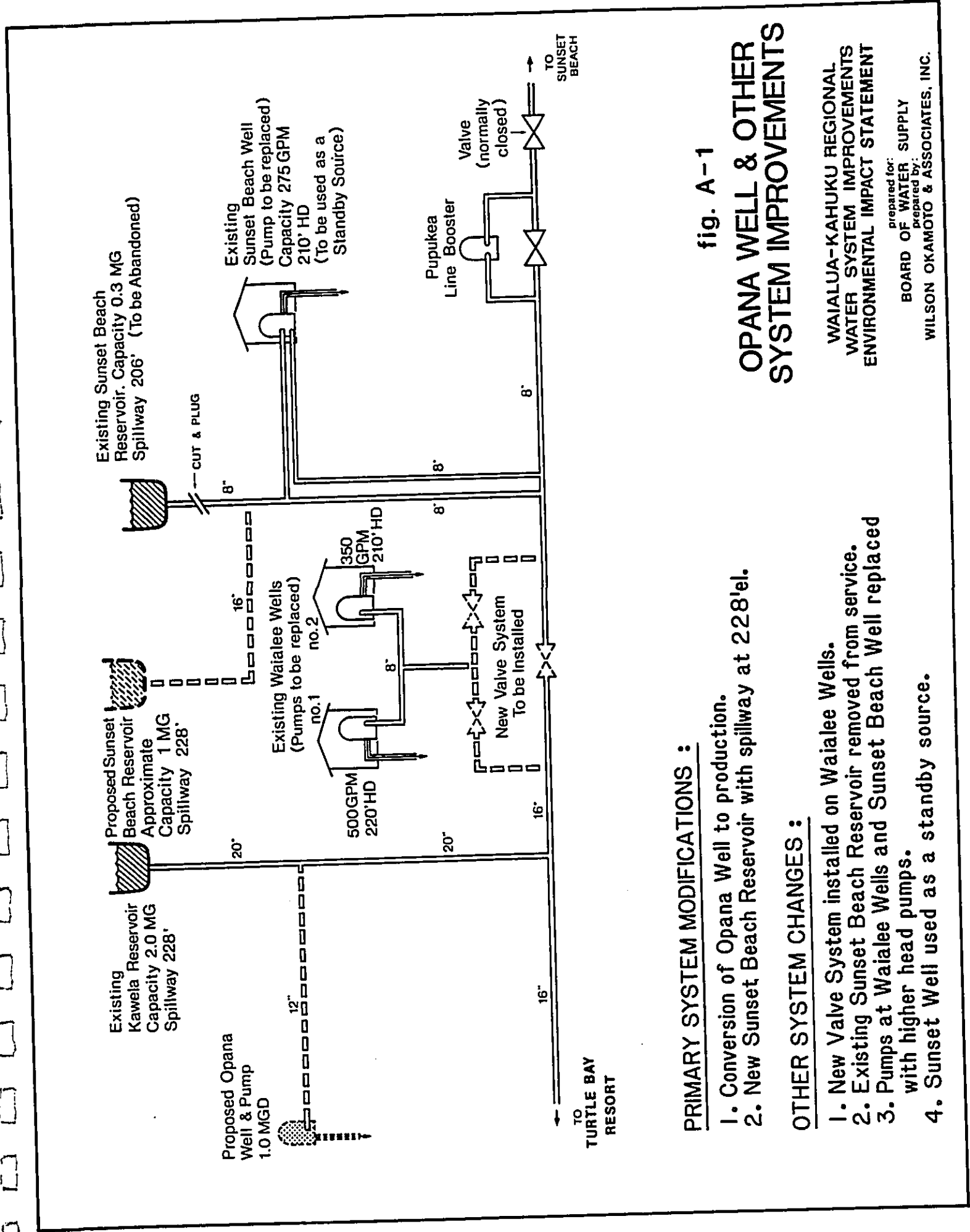


fig. A-1

OPANA WELL & OTHER SYSTEM IMPROVEMENTS

WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS ENVIRONMENTAL IMPACT STATEMENT

prepared for:
BOARD OF WATER SUPPLY
prepared by:
WILSON OKAMOTO & ASSOCIATES, INC.

PRIMARY SYSTEM MODIFICATIONS :

1. Conversion of Opana Well to production.
2. New Sunset Beach Reservoir with spillway at 228'el.

OTHER SYSTEM CHANGES :

1. New Valve System installed on Waialea Wells.
2. Existing Sunset Beach Reservoir removed from service.
3. Pumps at Waialea Wells and Sunset Beach Well replaced with higher head pumps.
4. Sunset Well used as a standby source.

system. Supply from the Opana Well will connect to the existing 20-inch main on Kawela Camp Road via a new 12-inch pipe. Telephone circuitry would connect the well pumps to the Kawela Reservoir.

The well site will be developed to include a pump, motor, electrical control center, chlorination unit, valves, piping, gages, sensor (to respond to reservoir water level fluctuations) and other appurtenances.

A paved access road to the well site will be provided. Additionally, a road drainage system and security fencing will be provided around the perimeter of the well site.

- Install New Valves to Separate Sunset Beach and Kawela Systems

Preliminary discussions with the BWS indicate separating the Kawela-Sunset Beach system into two subsystems would be desirable. Separation into a Kawela subsystem and a Sunset Beach subsystem would allow the proposed Opana Well to directly feed into the existing Kawela Reservoir, while the proposed new Sunset Beach Reservoir would be fed by the existing Waialeale Wells.

Separation of the system can be accomplished by installing a new valve system at a point where the Waialeale Wells connect into the distribution system. This new valve system at the Waialeale Well connection would also allow the wells to feed both Kawela and Sunset Beach Reservoirs, during periods of high demand, maintenance, or emergencies. Since the Sunset Beach Well is a "low quality" source, this well would be used for standby purposes only.

C. ALTERNATIVES

Alternative 1:

An altitude valve can be installed at the existing Sunset Beach reservoir, instead of constructing a new reservoir at Sunset Beach. This alternative would not provide a solution to limited capacity constraints but would be a less costly alternative to rectify the difference in reservoir elevations.

Alternative 2:

Another alternative would involve the disconnection of the existing Sunset Beach Reservoir and the utilization of the Kawela Reservoir to its full 2 MG capacity. Presently, the combined storage capacity is approximately 800,000 gallons. The full implementation of the Kawela Reservoir would bring the system storage capacity to 2 MG.

D. COST

The estimated cost of the proposed "Opana" improvements are presented in Table A-1.

III. WAIALUA WELL II

The project site is located south of Waialua, at the foot of Puu Iki, on the northern slope of the Waianae Range. The Mokuleia Forest Reserve and Mount Kaala, the highest point of the Waianae Range, are situated south of the well site. The proposed Waialua Well II site is surrounded by sugarcane fields to the north, mountainous terrain to the south and Waialua Ranch Partners cattle grazing lands. Waialua High School is located to the north.

The exploratory well, originally designated as Mokuleia I, is situated on the western end of the rectangular parcel at an approximate elevation of 200 feet.

The pipeline and access easement to the well site will be on existing sugar cane and Waialua Ranch Partners roads.

The Waialua II exploratory well has been drilled and tested by the Department of Land and Natural Resources through their well drilling program. Tests indicate a sustained pumping rate of 1.5 MGD. Test pumping data are provided in Appendix G.

A. EXISTING SYSTEM

The Waialua Reservoir II and Well II will be constructed in an area that currently has no BWS improvements. An 8-inch waterline is in operation on Farrington Highway, fronting Waialua High School. This 8-inch waterline connects to a 16-inch main on Waialua Beach Road, the nearest major transmission main.

The Haleiwa - Waialua system is supplied by the Haleiwa and Waialua reservoirs which have capacities of 1.0 MG and 1.5 MG, respectively. The Haleiwa Wells (2 wells) and the Waialua Wells (2 wells) provide water to supply the areas from Pupukea to Waialua.

B. PROPOSED "WAIALUA II" IMPROVEMENTS

The following system improvements are considered appropriate to implement the Waialua Well II:

- o Construct new Waialua Reservoir II with 225-foot spillway elevation.
- o Convert Waialua Well II into a production well.
- o Construct 16-inch transmission main.

TABLE A-1

"OPANA" IMPROVEMENTS COST ESTIMATE
PROPOSED SYSTEM

Sunset Beach Reservoir <u>1.0 MG Concrete Reservoir</u>		\$1,645,000
Conversion of Opana Well to a Production Well <u>Electrical</u> (Motor control center, electrical work, supervisory equipment)	\$153,000	
<u>Mechanical</u> (Pumps, piping & valves, instrumentation, flow metering, chlorination)	133,000	
<u>Control Building</u> (On-site piping, concrete work for pump, venturi box)	140,000	
<u>Site Work</u> (Road, grading, irrigation, chainlink fence, mute (acoustical work))	89,000	
<u>12" Connection Main</u> (100 LF x \$95/LF)	10,000	
<u>Telephone Circuit</u> (1350 LF x \$10/LF)	14,000	
<u>Reservoir Liquid Level Control and Necessary Adjustments</u>	<u>13,000</u>	
		\$ 552,000
Valving to Separate Sunset Beach and Kawela Systems <u>Valving, Appurtenances and Necessary Adjustments</u>		\$ 25,000
Replacement of Pumps at Waialeale and Sunset Beach Wells <u>Higher Head Pumps</u> (3 x \$18,980 EA)		\$ 57,000
Modification of Sunset Beach Well Controls		\$ 13,000
Inactivate Existing Sunset Beach Well		<u>\$ 13,000</u>
	SUBTOTAL	\$2,305,000
	20% CONTINGENCIES	<u>\$ 461,000</u>
	TOTAL	<u>\$2,766,000</u>

Proposed system improvements are shown in Figure A-2 and are discussed below:

- Construct new Waialua Reservoir II with 225-foot Spillway Elevation
With the Waialua Well II implementation, a reservoir may be constructed on the well site or at a nearby site for the storage and distribution of the developed water. The 225-foot spillway elevation of the proposed reservoir will assure reservoir system compatibility and enable full utilization of the existing Waialua and Haleiwa Reservoirs.

The proposed 1.0 MG (approximate) reservoir would be constructed in accordance with BWS standards.

- Convert Waialua Well II to a Production Well

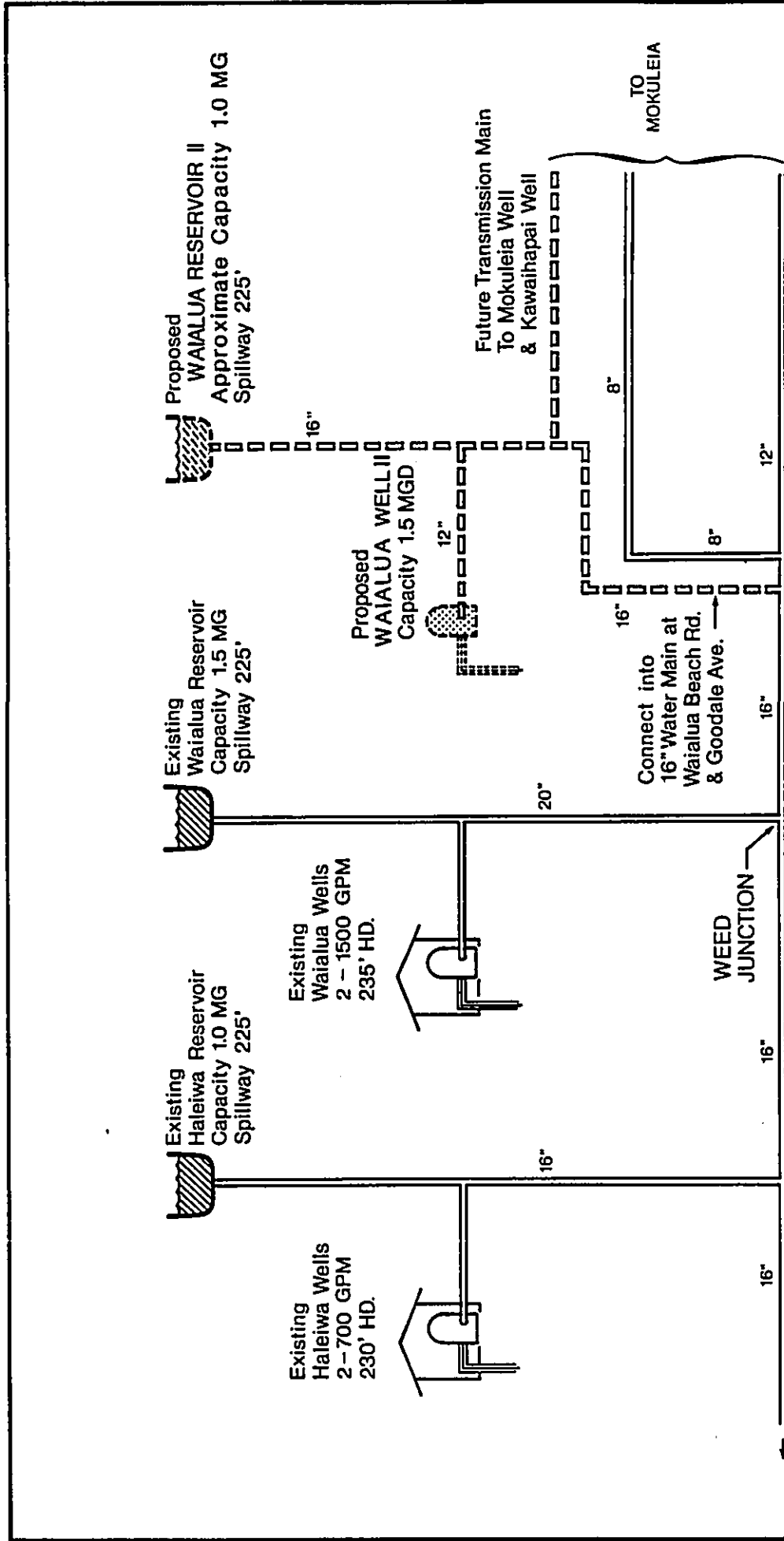
Implementation of the Waialua II production well will provide an additional yield of 1.5 MGD to the BWS system. Well pumping operations will be linked to the water level of the new reservoir. Pumpage will commence when the reservoir level declines to a predetermined level, and will continue until reservoir capacity is reached. A 12-inch connection main and telemetry lines will be installed within the road right-of-way between the well and reservoir.

Well site development will include the installation of a pump, motor, electrical control center, chlorination unit, valves, piping, gages, sensor (to respond to reservoir water level fluctuations) and other appurtenances. A road and security fencing around the site is required. Drainage improvements will be developed, as necessary, to handle on-site drainage in addition to flows from the washout and overflow lines from the reservoir.

A paved access road will be constructed from Farrington Highway to the well site, a distance of approximately 8,600 feet.

- Construct 16-inch Transmission Main

Supply from the Waialua Well II is proposed to feed the existing main on Waialua Beach Road and Goodale Avenue via a new 16-inch transmission main, a distance of approximately 14,600 feet.



TO
WAIMEA
BAY

PRIMARY SYSTEM MODIFICATIONS:

1. Conversion of Waialua Well II to production.
2. New Waialua Reservoir II with spillway at 225'el.
3. Construction of 16" Transmission main.

fig. A-2

**WAIALUA WELL II
IMPLEMENTATION**

FUTURE SYSTEM CHANGE:

1. Possible construction of transmission main to Mokuleia Well I and Kawaihapai Well.

WAIALUA-KAHUKU REGIONAL
WATER SYSTEM IMPROVEMENTS
ENVIRONMENTAL IMPACT STATEMENT

prepared for:
BOARD OF WATER SUPPLY
prepared by:
WILSON OKAMOTO & ASSOCIATES, INC.

C. ALTERNATIVES

The future implementation of additional well sites in the area and the construction of a water transmission main to the Waianae District is being considered. Such improvements would require major water system upgrading, portions of which can be implemented at this time.

A possible improvement would involve the installation of a larger main in Farrington Highway. The size of the main would be dependent upon the amount of water anticipated for ultimate development and the amount of water available for transport to the leeward side of the island. The implementation of the Kawaihapai Well and Reservoir will also determine the size of the line to be installed.

The evaluation of alternative reservoir sites should consider the possibility of placing the reservoir at a higher elevation. A transmission main to serve the Waianae District would require a reservoir elevation high enough to provide the necessary head to transport the required quantities of water. Site selection of the Waialua Reservoir II to assure future system compatibility should be considered.

If the reservoir is located at a higher elevation, consideration should be given to isolating the Mokuleia system from the Haleiwa-Waialua system by installing a pressure regulator between the two systems. The placement of altitude valves on the Haleiwa and Waialua reservoirs is an alternative consideration.

D. COST

The estimated cost of the proposed "Waialua II" improvements are presented in Table A-2.

