EXECUTIVE CHAMBERS

HONOLULU

GEORGE R. ARIYOSHI
GOVERNOR

November 5, 1986

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

Dear Ms. Uyehara:

Based on the recommendation of the Office of Environmental Quality Control, I am pleased to accept the final environmental impact statement for the Development of Wells, Reservoirs, Transmission Lines, and Appurtenances at Honolulu, Hawaii, as a satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

This environmental impact statement will be a useful tool in deciding whether this project should be allowed to proceed. My acceptance of the statement is an affirmation of its adequacy under applicable laws and does not constitute an endorsement of the proposal.

When the decision is made regarding this action, I expect the proposing agency to carefully weigh the societal benefits against the environmental impact which will likely occur. This impact is adequately described in the statement and, together with the comments made by reviewers, provides a useful analysis of alternatives to the proposed action.

With warm personal regards, I remain,

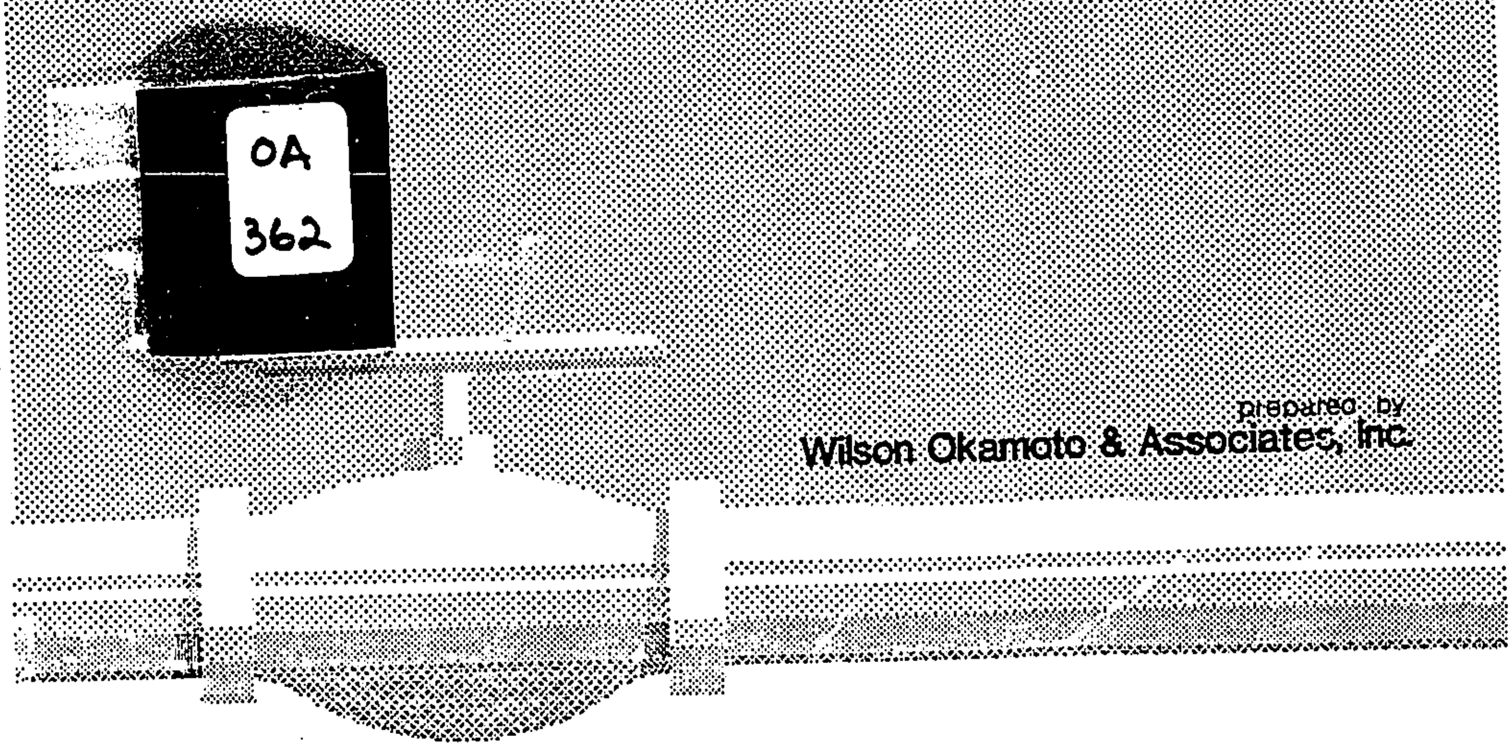
Yours very truly,

George R. Ariyoshi

cc: Honorable Kazu Hayashida

Final Environmental Impact Statement for Development of Wells, Reservoirs Transmission Lines and Appurtenances at Honolulu, Hawaii

Board of Water Supply
City & County of Honolulu



prepared by
Wilson Okamoto & Associates, Inc.

CITY AND COUNTY OF HONOLULU

BOARD OF WATER SUPPLY

FINAL REGIONAL ENVIRONMENTAL IMPACT STATEMENT

FOR

DEVELOPMENT OF WELLS, RESERVOIRS,

TRANSMISSION LINES AND APPURTENANCES

AT

HONOLULU, HAWAII

THIS ENVIRONMENTAL DOCUMENT IS SUBMITTED

PURSUANT TO CHAPTER 343, HRS

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

ACCEPTING AUTHORITY: Governor, State of Hawaii

Board Members:

Donna B. Goth, Chairman
Ernest A. Watari, Vice Chairman
Milton J. Agader
Russell L. Smith, Jr.
Wayne J. Yamasaki
Sister M. Davilyn Ah Chick

Kazu Hayashida Date: 9/26/86

KAZU HAYASHIDA
Manager and Chief Engineer

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

TABLE OF CONTENTS

LIST OF TABLES

FIGURES

PREFACE

This environmental document is prepared pursuant to requirements of Hawaii Revised Statutes, Chapter 343, and the Environmental Impact Statement Rules, Chapter 200 of Title 11, State of Hawaii, Department of Health Administrative 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 Environmental Impact Statement Rules, Section 11-200-7.

I. SUMMARY

I. SUMMARY

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

PROPOSED PROJECT: Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii

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I. PROPOSED ACTION

This environmental document addresses various proposed Board of Water Supply (BWS) projects located within the Honolulu District on the Island of Oahu. These projects include development of wells, reservoirs, transmission lines, and appurtenances. This environmental document may be accepted in whole or in part, to fulfill requirements of Chapter 343, Hawaii Revised Statutes (HRS) 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 in accordance with Chapter 343, HRS and the Environmental Impact Statement Rules, Chapter 200 of Title 11, State of Hawaii, Department of Health Administrative Rules.

The following summarizes the proposed water system improvements.

Source Development: Wells and springs 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.

Spring collection systems would include concrete walls and enclosures to protect the source from contamination.

Reservoirs: Water storage facilities are proposed to increase storage capacity and provide a more reliable water supply within the affected service area. The added storage capacity will enable the water system to more easily meet peak demands or emergency situations.

Transmission Lines: Proposed transmission mains will increase transmission capacities and provide redundancy in the transmission distribution system.

II. THE REGIONAL ENVIRONMENT

The Honolulu District extends from Makapuu Point to the Moanalua drainage divide. The area is bounded to the north by the crest of the Koolau Range and extends to the shoreline, which includes the coastal plain of southeastern Oahu. This region is highly urbanized and is the focal point of commercial, industrial, governmental and corporate activity.

The District is large enough to encompass diverse physical characteristics such as 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 - Water Quality Management Plan for the City and County of Honolulu (208 Plan)
D. State Department of Health - Drinking Water Program
E. State Exploratory Well Program
F. City and County of Honolulu - General Plan
G. City and County of Honolulu - Development Plan
H. City and County of Honolulu - Oahu Water Plan
I. State Land Use Classification & Conservation District Use
J. City and County of Honolulu - Zoning
K. Coastal Zone Management
L. Special Management Area
M. Special Design Districts
N. Honolulu Ground Water Control Area

IV. REGIONAL IMPACTS

Regional impacts addressed in the EIS include those associated with hydrology, water quality, flood hazard, spring and stream environments, population, public facilities, economy and displacement. Potential impacts which will be closely monitored by the BWS are those of source development upon spring or stream 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 facilitate future growth, in keeping with the County 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, air quality, traffic, and other nuisances which are unavoidable.

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. Although import of water from other water districts will still be required with the proposed improvements, these improvements will, nonetheless, help provide adequate water supplies to meet the projected needs of the Honolulu District.

B. The long-term productivity of the basal aquifer is not anticipated to be adversely affected, as the anticipated drafts will be within DLNR-established sustainable yields.

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

II. INTRODUCTION

II. INTRODUCTION

Water, the "life blood of the earth," was once readily available in quantities that were more than ample. Today, population growth and urbanization have increased the demand for water and have intensified the search for new sources.

In an ongoing effort to provide adequate water service and to meet the increasing needs of an expanded community, the City and County of Honolulu, Board of Water Supply (BWS) is considering the development of water sources and the construction of facilities to improve water supply, storage and transmission systems.

This "group" of proposed water facility projects are treated as a single action towards meeting environmental impact statement requirements of Chapter 343, Hawaii Revised Statutes (HRS) and Section 11-200-7 of the Environmental Impact Statement Rules, Chapter 200 of Title 11, State of Hawaii, Department of Health Administrative Rules. 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 in complying with Chapter 343. When specific sites are selected for development, an environmental assessment will be prepared in accordance with Chapter 343, HRS and the Environmental Impact Statement Rules of the State Department of Health.

Previous to the preparation of this document, environmental studies had been completed for a few proposed individual water improvement projects that are discussed in this report. These are:

Water Improvement Project	Type of Study
Dillingham Boulevard Transmission Main	Negative Declaration
Jonathan Springs Well	Negative Declaration
Kahuawai Springs	Draft Environmental Impact Statement
Kapakahi Well	Negative Declaration (for exploratory well only)
Kuliouou Well	Negative Declaration (for exploratory well only)
Manoa Well I	Negative Declaration
Manoa Well II	Negative Declaration
Waialae Nui Well	Negative Declaration
Wailupe Well I	Environmental Impact Statement

These water improvement projects are discussed in this report for a comprehensive analysis of water improvement efforts within the Honolulu District. Some of these environmental documents provided the foundation for study and analysis of those respective projects, and are referenced in Section XIV of this document.

This environmental document may be accepted in whole or in part, to fulfill requirements of Chapter 343, HRS for the individual water improvement facilities described herein. For those projects which may require further disclosers, addendum material may be supplied through preparation of supplemental environmental impact documents. Similarly, fulfillment of Federal Environmental Impact Statement procedures may be required for development of the Kakaako District Transmission Main as indicated herein. Accomplishment of these requirements is not prerequisite for acceptance of this document, but may require supplemental environmental documents.

Projects that may require preparation of a supplemental environmental impact statement are listed in Table 1. The accepting authority determines whether a supplemental statement is required in accordance with Chapter 200, Environmental Impact Statement Rules of Title 11, Department of Health Administrative Rules.

TABLE 1

PROJECTS THAT MAY REQUIRE A SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Subarea	Site No.	Development
Waialae	2	Kupaua Well
	3	Pia Well
	5	Wailupe Well II
	6	Kalani Iki Well
	7	Kapakahi Well
Kaimuki	9	Waiomao Well
	10	Palolo Well II
	11	Palolo Well III
	12	Manoa Well I
	S1	Waahila "180" Reservoir and Transmission Main
	S2	Waahila "405" Reservoir and Transmission Main
Downtown	14	Waaloa Well
	16	Herring Springs
	18	Nuuanu Aerator Well
	19	Kunawai Springs Well or Diversion
Kalihi	21	Kalihi Wells II & III

III. THE PROPOSED PROJECT

III. THE PROPOSED PROJECT

A. PROJECT LOCATION

The proposed water facility improvements will be located within the Honolulu District in the southeast sector of Oahu.

1. Water Use Districts

The BWS divides Oahu into seven water use districts for administrative and planning purposes. These districts are Honolulu, Windward, Waialua-Kahuku, Wahiawa, Pearl Harbor, Ewa, and Waianae.

The Honolulu water use district stretches from Makapuu Point, at its eastern extremity, to the Moanalua drainage divide. The area is bounded to the north by the crest of the Koolau Range, and extends to the shoreline which includes the coastal plain of southeastern Oahu. The area comprises 88 square miles, and consists of census tracts 1 through 72 inclusively. This district is coextensive with the Honolulu Judicial District and the Honolulu Ground Water Control Area.

2. Honolulu District Subareas

For document organization and presentation purposes, this report divides the Honolulu District into five subareas (see Figure 1). The boundaries for these subareas roughly follow the BWS hydrological isopiestic areas, which are delineated upon the basis of ground water levels. These borders represent approximate divisions of the hydrological areas and should not be interpreted as definite boundaries. From east to west, the five Honolulu subareas are: Waialae, Kaimuki, Downtown, Kalihi and Moanalua. All subareas extend north to the Koolau Crest, and south to the coastline.

a. Subarea 1 - Waialae

The Waialae subarea extends from Makapuu through Kahala. It includes the communities of Hawaii Kai, Kuliouou, Aina Haina, Waialae, and portions of Maunalani Heights and Kaimuki.

b. Subarea 2 - Kaimuki

Adjacent to the Waialae subarea, the Kaimuki subarea extends further west. It encompasses Kapahulu, Palolo Valley, St. Louis Heights, and portions of Maunalani Heights, Kaimuki, Manoa, Moiliili and most of Waikiki.

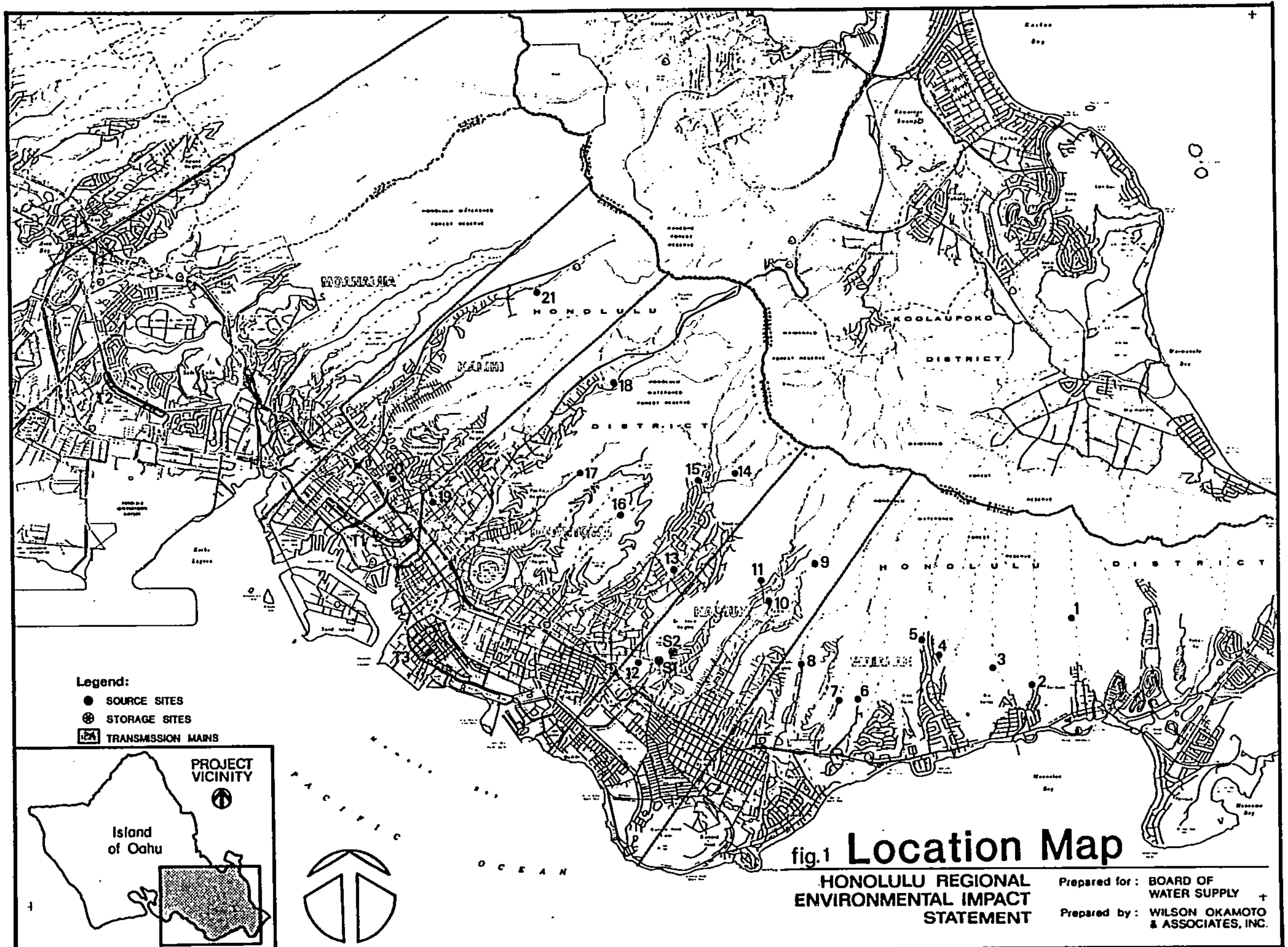

fig.1 Location Map

HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for : BOARD OF WATER SUPPLY

Prepared by : WILSON OKAMOTO & ASSOCIATES, INC.

c. Subarea 3 - Downtown

Many of the proposed improvements will occur in this subarea. The Downtown subarea abuts the Kaimuki subarea and includes the communities of downtown Honolulu, Makiki, Punchbowl, Tantalus, Pacific Heights, and Nuuanu. It also includes portions of Moiliili, Manoa and Palama.

d. Subarea 4 - Kalihi

The Kalihi subarea extends from Palama to Kalihi Valley. It also embodies Alewa Heights and Kamehameha Heights.

e. Subarea 5 - Moanalua

The Moanalua subarea includes Fort Shafter, Red Hill, Aliamanu, Salt Lake and the Honolulu International Airport. The western border of the subarea generally follows the Honolulu/Ewa Judicial District boundary, however for this report the Moanalua subarea also encompasses a portion of the Ewa Judicial District in order to include discussion of a proposed well at the H-1 freeway interchange in Halawa.

Statistical data presented in this report, regarding demographics, water use, water supply and other previously aggregated data are based upon information for the Honolulu Judicial District. However, for the planning purposes of this document, the difference in the bounded area is not considered a significant factor.

The discussion of each proposed water facility is presented by subareas in Chapter VII.

B. PROPOSED WATER SYSTEM IMPROVEMENTS

The proposed water system improvements include water sources, reservoir facilities, and transmission lines.

1. Source Development

The BWS is pursuing a water development program which will develop potable groundwater sources in suitable areas. Development of both wells and springs are proposed.

a. Wells

Source development begins with the location of a suitable water supply, in terms of quality and quantity that can be produced for a sustained period. At potential well sites exploratory wells are drilled to determine the yield and quality of the new source. If the exploratory wells prove feasible for source development, production facilities can be installed.

Development of exploratory wells into production wells are dependent upon the results of test pumping at the proposed sites. These results are utilized in determining the aquifer parameters and in the design and operation of the production well. Hence, until tests are conducted at exploratory well sites, a specific description of the proposed production wells and the required appurtenant improvements can be only estimated.

The typical exploratory well consists of 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 basal aquifer is expected to be the source, the exploratory well can be drilled to a depth below sea level. The completed well would consist of a 12-inch diameter steel casing grouted into place.

A series of aquifer tests are then conducted to determine the sustained well capacity and water quality. Upon completion of the test pumping, the well driller removes his pump, caps the well, and cleans the area.

When an exploratory well has been tested and found to be suitable for domestic use, it is converted into a production well. The typical production well facility will consist of the well and a permanent pump, a control building, and necessary transmission lines to connect the new source to the existing water system.

The control building may typically measure 15 feet by 45 feet in floor size and contain three main rooms. One room houses the electrical control panel, flow recorder, and the pump controls. A second room will contain chlorine cylinders and the third will be for the chlorinator pumps and air compressor. Thus, should a chlorine leak occur, protection is provided to the control room and the electrical equipment and controls. The control building and grounds are designed and landscaped for maximum visual compatibility with the local environment.

Transmission lines are buried with a minimum cover of three feet to absorb the impact of trucks or other heavy vehicles.

If water quality of the exploratory well does not meet acceptable standards for domestic water but is within the allowable limits for irrigation, then the well could serve as a secondary source. A typical secondary source will consist of the well, pump, pump controls and connections to the existing or proposed irrigation system. The irrigation system would be designed to be totally separate from the domestic system, with measures implemented to prevent cross-connections or contamination of the domestic water system.

b. Spring Collection Systems

The collection system consists of excavation and construction of concrete walls and cover to enclose and protect the source from contamination.

2. Water Storage

Water storage facilities have been proposed to increase storage capacity and provide a more reliable supply within the affected service area. The added capacity will enable the system to more easily meet peak demands or emergency situations.

Currently, the Honolulu area could benefit from greater reservoir storage capacity to meet emergency demands. This problem was exemplified during recent power outages in the wake of Hurricane Iwa (November 1982) and the island-wide power outage in July 1983. With inoperative electrical water pumps and insufficient storage capacity, the Honolulu area quickly lost water pressure and some areas were temporarily without water service.

Two storage reservoirs are proposed, each with a capacity of 4.0 million gallons. Typical dimensions for a reservoir of this capacity is about 20 feet high and 185 feet in diameter. The reservoirs will also need to be connected to the existing water distribution system. The spillway elevation of the reservoirs will determine the extent of their service areas.

3. Water Transmission Lines

The function of the proposed transmission mains is to increase transmission capacities and to provide redundancy in the transmission distribution system.

To assure that the water system will remain intact should a major earthquake occur within or near the Hawaiian Islands, the BWS designs its structural facilities using seismic zone 3 criteria.

C. IMPLEMENTATION

The BWS six-year Capital Improvement Program (CIP) (1985 to 1991) has scheduled the development of proposed projects discussed in this report (see Table 2). The BWS priority ranking for each project has been included.

The Kahuawai Springs and Manoa Well I are scheduled in the BWS CIP. The preparation of engineering reports for the Waialae Nui, Manoa II, Kuliouou and Kapakahi Wells is also included in the BWS CIP.

Water storage facilities scheduled for development in the BWS CIP are the Waahila "180" and "405" Reservoirs. Pipelines listed in the BWS CIP are the Dillingham Boulevard and Salt Lake Boulevard Transmission Mains.

The development of four production wells and one exploratory well may be funded by the State's Exploratory Well Drilling Program, which is administered by the Department of Land and Natural Resources (DLNR).

Existing exploratory wells which have been funded by the State include: Kuliouou, Wailupe I, Waialae Nui and Manoa Well II. The DLNR has proposed to construct the production facilities at these sites, and both the exploratory well and production facilities at the Kapakahi Well site.

The BWS long-range plans includes 26 projects described within this document. In addition to funding, development of these proposals will depend upon other factors such as project cost effectiveness and site availability.

TABLE 2

BWS SIX-YEAR CIP
FISCAL YEARS 1986-1991

Priority	Project	Expend Type	Prior Apprns (1000)	Fiscal Year (1000) 1986	1987	1988	1989	1990	1991	Total (1000)
Source Development										
6.	Honolulu Wells - Preparation of engineering reports for Waialae Nui, Manoa II, Kuliouou, and Kapakahi Wells	P & E	--	16	--	--	--	--	--	16
	TOTAL									16
24.	Kahuawai Springs Well Phase I - Preparation of EIS	P & E	20	--	--	--	--	--	--	20
	Phase II - Plans and Specs	P & E	90	--	--	--	--	*164	--	254
	Phase III - Purchase	Land	--	--	--	--	--	--	*50	50
	land and installation	Const.	--	--	--	--	--	--	*1397	1397
	TOTAL									1721
25.	Manoa Well I Phase I - Plans & Specs	P & E	--	--	--	--	--	100	--	100
	Phase II - Installation	Const.	--	--	--	--	--	--	1436	1436
	TOTAL									1536
Storage Development										
2.	Waahila "180" Reservoir	P & E	--	--	363	--	--	--	--	363
		Const.	--	--	--	7262	--	--	--	7262
	TOTAL									7625
6.	Waahila "405" Reservoir	P & E	--	--	--	238	--	--	--	238
		Const.	--	--	--	--	7186	--	--	7186
	TOTAL									7424
Transmission System										
16.	Dillingham Boulevard 42-inch main - Kalihi to Liliha	P & E	110	--	--	--	--	--	--	110

Table 2 Continued

Priority	Project	Expend Type	Prior Apprns (1000)	Fiscal Year (1000) 1986	1987	1988	1989	1990	1991	Total (1000)
	Phase I - Installation along Dillingham Blvd. from Kalihi Street to Waiakamilo Road (2230 lin. ft.); and along Liliha St. from King Street to Vineyard Blvd. (2015 lin. ft.)a/	Const.	--	--	--	--	--	3392	--	3392
	Phase II - Installation along Dillingham Boulevard from Waiakamilo Road to Liliha Street (2750 lin. ft.)	Const.	--	--	--	--	--	--	2416	2416
	TOTAL									5918
18.	Salt Lake Boulevard 36-inch main - Foster Village to Aliamanu	P & E	95	--	--	--	--	--	--	95
	Phase I - Installation from Ala Oli St. to Maluna St. (3,500 lin. ft.)	Const.	1020	--	--	--	--	--	--	1020
	Phase II - Installation from Maluna St. to Ala Lilikoi St. (4,775 lin. ft.)	Const.	--	--	--	--	--	--	4041	4041
	TOTAL									5156

a/ The segment between Waiakamilo Road and King Street (2755 lin. ft.) will be installed at a later date at an approximate cost of $200,000. Although this cost has not been budgeted in the current CIP program, it is anticipated to be expended in fiscal year 1989.

* These items were previously budgeted in F.Y. 83 by were not implemented. The items have been rebudgeted for F.Y. 90 and 91.

Adapted from: City and County of Honolulu, Board of Water Supply, Six-Year Capital Improvements Program, July 1, 1985 to June 30, 1991, June 20, 1985.

IV. THE REGIONAL ENVIRONMENT

IV. THE REGIONAL ENVIRONMENT

A. PHYSICAL ENVIRONMENT

1. Geology

a. Geologic Origin

The Hawaiian archipelago is mostly volcanic in nature. According to a current hypothesis, each island developed over a hot spot, a region of magma generation in the Earth's mantle located beneath the island of Hawaii. Movement of the Pacific Plate over this stationary hot spot, in a northwesterly direction, resulted in the formation of the Hawaiian Island chain. The island chain extends in a northwest-southeast direction, from Kure Atoll to the island of Hawaii, a total distance of about 1,367 miles. Beyond Kure Atoll are submerged seamounts.

Oahu is the third largest island in the archipelago, and the central hub of government, business and industrial activity in the State (see Section IV-B).

Most of Oahu's land mass was formed during the shield building period of the Koolau and Waianae volcanoes. Both developed as separate submarine volcanoes, originally forming two islands.

The Waianae volcano became inactive, but the Koolau volcano continued to grow. Koolau flows bridged the gap between the two islands to form the island of Oahu.

Extensive erosion carved deep valleys, following the shield building stage of the Waianae and Koolau volcanoes. A period of volcanic quiescence followed. A resurgence of minor post-erosional volcanic activity called the Honolulu Volcanic Series occurred along the southeast portion of the Koolau shield and resulted in the eruption of lava, ash and cinders, some of which became interbedded with terrestrial and marine sediments. The Honolulu Volcanic Series vents erupted along northeasterly trending rifts. They form many of the scenic landforms along the dry south-southeast coast of Oahu. Some of the vents, especially the tuff cones, are non-water bearing. However, a few areas are very permeable and the BWS utilizes springs issuing from them, such as Makiki Springs. The valley filling lava flows are partially responsible for the flatness of the major Honolulu valleys.

During the Great Ice Age, world-wide changes in sea level caused the interbedding of marine and terrestrial sediments on the coastal plains of Oahu. For example, fossil reef corals are found miles inland from the present shore, and submarine wave-cut benches are found hundreds of feet below present sea level.

In the coastal area, marine and estuarine sedimentary formations composed of consolidated calcareous reef sediments, muds, and sands predominate, though terrestrial sediments are also present. Further inland, and in the upland valley areas, alluvium and colluvium overlie the younger Honolulu Volcanic Series lava flows and the Koolau basalt. The older alluvium is characterized by greater compaction, weathering and cementation by clays and oxide cements.

2. Hydrology

The Koolau basalt is the principal aquifer in the Honolulu District. Groundwater recharge is transmitted and stored in open spaces within clinker, lava tubes, vesicles, imperfect flow contacts, and cooling cracks.

In the wetter areas of the valleys, ground water is also found perched on dense, impermeable lava flows and weathered ash of the Honolulu Volcanic Series.

There are four types of water sources available in the Honolulu District. These are: *surface water, potable ground water,* brackish ground water, and sea water. Of these, only potable ground water sources and one small surface water source are presently utilized or planned for domestic water development in the next decade. Brackish water is currently used only for golf course irrigation and air conditioning. The remaining water sources are not utilized because of the high capital investment, operational, and/or maintenance costs to treat the water to meet drinking water standards.

There are several types of ground water bodies. The most important and extensive are the bodies of basal ground water that underlie the coastal areas of Oahu. The basal water bodies, also known as Ghyben-Herzberg freshwater lenses, float upon denser water of higher salinity.

Another type of ground water is associated with sheetlike intrusive structures known as dikes which are formed from lava that has solidified within the conduits of a rift zone. Because dike rock is dense and less permeable, ground water is compartmentalized between dikes and is often found at high elevations. Dikes are not perfect barriers, and do allow leakage through them and spill-over from one compartment to another.

Water bodies perched on impermeable soils, ash beds, or dense lava flows comprise another type of ground water source. These sources are only locally significant because of their small size.

Caprock and alluvial sources are also found on Oahu. These sources occur as leakage from basal lenses, direct recharge from rain, or return irrigation water.

a. Basal Water

Figure 2 illustrates the hydrology of basal water. Basal waters are derived from leakage from adjacent dike compartments and from local infiltration of rainfall. Because of the difference in densities, freshwater will float on the heavier seawater. As a general "rule of thumb", the density ratio between freshwater and seawater 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 seawater. This relationship is known as the Ghyben-Herzberg principle. To exemplify this, in the Honolulu District, the freshwater head is about 20 feet above sea level and the implied depth to the midpoint of the transition zone is about 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 yield 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.

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.

b. Dike Water

Water impounded between impermeable dikes in the mountains is called dike water, or high-level water. Dikes are formed when molten magma solidifies in conduits within the volcano's rift zone. These conduits may feed eruptions on the surface but not all magma is extruded. They consist of nearly vertical slabs of dense, massive rock, generally a few feet thick, that extend for considerable distances and cut across existing older lava flows. High level water impounded in permeable lavas occuring between dikes in the interior portions of Oahu is of excellent quality and is

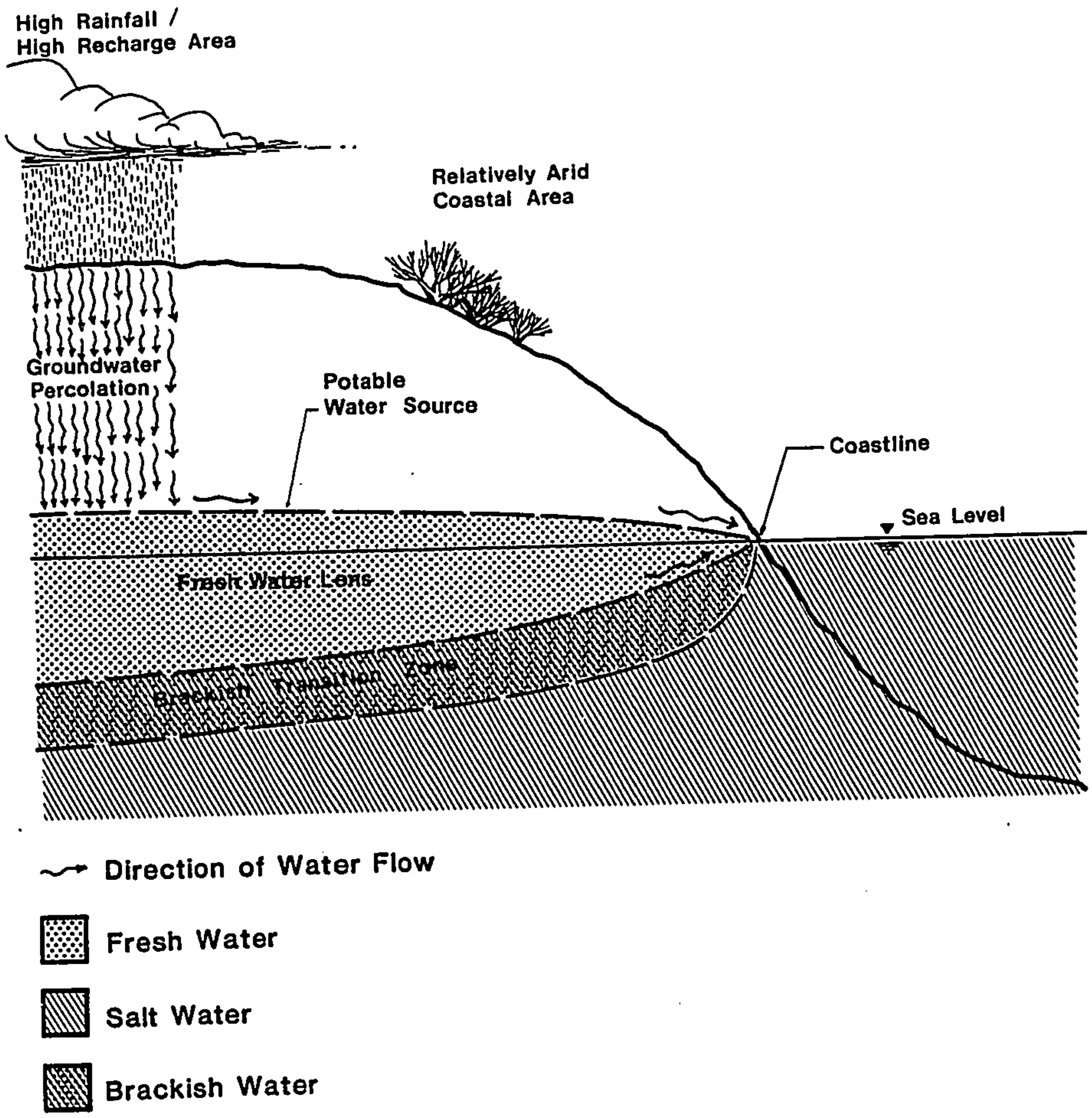

fig.2

Schematic of Basal Lens

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Prepared for : BOARD OF WATER SUPPLY

Prepared by : WILSON OKAMOTO & ASSOCIATES, INC.

generally hydrologically distinct from the basal water found in dike-free areas. The water is not subject to saline contamination because of high head, distance from the sea, and low permeability of the dikes which inhibit the lateral flow of seawater.

In many cases, dike-impounded water discharges at the ground surface where stream erosion has breached the dike. Once breached, the percentage of overall contribution to total stream flow depends on the size of the dike compartment and recharge; factors that determine base flow.

c. Perched Water

Infiltrated rainwater can be perched atop layers of impermeable material such as dense lava flows, solidified ash, or clay-rich sediments. Perched water sometimes occurs as springs. Perched water supplies can be developed by tunnels or by constructing masonry chambers around spring orifices to collect flow and to prevent surface contamination.

d. Caprock Water/Alluvial Water

In some coastal areas there is a relatively thick and somewhat impermeable barrier commonly called "caprock" which is composed of interbedded terrestrial and marine sediments with minor local occurrences of Honolulu Series volcanics. This caprock tends to restrict the seaward flow of basal freshwater and causes the thickness of the freshwater lens to be greater than it would be if the caprock was absent. Depending upon the extensiveness and impermeability of the caprock, the effects could range from minor thickening of a few feet to a very thick lens exceeding a thousand feet. Caprock water is derived from local rainfall, return irrigation water, and leakage of basal water bodies.

Alluvial water consists of water contained in deposits of stream origin. This type of water is derived from the infiltration of stream water and rainfall as well as leakage of groundwater into alluvium. Alluvial water may be found in the alluvium that forms and underlies stream channels, as well as alluvial fans.

3. <u>Topography</u>

The basic topography of the Honolulu District is controlled by the original 5 to 15 degree slopes of the lava flows. Extensive chemical weathering and stream erosion is reflected by deeply incised valleys. Slopes of 30 percent or more are found in the cliff and valley areas of the district and in the vicinity of young volcanic craters. Flatter slopes of 21-30 percent are found at valley heads, and at the outer slopes of Aliamanu, Punchbowl, Diamond Head, and Koko Head craters.

Lands on the coastal plains and at the mouth and floor areas of valleys are relatively flat, having slopes of 10 percent or less.

Areas with flatter slopes are less constrained by topographic features and thus have been targeted for development.

4. Climate

The region's climate is equable throughout the year. January is the coldest month, averaging $72^{o}F$, and August is the warmest, averaging $78^{o}F$. The warmest and coolest months of the year differ by an average of $6.5^{o}F$.

The watersheds are recharged primarily from orographic rainfall that is most persistent between May and September. Kona storms and other tropical disturbances contribute to the yearly recharge. Although the average rainfall in the State is 73 inches per year, Honolulu lies on the leeward coast of Oahu, and hence receives less rain than the windward side. Honolulu receives 20-30 inches of rain per year on the coastal plains, 40-75 inches in the mauka cliffs and valleys, and 100 to 150 inches along the ridgeline of the Koolau Range.

Trade winds persist throughout the year, but are least continuous from October through April. During these months, tropical storms occasionally bring heavy rains, which account for most of the rainfall on the leeward plains.

The average relative humidity is 72 percent in the mornings and 57 percent in the afternoons.

5. Soils

Soil types for all lands in the State have been identified and mapped by the U.S. Department of Agriculture, Soil Conservation Service (SCS). The Honolulu District is composed of many soil types. The soil types have been segregated into seven groups as shown in Table 3.

The upper slopes of the Koolau Range and the slopes surrounding the secondary volcanic craters are characteristically steep and rocky with outcrops of weathered rock and clay soils. However, cinder-ash is also found in these upper slopes, such as in the Tantalus-Roundtop area and also on the inner margins of the coastal plain between Makiki and Downtown.

TABLE 3

SOIL TYPES IN THE HONOLULU DISTRICT

Rock/Rough Areas - rRK, rRO, rRT

Clays, Silts and Loams - EmA, EmB, HnA, HoB, HxD, KaB, KaC, KanE, KavB, KavC, KlA, KlB, KlC, KlaB, KmA, KmaB, KsB, KsC, KsD, KtC, LaA, LaB, LaB3, LaC, LaC3, LaD, LaD3, LaE3, LoC, LoD, LoE, LoF, LuA, LuB, LvA, LvB, MdB, MdC, MdD, MkA, MlA, MnC, MoC, MoD2, MpB, MpC, MPD, MpD2, MpE, Mt, MuB, MuC, MuD, PID, WkA, WzA, HLMG, KTKE, LPE, PYD, TAE, TAF, TCC, TCE, WzC

Beach - BS

Coral Outcropping - CR

Sand - JaC

Fill - FL

Peat - rAAE

*Source: U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, August 1972.

On the lower slopes and floors of valleys, and on most of the coastal plain areas, the soils consists primarily of clays, silts, and loams. The texture of these soils varies from very fine in the coastal areas to rocky towards the higher elevations.

The shoreline is characterized by beaches and sandy areas. The sands are primarily derived from foraminiferal shells, fragmented mollusc shells, and fragments of other reef organisms. In some coastal areas, and at selected inland sites, the lands have been filled (FL) to allow development. These areas have been primarily filled with material dredged from the ocean or hauled from nearby areas.

The soil characteristics vary in specific areas due to the nature of the geological formation of Oahu, as previously discussed. The soil types at each water facility site have been identified in Section VII. Characteristic properties of these soils are presented in Table 4.

Another soil type which has been identified at the water facilities sites is Rockland (rRK). Rock land includes areas where exposed rock covers 25 to 90 percent of the surface. It is characterized by steep lands with very shallow soil, at high elevations.

6. Water Quality

a. Ground Water

Some of the proposed improvements would develop potable water. The ground water which would be developed for domestic use must meet water quality standards established by the State Department of Health (Chapter 20 of Title 11, Administrative Rules), in accordance with Federal requirements under the Safe Drinking Water Act (42 USC 300).

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 are based upon both the environmental quality and the appropriate use of the streams. The State DOH water quality standards (as had been proposed in 1977) were used as a guide to categorize streams. The four categories are:

- Pristine-Preservation

  Streams with high environmental and biological quality. Intended uses for this category varies.

TABLE 4

SOIL PROPERTIES

Soil Type	Slope	Elevation	Annual Rainfall	Parent Material	Depth to Bedrock	Depth to Seasonal High Water Table	Depth From Surface	Texture[1]	Permeability[2]	Water Capacity[3]	Erosion
Ewa Silty Clay Loam (EmA)	0-2%	0-150'	10-30"	Alluvium from igneous rock	5'	5'	0-60"	Silty clay loam	0.63-2.0	0.10-0.12	Slight
Hanalei Silty Clay (HnA)	0-2%	0-300'	20-120"	Alluvium from igneous rock	5'	0-5'	0-13"	Silty clay; peaty in places.	0.63-2.0	0.16-0.18	Slight
							13-36"	Silty clay			
Hanalei Stoney Silty Clay (HoB)	2-6%	0-300'	20-120"	Alluvium from igneous rock	5'	0-5'	0-13"	Silty clay; peaty in places.	0.63-2.0	0.16-0.18	Slight
							13-36"	Silty clay			
Honouliuli Clay (HxA)	0-2%	15-125'	18-30"	Alluvium from igneous rock	5'	5'	0-68"	Clay	0.20-0.63	0.14-0.16	Slight
Kaena Clay (KaB)	2-6%	50-150'	30-45"	Alluvium and colluvium from igneous rock	5'	(seep area)	0-54"	Stoney clay	0.06-0.63	0.11-0.13	Slight
Kawaihapai Clay Loam (KlA)	0-2%	0-300'	30-50"	Alluvium from igneous rock	5'	5'	0-22"	Clay loam; stoney or very stoney in places.	0.63-2.0	0.08-0.15	Slight
							22-54"	Sandy loam	2.0-6.3	0.12-0.14	
Kawaihapai Clay Loam (KlB)	2-6%	0-300'	30-50"	Alluvium from igneous rock	5'	5'	0-22"	Clay loam; stoney or very stoney in places.	0.63-2.0	0.08-0.15	Slight
							22-54"	Sandy loam	2.0-6.3	0.12-0.14	

TABLE 4 - Continued

Soil Type	Slope	Elevation	Annual Rainfall	Parent Material	Depth to Bedrock	Depth to Seasonal High Water Table	Depth From Surface	Texture[1]	Permeability[2]	Water Capacity[3]	Erosion
Kawaihapi Stoney Clay Loam (KlaB)	2-6%	0-300'	30-50"	Alluvium from igneous rock	5'	5'	0-22"	Clay loam; stoney or very stoney in places.	0.63-2.0	0.08-0.15	Moderate
							22-54"	Sandy loam	2.0-6.3	0.12-0.14	
Kokokahi Clay (KtC)	6-12%	0-125'	20-35"	Alluvium and colluvium from igneous rock	5'	(seep area)	0-44"	Clay or very stoney clay	0.06-0.63	0.12-0.14	Slight to moderate
Kokokahi Very Stoney Clay (KTKE)	0-35%	0-125'	20-35"	Alluvium and colluvium from igneous rock	5'	(seep area)	0-44"	Clay or very stoney clay with boulders	0.06-0.63	0.12-0.14	Moderate to severe
Lahaina Silty Clay (LaC)	7-15%	10-1500'	20-35"	Material weathered from igneous rock	5'	5'	0-31"	Silty clay.	0.63-2.0	0.10-0.12	Moderate
							31-60"	Silty clay loam	0.63-2.0	0.11-0.13	
Lolekaa Silty Clay (LoC)	8-15%	0-500'	70-90"	Old, gravelly, Alluvium and colluvium	5'	5'	0-42"	Silty clay	2.0-6.3	0.10-0.12	Slight to moderate
							42-65"	Loam	2.0-6.3	0.11-0.13	
Lolekaa Silty Clay (LoD)	15-25%	0-500'	70-90"	Old, gravelly, Alluvium and colluvium	5'	5'	0-42"	Silty clay	2.0-6.3	0.10-0.12	Moderate
							42-65"	Loam	2.0-6.3	0.11-0.13	Moderate to severe
Lolekaa Silty Clay (LoE)	25-40%	0-500'	70-90"	Old, gravelly, Alluvium and colluvium	5'	5'	0-42"	Silty clay	2.0-6.3	0.10-0.12	Moderate
							42-65"	Loam	2.0-6.3	0.11-0.13	Moderate to severe

TABLE 4 - Continued

Soil Type	Slope	Elevation	Annual Rainfall	Parent Material	Depth to Bedrock	Depth to Seasonal High Water Table	Depth From Surface	Texture[1]	Permeability[2]	Water Capacity[3]	Erosion
Lualualei Extremely Stoney Clay (LPE)	3-35%	10-125'	18-30"	Alluvium and colluvium	5'	5'	0-60"	Clay	0.06-0.20	0.11-0.13	Moderate to severe
Makiki Clay Loam (MkA)	0-2%	20-200'	30-60"	Alluvium mixed with volcanic ash and cinders	1.5'	5'	0-54"	Clay loam; stoney in places	2.0-6.3	0.13-0.15	Slight
Makiki Stoney Clay Loam (MIA)	0-3%	20-200'	30-60"	Alluvium mixed with volcanic ash and cinders	1.5'	5'	0-54"	Clay loam; stoney	2.0-6.3	0.13-0.15	Slight
Pamoa Silty Clay (PID)	5-20%	100-1500'	15-30"	Fine-textured old alluvium	5'	5'	0-62"	Silty clay and clay	0.2-0.63	0.09-0.11	Moderate to severe
Tantalus Silt Loam (TAE)	15-40%	100-2200'	50-150"	Volcanic ash and material weathered from cinders	1-3'	5'	0-29"	Silty clay loam, silt loam, and very very fine sandy loam.	2.0-6.3	--	Moderate
							29"	Cinders			
Tantalus Silt Loam (TAF)	40-70%	100-2200'	50-150"	Volcanic ash and material weathered from cinders	1-3'	5'	0-29"	Silty clay loam, silt loam, and very fine sandy loam.	2.0-6.3	--	Severe
							29"	Cinders			
Tantalus Silty Clay Loam (TCC)	8-15%	100-2200'	50-150"	Volcanic ash and material weathered from cinders	1-3'	5'	0-29"	Silty clay loam, silt loam, and very fine sandy loam.	2.0-6.3	--	Slight
							29"	Cinders			

TABLE 4 - Continued

Soil Type	Slope	Elevation	Annual Rainfall	Parent Material	Depth to Bedrock	Depth to Seasonal High Water Table	Depth From Surface	Texture[1]	Permeability[2]	Water Capacity[3]	Erosion
Waipahu Silty Clay (WzC)	6-12%	0-125'	25-35"	Old alluvium from igneous rock	5'	5'	0-70"	Silty clay	0.20-2.0	0.11-0.13	Moderate

1 Dominant USDA soil texture.

2 In inches per hour.

3 In inches per inch of soil

Source: U.S. Soil Conserveration Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, August, 1972.

- Limited Consumptive

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

- Exploitive-Consumptive

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

- Construct-Alter

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

The Nuuanu and Manoa Streams are categorized as Limited Consumptive; Halawa, Moanalua, Waialaenui, Wailupe, Pia and Kuliouou as Exploitive-Consumptive; and Kalihi, Kapalama and Makiki as Construct-Alter (see Table 5). All of the perennial streams in the Honolulu District have been modified to some extent (see Table 6).

7. Flood Hazard

Areas subject to coastal flooding or tsunami inundation are identified on Flood Insurance Rate Maps (FIRM) prepared for the City and County of Honolulu by the Federal Insurance Administration. Within the Honolulu District, areas prone to flood and tsunami hazards include the coastal areas between Sandy Beach Park and Queens Beach. The shore areas along Portlock Road to Niu Stream, including the shores of Kuliouou and the Paiko Peninsula, are also prone to indundation. At Aina Haina, the flood prone areas extend inland along Wailupe and Kului Streams. Further south, in the Kahala/Waialae-Iki area, the flood zone includes much of the coastal area and extends inland along Waialae-Iki Stream, Waialae-Nui Stream and Kapakahi Stream. Much of the Waikiki/McCully/Moiliili area is within the hazard zone. This area is generally bounded by Kapahulu Avenue and Winam Avenue to the east, Nakookoo Street and South King Street to the north, Kaluaokalani Way to the west and the shoreline to the south. Other flood prone areas include lands at Ala Moana Park, Kewalo Basin, Pearl Harbor, areas in Kapalama and along Nuuanu and Waolani Streams.

Flood hazard areas (which include tsunami indundation areas) are categorized by the probability of hazard, based upon surveys prepared by the U.S. Army Corps of Engineers. The flood hazard

TABLE 5

EXISTING STREAM - ECOLOGICAL CHARACTERISTICS

Stream Characteristics / Streams	Halawa	Moanalua	Kalihi	Kapalama	Nuuanu	Makiki	Manoa	Waialaenui	Wailupe	Pia	Kuliouou
Ecological Quality Status											
Pristine-Preservation											
Limited Consumptive					X		X				
Exploitive-Consumptive	X	X						X	X	X	X
Construct-Alter			X	X		X					
Stream Flow											
Continuous	X		X		X		X				
Interrupted		X		X		X		X	X	X	X

Source: Adapted from Amadeo S. Timbol and John A. Maciolek, Stream Channel Modification in Hawaii, Part A: Statewide Inventory of Streams Habitat Factors and Associated Biota, April 1978.

TABLE 6

SOME PHYSICAL CHARACTERISTICS OF HONOLULU STREAMS
HAVING CHANNEL MODIFICATIONS

Stream	Class[a]	Length of Channel (km) Total	Length of Channel (km) Modified	Alteration Features Type[b]	Alteration Features Date[c]	Location Distance (km)[d]	Location Elevation (m)[e]
Halawa Stream	C	40	4.1	1,3,4	1937, 1974	0	0
Moanalua Stream	I	44	15.1	1,2,3,4	1959, 1975	0	0
Kalihi Stream	C	18	4.8	3,4	1927, 1969	0	0
Kapalama Stream	I	9	9.0	1,2,3,4, 5,6	1938, 1965	0	0
Nuuanu Stream	C	30	17.9	1,2,3,4, 5	1932, 1975	0	0
Makiki Stream	I	10	3.2	1,3,4,6	1920, 1972	0	0
Manoa Stream	C	34	8.3	1,2,3,4	1960, 1973	0	0
Waialaenui Stream	I	14	7.5	1,3,4	1961, 1975	0	0
Wailupe Stream	I	13	3.2	2,3,4	1930, 1955	0.1	0
Pia Stream	I	11	2.3	1,3	1964, 1969	0	0
Kuliouou Stream	I	4	1.6	1	1969, 1973	0	0

[a] C = continuous, I = interrupted.

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

[c] Year of earliest and most recent channel modification.

[d] Horizontal distance from mouth to lowest point of channel modification.

[e] Elevation of lowest modification.

Source: Adapted from Amadeo S. Timbol and John A. Maciolek, Stream Modification in Hawaii, Part A: Statewide Inventory of Streams, Habitat Factors and Associated Biota, April 1978.

zones, within which the project sites are located, are indicated in Section VI. All of the proposed project sites are located in zones C or D, except for Site No. 13, Manoa Well III which is located in zones A5 and A10, and Site No. T3, Kakaako District Tranmission Main, a portion of which is located in zone A4 (see Table 7).

8. Stream Flow

Stream flow data compiled by the U.S. Geological Survey (USGS) provides flow data at specific points along individual streams. The following streams in the Honolulu District are presently gaged by the U.S.G.S. (U.S.G.S., 1983).

a. Kuliouou Stream (Station 2479)
b. Wailupe Stream (Station 2475)
c. Palolo Stream (Station 2440)
d. Manoa Stream (and tributary) (Station 2471, 2385, 2405)
e. Pauoa Stream (Station 2375)
f. Nuuanu Stream (Station 2320)
g. Waolani Stream (tributary to Nuuanu Stream) (Station 2354)
h. Kalihi Stream (Stations 2293, 2290, 2289)
i. Moanalua Stream (Station 2286, 2282, 2280)

Based on the number and locations of the U.S.G.S. gages, only the Kalihi Stream has data which enables an interpretation of a progressive increase in flows in a downstream direction. This arrangement may facilitate the monitoring of flows in conjunction with the development of the Kalihi Wells II and III.

Since existing gaging station locations for other major streams in the Honolulu District may not be suitable for relating source development to stream flow, the BWS shall arrange for appropriate stream flow monitoring by the U.S.G.S. for development of proposed sources.

Technical data compiled for Honolulu District gaging stations for the water year 1983 is presented in Appendix A. Additional data such as the amount of stream gain which occurs below the static head of proposed water sources, was not available.

9. Air Quality

Air quality measurements are performed by the State Department of Health year round. Sampling stations at Downtown Honolulu, Kalihi Kai and Waikiki report total suspended particles and sulfur dioxide for 1981, as presented in Table 8.

TABLE 7

FLOOD HAZARD ZONE DESIGNATIONS

Zone	Explanation
A	Areas with 1% probability of flooding in a given year (base flood elevations and flood hazard factors not determined).
A1-A30*	Areas with 1% probability of flooding in a given year (base flood elevations and flood hazard factors determined).
C	Areas of minimal flooding.
D	Areas of undetermined, but possible flooding.

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

* The numerals indicate the magnitude of difference between the 100-year and 10-year flood elevations. For numerals between 1-20, the difference is one half of the value; for values greater than 20, the difference is 10 less than the numerals shown. This information is used in establishing insurance rates.

TABLE 8

AIR QUALITY AT SPECIFIED LOCATIONS IN HONOLULU: 1981[1/]

Sampling Station	Total Suspended Particles Annual Minimum	Range Maximum	Arithmatic Average	Sulfur Dioxide Annual Minimum	Range Maximum	Arithmetic Average
Downtown	23	75	40	5	44	19
Kalihi Kai	32	93	53	5	8	5
Waikiki	18	78	36	5	5	5
Standards[2/]						
Primary			75			80
Secondary			60			60

1/ 24-hour sampling, in micrograms per cubic meter
2/ *National ambient air quality standards.*

Source: State of Hawaii, Data Book 1982.

The Department of Health also estimates emissions by type of source. These are based upon emission factors from the U.S. Environmental Protection Agency, and an inventory of pollutant sources in the State. Air quality in the Honolulu District is influenced mostly by motor vehicles with comparatively minor effects being contributed by industrial pollutants.

Urbanization concentrates the usage of large numbers of motor vehicles in Honolulu. Although the air is generally clean and low in pollutants, physical and meteorological factors may concentrate high levels of motor vehicle pollutants in certain parts of the city. These factors include: light and variable wind flow; modified local air circulation (due to tall buildings); higher surface temperatures (caused by buildings, paved surfaces and traffic); and large amounts of direct sunshine.

As documented in the Atlas of Hawaii, air quality was studied during the period between July through September 1971. During light traffic conditions, concentrations for suspended particles and carbon monoxide varied between 11 to 24 micrograms per cubic meter (ug/m^3) and 0.05 to 2.0 milligrams per cubic meter (mg/m^3) respectively. Heavy-traffic conditions raised pollution concentrations, especially at congested intersections. Concentrations of suspended particles were found to be as high as 70-90 ug/m^3 and 40 mg/m^3 for carbon monoxide in specific problem areas in downtown and near the University of Hawaii.

In general, however, trade winds are able to provide sufficient air circulation to disperse these pollutants.

10. Agricultural Lands of Importance

The State Department of Agriculture has identified agricultural lands of importance for the State, and categorizes these into three groups. "Prime" agriculture lands are those which 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 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. For example, specialty crops such as taro farming or aquaculture development may be very productive in areas which may not be desirable for traditional farming crops, if the areas being farmed have the unique characteristics required by these special crops. "Other" important agricultural lands include agricultural lands, which have not been rated "prime" nor "unique". These lands are also of statewide or local importance, however, 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.

The Honolulu District is a major urban area and has very few areas of agricultural importance. Prime agricultural land is limited to small areas in Moanalua, Palolo, Waialae Iki and Hawaii Kai. Other agricultural lands are found in scattered areas, in Fort Shafter, Makiki, Saint Louis Heights, Waialae-Iki and Hawaii Kai. The proposed water system improvements projects will not be situated on agricultural lands.

11. Wetland Areas

Wetlands have been described by the U.S. Army Corps of Engineers as "those lands subject to periodic to permanent indundation during the growing season which causes the selection of a group or an association of plants that can tolerate the wet conditions" (Elliot, 1977). These areas are unusually moist and provide habitats for wildlife which require this special environment. There are four wetland areas in the Honolulu District: Nuuanu Reservoirs, Paiko Lagoon, Diamond Head Crater, and Kaau Crater (C.O.E., 1977).

Three small open reservoirs and one large open reservoir are located in the upper end of Nuuanu Valley, along Nuuanu Pali Drive. One of the small reservoirs is referred to as the BWS Nuuanu Aerator facility. The reservoirs are frequented by waterbirds such as the Hawaiian coot and gallinule. The Nuuanu Reservoirs are owned and operated by the BWS.

The Nuuanu Reservoirs can control flooding that occurs occasionally in the area. The wetlands may be useful in the recharging of the perched water system, however, the wetlands do not serve to recharge the basal system.

Paiko Lagoon is fed by Kuliouou Stream and a nearby freshwater spring. Tidal fluctuations periodically expose its mudflats and a flat sand-covered reef. The maximum depth over the mudflat in the lagoon is 0.5 to 0.7 meters.

Near the center of Diamond Head Crater, runoff collects in a small pool, which is usually less than two feet deep. Currently there is a pump at the site which limits the amount of open water. Although the pond had covered a more extensive area during wet periods, foul odors from stagnating water and the presence of mosquitoes prompted the installation of the water pump.

Kaau Crater, a Honolulu Volcanic Series vent, is located at the headwall of Palolo Valley in a relatively high rainfall area. It is a naturally occurring bog and was once a natural lake (U.S. Department of the Army, Corps of Engineers, Wetlands and Wetland Vegetation of Hawaii, September 1977). Underlain by sediments washed into the crater, the water is poorly drained. Encroachment of marsh vegetation has since taken over the lake, and today the crater is covered by a mucky peat. The BWS Palolo tunnel is driven beneath the crater, and serves the areas of Palolo and upper Wilhelmina Rise.

None of the proposed water facility improvements will be located in these wetland areas with the exception of the Nuuanu Aerator Well which will be located on the grounds of the existing BWS Nuuanu Aerator facility.

12. Archaeological/Historic Sites

At the time of Captain James Cook's arrival in the Hawaiian islands, native Hawaiians lived in a cultural tradition 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 changed by the arrival of Europeans and other visitors. Contact with Europeans proliferated as merchant ships passed through the island and as missionaries arrived.

Historical features, which remain today, are a rememberance of the unique evolution of the islands' cultural heritage. In the Honolulu District, there are many such features. Presented in Table 9 are those historic sites in the Honolulu District which are listed on the Hawaii or National Registers, and those which have been recommended to the National Register.

The majority of the proposed project sites are situated in highly urbanized environments which, in the recent past have been altered or modified. The probability of uncovering significant archaeological remains at these sites, therefore, is small. However, as individual projects are undertaken, supplemental environmental impact statements may be required. Supplemental environmental impact statements will address archaeological characteristics for the project site.

If archaeological sites or remains such as human bones, stone artifacts, charcoal deposits, abandoned lo'i or petroglyphs are uncovered during construction of any of the proposed water system improvements, the BWS will suspend work and immediately notify the State Historic Preservation Office (SHPO).

TABLE 9

HISTORIC SITES IN THE HONOLULU DISTRICT

Site Name	HAWAII REGISTER Registered	NATIONAL REGISTER Recommended	NATIONAL REGISTER Registered	TMK[1]
Pohaku Ka Luahine	--	--	07/23/73	1-1-13:1
Pearl Harbor Naval Base	--	--	1966 NHL[3]	9-1-1, 10, 17 9-4-1,8,39, 48, 49 9-6-01 9-7-1, 4, 8, 10, 13, 18, 27 9-8-3, 4, 7, 9, 14, 19, 21 9-9-01, 3, 4
U.S.S. Bowfin	07/30/82	07/30/82	11/16/82	9-9-03:31
Nuuanu Petroglyphs	02/20/79	02/20/79	03/14/73	2-2-21:12, 19
John T. Waterhouse Home	08/14/78	08/14/78	--	1-8-6:7
The Hawaii Theatre	03/03/78	03/03/78	11/14/78	2-1-3:14
Kakaako Pumping Station	08/17/77	08/17/77	10/04/78	2-1-57:1
Georges de S. Canavarro House	01/07/80	01/07/80	05/28/80	1-8-26:5
Kamehameha V Post Office	02/20/79	02/20/79	05/05/72	2-1-2:12
Queen Emma's Summer House (Hanaiakamalama)	08/11/78	08/11/78	08/07/72	2-2-34:27
Alexander & Baldwin Building	06/02/79	06/02/79	09/07/79	2-1-13:1

Table 9 - Continued

Site Name	HAWAII REGISTER Registered	NATIONAL REGISTER Recommended	NATIONAL REGISTER Registered	TMK[1]/
C. Brewer Building	11/19/79	11/19/79	04/02/80	2-1-13:3
Linekona School	12/17/79	12/17/79	05/28/80	2-4-2:20
John Guild Residence	02/28/80	02/28/80	08/01/80	2-8-16:28
McKinley High School	05/03/80	05/03/80	08/11/80	2-3-9:1 (por)
War Memorial Natatorium	05/03/80	05/03/80	08/11/80	3-1-31:3
Alexander Young Building	06/09/80	06/09/80	08/05/80	2-1-11:7
Fire Stations of Oahu	07/19/80	07/19/80	12/02/80	
*Palama		*04/21/76		1-5-5:14
Kaimuki				3-2-36:7 (por)
Kalihi				1-3-5:22 (por)
Makiki				2-4-29:29 (por)
Old Kakaako				2-1-31:18
Waialua				6-6-13:3 (por)
Central				2-1-9:26
Toyo Theatre	09/08/80	09/08/80	--	1-7-26:10 (por)
Bishop Museum Complex	09/10/80	09/10/80	07/26/82	1-6-24:1 (por)
Lihiwai (George R. Carter House)	09/29/80	09/29/80	07/26/82	2-2-50:12 36, 42, 43
Aloha Tower	01/29/81	02/04/74	05/13/76	2-1-1:13
Our Lady of Peace Cathedral	07/25/81	05/10/71	08/07/72	2-1-10:14
Royal Mausoleum	01/29/81	04/05/71	08/07/72	2-2-21:12
Moana Hotel	--	--	08/07/72	2-6-1:12
Joseph W. Podmore Building	--	--	03/24/83	2-1-16:4

Table 9 - Continued

Site Name	HAWAII REGISTER Registered	NATIONAL REGISTER Recommended	NATIONAL REGISTER Registered	TMK1/
H. Alexander Walker Residence	07/30/82	--	04/24/73	1-8-8:1
Washington Place	--	--	06/18/73	2-1-18:1
U.S. Immigration Office	--	--	08/14/73	2-1-28:2
U.S. Post Office, Customhouse and Courthouse	--	--	01/27/75	2-1-25:4
U.S. Coast Guard Diamond Head Lighthouse (Diamond Head Lighthouse)	--	--	10/31/80	3-1-42:3
Thomas Square	--	--	04/25/72	2-4-1:1
Punchbowl Crater and National Cemetery (Puowaina-Hill of Sacrifice)	--	--	01/11/76	2-2-5:1, 2, 19, 33
St. Andrew's Cathedral	--	--	07/02/73	2-1-18:2
Royal Brewery	--	--	11/29/72	2-1-31:21
Punahou School Campus	4/26/71	--	08/07/72	2-8-18:1
Aliiolani Hale (Judiciary Building)	--	--	02/02/72	2-1-25:3
Chinatown Historical District	--	--	01/17/73	1-7-02, 03
Dillingham Transportation Building	--	--	09/07/79	2-1-14:3
Lishman Building	--	--	09/13/78	2-4-22:1
Merchant Street Historical District	--	--	06/28/73	1-7-2:35-36 2-1-2:12, 19, 20, 24, 32, 33, 34, 35

Table 9 - Continued

Site Name	HAWAII REGISTER Registered	NATIONAL REGISTER Recommended	NATIONAL REGISTER Registered	TMK1/
Kawaiahao Church and Mission Houses	--	--	1966 NHL	2-1-32:2, 15, 17, 22, 23, 24
Kapuaiwa Building	--	--	07/02/73	2-1-25:3
Iolani Palace	--	--	1966 NHL	2-1-25:2
Honolulu Academy of Arts	--	--	03/25/72	2-4-14:21
Hawaii Capitol Historic District	--	--	12/01/78	--
Falls of Clyde	--	--	07/02/73	2-1-15:11
Ernest Shelton Van Tassel Residence (Nutridge)	09/21/81	09/21/81	12/16/81	2-5-19:4
Makaniolu Shelter	09/02/78	09/02/78	--	3-8-4:1
U.S. Coast Guard Makapuu Point Lighthouse (Makapuu Point Lighthouse)	--	--	12/07/77	3-9-11:1
*University of Hawaii:	3/19/84	--	--	
Wist Hall				2-8-15:por.1
Hawaii Hall				2-8-23:por.3
George Hall				
Dean Hall				
Gartley Hall				
Crawford Hall				
Varney Circle				
Founder's Gate				
Andrews Outdoor Theatre				
Krauss Hall		8/24/84		

1/ Includes all or part of area indicated

2/ National Historic Landmark

Source: State of Hawaii, Department of Land and Natural Resources, State Parks Outdoor Recreation and Historic Sites Division, 1983, *1985.

Appropriate measures such as preserving the site, salvaging excavations or destroying the site without further study, will be coordinated with the SHPO.

For the few projects located in undeveloped areas, an archaeologist will be hired when the BWS proceeds with a particular project to survey the selected construction area for potential archaeological or historical resources.

13. Flora and Fauna

a. Flora

Vegetative cover at each project site is presented in Section VI. There are no rare or endangered plants known to occur at the project sites.

The vegetation at the project sites are identified by the habitat classificaton system developed by the Jones and Stokes Association (JSA) and field observation. In an unpublished paper for the *Hawaii Fish and Wildlife Plan*, JSA developed plant associations, or groupings of "plant species that tend to occur together in stands of vegetation". Similar plant associations were used to characterize habitat classes, which were then mapped.

In this report a single list of typical plant species which occur within each of four habitat classes is included (see Table 10). The lists indicate plant species which are typical of its habitat class, but all species listed may not occur at the site (the JSA habitat class designation for each project site is presented in Section VII). Only species of plant associations which occur on Oahu are included in the lists. The designation "Ur" used to describe developed, urban areas.

b. Fauna

There are no rare or endangered wildlife species known to occur at the project sites. The Honolulu District has been extensively developed and because of this, the birds found in the area are those common to areas of urban development. Introduced species of birds that are frequently seen include bulbuls, shama thrush, lace-necked and barred doves, Brazilian and red-necked cardinals, house sparrows, mynahs and white-eyes (mejiro). There are no endangered or native Hawaiian species identified for the area surrounding the project sites. However, the possibility exists that the Hawaiian Pueo (Asio flammeus sandwichensis) may utilize the area within the District for foraging.

TABLE 10
VEGETATION BY HABITAT CLASS

DRY SHRUB FORMATIONS (DS)

Scientific Name	Common Name
Vachellia farnesiana	klu
Prosopia chilensis	kiawe; algoroba
Sida fallax	ilima
Sida rhombifolia	ilima
Lantana camara	lantana
Waltheria indica	uhaloa
Chamaecrista leschenaultiana	Japanese tea
Abutilon mollissimum	mao; Hawaiian abutilon
Heteropogon contortus	pili grass
Chenopodium murale	nettle goosefoot
Malvastrum coromandelianum	false mallow
Chloris barbata	swollen fingergrass
Malva parviflora	little mallow
Sonchus oleraceus	pualele
Portulaca oleracea	pigweed; common purslane
Galinsoga parviflora	galinsoga
Bidens pilosa	pilipili; Spanish needle
Opuntia megacantha	cactus; panini
Panicum maximum	Guinea grass
Stachytarpheta jamaicensis	Jamaica vervain
Rhynchelvtrym repens	natal redtop
Panicum torridum	kakonakona; torrid panicgrass
Cynodon dactylon	Bermuda grass
Xanthium saccharatum	cocklebur
Laucaena glauca	koa haole
Ageratum conyzoides	ageratum
Emilia sonchifolia	red pualele
Argemone glauca	puakala; Hawaiian poppy
Erigeron albidus	horseweed
Reichardia picroides	
Dodonaea eriocarpa	aalii
Schinus terebinthifolius	Christmas berry
Psidium guajava	guava
Cenchrus echinatus	sandbur
Commelina diffusa	honohono
Oplismenus hirtellus	basket grass

MOIST SHRUB, SHRUB - FERN, AND FERN FORMATIONS (MS)

Scientific Name	Common Name
Psidium guajava	guava
Lantana camara	lantana
Leucaena glauca	koa haole

Stachytarpheta cayennensis	false vervain; joce
Indigofera suffruticosa	indigo
Nephrolepis exaltata	Boston fern
Sphenomeris chusana	palaa
Vergena litoralis	verbena
Bidens pilosa	pilipili; Spanish needle
Desmodium sandwicense	Spanish clover
Ipomoea indica	morning glory
Cynodon dactylon	Bermuda grass
Chrysopogon aciculatus	pilipili-ula
Paspalum orbiculare	rice grass
Brachiaria mutica	para grass
Phynchelytrum repens	natal redtop

CLOUD ZONE FOREST FORMATIONS (OKF)*

Scientific Name	Common Name
Eupritchardia martii	loulu palm
Cheirodendron platyphyllum	lapalapa
Metrosideros collina	ohia lehua
Bobea elatior	ahakea
Straussia kaduana	kopiko
Fagara oahuensis	
Labordia glabre	kamakahala
Lobelia gaudichaudiii	
Gouldia coriacea	
Myrsine lesseriana	kolea
Platydesma campanulata	
Dubautia plantaginea	
Broussaissia arguta	
Ilex sandwicensis	kawa'u
Psychotria hexandra	
Astellia veratroides	painui
Polypodiam lineare	
Peperomia ellipticibacca	alaawanui
Phyllostegia lantanoides	
Panicum koolauense	koolau panicgrass
Dubautia laxa	naenae
Isachne pallens	
Mariscus angustifolius	
Paspalum conjugatum	Hilo grass
Lycopodium cernuum	wawae'iole

RAIN FOREST FORMATION (OKF)*

Scientific Name	Common Name
Touchardia latifolia	olona
Rubus rosaefolius	thimbleberry
Dryopteris palaecea	alapaio

Cibotium chamissoi	tree fern; hapuu
Cibotium menziesii	tree fern; hapuu-ii
Dicranopteris linearis	staghorn fern; uluhe
Nephrolepis exaltata	Boston fern
Sadleria cyatheoides	amaumau
Clermontia oblongifolia	
Clermontia macrocarpa	
Broussaissia arguta	
Gonochormus spp.	
Bleachnum occidentalis	
Peperomia spp.	alaawanui
Elaphoglossum reticulatum	
Polypodium pseudogrammitus	
Polypodium lineare	
Mecodium recurvum	
Astellia veratroides	painiu
Metrosideros collina	ohia lehua
Bobea elatior	ahakea
Syzugium sandwicensis	ohia ha
Acacia koa	koa
Straussia Mariniana	kopiko
Elaeocarpus bifidus	kalia
Antidesma platyphyllum	hame
Dodonaea sandwicensis	aalii
Cheirodendron tryginum	olapa
Charpentiera ovata	papala
Ilex sandwicensis	kawa'u
Myrsine lessertiana	kolea
Claoxylon sandwicense	
Psychotria hexandra	
Pelea sandwicensis	alani
Cyanea angustrifolia	
Cyanea acuminata	
Cyrtandra grandiflora	
Cyrtandra plaudosa	
Phyllostegia grandiflora	
Gouldia coriacea	
Hedyotis centranthoides	
Rollandra crispa	

* Mapping combined both habitat classes.

Source: Adapted from Jones and Stokes Association "Habitat Classification and Mapping" Hawaii Fish and Wildlife Plan, State Division of Fish and Game, Honolulu, Hawaii 1973, unpublished.

Due to the development of the area, the animals found are those common to urban areas and include the domestic pets of urbanresidences and strays. Other animals such as the mongoose, rat and mouse are probably found also. Although feral pigs are inhabitants of valleys, it is unlikely that they would venture down from the Forest Reserve.

The stream fauna within the district are presented in Table 11. As indicated, most of these are introduced. The table only indicates the occurrence of these species within some part of the stream, and should not be interpreted to mean the occurrence of the species throughout the stream.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Economy

The Honolulu District encompasses the most urbanized area of the State. The area is a focal point of commercial, industrial governmental and corporate activity. Many statewide activities are headquartered or have major distributional activities located here.

The commercial character of the District is best exemplified by the Ala Moana Shopping Center, which is the World's largest open mall shopping complex. There are also many other shopping centers and a multitude of smaller commercial establishments which provide a variety of goods and services.

With the City of Honolulu as the State Capital, the Honolulu District houses most of the political and administrative government activities in the State. Most public agencies and offices are based here, including federal government regional offices, the State Legislature, the Governor's office, all major State departments, and the main functions of the City and County of Honolulu.

Always in close relation to these activities, the area is also the locale of statewide headquarters or main offices for many trusts and foundations, industries, corporations and financial institutions. These include such organizations as AMFAC, Inc.; the Dillingham Corporation; the Bishop Estate; the Campbell Estate; C. Brewer & Co., Ltd.; First Hawaiian Bank; and the Bank of Hawaii.

Resort activity and tourism also occur in Honolulu. At the waterfront, Waikiki Beach thrives as a busy destination spot. The area supports many hotels, condominiums, night clubs, theaters, restaurants, retail shops, and other visitor support facilities and services.

TABLE 11

STREAM BIOTA

Stream Biota / Streams	Halawa	Moanalua	Kalihi	Kapalama	Nuuanu	Pauoa	Makiki	Manoa	Waialaenui	Wailupe	Pia	Kuliouou
Fauna												
Crustaceans												
* *Atya bisulcata* (Atyid shirmp)					X		X					
* *Macrobrachium grandimanus* (Hawaiian Prawn)		X			X							
Macrobrachium lar (Tahitian Prawn)		X			X	X						
Procambarus clarkii (Crayfish)	X		X	X	X	X	X					
Pisces												
+ *Awaous genivittatus* (Goby)		X	X	X	X		X					
+ *Awaous stamineus* (Goby)		X	X		X		X					
Cyprinus carpio (Carp)							X					
Clarias fuscus (Chinese Catfish)		X	X	X	X		X					
+ *Eleotris sandwicensis* (Eleotrid)		X	X		X		X					
Gambusia affinis (Mosquito fish)		X		X	X		X					
Misgurnus anguillicaudatus (Oriental weatherfish)			X	X	X		X		X			
Micropterus dolomieui (Smallmouth bass)												
Opicephalus striatus (Snakehead)					X							
Poecilia latipinna (Sailfin molly)		X			X							
Poecilia mexicana (Shortfin molly)		X		X	X		X					
Poecilia reticulata (Guppy)		X	X	X	X	X	X		X			

Table 11 - Continued

Stream Biota	Halawa	Moanalua	Kalihi	Kapalama	Nuuanu	Pauoa	Makiki	Manoa	Waialaenui	Wailupe	Pia	Kuliouou
Poecilia vittata (Topminnow)			X			X						
* Sicydium stimpsoni (Goby)												
Tilapia mossambica (Tilapia)			X	X		X		X				
Xiphophorus helleri (Green swordtail)			X	X	X	X		X				
Xiphophorus maculatus (Southern platyfish)			X									

* Endemic
+ Indigenous
All others, introduced.

Source: Adapted from Amadeo S. Timbol and John A. Maciolek, Stream Channel Modification in Hawaii, Part A: Statewide Inventory of Streams, Habitat Factors and Associated Biota, April 1978.

Note: Tributaries of major streams may not be included in this table if no data regarding biota that inhabit these tributaries is available (i.e., Pukele Stream is a tributary of Manoa Stream, Moleka Stream is a tributary of Makiki Stream).

2. Population

The high level of economic activity that occurs on Oahu offers many opportunities for employment, business development and other conditions which encourage people to locate here. Hence, it is not surprising that a majority of the State's population resides on Oahu, and most of these people live in the Honolulu District. In 1980, the State population was 964,691, but 762,534 people lived on Oahu and there were 365,017 people in the Honolulu District (State Data Book 1982).

In essence, in 1980 approximately 37.8% of the State's population occupied 1.3% of the State's total land area.

The high concentration of the population in this limited area has also caused a concentration of demand for water. Population statistics are very important to predict the need for water so that appropriate measures may be taken to accommodate this need. Tables 12 and 13 indicate actual and projected populations for Oahu and the Honolulu District for the years 1970-2000.

The State Department of Planning and Economic Development projects the estimated population growth for Oahu and the neighbor islands. Distribution of the projected population growth within the BWS water districts are provided by the City's Department of General Planning.

3. Public Services

a. Water System

The BWS is not the sole provider of water on Oahu, but is the major provider in Honolulu. There are many privately owned and operated water sources which provide service to agriculture, commercial and other establishments. The BWS, however, is the primary water supplier for most urbanized uses.

Demand. The demand for water is closely linked with population size, although there are many other factors which influence consumption patterns.

The average daily distribution of water through the municipal system has risen from less than a million gallons, a century ago, to more than 130 million gallons in 1980. Based upon the size of the population to be served, the BWS can project water demand.

TABLE 12

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: City and County of Honolulu, Board of Water Supply, Oahu Water Plan, July 1982.

TABLE 13

ACTUAL AND PROJECTED POPULATION, 1970-2000
HONOLULU DISTRICT

Year	Resident	De Facto	Served by BWS
1970[1]........	324,871	347,072	326,691
1970[2]........	326,320	348,124	327,859
1971.........	333,670	357,414	337,614
1972.........	341,843	371,929	352,594
1973.........	348,161	385,589	366,719
1974.........	351,451	391,983	373,578
1975.........	353,327	394,021	376,081
1976.........	356,553	403,372	385,897
1977.........	357,771	409,646	392,636
1978.........	358,320	415,069	398,524
1979.........	362,577	424,871	408,791
1980[1]........	365,048	428,090	412,362
1980[2]........	365,906	427,352	411,737
1985.........	378,045	440,442	425,442
1990.........	390,291	458,698	443,698
1995.........	401,660	474,769	459,769
2000.........	408,212	479,389	464,389

[1]relates to April 1 population for years 1970 and 1980.

[2]relates to July 1 population for years 1970 to 1980.

Source: City and County of Honolulu, Board of Water Supply, Oahu Water Plan, July, 1982.

Table 14 presents total daily water demand for the years 1970-1980, and projected water demand for 1985 through 2000, in five year intervals. According to BWS projections of population size and per capita consumption rates for the year 2000, an average of about 92.4 million gallons a day will be needed to satisfy demand in Honolulu. This represents a 24 percent increase from the 1980 daily average of 74.32 million gallons.

While the per capita consumption of water for the Honolulu District is roughly equal to that for Oahu, the total daily water demand for Honolulu is about one-half of the total daily demand for Oahu. This is due to a concentration of the population in the Honolulu District.

Water consumption patterns may vary significantly by type of use. Generally, agricultural uses consume the most water, followed by municipal uses and military use.

Among the consumers of municipal supplied water, residential uses consume the most water. Table 15 indicates the distribution of BWS produced water for the year 1978.

In addition to type of use, water consumption is also influenced by a host of other factors such as: weather, geographical location, neighborhood density and affluence, occupancy level, and economic benefits.

Water usage is directly related to the weather cycle. Consumption is low during the rainy winter months and increases significantly during the hot summer months. During a 1978 study period, islandwide pumpage was 17 percent higher in the summer than in the winter, but the difference has been as much as 30 percent higher. This seasonal increase has been attributed to increases in the visitor population and increases in per capita consumption (i.e. for irrigation, filling swimming pools, etc.).

There is a noticeable difference in consumption between wet and dry areas. Consumers living in higher rainfall areas, such as in upper reaches of valleys and in the mountains, may use as little as one-third the amount of water used by consumers living in drier areas. In 1978, the average usage per single family residence was about 350 gallons daily for wet areas such as Wahiawa, Manoa, and Nuuanu, as compared to 850 gallons or more in drier areas such as Waialae-Kahala and Waianae. Overall, the average single family water usage in dry areas was more than double that in wet areas.

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TABLE 14

ACTUAL AND PROJECTED WATER DEMAND, 1970-2000

Year	TOTAL DAILY DEMAND (mgd)		CONSUMPTION PER CAPITA (gpcd)	
	Honolulu District	Total Oahu	Honolulu District	Total Oahu
1970.......	69.84	111.46	213	200
1971.......	71.59	114.97	212	199
1972.......	74.71	120.48	212	198
1973.......	76.75	126.86	209	200
1974.......	72.76	121.59	195	187
1975.......	77.29	134.59	206	203
1976.......	80.64	137.75	209	203
1977.......	79.64	136.99	203	197
1978.......	77.35	132.07	194	187
1979.......	76.37	133.53	187	184
1980.......	74.32	130.09	181	177
1985.......	78.30	141.40	184	181
1990.......	83.90	155.50	189	186
1995.......	89.20	169.60	194	192
2000.......	92.40	181.00	199	198

Adapted from: City and County of Honolulu, Board of Water Supply, Oahu Water Plan, July 1982.

TABLE 15

DAILY CONSUMPTION BY CONSUMER CLASS,
OF BOARD OF WATER SUPPLY PRODUCED WATER
ISLAND OF OAHU
(Year ending October 1978)

Consumer Class	Average (mgd)	Percent of Total
Single Family Residence.....	47.1	41.6%
Multiple Unit Residence.....	19.7	17.4
Commercial..................	15.3	13.5
Hotel.......................	6.4	5.6
Industrial..................	7.4	6.5
U.S. Military...............	3.0	2.7
U.S. Non-Military...........	0.1	0.1
State Government............	7.9	7.0
City Government.............	3.7	3.2
Agriculture.................	2.0	1.8
Religious Institution.......	0.6	0.6
Total.................	113.2	100.0%

Source: City and County of Honolulu, Board of Water Supply, Oahu Water Plan, July 1982.

Other factors affecting water consumption, such as neighborhood density and affluence, occupancy level, and economic benefits are not readily apparent or measurable. This is because accurate economic and social data are not available. However, it is reasonable to assume that single family consumption should be lower in densely populated areas than in sparsely populated neighborhoods, because of smaller irrigable areas. Higher than normal water usage by affluent families is likely, due to more automobiles, boats, and convenience appliances, and yards with elaborate sprinkling system requiring large amounts of water.

Increases in water rates have variable effects upon consumption by consumer groups. Generally, domestic consumption is expected to decrease as water rates increase. However, commercial, industrial and other economic activity water users may not be as responsive to rate increases, especially if the change in consumption patterns is not cost-effective. For example, a manufacturing company may find it cheaper to continue its present consumption pattern and to pay the higher unit rate, rather than invest additional capital for circulating, filtering, and other conservation devices.

Water Supply. Oahu's water supply is produced by water developers as indicated in Table 16. Plantation agricultural activities produce more than half of all water developed. Additionally, they also utilize a small fraction of water produced by the BWS (see Table 14).

The BWS is the second largest water developer and produces approximately one-fourth of Oahu's supply. The remainder is produced by military operations, industrial activity and private enterprises.

In the Honolulu District, the BWS is the primary water provider and supplies the district with approximately 80% of all water consumed (based upon preserved and permitted uses). Private water sources provide the remaining 20%.

Municipal water is provided by two interactive activities: adequate water sources are identified and developed; and water is transmitted to locations where it is utilized or stored in reservoirs. In the Honolulu District, the municipal system includes: two shafts, three springs, 36 wells at eight well sites, ten tunnels, 61 reservoirs, five line boosters, 39 booster pump stations, one filter facility and three aerators.

Source. Water is developed at ten pumped sites and seven gravity flow sites (see Table 17). These sources have a combined preserved use of 38.26 mgd for the pumped sites and 1.20 mgd from the gravity sites. In 1983, an average of 40.34 mgd were produced from both the pumped and gravity sites. Most of the water developed in the District is used on the coastal plain within the Kalihi and Downtown subareas. Sources located here are the large water shafts, well sites and tunnels. These two subareas, produce approximately 80% of the total district production.

Currently, water demands exceed water production within the district. Hence, it has been necessary to import water which has been produced from other districts. Most of the imported water originates from the Pearl Harbor District, although minimal quantities are brought in from the Windward District. In 1983, total water imports averaged 38.69 mgd, of which 37.22 mgd was supplied by the Pearl Harbor District, and the remainder by the Windward District.

TABLE 16

TOTAL WATER SUPPLY

OAHU 1980

Water Source Developer	Quantity Utilized (mgd)	(percentage)
Plantations (includes caprock water)	262	57%
Board of Water Supply	130	28
Military	28	6
Industrial and Other Private Use	41	9
	462 mgd	100%

Source: City and County of Honolulu, Board of Water Supply, Oahu Water Plan, July 1982.

Storage. Water storage is another vital aspect of the water supply system. Reservoir storage minimizes fluctuations in water pressure, provides water for emergencies, and helps to meet peak consumption demands.

Reservoir facilities allow water pumpage to proceed at stablized rates, rather than in response to consumption demand. Water stored during periods of low demand, is utilized during hours of peak demand.

In areas of higher elevation, reservoirs are required to minimize sporadic pumping to service consumers which can result in pressure fluctuations within the distribution systems. Water is pumped to these reservoirs and is allowed to gravity flow to consumers below. When the water in the reservoirs decreases to a predetermined level, pumps begin operation to refill the tanks.

TABLE 17

HONOLULU DISTRICT WATER SUPPLY, 1984
(All units mgd)

Sources		1984 Production
District Production		
Pumped Systems	Preserved Use	
Waialae Iki Well..........	0.19	0.10
Aina Koa Well.............	0.40	0.43
Waialae Shaft.............	0.24	0.17
Palolo Well...............	1.31	0.63
Kaimuki Station...........	4.00	4.85
Wilder Wells..............	7.00	9.32
Beretania Station.........	7.00	8.95
Kalihi Station............	4.83	7.72
Kalihi Shaft..............	9.50	8.37
Moanalua Wells............	3.79	4.17
Subtotal................	38.26	44.71
Gravity Systems	Base Flow	
Kalihi Tunnels............	0.10	*
Alewa Hgts. Spring........	0.10	0.10
Nuuanu Tunnels............	0.40	0.67
Booth Spring..............	--	0.00
Makiki Spring.............	0.20	0.24
Manoa Tunnel..............	0.20	0.23
Palolo Tunnel.............	0.20	0.22
Subtotal................	1.20	1.46
Total District Production............		46.17
* Temporarily out-of-service		
Imports		
From Windward District.....		0.53
From Pearl Harbor District.		29.58
Total Imports........................		30.11
TOTAL DISTRICT USE.......................		76.28

Source: City and County of Honolulu, Board of Water Supply, Annual Report & Statistical Summary, July 1, 1983 - June 30, 1984.

Storage facilities also provide temporary service in the event of emergencies such as periods of electrical power loss or breakage of transmission lines in high elevation service areas. Thus, water service continuity is maintained.

Transmission. Water is conveyed between water sources and consumers or reservoirs by a system consisting of a series of pump and booster pump stations. In some areas, gravity is utilized to transport water from higher to lower elevations.

b. Sewage System

There are two sewage treatment plants (STP) operating within the Honolulu District. These plants are the Sand Island Sewage Treatment Plant, a City operated facility, and the Hawaii-Kai Sewage Treatment Plant, a privately operated facility.

The Sand Island STP is an advanced primary treatment facility that has a design capacity of 82 million gallons per day (mgd) and serves a population of 451,000. The system currently (as of 1983) handles an average wastewater flow of 72 mgd. Effluent from the plant discharges through an ocean outfall extending 9,000 feet offshore to depths of 220 to 240 feet.

The system at Hawaii Kai is a secondary sewage treatment plant that serves a population of approximately 24,000. The system is currently (as of December 1977) operating at a design capacity of 3.1 mgd. Similar to the Sand Island plant, effluent is discharged by ocean outfall. The outfall extends 1,400 feet offshore to a depth of 46 feet.

The operation of these sewage facilities are not anticipated to adversely affect the ground water quality at the proposed water facility source sites. Both sewage treatment facilities are located at substantial distances from developable water sources. Thus, sewage leakages emanating from the plants' operating systems do not pose a threat of contaminating these sources. Also, both plants discharge their effluent through an ocean outfall, hence possible seepage into underlying ground water bodies (as with the utilization of injection wells) is avoided.

Sewage collection and transmission lines may cause water quality degradation of potable water supplies. Although sewer lines cannot feasibly be constructed without leaks, these lines are installed within allowable exfiltration (seepage) rates, which are established to minimize the contamination of potable ground water sources. (Sewerlines laid above the ground water table are tested for leaks or subject to an air pressure test). While contamination is possible, this impact should be negligible. However, temporary breaks and the progressive increase of exfiltration rates (as sewer lines age) may increase contaminant concentrations within potable water supplies beyond acceptable levels.

Sewer lines laid below the ground water table are subjected to the infiltration (leakage) test to minimize inflow of groundwater into the sewer system.

To mitigate adverse impacts upon water consumers, the BWS performs weekly microbiological monitoring from municipal wells. If the water quality is found to be below acceptable levels, the BWS can take immediate remedial actions.

Although the Honolulu District is, for the most part, serviced by the municipal sewer system, there are a few areas which are still serviced by cesspools. There were 4,491 cesspools in the Honolulu District in 1978 (State Department of Health and City and County of Honolulu, December 1980). These areas are the uppermost portion of Aiea Heights, upper Nuuanu Valley (off Nuuanu Pali Drive) . Makiki Heights, Mapunapuna, a portion of Diamond Head and a portion of Koko Head. These isolated areas will eventually be connected to the municipal sewage system. Although these cesspool serviced areas are not located within close proximity to the proposed sources, some are within areas that contribute to recharge. Therefore, groundwater quality will be monitored for these sources.

c. Transportation

Ground Transportation. The Honolulu District is serviced by many modes of ground transportation: including automobiles, trucks, buses, motorcycles and bicycles.

The area is traversed by major highways, gridded by smaller collector and local roadways. Public thoroughfares are free of tolls.

The most common vehicles found are passenger vehicles. The State's economy is not reliant upon heavy industrial activity, hence there is relatively little traffic by industrial vehicles.

Oahu's population is very mobile. Among its 763,000 residents, there were 407,000 Hawaii licenced drivers, in 1981. Additionally, the municipal bus service (TheBUS) took 73,547,000 passengers to their destinations, traveling 16,748,000 miles.

During fiscal year 1981, TheBUS system included 412 buses, traveling via 45 routes. The average daily ridership for the year was about 198,000.

Alternate ground travel include special "Handivan" public transportation for the handicapped and bikeways for cyclists.

Water Transportation. Situated in the middle of the Pacific Ocean, the Hawaiian Islands are heavily dependent upon import and export of goods and services by ships. Currently, there is only one deep draft harbor, Honolulu Harbor, on Oahu, but it is through this port that most shipping activity occurs.

The Honolulu Harbor receives and ships industrial and commercial goods, as well as provides service to many nautical travelers. In 1980, freight traffic totaled 7,646,270 short tons, mostly imports.

A second deep draft harbor, Barbers Point Deep Draft Harbor, is currently under construction at the Campbell Industrial Park.

Air Transportation. The Honolulu International Airport is the only commercial airport on Oahu and provides passenger and cargo services.

It is the busiest airport in the State. In 1980, more than 40% of all interisland air passenger travel and 98% of all overseas passenger travel in the State traversed through this terminal. The airport also accommodates the military, commuter air carriers, air taxi and general aviation services.

d. Health Care Services

The high population density of the Honolulu District is able to support a great number and wide variety of health care services.

These services include general hospitals such as the Kaiser Foundation Hospital, Kuakini Medical Center, Leahi Hospital, Queen's Medical Center, St. Francis Hospital, Straub Clinic and Hospital, and Tripler Army Medical

Center. There are also special care facilities which serve the needs of specific clients. These include the Browns School of Hawaii (psychiatric services), Kapiolani/Childrens Medical Center, Honolulu Home Care, Maluhia Hospital (elderly extended care), Maunalani Hospital (extended care), Nuuanu Hale Hospital (elderly extended care), Rehabilitation Hospital of the Pacific, and Shriners' Hospital for Crippled Children. Additionally, the State operates community health centers which provide a number of non-surgical services. These include the Diamond Head Health Center and the Lanakila Comprehensive Health Center.

e. Police and Fire Protection

Police and fire protective services are provided by the Honolulu Police Department, and the Honolulu Fire Department, respectively. The services are managed by the City and County of Honolulu.

V. RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

V. RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

The proposed facilities are supportive of both State and County plans regarding water resources. The water facilities are necessary to meet demands required by the anticipated population expansion, and maintain current levels of service.

The following is a description of specific, applicable State and County plans, policies and controls.

A. PLANS

1. Hawaii State Plan

The Hawaii State Plan establishes broad objectives and policies which guide all public planning decisions. With respect to water facility systems, it is the State's objective "to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities." To achieve this objective the State has established the following policies:

- Relate growth activities to existing and potential water supply.
- Support research and development of alternate water sources.
- Reclaim and encourage the productive use of runoff water and waste discharges.
- Assist in improving the quality, efficiency, service, and storage capacities of water systems for domestic and agricultural use.
- Support water supply services to areas experiencing critical water problems.
- Promote water conservation practices.

The proposed improvements support these objectives. The facilities are designed to provide an adequate water supply to meet existing water demand and projected growth activities in the Honolulu District. Currently, the district is not water self-sufficient and requires import from the Pearl Harbor and Windward Water districts. Development of additional water sources are intended to address this problem and help meet these demands.

The BWS seeks to develop productive water sources from existing springs with flows that are currently being "wasted" as overflow into drainage systems. Hence, through development of these sources, the BWS seeks optimum use of available resources.

Nonpotable sources have been identified for irrigation use. Development of these sources may release potable water, currently utilized for irrigation, for domestic use.

Also proposed are two water reservoirs that support the State's objectives for storage capacities.