TABLE A-2

"WAIALUA II" IMPROVEMENTS COST ESTIMATE
PROPOSED SYSTEM

Conversion of Waialua Well II to a Production Well		
<u>Electrical</u>		
(Motor control center, electrical work, supervisory equipment)	\$	153,000
<u>Mechanical</u>		
(Pumps, piping & valves, instrumentation, flow metering, chlorination)		133,000
<u>Control Building</u>		
(On-site piping, concrete work for pump, venturi box)		140,000
<u>Site Work</u>		
(Road, grading, irrigation, chainlink fence, mute (acoustical work))		89,000
<u>12" Connection Main</u>		
(100 LF x \$95/LF)		10,000
<u>Telephone Circuit</u>		
(1350 LF x \$10/LF)		14,000
<u>Reservoir Liquid Level Control and Necessary Adjustments</u>		13,000
<u>Access Road - A.C. (Asphalt Concrete)</u>		
(8,600 LF x \$39/LF)	<u>335,000</u>	
		\$ 887,000
Waialua Reservoir II		
<u>1.0 MG Concrete Reservoir</u>		\$1,645,000
16" Transmission Main		
(14,600 LF x \$120/LF)		<u>\$1,752,000</u>
	SUBTOTAL	\$4,284,000
	20% CONTINGENCIES	<u>\$ 857,000</u>
	TOTAL	<u>\$5,141,000</u>

B. COST EVALUATION OF MOKULEIA-MAKAHA
TRANSMISSION MAIN AND RESERVOIR

APPENDIX B

COST EVALUATION OF MOKULEIA-MAKAHA TRANSMISSION MAIN AND RESERVOIR

I. INTRODUCTION

The purpose of this appendix is to document preliminary cost analyses conducted for the proposed transmission main which, if implemented, would convey excess water from the Waialua-Kahuku District to the Waianae District. In this regard, the relative merits of three alternative alignments for the water transmission line were evaluated:

- o Around the Waianae Mountain Range, along Kaena Point
- o Tunneling through the Waianae Range
- o Crossing over the Waianae Range

In addition to the transmission main, the system includes one or more reservoirs to facilitate operation of the system. The requirements for this reservoir are also discussed herein.

II. COMPARISON OF ALTERNATIVE ALIGNMENTS

A. General

The proposed transmission main would connect the BWS system in Waialua to the Makaha "242" system. On the Waialua side, the system would start at a reservoir with a probable capacity of 2.0 to 6.0 million gallons (mg). For preliminary costing purposes, it is assumed that a 6.0 mg reservoir would be required. While the location and elevation of the tank would need to be determined through engineering analysis, it shall be assumed for this analysis that the tank will be situated close to the Kawaihapai Well. The reservoir would probably be located between elevations of 300 to 600 feet, depending on the amount of energy required to convey the water to Makaha. Access road and appurtenant costs are further assumed to be a part of the Kawaihapai Well development cost.

The transmission main is assumed to tie into the Makaha system at the intersection of Water Street and Farrington Highway at an existing 24-inch main.

B. Alternatives

1. Alternative 1 - The Kaena Point Route

This alternative proposes to align the transmission main around the Waianae Mountain Range, along Kaena Point. Assuming the starting point of the transmission main is a 6.0 mg reservoir located in the vicinity of the proposed Kawaihapai Well, with connection to the Makaha system at Water Street, the total length of the transmission main would be approximately 90,000 lineal feet.

If it is assumed that a 24-inch concrete cylinder pipe is used, the capacity of the transmission main would be about 9.0 mgd. Approximate cost for the system (pipe and reservoir) would be on the order of \$29 million. If this cost is amortized over 25 years, at 10% interest, annual cost would be about \$3.2 million.

If it is further assumed that the 9.0 mgd is sold at a rate of \$0.98/1,000 gal., annual revenue would be approximately \$3.2 million, which would result in a payback period of 9.1 years.

If the first cost of \$29 million is amortized over 25 years, at 10% interest, the minimum flow required to meet this annualized cost, and make the project economically feasible is 9.0 mgd. If the service life of water pipes is 50 years, the annual revenue of \$3.2 million becomes net income beyond the 25-year payback period. Operating cost for this alternative is not considered since pumping is not anticipated under this alternative.

2. Alternative 2 - Waianae Range Tunnel

The difference between Alternative 2 and Alternative 1, the Kaena Point Route, is that Alternative 2 proposes to avoid Kaena Point by tunnelling through the Waianae Range. The alignment of the tunnel is not defined, but would be near Kaena Point, where the elevation of the Waianae Range is low. On this basis, it is estimated that the total length of the main would be on the order of 84,000 lineal feet. Of this total, it is assumed that the tunneled portion would be about 4,000 lineal feet in length.

Assuming a 24-inch concrete cylinder pipe is used, a transmission main capacity of 9.4 mgd is estimated. The total cost of this system (pipe, tunnel and reservoir) is estimated to be on the order of \$33.4 million. If this cost is amortized over 25 years, at 10% interest, annual cost would be about \$3.7 million.

Annual revenue projected to be generated based on \$0.98/1,000 gal. is \$3.34 million which would result in a payback period of 10.0 years. If the first cost of \$33.4 million is amortized over 25 years, at 10% interest, the minimum flow required to meet this annualized cost and make the project economically feasible is 10.3 mgd. If the service life of water pipes is 50 years, the annual revenue of \$3.34 million becomes net income beyond the 25-year payback period.

3. Alternative 3 - Trans-Waianae Range Corridor

This alternative would provide for an alignment which would cross over the Waianae Mountain Range. It is assumed to require lift stations at approximately 300-foot vertical intervals, with a tank at the summit.

Oahu's central plain is at an elevation of approximately 1,000 feet. Waianae Range elevations of about 1,000-feet are found within a mile of Kaena Point, where the Range slopes towards the ocean. The Waianae Range's highest elevation is the 4,020-foot high Mount Kaala.

Assuming a 1,000-foot "cross-over" elevation, this alternative would require approximately 84,000 lineal feet of pipe, three lift stations, and an additional tank at the summit. If a 24-inch concrete cylinder pipe is used, the capacity of the transmission main would be approximately 9.0 mgd. The total estimated capital cost for this alternative is \$31.1 million. This cost translates to an annual cost of \$3.4 million if amortized over 25 years, at a 10% interest rate. Annual revenue from the 9.0 mgd at \$0.98/1,000 gal. would be approximately \$3.2 million, with a payback period of 14.1 years.

In addition to the initial capital cost, an annual operating cost of \$1.0 million is estimated for pumping.

The total annual cost of \$4.4 million (\$3.4 million plus \$1.0 million) would require transmission of 11.5 mgd to generate revenues necessary to offset the annual payback for the first 25 years plus the operating cost, assuming it to be constant.

C. Summary and Conclusion

Table B-1 summarizes cost features associated with each of the three alternatives. Recognizing that assumptions used provide for only preliminary evaluation, results indicate that both Alternatives 1 (Kaena Point Route) and 2 (Waianae Range Tunnel) warrant further study.

TABLE B-1

COST COMPARISON AMONG ALTERNATIVE
TRANSMISSION MAIN ALTERNATIVES
(1987 Cost in Million Dollars)

<u>Alternative</u>	<u>Est. (mgd) Capacity</u>	<u>Total Cost</u>	<u>Annual Cost^a</u>	<u>Annual Revenue</u>	<u>Annual Operating Cost</u>	<u>Payback Period (years)</u>	<u>"Break Even" Flow(mgd)</u>
1	9.0	\$29.0	\$3.2	\$3.2	--	9.1	9.0
2	9.4	\$33.4	\$3.7	\$3.34	--	10.0	10.3
3	9.0 ^b	\$31.1	\$3.4	\$3.2	\$1.0	14.1	11.5

^aAssumes 25-year amortization period at 10% interest rate.

^b9.0 mgd assumed to determine pump size.

Under the given set of assumptions, Alternative 3, the Trans-Waianae Range Corridor, is least desirable given high and recurring annual pumping costs.

C. ARCHAEOLOGICAL SURVEYS AT PROPOSED WELL LOCATIONS*

- * Waialua Well II formerly known as Mokuleia Well I
Mokuleia Well I formerly known as Mokuleia Well II (250 feet elevation)

No archaeological reconnaissance conducted at present Mokuleia Well I site (200 feet elevation) located in sugar cane field
The Kawaihapai archaeological reconnaissance survey area may not encompass the entire Kawaihapai Alternate Well site vicinity.

WAIALUA-KAHUKU REGIONAL WATER SYSTEM IMPROVEMENTS
ARCHAEOLOGICAL SURVEYS AT PROPOSED WELL LOCATIONS

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JULY 1985

Introduction

During June 1985, archaeological reconnaissance surveys were performed at the locations of a series of existing and proposed Board of Water Supply wellsites on the windward coast of the island of Oahu. The purpose of the work was to locate and identify archaeological or historical remains which might be adversely affected by construction activities associated with the development of these wells. This report covers the proposed well at Kawaihapai, which is to be located on a slope approximately one mile inland of Dillingham Airfield at an elevation of approximately 300 feet [Figure 1].

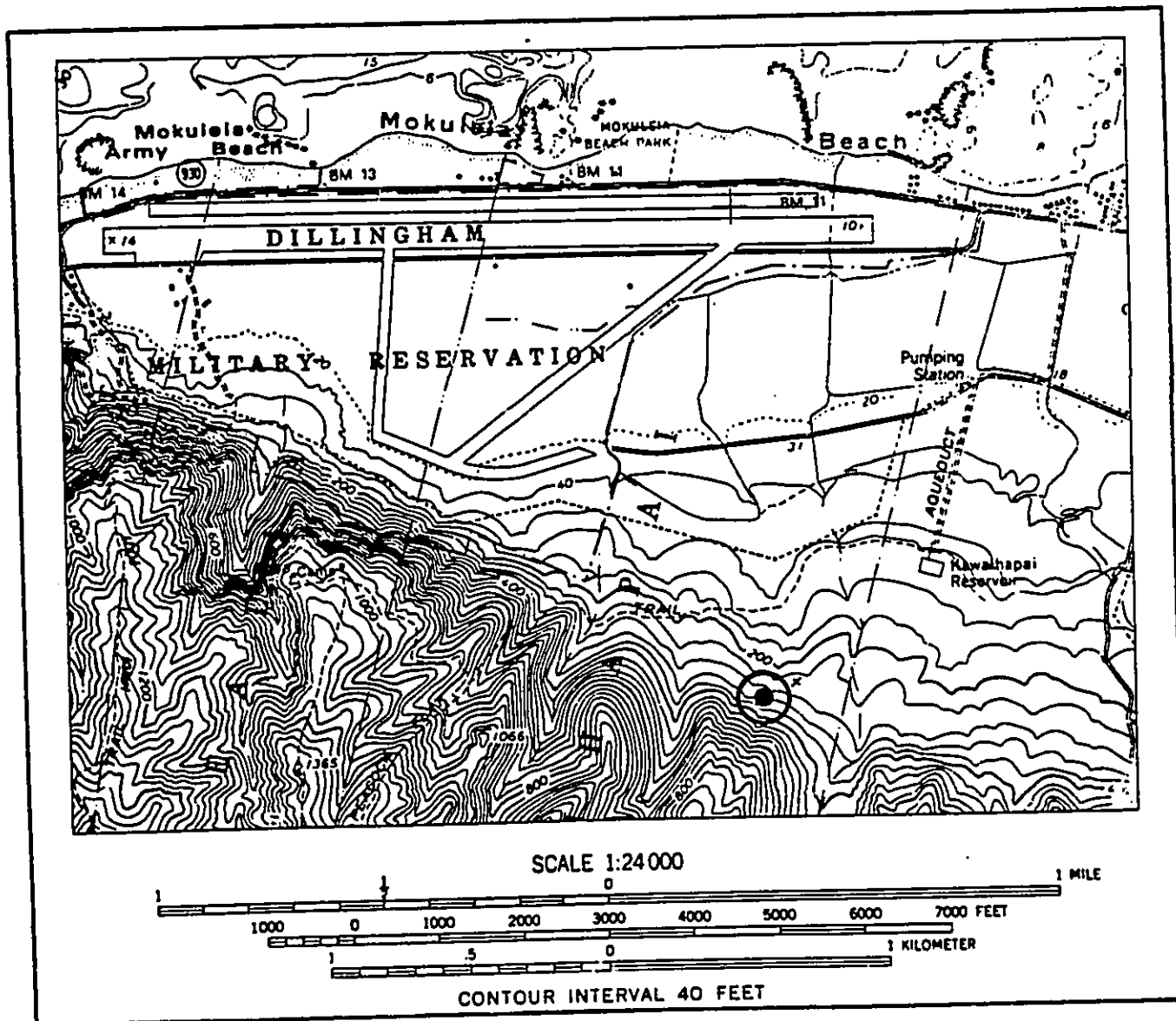


Figure 1. Location of Kawaihapai Wellsite.

Literature Search

Handy discussed agricultural sites in the Kawaihapai area in his 1940 publication:

"There is a sizable area of terraces in the lowlands [now surrounded by sugar cane], watered by Kawaihapai Stream. These terraces have evidently been lying fallow for some time, though several were being plowed for rice or taro in the summer of 1935. At the foot of the cliffs, watered by a stream the name of which was not learned, are several small terraces in which taro is grown by David Keaau. He says that taro cannot be grown in the lowlands, as salt water seeps in and sometimes flows in, mingling with the fresh water in the terraces and spoiling the taro. Above his inland terraces, along the base of the cliff and above the talus slope, grow three varieties of wild taro--all called Aweu--one white, one red like Kumu, and one striped black. I saw the first two varieties under the cliffs where the water-pipe intake begins, and I saw the third, said to have come from there, in the grounds of the Andrew Cox School" [Handy 1940:85].

McAllister described two sites in the vicinity of the proposed wellsite in his 1933 report. Judging from McAllister's map, the sites are located about one-half mile northwest of the proposed wellsite.

"Site 191. Kawailoa heiau, Kawaihapai.

"Only a portion of two terraces remains. The upper terrace is 66 feet long and 4 feet high, and is excellently paved with small stones a few inches in size. The southwest limits can not be discerned. On the east end is a wall 1.5 feet high which can be followed for about 10 feet. The lower terrace was 25 feet wide with a facing 2 feet high, which can only be traced a short distance. The houses [kahua hale] in which the kahunas lived were known as 'Paweo,' according to Hoonala. This is undoubtedly the site referred to by Thrum as Paweu, 'A small heiau 58 by 65 feet at the base of the hill; badly damaged by freshets.'"

"Site 192. Hidden waters, mountain side of Kawailoa heiau, Kawaihapai.

"These are the four hidden waters upon which Hiiaka called when she was refused water by the old inhabitants. Their names, as given by Hookala, are Ulunui, Koheiki, Ulehulu, and Waiakaaiea. Farther toward Kaena Point is another water known as Kawaikumuole, which is a conjunction of Kanaloa and Waihuna a Kaalai. Another hidden water, which Hookala says is mentioned in the Hiiaka chant, is Kuilaau o Kealia, but he does not know its location" [McAlister 1933:129].

Wall's 1900 map of Waiialua Agricultural Company land at Kamananui and Mokuleia indicates nothing at the site [State of Hawaii Survey Office 1900]. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.

Field Inspection

The field inspection revealed no archaeological or historical sites at the proposed well location.

Recommendations

Because of the absence of any archaeological or historical remains at the proposed Kawainapai wellsite, no further archaeological work is necessary. Construction of the pipeline through the lowlands should be monitored by an archaeologist to ensure that no sub-surface agricultural remains in that area are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin 104. Honolulu.

[This report presents the results of a selective archaeological survey of the island of Oahu.]

State of Hawaii, Department of Land and Natural Resources

USGS Quadrangle maps showing locations of archaeological and historical sites on Oahu.

State of Hawaii Survey Office

1900 Map of the Waialua Agricultural Company Lands at Kamanui and Mokuleia, Waialua, Oahu. Survey and Map by W. A. Wall. Registered Map No. 2054.

Sterling, Elspeth P. and Catherine C. Summers

1968 Sites of Oahu. Departments of Anthropology and Education, Bernice P. Bishop Museum. Honolulu.

[This is a compilation of information from numerous sources concerning the archaeological sites, history, traditions, legends, place names and land descriptions from the island of Oahu.]

MOKULEIA II: ARCHAEOLOGICAL SURVEY
AT PROPOSED WELL LOCATION

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JULY 1985

Introduction

During June 1985, archaeological reconnaissance surveys were performed at the locations of a series of existing and proposed Board of Water Supply well sites on the windward coast of the island of Oahu. The purpose of the work was to locate and identify archaeological or historical remains which might be adversely affected by construction activities associated with the development of these wells. This report covers the proposed well known as Mokuleia II, which is to be located on a ridge on the east side of Makaleha Stream at an elevation of approximately 250 feet [Figures 1 and 2].

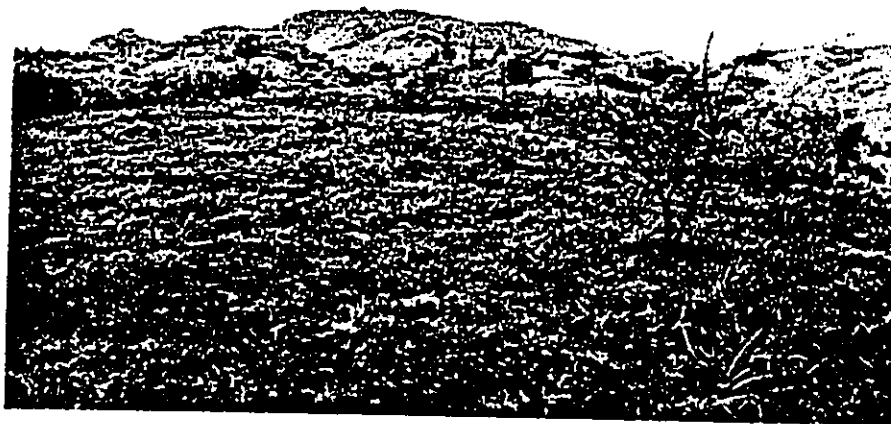


Figure 1. Mokuleia II Well site, Looking South.