2. State Functional Plans

The State Functional Plans are designed to facilitate the implementation of the Hawaii State Plan. The State Water Resources Development Plan is a "comprehensive plan for the development, utilization, and conservation of the water resources of the State." The following objectives and policies are pertinent to the proposed water improvement facilities.

- Objective: Maintain the long-term availability of freshwater supplies, giving consideration to the accommodation of important environmental values.

  Policy. Promote sound watershed and aquifer management practices.

  Policy. Manage surface drainage areas and ground water aquifers to prevent contamination of sources of water supply.

  Policy. Seek a balance among developmental and environmental values in the planning, evaluation, permitting and construction of water resources projects.

- Objective: Assure adequate municipal water supplies for planning urban growth.

  Policy. Promote the planning and development of new water supplies, giving priority support to areas experiencing critical water problems.

- Objective: Assure the availability of adequate water for agriculture.

  Policy. Increase the use of treated sewage effluent and other nonpotable water for irrigation purposes.

The proposed facilities are consistent with the objectives and policies of the State Water Resources Development Plan to assure adequate municipal water supplies for meeting growth objectives and to consider environmental requirements.

3. State Department of Health - Water Quality Management Plan for the City and County of Honolulu (208 Plan)

The 1972 Federal Water Pollution Control Act Amendments (P.L. 92-500) requires states to manage sources of pollution to achieve desirable standards of water quality. Section 208 of the Act specifies requirements for plans to implement this objective.

The State 208 plan has five major objectives. These are:

- To develop water quality standards for all water of the state.
- To develop and select control/development/financing strategies that increase net benefit.
- To develop a regulatory program for all point and nonpoint sources.
- To establish the management structures necessary to implement the control strategies effectively.
- To develop public consensus and support to ensure implementation of the plan.

The proposed facilities will not discharge effluent into State waters, and are not inconsistent with the State 208 Plan.

4. State Department of Health - Drinking Water Program

To assure safe drinking water quality standards, all potable water sources must be approved by the DOH as prescribed by Title 11 - Administrative Rules, Chapter 20 - Potable Water Systems, Section 29 - Use of New Sources of Raw Water for Public Water Systems. Accordingly, an engineering report for each new well will be submitted to the DOH for approval.

5. State Exploratory Well Drilling Program

The State Exploratory Well Drilling Program is administered by the State Department of Land and Natural Resources. The program funds the development of new water source facilities, including the construction of exploratory wells. If the exploratory wells supply adequate yields, then the wells are converted into production wells. The operation and management of the wells are later relinquished to the County Government. If these wells are constructed and turned over to the BWS on a "ready to serve" basis, their sustainable capacity is "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, on Oahu).

The proposed facilities to be constructed under this program include the development of one exploratory well (site no. 7 Kapakahi Well) and four production wells (sites: no. 1 - Kuliouou Well, no. 4 - Wailupe Well I, no. 8 - Waialae Nui Well, and no. 16 - Manoa Well II).

6. <u>City and County of Honolulu - General Plan</u>

The General Plan specifies long-range goals and objectives for planning Oahu's future, guiding both the quantity and quality of future growth.

The proposed water system improvements would facilitate implementation of the General Plan. It specifically addresses the concerns to adequately meet the anticipated water needs of an expanded population in Honolulu, while maintaining a high level of service.

The development of the proposed water facilities, together with plans to import more water from the Windward District, would free water which is now imported from the Pearl Harbor District. Hence, these developments would allow further urban growth in the Honolulu District, and encourage the development of the second urban center at the West Beach-Makakilo area.

7. <u>City and County of Honolulu - Development Plan</u>

Eight Development Plans were established to provide detailed schemes for "implementing and accomplishing the objectives and policies of the General Plan." The Development Plans guide the desired sequence, patterns and characteristics of future development. These plans also provide maps that indicate: 1) the planned distribution and intensity of land uses and public facilities; 2) statements of standards and principles, with respect to land uses; 3) statements of urban design principles and controls; and 4) statements indicating the sequence in which future development is to occur.

The Development Plan Public Facilities Maps designate proposed facilities which intend to fulfill the growth objectives of the Development Plans by providing adequate facilities to meet existing and projected needs. Prior to construction, all proposed public facilities must be designated on the appropriate Development Plan Public Facilities Map.

The Honolulu District is coextensive with two development plans. The East Honolulu Development Plan extends from Aina Koa Ridge to Makapuu Point and is identified as part of Oahu's urban fringe by the General Plan. The General Plan prescribes limited growth in this area to a level which essentially maintains its 1980 proportion of the islandwide population.

The Primary Urban Center Development Plan extends from the Waialae-Kahala area to Pearl City. The General Plan provides for increased urbanization in this area.

The proposed facilities are consistent with the objectives of the Development Plans.

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

The Oahu Water Plan is the City's water functional plan. It establishes the City's plans, policies and priorities for providing water.

The proposed water system improvements are intended to implement a part of this plan.

B. POLICIES AND CONTROLS

1. Department of the Army Permit

The Department of the Army permit is administered by the U.S. Army Corp 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; improvements, perched wetlands, and intermittent streams.

Issuance of the permit is based on an elevation 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.

Any water lines crossing under streams or over tidal waters, and any fill within the ordinary high water mark of the streams or in wetlands adjacent to the stream would require a Department of the Army permit. The BWS will submit applications for all projects requiring the Department of the Army's approval.

2. State Land Use Classification and Conservation District

The State Land Use Commission classifies lands into one of four Land Use Districts: Urban, Agricultural, Conservation, and Rural. All of the proposed projects are situated upon Urban or Conservation District lands (State Land Use designations for each water facility site is identified in section VII).

The Urban designation allows for development of the proposed water facilities.

Uses within the Conservation District require approval from the Board of Land and Natural Resources. The Conservation District encompasses "areas necessary for protecting watersheds and water sources; preserving scenic and historic areas; providing park lands, wilderness, and beach reserves; conserving endemic plants, fish, and wildlife; preventing floods and soil erosion; forestry; open space areas whose existing openness, natural condition, or present state of use, if retained, would enhance the present or potential value of abutting or surrounding communities, or would maintain or enhance the conservation of natural or scenic resources; areas of value for recreational purposes; other related activities; and other permitted uses not detrimental to a multiple use conservation concept." (Hawaii Revised Statutes, Title 13, Chapter 205, Section 205-2).

The proposed projects which are located within the Conservation District will require a Conservation District Use Permit to assure the judicious development and utilization of Conservation lands. Powerlines needed to service a particular facility will be included in the Conservation District Use Application submitted for that project. A blanket fire contingency plan will be submitted for Department of Land and Natural Resources approval.

3. City and County of Honolulu - Zoning

The City's Comprehensive Zoning Code allows for development of public facilities, such as the proposed water facilities, within all zones. (Zoning designations for the proposed water facility sites are identified in section VII).

4. Coastal Zone Management

The Hawaii Coastal Zone Management Program (HCZMP) is administered by the State Department of Planning and Economic Development (DPED). The HCZMP has established objectives and policies to protect, preserve, and where desirable, restore or enhance the natural and human developed resources within the coastal zone. The Program's concerns include: recreational resources; historic and pre-historic resources; scenic and open space resources; coastal ecosystems; economic uses; coastal hazards; and management of development.

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 consistent with other HCZMP objectives.

The DPED also reviews federal programs, permits, licences and development proposals for consistency with the State's CZM program. Therefore, if Federal permits or approvals (such as the Department of the Army Permit) are required for a given action, the action would be reviewed by the DPED for consistency with its ojbectives and policies. Federal permits or approvals are not required for any of the proposed BWS water system improvements.

5. Special Management Area

Development along the shorefront of the coastal zone is regulated by the City and County Department of Land Utilization (DLU).

None of the proposed water facility improvements will be located within the Special Management Area (SMA) with the exception of the Kakaako District Transmission Main which may be within the SMA along Ala Moana Boulevard. Coordination with the DLU regarding the need for an SMA permit for this facility may be required. Appropriate measures to minimize negative impacts upon coastal resources will be applied.

6. Special Design Districts

Site No. T3, the Kakaako District Transmission Main, is located within the State Kakaako Community Development District. Development of the transmission main will require coordination with the Hawaii Community Development Authority.

Originally called the Kakaako Special Design District, the State Kakaako Community Development District was established in an effort to plan for orderly growth and redevelopment of this service and light industrial area. The area is in close proximity to the central business district and holds much potential for growth and development. The Hawaii Community Development Authority (HCDA) was established to plan for a mixed-use district where "industrial, commercial, residential and public uses may co-exist compatibly within the same area."

The Kakaako District Transmission Main is located in this area. Development of utilities must be coordinated with the HCDA.

7. Honolulu Ground Water Control Area (HGWCA)

The Board of Land and Natural Resources (BLNR) is responsible for protecting the groundwater resource of the State. The BLNR establishes "sustainable yields" which represent the amount of water that may be developed without degrading the resource (ie., causing adverse saltwater intrusion into the aquifer or unreasonable lowering of water levels).

If it becomes evident that a resource is threatened by present or projected withdrawals, then the BLNR may designate the 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 Honolulu District as a Ground Water Control Area. The HGWCA is divided into two subareas: Moanalua-Kaimuki (BWS subareas 2-5) and Waialae-Hawaii Kai (BWS subarea 1). The sustainable yield established by the BLNR for the HGWCA is 60 mgd. By subareas, the sustainable yields for the Moanalua-Kaimuki and Waialae-Hawaii Kai subareas are 55 mgd and 5 mgd, respectively.

Limitations on water use are established at two levels: sustainable yields for each DLNR ground water control area, and specific limits for each water source site (see Table 18).

During designation of the HGWCA, 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 allowed.

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

The amount of water the DLNR can allot for future water use within each subarea without degrading the aquifer resource, is the difference between the sustainable yield (the estimated resource), and the sum of preserved and permitted uses (existing use). Currently this reserve is approximately 11.31 mgd.

The DLNR has not established preserved use limitations upon gravity systems such as developed tunnels and springs.

The development of springs may, however, require a water Withdrawal and Use Permit, if the spring improvements result in the drafting of groundwater. Water naturally flowing from springs is treated as surface water, which is not regulated by DLNR. If spring improvements increase spring flow, the additional water flow would be considered as groundwater, and therefore would require a permit from DLNR.

TABLE 18

DEPARTMENT OF LAND AND NATURAL RESOURCES
HONOLULU GROUND WATER CONTROL AREA, OAHU

Subarea/Source Site	Sustainable Yield (mgd)	Preserved Use (mgd)	Permitted Use (mgd)*	Reserve (mgd)
Waialae-Hawaii Kai Subarea Total	5.3	1.10	0.70	3.50
BWS Sources				
Waialae Iki Well		0.19		
Aina Koa Well		0.40		
Waialae Shaft		0.24		
Waialae Nui Well			0.70	
Private Sources		0.27		
Moanalua-Kaimuki Subarea Total	55.2	45.637	1.75	7.81
BWS Sources				
Kaimuki Station		4.00		
Palolo Well		1.31		
Wilder Station		7.00		
Beretania Station		7.00		
Kalihi Pump		4.83		
Kalihi Shaft		9.50		
Moanalua Station		3.79		
Manoa II			0.70	
Jonathan Springs			1.00	
Private Sources		8.207	0.05	
DISTRICT TOTAL	60.5	46.737	2.45	11.31

*Excludes saltwater sources.

Prior to designation of the HGWCA, the BWS controlled well drilling and draft in the Honolulu District. The BWS still controls well drilling and draft in non-designated areas on Oahu.

VI. REGIONAL IMPACTS

VI. REGIONAL IMPACTS

This section describes potential impacts that will be experienced beyond the immediate vicinity of the individual project sites, and cumulative impacts which will result from the combined effects of individual projects. Individual projects may or may not contribute to one or more of these effects, as discussed below. Project specific impacts are discussed in the following chapter.

A. HYDROLOGY

Development of the proposed water source facilities is not anticipated to adversely impact the quality of the basal aquifer. The expanded yield would be either within the DLNR sustainable yield for basal water sources in the Honolulu District or from caprock sources. However, the development of these facilities may affect the stream flows of perennial streams in close proximity to the sites. The BWS will contract with the U.S. Geological Survey to monitor these effects for all proposed exploratory wells and all proposed production wells.

Development of the proposed water storage and transmission facilities will not affect ground water recharge.

B. WATER QUALITY

The quality of ground water resources will not be adversely affected by the proposed improvements, as the increased draft will be within sustainable yield limits. By maintaining pumpages within the sustainable yield limits, unacceptable increases in salinity are not anticipated.

In accordance with the Safe Drinking Water Act, the BWS continuously monitors the quality of domestic water to ensure safe drinking standards are maintained. Also, before a source may be used, it must be approved by the State Department of Health.

The proposed sources are not threatened by contamination from cesspool seepage nor residual agricultural waste matter. In the past, no wells in Honolulu, either public or private, have been found to contain dibromochloropropane (DBCP) or ethylene dibromide (EDB). However, the chemical tetrachloroethylene (PCE), usually used in solvents and degreasing agents, has been detected at low concentrations at the Board's Kaimuki Station.

C. FLOOD HAZARDS

The proposed projects are not anticipated to increase flood hazards. Nevertheless, proposed projects located within flood zones, if selected for development, will 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.

D. SPRING AND STREAM ENVIRONMENTS

Impacts upon spring or stream environments may result from development of water sources. The development of spring waters may have an effect on ponds that occur at the sites, while the development of wells may affect the flow of nearby streams. The degree of impact to stream flow will depend on whether the well is directly or indirectly tapping the same body of water. The proposed Waaloa Well and possibly the Nuuanu Aerator well tap dike-confined water.

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

Potentially, reductions in spring and stream flow may also have an impact on aquafauna, and terrestrial biota dependent upon riparian vegetation. While the extent of these impacts are unknown, these are not anticipated to be severe relative to the existing modifications experienced by urban stream environments. Moreover, since the magnitude of any streamflow reduction can only be determined during long term pumpage, the BWS will monitor stream flow during the pumping test of the exploratory wells to determine the immediate effects, if any, of the source development on stream flows. The BWS will coordinate development with the U.S. Fish and Wildlife Service and the State Department of Land and Natural Resources to determine the minimum flow needed to preserve the aquafauna in a particular stream.

While stream flow standards have not yet been estabished for Honolulu, should such standards be established in the future, the BWS will conform to them. If it is found that a BWS water source has a detrimental impact on stream flow, the mitigative measures available include the reduction or termination of pumping from the affected source. Stream flow monitoring activities will be coordinated with the U.S. Geological Survey and the State Department of Land and Natural Resources.

E. POPULATION

The Board of Water Supply (BWS) is charged with the responsibility of providing safe drinking water for the people of the City and County of Honolulu. As the population of Honolulu increases the BWS system and services must be expanded correspondingly. Limitation on the BWS system or its ability to provide necessary services will severely constrain population growth and direction.

The proposed projects are intended to meet the needs of the population projected by DPED. These proposed water facility improvements are part of the BWS Oahu Water Plan and will minimize the dependency of the Honolulu District upon other water supply districts. By minimizing the amount of imported water to the Honolulu District, more water would be available for population growth in other areas such as the Secondary Urban Center in the West Beach-Makakilo area. This anticipated result is consistent with the objectives of the County General Plan.

F. PUBLIC FACILITIES

The proposed water improvements are not anticipated to cause direct cumulative impacts upon existing public facilities, with the exception of the municipal water system and municipal sewer 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. The proposed improvements are intended to facilitiate implementation of these objectives.

G. ECONOMY

The development of the proposed water facility improvements will have both long- and short-term cumulative economic benefits. During the implementation phase, construction activity will generate employment of limited duration. Subsequently, these 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. The proposed facilities will be sited to minimize impacts to the site and surrounding lands. Selection of alternative sites could also minimize adverse effects.

VII. WATER SYSTEM IMPROVEMENTS AND RELATED IMPACTS

VII. WATER SYSTEM IMPROVEMENTS AND RELATED IMPACTS

A. OVERVIEW

This section describes each of the proposed water facility improvements by BWS hydrological subareas. A description of each subarea is provided, followed by a profile of each facility. Each subarea description includes a list of proposed water facility improvements and a summary of existing water facilities in the area.

The project profiles describe the proposed individual projects in the format presented in Figure 3, as described below.

1. Site Identification

   Each proposed project is identified by a site number and name. All proposed source sites are identified by numbers one through 21. Transmission mains are identified by a prefix "T", e.g. T1. Storage facilities are identified by a prefix "S", e.g. S1.

   The BWS has also identified potential water sources which are anticipated to yield lesser quality non-potable water. These sources, are identified by the prefix "E", e.g. E1. These sources are not proposed for development by the BWS, but may be developed by other State or City and County agencies or private developers for secondary uses such as irrigation. These sources are described in Section VIII.B.1., Resource Conservation (Water Exchange).

2. General Data

   This section provides descriptive data of the site as it currently exists. These include location by tax map key, parcel area in acres, land ownership, State Land Use District, City Development Plan designation, City Zoning designation, flood hazard identification, soil type, vegetative cover, and approximate elevation.

   Data for flood hazards, soil type and vegetation are provided in symbolic form. Reference should be made to Chapter IV: section 7 for flood hazard zones; section 5 for soil classification and description; and section 13 for vegetation by habitat classification and plant associations.

3. Source/Project Description

   Each project profile describes existing conditions and identifies the type of improvement proposed at each site. See Chapter III, section B for a general description of the proposed water facilities. These are presented by type of improvement: source development, water storage and water transmission.

FIGURE 3

SAMPLE FORMAT

PROJECT PROFILE DESCRIPTION

Site No. # - ____________________

a. General Data

- o TMK:
- o Parcel Area:
- o Owner:
- o State Land Use District:
- o City Development Plan:
- o City Zoning:
- o Flood zone:
- o Soil:
- o Vegetation:
- o Approximate Elevation:

b. Source/Project Description

c. Potential Impacts

d. Other Requirements

The source and nature of well development is identified in Table 19.

TABLE 19

SOURCE AND NATURE OF WELL DEVELOPMENT

Subarea	Site No.	Development	Source[a)]	Exploratory Well[b)]
Waialae	1	Kuliouou Well	B	X
	2	Kupaua Well	B	
	3	Pia Well	B	
	4	Wailupe Well I	B	X
	5	Wailupe Well II	B	X
	6	Kalani Iki Well	B	
	7	Kapakahi Well	B	
	8	Waialae Nui Well	B	X
Kaimuki	9	Waiomao Well	B	
	10	Palolo Well II	B	
	11	Palolo Well III	B	
	12	Manoa Well I	A & B	X
Downtown	13	Manoa Well III	A	X
	14	Waaloa Well	D	X
	15	Manoa Well II	A	X
	16	Herring Springs	P	
	17	Kahuawai Springs	P	
	18	Nuuanu Aerator Well	P	
	19	Kunawai Springs Well or Diversion	P	
Kalihi	20	Jonathan Springs Well	B	X
	21	Kalihi Wells II & III	P	

General Notes

a) Source: A = alluvial water
B = basal aquifer
D = dike water
P = perched aquifer

b) Exploratory well: X = drilled and tested

4. Potential Impacts

The proposed projects will generate potential long-term and short-term environmental impacts. Some will be beneficial and others adverse. Most of the anticipated adverse impacts are short-term impacts generated by construction of the facilities. These construction related impacts will be incurred by all the proposed projects, to some degree, and are discussed in more detail below.

a. Construction Related Impacts

The use of conventional construction equipment will create short-term impacts to the local environment. Noise, air, and visual impacts, although limited to daylight hours, are often considered a nuisance and are unavoidable. The length of construction, contingent on the extent and phasing of the proposed developments, will therefore dictate construction related impacts. Construction activities are typically scheduled during the week days from 7:30 a.m. to 4:00 p.m, Monday to Fridays (excluding holidays). As most of the project sites are in proximity to residences and other urban areas, it is probable that the people living nearby will be affected by the construction. They will have to contend with some construction noises, an increase in dust levels and construction vehicles on the roads.

Dust and vehicular emissions will be generated during installation and construction of transmission lines, reservoirs, and control buildings. Dust control measures, such as water sprinkling, will be implemented to reduce dust levels, as necessary.

Construction equipment will also create additional noise during construction work hours. The projects' operations must conform to the State Department of Health's Public Health Regulations, Chapters 11-42 and 11-43. Noise permits will be required from the Noise and Radiation Branch of the Department of Health and contractors must comply with the conditions issued with the permits. Mufflers for noise control will be required for all construction equipment. All noise attenuating equipment will be maintained in proper operating condition and will be repaired or replaced as needed.

Other construction related impacts include the alteration of existing land forms, through the displacement of existing flora and fauna and earthwork operations.

The displacement of existing flora and fauna is not anticipated to be significant as there are no threatened nor endangered species at the project sites.

Site preparation/grading activities will be minimized and 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. Due to the conceptual nature of the projects at this time, archaeological surveys of each site were not conducted. However, as more detailed plans are formulated and as the project selection process continues, archaeological surveys shall be conducted in conjunction with the appropriate supplemental environmental documents. If archeological resources such as human bones, stone artifacts, shell midden, charcoal deposits, stone walls, abandoned lo'i or petroglyphs are uncovered, 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 actions by the Board will be coordinated with the Preservation Officer.

For the few projects located in undeveloped areas. An archaeologist will be hired when the BWS proceeds with a particular project to survey the selected construction area for potential archaeological or historic resources.

During development of well sites and reservoirs, construction equipment will use the 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 not be significant, but may cause some 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. Diversion of traffic may be required for limited periods of time. Detour plans will be developed and coordinated with the appropriate governmental agencies during the design of the individual projects. Connection of the proposed improvements to existing facilities may result in the temporary disruption of service. Affected users will be notified in advance by either the contractor or the Board of any scheduled disruption of water service.

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 include provision of jobs to local construction personnel. Local material suppliers and retail businesses may also benefit from the increased activities.

b. Post-construction Related Impacts

Relatively fewer adverse impacts are anticipated during operation of the facilities. Transmission mains will have negligible impacts, once installed. Storage facilities may present aesthetic impacts, but these effects may 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 have been proposed. Well pumps will generate noise, but these effects may be attenuated as necessary in populated areas.

Several of the proposed water development projects could affect flows of nearby streams. These streams will be monitored by the BWS and should the stream environment be adversely affected by a reduction in flow, the Board will take appropriate action by reducing or terminating pumpage from that source.

5. <u>Other Requirements</u>

Each project profile also includes a list of administrative and other requirements necessary to implement the project. Among these are permits, approvals, and interagency coordination. The requirements for each project varies, dependent upon the type of facility proposed and its site location.

B. WAIALAE SUBAREA

The Waialae Subarea extends from Makapuu Point through Kahala (see Figure 4). It includes the communities of Hawaii Kai, Kuliouou, Aina Haina, Waialae, and portions of Maunalani Heights and Kaimuki. There are eight project sites located within this subarea, as follows:

Site No.	Project Title
1	Kuliouou Well
2	Kupaua Well
3	Pia Well
4	Wailupe Well I

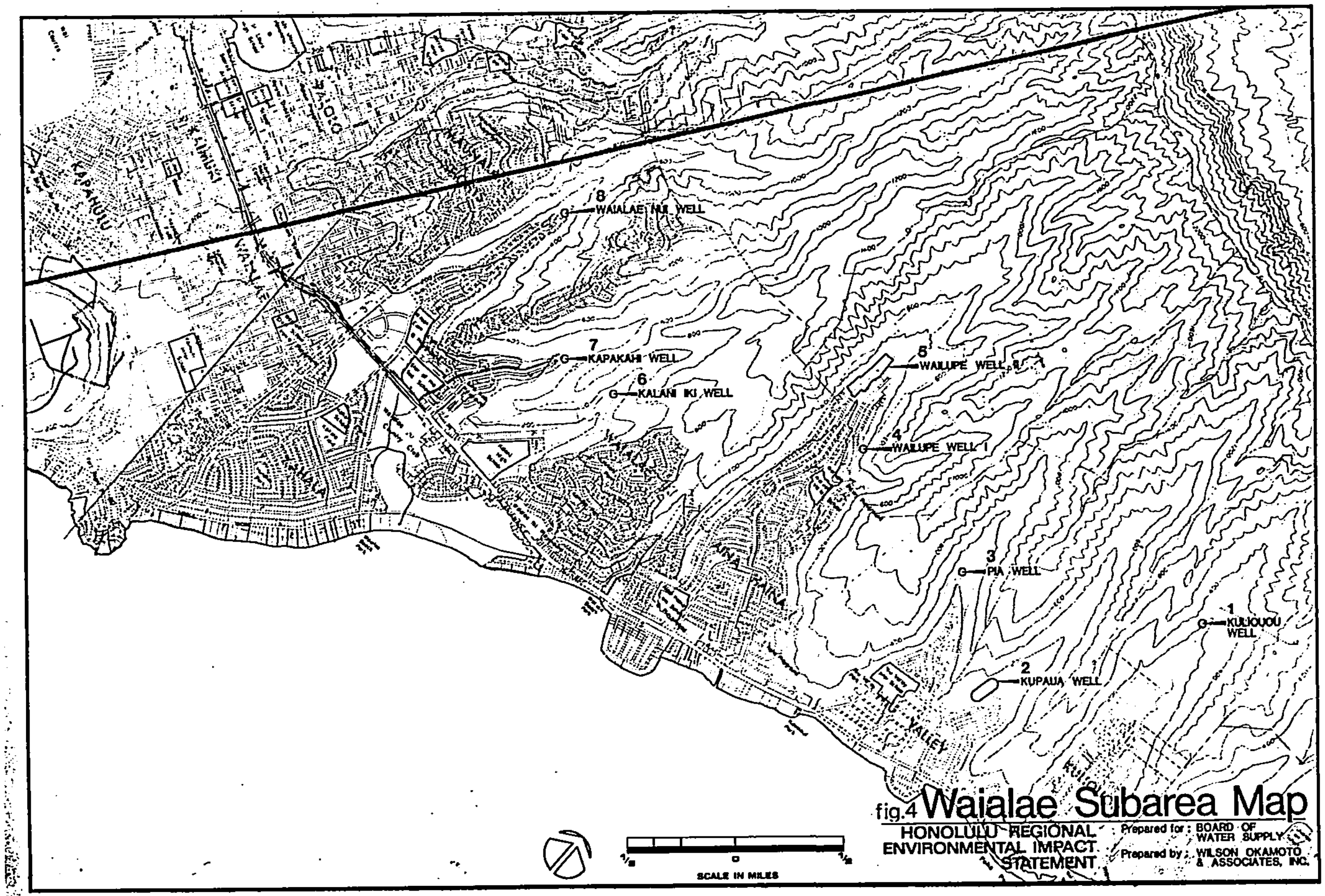

fig.4 Waialae Subarea Map

HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

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Prepared by: WILSON OKAMOTO & ASSOCIATES, INC.

5 Wailupe Well II

6 Kalani Iki Well

7 Kapakahi Well

8 Waialae Nui Well

The mean annual rainfall for this subarea ranges from about 30 inches near the coast to about 40 to 50 inches at the head of the various valleys. A number of streams have perennial flows in their uppermost reaches, but none are perennial throughout. Only intermittent flows occur in the vicinity of the project area.

Due to the lack of perennial flow, these streams do not sustain a population of either native or exotic fisheries. As a result, aquafauna will not be impacted.

There are four water sources in the subarea currently being used. Three sources are operated by the BWS. They are Aina Koa Well, Waialae Iki Well and Waialae Shaft. A privately owned well is operated by The Waialae Country Club. The subarea is also served by 24 reservoirs with storage capacities ranging between 0.2 to 3.5 MG, totaling 24.3 MG.

1. <u>Site No. 1 - Kuliouou Well</u>

   a. General Data

      o TMK: 3-8-11:03

      o Parcel Area: 10.347 acres

      o Owner: Hawaii Housing Authority

      o State Land Use: Urban

      o City Development Plan: Residential

      o City Zoning: Residential, R-4

      o Flood Zone: D

      o Soil: LPE

      o Vegetation: DS

      o Elevation: 200 feet with static water level at about 2.5 feet (msl)

b. Source Description

The project site is located north of an existing residential development comprised of single-family dwelling units. North of the site is the Kuliouou Forest Reserve. An exploratory well has been drilled and tested by the DLNR through their well drilling program. A negative declaration has been filed for the exploratory well. After the exploratory well is converted into a production well, it will be dedicated to the City.

The proposed production well is estimated to have a sustainable capacity of 0.2 mgd. Although the water from the well will be added to the municipal system, the sustained capacity which is produced will be credited to the State for State funded projects. A schematic design of the production facilities is presented in Appendix B.

Well records and pumping test data are contained in Appendix C.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Authorization by the Hawaii Housing Authority to use the site for well development.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- Construction related permits and approvals.

2. Site No. 2 - Kupaua Well

a. General Data

- TMK: 3-7-04:01
- Parcel Area: 417.846 acres
- Owner: Hawaiian Trust Co., Ltd./Hawaiian Humane Society
- State Land Use District: Urban
- City Development Plan: Residential
- City Zoning: Residential, R-4

- o Flood Zone: D
- o Soil: LPE
- o Vegetation: DS or UR
- o Approximate Elevation: 120 feet with static water level at about 2.5 feet (msl)

b. Source Description

The Kupaua Well is expected to yield an estimated 0.25 MGD of domestic water to be used by Kupaua Valley (Niu) residents. The new production well will be incorporated into the existing BWS system. The yield and water quality of the well will be determined after an exploratory well is drilled and pump tested.

Kupaua Valley forms the eastern tributary that feeds into Niu Valley. The proposed Kupaua Well site lies along the western side of Kupaua Valley above the present development limits. A specific well site has not been determined because most of the land in the area is privately owned.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Negotiation with private landowner for use of the site for well development.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- Construction related permits and approvals.

3. <u>Site No. 3 - Pia Well</u>

a. General Data

- o TMK: 3-7-15:64
- o Parcel Area: 1.053 acres
- o Owner: City and County of Honolulu, Board of Water Supply

- o State Land Use District: Conservation (General)
- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1
- o Flood Zone: D
- o Soils: LPE
- o Vegetation: DS
- o Approximate Elevation: 300 feet with static water level at about 2.5 feet (msl)

b. Source Description

The Pia Well is expected to produce about 0.25 MGD of domestic quality water. An exploratory well must be drilled to determine the actual yield and quality of water. If the exploratory well results are favorable, a production well will be developed and connected to the existing BWS water system.

Pia Valley forms the western tributary of the Niu Valley. The proposed well site will be located on an existing BWS reservoir site. Access to the site is via a paved access road at the end of Anolani Street. The nearest home is more than 490 feet away.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related impacts and approvals.

4. <u>Site No. 4 - Wailupe Well I</u>

a. General Data

- o TMK: 3-6-19:35
- o Parcel Area: 2.739 acres

- o Owner: City and County of Honolulu, Board of Water Supply
- o State Land Use District: Urban
- o City Development Plan: Residential
- o City Zoning: Residential, R-4
- o Flood Zone: C
- o Soil: LPE
- o Vegetation: DS or KF
- o Approximate Elevation: 380 feet with static water level at about 3.7 feet (msl)

b. Source Description

The proposed project involves the conversion of an existing exploratory well to a production well within Wailupe Valley. The well is sited on the same location as two *existing BWS reservoirs (Aina Haina "395" reservoirs).*

The drilling and testing of the exploratory phase of the well development has been performed by DOWALD of the State DLNR. The exploratory well has a 14-inch diameter casing, a depth of 435 feet, and a ground elevation of 379± feet mean sea level (msl). The well was pump tested at a constant discharge rate of 350 gpm for five days and was then pumped at a constant discharge rate of 300 gpm for another three days (12 hours per day). The results from the five-day test are as follows:

- At 250 gpm, drawdown = 6.2± feet
- At 300 gpm, drawdown = 8.0± feet
- At 350 gpm, drawdown*= 12.2± feet
- Chloride content of water = 75 mg/l
- Temperature of water = 19.5°C (67.1°F)

*During pumping test No. 2, the drawdown increased asymptotically 2.7 feet during the five days, to a final 14.9 ft. below static water level. From a semi-log plot of the drawdown data, it is estimated that drawdowns would be 16.8± ft. after 30 days, 17.6± ft. after 60 days, and 18.1± ft. after 90 days of pumping at a sustained rate of 350 gpm. The recovery of the water level in the well was almost instantaneous and complete minutes after the end of the 5-day test. The well recovered from 0.4 feet of static water level to 0.3 feet after 9 minutes, and to 0.2 feet after 90 minutes.

Extensive testing of the well for water quality and quantity has been completed. The exploratory well can now be converted into a production well and put into service at a capacity of 0.2 mgd.

Wailupe Valley has two 0.3 mg capacity water reservoirs located near the eastern end of the valley. These reservoirs are connected to the existing water distribution system which provides water for the upper areas of Aina Haina.

The latest consumption records for the area served by the two reservoirs show a consumption range of 175,000 to 216,000 gallons per day. Since Aina Haina is a stable community with little new development occurring in the valley, a fairly constant water consumption rate has been maintained in recent years. The anticipated 0.2 mgd from the new well will discharge directly into the main which connects the two on-site BWS water reservoirs to the existing water distribution system in Wailupe Valley. Water not immediately required by users will be stored in the reservoirs.

The production well will be dedicated to the City. An EIS for the project has already been completed and accepted.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- Construction related permits and approvals.

5. Site No. 5 - Wailupe Well II

a. General Data

o TMK: 3-6-24:01

o Parcel Area: 9.532 acres

- o Owner: Volumes Co. Ltd.
- o State Land Use District: Urban
- o City Development Plan: Preservation
- o City Zoning: Residential, R-4
- o Flood Zone: C
- o Soil: LPE
- o Vegetation: DS
- o Approximate Elevation: 386 feet with static water level at about 3.5 feet (msl)

b. Source Description

The estimated well yield at Wailupe Well II is 0.25 mgd. An exploratory well has been drilled and tested. Well test data are contained in Appendix D.

The Wailupe Well II site is located along the western side of Wailupe Valley at about the same elevation as the Wailupe Well I site. Access to the site is via Hao Street.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Negotiation with private landowner for use of the site for well development.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- Construction related impacts and approvals.

6. <u>Site No. 6 - Kalani Iki Well</u>

a. General Data

- o TMK: 3-5-24:01
- o Parcel Area: 795.647 acres
- o Owner: B.P. Bishop Estate

- o State Land Use District: Conservation (General)
- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1
- o Flood Zone: C
- o Soil: LPE
- o Vegetation: DS
- o Approximate Elevation: 500 feet with static water level at about 5 feet (msl)

b. Source Description

The proposed Kalani Iki Well is an alternative to the Kapakahi Well, Site No. 7, and is expected to yield between 0.2 to 1.0 mgd. Once an exploratory well has been drilled and tested, the production well may be developed and connected to the existing water system.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Negotiations with private landowner for use of the site for well development.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

7. Site No. 7 - Kapakahi Well

a. General Data

- o TMK: 3-5-24:01
- o Parcel Area: 795.647 acres
- o Owner: B.P. Bishop Estate
- o State Land Use District: Conservation (General)

- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1
- o Flood Zone: C
- o Soil: LPE
- o Vegetation: DS
- o Approximate Elevation: 240 feet with static water level at about 7 feet (msl)

b. Source Description

The Kapakahi Well is an alternative to the Kalani Iki Well, Site No. 6. Both the exploratory and production wells are to be developed by the DLNR. If successful the production well will be dedicated to the City. The expected yield of the production well is between 0.2 mgd and 1.0 mgd, depending upon exploratory well test results. The site is located at the end of Ainakoa Avenue.

A negative declaration has been filed for the exploratory well (OEQC Bulletin: 11/23/83).

c. Potential Impacts

- Possible degradation of water quality at the existing Aina Koa Well.
- Short-term construction related impacts.

d. Other Requirements

- Negotiation with private landowner for use of the site for well development.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

8. <u>Site No. 8 - Waialae Nui Well</u>

a. General Data

- o TMK: 3-5-24:01

- o Parcel Area: 795.647 acres
- o Owner: B.P. Bishop Estate
- o State Land Use District: Urban
- o City Development Plan: Residential
- o City Zoning: Residential, R-4
- o Flood Zone: C
- o Soil: LPE
- o Vegetation: DS
- o Approximate Elevation: 280 feet with static water level at about 11.5 feet (msl)

b. Source Description

The DLNR has recently drilled and successfully tested an exploratory well at Waialae Nui. The exploratory well will be converted into a production well. Improvements include the installation of a pump, a control station and transmission main. Access to the well site will be from Kilauea Place.

The well is approximately 370 feet deep·with a 14-inch casing for the first 330 feet (290 feet solid casing and 40 feet of louvered casing). Although testing shows that the well could produce 1.0 mgd, experience with other sources in the Waialae area show that salinity may rise adversely at rates greater than 0.5 mgd because of the thin lens. The proposed pump capacity is 1.01 mgd with water withdrawal of 0.7 mgd, as indicated in Appendix E.

The total project cost for the production facility is expected to be $824,000 and has been budgeted in the BWS CIP. This includes the preparation of plans and specifications, land purchase and installation of facilities. The DLNR has also proposed to develop the well under its well drilling program. If developed by DLNR, the rated capacity of the well would be credited to the State for State or State funded projects. The production well, if successfull will be dedicated to the City.

c. Potential Impacts

- Short-term construction related impacts

d. Other Requirements

- Negotiation with private landowner for use of the site for well development.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- Construction related permits and approvals.

C. KAIMUKI SUBAREA

Adjacent to the Waialae Subarea, the Kaimuki Subarea extends further west. It encompasses Kapahulu, Palolo Valley, St. Louis Heights, and portions of Maunalani Heights, Kaimuki, Manoa, Moiliili and most of Waikiki (see Figure 5). There are six projects proposed within this subarea. They are:

Site No.	Project Title
9	Waiomao Well
10	Palolo Well II
11	Palolo Well III
12	Manoa Well I
S1	Waahila "180" Reservoir & Transmission Main
S2	Waahila "405" Reservoir & Transmission Main

Presently, the subarea is served by 12 active wells, and one tunnel. BWS operates eight wells at the Kaimuki Station, and one well at the Palolo 405 Station. The remaining three are private wells.

Water is stored in 10 reservoirs, ranging between 0.2 and 2.0 MG., with a combined capacity of 5.17 MG.

1. Site No. 9 - Waiomao Well

a. General Data

- o TMK: 3-4-22:01
- o Parcel Area: 691.90 acres
- o Owner: City & County of Honolulu, Board of Water Supply

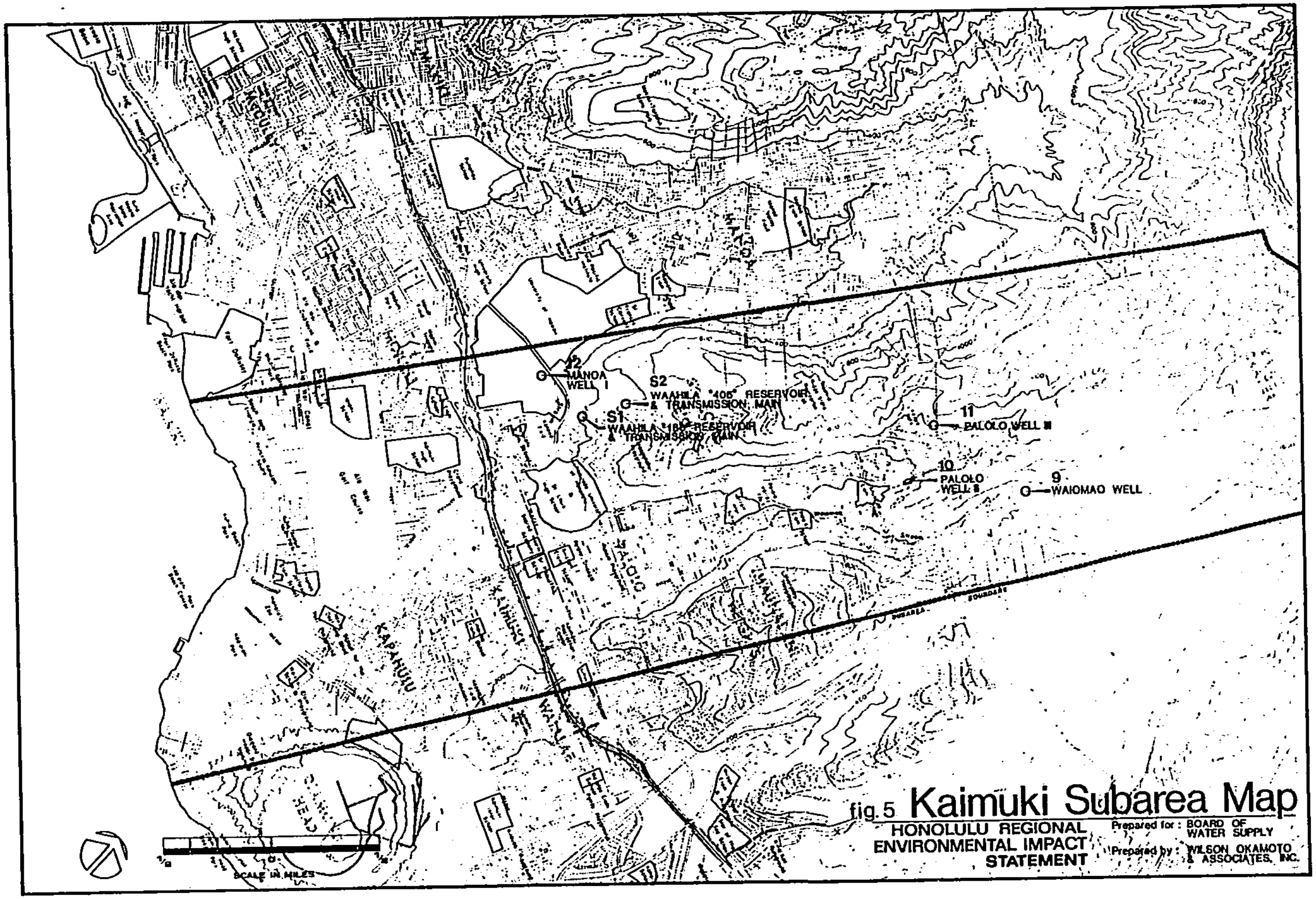

fig.5 Kaimuki Subarea Map

HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for: BOARD OF WATER SUPPLY

Prepared by: WILSON OKAMOTO & ASSOCIATES, INC.

- State Land Use District: Conservation (Protective)
- City Development Plan: Preservation
- City Zoning: Preservation, P-1
- Flood Zone: C
- Soil: LoF
- Vegetation: OKF
- Approximate Elevation: 640 feet with static water level at about 23 feet (msl)

b. Source Description

The proposed well will be located in the vicinity of an existing BWS chlorinator building near the end of Waiomao Road. The well is expected to yield about 0.5 mgd which will be added to the existing domestic water system. Development of this well would depend upon test results of an exploratory well.

c. Potential Impacts

- Short-term construction related impacts

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

2. <u>Site No. 10 - Palolo Well II</u>

a. General Data

- TMK: 3-4-12:23
- Parcel Area: 13,902 sq. ft.
- Owner: City and County of Honolulu
- State Land Use District: Urban
- City Development Plan: Residential

- o City Zoning: Residential, R-6
- o Flood Zone: C
- o Soil: KlaB
- o Vegetation: UR
- o Approximate Elevation: 360 feet with static water level at about 360 feet (msl)

b. Source Description

The proposed well is expected to produce between 0.1 mgd to 1.0 mgd. The expected daily use will be about 0.2 mgd.

The well site is located on a parcel of land between Pukele Stream and Palolo Place. Development of this well will depend upon test results of a proposed exploratory well.

c. Potential Impacts

- Potential reduction of stream flow at Pukele Stream (a tributary to Palolo Stream).
- Short-term construction related impacts.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of well for domestic use.
- Construction related permits and approvals.

3. <u>Site No. 11 - Palolo Well III</u>

a. General Data

- o TMK: 3-4-20:03
- o Parcel Area: 25.852 acres
- o Owner: City and County of Honolulu
- o State Land Use District: Conservation (Resource)
- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1

- o Flood Zone: C
- o Soil: LoF, LoD
- o Vegetation: DS
- o Approximate Elevation: 640 feet with static water level at about 22 feet (msl)

b. Source Description

This well is an alternative for the Palolo Well II Site No. 10, and is expected to produce 0.2 mgd.

The site is located at the top of Carlos Long Street in the vicinity of the City's Kawao Park. The parcel is owned by the BWS but jurisdiction of a portion of the parcel has been turned over to the City's Department of Parks and Recreation. Subsequently, the City developed Kawao Park as a passive recreational facility. Today, however, due to security and maintenance problems, the park has very little usage.

c. Potential Impacts

- Negligible impact upon existing park use (the well would be located away from most of the developed park areas).
- Short-term construction related impacts.
- Decrease yield at Palolo Well I.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.
- Coordinate plans with Department of Parks and Recreation.

4. <u>Site No. 12 - Manoa Well I</u>

a. General Data

- o TMK: 2-8-29:01

- o Parcel Area: 88.648 acres
- o Owner: State of Hawaii - University of Hawaii
- o State Land Use District: Urban
- o City Development Plan: Public Facility
- o City Zoning: Residential, R-6
- o Flood Zone: C
- o Soil: Quarry
- o Vegetation: Ur
- o Approximate Elevation: 40 feet with static water level at about 22 feet (msl)

b. Source Description

The proposed Manoa Well I is expected to yield an estimated 0.5 mgd to 1.5 mgd. The well site is located on the grounds of the University of Hawaii (U.H.), at the base of a sheer rock face created by past quarrying operations. Directly above the well site on the top of the rock face is Frear Hall, a university dormatory.

Test pumping results indicate the water source is largely basal water and some spring water. However, this proposed well may withdraw water from the same basin as existing wells at the BWS Kaimuki Station and may affect existing yields at this station to an unkown extent. The BWS has, therefore, postponed development of the Manoa Well I to a later date.

A negative declaration has been filed for the entire project.

c. Potential Impacts

- Degradation of yield at existing BWS wells in Kaimuki.
- Reduction of flow in Manoa Stream.
- Loss or degradation of existing pond in quarry.
- Short-term construction related impacts.

d. Other Requirements

- Coordination with the University of Hawaii for use of the site for well development and water exchange.
- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- Construction related permits and approvals.

5. Site No. S1 - Waahila "180" Reservoir and Transmission Main

a. General Data

- TMK: 3-3-56:01
- Parcel Area: 42.732 acres
- Owner: State of Hawaii, University of Hawaii
- State Land Use District: Urban
- City Development Plan: Public Facility
- City Zoning: Residential, R-6
- Flood Zone: C
- Soil: KanE, PID, KlA
- Vegetation: DS, Ur

b. Project Description

The proposed Waahila "180" reservoir is intended to serve the University of Hawaii area if the added capacity becomes necessary. At the same time, the reservoir will increase the storage capacity of the existing system.

The proposed "180" reservoir will have a storage capacity of 4.0 million gallons. The tank site is located above the existing University faculty housing area on Dole Street, at an elevation of about 180 feet above sea level.

Approximately 3,000 linear feet of new 24-inch transmission main will be required to integrate the new reservoir with the existing water system. The new main will extend from the new reservoir, easterly along Dole Street, downhill along Saint Louis Drive and connect to an existing 24-inch line at Waialae Avenue.

c. Potential Impacts

- Possible visual impact.

- Short-term construction related impacts.

d. Other Requirements

- Coordination with the University of Hawaii for use of the site.

- Construction related permits and approvals.