Literature Search

Handy discussed agricultural sites in Mokuleia in his 1940 publication:

"There are two extensive old terrace areas in Mokuleia on the flatland near the sea. One is just below the Dillingham Ranch, watered by an underground flow from a gulch west of the ranch house. This area of old terraces is now entirely planted in Chinese bananas. The other large area, which is now planted mostly in bananas but partly in cane, is seaward of Makaleha Stream. Wild taro grows in Makaleha Valley and its subsidiaries. Kamakau [n.d.] speaks of the 'abundance of food grown in Maka-

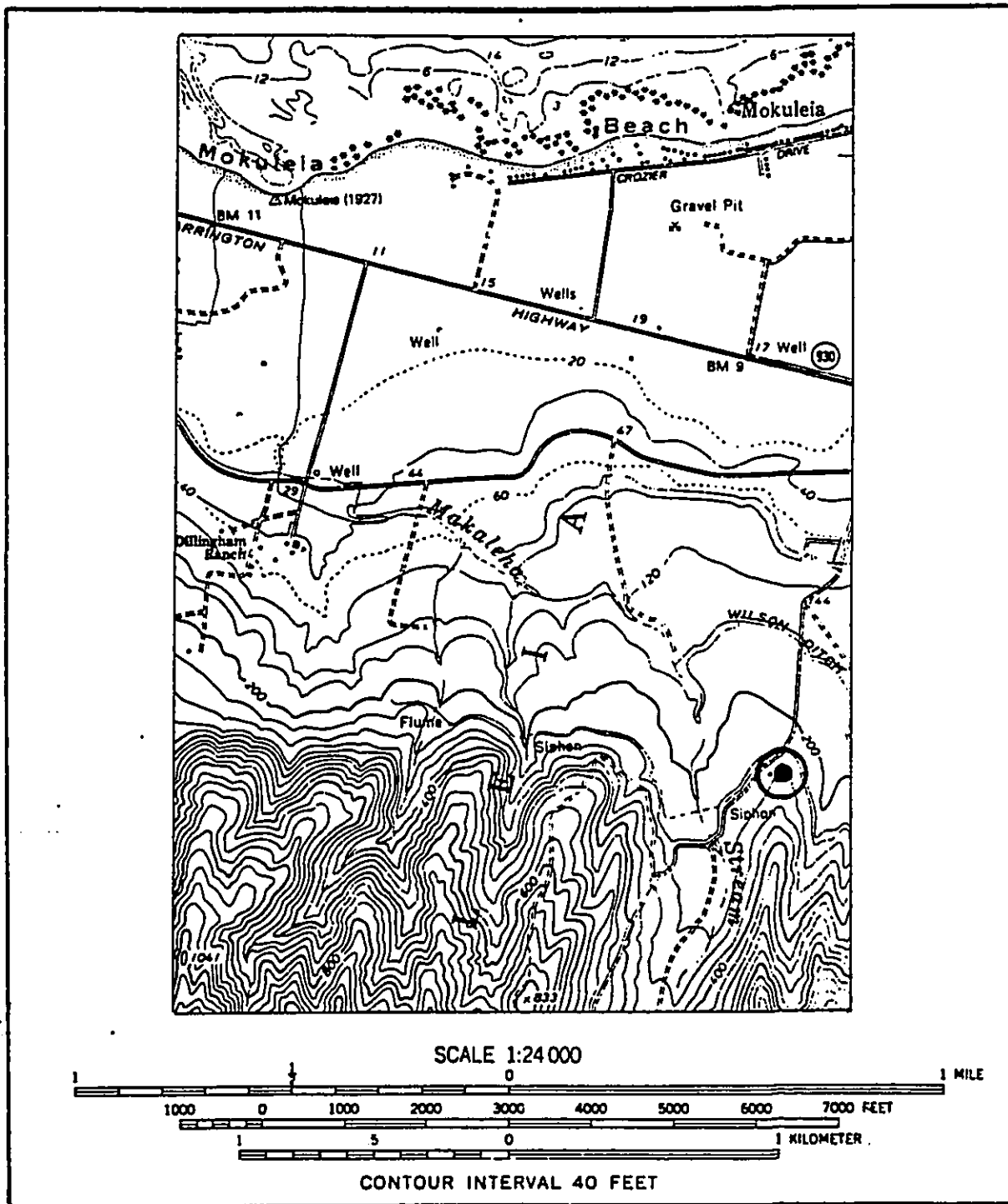


Figure 2. Location of Mokuleia II Wellsite.

leha, of the kihi and lapa varieties of taro, of sweet potatoes, awa, bananas..." [Handy 1940:85].

McAllister mentioned a site about one-half mile west of the proposed well location in his 1933 study:

"Site 196. Village site, Mokuleia.

"In the valley near the mountain side of the Greenfield house was once evidently a large Hawaiian settlement. Old coconut palms and the dead trunks of others, portions of house sites, isolated sections of terracing, can still be found, despite the inroads of roaming cattle. Water fresnets have also obliterated many remains. These sites are thought to have furnished the stones for the numerous walls, probably of later construction, on the hillside and in the valley" [McAllister 1933:129].

Wall's 1900 map of Waialua Agricultural Company land at Kamananui and Mokuleia shows a "pen," probably for livestock, 200 feet north of the proposed wellsite [State of Hawaii Survey Office 1900]. Maps from the State Historic Preservation Office indicate no sites in the vicinity.

Field Inspection

The field inspection revealed no archaeological or historical sites at the proposed well location.

Recommendations

Because of the absence of any archaeological or historical remains at the proposed Mokuleia II wellsite, no further archaeological work is necessary. Pipeline construction through the lowlands should be monitored by an archaeologist to ensure that no sub-surface agricultural remains in that area are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop Museum Bulletin 161. Honolulu.

Kamakau, Samuel M.

n.d. Extracts from Kuokoa, weekly newspaper in Hawaiian [translated by T. G. Thrum], ms. in B. P. Bishop Museum.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin 104. Honolulu.

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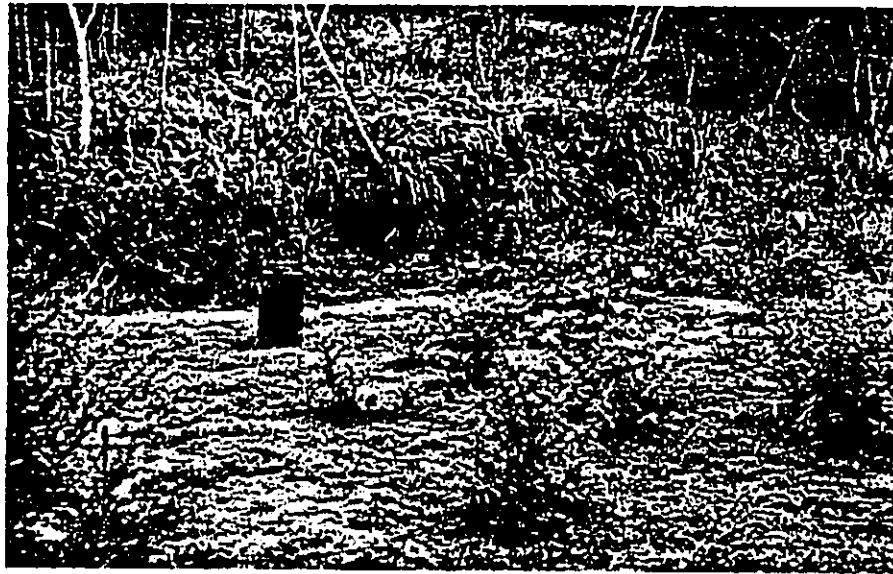


Figure 1. Mokuleia I Wellsite, Looking South.

Literature Search

McAllister reported three sites in the vicinity:

"Site 198. Burial cave, Kaumoku Gulch, Waialua.

"Powdered skeletal material was noticed on the side of a cliff beneath several very small caves. Upon examination portions of two skeletons were found in a lava tube whose entrance was so cleverly sealed that the material would not have been discovered had there not been a hole into a lower cave larger than a man's head. From the inside, light was noticed through the cracks of the rocks, and the entrance then discovered. No mortar had been us-

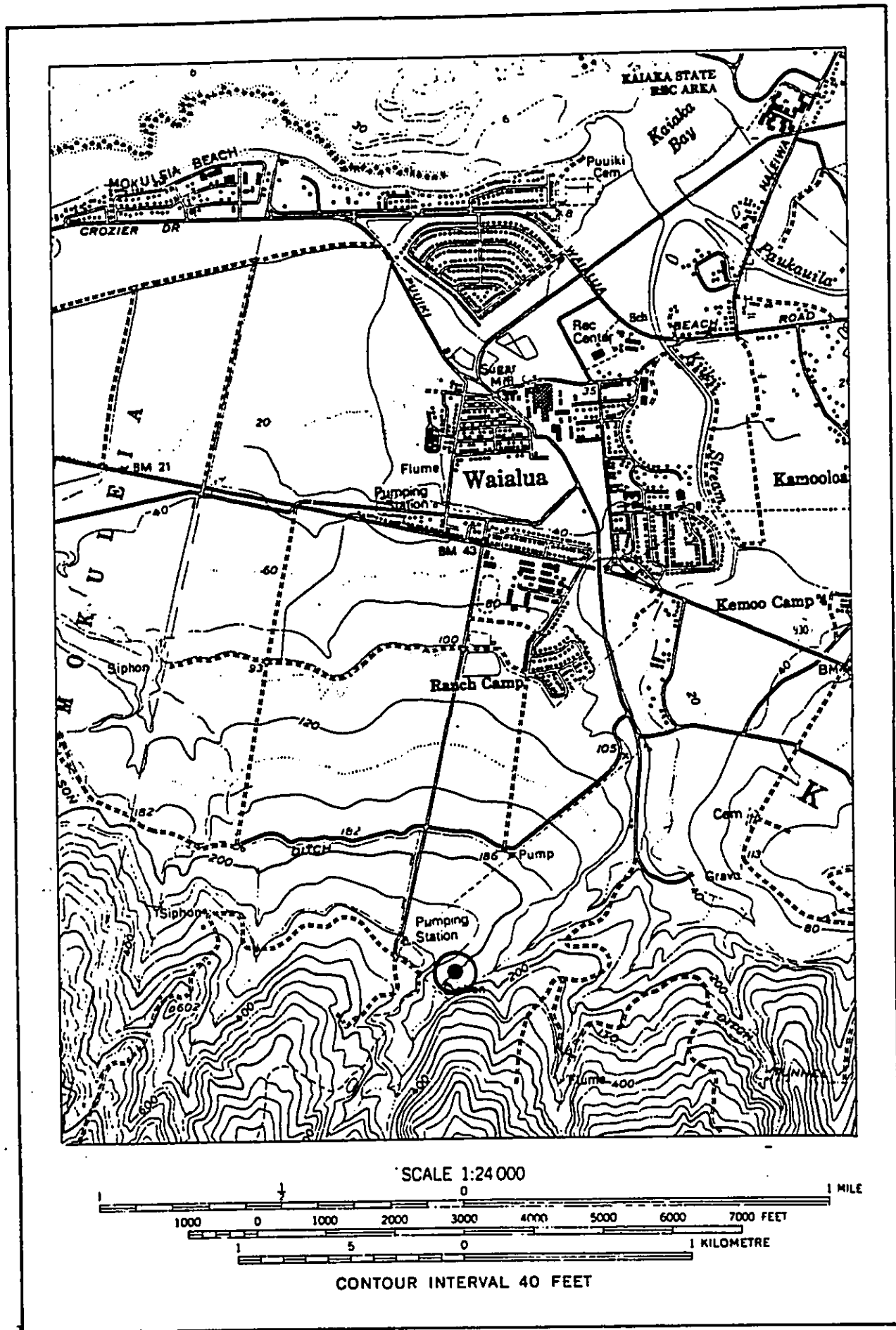


Figure 2. Location of Mokuleia I wellsite.

ed, but sharp-edged rocks had been carefully fitted together. There were no artifacts with the burial. The bones had probably been bundled together, but had evidently been disturbed by animals, as several had been recently gnawed. There was one skull but no mandible, one humerus, one radius, two ulnas, four femurs, three tibiae, and many fragments.

"Site 199. Piles of stones, near the mouth of Kaumoku Gulch, Waialua.

"Near the mountain side of the siphon put in in 1930 by the Waialua Agricultural Company are many piles of stones which, as I was told by Mr. Low, who is of the opinion that they are old Hawaiian, were there 24 years ago when cane was first planted on this land. The largest pile is oval in shape, 28 by 15.5 feet by 7 feet high. There are six piles in a group averaging from 50 to 200 feet apart, evenly faced but with the top comparatively level. Just west of this group are a number of stone walls and one or two small inclosures. The whole site is in the mouth of the gulch. The stones may have been cleared away for agricultural purposes before the plantation took over the land. A large field on the mountain side and east of the Dillingham ranch which had also formerly been planted in cane has similar mounds of stone. I was told that these stones were there in 1908 when the plantation took over the land. Hookala says they were piled in this manner to clear the land for agricultural purposes.

"Site 200. Cave in Kaumoku Gulch, Kamananui, Waialua.

"At present one can squirm about 200 feet into the interior but comes in contact with large stones which obstruct the passage. It is believed that in the construction of the water tunnel just above, the blasting dislocated these stones. Water also constantly drips from the roof making shallow pools in the passageway. Twenty years or more ago the cave is said to have contained skeletal material, though there is no evidence now of such remains, which undoubtedly would have decayed with so much moisture" [McAllister 1933:130-1].

Inspection of early maps on file at the State of Hawaii Survey Office [1892, 1900] revealed nothing of historical or archaeological interest at the wellsite, and Sterling and Summers [1968] have nothing to add beyond what had already been reported by McAllister. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.



Figure 3. McAllister's Site 199: Face of Stone Mound, Looking West.

Field Inspection

The large stone mounds reported by McAllister as Site 199 are located immediately adjacent to the existing well [Figure 3]. The entrance to a small cave, which might be McAllister's Site 200, is located in the hillside adjacent to the well. Because of the difficulty of access, the cave interior was not inspected.

Recommendations

The wellsite itself has already been developed, so there is no need for further archaeological work there. However, the pipeline route should be designed so as to avoid the large stone mounds of Site 199, and its construction should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop
Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin
104. Honolulu.

[This report presents the results of a selective arch-
aeological survey of the island of Oahu.]

State of Hawaii, Department of Land and Natural Resources

USGS Quadrangle maps showing locations of archaeo-
logical and historical sites on Oahu.

State of Hawaii Survey Office

1892 Kawaihoa, Paalaa and Kamananui, Waialua, Oahu. Map
compiled from maps of Rev. John S. Emerson with
additions from W. E. Rowell, by J. S. Emerson, March
1892.

1900 Map of the Waialua Agricultural Company Lands at Kama-
nanui and Mokuleia, Waialua, Oahu. Survey and Map by
W. A. Wall. Registered Map No. 2054.

Sterling, Elspeth P. and Catherine C. Summers

1968 Sites of Oahu. Departments of Anthropology and Educa-
tion, Bernice P. Bishop Museum. Honolulu.

[This is a compilation of information from numerous
sources concerning the archaeological sites, history,
traditions, legends, place names and land descriptions
from the island of Oahu.]

UKOA, OAHU: ARCHAEOLOGICAL SURVEY
AT PROPOSED WELL LOCATION

Prepared for:

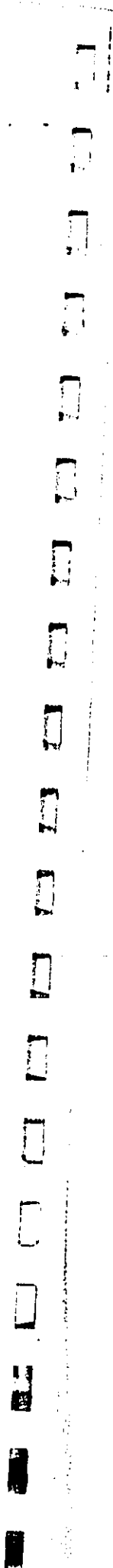
WILSON OKAMOTO AND ASSOCIATES
1150 South King Street
Honolulu, Hawaii 96814

Prepared by:

William Barrera, Jr.

CHINIAGO INC.
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JULY 1985



Introduction

During June 1985, archaeological reconnaissance surveys were performed at the locations of a series of existing and proposed Board of Water Supply wellsites on the windward coast of the island of Oahu. The purpose of the work was to locate and identify archaeological or historical remains which might be adversely affected by construction activities associated with the development of these wells. This report covers the proposed well at Ukoa which is to be located in a canefield adjacent to Kawaihoa Road at an elevation of approximately 180 feet [Figures 1 and 2].

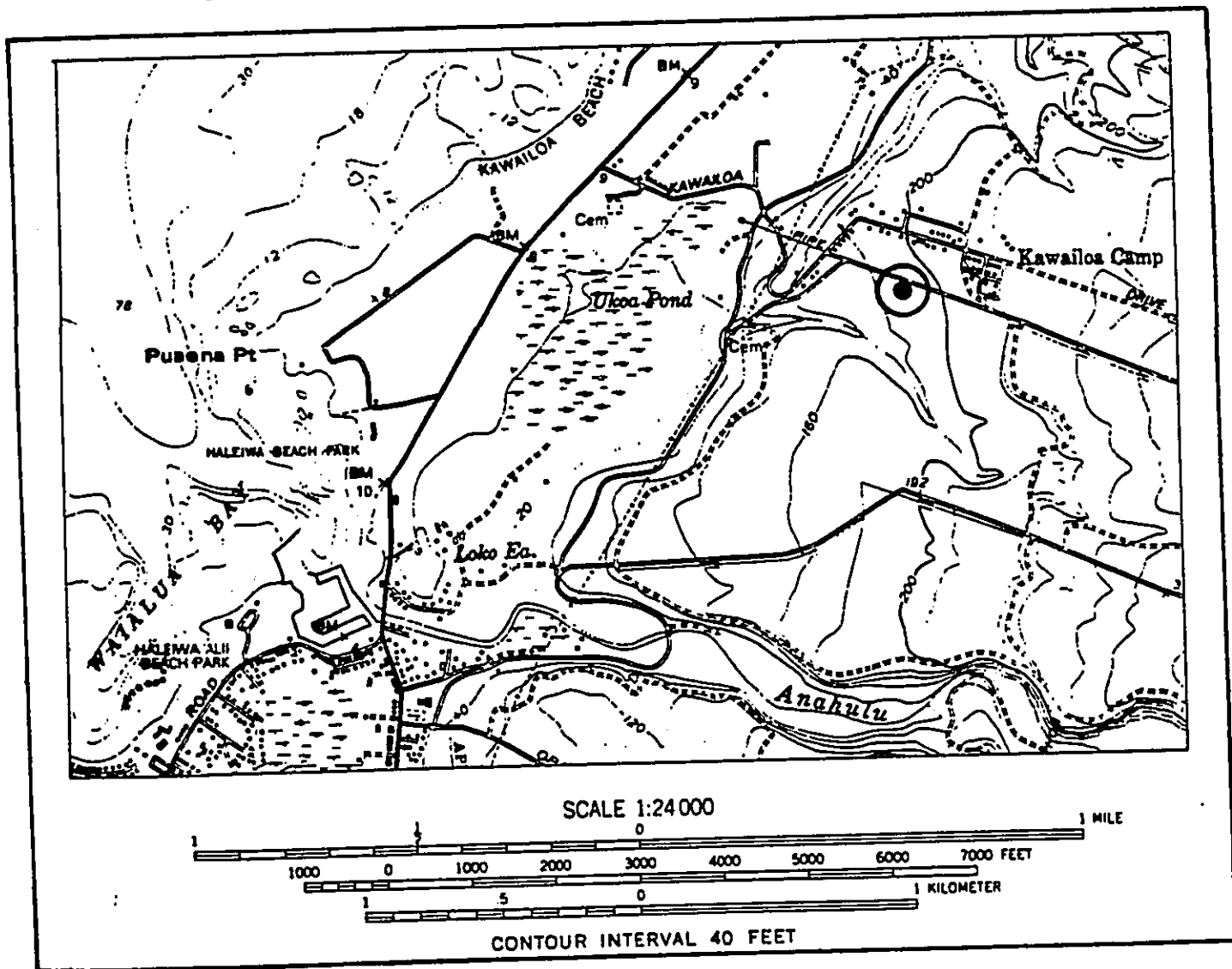


Figure 1. Location of Ukoa Well site.



Figure 2. Ukoa Wellsite, Looking Southeast.

Literature Search

Handy discusses agricultural sites in the adjacent valleys, but mentions nothing in the vicinity of the wellsite:

"Kawailoa. This ahupua'a included the extensive terrace areas north of the Waialua River, along the level land north and south of Ananulu River, in the lower part of Anahulu Gulch, and in the swampy land east of Puena point. [This swampy land apparently gave the district its name.] In Ananulu Gulch small flats with old mango trees, indicating kuleana, were observed several miles inland, and I am told that small areas were cultivated far up the gulch. Wild taros were seen in the side gulch at least 5 miles inland. The dry gulches between Anahulu and Waimea Streams probably never watered taro" [Handy 1940:86].

McAllister discussed Ukoa Fishpond, one-half mile west of the wellsite:

"Site 236. Ukoa fishpond, Waialua.

"One of the two waialua ponds; still in use. It is a long narrow fresh-water pond, approximately a mile in length. Most of it now overgrown with weeds. Laniwahine was the goddess

[moo] of Ukoa and lived there with her brother Puniula. Between the pond and the sea was a tunnel through which Laniwahine passed when she wished to bathe in the ocean. Offerings were left for her on a stone, located near Pump Number 4 of the Waialua Agricultural Company. The site of this stone was marked for many years by a dead tree which was not removed because of its association with Laniwahine. Now neither stone nor tree is to be found.

"This is the pond to which Lehuanui was sent by Oahunui to obtain fish. Here Lehuanui and his retainers found 'the fish packed thick at the makaha and were soon busily engaged in scooping out, cleaning and salting them" [McAllister 1933:142].

Kamakau also discussed legends associated with Ukoa Pond:

"Laniwahine was the guardian of Uko'a at Waialua, and Uko'a was regarded as the long house where she lived. She was a native of Uko'a and all her deeds centered about that place. The natives of Uko'a never failed to recognize her deeds, but few of her descendants are now left or perhaps none. Uko'a was a very strange fish pond in which lived extraordinary fishes. A fish might be a kumu fish on one side and on the other side a mullet; or on one side weke pueo and on the other mullet; or one side might be silver white like a white cock; when scaled the skin might be striped and variegated inside. It was clear to all her descendants that these strange fish belonged to Laniwahine and it was not right to eat them. But the mullet of Uko'a were full of fat when, as in all such ponds, the native guardian of the pond was remembered; [at other times] the fish had thin bodies and heads like wood or sometimes disappeared altogether" [Kamakau n.d.:47].

Neither a map drawn by Jackson in October of 1884 nor one by Wall done in 1901 [State of Hawaii Survey Office 1884, 1901] show anything in the vicinity of the wellsite. The same negative results were obtained by inspecting site maps from the State Historic Preservation Office.

Field Inspection

The field inspection revealed that the proposed wellsite is in a field of sugarcane. No archaeological or historical remains were observed.

Recommendations

As no archaeological or historical remains were found at the proposed wellsite, no further archaeological work is necessary there. The construction of the pipeline should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop Museum Bulletin 161. Honolulu.

Kamakau, Samuel M.

n.d. "Ka Moololo o Hawaii." Based on articles written for the newspapers Kuokoa and Ke Au Okoa, translated and edited by Martha Beckwith and Mary K. Pukui. Ms. on file at Bernice P. Bishop Museum, Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin 104. Honolulu.

[This report presents the results of a selective archaeological survey of the island of Oahu.]

State of Hawaii, Department of Land and Natural Resources

Site records, site maps and archaeological survey and excavation reports on file at the Historic Sites Section.

State of Hawaii Survey Office

1884 Waialua Bay, Oahu. Surveyed and Drawn by Jackson, October 1884. Reg. Map No. 1346.

1901 Map Showing Lands of the Waialua Agricultural Co. Ltd., Kawaiiloa Section, Waialua, Oahu. Map by W. A. Wall.

Sterling, Elspeth P. and Catherine C. Summers

1968 Sites of Oahu. Departments of Anthropology and Education, Bernice P. Bishop Museum. Honolulu.

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KAWAILOA, OAHU: ARCHAEOLOGICAL SURVEY
AT PROPOSED WELL LOCATION

Prepared for:

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JULY 1985

Introduction

During June 1985, archaeological reconnaissance surveys were performed at the locations of a series of existing and proposed Board of Water Supply wellsites on the windward coast of the island of Oahu. The purpose of the work was to locate and identify archaeological or historical remains which might be adversely affected by construction activities associated with the development of these wells. This report covers the proposed well at Kawaihoa, which is to be located adjacent to Ashley Road at an elevation of approximately 400 feet [Figures 1 and 2].



Figure 1. Kawaihoa Wellsite Looking South.

Literature Search

Handy discusses agricultural sites in the adjacent valleys, but mentions nothing in the vicinity of the wellsite:

"Kawaihoa. This ahupua'a included the extensive terrace areas north of the Waialua River, along the level land north and south of Anahulu River, in the lower part of Anahulu Gulch, and in the swampy land east of Puena point. [This swampy land apparently gave the district its name.] In Anahulu Gulch small flats with old mango trees, indicating kuleana, were observed several miles inland, and I am told that small areas were cultivated far up the gulch. Wild taros were seen in the side gulch at least 5

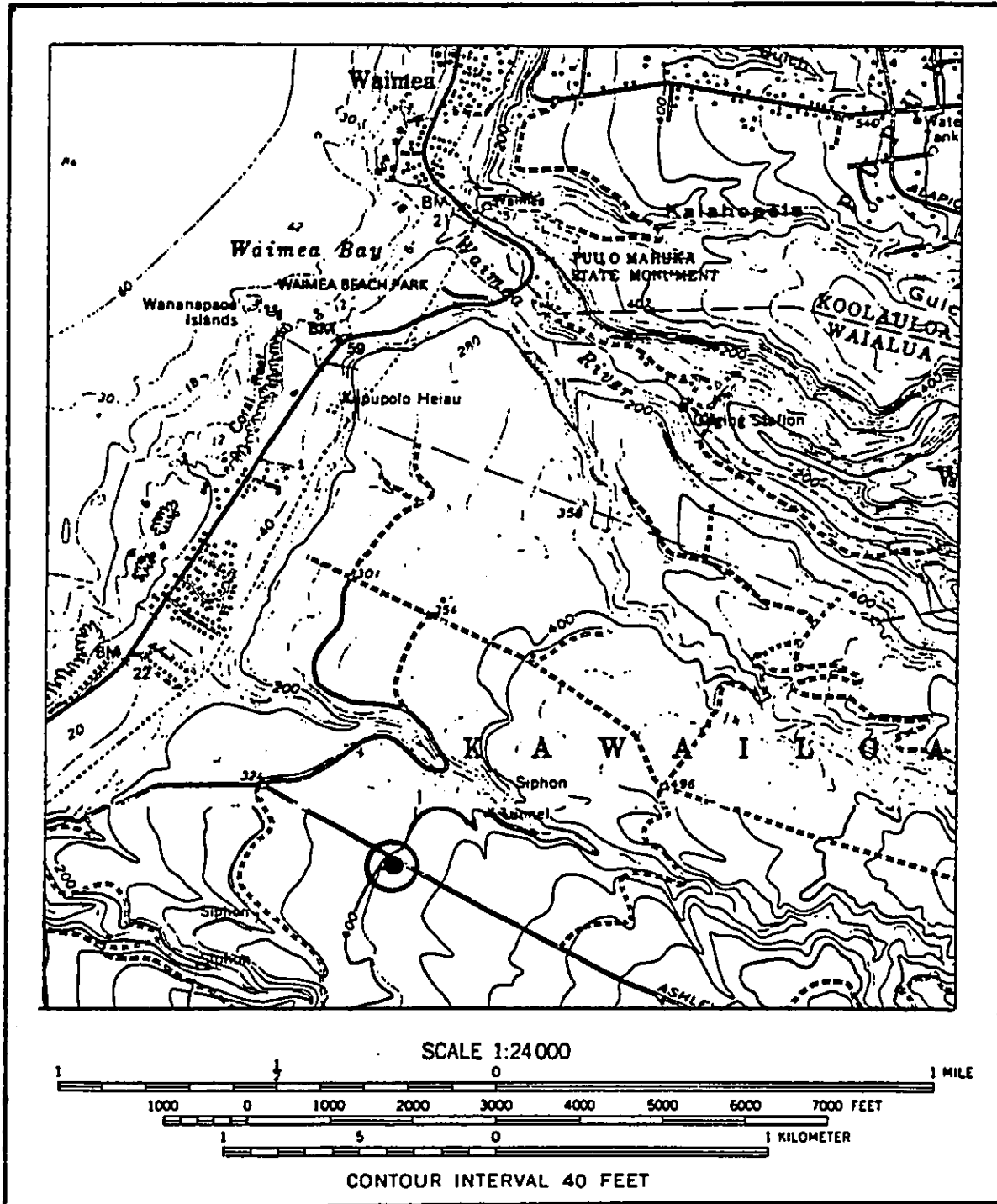


Figure 2. Location of Kawailoa Well site.

miles inland. The dry gulches between Anahulu and Waimea Streams probably never watered taro" [Handy 1940:86].

Neither Sterling and Summers [1968] nor McAllister [1933] mention any sites in the vicinity, and a 1901 Waialua Agricultural Company Map [State of Hawaii Survey Office 1901] shows nothing near the site. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.

Field Inspection

The field inspection revealed that the proposed wellsite is in a field of sugarcane. No archaeological or historical remains were observed.

Recommendations

As no archaeological or historical remains were found at the proposed wellsite, no further archaeological work is necessary there. The construction of the pipeline should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop
Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin
104. Honolulu.

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State of Hawaii Survey Office

1901 Map Showing Lands of the Waialua Agricultural Co.
Ltd., Kawaiiloa Section, Waialua, Oahu. Map by W. A.
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WAIMEA, OAHU: ARCHAEOLOGICAL SURVEY
AT PROPOSED WELL LOCATION

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JULY 1985

Introduction

During June 1985, archaeological reconnaissance surveys were performed at the locations of a series of existing and proposed Board of Water Supply wellsites on the windward coast of the island of Oahu. The purpose of the work was to locate and identify archaeological or historical remains which might be adversely affected by construction activities associated with the development of these wells. This report covers the proposed well at Waimea, which is to be located adjacent to a cane haul road at an elevation of approximately 500 feet [Figures 1 and 2].

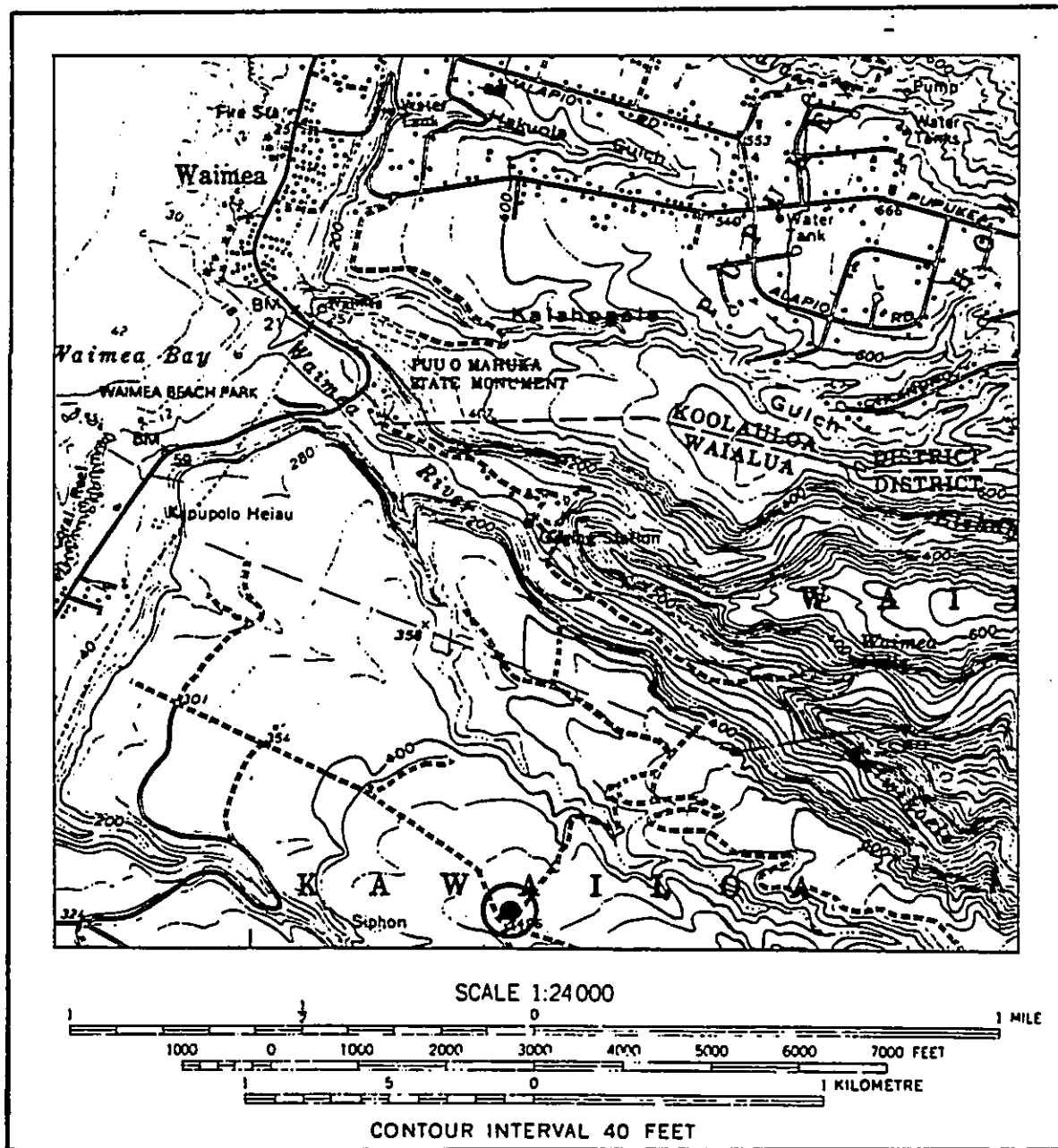


Figure 1. Location of Waimea Wellsite.



Figure 2. Waimea Well site, Looking South.

Literature Search

Handy mentioned the area southwest of Waimea Valley in his publication on agricultural practices of Oahu:

"Kawailoa. This anupua'a included the extensive terrace areas north of the Waialua River, along the level land north and south of Anahulu River, in the lower part of Anahulu Gulch, and in the swampy land east of Puena point. [This swampy land apparently gave the district its name.] In Anahulu Gulch small flats with old mango trees, indicating kuleana, were observed several miles inland, and I am told that small areas were cultivated far up the gulch. Wild taros were seen in the side gulch at least 5 miles inland. The dry gulches between Anahulu and Waimea Streams probably never watered taro" [Handy 1940:86].