6. Site No. S2 - Waahila "405" Reservoir and Transmission Main

a. General Data

o TMK: 3-3-56:01

o Parcel Area: 42.732 acres

o Owner: State of Hawaii - University of Hawaii

o State Land Use District: Urban

o City Development Plan: Public Facility

o City Zoning: Residential, R-6

o Flood Zone: C

o Soil: PID

o Vegetation: DS, Ur

b. Project Description

The proposed Waahila "405" reservoir will have a storage capacity of 4.0 million gallons and will be connected to an existing 20-inch line on Dole Street by a new 24-inch transmission main.

The reservoir site will adjoin the westerly edge of the Saint Louis Heights residential area and will be mauka of the Waahila "180" reservoir at an elevation of about 405 feet above sea level.

c. Potential Impacts

- Visual impact.

- Short-term construction related impacts.

d. Other Requirements

- Coordination with the University of Hawaii for use of the site.

- Construction related permits and approvals.

D. DOWNTOWN SUBAREA

The Downtown Subarea abuts the Kaimuki Subarea and includes the communities of downtown Honolulu, Pacific Heights, and Nuuanu (see Figure 6). It also includes portions of Moiliili, Manoa, and Palama. Most of the proposed improvements will occur in this subarea. There are a total of seven (7) proposed well sites in this subarea and one (1) proposed transmission main (exchange water sources are indicated with a prefix "E" and are discussed in Section VIII.B.1). These are:

Site No.	Project Title
13	Manoa Well III
14	Waaloa Well
15	Manoa Well II
16	Herring Springs
17	Kahuawai Springs
18	Nuuanu Aerator Well
19	Kunawai Springs Well or Diversion
T3	Kakaako District Transmission Main

Currently, the subarea is serviced by six private wells. The BWS operates nine wells at its Beretania Station, four wells at Wilder Station, five tunnels, a small surface water diversion, and two springs. Water is stored in 13 reservoirs, with capacities ranging 0.05 to 2.72 MG, which cumulatively total 9.67 MG.

1. Site No. 13 - Manoa Well III

a. General Data

o TMK: 2-9-36:03

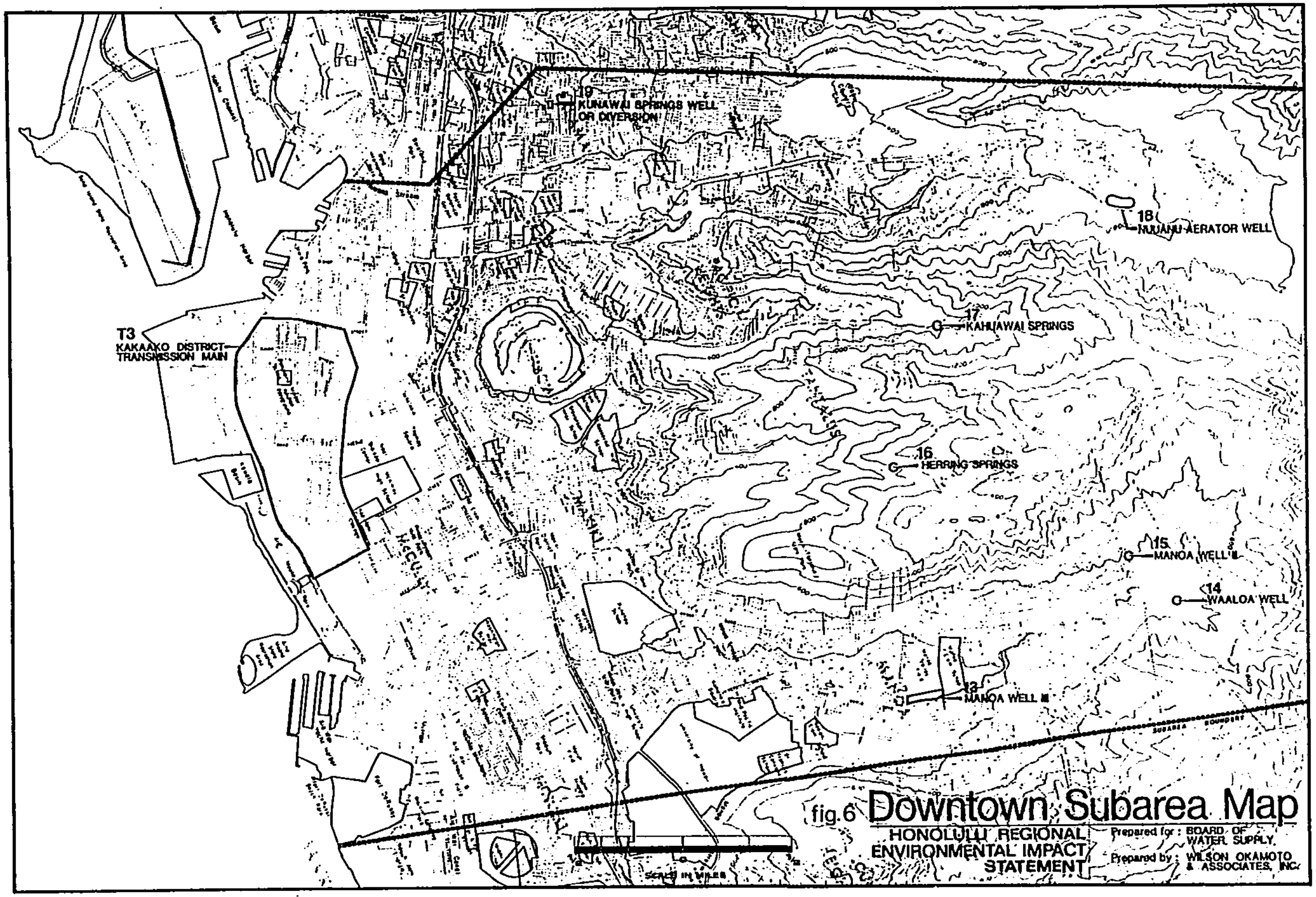

fig.6 Downtown Subarea Map

- Parcel Area: 48.141 acres
- Owner: City and County of Honolulu, Department of Parks and Recreation
- State Land Use District: Urban
- City Development Plan: Parks and Recreation
- City Zoning: Preservation, P-1
- Flood Zone: A5, A10
- Soil: HnA
- Vegetation: Ur
- Approximate Elevation: 280 feet with static water level at about 270 feet (msl)

b. *Source Description*

The proposed Manoa Well III is expected to produce up to 0.5 mgd of water. The well is located within the park along its eastern boundary, adjacent to Manoa Stream. The area is presently unimproved. Water from the Manoa Well III is non-potable and can be used for landscape irrigation at the park and at Manoa Elementary School through a separate system.

Test pumping data are provided in Appendix F. No effects to stream flow of Manoa Stream were recorded at the U.S.G.S. gaging station near this well during test pumping (see Appendix G).

c. Potential Impacts

- Land use conflicts with existing mini gardens.
- Possible flow reduction of Manoa Stream (should the well be placed into service, flows will be monitored to detect and mitigate adverse affects).
- Short-term construction related impacts.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.

- Construction related permits and approvals.
- Construction plans to be coordinated with the Department of Parks and Recreation.

2. <u>Site No. 14 - Waaloa Well</u>

a. General Data

- o TMK: 2-9-54:14
- o Parcel Area: 21.60 acres
- o Owner: City and County of Honolulu, Board of Water Supply
- o State Land Use District: Conservation (Resource)
- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1
- o Flood Zone: C
- o Soil: HoB
- o Vegetation: Ur, MF, OKF
- o Approximate Elevation: 528 feet with static water level at about 418 feet (msl)

b. Source Description

The Waaloa Well is expected to produce about 0.4 mgd of dike water for domestic use. It was drilled in 1970, in upper Manoa Valley, above the existing residential development. Test pumping data for the Waaloa Exploratory Well are provided in Appendix H.

The flows of several springs combine to form Waaloa Stream, which is a tributary of Manoa Stream. Waaloa Stream is an intermittent stream that flows only during periods of heavy rainfall. The well is located near Waaloa Stream, near the end of the unimproved portion of Waaloa Road.

A transmission line will be required to connect the proposed well with the existing water system. The transmission main will extend for a distance of 1,000 to 2,000 feet, from the well to the existing transmission line. The existing line runs within an easement to Waaloa

Way. The access road crosses Manoa Stream and two of its tributaries (Waaloa and Waiakeakua Streams) several times which may increase difficulty in the transmission line design and construction. The cost of construction must be weighed against the benefits derived from additional water development.

c. Potential Impacts

- Disruption of traffic along Waaloa Road during construction of transmission main (Waaloa Road is an unimproved single-lane dirt road used by lessees).

- Other short-term construction related impacts which may inconvenience residents.

The Waaloa Well is not anticipated to adversely impact stream flow in Manoa Stream. Also, the cumulative impact that the Waaloa Well and the Manoa Well III (Site No. 13) may have on Manoa Stream is not anticipated to be significant. However, stream flow will be monitored during development. If the monitoring shows stream flow in Manoa Stream is adversely affected, mitigative measures acceptable to both the State Department of Land and Natural Resources and the U.S. Fish and Wildlife Service will be implemented.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.

- DOH approval of the well for domestic use.

- DLNR Conservation District Use Permit.

- Construction related permits and approvals.

3. <u>Site No. 15 - Manoa Well II</u>

a. General Data

- TMK: 2-9-54:33

- Parcel Area: 2.136 acres

- Owner: City and County of Honolulu, Board of Water Supply

- State Land Use District: Conservation (Resource)

- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1
- o Flood Zone: C
- o Soil: LoC, TAE (overlaid with imported fill)
- o Vegetation: Ur
- o Approximate elevation: 384 feet with static water level at about 73 feet (msl)

b. Source Description

The proposed Manoa Well II will be located within the existing Manoa "405" Reservoir site off of Loulu Street. It will be constructed at a location south of the reservoir structure, approximately 65 feet from the chainlink gate. Selection of the site was based upon hydrologic assessments by the Board of Water Supply which indicated a high potential for ground water recovery within this vicinity. The site is owned by the City and County of Honolulu. The close proximity to the existing reservoir and existing distribution system will simplify the incorporation of the well into the Honolulu Water District system. The location avoids using any additional Conservation land and the necessity to construct additional mains and access roads which would otherwise add to the impact of this project.

The existing reservoir and site improvements at the proposed production well site were constructed 23 years ago to service the Honolulu Water District's high service water system. These improvements included a prestressed concrete reservoir structure, overhead electrical service, asphalt concrete access and reservoir perimeter roads and loading area, 6-ft high chainlink security fence, catch basins, manholes, and water valve building. Other improvements included a 16-in and 12-in water transmission line and an 18-in drain line. An existing booster pump constructed in 1975 pumps water to the 705-ft Woodlawn Reservoir during periods of low flow from the Manoa Tunnel.

The proposed production well will be located at the 384-ft elevation. Water from the well will be pumped through an 8-in pipe to an existing 16-in transmission line. The proposed production well and control building will occupy areas that are currently paved. The project limits will comprise approximately 3000 square feet and only minimal grading will be required.

The DLNR has drilled and tested an exploratory well. The proposed pump capacity is 1.01 mgd with water withdrawal of 0.7 mgd, as indicated in Appendix E. Test pumping data are provided in Appendix I.

Cost of construction for the production well facilities is estimated at $1,135,000. While funds for the installation of the water pump and construction of the control building and appurtenant facilities have been budgeted in the Board of Water Supply's Capital Improvement Program, the DLNR has proposed to fund development of the production facilities, in which case, the yield would be credited to the State for State funded projects. Upon its completion, the production well would be dedicated to the City.

A negative declaration has been completed for this project.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

A Water Withdrawal and Use Permit was obtained from the DLNR in December 1981.

4. Site No. 16 - Herring Springs

a. General Data

- o TMK: 2-5-19:8
- o Parcel Area: 375.02 acres
- o Owner: State of Hawaii
- o State Land Use District: Conservation (Resource)
- o City Development Plan: Preservation
- o City Zoning: Preservation, P-1
- o Flood Zone: C

- o Soil: TAF
- o Vegetation: OKF
- o Approximate Elevation: 1,000 feet

b. Source Description

Herring Springs was, at one time, an active domestic water source that produced up to 0.2 mgd. Repair and maintenance costs of the pipeline, however, became prohibitive and the source was deactivated. Today, the high cost of new source development and the increased water demand, especially in the Honolulu District, has caused the BWS to reevaluate the feasibility of reactivating the Herring Springs source.

The proposed improvements will consider including a new shorter plastic pipeline which will connect to the existing Makiki Springs pipeline, and the existing line will be abandoned. The water will add to the BWS "705" system.

The proposed water facilities are located along the Moleka Stream within the State Forest Reserve on Tantalus. The only access to the site is via the Makiki Valley Trail.

Maintenance of the transmission line will be minimized by the use of plastic pipe. The existing cast iron pipe line runs through the forest reserve with no direct vehicular access.

c. Potential Impacts

- Direct impact on Moleka Stream by diversion of flow.
- Clearing of existing vegetation along pipeline alignment.
- Possible erosion.
- Short-term construction related impacts.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit (see Section V.B.6.).
- DOH approval for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

5. <u>Site No. 17 - Kahuawai Springs</u>

a. General Data

- TMK: 2-2-41:03
- Parcel Area: 36.405 acres
- Owner: City and County of Honolulu, BWS
- State Land Use District: Conservation (Resource)
- City Development Plan: Preservation
- City Zoning: Preservation, P-1
- Flood Zone: C
- Soil: TAE
- Vegetation: MS
- Approximate Elevation: 660 feet

b. Source Description

Kahuawai Springs is expected to produce about 0.2 mgd of domestic water. The spring is one of several springs that feed Pauoa Stream. Construction of a concrete walled sump around the spring will be used for development. A draft environmental impact statement has been completed for the project.

c. Potential Impacts

- Possible impact upon nearby springs and flow of Pauoa Stream.
- Short-term construction related impacts.

Pauoa Stream may experience a reduction in stream flow during the dry summer months. Mitigative measures may be implemented to monitor stream flow at a suitable location and to maintain minimum flows at all times. Only water in excess of the minimum flows will be diverted.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit (see Section V.B.6.).

- DOH approval for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

6. Site No. 18 - Nuuanu Aerator Well

a. General Data

o TMK: 1-9-07:2

o Parcel Area: 73.0 acres

o Owner: State of Hawaii

o State Land Use District: Conservation (Resource)

o City Development Plan: Preservation

o City Zoning: Preservation, P-1

o Flood Zone: C

o Soil: LoC

o Vegetation: MS, Ur

o Approximate Elevation: 740 feet with static water level at about 700 feet (msl)

b. Source Description

The Nuuanu Aerator Well is to be located on the grounds of the existing BWS Nuuanu Aerator facility, located along Nuuanu Pali Drive. The estimated yield is about 1.0 mgd and the water will be added to the BWS domestic water system, depending upon the results from the drilling and testing of an exploratory well. The well is expected to tap water perched on alluvium and Nuuanu volcanics. But, if the well is dug too deep, it could penetrate into dike water contained in the Koolau volcanics.

c. Potential Impacts

- Degradation of existing pond and flow of nearby Makuku Stream (a tributary of Nuuanu Stream).
- Construction related impacts.

Impacts to Nuuanu Stream flows are presently unknown. Impacts to stream flow can only be determined by long-term pumpage of a production well correlated with measurements from existing gaging stations. The test pumping of the exploratory well can indicate whether any stream flow reduction will occur.

The Nuuanu Reservoir wetlands will not be impacted by development of the Nuuanu Aerator Well.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

7. Site No. 19 - Kunawai Springs Well or Diversion

a. General Data

- o TMK: 1-7-36:10, 1-7-37:41
- o Parcel Area: 1.475 acres
- o Owner: City and County of Honolulu, Department of Parks and Recreation
- o State Land Use District: Urban
- o City Development Plan: Parks and Recreation
- o City Zoning: Preservation, P-1
- o Flood Zone: C
- o Soil: KaB
- o Vegetation: Ur
- o Approximate Elevation: 100 feet

b. Source Description

The area surrounding Kunawai Springs has been developed into a City and County of Honolulu park and a condominium. The proposed well will be located within the Kunawai

Springs Park boundaries. The well is anticipated to produce about 0.5 mgd. The quality of the water is uncertain at this time and will be determined during test pumping. If the water is non-potable, it can be used for irrigation, which would result in less water being pumped. Non-potable water could be used to irrigate the park grounds.

All of the water from the springs overflow the existing pond and is currently discharged into the City storm drainage system. The well will therefore make use of a potential potable water resource that is currently undeveloped and flows to the sea via Nuuanu Stream. The portion of Nuuanu Stream that receives the spring water discharge is channelized and is of low ecological value.

c. Potential Impacts

Well Development

- Reduction of outflow from springs.
- Potential loss of existing pond.
- Aesthetic impact upon existing park.
- Short-term construction related impacts.

Spring Diversion

- Short-term construction related impacts.

d. Other Requirements

- Coordination with the City Department of Parks and Recreation for use of the site.
- DLNR Water Withdrawal and Use Permit (see Section V.B.6.).
- DOH approval for domestic use.
- Construction related permits and approvals.

8. Site No. T3 - Kakaako District Transmission Main

a. General Data

o TMK: Various

- o Parcel Area: N/A
- o Owner: Various
- o State Land Use District: Urban
- o City Development Plan: Commercial
- o City Zoning: Kakaako Community Development District
- o Flood Zone: A4 (area with approximate boundaries of Ala Moana Boulevard, Auahi Street, Ward Avenue and Ala Moana Park Drive), C
- o Soil: FL
- o Vegetation: Ur

b. Project Description

The proposed Kakaako District Transmission Main will be located within the area bounded by Punchbowl Street to the west, Kapiolani Boulevard to the north, Piikoi Street to the east, and Ala Moana Boulevard to the south.

The specific location and requirements of the main have yet to be determined, pending finialization of detailed phasing plans by the Hawaii Community Development Authority.

The area in which the transmission line would be installed is within the State Kakaako Community Development District. There are also five significant historic sites located within the area. The five sites are listed on the National Register of Historic Places and include: the Old Kakaako Fire Station (TMK: 2-1-31:18); the Kawaiahao Church and Mission Houses (TMK: 2-1-32:2, 15, 17, 22-24); the Kakaako Pumping Station (TMK: 2-1-57:1); the U.S. Immigration Office (TMK: 2-1-28:2); and the Royal Brewery (TMK: 2-1-31:21). The Kakaako Pumping Station and the Old Kakaako Fire Station are also listed on the Hawaii Register of Historic Places. Sites eligible for inclusion on the National Register are the Advertiser Building, Brass Foundry, and Oahu Ice & Cold Storage Co.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Coordination with the Hawaii Community Development Authority.
- Fulfillment of Federal EIS requirements may be necessary.
- Construction related permits and approvals.
- Coordination with the Department of Land Utilization on Special Management Area Permit.
- Review and approval of preliminary and final construction plans by the State Department of Transportation, Highways Division for work affecting Ala Moana Boulevard.

E. KALIHI SUBAREA

The Kalihi Subarea extends from Palama to Kalihi Valley (see Figure 7). It also embodies Alewa Heights and Kamehameha Heights. There are three (3) proposed projects within this subarea (exchange water sources indicated with the prefix "E", e.g. E1; are discussed in section VIII.B.1.):

Site No.	Project Title
20	Jonathan Springs Well
21	Kalihi Wells II & III
T1	Dillingham Boulevard Transmission Main

The subarea is served by 14 wells. Six of these are privately operated while nine are municipal wells. The BWS also operates four tunnels, and one spring. The subarea is further served by four reservoirs which have a combined capacity of 2.22 MG, with individual reservoir capacities ranging between 0.2 to 1.0 MG each.

1. Site No. 20 - Jonathan Springs Well

   a. General Data

      o TMK: 1-6-05:31

      o Parcel Area: 1.88 acres

      o Owner: City and County of Honolulu, BWS

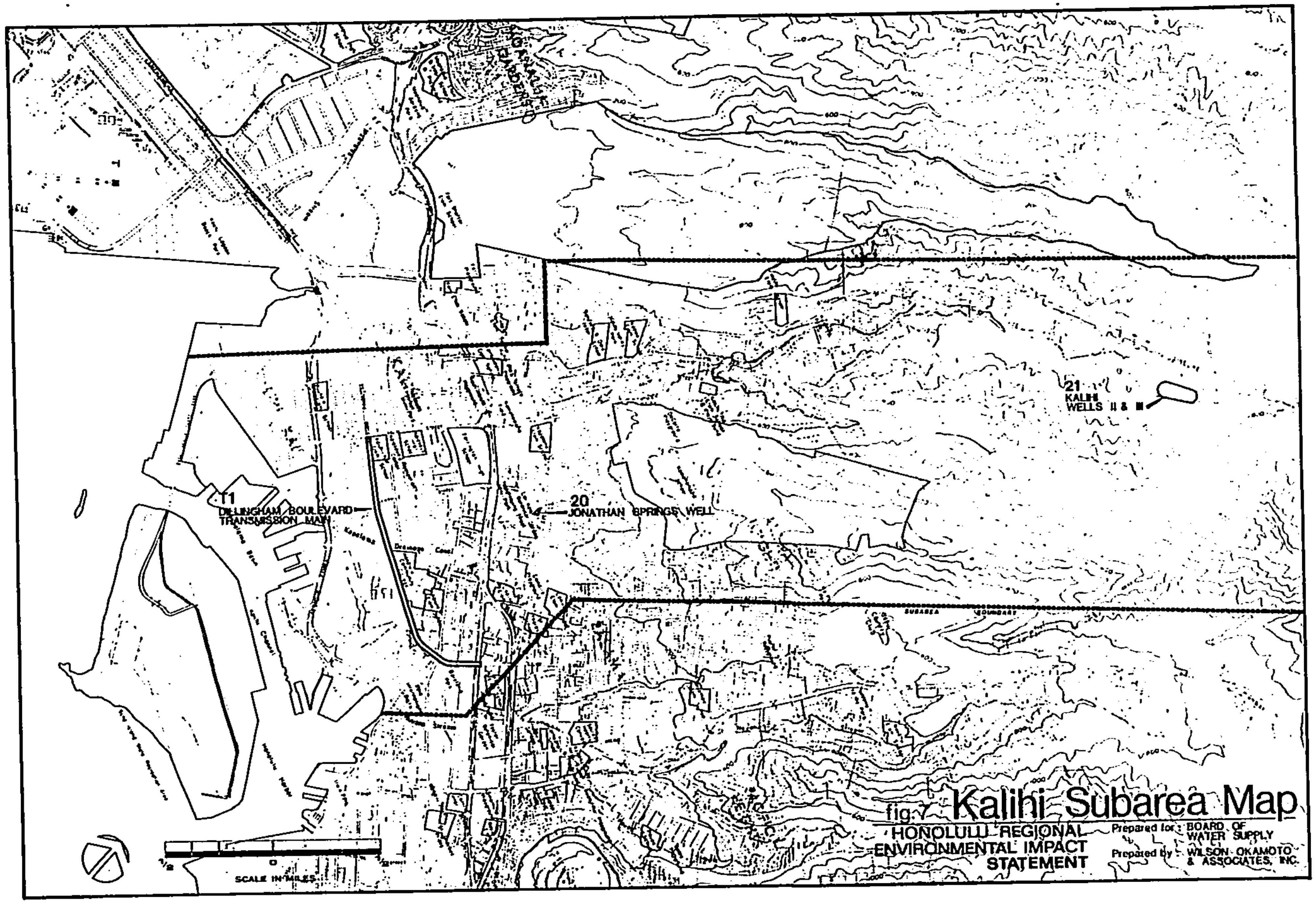

fig.7 Kalihi Subarea Map

- State Land Use District: Urban
- City Development Plan: Parks and Recreation
- City Zoning: Preservation, P-1
- Flood Zone: C
- Soil: KlaB
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 21 feet (msl)

b. Source Description

An exploratory well has been constructed with an installed capacity of 1.5 mgd and an operating capacity of up to 1.0 mgd. The surplus amount (i.e., the difference between operating capacity and installed capacity is reserved for emergencies).

The project includes the following construction:

1. Installation of an 8-inch transmission line from the well to the existing main on School Street.

2. Installation of a pump, construction of a concrete control building to house electrical equipment and appurtenances, and installation of a six-foot high security fence around the well and control building.

3. Repavement of Loi Kalo Place and installation of coral pavement with penetration type emulsified asphalt coat from Loi Kalo Place to the control building on the unimproved lot.

The deepwell pumping unit is rated at 1.5 mgd capacity. The unit includes control valves, mute, blow-off line, flow tube and piping.

The development of this resource is intended to increase the operational efficiency of the existing water system. In conjunction with the development of this source are plans to reduce pumpage at other sources within the subarea. Thus, the sustainable capacity of the water system within the Kalihi subarea will not be increased.

There are no flowing streams adjacent to the project site. Kapalama Canal, located adjacent to the project site, is a man-made, concrete-lined drainage canal which is currently used for storm water drainage. While the canal has minimal recreational value between King Street and Nimitz Highway, a proposal to improve this section of the Canal has been considered by the City and County for a number of years. Conceptual plans for these improvements provide for picnic areas and lookouts, a mini-park, landings for handcarried boats, vertical canal walls to optimize areas for vegetation, fishing platforms, a pedestrian promenade, and landscaping along Kohou Street.

The land containing Jonathan Springs Park (Loi Kalo Botanic Garden) is owned by the BWS. The park was developed by the Department of Parks and Recreation as a botanical garden with passive recreational use. The park presently contains a pond for taro cultivation, footpaths, comfort-utility station, fencing and landscaping using mainly endemic plants.

The exploratory well is in place and the control building is located outside the area containing the indigenous plants. The facilities were sited to ensure compatibility with the Park. Yield-drawdown and long term test data for the Jonathan Springs Exploratory Well are provided in Appendix J. A negative declaration has been filed for the production facilities.

The recreational use of the park is limited due to inadequate vehicular access and parking, and by security problems. Any future development of the park for recreational purposes will require solutions to these problems.

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Coordination with the City Department of Parks and Recreation for use of the site.
- DLNR Water Withdrawal and Use Permit (see Section V.B.6.).
- DOH approval of the well for domestic use.
- Construction related permits and approvals.

2. <u>Site No. 21 - Kalihi Wells II & III</u>

a. General Data

- o TMK: 1-4-18:06
- o Parcel Area: 287.309 acres
- o Owner: City and County of Honolulu, BWS
- o State Land Use District: Conservation (Resource)
- o City Development Plan: Preservation
- o City Zoning: Presentation, P-1
- o Flood Zone: D
- o Soil: LoD
- o *Vegetation:* MS
- o Approximate Elevation: 600 feet with static water level at about 580 feet (msl)

b. Source Description

The proposed Kalihi Wells II and III will be located in the vicinity of the existing BWS Kalihi well. The site of these wells is situated deep in Kalihi Valley above the existing residential development. Each well is expected to produce about 0.25 mgd of potable water that will be introduced into the existing domestic water system. Development of these production wells will be preceded by exploratory well drillings and test pumpings.

The proposed wells are located within the State Conservation District.

c. Potential Impacts

- Short-term construction related impacts.

Impacts to Kalihi Stream are not anticipated. However, stream flow will be monitored during development. If the monitoring shows stream flow in Kalihi Stream is adversely affected, mitigative measures acceptable to both the State Department of Land and Natural Resources and the U.S. Fish and Wildlife Service will be implemented.

d. Other Requirements

- DLNR Water Withdrawal and Use Permit.
- DOH approval of the well for domestic use.
- DLNR Conservation District Use Permit.
- Construction related permits and approvals.

3. Site No. T1 - Dillingham Boulevard Transmission Main

a. General Data

- o TMK: NA
- o Parcel Area: NA
- o Owner: City and County of Honolulu
- o State Land Use District: Urban
- o City Development Plan: Proximate to Public Facilities, Commercial, Industrial, Medium and Low Density Apartments
- o City Zoning: NA
- o Flood Zone: C
- o Soil: FL, EmA, KaB
- o Vegetation: Ur

b. Project Description

The proposed project consists of the installation of 7,150 linear feet of 42-inch pipe along Dillingham Boulevard from Kalihi Street to the intersection of Liliha Street and Vineyard Boulevard. The new water main will link with an existing 42-inch main at the intersection of Liliha Street and Vineyard Boulevard. The purpose of the project is to increase transmission capacity and assure continuity of water flow by having parallel mains between the Pearl Harbor-Halawa sources and downtown Honolulu. The line will have the capacity to transmit a flow rate of approximately 34 million gallons per day.

The proposed alignment will begin at the intersection of Kalihi Street and Dillingham Boulevard and continue along the mauka portion of Dillingham Boulevard for approximately 100 feet; at this point it will cross to the makai side of the boulevard and follow the street right-of-way until Kapalama Canal; it will then be routed underneath and across the canal, and continue along Dillingham Boulevard to Honolulu Community College. The line will then cross over Dillingham Boulevard and be routed along the mauka side to King Steet, where it will cross to the Diamond Head side of Liliha Street, and continue to Vineyard Boulevard where it will connect to an existing 42-inch main.

Provisions will be made for the new main to connect to a 16-inch line at Waiakamilo Road and a 42-inch line at King/Liliha Streets.

The proposed waterline will be installed within the right-of-way of Dillingham Boulevard between Kalihi Street and Vineyard Boulevard. Due to extensive urban development, very little of the natural resource base remains.

Construction time for the proposed project is estimated at 9 to 12 months. Phase I of the project is anticipated to cost approximately $3.39 million, and will be funded by the BWS. A negative declaration has been filed for the project.

c. Potential Impacts

- Traffic related impacts.
- Other short-term construction related impacts.

d. Other Requirements

- Construction plans will be coordinated with the Division of Engineering and the Division of Wastewater Management of the City and County's Department of Public Works.
- Construction related permits and approvals.
- Preliminary and final construction plans for work within the State highway right-of-way will be submitted to the State Department of Transportation Highways Division for review and approval.

F. MOANALUA SUBAREA

The Moanalua Subarea includes Fort Shafter, Red Hill, Aliamanu, Salt Lake and the Honolulu International Airport (see Figure 8). The western border of the subarea generally follows the Honolulu/Ewa Judicial District boundary. However, for this report, the Moanalua Subarea encompasses a portion of the Ewa Judicial District in order to include discussion of a proposed well at the H-1 freeway interchange in Halawa.

One project is proposed in this subarea (exchange water sources are indicated with a prefix "E", e.g. E1, and are discussed in Section VIII.B.1.):

Site No.	Project Title
T2	Salt Lake Boulevard Transmission Main

The Moanalua Subarea is presently serviced by 11 wells, seven of which are private. The BWS has three wells at its Moanalua Station and the Kalihi Shaft.

1. Site No. T2 - Salt Lake Boulevard Transmission Main

   a. General Data

      - TMK: 1-1-10
      - Parcel Area: NA
      - Owner: City and County of Honolulu
      - State Land Use District: Urban
      - City Development Plan: NA
      - City Zoning: Residential, R-6
      - Flood Zone: D
      - Soil: MdB, MdC, rRK
      - Vegetation: Ur

   b. Project Description

      The proposed 36-inch transmission main will run along Salt Lake Boulevard from Maluna Street to Ala Lilikoi Street, a distance of about 4,800 linear feet. The new main will provide additional capacity in the system and will ensure continuity of service during maintenance and repair operations to the existing 36-inch transmission main.

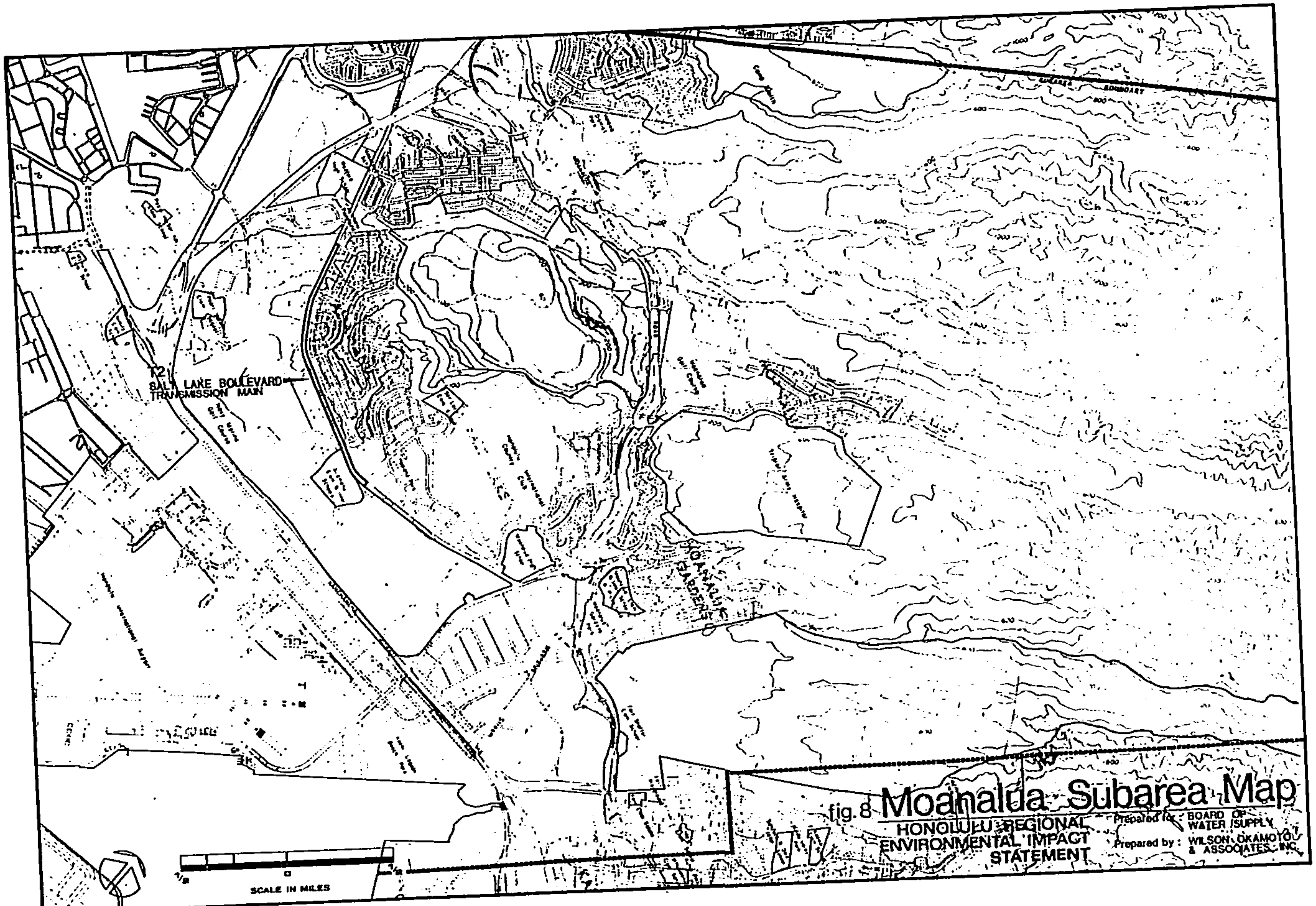

fig. 8 Moanalua Subarea Map
HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

c. Potential Impacts

- Short-term construction related impacts.

d. Other Requirements

- Construction related permits and approvals.

VIII. ALTERNATIVES

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A. SOURCE ALTERNATIVES

Due to the higher capital and operational cost involved in developing alternate water sources, the complete utilization of the available ground water is planned.

However, to meet the projected demand beyond the year 2000, alternate freshwater sources must be developed. The BWS is evaluating a number of source alternatives for future development:

1. No Action

Under the no action alternative, existing pumpages would be maintained and no new water sources would be developed in the Honolulu District. However, the Honolulu District is the most heavily populated area on the island and has the highest domestic water demand. Additional water sources are required to meet present and projected demands. If new water sources are not developed within the district then water must be transmitted from surrounding areas. This will result in additional transmission, storage and pumping costs.

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 below BWS' estimates of sustainable capacity.

The BWS estimated sustainable capacity represents the average high 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. This scenario is dependent upon increases in the amount of water BLNR allows BWS to draft at specific source sites, which could be accomplished through issuance of Water Withdrawal and Water Use Permits, by the BLNR.

Sustainable yield, total allowed draft and reserve are indicated in Table 20. The BWS total pumping capacity and unused pumping capacity is 109.2 and 70.54 mgd, respectively. It should be noted that the sustainable yield figures are best estimates only.

TABLE 20

GROUND WATER RESOURCE AND SOURCE DEVELOPMENT CONSTRAINTS

(All units mgd)

	Subareas		Total
	Waialae-Hawaii Kai	Moanalua-Kaimuki	
Sustainable Yield*	5.00	55.000	60.000
Total Allowed Draft**	1.50	47.187	48.687
BWS Sources	1.23	37.430	38.660
Private Sources	0.27	8.207	8.477
Reserve	3.50	7.810	11.310
BWS Pumping Capacity	4.88	105.320	109.200
BWS Unused Pumping Capacity	3.65	67.890	70.540

* 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."

3. Surface Sources

There are approximately eleven (11) perennial stream systems in the Honolulu 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.

There are some problems associated with the development of surface water sources. An open system poses greater liabilities to the Board of Water Supply as a result of unauthorized entry and possible contamination. Water quality and quantity could fluctuate greatly between "wet" and "dry" periods.

4. Desalting

The use of desalted sea or brackish water for potable water 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).

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

The State Department of Land and Natural Resources is planning a demonstration desalting plant on Oahu to determine if desalting brackish water is a viable alternative to meet Hawaii's future water needs.

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.

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.

There are a number of areas in Honolulu where lower quality water may be potentially developed, see Table 21. These areas are described below and include general information such as location by tax map key, parcel area in acres, landownership, State Land Use District, City Development Plan designation, City Zoning designation, flood hazard identification, soil type and vegetative cover (see Figure 9).

Data for flood hazards, soil type and vegetation are provided in symbolic form. Reference should be made to Chapter IV: section 7 for flood hazard zones, section 5 for soil classification and description, and section 13 for vegetation by habitat classification and plant associations.

Additionally, each source is described by anticipated sustainable capacity and existing land use at or in the vicinity of the site.

Although the BWS has identified these secondary water sources, BWS' highest priority for source development includes only potable sources. The BWS therefore, has no immediate plans to develop these sources.

Other State or City and County agencies or private developers who find it feasible to develop these sources may utilize the information provided below. Use of these lower quality waters in exchange for potable water currently consumed, will optimize the use of the existing municipal water supply.

If developed, these secondary sources may require installation of exploratory test wells and test pumping. If test results indicate a source is of adequate quality and quantity, a production well can be installed, with the appropriate appurtenances. These secondary sources would not be allowed to connect with the municipal potable water system, thereby minimizing the potential for mixing with the existing system.

<u>Site No. E1 - Mid Pacific Caprock Spring</u>

a. General Data

- o TMK: 2-9-04:03
- o Parcel Area: 11.395 acres
- o Owner: Mid Pacific Institute
- o State Land Use District: Urban

Table 21

LIST OF NON-POTABLE WATER SOURCES
IN THE HONOLULU DISTRICT

E1. Mid Pacific Caprock Springs
E2. Moiliili Caprock Well
E3. Punahou School Caprock Spring
E4. Central Union Caprock Well
E5. Makiki Park Caprock Well
E6. Kaahumanu Caprock Well
E7. Thomas Square Caprock Well
E8. BWS Building Caprock Well
E9. Capitol District Well
E10. Central Fire Station Caprock Well
E11. Liliuokalani Gardens Caprock Well
E12. Palama Settlement Caprock Well
E13. Kalakaua School Caprock Wells
E14. Kalihi Union Caprock Well
E15. Moanalua Caprock Well
E16. Moanalua Alluvial Well
E17. Halawa Alluvial Well

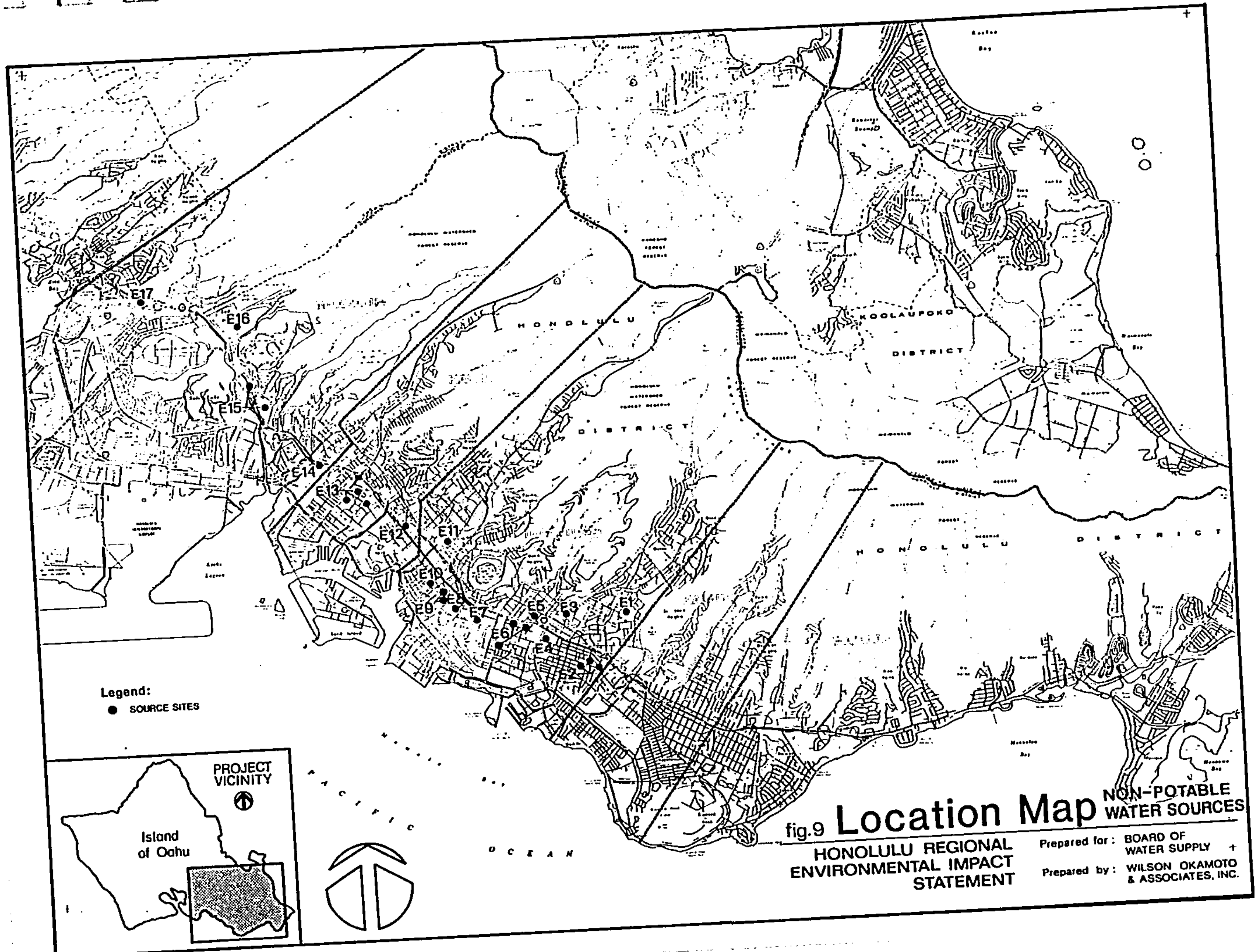

fig.9 **Location Map** NON-POTABLE WATER SOURCES

HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for : BOARD OF WATER SUPPLY

Prepared by : WILSON OKAMOTO & ASSOCIATES, INC.

- City Development Plan: Public Facility
- City Zoning: Residential, R-4
- Flood Zone: C
- Soil: HnA
- Vegetation: Ur
- Approximate Elevation: 120 feet

b. Source Description

The Mid Pacific Caprock Springs well can be expected to produce about 0.1 mgd of nonpotable water that can be used to irrigate the Mid Pacific School grounds. This would allow the potable water currently being used for irrigation to be used for domestic purposes. Development of this well would depend upon test results of a proposed exploratory well. Nonpotable water would not be added to the municipal system, and would be transmitted through a separate system. As an alternative to well development, a "spring box" collection system may be considered at this site.

The springs are located adjacent to the Mid Pacific School athletic field with the overflow presently discharging into a storm drain. The springs do not feed any significant body of water and therefore the use of the spring waters would represent a more beneficial use of a natural resource that would otherwise be lost.

Site No. E2 - Moiliili Caprock Well (Three potential locations)

a. General Data

o	TMK:	2-7-8:02	2-8-5:01	2-8-5:03
o	Parcel Area:	7.693 acres	0.348 acres	3.439 acres
o	Owner:	State of Hawaii Stadium Park	City & County of Honolulu Moiliili Field	City & County of Honolulu Moiliili Triangle Park

- State Land Use District: Urban
- City Development Plan: Parks and Recreation
- City Zoning: Preservation, P-1
- Flood Zone: C

- Soil: EmA
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

The Moiliili Caprock Well can be expected to produce about 0.1 mgd of water for irrigation. An exploratory well would be drilled and tested prior to development. If successful, water from the production well could be used to irrigate any of a number of City and County or State park facilities in the area. Nonpotable water would not be added to the municipal system but would be transmitted through a separate system.

There are three alternative sites for the well. One site is the Stadium Park, a passive park with picnic areas, jogging and skating paths, and a covered pavillion. Many large trees have been planted throughout the park. Due to its minimal size, the well facilities should not have significant adverse impacts on the scenic or recreational value of the park. Much of the water produced from the well can be used for this park.

The Moiliili Triangle Park, a second possible site, is a small passive park at the junction of South King Street and South Beretania Street. There are a number of very large canopy trees on the site. The developable area in the park is restricted by the narrow shape of the parcel and the large trees on the site. If the well is developed on this site, most of the water will have to be pumped off-site due to the relatively low water demands of this park. A transmission main will be required to connect the well to the off-site use.

Moiliili Field, the third potential site, is an active park with two softball fields and restrooms. There are large trees along the perimeter of the park. Siting of a well facility in this park would have to consider the open space needed for the two ball fields and the spectators.

<u>Site No. E3 - Punahou School Caprock Spring</u>

a. General Data

- TMK: 2-8-18:01

- o Parcel Area: 73.893 acres
- o Owner: Punahou School
- o State Land Use District: Urban
- o City Development Plan: Public Facility
- o City Zoning: Residential, R-6
- o Flood Zone: C
- o Soil: KlB
- o Vegetation: Ur
- o Approximate Elevations: 100 feet

b. Source Description

The Punahou Springs are located on the Punahou School campus, adjacent to the school chapel. The springs feed a large pond and the overflow channeled into the storm drain system. The development of the springs would utilize this excess flow for possible irrigation of the school grounds. A well or spring box could be developed. Development of a production well would be preceded by installation and test pumping of an exploratory well.

The Punahou School Caprock Springs can be expected to yield approximately 0.1 mgd of water that is suitable for irrigation. The water could to be used to irrigate a portion of Punahou School, thereby releasing a similar amount of potable water for domestic use. A system separate from the main municipal system will be required. The Punahou School Campus is listed on the National Register of Historic Places.

Site No. E4 - Central Union Caprock Well

a. General Data

- o TMK: 2-8-11:02
- o Parcel Area: 8.394 acres
- o Owner: Central Union Church of Honolulu
- o State Land Use District: Urban

- o City Development Plan: Public Facility
- o City Zoning: Apartment, A-2
- o Flood Zone: C
- o Soil: MkA
- o Vegetation: Ur
- o Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

This potential secondary source is on the grounds of the Central Union Church and is expected to yield about 0.1 mgd. The water may be used for irrigation purposes.