No information about the vicinity of the proposed well site was found in McAllister [1933] or Sterling and Summers [1968]. An 1884 map of Waimea Bay by Jackson and Wall's 1901 map of Waialua Agricultural Company land [State of Hawaii Survey Office 1884, 1901] show nothing in the vicinity of the well site. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.

Field Inspection

The field inspection revealed that the proposed well-site is in a field of sugarcane. No archaeological or historical remains were observed.

Recommendations

As no archaeological or historical remains were found, no further archaeological work is necessary at the Waimea wellsite itself. The construction of the pipeline should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop
Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin
104. Honolulu.

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State of Hawaii, Department of Land and Natural Resources

Site records, site maps and archaeological survey and
excavation reports on file at the Historic Sites Sec-
tion.

State of Hawaii Survey Office

1884 Waimea Bay, Oahu. Surveyed and Drawn by Jackson, Oc-
tober 1884. Reg. Map No. 1344.

1901 Map Showing Lands of the Waialua Agricultural Co.
Ltd., Kawaihoa Section, Waialua, Oahu. Map by W. A.
Wall.

Sterling, Elspeth P. and Catherine C. Summers

1968 Sites of Oahu. Departments of Anthropology and Educa-
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OPANA, OAHU: ARCHAEOLOGICAL SURVEY
AT PROPOSED WELL LOCATION

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JULY 1985

Introduction

During June 1985, archaeological reconnaissance surveys were performed at the locations of a series of existing and proposed Board of Water Supply wellsites on the windward coast of the island of Oahu. The purpose of the work was to locate and identify archaeological or historical remains which might be adversely affected by construction activities associated with the development of these wells. This report covers the existing well at Opana, which is located at the base of a bluff one half mile inland of Kawela Bay at an elevation of approximately 150 feet [Figures 1 and 2].



Figure 1. Opana Wellsite Looking West.

Literature Search

Handy discussed Opana in his publication on Hawaiian agricultural practices on the island of Oahu:

"Opana. Touching Opana and extending into Hanakoa [sic] was a small spring-watered terrace area, named Kawela [same name as the bay].

"McAllister says that according to legends told him by his informants there was 'formerly' no fresh water at Kawela Bay [in Opana] but that the gods Kane and Kanaloa struck water from a rock now 'known as Waikane, and at the foot of the cliff in the land Hanakoa [sic]', and that water 'continued to flow up to the time the

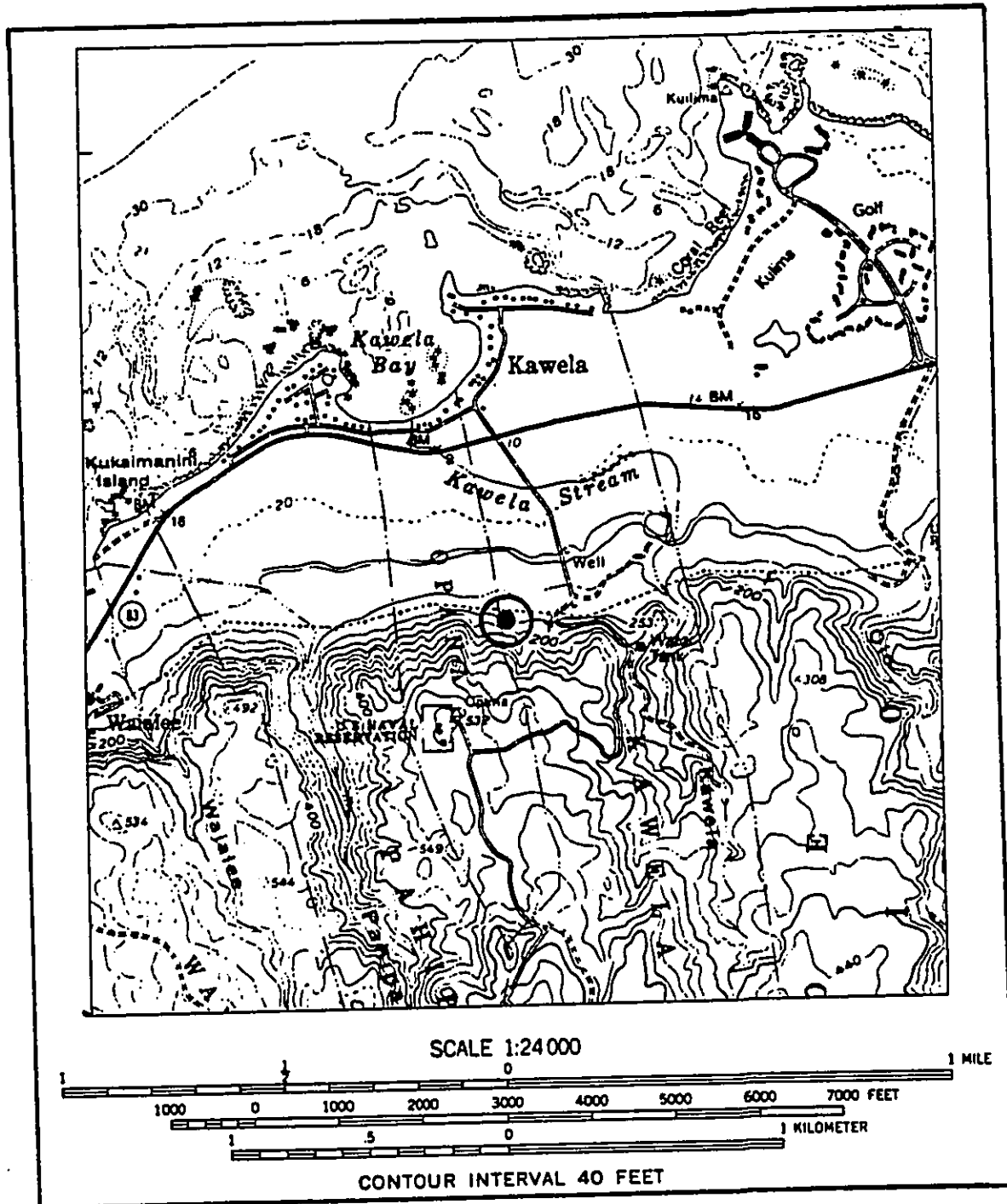


Figure 2. Location of Opana Well site.

plantation built a pump just below the rock"
[Handy 1940:88].

McAllister reported legendary information relevant to the Opana area:

"Site 259. Large stone, known as Waikane, beside the stream bed on the mountain side of Kewala [sic] Bay and at the foot of the palis in the land Hanakaoe.

"Long ago the Hawaiians had to go far up the valley in order to get fresh water, but when Kane struck the stone water flowed from it and continued to flow up to the time the plantation built a pump just below the rock [McAllister 1933:152].

Inspection of Maps #3 and #4 of the Kahuku Plantation, surveyed in 1890 by Loepenstein [State of Hawaii Survey Office 1890], revealed no historical remains at the location of the wellsite. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.

Field Inspection

The field inspection revealed that there are no historical or archaeological remains at the wellsite.

Recommendations

The Opana wellsite itself has already been developed, so there is no need for further archaeological work there. The construction of the pipeline should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin 104. Honolulu.

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State of Hawaii, Department of Land and Natural Resources

Site records, site maps and archaeological survey and excavation reports on file at the Historic Sites Section.

State of Hawaii Survey Office

1890 Map No. 3 of the Kahuku Plantation, Koolauloa, Oahu. Map and Survey by M. Loebenstein.

1890 Map No. 4 of the Kahuku Plantation, Koolauloa, Oahu. Map and Survey by M. Loebenstein.

Sterling, Elspeth P. and Catherine C. Summers

1968 Sites of Oahu. Departments of Anthropology and Education, Bernice P. Bishop Museum. Honolulu.

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KAWELA, OAHU: ARCHAEOLOGICAL SURVEY
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Introduction

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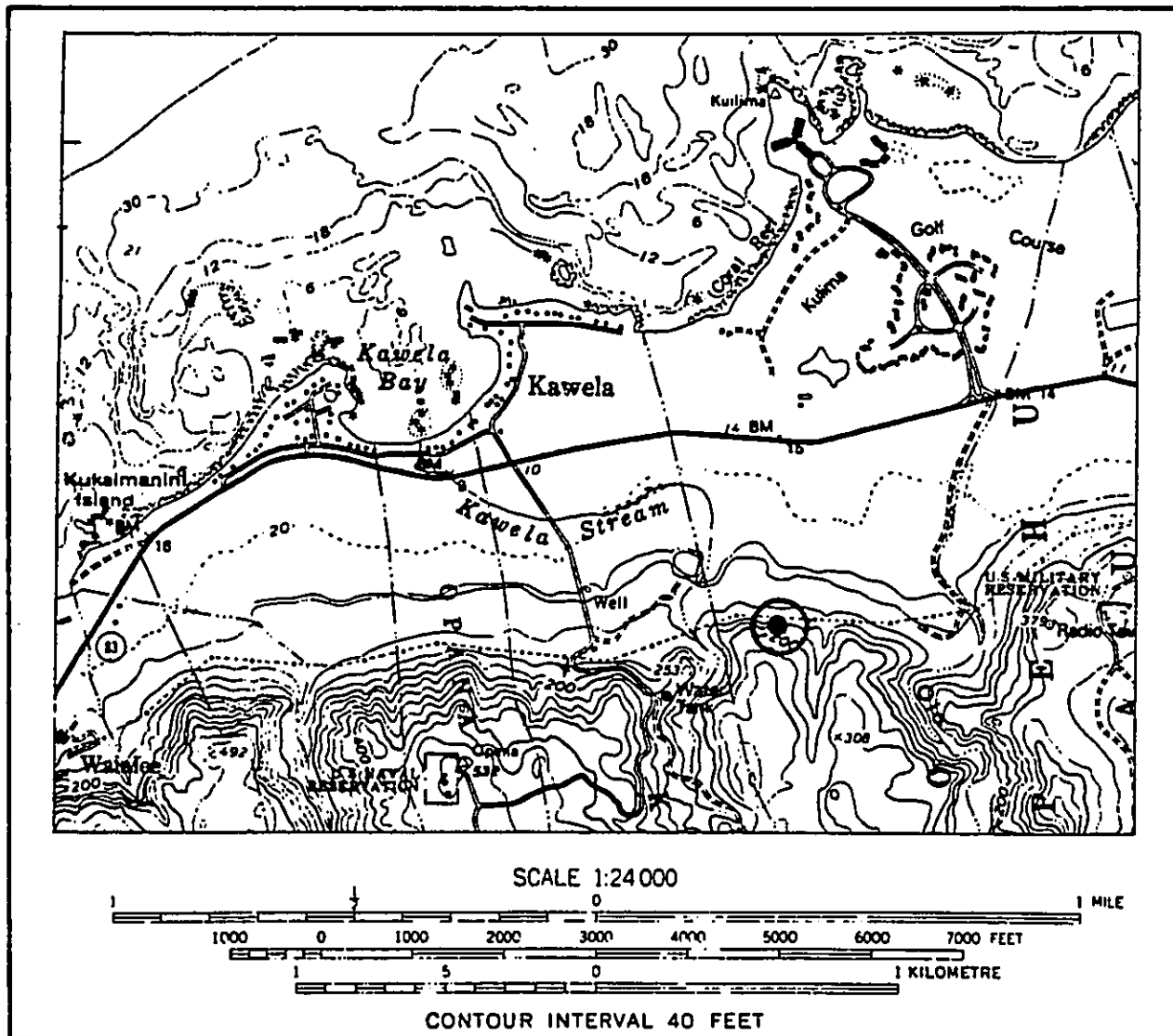


Figure 1. Location of Kawela Wellsite.

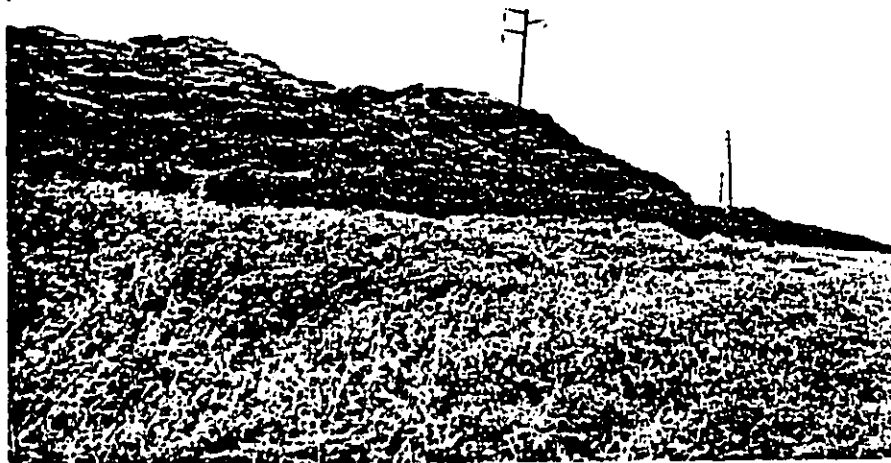


Figure 2. Kawela Wellsite, Looking Southwest.

Literature Search

No information about the vicinity of the proposed wellsite was found in McAllister [1933], Handy [1940], or Sterling and Summers [1968]. Inspection of Map #3 of the Kahuku Plantation, surveyed in 1890 by Loebenstein [State of Hawaii Survey Office 1890], revealed no historical remains at the location of the proposed wellsite. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.

Field Inspection

The field inspection revealed that there are no historical or archaeological remains at the proposed wellsite.

Recommendations

As no archaeological or historical remains were found, no further archaeological work is necessary at the Kawela wellsite itself. The construction of the pipeline should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

Sources Consulted

Handy, E. S. Craghill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

1933 Archeology of Oahu. Bernice P. Bishop Museum Bulletin 104. Honolulu.

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1890 Map No. 3 of the Kanuku Plantation, Koolauloa, Oahu. Map and Survey by M. Loebenstein.

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HANAKAOE, OAHU: ARCHAEOLOGICAL SURVEY
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Literature Search

No information about the vicinity of the site was found in McAllister [1933], Handy [1940], or in Sterling and Summers [1968]. Inspection of Maps #2 and #3 of the Kahuku Plantation, surveyed in 1890 by Loebenstein [State of Hawaii Survey Office 1890], revealed that the proposed well site is outside of the areas covered by those maps. Maps from the State Historic Preservation Office also indicate no sites in the vicinity.

Field Inspection

The field inspection revealed that the proposed well site has already been extensively landscaped, and that no archaeological or historical remains are present.

Recommendations

As no archaeological or historical remains were found, no further archaeological work is necessary at the Hanakaoe well site itself. The construction of the pipeline should be monitored by an archaeologist to ensure that no sub-surface remains are destroyed without first being studied.

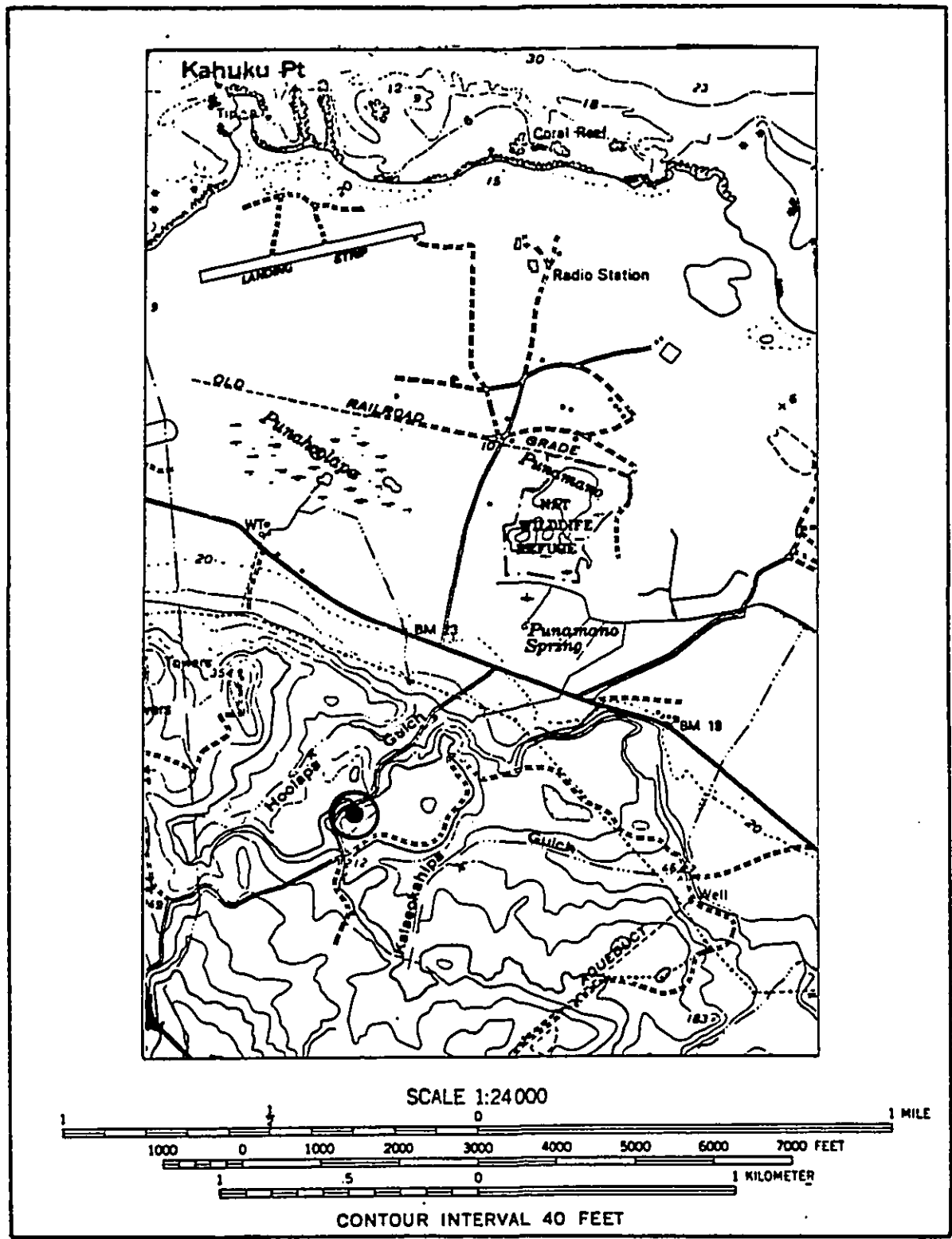


Figure 1. Location of Hanakaoe wellsite.