Site No. E5 - Makiki Park Caprock Well

a. General Data

- o TMK: 2-4-22:01
- o Parcel Area: 8.444 acres
- o Owner: City and County of Honolulu, Department of Parks and Recreation
- o State Land Use District: Urban
- o City Development Plan: Parks and Recreation
- o City Zoning: Preservation, P-1
- o Flood Zone: C
- o Soil: MkA
- o Vegetation: Ur
- o Approximate Elevation: 60 feet with static water level at about 2 feet (msl)

b. Source Description

The Makiki Park Caprock Well can be expected to yield between 0.1 mgd to 0.5 mgd. The water can be used to irrigate Makiki District Park and potentially Cartwright Field, located makai of the H-1 Freeway. Development of this resource would require installation and testing of an exploratory well to determine the quantity and quality of the water. The irrigation water would operate through a system separate from the municipal water system.

Site No. E6 - Kaahumanu Caprock Well (Three potential locations)

a. General Data

o	TMK:	N/A Under F.A.P. I-H1-1(23) near corner of Piikoi Street and H-1 freeway eastbound on-ramp	2-3-12:21	2-4-10:15
o	Parcel Area:	N/A	75,386 s.f.	2.373 acres
o	Owner:	State of Hawaii	City & County of Honolulu Sheridan Park	State of Hawaii Cartwright Field
o	State Land Use District:	Urban	Urban	Urban
o	City Development Plan:	N/A (Roadway)	Parks and Recreation	Parks and Recreation
o	City Zoning:	Proximate to Medium density apartment, A-2	Preservation, P-1	Preservation, P-1
o	Flood Zone:	C	C	C
o	Soil:	MkA	MkA	MkA
o	Vegetation:	Ur	Ur	Ur
o	Approximate Elevation:	30 feet	10 feet	30 feet

(Static water level at about 2 feet (msl))

b. Source Description

The Kaahumanu Caprock Well can be expected to yield about 0.1 mgd. Water quantity and quality must be confirmed by drilling and testing of an exploratory well.

Potential users could include Sheridan Park, McKinley High School, Kaahumanu Elementary School and Cartwright Field.

A well could be located under the H-1 Freeway viaduct near the corner of Piikoi Street and the H-1 Freeway eastbound on-ramp. Other alternative sites are located within Sheridan Park and Cartwright Field.

Site No. E7 - Thomas Square Caprock Well

a. General Data

- TMK: 2-4-01:01
- Parcel Area: 6.419 acres
- Owner: City and County of Honolulu, Department of Parks and Recreation
- State Land Use District: Urban
- City Development Plan: Parks and Recreation
- City Zoning: Preservation, P-1 (Thomas Square/Academy of Arts District)
- Flood Zone: C
- Soil: MkA
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

If developed, a well in Thomas Square can be expected to yield between 0.1 mgd and 0.2 mgd. Development of a production well would depend upon exploratory well test pumping results. The water could be used to irrigate the park and possibly the City's Neal S. Blaisdell Center grounds or the McKinley High School complex. Off-site water use would require a transmission line.

Thomas Square is listed on the National Register of Historic Places, and is also within the City and County of Honolulu's Thomas Square/Academy of Arts District (Historic, Cultural and Scenic District No. 5).

Site No. E8 - BWS Building Caprock Well

a. General Data

- TMK: 2-1-36:04, 05

- Parcel Area: 5.750 acres
- Owner: City and County of Honolulu, BWS
- State Land Use District: Urban
- City Development Plan: Public Facilities
- City Zoning: Apartment, A-2 (Hawaii Capitol District)
- Flood Zone: C
- Soil: MkA
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

The BWS Building Caprock Well is an existing well drilled in 1956 and can yield about 0.25 mgd of irrigation water. This well is currently used to supply the fountain in the front of the BWS Public Service Building.

The areas that may utilize this water include the BWS Building grounds, the Municipal Building or the State Capitol grounds. A new pump, controls, and distribution system would be required for expanded use.

The site is located within the Hawaii Capitol District (Historic, Cultural and Scenic District No. 1).

Site No. E9 - Capitol District Caprock Well (Two Potential Locations)

a. General Data

o	TMK:	2-1-18:46, 47	2-1-18:16
o	Parcel Area:	220,786 s.f.	68,193 s.f.
o	Owner:	State of Hawaii Department of Health Building (Kinau Hale)	State of Hawaii Liliuokalani Building
o	State Land Use District:	Urban	Urban

o	City Development Plan:	Public Facilities	Public Facilities
o	City Zoning:	Medium density Apartment, A-2 (Hawaii Capitol District)	Medium density Apartment, A-2
o	Flood Zone:	C	C
o	Soil:	MkA	MkA
o	Vegetation:	Ur	Ur
o	Approximate Elevation:	20 feet.	20 feet

(Static water level at about 2 feet (msl))

b. Source Description

The Capitol District Caprock Well can be expected to produce between 0.1 mgd to 0.2 mgd of irrigation water.

A well could be located on the grounds of the State Department of Health building which is also known as Kinau Hale. Another alternative site is located within the grounds of the Liliuokalani Building.

The water could be used to irrigate the State Capitol grounds or the Municipal Building grounds, the landscaping along Vineyard Boulevard and the Vineyard Parking Garage grounds, the Liliuokalani Building grounds or the State Department of Health Building grounds. An exploratory well would need to be drilled and test pumped to verify the anticipated water quality and yield.

The sites are located within the Hawaii Capitol District (Historic, Cultural and Scenic District No. 1).

<u>Site No. E10 - Central Fire Station Caprock Well</u>

a. General Data

- o TMK: 2-1-09:27
- o Parcel Area: 30,276 square feet
- o Owner: City and County of Honolulu
- o State Land Use District: Urban

- City Development Plan: Parks and Recreation
- City Zoning: Preservation, P-1
- Flood Zone: C
- Soil: MkA
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

The proposed Central Fire Station Caprock Well could be developed as a secondary source to provide irrigation water. It is expected to produce between 0.1 mgd and 0.5 mgd depending upon the exploratory well test pumping results. The production well would be located adjacent to the fire station, within Kamalii Park, and would operate through an irrigation system independent of the municipal system.

Kamalii Park is about 30,000 square feet in area. The well facilities may require a few hundred square feet.

The Our Lady of Peace Cathedral is in close proximity to the site, and is listed on both the State and National Registers of Historic Places.

<u>Site No. E11 - Liliuokalani Gardens Caprock Well</u>

a. General Data

- TMK: 1-7-20:01
- Parcel Area: 4.783 acres
- Owner: City and County of Honolulu, Department of Parks and Recreation
- State Land Use District: Urban
- City Development Plan: Parks and Recreation
- City Zoning: Preservation, P-1
- Flood Zone: A

- Soil: KaB
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

Liliuokalani Gardens is a City park that is located along Nuuanu Stream. Exploratory well drilling would precede development of the proposed production well. A production well at this location could be expected to produce about 0.1 mgd of water which could be used to irrigate the park grounds.

Site No. E12 - Palama Settlement Caprock Well

a. General Data

- TMK: 1-7-45:01
- Parcel Area: 6.556 acres
- Owner: Palama Settlement
- State Land Use District: Urban
- City Development Plan: Residential
- City Zoning: Residential, R-6
- Flood Zone: C
- Soil: EmA
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

It is anticipated that approximately 0.1 mgd can be pumped from a production well. The water could be used to irrigate the Palama Settlement Grounds and possibly other off-site areas such as the landscaping along Vineyard Boulevard.

There are a number of facility improvements proposed by the Palama Settlement on the parcel which, in turn, will limit the areas that can be developed into a well site.

Site No. E13 - Kalakaua School Caprock Well (Three potential locations)

a. General Data

o	TMK:	1-5-25:01	1-6-21:05	1-5-03:20
o	Parcel Area:	25,722 s.f.	26.455 acres	29,005 s.f.
o	Owner:	State of Hawaii Kalakaua Intermediate School	City & County of Honolulu Farrington High School	City & County of Honolulu BWS Kalihi Pump Station
o	State Land Use District:	Urban	Urban	Urban
o	City Development Plan:	N/A (Roadway)	Public Facilities	Public Facilities
o	City Zoning:	Low density Apartment, A-1	Residential R-6	Business B-2
o	Flood Zone:	C	C	C
o	Soil:	HxA	EmA	EmA
o	Vegetation:	Ur	Ur	Ur
o	Approximate Elevation:	40 feet	40 feet	40 feet

(Static water level at about 2 feet (msl))

b. Source Description

If developed, the Kalakaua School Caprock Wells can be expected to yield a total amount between 0.1 mgd to 0.5 mgd of water from up to three wells for irrigation use. Three alternative sites may be considered for this source.

The primary site is located near Kalakaua Intermediate School, along Kalihi Street next to Kalakaua Playground. The wells could be located along the mauka boundary of the school, within an abandoned portion of Alokele Street. The water from the wells could be used to irrigate the grounds of Kalakaua School, Kalakaua Playground and Kalihi Kai Elementary School.

An alternative to the Kalakaua Intermediate School site is Farrington High School which is located along North King Street. The water from the wells could be used to irrigate the school grounds and possibly the landscaping along a portion of North King Street.

The BWS Kalihi Pumping Station located at the corner of North King and Waiakamilo Streets, is another alternative site. While developable area of the lot is limited, it is still possible to develop a well at the site. The well would provide irrigation water for the BWS site and possibly Farrington High School grounds and the landscaping along King Street.

Site No. E14 - Kalihi Union Caprock Well

a. General Data

- TMK: 1-3-02:36
- Parcel Area: 4.339 acres
- Owner: Kalihi Union Church
- State Land Use District: Urban
- City Development Plan: Residential
- City Zoning: Residential, R-7
- Flood Zone: C
- Soil: HxA, MlA
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 2 feet (msl)

b. Source Description

The Kalihi Union Well would be located on the grounds of the Kalihi Union Church on North King Street. The well is expected to yield about 0.1 mgd of water that can be used for irrigation. Development of this resource would depend upon the results of exploratory well test pumping. The irrigation water would be provided through a separate water system. The site is presently occupied by the Kalihi Union Church, a pre-school, a Sunday School, Kalihi Mental Health Clinic and the Cosmopolitan Social Services.

There are a number of activities occurring on the property, many of which involve children. Safety and noise are major concerns that could restrict development of the well.

Site No. E15 - Moanalua Caprock Well (Three potential locations)

a. General Data

o	TMK:	1-1-37:06	1-1-09:5	1-1-09:4
o	Parcel Area:	0.36 acres (15,687 s.f.)	10.692 acres	23.162 acres
o	Owner:	City & County of Honolulu Existing BWS Well Site	City & County of Honolulu Moanalua Playground	Samuel M. Damon Trust Estate Moanalua Gardens
o	State Land Use District:	Urban	Urban	Urban
o	City Development Plan:	Public Facility	Parks and Recreation	Parks and Recreation
o	City Zoning:	Residential R-4	Preservation P-1	Preservation P-1
o	Flood Zone:	A	A	A
o	Soil:	KlB, KlaB	KlB	KlB
o	Vegetation:	Ur	Ur	Ur
o	Approximate Elevation:	40 feet	40 feet	40 feet

(Static water level at about 2 feet (msl))

b. Source Description

The Moanalua Caprock Well can be expected to produce approximately 0.1 mgd of irrigation water. An exploratory well would need to be drilled and test pumped prior to its development into a production well. The water may be used to irrigate Moanalua Gardens, Moanalua Elementary School, freeway landscaping or the Moanalua Playground.

The BWS owned 0.36 acre parcel, north of Moanalua Playground, is occupied by an existing BWS well facility consisting of a control building and three wells. However, there may be enough area on that parcel or an adjacent State owned parcel for a new well facility.

Moanalua Gardens is a 23.162 acre private urban park located east of Moanalua Playground. This passive park consists of scenic open space, featuring large trees and two streams. Moanalua Gardens is open to the public and is often used for picnicking, birthday parties and weddings.

At the southern end of the Moanalua Gardens site there are two historic sites. These are a Chinese Hall and the Kamehameha V Cottage.

Site No. E16 - Moanalua Alluvial Well

a. General Data

- TMK: 1-1-12:13
- Parcel Area: 59.318 acres
- Owner: Samuel M. Damon Trust Estate
- State Land Use District: Urban
- City Development Plan: Public Facilities
- City Zoning: Preservation, P-1
- Flood Zone: C
- Soil: LaC
- Vegetation: Ur, DS
- Approximate Elevation: 140 feet with static water level at about 120 feet (msl) (estimated)

b. Source Description

The Moanalua Alluvial Well could produce about 0.2 mgd of water for irrigation. The well would be located on the grounds of the Moanalua Golf Course although its exact location has not been determined. The water could be used to irrigate the golf course or freeway landscaping.

Site No. E17 - Halawa Alluvial Well

a. General Data

- TMK: NA

- Parcel Area: NA
- Owner: State of Hawaii
- State Land Use District: Urban
- City Development Plan: NA
- City Zoning: Residential, R-6
- Flood Zone: D
- Soil: KtC, KlA, KTKE, WzC
- Vegetation: Ur
- Approximate Elevation: 40 feet with static water level at about 10 feet (msl) (estimated)

b. Source Description

The Halawa Alluvial Well can be anticipated to produce about 0.1 mgd and could be located within the landscaped area of the H-1 Freeway Halawa Interchange. An exploratory well will need to be drilled and tested prior to development of a production well. The well could provide irrigation water for the interchange landscaping. Access to the well would be off one segment of the interchange.

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 contribute to ground water recharge in certain areas. However, in the case of recharge, 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 concerns the transmission and distribution of water supplies. The metering of water entering the water system, and of water consumption, enables the BWS to account for its water supplies. A leak detection program was initiated in 1976. The program allowed the BWS to initiate repairs quickly, thus limiting and reducing losses. Other benefits arising from this monitoring program include identification of poor soil conditions; the need for changes in materials, standards and construction practices; and the need for pipe replacements.

In the event of power and/or mechanical failures, it is BWS policy that any disruption to water service is minimized as much as possible. 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. These factors could, with knowledgeable personnel, reduce the severity and duration of emergencies to a minimum.

Consumer conservation is fostered through various means. Public involvement is encouraged through dissemination of information and persuasion. 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 low ground water level condition. 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, these will be of temporary duration, occuring only during installation of the facilities. Appropriate measures will be taken to minimize these effects.

Most of the projects' anticipated long-term adverse impacts can be mitigated. However, the commitment of land area cannot be avoided.

Utilization of these lands may preclude options for future development at some sites. As previously discussed, the proposed Kakaako District Transmission Main will be located within the State Kakaako Community Development District, and in the vicinity of three sites listed on the Hawaii and/or National Registers of Historic Places.

The possible reduction of stream flow due to development of the proposed projects is considered to be a probable adverse impact which cannot be avoided.

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

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The proposed water facility improvements will develop additional water sources and improve the existing municipal system. Although import from other water districts on Oahu will still be required, the proposed improvements would help provide adequate water supplies to meet the projected needs of the Honolulu District. Development of additional sources is required to meet the projected needs of the Honolulu District and provide for anticipated growth as desired by the City and County of Honolulu's General Plan.

The long-term productivity of the basal aquifer is not anticipated to be adversely affected, as the anticipated draft will be within the DLNR established sustainable yields.

XI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

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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

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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, as individual water system improvements are implemented.

Archaeological/Historic Resources

A few of the proposed projects are located in undeveloped areas. Impacts of development of these projects to unrecorded or buried historical resources is unknown.

XIII. AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED

XIII. AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED

FEDERAL AGENCIES

Department of Agriculture
Soil Conservation Service

Department of the Army
Corps of Engineers

Department of Interior
Fish and Wildlife Service
Division of Ecological Services

Headquarters, U.S. Navy Base

Environmental Protection Agency

U.S. Department of Interior
Division of Water Resources
U.S. Geological Survey

STATE AGENCIES

Department of Accounting and General Services

Department of Agriculture

Department of Defense

Department of Education

Hawaii Housing Authority

Department of Hawaiian Home Lands

Department of Health

Department of Land and Natural Resources

Office of Hawaiian Affairs

Department of Planning and Economic Development

Department of Transportation

University of Hawaii
Environmental Center

University of Hawaii
Water Resources Research Center

Office of Environmental Quality Control

COUNTY AGENCIES

Building Department

Department of General Planning

Honolulu Fire Department

Honolulu Police Department

Department of Housing and Community Development

Office of Information and Complaint

Department of Land Utilization

Department of Parks and Recreation

Department of Public Works

Department of Transportation Services

INDIVIDUALS

Senator Daniel K. Inouye

Senator Spark M. Matsunaga

Congressman Daniel K. Akaka

Congressman Cecil Heftel

Honorable Richard Wong

Honorable Henry H. Peters

Ms. Patsy T. Mink

Ms. Alice Chook

Mr. C.T. Shiraishi

OTHER ORGANIZATIONS

Life of the Land

Sierra Club

Outdoor Circle

Bishop Museum

Hawaiian Humane Society

Mid-Pacific Institute

Budget Realty, Ltd.

Volumes Co., Ltd.

Bernice Pauahi Bishop Trust Estate

Punahou School

Palama Settlement

Kalihi Union Church

Estate of Samuel M. Damon

Central Union Church

NEIGHBORHOOD BOARDS

Hawaii Kai Neighborhood Board No. 1

Kuliouou-Kalani Iki Neighborhood Board No. 2

Waialae-Kahala Neighborhood Board No. 3

Kaimuki Neighborhood Board No. 4

Diamond Head/Kapahulu/St. Louis Heights Neighborhood Board No. 5

Aiea Neighborhood Board No. 20

Palolo Neighborhood Board No. 6

Manoa Neighborhood Board No. 7

McCully/Moiliili Neighborhood Board No. 8

Waikiki Neighborhood Board No. 9

Makiki/Lower Punchbowl/Tantalus Neighborhood Board No. 10

Ala Moana-Kakaako Neighborhood Board No. 11

Nuuanu/Punchbowl Neighborhood Board No. 12

Downtown Neighborhood Board No. 13

Mr. Wendell H.C. Chun, Chairman
Liliha/Kapalama Neighborhood Board No. 14
c/o Liliha Library
1515 Liliha Street
Honolulu, Hawaii 96817

Kalihi-Palama Neighborhood Board No. 15

Kalihi Valley Neighborhood Board No. 16

Aliamanu-Salt Lake-Foster Village Neighborhood Board No. 18

UTILITY COMPANIES

Hawaiian Electric Company

Hawaiian Telephone Company

The Gas Company

XIV. REFERENCES

XIV. REFERENCES

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XV. GLOSSARY

XV. GLOSSARY

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

Aquifer - A water bearing stratum (layer) of permeable rock, sand or gravel. In basal aquifers, freshwater floats upon seawater.

Artesian Well - A well in which water rises after the aquifer is reached.

Basal water - Aquifer confined water.

Caprock - An overlying stratum that is less permeable than water bearing stratum. Usually found in coastal areas, the caprock retards seaward flow of freshwater.

Permitted Use - A quantity of water for which water use rights have been approved by the DLNR by a permitting process.

Preserved Use - The quantity of water which is reserved for water users certified to have existed at the time Honolulu became a Groundwater Control Area.

Riparian - Relating to or living or located on the bank of a natural watercourse (as a river) or sometimes of a lake or a tidewater.

Riparian Rights - A right (as access to or use of the shore, bed, and water) of one owning riparian land.

Sustainable Capacity - The rate at which water may be withdrawn from a specific source site, such as a well or shaft, without unduly impairing source utility.

Sustainable Yield - 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.

XVI. APPENDICES

A. U.S.G.S. Water Resources Data for Selected Streams in the Honolulu District, Water Year 1983

B. Kuliouou Well Schematic Design

C. Kuliouou Well 1843-01 Well Records and Pumping Test Data

D. Wailupe Well II Test Data

E. Memorandum to the Board of Land and Natural Resources from Robert T. Chuck, Manager-Chief Engineer, Division of Water and Land Development, Department of Land and Natural Resources

F. Manoa III Exploratory Well No. 1948-02 Long Term Pumping Test

G. Manoa Stream Flow Monitoring Data for Manoa Well III

H. Memorandum to Mr. Bunji Higaki From J. Grance Regarding the Waaloa Exploratory Well

I. Manoa II Well 1948-01 Pumping Test No. 2

J. Memorandum to Mr. Kazu Hayashida From Herbert H. Minakami Regarding the Yield-Drawdown and Long Term Tests of Jonathan Springs Exploratory Well No. 2052-12

A. U.S.G.S. WATER RESOURCES DATA FOR SELECTED STREAMS IN THE HONOLULU DISTRICT, WATER YEAR 1983 *

*Source: U.S. Geological Survey, Water Resources Data Hawaii and Other Pacific Areas, Water Year 1983 Vol. 1, Hawaii, Water Data Report HI-82-1, 1983.

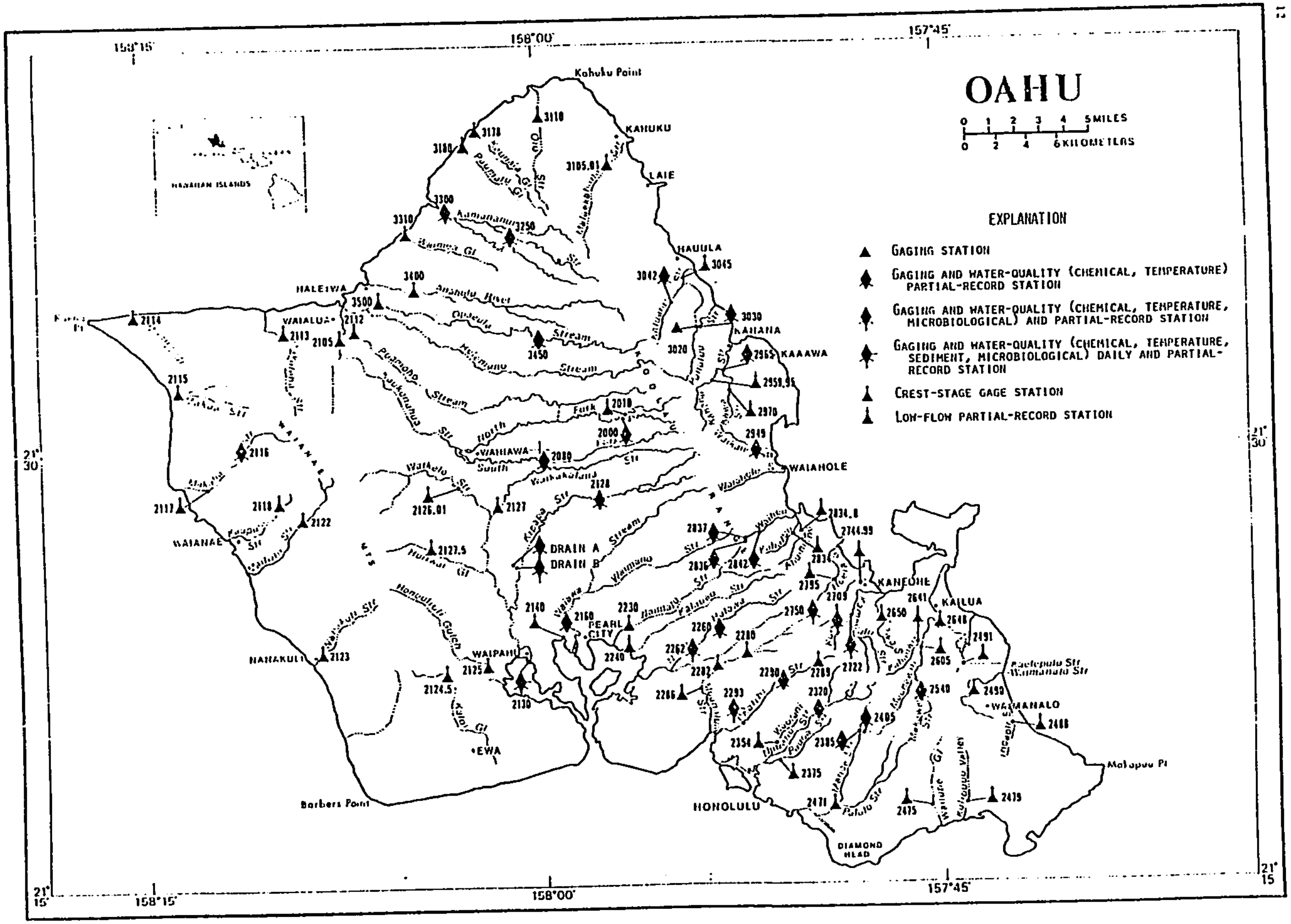


Figure 4.--Locations of gaging, water-quality, and partial-record stations on Oahu.

16229000 KALIHI STREAM NEAR HONOLULU--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972, 1974 to current year.

REMARKS.--Miscellaneous chemical analyses published for this station for 1969, 1973 water years.

WATER QUALITY DATA, WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (UMHOS)	PH (STAND-ARD UNITS)	TEMPER-ATURE (DEG C)
OCT 26...	1050	1.4	145	7.0	21.5
NOV 24...	1100	2.9	145	7.1	22.0
DEC 28...	1155	6.8	130	7.3	21.0
JAN 26...	1550	2.0	150	7.2	19.5
FEB 24...	1100	.96	160	7.0	19.5
MAR 29...	1220	.63	160	7.4	23.5
MAY 26...	1200	.92	160	7.4	20.0
JUN 28...	1010	1.0	145	6.7	21.5
AUG 29...	1000	1.5	140	6.7	21.5
SEP 28...	1100	6.1	130	7.0	22.0

DATE	TIME	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	PERCENT SODIUM	SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	ALKA-LINITY LAB (MG/L AS CACO3)
NOV 24...	1100	36	6	6.7	4.7	14	45	1.0	1.1	30
FEB 24...	1100	36	2	5.9	5.1	14	45	1.0	.9	34
MAY 26...	1200	36	4	6.0	5.2	13	43	1.0	.9	32
AUG 29...	1000	33	7	5.3	4.7	13	46	1.0	.9	26

DATE	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, DIS-SOLVED (TONS PER AC-FT)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	PHOS-PHORUS, DIS-SOLVED (MG/L AS P)	IRON, DIS-SOLVED (UG/L AS FE)	MANGA-NESE, DIS-SOLVED (UG/L AS MN)
NOV 24...	9.0	22	<.10	12	88	.12	<.10	--	260	8
FEB 24...	6.3	21	<.10	12	86	.12	<.10	.020	140	6
MAY 26...	7.0	21	<.10	13	85	.12	.93	--	150	3
AUG 29...	5.7	19	.10	12	76	.10	2.1	--	180	13

< Actual value is known to be less than the value shown.

16229300 KALIHI STREAM AT KALIHI
(National stream-quality accounting network station)

LOCATION.--Lat 21°20'29", long 157°52'36", Hydrologic Unit 20060000, on right bank at Kalihi, 0.4 mi northwest of Bishop Museum, and 2.4 mi northwest of Honolulu Post Office.

DRAINAGE AREA.--5.18 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--Water year 1962 (annual maximum), July 1962 to current year.

GAGE.--Water-stage recorder and concrete control. Altitude of gage is 70 ft, from topographic map. Aug. 28, 1961, to June 30, 1962, crest-stage gage at site 600 ft downstream at different datum.

REMARKS.--Records fair. No diversion above station. Recording rain gage located at station.

AVERAGE DISCHARGE.--21 years, 11.1 ft^3/s (8,040 acre-ft/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 7,110 ft^3/s Apr. 19, 1974, gage height, 9.98 ft from rating curve extended above 180 ft^3/s on basis of slope-area measurement at gage height 9.98 ft; minimum, 0.16 ft^3/s June 24, 1966.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of May 14, 1960, reached a stage of 8.0 ft from floodmarks, present site and datum, discharge, 6,350 ft^3/s, from slope-area measurement of peak flow.

EXTREMES FOR CURRENT YEAR.--Maximum discharge 1,040 ft^3/s Oct. 28, gage height, 4.10 ft, no peak above base of 1,600 ft^3/s; minimum, 0.71 ft^3/s Mar. 30, 31, Apr. 1.

DISCHARGE (CUBIC FEET/SECOND) WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.2	8.2	3.1	14	2.5	1.2	.83	1.3	3.3	1.1	1.7	2.0
2	3.2	7.5	2.7	9.2	2.3	1.2	1.7	2.6	1.7	1.3	2.1	1.8
3	3.4	49	4.8	7.8	2.3	1.1	7.2	1.3	1.7	1.7	17	1.9
4	3.3	15	6.0	8.1	2.3	1.1	1.6	2.0	1.5	1.2	9.3	2.1
5	9.5	11	4.5	6.4	2.3	1.2	1.4	4.5	3.6	4.3	6.9	2.4
6	12	12	30	5.9	2.1	1.1	1.1	3.5	2.2	3.7	4.8	5.1
7	5.0	7.8	6.6	5.8	2.0	1.5	1.1	3.5	1.7	11	3.4	8.7
8	3.3	6.1	4.1	6.0	1.9	1.1	1.6	2.4	1.4	9.4	2.9	12
9	3.9	5.1	3.5	4.8	1.9	1.0	1.2	1.8	1.5	6.2	2.5	5.7
10	3.4	4.7	3.3	4.6	1.9	1.1	1.0	1.3	1.7	5.8	2.2	4.0
11	4.9	4.4	3.0	4.7	1.8	1.2	1.1	1.3	1.2	6.0	2.3	4.7
12	9.0	6.7	32	39	1.8	1.0	1.3	1.2	1.2	5.9	4.9	3.9
13	12	10	12	6.8	1.8	1.0	.95	1.1	1.1	6.3	2.0	3.4
14	4.1	4.5	6.3	8.0	1.8	1.1	1.1	1.4	1.0	6.4	1.9	3.1
15	3.0	3.9	4.4	4.8	1.8	1.1	1.3	1.3	1.5	4.6	1.8	3.5
16	4.5	3.9	4.2	4.2	2.0	1.1	3.6	1.1	3.5	3.7	11	3.2
17	4.1	3.5	37	3.9	1.7	1.2	3.7	1.2	1.9	3.3	5.1	13
18	4.1	3.4	18	3.6	1.5	1.1	1.8	2.9	1.4	19	3.3	2.6
19	3.0	3.3	7.6	3.6	1.5	1.1	2.3	1.6	1.5	9.7	2.4	2.0
20	2.8	5.0	5.2	3.3	1.2	1.0	1.7	2.8	3.1	5.4	2.3	2.3
21	2.5	5.7	4.7	3.3	1.3	1.0	2.6	10	1.5	3.6	2.4	4.2
22	2.3	3.6	21	3.1	1.2	1.0	2.6	2.8	1.4	2.8	3.0	5.4
23	1.8	12	89	3.2	1.2	2.1	2.2	2.0	1.3	2.6	4.4	2.4
24	1.8	5.9	40	3.3	1.4	1.3	2.4	2.2	2.3	3.1	4.5	2.1
25	1.7	3.4	15	3.0	1.2	1.5	1.8	1.4	1.5	2.5	3.6	2.8
26	1.8	3.0	14	2.8	1.8	1.2	1.7	1.3	2.6	2.2	2.8	5.0
27	45	3.2	19	2.8	1.2	1.1	1.8	1.8	1.7	1.7	2.7	6.9
28	133	2.8	19	2.6	1.2	1.0	1.7	1.3	1.6	1.6	2.1	10
29	79	4.4	64	2.7	---	1.1	1.4	1.2	1.2	2.7	1.9	33
30	46	4.5	21	2.7	---	1.0	1.1	1.1	1.1	4.4	2.6	10
31	15	---	12	4.2	---	.81	---	1.7	---	2.1	2.0	---
TOTAL	431.6	223.5	517.0	188.2	48.9	35.61	56.88	66.9	53.9	145.3	121.8	169.2
MEAN	13.9	7.45	16.7	6.07	1.75	1.15	1.90	2.16	1.80	4.69	3.93	5.64
MAX	133	49	89	39	2.5	2.1	7.2	10	3.6	19	17	33
MIN	1.7	2.8	2.7	2.6	1.2	.81	.83	1.1	1.0	1.1	1.7	1.8
AC-FT	856	443	1030	373	97	71	113	133	107	288	242	336

CAL YR 1982	TOTAL	7602.6	MEAN	20.8	MAX	421	MIN	1.7	AC-FT	15080
WTR YR 1983	TOTAL	2058.79	MEAN	5.64	MAX	133	MIN	.81	AC-FT	4080

16232000 NUUANU STREAM BELOW RESERVOIR 2 WASTEWAY, NEAR HONOLULU

LOCATION.--Lat 21°20'57", long 157°49'40", Hydrologic Unit 20060000, on right bank beside Old Pali Road in upper Nuuanu Valley, 0.2 mi downstream from reservoir 2 wasteway, and 3.5 mi northeast of Honolulu Post Office.

DRAINAGE AREA.--3.35 mi².

PERIOD OF RECORD.--October 1913 to January 1921. September 1921 to current year.

REVISED RECORDS.--WSP 985: 1921-35(M). WSP 1319: 1931. WSP 1569: Drainage area. WSP 1639: 1931, 1935.

GAGE.--Water-stage recorder and sharp-crested weirs. Datum of gage is 631.71 ft above mean sea level. Prior to Sept. 7, 1915, nonrecording gage at same site at datum 0.03 ft lower and Sept. 7, 1915, to Mar. 31, 1918, at same datum.

REMARKS.--Records good. Low-flow regulation by reservoirs 2, 3, and 4, capacities, 21 acre-ft, 34 acre-ft, and 1,630 acre-ft, respectively. Honolulu Board of Water Supply diverts ground water from tunnels in drainage area. Observations of specific conductance, pH, and water temperature made during the year are published elsewhere in this report.

AVERAGE DISCHARGE.--67 years (water years 1915-16, 1918-20, 1922-83), 7.10 ft³/s (5,140 acre-ft/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 6,990 ft³/s Jan. 16, 1921, gage height, 8.74 ft, from floodmarks, from rating curve extended above 420 ft³/s by test of model of station site; minimum, 0.09 ft³/s Sept. 10, 11, 1925.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 183 ft³/s Oct. 27, gage height, 3.01 ft, no peak above base of 240 ft³/s; minimum, 0.77 ft³/s, Apr. 18.

DISCHARGE (CUBIC FEET/SECOND) WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.5	5.2	3.3	6.1	4.0	2.5	1.6	1.4	1.9	1.0	1.4	1.6
2	3.3	5.0	3.0	5.8	3.9	2.5	1.9	1.8	1.5	1.2	1.8	1.6
3	3.6	11	3.6	5.5	3.8	2.5	2.8	1.3	1.5	1.2	7.0	1.5
4	3.3	28	3.6	6.3	3.6	2.5	1.8	1.6	1.5	1.1	2.6	1.5
5	4.3	36	3.2	5.4	3.8	2.4	2.4	2.2	1.9	1.5	2.0	1.6
6	9.0	8.2	6.9	5.3	3.7	2.3	1.7	1.5	1.7	1.4	1.8	2.8
7	3.8	5.3	3.6	5.2	3.6	2.5	1.6	2.5	1.4	2.0	1.7	2.3
8	3.6	4.7	3.0	5.2	3.6	2.4	1.8	1.6	1.4	2.5	1.7	2.7
9	4.4	4.4	3.0	5.0	3.6	2.3	1.5	1.5	1.6	1.6	1.5	1.8
10	3.6	4.5	3.1	4.9	3.6	2.3	1.6	1.3	1.5	1.5	1.5	1.7
11	3.8	4.6	3.0	5.0	3.4	2.3	1.3	1.5	1.3	1.7	1.6	1.9
12	3.9	6.6	7.5	20	3.4	2.1	1.4	1.4	1.4	2.1	1.9	1.7
13	6.4	5.4	5.3	5.8	3.3	2.1	1.5	1.5	1.2	1.9	1.5	1.7
14	3.6	4.2	3.0	5.8	3.0	2.2	1.5	1.5	1.2	1.9	1.5	1.6
15	3.4	3.6	3.0	5.2	3.2	2.0	1.4	1.3	1.5	1.5	1.5	1.7
16	4.0	3.8	3.1	5.1	3.2	2.0	1.6	1.2	1.5	1.5	3.9	1.6
17	3.6	3.8	11	4.9	3.0	2.0	1.6	1.5	1.3	1.5	2.2	3.1
18	3.7	3.7	6.5	4.9	3.0	2.0	1.1	3.0	1.3	4.2	1.9	1.8
19	3.4	6.4	3.6	4.8	3.0	2.0	1.4	1.5	1.3	3.2	1.6	1.4
20	3.3	6.5	3.4	4.8	3.0	1.9	1.4	2.5	1.3	2.1	1.6	1.5
21	3.1	4.0	3.1	4.7	2.8	1.9	1.5	5.8	1.3	1.8	1.6	1.8
22	3.2	3.3	4.8	4.6	2.8	1.9	1.6	1.9	1.3	1.6	2.1	2.2
23	3.1	3.8	11	4.8	2.8	2.1	1.5	1.6	1.3	1.5	3.6	1.6
24	3.0	3.2	6.4	4.6	2.8	1.9	2.0	1.6	1.3	1.6	2.5	1.6
25	2.6	3.3	4.8	4.4	2.8	2.0	1.5	1.5	1.2	1.4	2.0	2.1
26	2.9	3.2	4.8	4.3	2.8	1.8	1.5	1.5	1.5	1.4	1.9	2.8
27	15	3.2	5.0	4.3	2.8	1.8	1.5	1.6	1.3	1.4	1.7	3.7
28	32	3.1	6.3	3.9	2.6	1.8	1.4	1.6	1.2	1.4	1.6	3.3
29	15	3.4	19	4.1	---	1.8	1.3	1.5	1.1	1.5	1.6	15
30	9.8	4.3	8.0	4.1	---	1.5	1.4	1.5	1.1	1.8	1.7	3.0
31	6.5	---	5.9	4.6	---	1.6	---	1.6	---	1.5	1.7	---
TOTAL	177.7	195.7	164.8	169.4	90.9	64.9	48.1	55.3	41.8	53.5	64.2	74.2
MEAN	5.73	6.52	5.32	5.46	3.25	2.09	1.60	1.78	1.39	1.73	2.07	2.47
MAX	32	36	19	20	4.0	2.5	2.8	5.8	1.9	4.2	7.0	15
MIN	2.6	3.1	3.0	3.9	2.6	1.5	1.1	1.2	1.1	1.0	1.4	1.4
AC-FT	352	388	327	336	180	129	95	110	83	106	127	147

CAL YR 1982	TOTAL	5439.0	MEAN	14.9	MAX	189	MIN	2.6	AC-FT	10790
WTR YR 1983	TOTAL	1200.5	MEAN	3.29	MAX	36	MIN	1.0	AC-FT	2380

16238500 WAIHI STREAM AT HONOLULU

LOCATION.--Lat 21°19'55", long 157°48'12", Hydrologic Unit 20060000, on left bank 100 ft upstream from bridge on Waaloa Way, 700 ft upstream from confluence with Waiakeakua Stream, and 4.2 mi northeast of Honolulu Post Office.

DRAINAGE AREA.-1.14 mi².

PERIOD OF RECORD.--May 1913 to January 1921, August 1925 to current year. Prior to July 1960, published as West Branch Manoa Stream near Honolulu.

REVISED RECORDS.--WSP 1319: 1930-32(M), 1939(M). WSP 1569: Drainage area.

GAGE.--Water-stage recorder and combination Parshall flume and V-notch weir. Datum of gage is 289.84 ft above mean sea level (Honolulu Board of Water Supply bench mark). Prior to June 17, 1914, non-recording gage at same site at different datum. June 17, 1914, to Jan. 16, 1921, water-stage recorder at site 150 ft upstream at different datum, Aug. 4, 1925, to Mar. 15, 1928, at present site at datum 2.35 ft lower and Mar. 16, 1928 to Mar. 23, 1977 at datum 1.00 ft higher.

REMARKS.--Records fair. Observations of specific conductance, pH, and water temperature made during the year are published elsewhere in this report.

AVERAGE DISCHARGE.--65 years (water years 1914-20, 1926-83), 3.61 ft³/s (2,620 acre-ft/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,250 ft³/s Jan. 16, 1921, gage height, 10.4 ft, from floodmarks, site and datum then in use, from rating curve extended above 60 ft³/s; minimum, 0.07 ft³/s Jan. 17, 18, 1977.

EXTREMES FOR CURRENT YEAR.--Peak discharges above base of 310 ft³/s and maximum (*):

Date	Time	Discharge (ft³/s)	Gage height (ft)
Oct. 6	0645	320	4.12
Oct. 27	2345	*462	4.62

Minimum discharge, 0.21 ft³/s for several days in March.

DISCHARGE (CUBIC FEET/SECOND) WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.1	2.9	1.5	5.4	.83	.38	.32	.79	2.3	.91	1.4	1.8
2	.95	2.3	1.2	2.9	.73	.38	.46	2.3	1.1	1.0	2.2	1.6
3	1.2	8.6	2.1	2.4	.73	.38	2.1	1.1	.88	1.5	9.0	1.6
4	1.0	3.1	1.7	3.7	.69	.38	1.0	2.5	.77	1.0	5.6	1.5
5	2.2	4.9	1.2	2.1	.97	.46	.79	6.0	1.3	4.1	3.7	1.4
6	20	7.3	6.9	2.1	.71	.26	.39	3.1	1.7	3.0	3.3	4.8
7	2.0	2.6	1.7	1.9	.55	.26	.30	4.7	1.1	8.4	2.3	6.6
8	1.9	2.0	1.3	2.3	.58	.26	.56	2.0	.93	7.9	2.2	7.7
9	5.8	1.8	1.2	1.7	.52	.21	.28	1.5	2.6	3.9	1.8	3.4
10	1.9	1.7	1.5	1.6	.48	.21	.27	1.1	2.1	4.6	1.6	2.4
11	4.4	1.5	1.2	1.7	.45	.21	.31	.98	1.4	3.9	1.5	2.1
12	3.5	5.4	11	8.5	.46	.21	.32	.83	1.3	3.8	2.3	1.9
13	7.1	5.2	3.1	1.9	.46	.21	.28	.77	1.0	3.7	1.6	2.3
14	2.2	1.9	1.8	2.2	.46	.21	.28	.81	.87	5.1	1.5	1.5
15	1.7	1.7	1.4	1.6	.46	.21	.29	.65	2.1	3.2	1.3	1.4
16	2.0	1.7	1.6	1.5	.54	.26	.88	.50	1.8	2.6	10	1.6
17	1.7	1.5	21	1.4	.54	.32	1.2	.72	1.4	2.8	7.6	2.6
18	2.0	1.4	5.5	1.3	.54	.46	.47	1.4	1.1	6.1	4.1	1.7
19	1.4	1.3	2.7	1.3	.53	.62	.59	.68	1.3	8.4	2.8	1.5
20	1.2	1.5	2.2	1.2	.55	.54	.58	2.3	3.5	4.6	2.2	1.8
21	1.1	4.4	2.2	1.2	.55	.38	1.0	2.7	1.9	3.1	1.9	2.6
22	1.3	1.8	10	1.1	.43	.46	1.2	1.0	1.6	2.5	3.7	2.3
23	1.0	2.7	19	1.2	.52	.29	1.3	.78	1.5	2.1	4.9	1.4
24	.91	1.8	5.2	1.2	.53	.21	2.2	.68	1.7	2.2	8.6	1.3
25	.86	1.4	5.9	1.1	.54	.26	1.5	.55	1.5	1.8	3.8	6.9
26	.87	1.8	6.8	1.0	.68	.32	1.7	.48	3.6	1.6	3.9	5.8
27	23	1.3	5.2	.94	.39	.26	2.2	.88	1.8	1.5	3.2	11
28	22	1.2	5.1	.81	.46	.26	1.4	.50	1.4	1.4	2.4	5.5
29	13	3.9	13	.79	---	.26	.98	.59	1.2	1.6	2.1	16
30	7.7	3.5	4.2	.82	---	.26	.76	.41	1.0	2.2	2.4	5.5
31	3.4	---	3.0	1.5	---	.32	---	.91	---	1.6	2.2	---
TOTAL	140.39	84.1	151.4	60.36	15.88	9.71	25 91	44.21	47.75	102.11	107.1	109.5
MEAN	4.53	2.80	4.88	1.95	.57	.31	.86	1.43	1.59	3.29	3.45	3.65
MAX	23	8.6	21	8.5	.97	.62	2.2	6.0	3.6	8.4	10	16
MIN	.86	1.2	1.2	.79	.39	.21	.27	.41	.77	.91	1.3	1.3
AC-FT	278	167	300	120	31	19	51	88	95	203	212	217

CAL YR 1982 TOTAL 2220.18 MEAN 6.08 MAX 83 MIN .78 AC-FT 4400
WTR YR 1983 TOTAL 898.42 MEAN 2.46 MAX 23 MIN .21 AC-FT 1780

16240500 WAIAKEAKUA STREAM AT HONOLULU

LOCATION.--Lat 21°19'53", long 157°48'12", Hydrologic Unit 20060000, on right bank 5 ft downstream from bridge on Waaloa Way, 500 ft upstream from confluence with Waihi Stream, and 4.2 mi northeast of Honolulu Post Office.

DRAINAGE AREA.--1.06 mi^2.

PERIOD OF RECORD.--May 1913 to January 1921, August 1925 to current year. Prior to July 1960, published as East Branch Manoa Stream near Honolulu.

REVISED RECORDS.--WSP 1319: 1919(M), 1930-33(M). WSP 1569: Drainage area. WSP 1937: 1949(M), 1960(M).

GAGE.--Water-stage recorder and combination Parshall flume and concrete weir. Datum of gage is 294.50 ft above mean sea level (Honolulu Board of Water Supply bench mark). Prior to May 20, 1914, nonrecording gage at site 200 ft upstream at different datum. May 20, 1914, to Jan. 16, 1921, water-stage recorder at site 30 ft upstream at different datum. Aug. 18, 1925, to Mar. 15, 1928, water-stage recorder at present site at datum 2.99 ft lower, and Mar. 16, 1928, to Oct. 18, 1933, at datum 0.41 ft higher than present datum.

REMARKS.--Records fair. Honolulu Board of Water Supply at times diverts a small amount of ground water from tunnel above station. Occasional small diversions for irrigation above station. Observations of specific conductance, pH, and water temperature made during the year are published elsewhere in this report.

AVERAGE DISCHARGE.--65 years (water years 1914-20, 1926-83), 5.09 ft^3/s (3,690 acre-ft/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,090 ft^3/s Jan. 16, 1921, gage height, 10.4 ft, from floodmarks, site and datum then in use, from rating curve extended above 58 ft^3/s. Current peak discharges are derived from rating curve extended above 1,760 ft^3/s on the basis of slope-area measurement at gage height 5.28 ft; minimum, 0.6 ft^3/s June 7, 8, 1926.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 280 ft^3/s Oct. 27, gage height, 3.13 ft, no peak above base of 310 ft^3/s; minimum, 2.2 ft^3/s Apr. 15, 16.