Sources Consulted

Handy, E. S. Craighill

1940 The Hawaiian Planter. Volume I. Bernice P. Bishop
Museum Bulletin 161. Honolulu.

McAllister, J. Gilbert

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D. BOTANICAL SURVEY*

- * Waialua Well II formerly known as Mokuleia Well I
- Mokuleia Well I formerly known as Mokuleia Well II (250 feet elevation)
- Mokuleia Well I site located in sugar cane field (200 feet elevation)
- The Kawaihapai Well botanical survey area may not encompass the entire Kawaihapai Alternate Well site vicinity.

WAIALUA-KAHUKU REGIONAL EIS
BOTANICAL SURVEY

PREPARED FOR WILSON OKAMOTO AND ASSOCIATES, INC.

KENNETH M. NAGATA

2 JULY 1985

INTRODUCTION AND METHODS

Nine localities on the north shore of Oahu in the Waialua-Kahuku region were selected by the Board of Water Supply as potential well sites. Three of these are in the Waianae Mountains and six are in the Koolau Mountains. All are approximately 0.5 acres in size and are situated in sugar cane fields, pastures or in waste places far from forest reserves. Walk-through surveys were conducted during June 1985 to determine the vegetational composition of these sites. Special attention was given to rare and endangered species.

RESULTS

INTRODUCTION

The classification of the vegetation zones employed in this study are those of Ripperton and Hosaka (1942). The taxonomy follows that of St. John (1973).

MOKULEIA I

The study site is situated in a ravine at 200' elevation near Kamananui, Waialua District, Waianae Mountains. The slopes of the ravine are dominated by stands of koa-haole (Leucaena leucocephala) with groves of Java plum (Eugenia cumini), ironwood (Casuarina equisetifolia) and swamp mahogany (Eucalyptus robusta). The bottom is mostly dominated by guinea grass (Panicum maximum) and koa-haole with occasional Christmas berry (Schinus terebinthifolius), Trema occidentalis and Java plum. Ripperton and Hosaka have classified the vegetation in the region as xerophytic shrub with trees in the upper part (zone B). According to their scheme the characteristic species of this zone include lantana (Lantana camara), koa-haole, klu (Acacia farnesiana), 'uhaloa (Waltheria americana), 'ilima (Sida fallax) and false mallow (Malvastrum coromandelianum).

A wide section of a secondary access road comprises a significant portion of the study site. Typical roadside adventives such as false mallow, 'uhaloa,

synedrella (Synedrella nodiflora), ageratum (Ageratum conyzoides), spiny amaranth (Amaranthus spinosus), sensitive plant (Mimosa pudica), Cuphea carthagenensis, Galinsoga ciliata, beggar's tick (Bidens pilosa), Crassocephalum crepidioides, indigo (Indigofera suffruticosa), goosegrass (Eleusine indica) and bermuda grass (Cynodon dactylon) dominate this portion. The remainder of the site is situated on the lower slope of the ravine and dominated by koa-haole up to 18' tall with scattered emergent Java plum 20-30' tall. The understory consists mostly of guinea grass and adventives such as pluchea (Pluchea odorata), lion's ear (Leonotus nepetaefolia), bitter melon (Momordica charantia var. pavel), cocklebur (Xanthium saccharatum) and lantana.

MOKULEIA II

Mokuleia II is situated at approximately 280' elevation along the Mt. Kaala access road in the land of Mokuleia, Waialua District, Waianae Mountains. Although the natural cover of the region has been described as xerophytic shrub, most of the land is now in sugar cane or in pasture. The site is located in a pasture adjacent to the FAA compound, just mauka of the sugar cane fields.

Guinea grass is the major component of the pasture vegetation. Browsed koa-haole shrubs 1-2' tall are scattered throughout the pasture. Numerous common wayside species are found in the site but in small numbers. These include klu, 'uhaloa, false mallow, lantana, lion's ear, fuzzy rattle-pod (Crotalaria incana), comb hyptis (Hyptis pectinata), a pua-lele (Emilia fosbergii), bitter herb (Centaurium erythaea), a vervain (Stachytarpheta urticaefolia), yellow wood sorrel (Oxalis corniculata), allseed (Polycarpon tetraphyllum) and dwarfed guava shrubs (Psidium guajava). In addition, several Java plum seedlings and an undetermined adventive species of Sida were observed. Bermuda grass and rhodes grass (Chloris gayana) are common grasses in the study site.

KAWAIHAPAI

This site is located on the lower slopes of a ridge at approximately 250' elevation in the land of Kawaihapai, Waialua District, Waianae Mountains. It falls within Ripperton and Hosaka's vegetation zone B. According to their scheme the natural cover of the zone is one of xerophytic shrub with some trees in the upper part. The entire region, however, has been transformed into a pasture of guinea grass and koa-haole with scattered emergent kiawe (Prosopis pallida).

The dominant species in the site is guinea grass. Browsed shrubs of koa-haole 4-5' tall and small kiawe trees up to 20' tall are the other significant components of the vegetation. The following species are present but in small numbers: cocklebur, false mallow, comb hyptis, fuzzy rattle-pod, bitter herb, klu, ageratum, spiny amaranth, large crabgrass (Digitaria sanguinalis), cow pea (Phaseolus lathyroides), and honohono (Commelina diffusa). In addition, several seedlings of Java plum and silk oak (Grevillea robusta) were observed. One or possibly two common native species are present in small numbers in the site: Ipomoea cairica, a common indigenous vine in lowland areas, and pōpolo (Solanum nigrum) which is either indigenous or a Polynesian introduction. Several indigenous alahe'e (Canthium odoratum) and a single naio (Myoporum sandwicense), an endemic species, were observed in the vicinity but were not present in the site.

Further upslope several hundred yards from the site, grazing is apparently less intense. Here, groves of Java plum, silk oak and scrubby Christmas berry are common and the vegetation type is typical of zone B. The Pahole Natural Area Preserve with several rare and endangered species is located in the mountains mauka of the site. . . . Approximately two miles of pasture separate the preserve and the Kawaihapai site and the presence of any of these rare species existing in the pasture lands is practically nil.

UKOA

The Ukoa site is located in the sugar cane lands at approximately 120' elevation in the land of Kawaihoa, Waialua District, Koolau Mountains. Although it lies within Ripperton and Hosaka's vegetation zone B the natural cover has been replaced by sugar cane fields. The dominant species of the entire region is sugar cane (Saccharum officinarum) and because the fields were recently planted the area at the time of the survey was devoid of other plant species but for a single exception: nut sedge (Cyperus rotundus).

WAIMEA

This site is located in the sugar cane lands at 496' elevation in the land of Kawaihoa, Waialua District, Koolau Mountains. According to the Ripperton and Hosaka scheme, the natural cover of the region is one of mixed open forest and shrubs (zone C, low phase). The characteristic species of this vegetation type include koa-haole, guava, lantana, Spanish clover (Desmodium spp.) and bermuda grass. Except for the ravines, the natural cover in this region has been replaced by sugar cane fields.

The Waimea site is situated in a weedy portion of the cane fields. Common weedy species such as nut sedge, spiny amaranth, lion's ear, ageratum, fuzzy rattle-pod, pua-lele (Emilia fosbergii), fir leaved celery (Apium tenuifolium), sow thistle (Sonchus oleraceus), little bell (Ipomoea triloba), partridge pea (Cassia leschenaultiana), three-flowered beggarweed (Desmodium triflorum), garden spurge (Euphorbia hirta) and Euphorbia glomerifera abound between the rows of sugar cane and along the roadways. Common grasses in the site are guinea grass, goosegrass and Panama grass (Paspalum fimbriatum). Koa-haole shrubs approximately 1-2' tall, bur clover (Medicago polymorpha) and Melilotus indica are occasional throughout this portion of the fields. Except for a nearby gulch which is dominated by koa-haole, Java plum and guinea grass, the site is completely

surrounded by sugar cane.

KAWAILOA

The Kawaihoa site is situated at approximately 400' elevation in the land of Kawaihoa, Waialua District, Koolau Mountains. It lies within Ripperton and Hosaka's vegetation zone C, low phase. Although the natural cover of this zone is one of mixed open forest and shrubs, the entire region has been planted in sugar cane.

The site is situated in the sugar cane fields along a cane haul road. The cane within these fields are more than 10' in height and form a complete cover. Thus, the fields are devoid of other species except along the verges and along the roadways. Only small numbers of a few species were observed in the site. These are nut sedge, fir-leaved celery, bur clover, sow thistle, garden spurge, a pua-lele (Emilia sonchifolia var. javanica), Euphorbia glomerifera, slender amaranth (Amaranthus viridis), prostrate spurge (Euphorbia prostrata), goosegrass, rhodes grass, Panama grass and bermuda grass.

OPANA

The Opana site is located at approximately 160' elevation on the lower slopes of the bluffs near Kawela, Koolauloa District, Koolau Mountains. Ripperton and Hosaka have classified the vegetation of the region as zone B which is characterized by a natural cover of xerophytic shrub with some trees in the upper part. The characteristic species of this zone include lantana, koa-haole, klu, 'uhaloa, 'ilima and false mallow.

The vegetation in the site is one of Christmas berry - koa-haole - guinea grass scrub and somewhat resembles the natural cover described by Ripperton and Hosaka. The upper canopy, consisting exclusively of shrubby Christmas berry 10-20' tall and koa-haole 6-10' tall, provide approximately 70% cover. Guinea grass approximately 3' tall dominates the herb layer. So complete is the cover

provided by these three species that only small numbers of few other species are present. These are klu, partridge pea, bitter herb, ageratum, pōpolo, pluchea, Indian pluchea (Pluchea indica), ironweed (Vernonia cinerea), a vervain (Stachytarpheta urticaefolia), prickly sida (Sida spinosa), phyllanthus weed (Phyllanthus debilis), perennial foxtail (Setaria geniculata), sourgrass (Tricachne insularis) and Bidens alba var. radiata.

This Christmas berry - koa-haole - guinea grass scrub is typical of the region especially upslope of the site. Conspicuous species found in the surrounding vegetation but not within the site are ironwood, guava, kolomona (Cassia surattensis), molassasgrass (Melinis minutiflora) and paragrass (Brachiaria mutica). The lowlands below the bluffs are abandoned agriculture fields now dominated by Johnson grass (Sorghum halepense).

KAWELA

This site is situated on the lower slopes of the bluffs at approximately 200' elevation not far from the Opana site, in the land of Anaka'oe, Koolauloa District, Koolau Mountains. The vegetation of the area has been classified as zone B.

The vegetation in the Kawela site is somewhat similar to that of the Opana site. It can be described as a koa-haole - guinea grass - paragrass scrub with emergent Christmas berry. Koa-haole 10-18' tall provide approximately 30% of the vegetation cover and guinea grass and paragrass form an almost complete herb layer 3-7' deep. Occasional Christmas berry up to 20' tall are scattered throughout the area. Small numbers of the following species were observed: pluchea, pōpolo, lantana, false mallow, virgate mimosa (Desmanthus virgatus), Spanish clover (Desmodium canum), a vervain (Stachytarpheta urticaefolia), Bidens alba var. radiata and huehue haole (Passiflora suberosa). The surrounding vegetation is similar to that in the site and the lowlands below the bluffs are dominated by Johnson grass.

HANAKAOE

Hanaka oe is situated on a flat, graded area on the mauka side of a hill at approximately 200' elevation in the land of Kahuku, Koolauloa District, Koolau Mountains. Ripperton and Hosaka included this region in their vegetation zone C, low phase. Although the natural cover of this zone was described as mixed open forest and shrubs, much of the region had been developed into sugar cane fields (now abandoned).

The site is positioned on an extensive, graded portion of a hill. Large sections of the area are devoid of vegetation and evidence of continuous vehicular traffic was observed. Because of the original extensive topographic as well as vegetational modification and perhaps repeated disturbance, the vegetation of this area is atypical of the region. The vegetation can best be described as a mosaic of scrubby koa-haole, grasses and smaller shrubs, and eroding soils. Five species of grass are common in the site: bermuda grass, rhodes grass, large crabgrass, buffelgrass (Cenchrus ciliaris) and Andropogon pertusus. Also present in small to moderate numbers are partridge pea, Spanish clover, fuzzy rattle-box, virgate mimosa, indigo, sensitive plant, 'uhaloa, pōpolo, Ipomoea obscura, a vervain (Stachytarpheta urticaefolia), and Bidens alba var. radiata.

Immediately surrounding the site is secondary vegetation dominated by dense stands of koa-haole 15-20' tall, Christmas berry and ironwood. Also observed in the surrounding area in exposed sites was the common endemic 'ulei (Osteomeles anthyllidifolia). Further in the distance are the abandoned sugar cane fields. A single specimen of the rare Capparis sandwichiana var. sandwichiana is known from the limestone outcrops approximately two miles east of the site and a colony of Santalum ellipticum var. littorale is known from a hill two and a half miles away (pers. observation). These were not observed in the vegetation surrounding the site despite an extensive search.

SUMMARY

All of the sites surveyed are situated in cultivated sugar cane fields, pastures or in other areas of completely secondary vegetation. Excluding pōpolo a common species in Hawaii which may or may not be indigenous, only one native species was observed in any of the sites. This common indigenous species, Ipomoea cairica, was found only in the Kawaihapai site. Two other common native species were observed in the vegetation surrounding this site but in extremely small numbers. No rare and endangered plant species were encountered.

LITERATURE REFERENCES

- Ripperton, J.C. and E.Y. Hosaka. 1942. Vegetation Zones of Hawaii. Hawaii Agricultural Experiment Station Bulletin 89. Honolulu. 60 pp.
- St. John, H. 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Pacific Tropical Botanical Garden. Memoir No. 1. Lawai. 519 pp.

E. AQUATIC SURVEY OF KAMANANUI STREAM AND UKOA MARSH

AQUATIC SURVEY OF KAMANANUI STREAM AND UKOA MARSH
WAIALUA-KAHUKU, ISLAND OF O'AHU

Submitted to Wilson Okamoto and Assoc.

July, 1985

by

Kelly M. Archer - Aquatic Biologist

INTRODUCTION AND STUDY SITES

Kamananui Stream and Ukoa Marsh on the north shore of O'ahu, near Haleiwa, were the subject of an aquatic biological survey during June, 1985. The emphasis of this survey was to locate and identify native species among the conspicuous aquatic invertebrates and fish.

Kamananui Stream is the principal tributary of Waimea River and is the source of water for Waimea Falls, a tourist attraction of the privately owned Waimea Falls Park. The stream is characterized by strong, clear-flowing riffles and infrequent, deep pools. The vegetative canopy is generally high, or open, which allows for a large amount of solar insolation of stream water. The stream bed is composed of boulders and cobble with only thin deposits of silt. Kamananui is a perennial stream, although under severe drought conditions (as during the summer and fall of 1984) the stream may not flow continuously.

Ukoa Marsh is located immediately northeast of Haleiwa, O'ahu. The marsh is owned by Bishop Estate and is currently being utilized for cattle grazing and, apparently, as a source of water for Waiialua Sugar Company. The sugar company maintains a pump station near the northeastern end of the marsh along the access road to Kawaihoa Camp.

A wetland vegetation survey and an ornithological survey (Refs. 1,2), both completed for the Army Corp of Engineers, were undertaken in the Ukoa Marsh area in 1977. Both of these previous surveys stated that relatively little open water was evident. In addition, the Kawaiiloa Landfill project, located opposite the Kawaiiloa access road, had caused part of the wetland to be filled in with sediment.

Bulrushes (Scirpus spp.), native sawgrass (Cladium leptostachyun), california grass (Brachiaria mutica), water hyacinth (Eichornia crassipus), and water lettuce (Pistia stratiotes) were the dominant plant species of the marsh during this 1985 survey. An open water region of approximately 50 m² was located in the marsh area nearest Kamehameha Highway. The water depth ranged from 2 to 10 cm. The only other location within Ukoa Marsh where standing water was found during this survey was along the road leading to Kawaiiloa Camp. Near the pumping station a small, narrow and fairly deep (20-50 cm) channel of water was completely overgrown by water hyacinth. The rest of the study area was composed of bulrushes and other vegetation growing in saturated soil.

METHODS

Kamananui Stream

Visual sampling, including the use of face mask and snorkel, was employed to locate and identify fish and invertebrates in Kamananui Stream. The entire stream was surveyed, from the parking area of Waimea Falls Park to a point above the falls at an elevation of approximately 135 m.