DISCHARGE (CUBIC FEET/SECOND) WATER YEAR OCTOBER 1982 TO SEPTEMBER 1983
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.7	5.9	4.2	8.3	3.6	2.9	2.5	3.0	4.6	2.4	2.7	2.9
2	4.6	5.4	4.0	5.7	3.6	2.8	2.8	4.6	3.1	2.6	4.4	2.9
3	4.8	12	4.9	5.3	3.6	2.8	4.4	3.3	2.9	3.2	10	2.9
4	4.7	6.5	4.9	5.9	3.4	2.8	3.0	5.0	2.8	2.7	6.1	3.4
5	5.6	7.2	4.0	5.0	3.7	2.8	2.7	9.0	3.4	5.6	4.7	3.0
6	18	8.3	8.3	5.0	3.5	2.8	2.5	4.8	4.0	4.1	4.6	3.2
7	5.3	5.5	4.4	5.0	3.4	2.9	2.4	8.0	3.1	7.5	3.4	8.2
8	5.2	5.0	4.0	5.1	3.3	2.9	2.8	4.5	2.9	7.5	3.2	9.6
9	7.0	4.8	3.7	4.7	3.3	2.8	2.4	3.5	3.9	4.1	2.9	4.5
10	5.0	4.5	4.3	4.7	3.3	2.7	2.4	3.1	5.7	5.0	2.8	3.6
11	6.7	4.4	3.6	5.4	3.2	2.8	2.4	3.0	3.3	4.2	2.8	3.3
12	6.6	7.7	14	9.3	3.2	2.7	2.7	2.9	3.1	4.2	3.3	3.3
13	9.2	6.5	6.1	4.8	3.2	2.8	2.4	2.8	2.8	4.0	3.3	3.4
14	5.3	4.6	4.4	5.2	3.2	2.8	2.4	3.1	2.7	6.3	2.8	3.0
15	4.9	4.5	3.8	4.6	3.1	2.8	2.3	3.0	3.9	4.3	2.7	2.8
16	5.2	4.4	4.1	4.4	3.1	2.7	3.7	2.8	3.5	3.5	14	3.2
17	4.9	4.4	23	4.3	3.1	2.7	3.6	3.0	2.9	3.6	7.8	4.0
18	5.0	4.2	7.6	4.3	3.1	2.7	2.6	3.6	2.7	7.0	4.6	3.5
19	4.7	4.2	4.6	4.2	3.0	2.7	2.7	3.2	3.0	9.1	3.6	3.1
20	4.6	4.5	4.1	4.2	3.0	2.7	2.5	8.0	5.6	5.1	3.2	3.1
21	4.5	8.0	4.2	4.1	3.0	2.7	2.9	9.7	3.4	3.8	3.0	3.8
22	4.8	4.8	9.7	4.0	3.0	2.7	3.4	3.6	3.1	3.4	4.8	4.1
23	4.4	5.9	17	4.0	2.9	2.7	3.5	3.0	3.1	3.2	5.6	3.0
24	4.2	4.6	6.8	4.0	3.0	2.7	4.6	2.9	3.2	3.3	8.5	2.8
25	4.2	4.1	10	3.9	2.9	2.8	3.5	2.8	3.4	3.0	4.3	6.3
26	4.3	4.1	9.7	3.8	3.4	2.8	3.8	2.7	4.9	2.9	4.4	5.5
27	20	4.0	6.8	3.8	3.0	2.7	4.6	3.1	3.2	2.8	3.8	8.6
28	24	3.8	11	3.7	3.0	2.6	3.2	2.7	2.8	2.8	3.2	5.4
29	14	5.6	24	3.6	---	2.5	3.0	2.7	2.7	3.0	3.0	16
30	10	5.5	7.4	3.7	---	2.5	2.9	2.6	2.5	3.1	3.4	7.4
31	6.3	---	5.9	4.2	---	2.5	---	3.3	---	2.8	3.1	---
TOTAL	222.7	164.9	234.5	148.2	90.1	84.8	90.6	123.3	102.2	130.1	140.0	144.8
MEAN	7.18	5.50	7.56	4.78	3.22	2.74	3.02	3.98	3.41	4.20	4.52	4.83
MAX	24	12	24	9.3	3.7	2.9	4.6	9.7	5.7	9.1	14	16
MIN	4.2	3.8	3.6	3.6	2.9	2.5	2.3	2.6	2.5	2.4	2.7	2.8
AC-FT	442	327	465	294	179	168	180	245	203	258	278	287

CAL YR 1982	TOTAL	3021.5	MEAN	8.28	MAX	68	MIN	2.6	AC-FT	5990
WTR YR 1983	TOTAL	1676.2	MEAN	4.59	MAX	24	MIN	2.3	AC-FT	3320

Annual maximum discharge at crest-stage partial-record stations during water year 1983--Continued

Station No.	Station name	Location	Drainage area mi²	Period of record	Annual Maximum Date	Gage height (feet)	Discharge (ft³/s)
		Hawaii, Island of Oahu--Continued					
16223000	Waimalu Stream near Aiea	Lat 21°23'48", long 157°56'56", 1,300 ft upstream from bridge on Moanalua Road and 1.2 mi northwest of Aiea High School.	5.97	1952-70≠, 1973-83	10-28-82	3.35	1,840
***16228000	Moanalua Stream near Honolulu	Lat 21°22'53", long 157°52'22", on left bank 1.8 mi northeast of Tripler Hospital and 5.0 mi north of Honolulu Post Office.	2.73	1927-78≠, 1979-83	10-28-82	4.94	700
***16228200	Moanalua Stream near Aiea	Lat 21°22'37", long 157°53'03", on right bank 1.1 mi northeast of Tripler Hospital and 2.9 mi east of Aiea sugar refinery.	3.34	1969-83	10-28-82	4.56	962
***16228600	Moanalua Stream at Tripler Hospital	Lat 21°21'52", long 157°54'05", on right bank 0.5 mi west of Tripler Hospital and 1.6 mi northeast of Aliamanu School.	4.44	1971-83	10-28-82	15.20	1,170
***16228900	Kalihi Stream near Kaneohe	Lat 21°22'35", long 157°49'32", on right bank 800 ft downstream from Likelike Highway and 2.8 mi southwest of Castle High School in Kaneohe.	.60	1967-71≠, 1972-83	10-28-82	2.56	187
***16235400	Waolani Stream at Honolulu	Lat 21°20'00", long 157°51'04", at Wyllie Street bridge and 1.8 mi northeast of Honolulu Post Office.	1.28	1958-83	12-23-82	1.01	132
***16237500	Pauoa Stream at Honolulu	Lat 21°19'18", long 157°51'03", at Lusitana Street bridge and 1.1 mi northeast of Honolulu Post Office.	1.43	1958-83	12-23-82	.29	a150
***16247100	Manoa-Palolo Drainage Canal at Moiliili	Lat 21°17'24", long 157°49'17", on left bank at Kaimuki High School, 0.3 mi downstream from confluence of Manoa and Palolo Streams, and 0.6 mi upstream from point of discharge into Ala Wai Canal.	9.35	1968-83	12-23-82	5.00	1,030
***16247500	Wailupe Gulch at Aina Haina	Lat 21°17'46", long 157°45'29", at Ani Street bridge and 1.0 mi upstream from Kalanianaole Highway in Aina Haina.	2.35	1958-83	10-27-82	-	a400
***16247900	Kuliouou Valley at Kuliouou	Lat 21°17'50", long 157°43'35", at Kuliouou, 300 ft downstream of single-lane wooden bridge, and 0.6 mi upstream from Highway 72.	1.18	1958-59, 1970-83	12-23-82	29.92	220
16248800	Inoaole Stream at Waimanalo	Lat 21°29'31", long 157°42'40", 30 ft upstream from culvert on Hihimanu Street and 0.8 mi northwest of Waimanalo Post Office.	1.21	1958-83	10-28-82	3.45	a50
16249000	Waimanalo Stream at Waimanalo	Lat 21°21'12", long 157°43'52", on right bank 40 ft upstream from Highway 72 and 2.3 mi northwest of Waimanalo Post Office.	2.16	1967-70≠, 1971-83	10-28-82	5.92	a600
16249100	Kaelepulu Stream tributary at Kailua	Lat 21°21'44", long 157°44'22", 30 ft upstream from Kalanianaole Highway, 1.6 mi northwest of Waimanalo School, and 2.1 mi south of Kailua Post Office.	.16	1963-83	10-28-82	2.74	87
16260500	Maunawili Stream at Highway 61, near Kailua	Lat 21°22'51", long 157°45'48", on right bank at downstream side of bridge on Highway 61, 0.6 mi west of Maunawili School, and 1.6 mi southwest of Kailua Post Office.	5.34	1958-67, 1968-71≠, 1972-83	10-28-82	6.38	a400

** Also a water-quality partial-record station.
≠ Operated as a continuous-record gaging station.
a Estimated.
***Stream Gaging Stations Located in the Honolulu District

B. KULIOUOU WELL SCHEMATIC DESIGN

B. KULIOUOU WELL SCHEMATIC DESIGN

INTRODUCTION

The schematic design of the Kuliouou Well is included in the Honolulu Regional EIS Scope of Work to assist the BWS in determining the best method of implementing this source. This section summarizes the consultant's schematic design. Preliminary design criteria were obtained through discussion with BWS engineering and operations staff.

The Kuliouou exploratory well was developed by the DLNR. Test pumping results indicate that a production well would produce approximately 0.2 MGD of potable water. The DLNR may fund the development of the production well under the Exploratory Well Drilling Program.

LOCATION

The proposed production well would be located at the 200-foot elevation, north of an existing single-family residential development in Kuliouou Valley, and west of an existing 0.2 MG reservoir. The site is within the BWS Waialae Water subarea and the DLNR Waialae-Hawaii Kai groundwater control subarea.

EXISTING SYSTEM

Currently the upper reaches of Kuliouou Valley are serviced by water that is developed in other areas and pumped by a booster pump station to the existing reservoir (via a 12" transmission main). As valley residents consume water, the reservoir water level descends. The reservoir begins to refill when a water level is reached that signals the pump station to commence water pumpage. Pumpage continues until the reservoir is again filled to capacity.

PROPOSED SYSTEM

The proposed system would develop potable water in the valley for domestic use (see Figure B-1). The exploratory well would be developed into a production well to produce 0.20 MGD (139 gallons per minute (GPM) at 24 hours per day). A 8-inch ductile iron line would be installed from the well and connect to an existing 12-inch distribution line at the mauka end of Kalaau Place.

It is anticipated that only 0.06 MGD (42 GPM), of the 0.20 MGD well capacity, would be utilized by Kuliouou Valley residents residing mauka of the booster pump station (see Figure B-2). The remaining 0.14 MGD (97 GPM) would be allowed to flow into the main municipal system for use in the lower valley (makai of the booster pump station) or other areas.

Operation of the proposed system within the upper valley would be similar to the existing system. Residents would utilize water stored in the reservoir, which would refill automatically as the water level decreased to a predetermined level. Under normal circumstances the production well would operate 24 hours a day, but would cease pumpage if the reservoir water level reaches its maximum capacity.

The existing booster pump station would provide stand-by coverage during maintenance and emergency situations, when the well is not operational. The booster pump would also be activated when water demand exceeds the wells pumpage capacity for an extended period of time. Under these circumstances, the booster pump would be activated automatically when the reservoir's water level drops below normal levels, at a predetermined point.

Water from the well, which is to be used for the lower valley or other areas, would flow from the reservoir through the existing 12-inch water line.

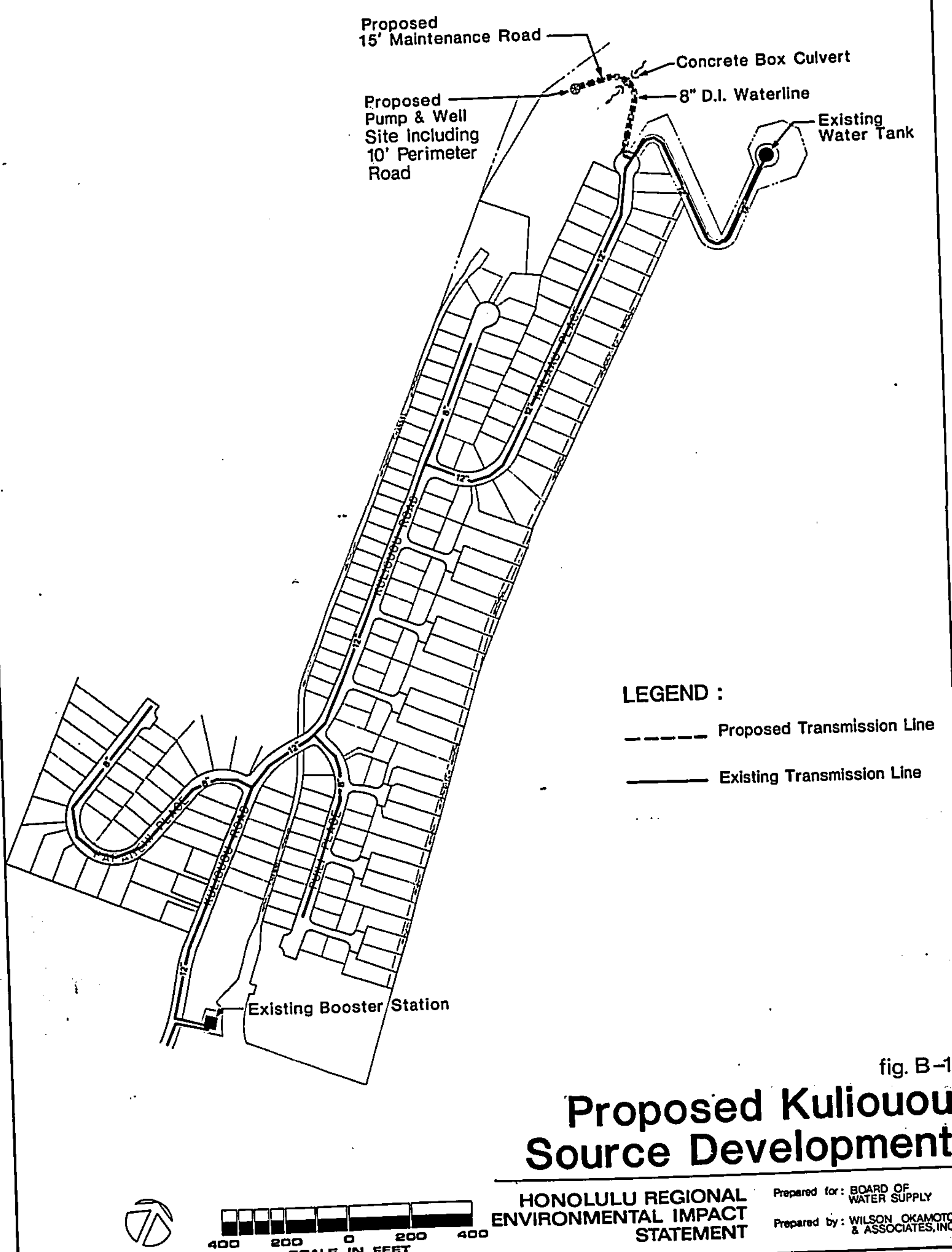


fig. B-1

Proposed Kuliouou Source Development

HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for: BOARD OF WATER SUPPLY

Prepared by: WILSON OKAMOTO & ASSOCIATES, INC.

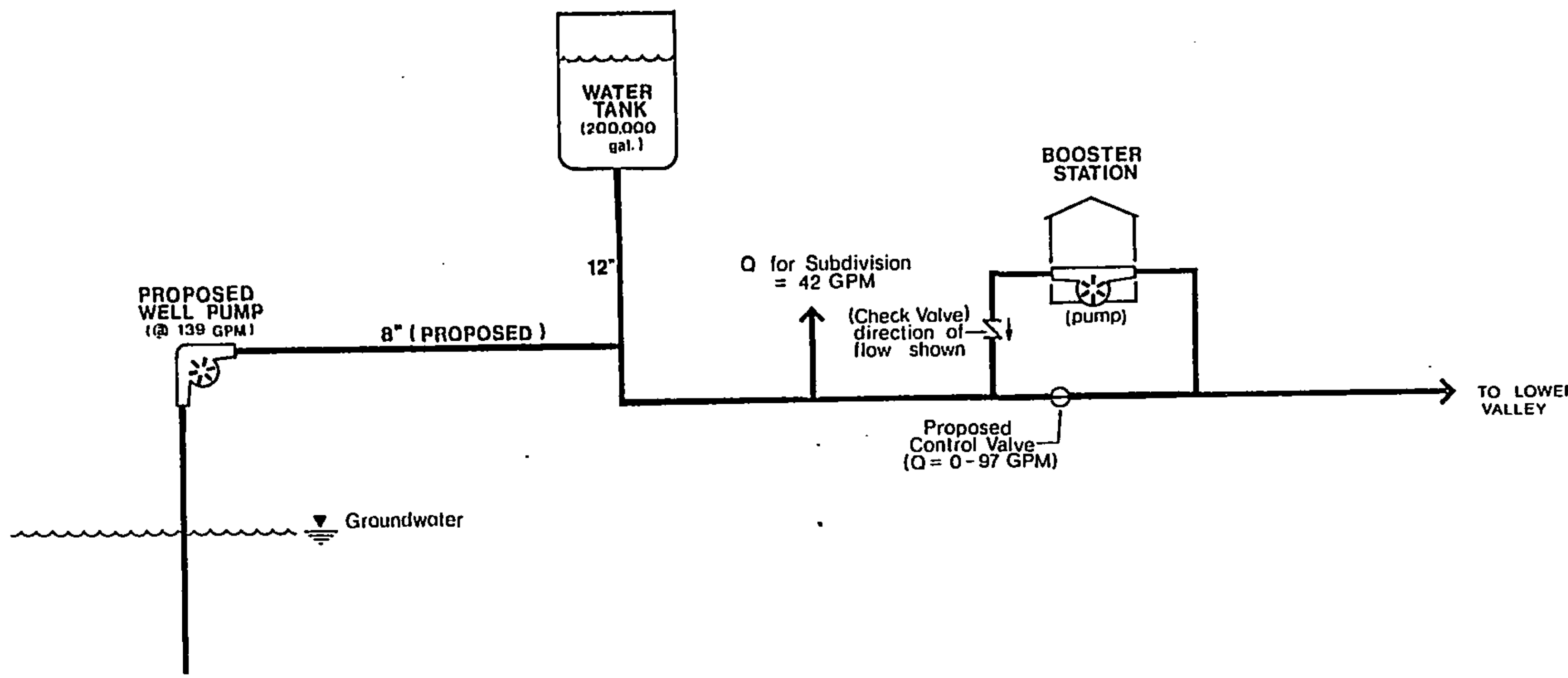


fig. B-2

Proposed System Operation

HONOLULU REGIONAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for: BOARD OF WATER SUPPLY

Prepared by: WILSON OKAMOTO & ASSOCIATES, INC.

During normal operation, a maximum of 0.14 MGD (97 GPM) would flow into the main distribution system. As water flows out of the upper valley at the booster pump station, a "control" valve controlling outflow will open, and an existing "check" valve, which prevents water from flowing into the booster station, would close.

During maintenance of the well, emergencies or periods of excessive consumption, when the booster pump station is required to supply water in the upper valley, water would be pumped from the main municipal system. The existing check valve which normally prevents outflowing water from entering the booster pump station, would open, and the control valve would close.

The proposed system will require conversion of the exploratory well to a production well, maintenance and perimeter roadway improvements, transmission improvements, reservoir modification and booster station improvements.

The well site will be developed to include installation of a pump and motor, an electrical motor control center, a chlorination unit, valves, piping, gages and sensor (to respond to reservoir water level fluctuations).

The existing access road to the site requires A.C. paving and construction of a drainage culvert. The maintenance road will be 15 feet wide and approximately 450 feet in length. It is estimated that a 12-foot by 9-foot box culvert would be needed to convey storm flows across the maintenance road. Also, a perimeter road 10 feet wide and approximately 100 feet in length, with security fencing is required around the well site.

A 8-inch ductile iron pipe and a telephone circuit will traverse the maintenance road and connect to an existing 12-inch distribution water line at the mauka end of Kalaau Place. The telephone line is required for activating or deactivating the well pump in response to changes in reservoir water levels.

Improvements would be required at the reservoir and the pump station. The reservoir's liquid level control will be adjusted to signal pump operations at the well and to signal the booster pump station, if needed. Similar sensor adjustments will be required at the booster station. Additionally, valve improvements will be required to allow outflow of surplus well water to lower area residences. Also, if the valve improvements cannot be accomplished at the booster pump station and is instead buried, a manhole will have to be constructed for maintenance purposes.

The estimated cost of these improvements is presented in Table B-1.

ALTERNATE SYSTEM

Another option for water system improvements in Kuliouou Valley prescribes well development to service the needs of only those residents mauka of the booster pump station. In this scenario, only 0.06 mgd of the wells' 0.20 mgd capacity would be utilized.

Similar to the existing system, water would be pumped to the reservoir for use by residents. However, the water would be supplied from the well rather than from the booster pump station. The pump station would operate on a stand-by basis in a manner similar to that described above for the proposed system.

The alternate system would require well development and access improvements as described for the proposed system. An 8-inch ductile iron line would be installed from the well and connect to the existing 12-inch distribution line at the mauka end of Kalaau Place.

Minimal improvements would be required at the reservoir and booster pump station to modify instructional signals for water pumpage.

The cost estimate of the alternate system is presented in Table B-2.

TABLE B-1

KULIOUOU WELL COST ESTIMATE
PROPOSED SYSTEM

Well Site	
Electrical (Motor control center, electrical work, supervisory equipment)	$110,000
Mechanical (Pumps, piping & valves, instrumentation, flow metering, chlorination)	95,000
Control Building (On-site piping, concrete work for pump, venturi box)	100,000
Site Work (Road, grading, irrigation, chainlink fence, mute (acoustical work))	64,000
Access and Transmission	
Maintenance and Perimeter Roads - A.C. (Asphalt Concrete) (450 LF x $15/LF) + (100 LF x $14/LF)	8,000
Culvert - Concrete Box Culvert	57,000
Transmission Line - 8" Ductile Iron (450 LF x $65/LF)	29,000
Telephone Circuit (1350 LF x $8/LF)	11,000
Reservoir	
Liquid Level Control and Necessary Adjustments	10,000
Booster Pump Station	
Valving, Appurtenances and Necessary Adjustments	20,000
SUBTOTAL	$504,000
20% CONTINGENCIES	101,000
TOTAL	$605,000

TABLE B-2

KULIOUOU WELL COST ESTIMATE
ALTERNATE SYSTEM

Well Site	
Electrical (Motor control center, electrical work, supervisory equipment)	$110,000
Mechanical (Pumps, piping & valves, instrumentation, flow metering, chlorination)	95,000
Control Building (On-site piping, concrete work for pump, venturi box)	100,000
Site Work (Road, grading, irrigation, chainlink fence, mute (acoustical work)	64,000
Access and Transmission	
Maintenance and Perimeter Roads - A.C. (Asphalt Concrete) (450 LF x $15/LF) + (100 LF x $14/LF)	8,000
Culvert - Concrete Box Culvert	57,000
Transmission Line - 8" Ductile Iron (450 LF x $65/LF)	29,000
Telephone Circuit (1350 LF x $8/LF)	11,000
Reservoir	
Liquid Level Control and Necessary Adjustments	10,000
SUBTOTAL	$484,000
20% CONTINGENCIES	97,000
TOTAL	$581,000

COMPARISON OF THE PROPOSED AND ALTERNATE SYSTEMS

Development of improvements to the Kuliouou Valley water system as proposed would provide water and allow for system redundancy in the upper valley, and provide an average of 0.14 MGD for use in the lower valley or other areas.

The alternate system would provide water and allow for system redundancy in the upper valley, but would not provide water for use in the lower valley or other areas. The capacity of the well would not be fully utilized.

In addition to optimizing the utilization of the well's resource, there are economic benefits for developing the system as proposed. Municipal water is sold to residential consumers at a rate of $0.84/1000 gallons. The BWS operational and maintenance costs are approximately $0.26/1000 gallons, therefore an estimated net income of $0.58/1000 gallons may be realized. The sale of 140,000 additional gallons per day would yield approximately $30,000 per year of net revenue. As the difference in capital cost for developing the proposed system versus the alternate system is approximately $24,000 ($605,000 - $581,000), the difference may be recovered within a short time.

C. KULIOUOU WELL 1843-01 WELL RECORDS AND PUMPING TEST DATA

March 24, 1983

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

Dear Mr. Hayashida:

Kuliouou Well 1843-01

As a follow-up to my oral communication with you on the results of the recently drilled Kuliouou Well, I am pleased to confirm that preliminary analysis of the data indicates that the Kuliouou exploratory well has a safe pumping capacity of approximately 300,000 gallons per day (210 gpm), producing water having a chloride content of about 100 ppm. The temperature of the pumped water was 71°F.

A total of about 300 hours of pumping was conducted at various rates ranging from 70 to 350 gpm and the chloride content of the pumped water was carefully monitored. Additionally, water samples were taken for analyses by BWS personnel and the U.S.G.S.

The well records and pumping test data will be assembled and published as a DOWALD circular, copies of which will be sent to you when available. If you have any questions, please do not hesitate to call on me.

Very truly yours,

ROBERT T. CHUCK
Manager-Chief Engineer

DL:ko

United States Department of the Interior

GEOLOGICAL SURVEY
P. O. Box 50166
Honolulu, Hawaii 96850

April 6, 1983

Mr. Robert T. Chuck
Manager-Chief Engineer
Div. of Water & Land Development
P. O. Box 373
Honolulu, Hawaii 96809

Dear Bob:

Enclosed are the analytical results of your water sample from Kuliouou Well 3-1843-01, Oahu. The data has been stored at our national computer center in Reston, Virginia.

We are also enclosing chloride results for water samples collected from the Molokai Reservoir network stations. Please call us if you have any questions.

Sincerely,

Stanley F. Kapustka
District Chief

Enclosures:
Kuliouou 3-1843-01
Molokai chloride results

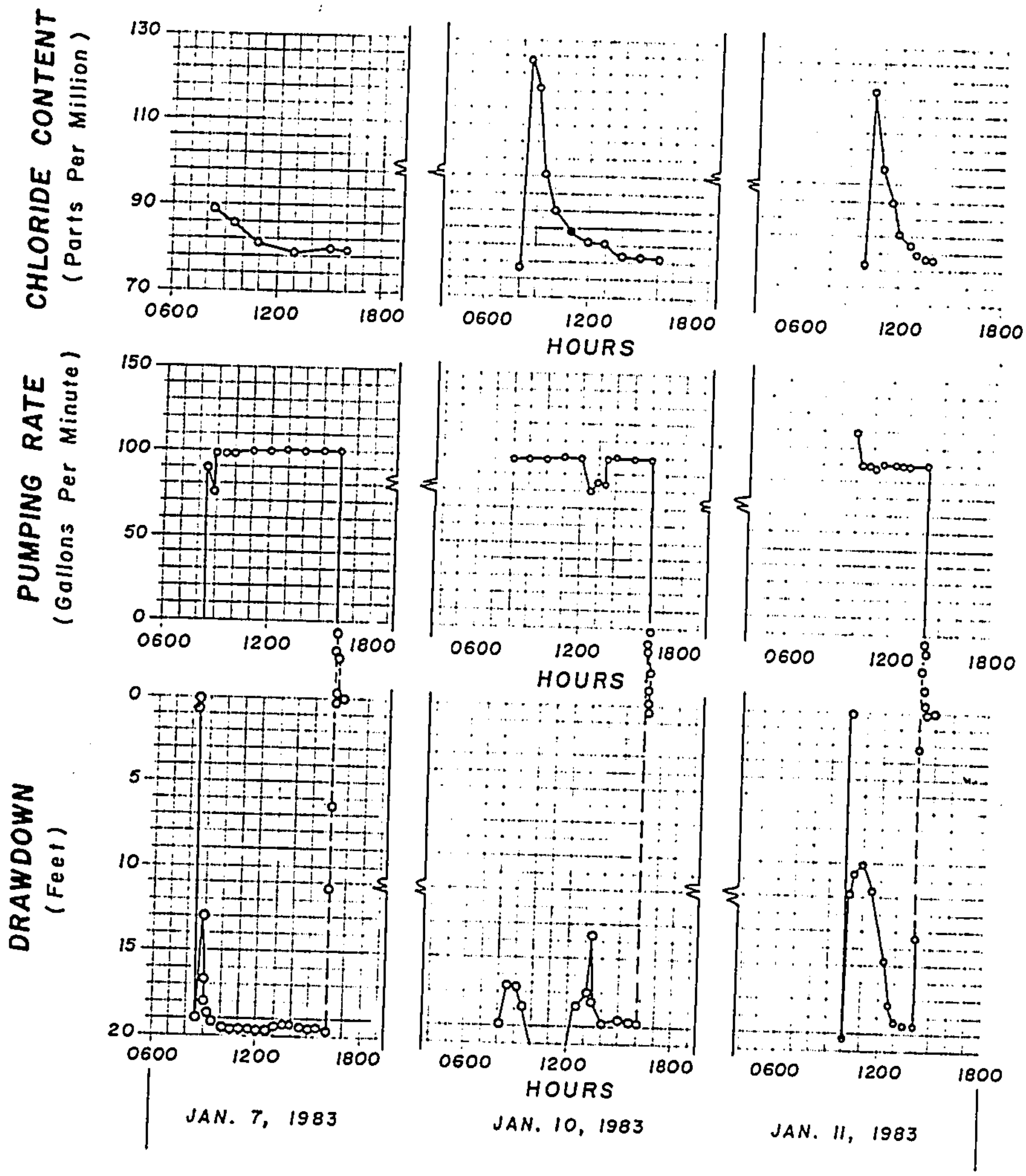
PROCESSING DATE: 83/03/31

STATION NUMBER: 211826157434301 LOCAL IDENTIFIER: 3-1843-01 STATE, KULIOUO WATER YEAR - 1983

TYPE OF STATION: WELL LATITUDE-LONGITUDE: 211826 1574340.01 STATE: 15 COUNTY: 003 DISTRICT: 15

DATE	TYPE	TIME	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) 00940	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) 70301	FLUO-RIDE, DIS-SOLVED (MG/L AS F) 00950	HARD-NESS (MG/L AS CACO3) 00900	POTAS-SIUM, DIS-SOLVED (MG/L AS K) 00935	SODIUM AD-SORP-TION RATIO 00931	PERCENT SODIUM 00932	PH LAB (UNITS) 00403	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) 90095	ALKA-LINITY LAB (MG/L AS CACO3) 90410
FEB. 11...	2	0930	100	305	<0.1	120	3.0	2.4	46	7.9	510	75

DATE	AGENCY ANA-LYZING SAMPLE (CODE NUMBER) 00028	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) 00631	IRON, DIS-SOLVED (UG/L AS FE) 01046	MANGA-NESE, DIS-SOLVED (UG/L AS MN) 01056	CALCIUM DIS-SOLVED (MG/L AS CA) 00915	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) 00925	SILICA, DIS-SOLVED (MG/L AS SIO2) 00955	SODIUM, DIS-SOLVED (MG/L AS NA) 00930	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) 95902	SULFATE DIS-SOLVED (MG/L AS SO4) 00945
FEB. 11...	80020	0.85	11	2	15	17	55	51	40	13

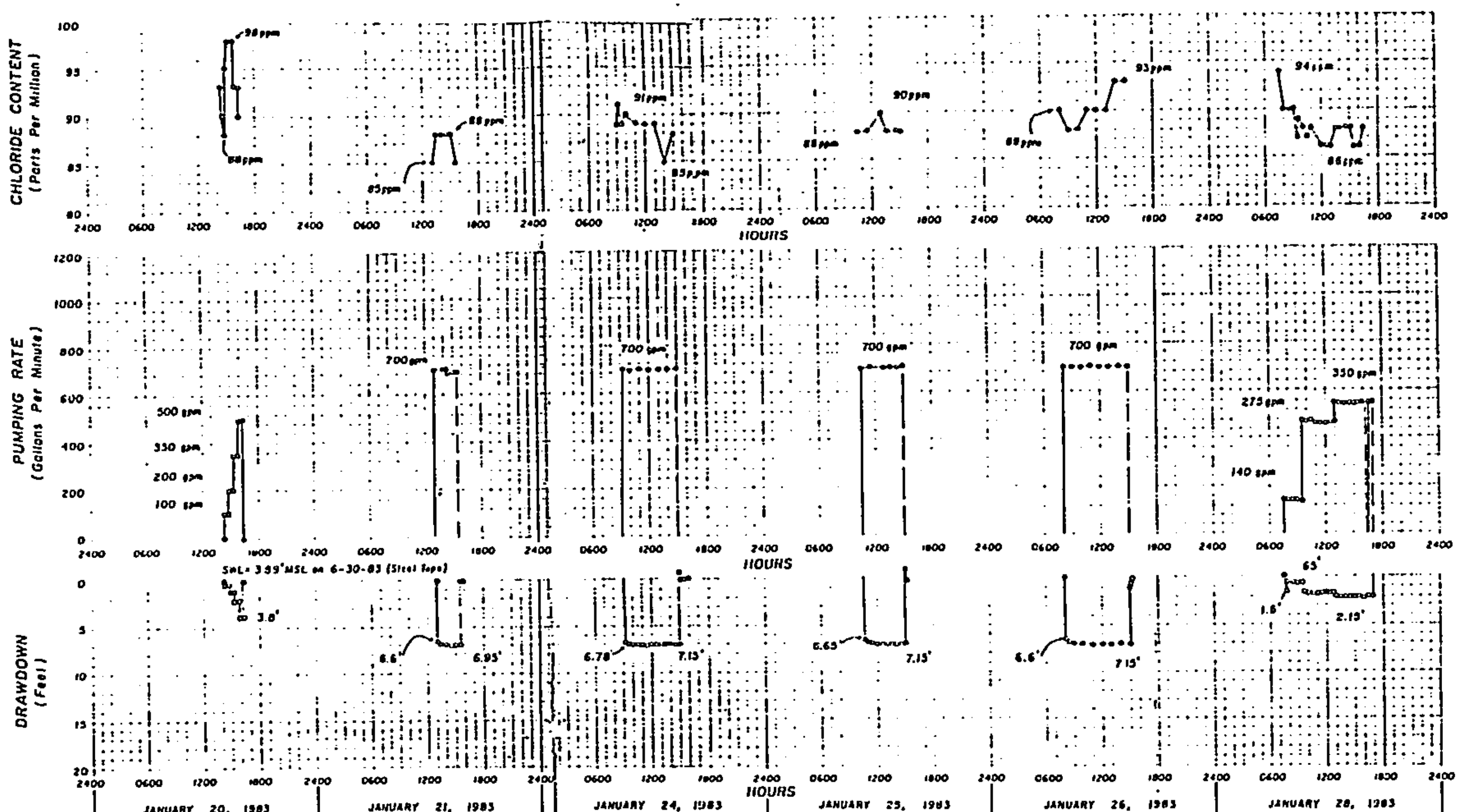


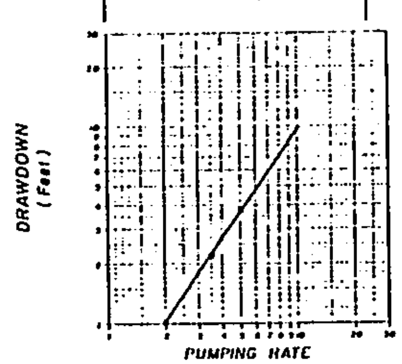
PHYSICAL DATA
Ground Elevation: 218'
Size of Casing: 12"
Depth of Casing(solid): 208.25'
Depth of Casing(screened): 248.25'
Depth of Hole: 248' (-30' MSL)
Water Temperature: 72.5° F
Latitude: 21° 18' 27"
Longitude: 157° 43' 40"
DEPTHS REFERRED TO GRD. ELEV.

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

PUMPING TEST No. I
KULIOUOU WELL 1843-01
HONOLULU, OAHU, HAWAII

Job No. 4 - OW - 23





PHYSICAL DATA

Ground Elevation 220.35' (Top of 6" Nipple)
Size of Casing 12"
Depth of Casing (solid) 208'
Depth of Casing (screened) 248'
Depth of Hole 268'
Water Temperature
Latitude 21° 18' 27"
Longitude 157° 43' 40"

Test Conducted By J. MENOR

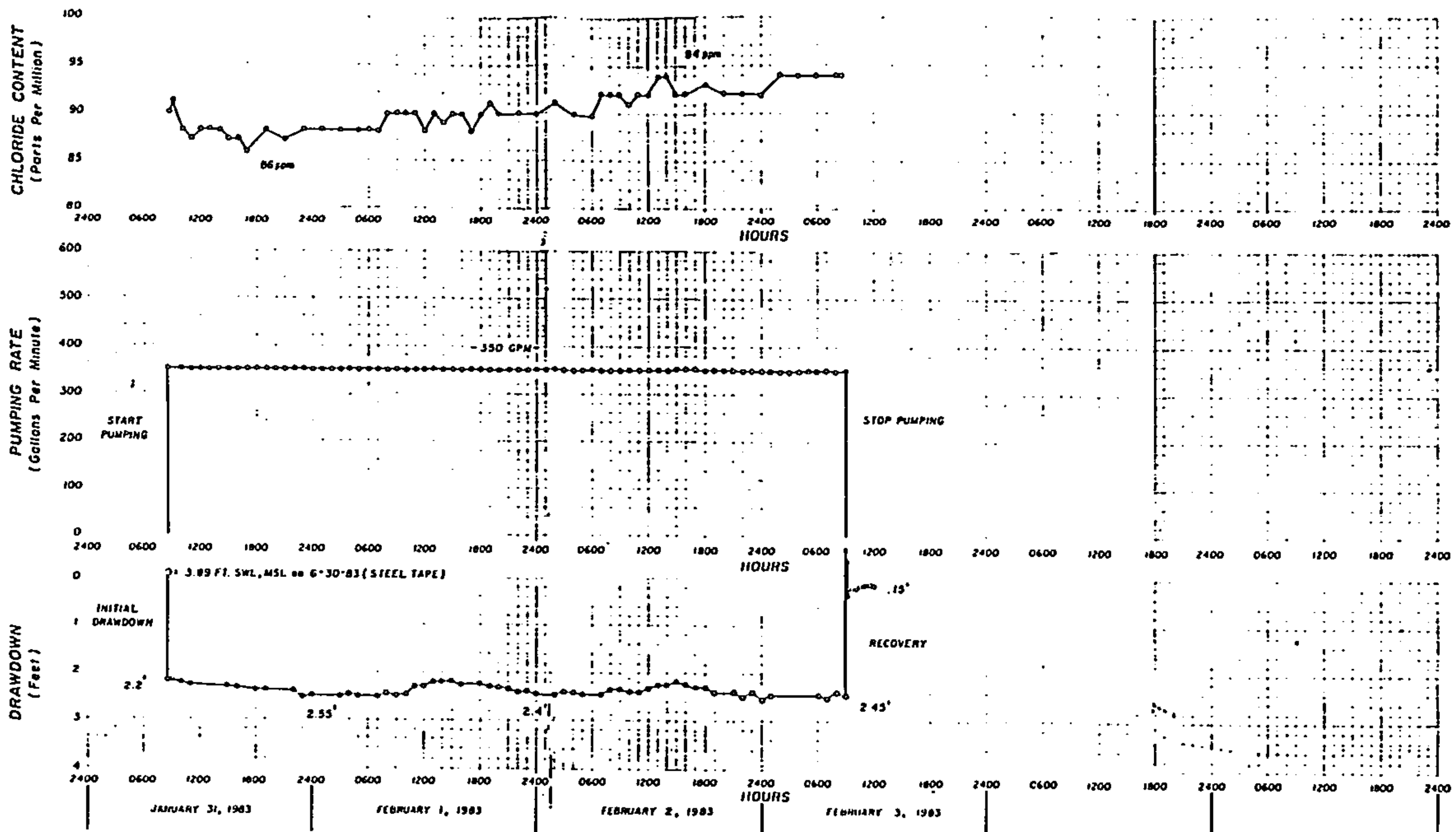
STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT

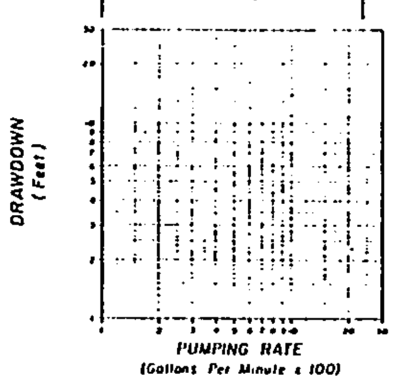
KULIOUOU WELL 1843-01

PUMPING TEST NO. 2

HONOLULU, OAHU, HAWAII

Job No 4-OW-23





PHYSICAL DATA

Ground Elevation 220.35' (Top of 6" Nipple)
Size of Casing 12"
Depth of Casing (solid) 208'
Depth of Casing (screened) 248'
Depth of Hole 268'
Water Temperature:
Latitude 21° 18' 27"
Longitude 157° 43' 40"

Test Conducted By J. MENOR, M. OHYE

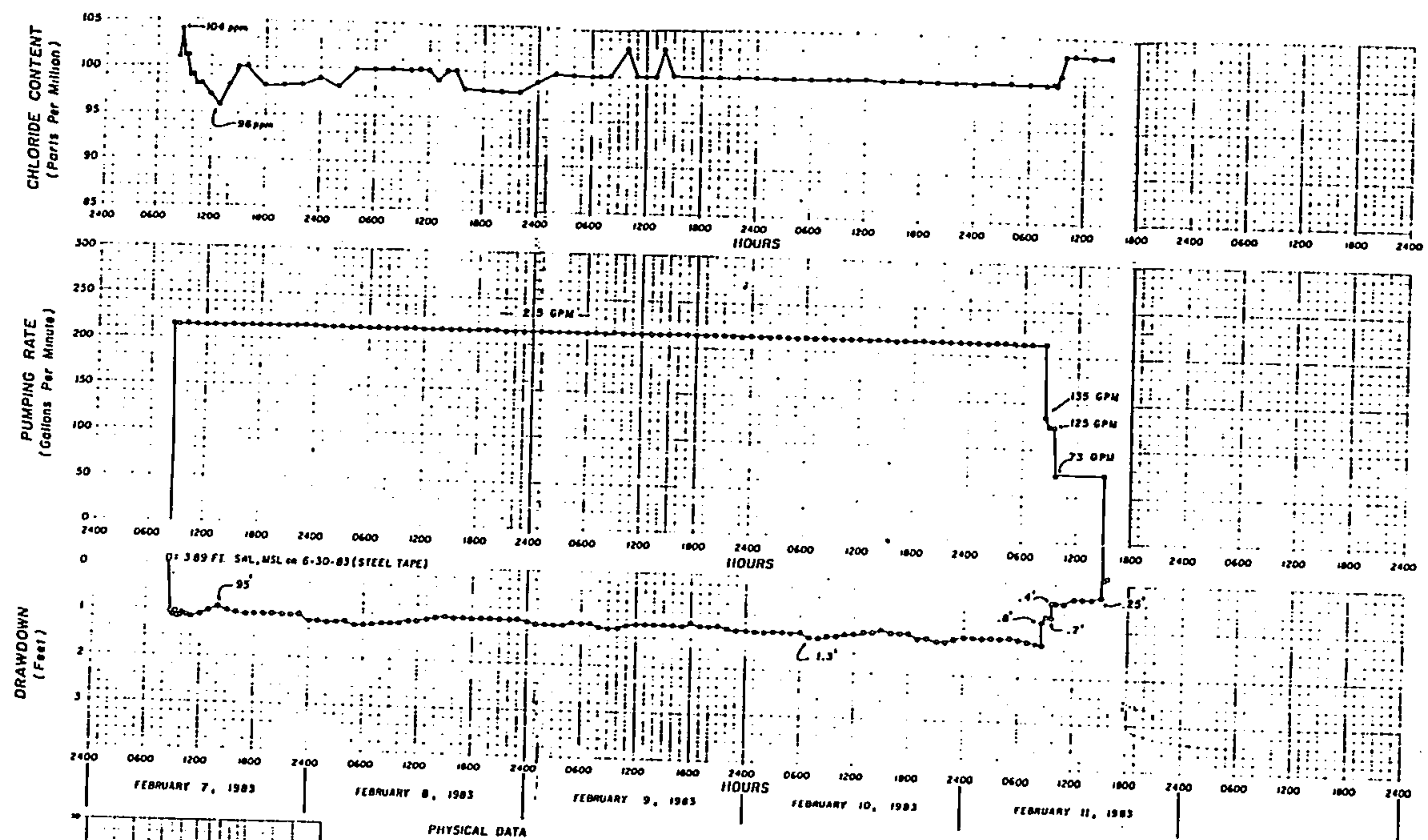
STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT

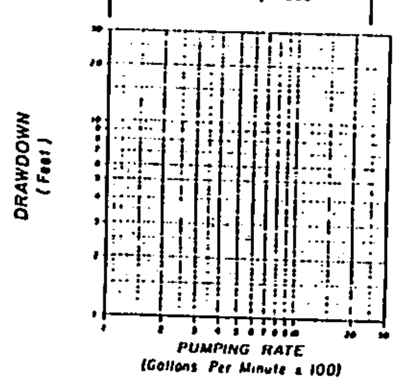
KULIOUOU WELL 1843-01

PUMPING TEST NO. 3

HONOLULU, OAHU, HAWAII

Job No. 4-OA-23





PHYSICAL DATA

Ground Elevation 220.35' (Top of 6" Nipple)
Size of Casing 12"
Depth of Casing (solid) 208'
Depth of Casing (screened) 248'
Depth of Hole 268'
Water Temperature
Latitude 21° 18' 27"
Longitude 157° 43' 40"

Test Conducted By J MENOR, M.OHYE

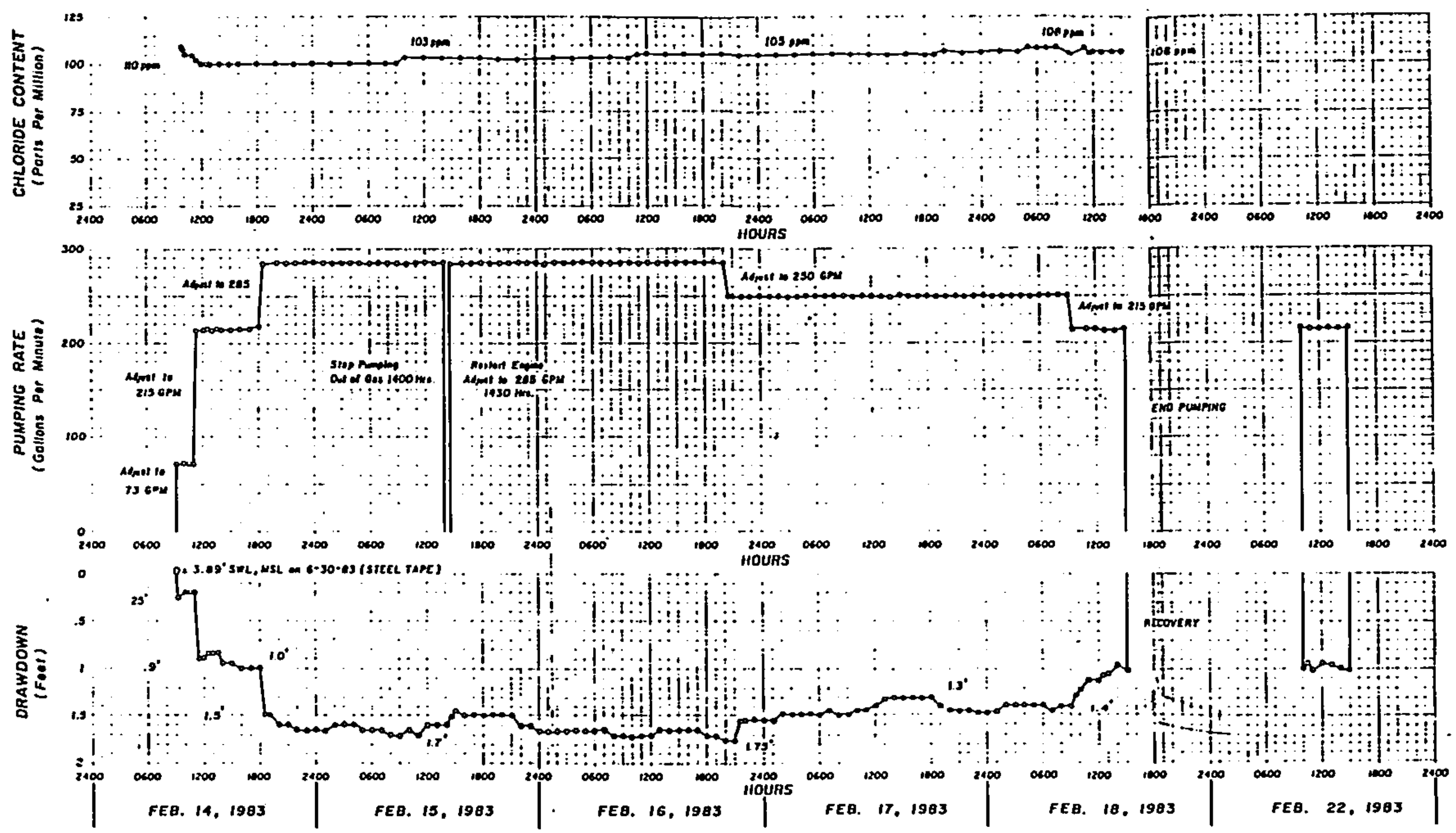
STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT

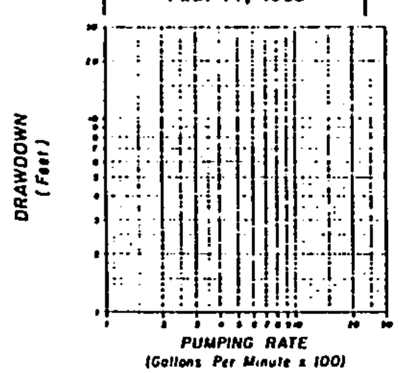
KULIOUOU WELL 1843-01

PUMP TEST NO. 4

HONOLULU, OAHU, HAWAII

Job No. 4-OW-83





PHYSICAL DATA

Ground Elevation 220 35' (Top of 6" Nipple)
Size of Casing 12"
Depth of Casing (solid) 200'
Depth of Casing (screened) 248'
Depth of Hole 268'
Water Temperature 70°
Latitude 21° 18' 27"
Longitude 157° 43' 40"

Test Conducted By J MENOR, M OHTE

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

KULIOUOU WELL 1843-01

PUMP TEST NO. 5

HONOLULU, OAHU, HAWAII

Job No. 4-OW-23

D. WAILUPE WELL II TEST DATA

WAILUPE WELL II
YIELD-DRAWDOWN TEST
JANUARY 13, 1986

Elevation of Well:	380± ft. msl
Bottom of Well Elevation:	-110± ft. msl
Bottom of Casing Elevation:	5± ft. msl
Bottom of Louvered Well Casing Elevation:	- 15± ft. msl
Bottom Airline Elevation:	-12.42± ft. msl
Casing Diameter:	12-inch I.D.
Location of Well:	TMK: 3-6-04:1

Time	Pressure (psi)	Draw-down (ft.)	Rate (gpm)	Temper-ature (°F)	Chloride (ppm)	Remarks
0845	8.4					Static; Static Hd. 6.98' msl
0900						Start test
0905	3.6	11.08	105			
0910			105	68.7		
0923	7.0	3.23	105			
0930				69.4	24	Sample 1
0941	7.0	3.23				
0955	7.1	3.00	102			
1010	7.0	3.23				
1027	7.0	3.23		69.5		
1030						Change rate
1032	4.9	8.08	209			
1045				68.6	24	Sample 2
1046	4.9	8.08				
1058	5.0	7.85	206			
1124	5.0	7.85				
1141	5.0			68.6	25	Sample 3

WAILUPE WELL II
YIELD-DRAWDOWN TEST
Page 2

Time	Pressure (psi)	Draw-down (ft.)	Rate (gpm)	Temperature (°F)	Chloride (ppm)	Remarks
1200						Change rate
1203	2.3	14.09	299			
1212	2.4	13.86		68.6		
1221	2.4	13.86	295			
1230				68.2	25	Sample 4
1235	2.4	13.86	295			
1245						Change rate
1248	0.3	18.71	350			
1252	0.2	18.94	350			
1255				68.2		
1258	0.2	18.94				
1310	0.2	18.94				
1315				68.2	25	Sample 5
1320	0.2	18.94	350			
1330						End Test

Meter end: 04110815
Meter start: 04054370

Total gallons pumped: 56,445

WAILUPE WELL II
SUSTAINED TEST

Date/ Time	Pressure (psi)	Draw-down (ft.)	Rate (gpm)	Temper-ature (°F)	Chloride (ppm)	Remarks
1/15/86						
0918	8.6					Static; Static Hd. 7.45 'msl
0930						Start
0937			330			Adjust rate
0938	1.7	15.94				Engine vibrations; readjust rate
0946	2.4	14.33	308			
0948				68.6		
1000				68.5	24	Sample 1
1002	2.4	14.33				
1241	2.3	14.56	304			
1445	2.6	13.86	293			
1600	2.3	14.56	299			
1645	4.1	10.40	240			Reduce engine speed*
2000	4.1	10.40	240			
1/16/86						
0400	4.0	10.63	238			
0745	1.8	15.71	305			Readjust engine speed
0937	1.8	15.71	305			
0945				68.5	24	Sample 2
1800	1.8	15.71	305			
1/17/86						
0200	1.7	15.94	303			
0824	1.6	16.17	300			
0830				68.5	25	Sample 3
1200	1.55	16.29				
1650	3.4	12.02	241			Reduce engine speed
2000	3.4	12.02	236			

WAILUPE WELL II
SUSTAINED TEST
Page 2

1/18/86					
0400	3.4	12.02	235		
0810	1.0	17.56	313		Readjust engine speed
0900				25	Sample 4
1200	1.0	17.56	308		
1700	1.0	17.56	308		
1705	3.4	12.02	240		Reduce engine speed
1900	3.6	11.55	234		Adjust rpm
2400	3.7	11.32	230		
1/19/86					
0800	3.7	11.32	230		
0810	1.5	16.41	300		Readjust engine speed
0845	1.5	16.41	300	25	Sample 5
1400	1.0	17.56	308		
1800	0.9	17.79	308		
1810	3.4	12.02	232		Reduce engine speed
1/20/86					
0200	3.7	11.32	224		
0400	3.8	11.09	220		
0738	0.8	18.02	305		Readjust engine speed
0846	0.9	17.79	305		
0930					End test

Meter end:	06048280
Meter begin:	04123645
Total gallons pumped:	1,924,635
Average pumpage:	267 gpm

* Engine speed was reduced to diminish engine noise.