Visual sampling involves walking along, and within, the stream carefully observing the stream bed and water column. The face mask and snorkel are utilized in pools and relatively deep stream reaches. This method of sampling has proven to be effective in accurately determining the presence of fish and conspicuous invertebrates in the small, slow-flowing streams common in Hawaii (Ref. 3). Nocturnal or highly cryptic species, such as the Chinese catfish (Clarius fuscus), are often underrepresented or not identified. With the emphasis of this survey being the more easily located and identifiable native stream fauna, the importance of this weakness in the method is minimized.

Ukoa Marsh

As in Kamananui Stream, visual sampling was employed in Ukoa Marsh. Comprehensive surveillance of the open water portion of the marsh was made although the entire area was surveyed. Conditions were not conducive for the use of a face mask and snorkel in Ukoa Marsh during this survey. Again, secretive alien species often escape detection when using visual sampling to identify aquatic fauna.

RESULTS

The list of aquatic fauna identified in Kamananui Stream and Ukoa Marsh during this survey are found in Tables 1 and 2, respectively. Two native fish species were found to be well established in Kamananui Stream, while no native species were identified in Ukoa Marsh.

DISCUSSION

Kamananui Stream

The presence of large, apparently healthy, populations of two of the native freshwater gobies (o'opu) in Kamananui Stream, as well as the substrate and flow characteristics of the stream, would place Kamananui in the Moderate to High Quality rating category using criteria developed to evaluate Windward O'ahu streams (Ref. 3). The stream reach nearest the mouth of Waimea River was not surveyed, however; local residents and employees of Waimea Falls Park have indicated that the native eleotrid, Eleotris sandwichensis (o'opu okuhe), and the native palaemonid prawn, Macrobrachium grandimanus (o'opu o'eha'a), are regularly present, and fished for, in this reach of the river. The presence of these two native, diadromous species also supports the Moderate to High Quality rating.

The surprising absence of the mountain o'pae, Atyoida bisulcata (o'pae kala'ole), is somewhat of an enigma. Many Low to Moderate Quality Windward O'ahu streams support large populations of this shrimp (Ref. 3). No recent published reports of Kamananui Stream are available for comparison with this survey's findings although unpublished data (Ref. 4) indicate that no other native species have been found in this stream in the last fifteen years.

Ukoa Marsh

It is apparent, from the findings of this survey, that Ukoa Marsh is undergoing fairly rapid change. Sediment and vegetation are filling in much of the area which was once open water. With the exception of the small channel near the pumping station, cattle are now able to graze throughout the marsh.

The reasons behind the rapid aging of the marsh are probably quite complex. Some obvious causes include: seepage and sedimentation due to the Kawaiiloa Landfill, the withdrawal of water for irrigation purposes, the temporary effects of the state-wide drought in 1984 on water levels which would have favored the establishment of vegetation, and the effect of cattle grazing on the water quality of the marsh.

The bird survey conducted in 1977 (Ref. 2) commented on some of the obvious aquatic fauna of Ukoa Marsh. Table 3 is a list of the species identified. Tilapia (Tilapia spp.) and carp (Cyprinus carpio), two relatively large fish identified in the 1977 study, were not seen during this survey. It is possible that small populations are still present in the marsh, but it is apparent that these fish are no longer well established.

The diadromous Tahitian prawn (Macrobrachium lar) was also not observed in the marsh during this survey. With an open migration route to the ocean through Loko Ea Ponds no longer intact, the absence of this species is understandable. Because of the lack of open access to the ocean, Ukoa also does not serve as an important "nursery" for the young of inshore marine fish and invertebrates as is common for marshes with open access such as Kawainui Marsh in Kailua, O'ahu.

Although Ukoa Marsh may not be considered a valuable natural resource in terms of the aquatic fauna which are present, the marsh does provide valuable habitat for native waterbird populations. Observations of gallinule, coot and stilt populations were made during this survey.

CONCLUDING REMARKS

Kamananui Stream, by virtue of the native species found and the physical characteristics of the stream, can be considered one of the highest quality streams in the Waialua-Kahuku District. Care should be taken to protect this watershed from factors which would affect stream quality. These factors would, of course, include the lowering of stream flows.

Ukoa Marsh has decreased in value as a resource for aquatic fauna within the last few years. Environmental factors (siltation, the growth of vegetation, etc.) have made the marsh a less attractive habitat for many fish species. The inherent value of Ukoa Marsh would appear to be the habitat it provides for the native waterbird populations. With suitable habitat at a minimum for these birds on O'ahu, the importance of Ukoa Marsh is heightened.

Both Kamananui Stream and Ukoa Marsh must be monitored in the event wells are developed in the area. The effect of a lowered water table on both of these aquatic environments might involve a drastic reduction in their ability to support aquatic fauna or waterbird populations in the case of Ukoa Marsh.

Table 1. Aquatic fauna observed in Kamananui Stream, Waimea, O'ahu, June 1985.

Scientific Name	Common Name	Origin ¹
Crustaceans		
<u>Macrobrachium</u> <u>lar</u>	Tahitian prawn	alien
Fishes		
<u>Awaous</u> <u>stamineus</u>	o'opu nakea	endemic 2
<u>Mugil</u> <u>cephalus</u>	mullet	indigenous
<u>Poecilia</u> <u>mexicanus</u>	shortfin molly	alien
<u>Poecilia</u> <u>reticulata</u>	guppy	alien
<u>Stenogobius</u> <u>genivittatus</u>	o'opu naniha	indigenous
<u>Xiphophorus</u> <u>helleri</u>	swordtail	alien

1
 endemic - found naturally in Hawaii only.
 indigenous - found naturally in Hawaii and elsewhere.
 alien - introduced

2
 The systematics of this species and other native gobies is currently in question. See Kinzie and Ford (Ref. 5) for a thorough discussion.

Table 2. Aquatic fauna observed in Ukoa Marsh, Haleiwa, O'ahu, June 1985.

Scientific Name	Local Name	Origin
Crustaceans		
<u>Procambarus clarkii</u>	crayfish	alien
Fishes		
<u>Poecilia reticulata</u>	guppy	alien
<u>Xiphophorus helleri</u>	swordtail	alien
Amphibians		
<u>Bufo marinus</u>	Bufo toad	alien
<u>Rana rugosa</u>	wrinkled frog	alien

Table 3. Aquatic fauna identified during ornithological survey conducted in 1977 (Ref. 2).

Scientific Name	Local Name	Origin
Crustaceans		
<u>Macrobrachium</u> <u>lar</u>	Tahitian prawn	alien
Fishes		
<u>Cyprinus</u> <u>carpio</u>	carp	alien
<u>Poecilia</u> sp.	guppies, mollies	alien
<u>Tilapia</u> spp.	tilapia	alien
Amphibians		
<u>Rana</u> <u>rugosa</u>	wrinkled frog	alien
<u>Rana</u> <u>catesbiana</u>	bullfrog	alien

LITERATURE CITED

1. Elliott, Margaret E. and Erin Marie Hall. 1977. Wetlands and Wetland Vegetation of Hawaii. Prepared for the United States Army Corps of Engineers, Pacific Ocean Division, Fort Shafter. Contract # DACW 84-77-C-0014.
2. Shallenberger, Robert J.. 1977. An Ornithological Survey of Hawaiian Wetlands. Prepared for the U.S. Army, Engineer District, Honolulu. Contract # DACW 84-77-C-0036.
3. Archer, Kelly M. 1984. Biological Survey and Quality Rating of Windward O'ahu Streams. Submitted to VTN Pacific, Inc.
4. Hawaii Cooperative Fishery Research Unit, unpublished data.
5. Kinzie, R.A. III and J.I. Ford. 1982. Population biology in small Hawaiian streams. Technical Report No. 147, Water Resources Research Center, University of Hawaii, Honolulu, Hawaii.

F. OPANA WELL PUMPING TESTS

MEMORANDUM

August 20, 1969

To: Mr. Richard Lum
 From: J. Grance
 Subject: Five Hour Pump Test - Opana Test Well

This pump test was run on August 18, 1969. Pumping started at 10:30 a.m. and ended at 3:30 p.m. The pumping rate varied from 370 gpm to 1780 gpm. The chloride remained steady at 31 ppm.

An orifice meter was used to measure the pump rate. To achieve the minimum and maximum rates a 6" orifice plate and a 7½" orifice plate was used.

Well Data:

Diameter: 16" ID
 Depth: 307'
 Casing: 158.7'
 Airline: 145'

Test Results:

Rate Gpm	Drawdown Ft.	Chloride Ppm	Lab. Ec	Hardness Ppm	Alk. Ppm
420	1.96	31	212	58	48
420	1.73	32	212	58	
500	2.43	31	209	54	
793	4.50	31	210	55	
1175	10:28	31	211	55	48
1440	14.44	31	212	56	
1780	21.60	31	212	56	

Complete results are attached.

J. Grance
 J. Grance

Noted:

Stanley Mackawa
 Stanley Mackawa

OPANA TEST WELL

Diameter: 16" ID
 Depth: 307'
 Casing: 158.7'
 Airline: 145'
 Head: 10.0' (approx.)

August 18, 1969

Time	Water Level		Drawdown Ft.	Rate Gpm	Cl Ppm	Remarks
	Psi	Ft.				
10:10	10.45	24.14				Static - Used 10" x 6" orifice meter
10:30						Start pump
10:31	9.90	22.87	1.27	370		
10:35	9.90	22.87	1.27	370		
10:40	9.60	22.18	1.96	420	31	Sample No. 1
10:50	9.60	22.18	1.96	420		
10:55	9.70	22.41	1.73	420		
11:05	9.70	22.41	1.73	420		
11:20	9.70	22.41	1.73	420	32	Sample No. 2
11:25						Change rate
11:30	9.40	21.71	2.43	500		
11:40	9.40	21.71	2.43	500		
11:45	9.40	21.71	2.43	500		
11:50	9.40	21.71	2.43	500		
11:55	9.40	21.71	2.43	500		
12:05	9.40	21.71	2.43	500	31	Sample No. 3
12:10						Change rate
12:15	8.50	19.64	4.50	793		

Opana Test Well (cont.)

Time	Water Level		Drawdown Ft.	Rate Gpm	Cl Ppm	Remarks
	Psi	Ft.				
12:30	8.50	19.64	4.50	793		
12:45	8.50	19.64	4.50	793		
13:00	8.50	19.64	4.50	793		
13:15	8.50	19.64	4.50	793		
13:25	8.50	19.64	4.50	793	31	Sample No. 4
13:30						Change orifice plate to 7½". Change rate
13:35	6.30	14.55	9.59	1135		
13:45	6.20	14.32	9.82	1135		
13:55	6.20	14.32	9.82	1135		
14:00	6.00	13.86	10.28	1175		
14:05	6.00	13.86	10.28	1175		
14:10	6.00	13.86	10.28	1175		
14:15	6.00	13.86	10.28	1175	31	Sample No. 5
14:20						Change rate
14:25	4.50	10.40	13.74	1425		
14:30	4.50	10.40	13.74	1425		
14:50	4.30	9.93	14.21	1440		
14:55	4.20	9.70	14.44	1440		
15:00	4.20	9.70	14.44	1440		
15:05	4.20	9.70	14.44	1440		
15:10	4.20	9.70	14.44	1440	31	Sample No. 6
15:11						Change rate

Opana Test Well (cont.)

Time	Water Level		Drawdown Ft.	Rate Gpm	Cl Ppm	Remarks
	Psi	Ft.				
15:18	1.10	2.54	21.60	1780		
15:25	1.10	2.54	21.60	1780	31	Sample No. 7 Stop Pump
15:26	5.00	11.55	12.59			
15:27	7.50	17.32	6.82			
15:28	10.30	23.79	.35			
15:30	10.35	23.91	.23			
15:35	10.40	24.02	.12			

CHEMICAL LABORATORY REPORT

Subject: Opana Test Well Pump Test

<u>Sample</u>	<u>Date, Time a</u>	<u>Rate</u> gpm	<u>Drawdown</u> ft	<u>Ppm</u>		<u>Sp. Cond.</u> (Microhmhos)
				<u>Chloride</u>	<u>Nitrate</u>	
1	8/20/69, 1315	800	5.5	31	-	212
2	1615	"	"	31	0.55	214
3	2400	"	"	31	-	200
4	8/21/69, 0700	"	"	32	-	209
5	1715	"	"	32	0.60	209
6	2400	"	"	32	-	215
7	8/22/69, 0700	"	"	32	-	215
8	1600	"	"	32	0.50	213
9	2400	"	"	32	-	215
10	8/23/69, 0700	"	"	32	-	215
11	1600	"	"	32	0.50	215
12	2400	"	"	32	-	210
13	8/24/69, 0700	"	"	32	-	213
14	1600	"	"	32	0.55	215
15	2400	"	"	32	-	215
16	8/25/69, 0700	"	"	32	-	217
17	1255	"	"	32	0.60	214

a Pumping started at 1300 on 8/20/69; ended at 1300 on 8/25/69.

Well data: Bottom of well at elevation -182 ft.
 End of casing " " -32 ft.
 Diameter of well: 12 in. I.D.

September 23, 1969
 GT/dw

E. W. Lee
 for Y. F. Lee
 Chemist

Copies to: RTK, RWKL

OPANA WELL NO. 2*
GEOLOGIC LOG

<u>Depth Interval</u>	<u>Description</u>
0 - 30	Brown soil and weathered basalt boulders
30 - 40	Medium gray aa
40 - 45	Mixture of gray aa and dense blood-red aa
45 - 60	Dark gray aa, aa with white clay mineral in vesicles, and blood-red aa
60 - 65	Medium gray aa
65 - 70	Fresh dark gray dense aa
70 - 80	Mixture of slightly weathered aa and pahoehoe
80 - 85	Slightly weathered aa
85 - 95	Mixture of brown aa and pahoehoe
95 - 100	Slightly weathered medium gray pahoehoe
100 - 115	Reddish sand size cuttings (aa?) with minor olivine phenocrysts
115 - 120	Same as above except cuttings are medium gray aa slightly weathered
120 - 125	Slightly weathered aa
125 - 140	Mixture of slightly weathered pahoehoe and red-orange cinder material
140 - 145	Brown aa with less than 10% olivine phenocrysts
145 - 150	Slightly weathered medium gray aa
150 - 160	Mixture of gray pahoehoe and aa
160 - 165	Mixture of brown and gray aa(?) with occasional olivine phenocrysts
165 - 170	Moderately weathered gray aa
170 - 175	Brown pahoehoe including minor amounts of aa
175 - 185	Fresh dark gray aa, some cuttings show iron oxide stain

*Refers to Well No. 1 in the text

Opana Well No. 2
Geologic Log
Page 2

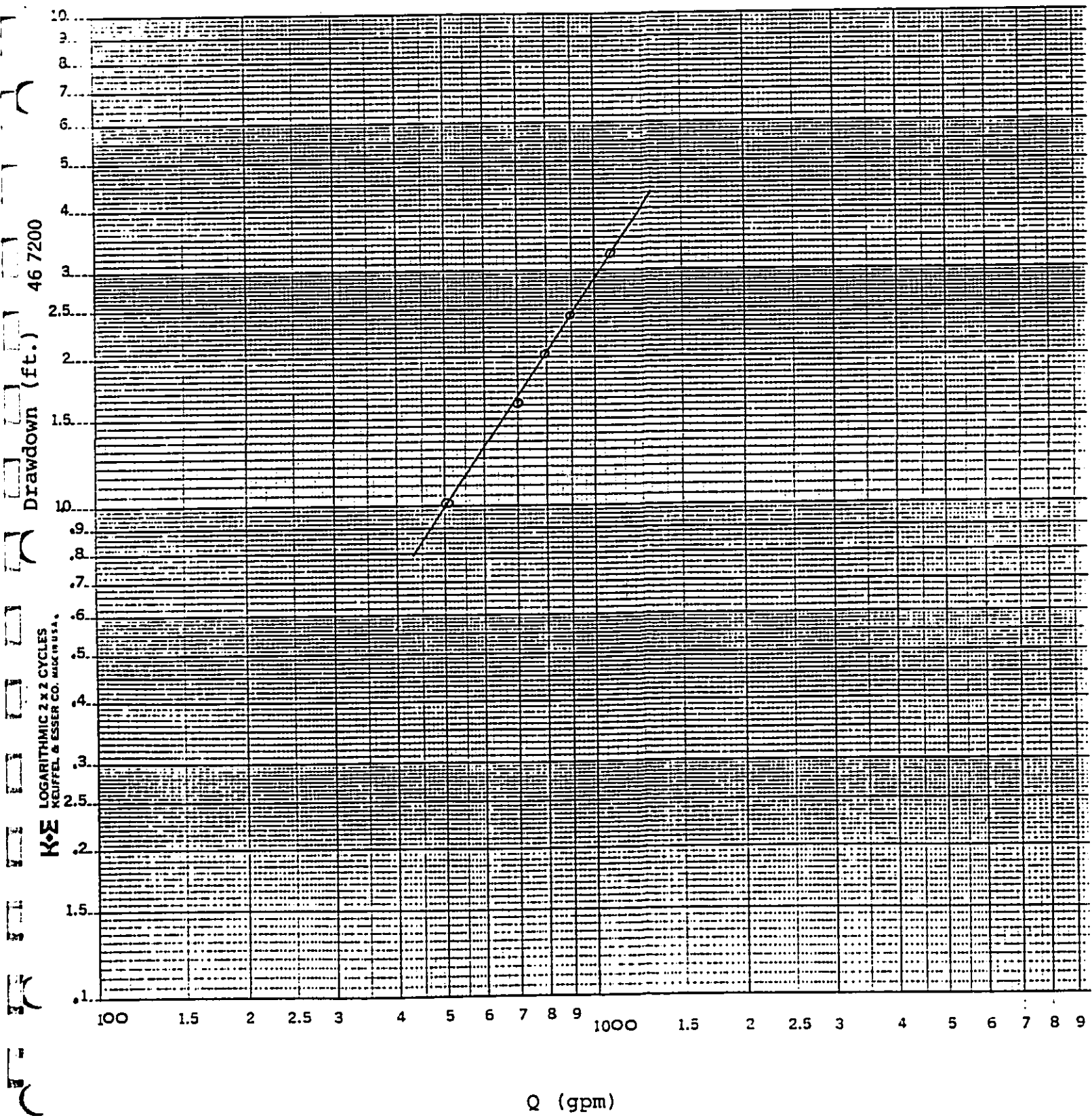
<u>Depth Interval</u>	<u>Description</u>
185 - 190	Slightly weathered pahoehoe
190 - 195	Brown pahoehoe with white clay minerals in vesicles
195 - 200	Slightly weathered gray pahoehoe
200 - 205	Mixture of brown and red weathered pahoehoe
205 - 215	Gray pahoehoe with occasional olivine phenocrysts
215 - 220	Fresh dark gray dense pahoehoe; minor amount of white clay mineral filling some vesicles
220 - 225	Sand size dark gray aa(?)
225 - 230	Dense brown-red aa with 10% olivine phenocrysts
230 - 235	Same as above except sample contains scoriaceous cuttings
235 - 240	Dark gray aa with 20% olivine phenocrysts
240 - 245	Same as above; with some pahoehoe cuttings mixed in
245 - 255	Mixture of reddish brown scoriaceous pahoehoe with white clay minerals filling vesicles and dense dark gray aa. Some olivine phenocrysts present.
255 - 260	Same as above; except no olivine
260 - 265	Dark gray aa with abundant olivine phenocrysts