CHEMICAL LABORATORY REPORT

Subject: Wailupe Well II Pumping Tests

I. Short Term Yield-Drawdown Test

Sample	Date	Time	Temp. °F	Rate gpm	Draw-down ft.	Sp.Cond. umhos	Ppm Alk.	H	Cl	No_3
1	1/13/86	0930	69.4	105	3.23		58	59	24	
2	"	1045	68.6	208	8.08	213			24	
3	"	1142	68.6	208	7.85		58	59	25	
4	"	1230	68.2	295	13.86	217			25	
5	"	1315	68.2	350	18.94		58		25	1.4

Pumping started at 0900 on 1/13/86; ended at 1330 on 1/13/86.

Lab Nos. 170, 727-731.

II. Sustained Test

Sample	Date	Time	Temp. °F	Rate gpm	Draw-down ft.	Sp.Cond. umhos	Ppm Alk.	H	Cl	No_3	pH
1	1/15/86	1000	68.5	308	14.33		56	51	24	1.3	7.40
2	1/16/86	0945	68.5	300	15.71	215			24		
3	1/17/86	0830	68.5	300	16.17		56	53	25		
4	1/18/86	0900	-	300	17.56	215			25		
5	1/19/86	0845	-	300	16.41		56	53	25	1.4	7.80
6	1/20/86	0845	-	-	17.79	215	56	53	25	1.4	7.80

Pumping started at 0930 on 1/15/86; ended at 0930 on 1/20/86.

Lab Nos. 170, 784-789.

Well Data: Depth of Well: 380 ± ft. msl
End of casing: 5 ± ft. msl
Diameter of well: 12 in. I.D.

E. H. Tokunaga
E. H. Tokunaga
Chemist

Jan 27, 1986
GT:ja

cc: C. Jamile, G. Hiu, ~~A.~~ Morisako, L. Whang, R. Fujii

WAILUPE GULCH AT AINA HAINA, OAHU
(For BWS Wailupe Well)

Water Temperature in deg. C, Specific Conductance in micromhos/cm, pH in units.

Date	Water Quality	Site 2	Site 3	Site 4
1-14-86	Wat. Temp.		19.5	20.5
	Sp. Cond.		240	540
	pH		6.9	7.2
			(1025)	(1215)
1-15-86	Wat. Temp.		19.0	19.0
	Sp. Cond.		245	535
	pH		6.4	6.9
			(0820)	(0845)
	Pump started at 0930			
	Wat. Temp.	20.5	20.5	24.0
	Sp. Cond.	200	200	390
	pH	6.5	6.7	7.1
		(1530)	(1425)	(1625)
1-16-86	Wat. Temp.	20.5	20.5	24.5
	Sp. Cond.	195	195	235
	pH	6.6	6.6	7.1
		(1345)	(1410)	(1445)
1-17-86	Wat. Temp.	21.0	21.0	24.0
	Sp. Cond.	195	200	220
	pH	6.6	6.8	7.1
		(1420)	(1335)	(1310)
1-20-86	Wat. Temp.	20.5	20.5	21.0
	Sp. Cond.	195	195	220
	pH	7.2	7.4	7.5
		(0900)	(0820)	(0730)

WAILUPE GULCH AT AINA HAINA, OAHU
(For BWS Wailupe Well)

Water Temperature in deg. C, Specific Conductance in micromhos/cm, pH in units.

Date	Water Quality	Site 2	Site 3	Site 4
1-21-86	Wat. Temp.		20.5	24.0
	Sp. Cond.		220	300
	pH		6.7	7.2
			(1350)	(1335)

() Time readings were taken

WAILUPE GULCH AT AINA HAINA, OAHU
(discharge measurements made for BWS Wailupe well)

Discharge in cfs

Date	Site 1	Site 2	Site 3	Site4
12-10-85	0	0.09 (1145)	0.18 (1210)	0.19 (1415)
	Weather: Partly cloudy			
1-14-86	0	0	.013 (1020)	.015 (1210)
	Weather: Partly cloudy			
1-15-86	0	0	.011 (0815)	.011 (0840)
	Pump started at 0930 (pump rate, 300 gal/min)			
	0	.60 (1520)	.54 (1420)	.54 (1640)
	Weather: Sunny and clear			
1-16-86	0	.59 (1340)	.64 (1405)	.62 (1440)
	Weather: Sunny and clear			
1-17-86	0	.60 (1415)	.62 (1330)	.62 (1300)
	Weather: Overcast with slight drizzle			

From the evening of Jan. 17 to 0740 on Jan. 20, the pump rate was lowered to 200 gal/min in order to reduce the noise level from the pump.

1-20-86	Pump rate increased from 200 to 300 gal/min at 0740			
	0		.56 (0815)	.46 (0750)
	0	.56 (0850)	.62 (0910)	.61 (0940)

WAILUPE GULCH AT AINA HAINA, OAHU
(discharge measurements made for BWS Wailupe well)

Discharge in cfs

Date	Site 1	Site 2	Site 3	Site4
	Pump stopped at 0930 Weather: Overcast			
1-21-86	0	0	.029 (1345)	.037 (1330)
	Weasther: Partly cloudy			

() Time of discharge measurement

E. MEMORANDUM TO THE BOARD OF LAND AND NATURAL RESOURCES FROM ROBERT T. CHUCK, MANAGER-CHIEF ENGINEER, DIVISION OF WATER AND LAND DEVELOPMENT, DEPARTMENT OF LAND AND NATURAL RESOURCES

DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development
Honolulu, Hawaii

June 22, 1984

Chairperson and Members
Board of Land and Natural Resources
State of Hawaii
Honolulu, Hawaii

Gentlemen:

Modify Honolulu Board of Water Supply
Withdrawal and Use Permit Application for
the Manoa II Well and Waialae Nui Well,
Honolulu Ground Water Control Area, Oahu

The Board of Land and Natural Resources on December 4, 1981, approved the issuance of Water Supply Withdrawal and Use Permits for the Manoa II Well (State Well No. 1948-01) and the Waialae Nui Well (State Well No. 1747-03).

The Department has been requested by the Board of Water Supply to increase its permitted water withdrawal and pump capacity as follows:

	Permitted		Proposed	
	Water Withdrawal	Pump Capacity	Water Withdrawal	Pump Capacity
Manoa II Well, 1948-01	0.5 mgd	500 gpm or 0.72 mgd	0.7 mgd	700 gpm or 1.01 mgd
Waialae Nui Well, 1747-03	0.4 mgd	425 gpm or 0.6 mgd	0.7 mgd	700 gpm or 1.01 mgd

The additional quantity of water to be withdrawn from the two wells is 0.5 mgd. The water proposed to be withdrawn will not adversely affect the basal lens in the Honolulu Ground Water Control Area. The present status of the basal lens in the Honolulu Ground Water Control Area is as follows:

Sustainable Yield (Moanalua-Kaimuki Subarea): 55.00 mgd
Certified Uses: 41.83 mgd
Water Use Permits Issued by BLNR: 6.35 mgd
Total Uses Authorized: 48.18 mgd
Water Available: 6.82 mgd

RECOMMENDATION:

That the Board approve the increase in water withdrawal to 0.7 mgd and pump capacity to 1.01 mgd for the Water Withdrawal and Use Permits issued to the Honolulu Board of Water Supply for the Manoa II Well (State Well No. 1948-01) and the Waialae Nui Well (State Well No. 1747-03). Both wells will be for municipal use.

Respectfully submitted,

Robert T. Chuck
ROBERT T. CHUCK
Manager-Chief Engineer

APPROVED FOR SUBMITTAL:

S. Ono
SUSUMU ONO, Chairperson

Approved by the Board of Land & Natural Resources at the meeting held on
6/22/84

ITEM D-5

F. MANOA III EXPLORATORY WELL NO. 1948-02
LONG TERM PUMPING TEST

MANOA III EXPLORATORY WELL NO. 1948-02
Long Term Pumping Test

Location	:	2-9-36:3
Elevation at ground	:	+ 182.0 ft.
Elevation at bottom of well	:	- 44.2 ft.
Elevation at end of casing	:	- 44.2 ft.
Diameter of casing	:	9 7/8 in. I.D.
Head	:	+ 160.9 ft.
Drilling Completed	:	November 13, 1985
Drilling Company	:	Roscoe Moss
Date of Long-Term Test	:	January 6-8, 1986

Date Time	Q (gpm)	Drawdown (ft.)	Cl (ppm)	Temperature °F	Remarks
01/6/86					
0930					Started pumping
0935	96	92.40			
0945	100	143.22			
0950					Reduced rate
1000	55	147.15			
1030	54	151.30		75.0	
1100	52	153.62			
1215	51	154.08			
1300	48	155.23			
1305					Changed rate
1308	35	145.07			
1310	43	143.45			
1317	44	142.76			
1330	44	141.83			
1400	44	143.22			
1420	46	142.06			
1430	47	141.83			
1445	45	141.60	20	75.5	
1500					Stopped pumping
1501	0	110.88			
1502	0	92.40			

MANOA III EXPLORATORY WELL NO. 1948-02

Date Time	Q (gpm)	Drawdown (ft.)	Cl (ppm)	Temperature °F	Remarks
01/7/86					
0930					Started pumping
0932	44	11.55			
0938	45	35.81			
0945	45	50.82		74.3	
1005	45	64.68		74.4	
1030	46	73.92			
1105	47	78.54		74.6	
1200	43	97.02		75.0	
1305	46	124.74			
1400	47	133.98		75.4	
1445	47	138.60	20		
1500					Stopped pumping
1501	0	106.26			
1502	0	90.09			
1503	0	86.63			
1504	0	80.85			
1505	0	78.54			
1507	0	77.39			
01/8/86					
0930					Started pumping
0932	47	16.17			
0935	44	32.34			
1035			20	74.8	
1130	46	117.81		75.0	
1200	44	128.21			Ran out of fuel,
1233					stopped pumping
1238					Resumed pumping
1245	47	135.13		75.2	
1310	45	146.69			
1330	43	145.53		75.4	
1400	43	145.53			
1425	42	145.53			
1430					Stopped pumping
1431	0	92.40			
1432	0	87.78			
1433	0	85.47			
1434	0	82.01			
1435	0	79.69			
1445	0	66.99			
1500	0	28.87			
1515	0	13.86			
1525	0	9.24			

G. MANOA STREAM FLOW MONITORING DATA FOR MANOA WELL III

MANOA STREAM, AT HONOLULU, OAHU
(For Manoa well near Manoa School)

Discharge in cfs

Date	Site 1 (162385)	Site 2 (162405)	Site 3A	Site 3	Site 4	Site 5
7-12-85	.16	a 1.25	1.44	1.60	1.55	1.64
11-21-85	a .78	2.04		3.64	3.65	4.10
		(Site 3A discontinued)				
12-18-85	.40	1.68		2.65	2.67	2.63
1-06-86	.19 (0950)	1.45 (0910)		1.84 (0800)	1.81 (0710)	1.74 (0725)
	Pump started at 0930 (pump rate, 45 gal/min)					
				4.80 (1400)	4.25 (1425)	4.40 (1450)
	Pump stopped at 1500					
	Weather: overcast with showers.					
	(The large increase in streamflow for sites 3, 4, 5, after pump was started was due to showers during the day.)					
1-07-86	.21 (0925)	1.66 (0855)		2.58 (0735)	2.85 (0710)	2.65 (0800)
	Pump started at 0930 (pump rate, 45 gal/min)					
	.27 (1515)	1.60 (1445)		2.07 (1255)	2.19 (1345)	2.19 (1410)
	Pump stopped at 1500					
	Weather: partly cloudy.					
	(The large decrease in streamflow at individual sites after pump was started was due to diminishing showers.)					
1-08-86	.21 (1030)	1.47 (0950)		1.88 (0820)	1.84 (0750)	1.96 (0905)

MANOA STREAM, AT HONOLULU, OAHU
(For Manoa well near Manoa School)

Discharge in cfs

Date	Site 1 (162385)	Site 2 (162405)	Site 3A	Site 3	Site 4	Site 5
	Pump started at 0930 (pump rate, 45 gal/min)					
	.20 (1505)	1.47 (1520)		1.88 (1330)	1.99 (1405)	2.07 (1430)
	Pump stopped at 1500					

( ) Time of discharge measurement
: Discharge taken from rating for station

Note:

Site 1---Discontinued gaging station, 16238500 (Waihi Stream at Honolulu,Hawaii)

Site 2---Gaging station, 16240500 (Waiakeakua Stream at Honolulu,Hawaii)

Site 3A--About 600 ft upstream from where Oahu Avenue crosses Manoa Stream

Site 3---100 ft upstream of well site

Site 4---200 ft downstream of Kahaloa Drive bridge

Site 5---300 ft downstream of East Manoa Road bridge, just below McDonalds

MANOA STREAM, AT HONOLULU, OAHU
(For Manoa Well near Manoa School)

Water Temperature in deg. C, Specific Conductance in micromhos/cm, pH in units

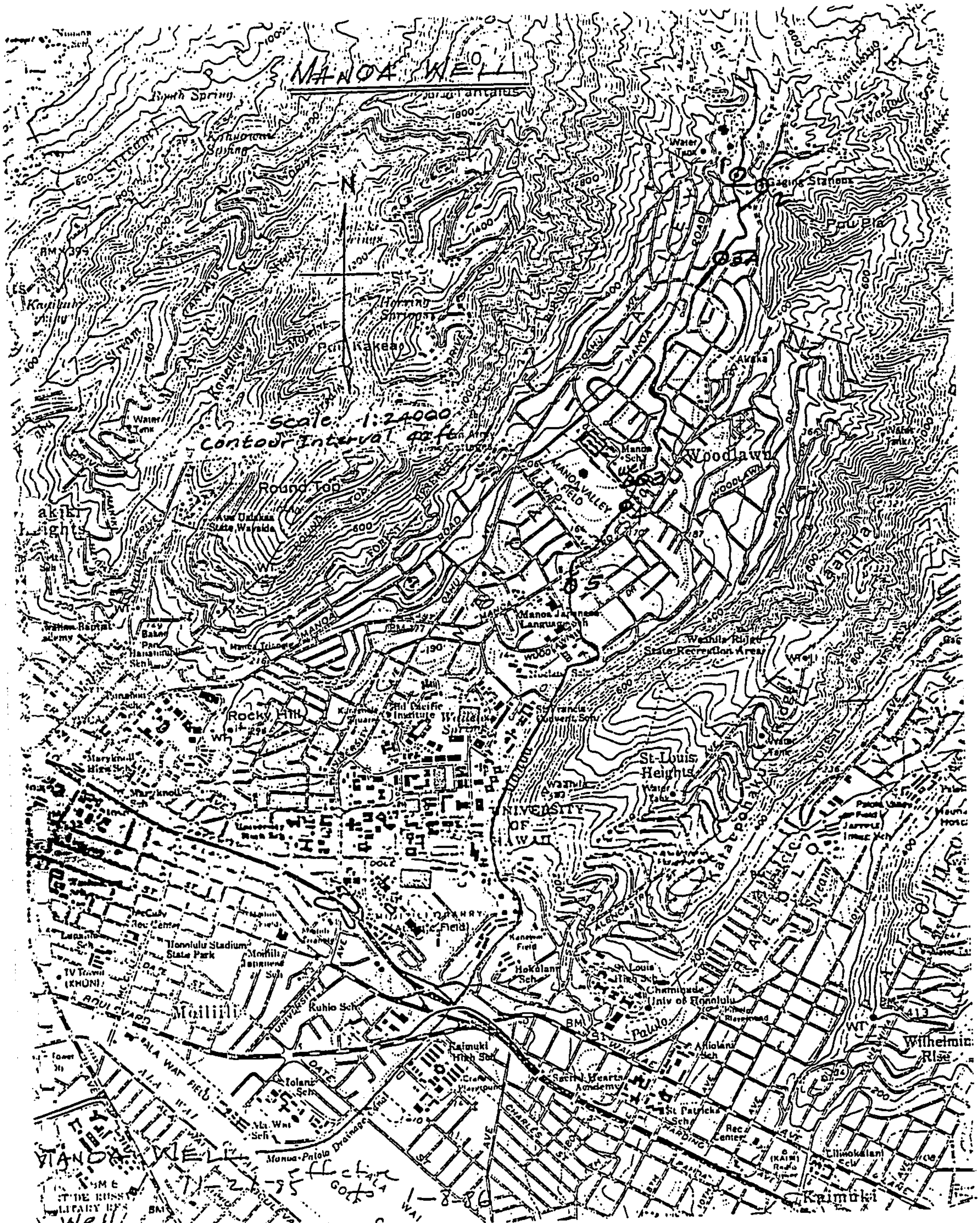
Date	Water Quality	Site 1 (162385)	Site 2 (162405)	Site 3A	Site 3	Site 4	Site 5
[illegible]-12-85	Wat. Temp.	23.0		22.5	23.5	24.0	25.0
	Sp. Cond.	220		175	170	170	178
	pH	7.2		7.3	7.3	7.4	7.8
		(1500)		(1300)	(1200)	(1120)	(1035)
1[illegible]-21-85	Wat. Temp.		21.0		22.0	22.5	21.5
	Sp. Cond.		150		180	180	190
	pH		6.8		6.8	7.0	7.3
			(1535)		(1425)	(1350)	(1010)
12-18-85	Wat. Temp.	20.0	19.5		19.0	19.0	18.5
	Sp. Cond.	175	130		190	185	200
	pH	6.9	7.1		7.0	7.1	7.2
		(1115)	(1210)		(0750)	(0730)	(0740)
1-06-86	Wat. Temp.				20.0	20.0	19.5
	Sp.Cond.				170	180	190
	pH				7.3	7.3	7.3
					(0830)	(0745)	(0810)
	Pump started at 0930.						
	Wat. Temp.	20.0	20.0		21.0	21.5	23.0
	Sp. Cond.	210	130		170	170	175
	pH	6.6	7.1		7.0	6.9	7.3
		(1015)	(0935)		(1415)	(1445)	(1510)
	Pump stopped at 1500.						
[illegible]-07-86	Wat. Temp.	19.0	18.5		18.5	18.0	18.0
	Sp. Cond.	225	140		185	190	210
	pH	7.1	7.2		7.2	7.2	7.3
		(0945)	(0920)		(0755)	(0730)	(0825)

MANOA STREAM, AT HONOLULU,OAHU
(For Manoa Well near Manoa School)

Water Temperature in deg. C, Specific Conductance in micromhos/cm, pH in units

Date	Water Quality	Site 1 (162385)	Site 2 (162405)	Site 3A	Site 3	Site 4	Site 5
	Pump started at 0930.						
	Wat. Temp.	20.5	19.5		19.5	20.5	22.5
	Sp. Cond.	210	140		175	185	195
	pH	7.2	7.2		7.0	7.0	7.5
		(1535)	(1510)		(1325)	(1405)	(1435)
	Pump stopped at 1500.						
1[illegible]08-86	Wat. Temp.	19.5	19.0		19.0	18.5	19.0
	Sp. Cond.	200	135		170	175	180
	pH	7.0	7.1		7.1	7.2	7.2
		(1045)	(1010)		(0850)	(0820)	(0935)
	Pump started at 0930.						
	Wat. Temp.	20.5	20.0		19.5	20.5	22.5
	Sp. Cond.	200	135		175	175	180
	pH	6.6	6.7		6.6	6.7	7.5
		(1525)	(1545)		(1400)	(1425)	(1500)
	Pump stopped at 1500.						

() Time readings were taken.


MANOA WELL
N
Scale 1:24000
Contour Interval 40 ft
Round Top
Woodlawn
Rocky Hill
St Louis Heights
UNIVERSITY OF HAWAII
Honolulu Stadium State Park
Moiliili
Kaimuki
Wilhelmina Rise
Manoa Japanese Language Sch
Waahila Ridge State Recreation Area
Kuhio Sch
Kaimuki High Sch
Sacred Hearts Academy
St Patricks Sch
Manoa-Palolo Drainage Canal
MANOA WELL

H. MEMORANDUM TO MR. BUNJI HIGAKI FROM J. GRANCE REGARDING THE WAALOA EXPLORATORY WELL

MEMORANDUM

December 15, 1970

To: Mr. Bunji Higaki

From: J. Grance

Subject: <u>Waaloa Exploratory Well</u>

A five-hour pump test was run on November 30, 1970. The orifice meter used to measure the flow was an 8" pipe with a 5" orifice plate. At no time during the test did the water level stabilize.

An extended pump test was started on December 2, 1970 and run at a constant rate of about 300 gpm for approximately 48 hours. The rate was then increased to about 600 gpm for another 12 hours for a total time of approximately 60 hours. The water levels again did not stabilize. An 8" pipe with a 4 1/4" orifice plate was used during this second test.

Statistics of both pump tests are attached.

J. Grance

J. Grance

WAALOA EXPLORATORY WELL
5-HOUR PUMP TEST

Diameter: 16" I.D.
Depth: 537' (-6')
Casing: 138' (+393')
Airline: 130' (+401')
Elevation: 531' (Top of flange on well)
Head: 426.41' (Approx.)
November 30, 1970

Time	Water Level Psi	Water Level Ft.	Drawdown Ft.	Rate Gpm	Chloride Ppm	Remarks
1115	11.0	25.41				Static
1120						Start pump
1125	10.00	23.10	2.31	332	16	Sample No. 1
1130	9.30	21.48	3.93	345		
1135	9.10	21.02	4.39	345		
1145	8.85	20.44	4.97	358		
1150	8.65	19.98	5.43	358		
1200	8.50	19.64	5.77	372		
1210	8.40	19.40	6.01	372		
1220	8.30	19.17	6.24	372		
1232	8.20	18.94	6.47	372		
1240	8.10	18.71	6.70	372		
1250	8.05	18.60	6.81	372		
1300	8.00	18.48	6.93	372		
1310	8.00	18.48	6.93	372		
1320	7.90	18.25	7.16	372		
1330	7.90	18.25	7.16	372		
1340	7.80	18.02	7.39	372		
1350	7.70	17.79	7.62	372	14	Sample No. 2

Time	Water Level Psi	Water Level Ft.	Drawdown Ft.	Rate Gpm	Chloride Ppm	Remarks
1400	7.65	17.67	7.74	372		
1410	7.65	17.67	7.74	372		
1420	7.60	17.56	7.85	372		
1421						Increased Rate
1423	7.35	16.98	8.43	425		
1433	7.30	16.86	8.55	425		
1440	7.20	16.63	8.78	425		
1445	7.15	16.52	8.89	425	14	Sample No. 3
1450	7.10	16.40	9.01	425		
1451						Increased Rate
1455	6.60	15.25	10.16	529		
1500	6.50	15.02	10.39	529		
1505	6.45	14.90	10.51	529		
1510	6.40	14.78	10.63	529		
1515	6.40	14.78	10.63	529	15	Sample No. 4
1520	6.35	14.67	10.74	529		
1521						Increased Rate
1525	5.25	12.13	13.28	700		
1530	5.10	11.78	13.63	700		
1535	5.00	11.55	13.86	700		
1545	4.80	11.09	14.32	700		
1555	4.70	10.86	14.55	700		
1605	4.65	10.74	14.67	694		
1615	4.55	10.51	14.90	694	14	Sample No. 5
1620	4.50	10.40	15.01	694		Stop pump

Time	Water Level Psi	Water Level Ft.	Drawdown Ft.	Rate Gpm	Chloride Ppm	Remarks
1621	7.95	18.36	7.05			Recovery
1622	7.80	18.02	7.39			
1623	7.80	18.02	7.39			
1624	7.80	18.02	7.39			
1625	7.85	18.13	7.28			
1626	7.90	18.25	7.16			
1627	8.00	18.48	6.93			
1628	8.05	18.60	6.81			
1629	8.10	18.71	6.70			
1631	8.20	18.94	6.47			
1634	8.35	19.29	6.12			
1635	8.40	19.40	6.01			
1644	8.70	20.10	5.31			
2000	10.90	25.18	.23			Maximum recovery from pressure chart

JG
12/15/70

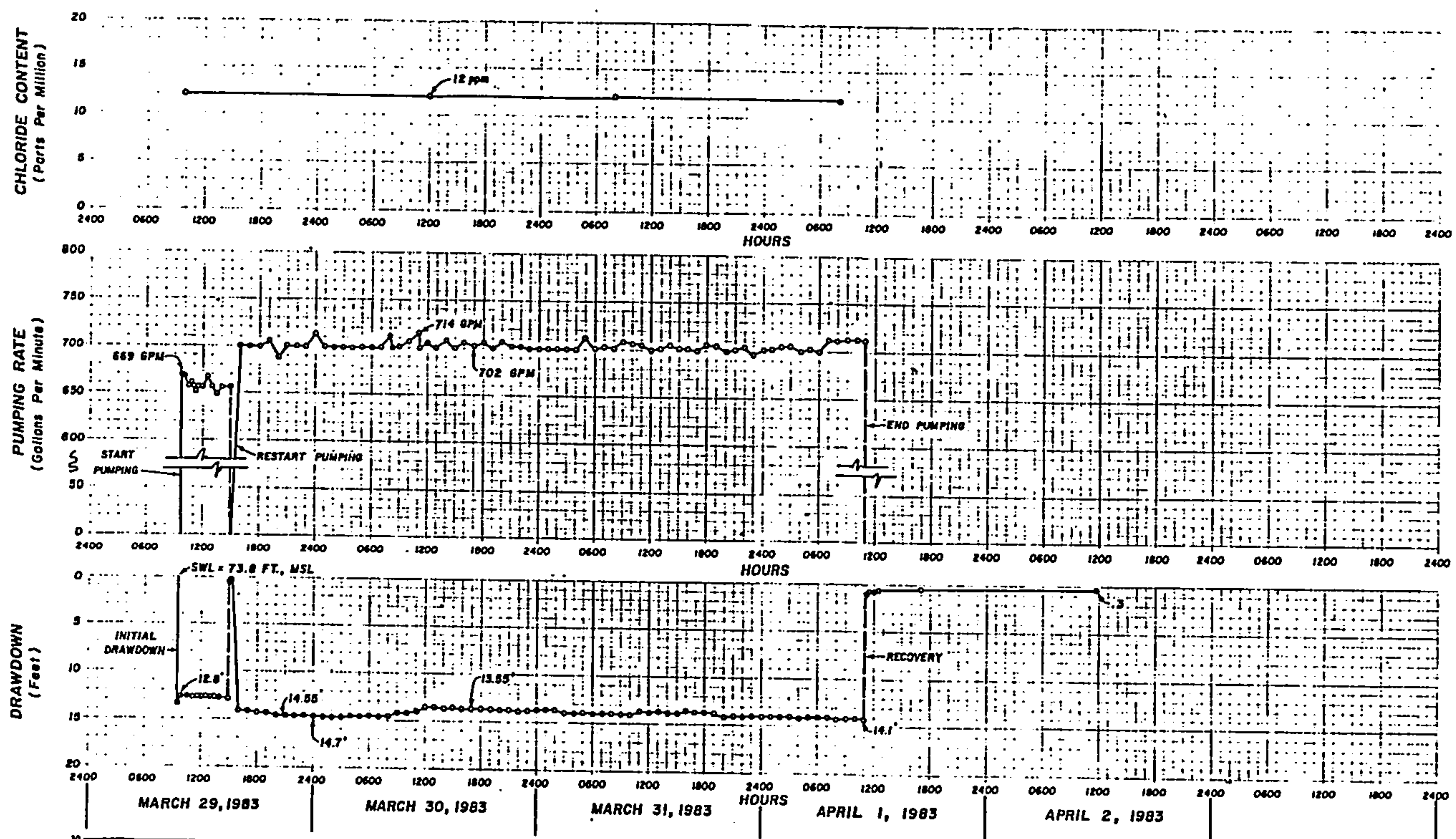
WAALOA EXPLORATORY WELL
EXTENDED PUMP TEST

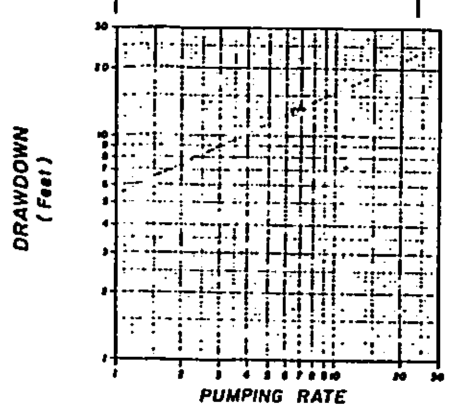
December 2, 1970

Time	Water Level Psi	Water Level Ft.	Drawdown Ft.	Rate Gpm	Chloride Ppm	Remarks
1005	10.95	25.29				Static
1025						Start pump
1030	9.65	22.29	3.00	290		
1040	9.35	21.60	3.69	300	14	Sample No. 1
1102	9.00	20.79	4.50	310		
1340	8.20	18.94	6.35	295		
1440	8.00	18.48	6.81	295		
December 3, 1970						
0920	7.10	16.40	8.89	300		
1415	6.75	15.59	9.70	305	14	Sample No. 2
December 4, 1970						
0845	6.00	13.86	11.43	305	14	Sample No. 3
0910						Increased Rate
0915	4.25	9.82	15.47	605		
0930	3.85	8.89	16.40	605		
1450	2.55	5.89	19.40	600		
2355	2.00	4.62	20.67	600	15	Reading from chart Sample No. 4
2400						Stop pump
December 7, 1970						
0900	9.20	21.25	4.04			Recovery taken from pressure chart

JG
12/15/70

I. MANOA II WELL 1948-01 PUMPING TEST NO. 2





PHYSICAL DATA

Ground Elevation: 384.3'
Size of Casing: 12"
Depth of Casing (solid): 484' (-100', MSL)
Depth of Casing (screened): 786' (-402', MSL)
Depth of Hole: 786' (-402', MSL)
Water Temperature: 69.5°
Latitude: 20° 19' 59"
Longitude: 157° 48' 18"

Test Conducted By: Joe Manor

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

MANOA II WELL 1948-01

PUMPING TEST NO. 2

J. MEMORANDUM TO MR. KAZU HAYASHIDA FROM HERBERT H. MINAKAMI REGARDING THE YIELD-DRAWDOWN AND LONG TERM TESTS OF JONATHAN SPRINGS EXPLORATORY WELL NO. 2052-12

Honolulu Board of Water Supply

to MR. KAZU HAYASHIDA

from HERBERT H. MINAKAMI

date JUNE 16, 1981

subject YIELD-DRAWDOWN AND LONG TERM TESTS OF JONATHAN SPRINGS EXPLORATORY WELL NO. 2052-12

We forward the Jonathan Springs Exploratory Well Yield-Drawdown and Long Term test data for your information.

The Yield-Drawdown test ran for 5 hrs. from 387 gpm to 1,095 gpm with a maximum drawdown of 0.80 ft. The chloride decreased from 123 ppm to 121 ppm and the temperature remained constant at 72.0°F.

The Long Term test ran for 32 hrs. The average pumping rate was 1,165 gpm with 1.15 ft. of drawdown. The chlorides were all 120 ppm.

HERBERT H. MINAKAMI

Attach.

AHM:bw
cc: C. Lao
G. Hiu

JONATHAN SPRINGS EXPLORATORY WELL NO. 2052-12

Location : 1-6-05: 31
Elevation at ground : +30.7 ft.
Elevation at bottom of well: -120.3 ft.
Elevation at end of casing : -19.3 ft.
Diameter of casing : 13-13/16 in.
Head : 21.9 ft.
Drilling completed : May, 1981
Drilling Company : Roscoe-Moss
Date of Yield-Drawdown test: June 2, 1981

Time	Q (gpm)	Drawdown (ft.)	Chloride (ppm)	Temperature (°F)	Remarks
0945					Started pumping
0950	393	0.23			
1015	387	.23	123	72.0	
1030					Changed rate
1040	503	.34			
1100	517	.34	122	72.0	
1115					Changed rate
1120	623	.46			
1145	626	.46	122	72.0	
1200					Changed rate
1205	828	.57			
1230	823	.57	121	72.0	
1245					Changed rate
1250	1,010	.69			
1300	1,003	.69			
1330	1,017	.69	121	72.0	
1345					Changed rate
1350	1,136	.80			
1415	1,136	.80			
1430	1,095	.80	121	72.0	
1445					Stopped pumping
1446	0	0			

AHM:bw
6/16/81

JONATHAN SPRINGS EXPLORATORY WELL NO. 2052-12

Date of Long Term Pumping Test: June 3-6, 1981

Date Time	Q (gpm)	Drawdown (ft.)	Chloride (ppm)	Temperature (°F)	Remarks
6/3/81					
0700					Started pumping
0705	1,210	1.15			
0815	1,132	1.15		72.0	
1445	1,136	1.15	120	72.0	
1500					Stopped pumping (8 hrs.)
1501	0	.00			
6/4/81					
0815					Started pumping
0820	1,136	1.15			
0920					Stopped pumping
1020					Resumed pumping
1430	1,064	.92			
1500	1,136	1.15	120	72.0	
1515					Stopped pumping (6 hrs.)
1516	0	.00			
6/5/81					
0700					Started pumping
0705	1,111	1.15			
0800	1,172	1.15			
1000	1,128	1.15			
1530	1,132	1.15			
1645	1,136	1.15	120	72.0	
1700					Stopped pumping (10 hrs.)
1701	0	.00			
6/6/81					
1000					Started pumping
1005	1,136	1.15			
1100	1,176	1.15			
1630	1,176	1.15			
1745	1,181	1.15	120	72.0	
1800					Stopped pumping (8 hrs.)
1801	0	.00			

AHM:bw
6/16/81

XVII. ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE COMMENTS AND RESPONSES

XVII. 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.

Name	Date of Comments	Date of Response
FEDERAL AGENCIES		
Department of the Army, Corps of Engineers	11/15/84	11/27/84
Department of Interior, Fish and Wildlife Service	11/15/84	11/27/84
Department of Agriculture, Soil Conservation Service	11/21/84	--
Department of Defense, HQ Pearl Harbor	11/29/84	--
STATE AGENCIES		
Department of Health	11/14/84	11/23/84
Department of Accounting and General Services	11/16/84	--
UH Water Resources Research Center	11/21/84	11/29/84
Department of Land and Natural Resources	11/28/84	1/11/85
Department of Planning and Economic Development	11/27/84	12/11/84
Department of Transportation	12/05/84	
Environmental Center	12/07/84	1/10/85
Office of Environmental Quality Control	11/14/84	11/23/84
CITY & COUNTY AGENCIES		
Department of Transportation Services	10/29/84	--
Department of Public Works	10/29/84	11/14/84
Department of General Planning	10/30/84	11/09/84
Department of Parks and Recreation	11/27/84	12/06/84
Department of Land Utilization	11/28/84	12/04/84
UTILITY COMPANIES		
Hawaiian Electric Co., Inc.	11/16/84	11/29/84
OTHER ORGANIZATIONS		
Life of the Land	11/20/84	12/05/84
Native Hawaiian Legal Corporation	12/07/84	12/13/84

DEPARTMENT OF THE ARMY
PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

843020

November 15, 1984

P/E

Mr. Kazu Hayashida, Chairman
Board of Water Supply
City and County of Honolulu
630 S. Beretania St.
Honolulu, Hawaii 96813

Dear Mr. Hayashida:

Thank you for the opportunity to review and comment on the EIS Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu. The following comments are offered:

a. If any transmission lines are constructed in the waters of the United States, a Department of the Army permit may be required from the Corps of Engineers.

b. The report addresses flood hazards on pages IV-16 to IV-19 and on page VI-2. Flood zone designations for the proposed project sites have been designated Zone C or D, with the exception of Site T3, Kakaako District Transmission Line, located in Zone A4 (Enclosure 1).

Among the alternatives considered, only two sites are located in flood hazard areas. Alternatives for the Moanalua Caprock Well (Enclosures 2 and 3) are of Zone A designation (Enclosure 4). The Liliuokalani Gardens Caprock well site (Enclosure 5) along the bank of Nuuanu Stream (Enclosure 6) is located in Zone A.

A description of flood zone designations is included for your information.

Sincerely,

Thomas Ushijima
Acting Chief, Engineering Division

Enclosures

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

C0484-01

COPY

November 27, 1984

RECEIVED
DEC 3 1984
WILSON OKAMOTO & ASSOCIATES

Mr. Thomas Ushijima
Acting Chief
Engineering Division
Corps of Engineers
Pacific Ocean Division
Department of the Army
Fort Shafter, Hawaii 96858-5440

Dear Mr. Ushijima:

Subject: Your Letter of November 15, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comments, we offer the following:

1. A Department of the Army permit will be obtained before we perform work in the waters of the United States.

2. An explanation of the flood zone designations is given in Table 6 (p. IV-20).

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

842986

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307
NOV 15 1984

Mgr. cy 11-16 dc
AM
P/E

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
Honolulu, Hawaii 96843

Re: Environmental Impact Statement Preparation Notice, Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu, Hawaii

Dear Mr. Hayashida:

We have reviewed the referenced Preparation Notice and offer the following comments for your consideration.

The majority of the proposed well sites are in areas that have been extensively modified and affected by urban development. This reduces the potential for adverse impacts on endangered and endemic species. We concur with your determination that no endangered or threatened species occur at the proposed project sites.

The Preparation Notice identifies potential streamflow reductions caused by water development at the following sites:

	Project Site	Affected Stream
1. Site #10	Pukele Alluvial Well	Pukele Stream
2. Site #13	Manoa Park Alluvial Well	Manoa Stream
3. Site #16	Herring Springs	Moleka Stream
4. Site #17	Kahuawai Springs	Pauoa Stream
5. Site #18	Nuuanu Aerator Well	Nuuanu Stream
6. Site #19	Kunawai Springs Well or Diversion	Nuuanu Stream

Regarding the potential reductions in stream flows, the Service recommends that the following topics be addressed in the Draft Enivironmental Impact Statement:

a. Many of the above streams support populations of indigenous stream animals in their lower reaches. For example, the lower reaches of Nuuanu Stream support populations of the indigenous fishes Awaous stamineus, Stenogobius genivittatus, and Eleotris sandwicensis (Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams; Habitat Factors and Associated Biota, U.S. Fish and Wildlife Service, 1978). A reduction in flow may reduce the amount of habitat available for these animals. The BWS should determine the magnitude of the flow reduction for the projects that would affect existing perennial streams. This will aid in determining the effects a particular project will have on stream organisms.

b. The Preparation Notice states that Manoa Stream will be "monitored to detect and mitigate adverse effects." The DEIS should discuss the types of mitigation the BWS will undertake if flow reduction occurs in Manoa, Pauoa, and Nuuanu Streams due to proposed water development.

We appreciate this opportunity to comment.

Sincerely yours,

Ernest Kosaka

Ernest Kosaka
Project Leader
Office of Environmental Services

cc: DAR
DF&W
RO, FWS, Portland, OR (AHR)
EPA, San Francisco

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C1484-01

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

November 27, 1984

RECEIVED
DEC 3 1984
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 November 15, 1984, on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoir, Transmission Lines, and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comments, we offer the following:

1. A stream inventory on aquafauna will be included in the EIS.

2. The magnitude of any streamflow reduction can only be determined during long-term pumpage. However, we plan to monitor streamflow during the pumping test of the exploratory wells to determine the immediate effects, if any, of the wells on streamflows. We will also comply with the instream flow standards that the State may enact in the future for the Honolulu region. Furthermore, we will arrange for appropriate streamflow monitoring by the U. S. Geological Survey should we develop any of the proposed sources.

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CITY AND COUNTY OF HONOLULU

COPY

Mr. Ernest Kosaka
Page 2

November 27, 1984

3. We shall be working closely with your agency and the State's Department of Land and Natural Resources to determine the minimum flow needed to preserve the aquafauna in a particular stream. The EIS shall discuss the mitigative actions that may be taken if the well projects affect streamflow significantly.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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NOV 16 1 29 PM '84

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

842987

Leslie S. Matsubara
DIRECTOR OF HEALTH

In reply, please refer to:
EPHSD-88

November 14, 1984

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City & County of Honolulu
630 S. Beretania St.
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Subject: Request for Comments on Environmental Assessment for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for allowing us to review and comment on the subject environmental assessment.

Section 11-20-29 of Chapter 20, Title 11, Administrative Rules, requires all new sources of potable water serving public water systems to be approved by the Director of Health prior to their use to serve potable water. Such approval is based primarily upon the satisfactory submission of an engineering report which adequately addresses all concerns as set down in Section 11-20-29. The engineering report must be prepared by a registered professional engineer and bear his or her seal upon submittal.

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.

Sincerely,

MELVIN K. KOIZUMI
Deputy Director for
Environmental Health

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

November 23, 1984

RECEIVED
NOV 26 1984

Mr. Melvin K. Koizumi
Deputy Director for
Environmental Health
Department of Health
State of Hawaii
P. O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Koizumi:

Subject: Your Letter of November 14, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

An engineering report for each new well will be submitted for approval in accordance with Section 11-20-29 of Chapter 20, Title 11.