Opana Well No. 2
 Step-Drawdown Test - August 4, 1986
 Well Elevation: 133'±
 Bottom of Well Elevation: -130'±
 Bottom of Casing Elevation: -30'±
 Length of Airline: 146'
 Diameter of Well: 12" ID
 Location of Well: TMK: 5-7-02: Por. 1

<u>Time</u>	<u>Pressure (psi)</u>	<u>Drawdown (ft.)</u>	<u>Rate (gpm)</u>	<u>Temp. (°F)</u>	<u>Cl⁻ (ppm)</u>	<u>Remarks</u>
0857	10.9					Static water level 12.18'±
0900						Start test
0903	10.5	.92	502			
0906	10.5	.92				
0908	10.45	1.04				
0916				67.5		
0920						Fix leak in airline
0935				67.5	50	Sample 1
0951	10.45	1.04	504			
1000						Change rate
1002	10.20	1.62	700			
1017	10.20	1.62	700			
1030				67.3	49	Sample 2
1040	10.20	1.62				
1100						Change rate
1102	10.05	1.96	793			
1108	10.00	2.08				
1115				67.4	48	Sample 3
1119	10.00	2.08				
1130						Change rate
1132	9.90	2.31	896			
1140	9.85	2.43				
1145				67.4	48	Sample 4
1157	9.85	2.43				
1200						Change rate
1201	9.50	3.24	1002			
1209	9.50	3.24	1082			
1219				67.5		
1240				67.6	48	Sample 5
1258	9.50	3.24				
1300						Stop test

Meter end: 06890950
 Meter begun: 06704600
 Total gallons pumped: 186,350

Opana Well No. 2
Step - Drawdown Test
August 4, 1986



G. WAIALUA WELL II PUMPING TEST

PUMPING TEST RECORD
for

WAIALUA - MELEKA
(Name)

Well 3307-19
(No.)

OAHU Island 4-DW-23 Project or Job No. Nov. 13 1934

Description of Well--

1. Elevation: ground surface 201.23 ft., top of casing _____ ft., rotary table _____ ft., referenced to _____ bechmark.
2. Total depth of well 302 ft.; or -100 ft. elevation, msl
3. 1 1/2 in. solid casing to 13 1/2 ft. depth, perforated to 225 ft. depth
4. Static water level on Nov. 13 1934: _____ ft. below ground surface, top of casing; or 22.2 ft. elevation msl measured AIRLINE method

Description of Pump and Pump Setting--

5. _____ type pump with _____ stage bowl assembly
6. Gasoline diesel, electric, power with 250 horsepower
7. Shaft speed: 1500 rpm at 2100 gpm flow
8. Depth of pump intake: 231 ft. below SR; or -29 ft. elev. msl
9. Depth of airline bottom: 199 ft. below SR; or -3 ft. elev. msl
10. Center of gage: _____ ft. elev., msl. Flow measured with _____
11. Test conducted by M. DUVE

Date & Time	Sample No.	Pumping rate (gpm)	Airline (feet)	Drawdown (feet)	Chlorides (ppm)	Temp. (°F)	Cond. (mmhos 25°C)
1012-24							
							METER RDS
1000		0	20.30				75.4-95.0
1015			20.35				
1030			20.35	(STATIC)			
		START PUMPING					
1035		2136	15.20	5.15			
1040		2136	15.15	5.20			
1045		2172	15.05	5.30			
		ADJUST PUMPING RATE					
1100	1	2114	15.15	5.20	39		
1130		2112	14.95	5.20			
1200		2135	14.90	5.45			
1215	2	2135	14.85	5.50	39		
1300	3	2135	14.80	5.55			
		ADJUST PUMPING RATE					
1400	4	2127	14.95	5.10	39	73°	
1500	5	2127	14.95	5.10			
1600		2117	14.95	5.40			
1700	6	2120	14.90	5.45	39		
1800		2120	14.95	5.50			

PUMPING TEST RECORD
for

WAIPIPIA - MAUNA
(name)

Well 3307-17
(No.)

SABU Island 4-241-83 Project or Job No. Nov. 13 1984

Date & Time	Sample No.	Pumping rate (gpm)	Airline (feet)	Drawdown (feet)	Chlorides (ppm)	Temp. (°F)	Cond. (mmhos 25°C)
10-2-84							
10-3-84							
10-4-84	7	2100	14.50	5.55			
10-5-84		2100	14.50	5.55			
10-6-84	8	2100	14.75	5.60	39		
10-7-84		2065	14.75	5.60			
10-8-84	9	2114	14.75	5.60			
10-9-84		2100	14.75	5.55			
10-10-84							
10-11-84	10	2100	14.75	5.55	39		
10-12-84		2100	14.75	5.60			
10-13-84	11	2100	14.75	5.60			
10-14-84		2114	14.75	5.60			
10-15-84	12	2100	14.75	5.60			
10-16-84		2100	14.75	5.60			
10-17-84	13	2103	14.75	5.60			
10-18-84		2100	14.75	5.60			
10-19-84	14	2114	14.70	5.65	39		
10-20-84		2100	14.70	5.65			
10-21-84	15	2100	14.70	5.65			
10-22-84		2100	14.70	5.65			
10-23-84	16	2100	14.75	5.60	37		RWS ON SITE
10-24-84		2094	14.80	5.55			DIGITAL REPAIR
10-25-84	17	2100	14.75	5.60			INTERFER. TEST
10-26-84		2100	14.75	5.60			
10-27-84	18	2100	14.70	5.65	39		
10-28-84		2100	14.75	5.60			
10-29-84	19	2100	14.75	5.60			
10-30-84		2086	14.75	5.60			
10-31-84	20	2100	14.75	5.60	37		
11-1-84		2100	14.75	5.60			
11-2-84		2100	14.75	5.60			

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PUMPING TEST RECORD
for

WAIANIANIWA - WAIANIANIWA
(name)

Well 2217-13
(No.)

1981 Island 1-24-81 Project or Job No. 1-4 1981

Date & Time	Sample No.	Pumping rate (gpm)	Airline (feet)	Drawdown (feet)	Chlorides (ppm)	Temp. (°F)	Cond. (mmhos 25°C)
11-15-81							
11-15-81		2100	14.75	5.60			
11-15-81							
11-15-81	22	2114	14.75	5.60	39		
11-15-81		2096	14.75	5.60			
11-15-81	23	2120	14.75	5.60			
11-15-81		2103	14.75	5.60			
11-15-81	24	2100	14.75	5.60	39		
11-15-81		2100	14.75	5.60			
11-15-81	25	2100	14.75	5.60			
11-15-81		2096	14.75	5.60			
11-15-81	26	2100	14.70	5.65	39		
11-15-81		2100	14.65	5.70			
11-15-81	27	2100	14.60	5.75			
11-15-81		2093	14.60	5.75			
11-15-81	28	2100	14.65	5.70	39		
11-15-81		2093	14.70	5.65			
11-15-81	29	2093	14.70	5.65			
11-15-81		2128	14.70	5.65			
11-15-81	30	2100	14.65	5.70			
11-15-81		2096	14.60	5.75			
11-15-81	31	2093	14.60	5.75	39		
11-15-81		2079	14.55	5.80			
11-15-81	32	2100	14.65	5.70			
11-15-81		2100	14.65	5.70			
11-15-81	33	2100	14.65	5.70			
11-15-81		2100	14.65	5.70			
11-15-81							
11-15-81	34	2100	14.65	5.70	39		
11-15-81		2100	14.65	5.70			
11-15-81		2100	14.70	5.65			

PUMPING TEST RECORD
for

AIALUA - A. ALUA
(name)

Well 2207-19
(No.)

SAHU Island 4-014-23 Project or Job No. A/02 1984

Date & Time	Sample No.	Pumping rate (gpm)	Airline Drawdown		Chlorides (ppm)	Temp. (°F)	Cond. (mmhos 25°C)
			(feet)	(feet)			
11-16-84							
0400		2100	14.70	5.65			
0500		2100	14.70	5.65			
0600		2100	14.70	5.65			
0700	37	2100	14.70	5.65			
0800		2122	14.70	5.65			
0900	38	2114	14.65	5.70	39		BWS - WATER SAMPLE
1000		2100	14.70	5.65			
1100	39	2100	14.55	5.80			
1200		2100	14.60	5.75			
1300	40	2117	14.50	5.85			
1400		2100	14.60	5.75			
1500	41	2100	14.60	5.75			
1600		2100	14.55	5.80			
1700	42	2100	14.60	5.75			
1800		2079	14.60	5.75			
1900	43	2093	14.55	5.80			
2000		2100	14.50	5.85			
2100	44	2100	14.55	5.80			
2200		2100	14.55	5.80			
2300	45	2100	14.55	5.80			
2400		2096	14.60	5.75			
11-17-84							
0100	46	2100	14.60	5.75			
0200		2100	14.60	5.75			
0300	47	2100	14.60	5.75			
0400		2100	14.65	5.70			
0500	48	2078	14.65	5.70			
0600		2096	14.70	5.65			
0700	49	2096	14.65	5.70			
0800		2100	14.60	5.75			

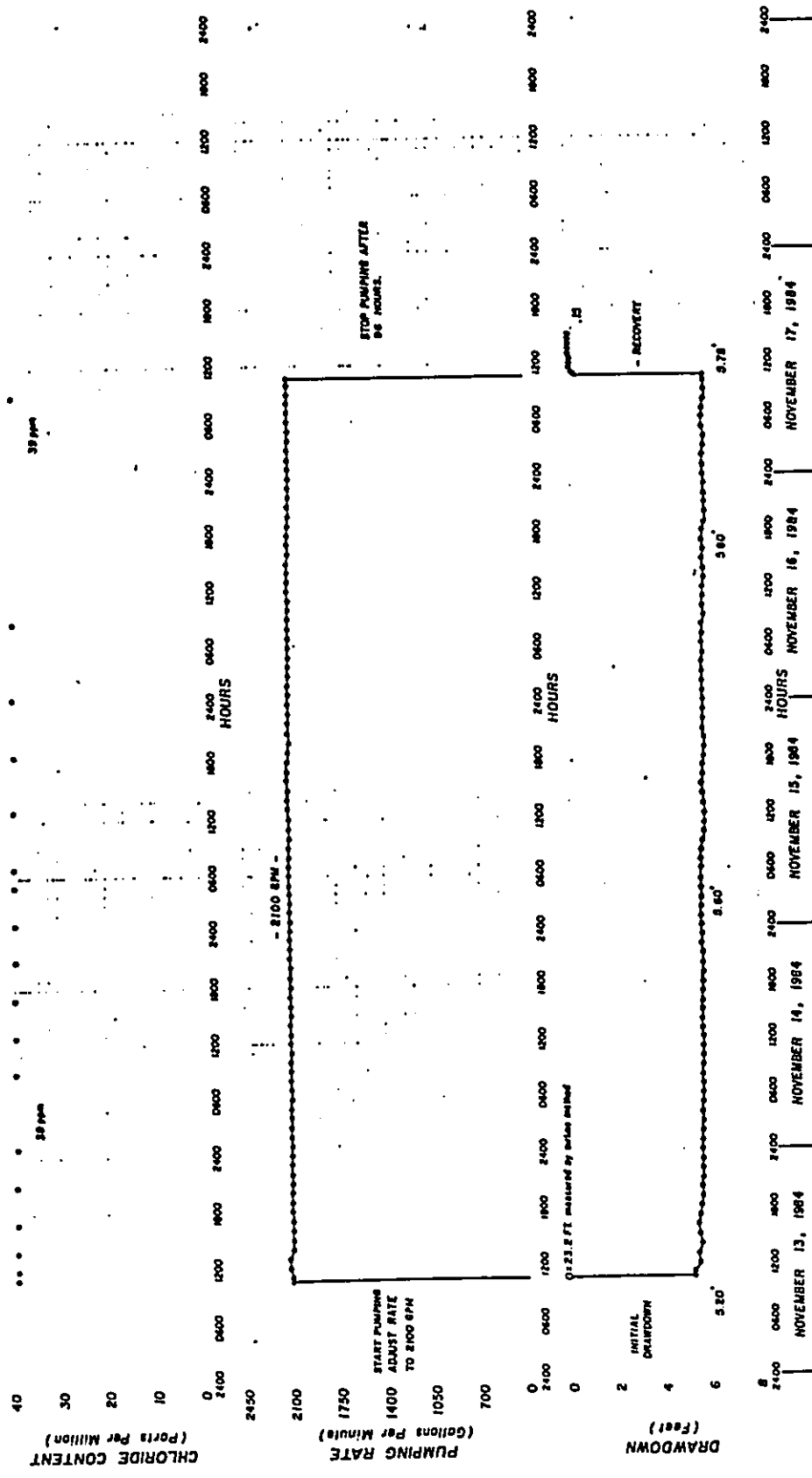
Dowald 8/63

Pump TEST # 2
CHLORIDE TITRATION RECORD

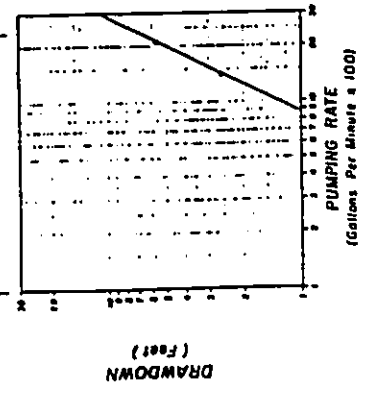
for
WAIALUA - MAUKA Well 3307-19
(No.)

CAHU Island 4-01W-23 Project or Job No. Nov 1984
Titrations conducted by M. O'NE

Sample No.	Date Taken	Sample (ml)	Burette Rdg		AgNO ₃ (ml)	AgNO ₃ 2 ml / ml	Mult. Factor	Chlorides (ppm)
			Before	After				
	11-13-84							
1	1100	50	5.5	9.4	3.9	3.9	10	38
2	1200		9.5	13.5	4.0	3.9	10	39
3	1300		13.5	17.5	4.0	3.9	10	39
4	1400		17.5	21.5	4.0	3.9	10	39
5	1700		10.1	14.1	4.0	3.9	10	39
6	2100		14.1	18.1	4.0	3.9	10	39
	11-14-84							
10	0100		10.1	14.1	4.0	3.9	10	39
12	0500		6.1	10.1	4.0	3.9	10	39
14	0900		2.1	6.1	4.0	3.9	10	39
16	1300		10.1	14.0	4.0	3.9	10	39
18	1700		18.2	22.2	4.0	3.9	10	39
20	2300		14.2	18.2	4.0	3.9	10	39
	11-15-84							
22	0100		10.2	14.2	4.0	3.9	10	39
24	0500		6.2	10.2	4.0	3.9	10	39
26	0900		2.2	6.2	4.0	3.9	10	39
28	1300		6.2	10.2	4.0	3.9	10	39
31	1900		12.0	16.0	4.0	3.9	10	39
	11-16-84							
34	0100		8.0	12.0	4.0	3.9	10	39
36	0700		4.0	8.0	4.0	3.9	10	39
39	1100		12.0	16.0	4.0	3.9	10	39
	11-17-84							
51	0900		11.8	15.8	4.0	3.9	10	39



PHYSICAL DATA
 Ground Elevation 201.77'
 Size of Pump 16"
 Depth of Compartment 185'
 Depth of Non-Compartment 245'
 Water Temperature 72.8°F
 Latitude 21° 33' 11"
 Longitude 158° 07' 16"



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

WAIALUA-MAUKA 3307-19
 PUMPING TEST NO. 2

Test Conducted by M. ONTE