We also acknowledge your right to impose environmental restrictions on each project when the plans are submitted for your review.

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

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

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Nov 23 12 00 '84

University of Hawaii at Manoa

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

21 November 1984

P/E

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City & County of Honolulu
630 S. Beretania Street
Honolulu, HI 96843

Dear Mr. Hayashida:

SUBJECT: Environmental Impact Statement Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu, September 1984

We have reviewed the subject EISPN and offer the following comments. We have serious misgivings about "overall" EIS's because of their generalized nature which is lacking in specific and detailed information on which to base our analysis. In this instance where many of the proposed projects are relatively small and within areas that are presently urbanized, their environmental impact is acknowledged to be relatively small. Therefore, an overall approach is satisfactory. However, in those projects where new wells are to be installed, supplemental EIS's should be prepared to address matters such as its effect on the groundwater.

Thank you for the opportunity to comment. This material was reviewed by WRRC personnel.

Sincerely,

Edwin T. Murabayashi

Edwin T. Murabayashi
EIS Coordinator

ETM:jm

cc: Env. Center

AN EQUAL OPPORTUNITY EMPLOYER

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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07424-01

November 29, 1984

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DEC 04 1984
WILSON OKAMOTO & ASSOCIATES

Mr. Edwin T. Murabayashi
Water Resources Research Center
University of Hawaii at Manoa
Holmes Hall 283
2540 Dole Street
Honolulu, Hawaii 96822

Dear Mr. Murabayashi:

Subject: Your Letter of November 21, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comment, Supplemental EIS's will be prepared, as necessary, for our projects except those that are already addressed in accepted EIS's or have had Negative Declarations published in the Office of Environmental Quality Control Bulletin.

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

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

843291

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

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

DEC 28 1984

Mgr. cy 1-2
P/E

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:

This is to add to our letter of November 27, 1984, regarding the environmental assessment for developing the water system for the Honolulu region. We have a number of concerns to express.

Archaeology

This document does not assess the impact the projects will have on archaeological resources. The assessment should refer to any archaeological surveys which have been done in the project areas. If no surveys have been made, the assessment should explain the reasons. The potential for impacts to subsurface deposits should also be assessed.

The proposal to consult with the State Historic Preservation Office when archaeological resources are found during construction should be more explicit.

The assessment should identify the kinds of archaeological resources that will trigger consultation with the State Historic Preservation Officer, such as the following: human bones, stone artifacts, shell midden, charcoal deposits, stone walls, abandoned lo'i, petroglyphs. The assessment should indicate the proposed mitigation measures to be taken if the State Historic Preservation Officer recommends that the find is significant, such as preserving the site, salvage excavations to be sponsored by the Board of Water Supply, or destruction without further study.

Forestry

A fire contingency plan is requested for review by this office. A blanket fire contingency plan to cover all sites will suffice.

JAN 3 1 02 PM '85

Sincerely,

SUSUMU ONO
Chairperson
and
State Historic Preservation Officer

C2484-01

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 11, 1985

RECEIVED
JAN 1 6 1985
WILSON OKAMOTO & ASSOCIATES

Mr. Susumu Ono, Chairperson
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

Subject: Your Letter of December 28, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for your comments on our proposed water system improvement projects. Your letter will be appended to the EIS.

We offer the following responses to your comments.

1. An assessment of the impact on archaeological resources will cover either surveys already done or reasons why surveys were not done, as well as the potential impact on subsurface deposits.

2. Procedures to initiate consultation with the State Historic Preservation Office will be made more explicit in the EIS. This will include a list of archaeological findings that will trigger the notification of the Historic Preservation Officer.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

Mitigative measures for the projects will be outlined in the Draft EIS should any archaeological findings prove significant.

3. A blanket contingency plan will be submitted for your approval.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

KAMAMALU BUILDING, 250 SOUTH KING ST., HONOLULU, HAWAII
MAILING ADDRESS: P.O. BOX 2359, HONOLULU, HAWAII 96804 • TELEX: 7430250 HIDED

GEORGE R. ARIYOSHI, Governor
KENT M. KEITH, Director
MURRAY E. TOWILL, Deputy Director
LINDA KAPUNIAI ROSEHILL, Deputy Director

DIVISIONS:
Business and Industry Development Division
Energy Division
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Research and Economic Analysis Division

OFFICES:
Director's Office
Administrative Services Office
Information Office

843114

AM
P/E

Ref. No. P-678

November 27, 1984

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

Dear Mr. Hayashida:

Subject: EIS Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

We have reviewed the subject document and offer the following comments with respect to the relevant objectives and policies of the Hawaii Coastal Zone Management (CZM) Program.

Coastal Ecosystems

CZM Policy: Minimize disruption or degradation of coastal water ecosystems by regulating stream diversions, channelization, and similar uses, recognizing competing water needs.

Site No. 13 - Manoa Park Alluvial Well: We note in the section on potential impacts that if this particular well is developed, there will be a possible reduction in the flow of the Manoa Stream. Although the flow will be monitored to mitigate adverse impacts, it is not specified how, and to what extent, this will be accomplished.

Site No. 14 - Waaloa Well: Waaloa Stream is a tributary of Manoa Stream. It would appear that the use of the Waaloa Well in conjunction with the development of the Manoa Park Alluvial Well would further reduce the flow of the Manoa Stream.

In the last paragraph of Section 6b on Pg. IV-16, Manoa Stream, rather than Makiki Stream, should be described as "Limited Consumptive" (see Table 4 on Pg. IV-17).

We appreciate the opportunity to comment on this document.

Very truly yours,

Kent M. Keith

Kent M. Keith

q.

C2484-01

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

December 11, 1984

RECEIVED
DEC 19 1984
WILSON OKAMOTO & ASSOCIATES

Mr. Kent M. Keith, Director
Department of Planning and
Economic Development
State of Hawaii
P. O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Keith:

Subject: Your Letter of November 27, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comments on the Manoa Park Alluvial Well and Waaloa Well, we offer the following:

1. The magnitude of any streamflow reduction can only be determined during long-term pumpage. However, we plan to monitor streamflow during the pumping test of the exploratory wells to determine the immediate effects, if any, of the wells on streamflows. We will also comply with the instream flow standards that the State may enact in the future for the Honolulu region. Furthermore, we will arrange for appropriate streamflow monitoring by the U. S. Geological Survey should we develop any of the proposed sources.

   We shall be working closely with the U. S. Fish and Wildlife Service and the State's Department of Land and Natural Resources to determine the minimum flow needed to preserve the aquafauna in a particular stream. The EIS shall discuss the mitigative actions that may be taken if the well projects affect streamflow significantly.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

December 11, 1984

2. We will correct page IV-6 to indicate that Manoa Stream is categorized as "Limited Consumptive" and not Hakiki Stream.

Because the Honolulu Groundwater Basin is under the jurisdiction of the State Board of Land and Natural Resources, we shall be complying with their requirements on any well projects that we are allowed to undertake. The requirements should include those mentioned in your letter.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates

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Nov 14 2 55 PM '84

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

Mgr. 11-15
P/E

November 7, 1984

PN:0036

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

Dear Mr. Hayashida:

Preparation Notice
Environmental Impact Statement
Regional Development of Wells, Reservoirs,
Transmission Lines, and Appurtenances in Honolulu
Honolulu, Oahu

In accordance with our usual review procedures for projects at the EIS preparation stage we have conducted an in-house review of the above cited document. I offer the following comments for your consideration in preparing the draft EIS.

Satisfaction of EIS-system requirements

The preparation of an "umbrella" EIS for a group of water development projects is highly appropriate, as we have noted earlier, because there are commonalities among the projects, among the environments in which they will be carried out, and particularly among their environmental impacts, that are much more effectively addressed in an "umbrella" EIS than in individual EIS's for the various projects.

However, as we have also noted earlier, the appropriateness of acceptance of an "umbrella" EIS for a large number of projects is contingent upon the recognition in it that supplementary EIS's will be required for some of the projects and may be required for others, and we applaud the recognition in this document that supplementary EIS's may be required (p. I-2).

The document covers 21 potable-water-well projects, 4 reservoir and/or transmission-main projects, and 18 potential non-potable-water-well projects. For one of the potable-water-well projects (Wailupe Well I) an EIS has already been accepted. Negative declarations have been issued for one of the transmission main projects, for four of the potable-water-well projects, and for two potable-water exploration projects (p. I-2). We note that it is recognized that one of the potable-water-well projects for which a negative declaration has been filed, Manoa Well I, if carried out, might affect the yields at the existing BWS Kaimuki Station (p. 30). The effect, if there were one, would undoubtedly be

a reduction in yield. Because such an effect would have to be considered a significant impact, we consider the negative impact quite improperly issued on this project.

Table 1 (p. III-9) indicates that some of the projects will not be implemented until 1989. With the passage of time, the plans for the projects may change, the environments in which they will be carried out are likely to change, and the understanding of their probable environmental impacts is very likely to be improved. It is for these reasons, and also because it seems quite impracticable to discuss in adequate detail the environmental impacts of all of the projects in a single EIS, that we applaud the recognition of the BWS that supplementary environmental assessments and even supplementary EIS's are likely to be required for some of the projects.

We strongly urge that, in so far as possible, those projects for which supplementary EIS"s will be required be identified in the "umbrella" EIS, and, further, that it be recognized that need may be found with the passage of time for more extensive assessments and even EIS's for some projects not so identified now.

Sustainable yield and sustainable capacity

Introduction

No impacts of a water development project are of greater importance than its impacts on the water resource developed and on the uses that are or may be made of the water or derived from the resource. The ability of a resource to meet demands for water derived from it is referred to as its sustainable yield.

We know that there are water-resource experts on the BWS staff who are well aware, not only of the concept of sustainable yield, but of its implication for water development. However, the definitions given in the document and the ways in which it is used suggest that the authors of the document do not fully understand either the concept, its implications, or the limitation of sustainable yield estimates. For these reasons, we preface our discussion of specific references to the concept in the document and recommendations as usage in the expansion of the document into an EIS by a more general discussion of the concept.

The document also introduces the term sustainable capacity with reference to individual development from a water resource. The definition and use of this term also merits discussion.

Definitions of sustainable yield

Although the concept of sustainable yield may be indicated adequately by various definitions, neither the explicit definition nor the implicit definition in the document is satisfactory. The explicit definition (p. XV-2) is: "the quantity of water that may be withdrawn from a specific aquifer, at a maximum rate that will not degrade the water body." The implicit definition is in the statement (p. V-13) that sustainable yields "represent the amount of water that may be developed without degrading the resource (i.e., increasing sea water intrusion into the aquifer)."

Should use DLNR's definition of sustainable limit, since they use it to regulate. (?)

The words "quantity" and "amount" usually refer to volumes or to masses or weights. A sustainable yield, however, is a draft, flow, or discharge rate (volume per unit time). In unlimited time there is no limit to the quantity on amount (volume) of water that may be drawn from a particular resource.

A sustainable yield does represent a maximum. It represents the upper limit of the average draft rate that is indefinitely sustainable under certain conditions. One condition as to that rate appropriately refers to degradation of the resource, but it cannot appropriately be phrased as complete avoidance of degradation; and a second condition that should appropriately be included refers to the means of development.

We suggest that sustainable yield be defined more or less as follows: "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." Our reasons for suggesting this definition may best be indicated by discussion of the application of the concept of sustainable yield to Herzberg lenses that are the major sources of Honolulu's present potable water supply and the additional supplies proposed for development.

Sustainable yield of a Herzberg lens

The water of a spring fed by a Herzberg lens may be developed without effect on the lens. However, no direct draft on the lens can be made without reductions in head, in storage, in the depths to various isohaline surfaces in the lens, and in the discharges of any springs fed by the lens and the flows to other groundwater bodies to which the lens may be tributary. With possible rare exceptions all of these effects are detrimental, and the detriments associated with several are likely to be significant even if outweighed by the benefit produced by the draft. It is for this reason that we qualify the detrimental effects in the definition of sustainable yield as those "undue".

The significance of the detriments depends on the uses that are made of the water that is both yielded naturally by the Herzberg lens in the form of spring flows or drawn from wells, and on the temporal requirements and salinity tolerances associated with these uses. A sustainable yield estimate should, therefore, be accompanied by a statement of the water uses assumed and on the requirements associated with those uses.

The storage in a Herzberg lens, which may be equivalent to many years of sustainable yield, is one of the most valuable characteristics of the lens, permitting draft rates in excess of the sustainable yield during periods of high demand, low recharge, or both, so long as there is compensation in the form of draft rates less than the sustainable yield during other periods. It is for this reason that sustainable yield is defined in terms of an average draft rate. In actuality an estimate of the sustainable yield should be accompanied by a statement of the temporal pattern of draft assumed in the estimates.

The effects of decreased depths to isohaline surfaces in a Herzberg lens on the salinity of water produced by wells depends on the nature, number, and spacing of wells. A greater increase in salinity results, for example, from the use of deep wells at a few sites than from the use of shallower wells more widely dispersed, or from the use of Maui-type wells than from the use of deep drilled wells. However, in general, the cost of a well system increases with its effectiveness in minimizing the salinity of the water it produces. What cost of development is justified depends, of course, on the value of the water developed. The technology available for development, the costs of development, and the value of the water are all variable with time, and it is for this reason that the criterion of use of a practicable technology is introduced in the definition of sustainable yield.

The sustainable yield of a Herzberg lens cannot be estimated except on the basis of estimates of the rates of delivery of water to it not only by direct recharge but through flow from other aquifers that may be tributary to it; and on the basis of estimates of the rates of outflow from it in the form of necessary inputs to other aquifers to which it may be tributary, spring flows utilized by development or contributory to "in-stream" uses, and underflows necesary to flush the more saline waters from the deeper parts of the lens. Hence an estimate of the sustainable yield of a lens should be accompanied by a statement of the inflow and outflow rates whose necessary continuance is assumed.

No method of estimation of the sustainable yield of a Herzberg lens is capable of producing an exact value, even for a particular set of assumptions as to temporal draft pattern, salinity tolerance, inflow and outflow requirement, and technology. In general, only very rough estimates are possible before development begins, and the reliability of possible estimates increases as the draft from the lens approaches the sustainable yield. Hence it is highly desirable to accompany any sustainable yield estimate with an estimate of the range of uncertainty in estimation.

An estimate of the sustainable yield of a system of interconnected water resources is of greater significance than an estimate of the sustainable yield of an individual resource within the system.

Definition of Sustainable Capacity

Sustainable capacity is defined (p. XV-2) as "the quantity of water that may be withdrawn from a specific source site, such as a well or shaft, at a maximum rate that will not unduly impair source utility." It is also referred to (p. VIII-2) as the "amount of water which could be withdrawn from a specific source without adverse impacts upon the water body it is tapping."

As in the case of sustainable yield, definition in terms of a quantity of amount rather than a draft rate is inappropriate and we assume the definition in terms of draft rate is intended.

We also assume that "sustainable" capacity is not intended to be a maximum instantaneous rate but, as in the case of a "sustainable yield" the upper limit to an average rate. We assume, further, that exact equivalence between the sustainable capacity of a well and its existing pump capacity is not intended. The two definitions suggest reference to three different features:

a) A specific development such as a drilled well (or a cluster of drilled wells) or a shaft (Maui-type well);

b) The site of such a development;

c) The water body tapped by such a development (an aquifer, i.e. water resource).

At places throughout the document reviewed, there are statements implying recognition of the concept of sustainable yield, it is mentioned explicitly in a few discussions, and sustainable yield is defined explicitly and implicitly on p. v-13, and the sustainable yields are listed in Table 17 (p. v-15) for the subareas in which the proposed water well projects are proposed.

We also assume that by a capacity that is "sustainable" is not meant either a present pump capacity or a maximum possible instantaneous rate of draft, and that the "maximum rate" intended in the definition is, as in the case of sustainable yield, an upper limit to an average rate.

However, in the two definitions there seem to be references to three different features to which a sustainable capacity applies or by which it is defined:

1) A particular existing development such as a well (or well cluster) or a shaft (a Maui-type well);

2) The site of such a development; and

3) The water body tapped by such a development (an aquifer or water resource).

By impairment of source utility, is meant, we assume, not impairment of a development but impairment of the characteristics of the water it produces, for example the salinity. But impairment of "source utility" seems restricted to an adverse effect on the water produced by the particular development, whereas "adverse impact on the water body it taps" seems to imply adverse effects on the water produced by other developments tapping the same water body.

Whether a sustainable capacity applies to a particular existing development or to the site of such a development, it cannot be considered independent of drafts made on other developments tapping the same aquifer. However, whether the drafts of the other developments remain constant or changed, the sustainable capacity, if it applies to the rate of an existing development rather than the development itself, might be increased for example by adding new wells or by increasing the length of tunnel of a Maui-type well.

Use of the Concepts of
Sustainable Yield and Sustainable Capacity

Estimates of sustainable capacities of 13 pumped and gravity-flow water developments (or their sites) are presented in Table 16 (p. IV-50), but their significance is uncertain because of the uncertainty of the meaning of the term "sustainable capacity". The significance of totals shown in the table is uncertain for the additional reason that no sustainable capacities are listed for the Kaimuki Station, the Beretania Station, or the Moanalua wells.

In discussing the potential for increased pumpage at existing BWS sources (p. VIII-2), the document states that "Limitations in allowable draft, set by the Board of Land and Natural Resources (BLNR) has constrained BWS water development below BWS' estimates of sustainable capacity." It is appropriate that the BLNR limit the total of the drafts permitted by all parties from a particular water body to the sustainable yield of that body.

However, the following comparisons among sustainable yields, drafts allowed by BLNR, and sustainable capacities of existing BWS sources for the sites of those sources, from table 18 (p. VIII-4) indicate excesses of sustainable yields over total allowed drafts in both the Moanalua-Kaimuki subarea and the Waialae-Hawaii Kai subarea. We recognize that the BWS is not responsible for BLNR limits on draft. However, in so far as possible the EIS should explain the differences between the BLNR limit and the sustainable yields.

	Subarea	
	Waialae-Hawaii Kai	Moanalua-Kaimuki
Sustainable yield	5.25	55.0
Total allowed draft	1.5	43.4
Allowed BWS draft	1.23	35.1
BWS sustainable capacity	1.25	39.0

In the discussion of the potential for increased pumpage at existing BWS sources (p. VIII-2) it is also stated that: "Because the pumping capacity at existing BWS source facilities exceed the sustainable yield, it is possible to increase the amount of developable water without development of new water source sites. This scenario is dependent upon increases in the amount of water DLNR allows BWS to draft at specific source sites, which could be accomplished through issuance of water withdrawal and water use permits, by the BLNR." It would, of course, be physically feasible to increase the draft from an existing development to the limit of pump capacities. However, no matter what excess pumping capacity the BWS may have, it would be irresponsible for the BLNR to allow the average total draft from an aquifer or set of aquifers to exceed the sustainable yield of that aquifer or set of aquifers.

In the discussion of the water quality impacts of the proposed development (p. VI-2), it is stated that "The quality of groundwater resources will not be adversely affected by the proposed improvements as the increased draft will be within the DLNR sustainable yield limits." As we have pointed out earlier, any increase in draft from a Herzberg lens will result in a decrease in head and in the depths to particular isohaline surfaces, and hence to increase in the salinity of the water developed by wells penetrating to those isohaline surfaces. The sustainable yield estimates presumably represent judgements that average drafts, if kept below the estimated values, will not result in undue increases in salinity or other undue detriments—not that there will be no increases in salinity.

Hydrology

Sustainable yields and sustainable capacities, although expressed in hydraulic units (volume per unit time) are neither hydraulic nor hydrologic values. We have the following minor comment on statements in the document that relate to hydrology.

It is stated in the discussion of basal (Herzberg lens) hydrology (p. IV-4, para. 3, line 9) that "this ratio of 1 foot of head to 40 feet of depth of the half-seawater salinity surface) is known as the Ghyben-Herzberg principle." The ratio is not the principle (a special case of the Archimedes principle applying to floating bodies) but derives from it.

Later in the same discussion (p. IV-5, para. 1, line 9) it is stated that there are exceptions to the Ghyben-Herzberg principle, for example in coastal areas such as Honolulu where there is a "caprock". The effect of the caprock, is merely to increase the head and depth of fresh water in a Herzberg lens and does not represent an exception to the principle.

There is a practically universal exception to the Herzberg principle when it is expressed such a way as to suggest that the ratio applies in the vertical, which would be strictly valid only in the static case. An expression indicating that the ratio actually applies along a normal to the hydraulic gradient would be valid in the steady-state dynamic case. Expression indicating that the ratio applies only to asymptote approached with time would be valid for the non-steady-state dynamic case. Even these changes in expression might, however, be considered merely modifications of the Herzberg principle.

We hope you will find these comments helpful in your preparation of the DEIS.

Yours truly,

Doak C. Cox
Director

cc: OEQC
Ed Murabayashi
Jacquelin Miller

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

C2481-01

January 10, 1985

RECEIVED
JAN 14 1985
WILSON OKAMOTO & ASSOCIATES

Dr. Doak C. Cox, Director
Environmental Center
University of Hawaii at Manoa
2550 Campus Road, Crawford 317
Honolulu, Hawaii 96822

Dear Dr. Cox:

Subject: Your Letter of November 7, 1984, on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment on our proposed water system improvement projects. Your letter will be appended to the EIS.

We shall prepare, if necessary, supplementary EIS's for those individual projects which we definitely plan to undertake.

In response to your comments, we offer the following:

1. "Sustainable yield" will be redefined to make it more concise with reference to flow, upper limit characteristics, effects on the aquifer, and limitations related to development capabilities. (re: E.I.S. p. XV-2, p. V-13)

2. Ghyben-Herzberg lens sustainable yield estimates shall be accompanied by a statement noting its temporal draft pattern.

3. The estimated inflow and outflow rates of the Ghyben-Herzberg lens will be included to provide the basis of the sustainable yield estimate.

4. Since sustainable yield estimates change and become more exact as development progresses, a range of uncertainty will be provided.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

January 10, 1985

5. "Sustainable capacity" will be redefined to make it more concise with reference to flow, upper limit characteristics, effects on the source, and pump capacity. (re: p XV-2, p. VIII-2)

6. The information given in Table 16, page IV-50 will be reevaluated in light of a redefined "sustainable capacity".

7. An explanation for the differences between DLNR limits and sustainable yields will be included in the E.I.S. (re: p. VIII-4, Table 18).

8. A qualifying statement will acknowledge potential pumpage increases will be made only in accordance with DLNR limits (re: p. VIII-2).

9. It will be noted that sustainable yield draft effects on the Ghyben-Herzberg lens will not cause undue increases in salinity or other undue detriments. (re: p. VI-2).

10. The Ghyben-Herzberg principle will be redefined and the resulting fresh water head to depth ratio will be examined for both the steady-state and non-steady-state dynamic cases. Based upon the redefinition, the caprock effect will be shown as an extension rather than an exception to that principle. (re: p. IV-4, para. 3, line 9; p. IV-5, para. 1, line 9).

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

GEORGE R. ARIYOSHI
GOVERNOR

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Nov 16 1 29 PM '84

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STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
550 HALEKAUWILA STREET
ROOM 301
HONOLULU, HAWAII 96813

LETITIA N. UYEHARA
DIRECTOR

TELEPHONE NO.
548-6915

Mgr. - cy 11-16 dc
AM
P/E

November 14, 1984

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: Environmental Impact Statement Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

We wish to confirm our understanding that this environmental impact statement is being prepared to cover the cumulative effects of water development within this region, and supplemental environmental impact statements with greater detail will be prepared as individual wells are developed.

Our concern is that it is difficult to assess specific impacts without detailed information on individual projects.

Sincerely,

Letitia N. Uyehara

Letitia N. Uyehara
Director

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

C21/84

November 23, 1984

RECEIVED
NOV 29 1984
WILSON OKAMOTO & ASSOCIATES

Ms. Letitia N. Uyehara
Director
Office of Environmental
Quality Control
State of Hawaii
Room 301
550 Halekauwila Street
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Your Letter of November 14, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

We will prepare supplemental environmental impact statements, as necessary, for projects we undertake except for those that are already addressed in accepted EIS's or have had Negative Declarations published in your Office of Environmental Quality Control Bulletin.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

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

EILEEN R. ANDERSON
MAYOR

MICHAEL J. CHUN, Ph.D.
DIRECTOR AND CHIEF ENGINEER

MAURICE H. KAYA
DEPUTY DIRECTOR

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October 29, 1984

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NOV 21 1984
VTN PACIFIC

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

Dear Mr. Hayashida:

Re: EIS Preparation Notice for Regional Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu, Hawaii

We are responding to your request for comments on the proposed Honolulu regional water development plan.

1. Sewage System (page IV-52). The average wastewater flow received at the Sand Island Treatment Plant during 1983 was 72 mgd.

2. Exfiltration (page IV-53). Sewer lines laid above the ground water table are tested for leaks or subjected to an air pressure test during construction. Lines which fail the exfiltration test are repaired or reconnected to the limits specified in the Standard Specifications. Sewer lines laid below the ground water table are subjected to the infiltration (leakage) test to minimize inflow of ground water into the sewer system.

3. Cesspool Service Areas (page IV-56. Most of the areas of the Honolulu water use district are served by municipal sewers except for the following locations:

a. Uppermost portion of Aiea Heights
b. Upper Nuuanu Valley (off Nuuanu Pali Drive)
c. Makiki Heights
d. Mapunapuna
e. Portion of Diamond Head
f. Portion of Koko Head

According to the 208 Plan for the City and County, there were 4,491 cesspools in the Honolulu District in 1978.

4. Kapalama Canal (page VII-54). Kapalama Canal from King Street to Nimitz Highway has been programmed for improvements. The conceptual development plan will provide picnic areas and lookouts, a mini-park, landings for handcarried boats, vertical canal walls to optimize areas for vegetation, fishing platforms, a pedestrian promenade, and landscaping along Kohou Street. The proposed project has been deferred for a number of years due to lack of funds.

5. Dillingham Boulevard Transmission Main (pages VII-57 to 59). Construction plans for this project should be coordinated with the Divisions of Engineering and Wastewater Management.

6. Many of the water resources being proposed for development in the Honolulu water district will have capacity less than 0.5 mgd. Are small resources being developed accordingly to serve cost-effective criteria which include amortization of capital costs, and operation and maintenance costs? Can we expect higher water rates because of the proposed projects?

7. Kuliouou Well (page XVI-7). A more accurate cost of water per 1,000 gallons should include amortization of capital costs for the recommended system.

Me ke aloha pumehana,

for MICHAEL J. CHUN
Director and Chief Engineer

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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NOV 21 1984
VTN PACIFIC

November 14, 1984

TO: MICHAEL J. CHUN, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

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

SUBJECT: YOUR LETTER OF OCTOBER 29, 1984 ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE FOR THE REGIONAL DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES AND APPURTENANCES IN HONOLULU

Thank you for reviewing the EIS Preparation Notice for our proposed water system projects in the Honolulu Water District. Your letter will be appended to the Draft EIS.

In response to your comments, we offer the following:

1. We will update the average wastewater flow received at the Sand Island Treatment Plant from 67 mgd in 1977 to 72 mgd in 1983.

2. Your exfiltration/infiltration leakage test requirements will be incorporated in the text of the Draft EIS.

3. The number of cesspools in the Honolulu District in 1978 and the areas not served by the municipal sewer system will be noted in the Draft EIS.

4. Your proposed improvement plans for Kapalama Canal will be noted in the Draft EIS.

5. Construction plans for the Dillingham Boulevard Transmission Main will be coordinated with your Engineering Division and Wastewater Management Division.

6. Many of the proposed sources listed in the environmental document are conceptual. Rough cost estimates are made to determine the economical feasibility to consider pursuing the construction of the facility. Because the Board relies primarily on the income received from water revenues, any increase in operational costs would have to be made up by increasing revenues.

7. We agree that a more accurate cost per thousand gallons may be obtained by including the amortized capital costs. However, the cost differential would be small.

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

L.G. Rathburn
For KAZU HAYASHIDA
Manager and Chief Engineer

cc: VTN Pacific, Inc.

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

EILEEN R. ANDERSON
MAYOR

WILLARD T. CHOW
CHIEF PLANNING OFFICER

RALPH PORTMORE
DEPUTY CHIEF PLANNING OFFICER

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P/E

DGP10/84-3833

October 30, 1984

MEMORANDUM

TO: Mr. Kazu Hayashida, Manager and Chief Engineer
Board of Water Supply

VIA: Mr. Andrew I. T. Chang, Managing Director

SUBJECT: Environmental Impact Statement Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

We agree with the determination that the development of the proposed water facility improvements warrants the preparation of an Environmental Impact Statement for the reasons stated on page II-1.

Ralph Kawamoto
RALPH KAWAMOTO
Planner

APPROVED:

WILLARD T. CHOW

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

C2484.01

November 9, 1984

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NOV 15 1984
WILSON OKAMOTO & ASSOCIATES

TO: WILLARD T. CHOW, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

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

SUBJECT: YOUR MEMORANDUM OF OCTOBER 30, 1984 ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE FOR THE REGIONAL DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES, AND APPURTENANCES IN HONOLULU

Thank you for your comments on the environmental document for our proposed water system improvement projects. Your memorandum will be appended to the Draft EIS.

If you have any questions, please call Lawrence Whang at extension 6138.

L.G. Rathburn
For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates

DEPARTMENT OF PARKS AND RECREATION

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

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EILEEN R. ANDERSON
MAYOR

EMIKO I. KUDO
DIRECTOR

SAM L. CARL
DEPUTY DIRECTOR

OSCAR K. ASAHINA
EXECUTIVE ASSISTANT

P/E

November 27, 1984

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

FROM: EMIKO I. KUDO

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
REGIONAL DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION
LINES AND APPURTENANCES IN HONOLULU

Thank you for the opportunity to comment on your environmental impact statement preparation notice for the regional development of water resources in Honolulu. Since proposed wells are sited in several parks under our jurisdiction, namely, Liliuokalani Gardens, Thomas Square, Kunawai Springs, Manoa Field and Jonathan Springs (Loi Kalo Botanic Garden), we hope to be kept informed of details of the proposed actions.

Emiko I. Kudo

(Mrs.) EMIKO I. KUDO, Director

EIK:vc

December 6, 1984

TO: EMIKO I. KUDO, DIRECTOR
DEPARTMENT OF PARKS AND RECREATION

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

SUBJECT: YOUR MEMORANDUM OF NOVEMBER 27, 1984, ON THE ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE FOR THE REGIONAL DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES AND APPURTENANCES IN HONOLULU

Thank you for reviewing the environmental assessment on our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comment, we will coordinate the plans for projects proposed in City parks with your department.

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

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto (with incoming letter)

MHS:ja
cc: K. Hayashida
L. Whang

84-3107

DOCUMENT CAPTURED AS RECEIVED

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

EILEEN R. ANDERSON
MAYOR

MICHAEL M. McELROY
DIRECTOR

ROBERT B. JONES
DEPUTY DIRECTOR

843081

LU10/84-5342(JDN)

November 28, 1984

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P/E

MEMORANDUM

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

FROM : MICHAEL M. McELROY, DIRECTOR

SUBJECT : ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN) FOR THE REGIONAL DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES, AND APPURTENANCES IN HONOLULU

We have reviewed the subject EISPN and find that it addresses the principal areas of concern. There is one item regarding the Special Management Area (SMA) (page V-12) that needs clarification. Specifically, the Downtown Subarea Site No. T3 - Kakaako District Transmission Main (p. VII-49) may involve the SMA. The SMA in this area is mauka from the centerline of Ala Moana Boulevard. Any development in this area will require SMA approval.

Please contact John Nakagawa of our staff at 523-4648 if there are any questions.

Michael M. McElroy

MICHAEL M. McELROY
Director of Land Utilization

MMM:sl

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MAR 0 6 1985
WILSON OKAMOTO & ASSOCIATES

December 4, 1984

TO: MICHAEL M. McELROY, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

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

SUBJECT: YOUR MEMORANDUM OF NOVEMBER 28, 1984, ON THE EIS PREPARATION NOTICE FOR THE REGIONAL DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES, AND APPURTENANCES IN HONOLULU

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comment on the Special Management Area (SMA), we will coordinate our plans on the Kakaako District Transmission Main with your department and will apply for a SMA Permit, if it is required.

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

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto (with incoming letter)

MHS:ja
cc: K. Hayashida
L. Whang

84-3081

HAWAIIAN ELECTRIC COMPANY, INC. • PO BOX 2750 • HONOLULU, HAWAII 96840

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NV/G

HEI

Brenner Munger, Ph.D., P.E.
Manager
Environmental Department
(808) 548-6880

November 16, 1984

Mgr.
AM
P/E

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

Dear Mr. Hayashida:

Subject: Environmental Impact Statement Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

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

1. The subject Preparation Notice does not address the HECO Transmission circuits in the areas of proposed wells nor does it address electrical facilities required to provide service to the wells.

2. Many of the proposed wells are located within conservation and preservation districts. Any overhead or underground power lines through the conservation district may require a separate EIS if not addressed in this EIS. It is HECO's position that it is the developer's responsibility to provide the necessary new easements as well as submit appropriate CDUA's on HECO's behalf.

Thank you for the opportunity to comment on this document.

Sincerely,

Brenner Munger

Brenner Munger, Ph.D., P.E.
Manager, Environmental Department

SLC:cal

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

November 29, 1984

Dr. Brenner Munger, Manager
Environmental Department
Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96840

Dear Dr. Munger:

Subject: Your Letter of November 16, 1984 on the Environmental Impact Statement (EIS) Preparation Notice for the Regional Development of Wells, Reservoirs, Transmission Lines, and Appurtenances in Honolulu

Thank you for reviewing the environmental assessment for our proposed water system improvement projects. Your letter will be appended to the EIS.

In response to your comments, we offer the following:

1. The EIS reflects our long range planning program. Some of the proposed projects are conceptive; therefore, it would not be feasible to fully describe each site at this time because no decision has yet been made by the Board on whether it would be feasible to proceed with the projects.

   Supplemental EIS's will be prepared, as necessary, for our projects except for those that are already addressed in accepted EIS's or have had Negative Declarations published in the Office of Environmental Quality Control Bulletin.

   The HECO transmission circuits in the area and other electrical facilities needed to provide service to the well will be addressed, as required, in the Supplemental EIS or Environmental Impact Assessment for projects undertaken.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

2. We will provide the necessary easements for overhead or underground power lines needed and include the construction of electrical services in our Conservation District Use Application submittals to the Department of Land and Natural Resources, State of Hawaii, for our proposed facilities in the Conservation District.

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

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto

Whang

Native Hawaiian Legal Corporation

1164 BISHOP STREET, SUITE 1102, HONOLULU, HAWAII 96813 TELEPHONE (808) 521-2302

December 7, 1984

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

Re: Request for Consultation

Dear Mr. Whang:

As the legal representative for the Waianae Land Use Concerns Committee and Na Opio Aloha Aina, and pursuant to the notice contained in the OEQC Bulletin of November 23, 1984, please list this office as a consulting party during the preparation of your Environmental Impact Statement of the Honolulu Wells, Reservoirs, and Transmission Lines and Appurtenances the Board of Water Supply proposes to develop.

Should there be any questions, please feel free to call me.

Sincerely,

ALAN T. MURAKAMI
Staff Attorney

ATM:mb

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BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

December 13, 1984

RECEIVED
DEC 19 1984
WILSON OKAMOTO & ASSOCIATES

Mr. Alan T. Murakami
Native Hawaiian Legal
 Corporation
Suite 1102
1164 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Murakami:

Subject: Your Letter of December 7, 1984 on the Environmental Impact Statement Notice for the Regional Development of Wells, Reservoirs, <u>Transmission Lines, and Appurtenances in Honolulu</u>

We have added your organization to our consulted parties list. Enclosed is a copy of the environmental assessment for your review and comments.

Should you have any comments, we would appreciate receiving them by January 15, 1985.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Enclosure

cc: Wilson Okamoto

C2484-01

LIFE OF THE LAND

Board of Water Supply
City and County of Honolulu
630 South Beretania
Honolulu, Hawaii 96843
Attention: Mr. Larry Whang

RECEIVED

November 20, 1984

WILSON OKAMOTO & ASSOCIATES

Gentlemen:

Subject: Regional EIS for Honolulu District Water System Improvements

We wish to be a consulted party for the subject EIS. Please send us copies of the Draft EIS and Revised EIS when they are completed.

Unfortunately, the EIS Preparation Notice you sent us titled "Regional Environmental Impact Assessment for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii" leaves much to be desired. Your consultants have produced illegible graphics, reams of paper, irrelevant facts, and some astonishing theories about how wells affect or do not affect stream flow.

Perched water may account for some of the flow of perennial leeward Oahu streams, but most of their dry-weather flow stems from leakage and overflow of dike impounded ground water. Hence, to evaluate the potential impacts of proposed new BWS water sources in the Honolulu District, it is necessary to know:

- which proposed water sources will be tapping dike water
- the elevation of these proposed sources and their probable static head
- the amount of stream gain which occurs below the static head of proposed water sources
- the dry-weather flow of streams at different elevations
- the estimated yield of proposed water sources

This information belongs in the Regional EIS. It was omitted from the EIS Preparation Notice. We will not settle for an inaccurate table on soil types.

Since the extent to which Manoa and Nuuanu Streams are dried up by proposed BWS wells is solely a BWS decision, the Regional EIS should explicitly state how much stream flow the BWS is willing to preserve in these streams. You cannot pass the "buck" to the Board of Land and Natural Resources on this issue.

The Regional EIS also needs to address the potential for pesticides and urban runoff polluting the ground water which will be developed by proposed sources. If appropriate, the EIS should discuss the feasibility of the BWS becoming a supplier of non-potable irrigation water to public agencies in Honolulu.

Yours,

Fred Benco

Fred Benco
Vice President

250 S Hotel St Rm. 211, Honolulu, Hawaii 96813. Tel. 521-1300

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

C2484-01

COPY

December 5, 1984

RECEIVED
DEC 12 1984
WILSON OKAMOTO & ASSOCIATES

Mr. Fred Benco
Vice President
Life of the Land
Room 211
250 South Hotel Street
Honolulu, Hawaii 96813

Dear Mr. Benco:

Subject: <u>Your Letter of November 20, 1984 Regarding the Regional Environmental Impact Assessment (EIA) for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii</u>

Thank you for your comments on our EIA. Your comments will be appended to the Draft and Revised Environmental Impact Statement (EIS).

You are already a consulted party for the proposed EIS and will therefore be receiving copies of the Draft and Revised EIS.

Your concerns will be appropriately addressed in the preparation of the Draft EIS.

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

XVIII. DRAFT ENVIRONMENTAL IMPACT STATEMENT COMMENTS AND RESPONSES

XVIII. DRAFT ENVIRONMENTAL IMPACT STATEMENT COMMENTS AND RESPONSES

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

Name	Date of Comments	Date of Response
FEDERAL AGENCIES		
Department of Agriculture, Soil Conservation Service	04/24/86	--
Department of the Army, Corps of Engineers	04/04/86	04/17/86
Department of Interior, Fish and Wildlife Service	05/27/86	06/06/86
Department of Interior, U.S. Geological Survey	04/15/86	04/25/86
Department of Navy	04/24/86	--
STATE AGENCIES		
Department of Accounting and General Services	04/17/86	04/30/86
Department of Agriculture	05/13/86	--
Department of Defense	03/25/86	--
Department of Education	03/20/86	--
Office of Environmental Quality Control	04/17/86	05/23/86
Department of Hawaiian Home Lands	04/29/86	--
Department of Health	04/01/86	04/14/86
Department of Land and Natural Resources	04/16/86	04/25/86
Department of Planning and Economic Development	05/07/86	--
Department of Transportation	04/02/86	04/15/86
UH Environmental Center	05/14/86	06/06/86
UH Water Resources Research Center	04/02/86	--
NEIGHBORHOOD BOARDS		
Kalihi-Palama #15	05/30/86	06/09/86
Palolo	--	05/21/86
Palolo #6	05/08/86	05/20/86
CITY & COUNTY AGENCIES		
Building Department	03/24/86	--
Department of General Planning	04/02/86	05/08/86
Honolulu Fire Department	05/08/86	05/16/86
Honolulu Police Department	04/11/86	--
Department of Housing & Community Development	05/05/86	--

Name	Date of Comments	Date of Response
Department of Land Utilization	05/15/86	05/30/86
Department of Parks and Recreation	04/03/86	04/15/86
Department of Public Works	04/08/86	--
Department of Transportation Services	03/25/86	--
UTILITY COMPANIES		
Hawaiian Electric Co., Inc.	04/08/86	04/16/86
PUBLIC INFORMATIONAL MEETINGS		
Kalani High School	04/09/86	05/28/86
Washington Intermediate School	04/14/86	06/05/86

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

ES
Room 6307

MAY 27 1986

RECEIVED
MAY 28 1986
WILSON OKAMOTO & ASSOCIATES

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

The Service has reviewed the Draft Environmental Impact Statement (EIS) for the Development of Wells, Reservoirs, and Transmission Lines and Appurtenances at Honolulu, Hawaii. The document has not addressed Service concerns, as stated in our letter of November 15, 1984, for the effects of well development upon the biological resources of Manoa, Pauoa, and Nuuanu Streams. Specifically, the EIS should identify the magnitude of stream flow reduction anticipated as a result of well development in the watersheds. Furthermore, the mitigation measures which the Board of Water Supply will undertake if flow reduction does occur in these ecologically significant streams, should be clearly stated.

The Service, therefore, recommends that these issues be adequately addressed in the final EIS.

We appreciate this opportunity to comment.

Sincerely yours,

William R. Kramer

Ernest Kosaka
Project Leader
Office of Environmental Services

cc: NMFS - WPPO
HDF&W
EPA, San Francisco
Board of Water Supply
✓Wilson Okamoto & Assoc., Inc.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 6, 1986

RECEIVED
JUN 10 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 May 27, 1986 on the Draft Environmental Impact Statement for the Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu

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. Monitoring of Manoa Stream during the test pumping of the Manoa Park Alluvial Well (Site #13) showed no discernable reduction in streamflow. We plan to monitor streamflow should we decide to develop the source.

2. Pauoa Stream may experience a reduction in streamflow during the dry summer months. Mitigative measures may be implemented to monitor streamflow at a suitable location and to maintain minimum flows at all times. Only water in excess of the minimum flows will be diverted.

3. Impacts to Nuuanu Stream flows are unknown at this time. Impacts to streamflow can only be determined by long-term pumpage of a production well correlated with measurements from existing gaging stations. The test pumping of the exploratory well can give us an indication whether any streamflow reduction will occur.

DOCUMENT CAPTURED AS RECEIVED

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

Mr. Ernest Kosaka
Page 2

June 6, 1986

4. The BWS will comply with minimum streamflow standards when they are established. To meet future minimum streamflow standards, pumpage from affected wells would be regulated.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates

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

REPLY TO
ATTENTION OF

April 4, 1986

Mr. Lawrence Whang
Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Whang:

Thank you for the opportunity to review and comment on the Draft EIS for Development of Wells, Reservoirs, Transmission Lines and Appurtenances, Honolulu, Hawaii. The following comments are offered:

a. Any water lines crossing under streams or over tidal waters would require a Department of Army (DA) permit. Any fill within the ordinary high water mark of the streams or in wetlands adjacent to the streams would also require a DA permit.

b. The proposed improvements are shown and discussed in Section VII, "Water System Improvements and Related Impacts." Flood zone designations have been assigned Zone C or D with two exceptions. The first is Site No. 13, Manoa Well III located in the Downtown Subarea (see enclosure 1). The proposed site is in Zone A5 and Zone A10. The second is Site No. T3, Kakaako District Transmission Main located also in the Downtown Subarea (see enclosure 2). A small portion of the proposed site is in Zone A4 and the rest in Zone C.

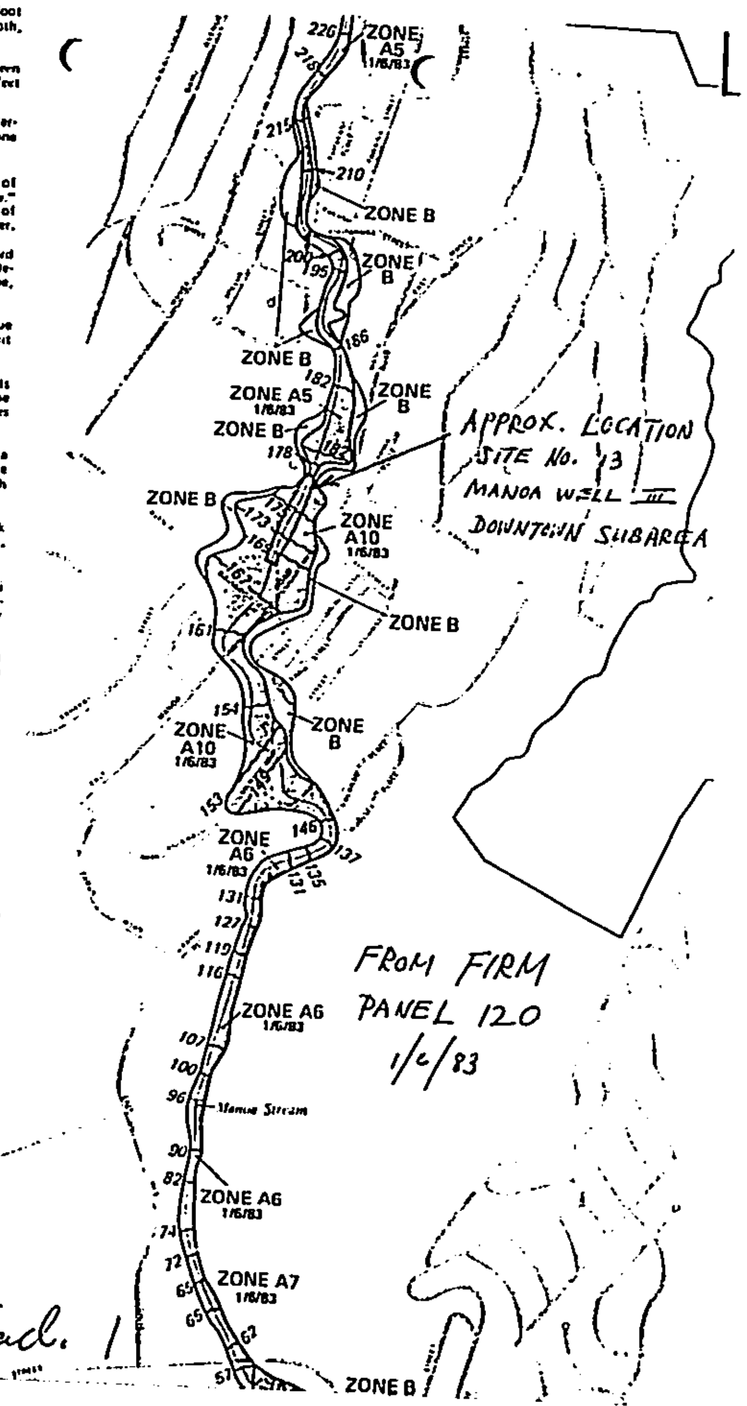
c. Alternative Sites, Section VIII. All sites are in Zone C or D except for two sites. The first is E11, Liliuokalani Garden Caprock Well shown on enclosure 3. The site is in Zone A. The second is E15, Moanalua Caprock Well shown on enclosure 4. The site is also in Zone A. A description of the flood zone designation is enclosure 5.

Sincerely,

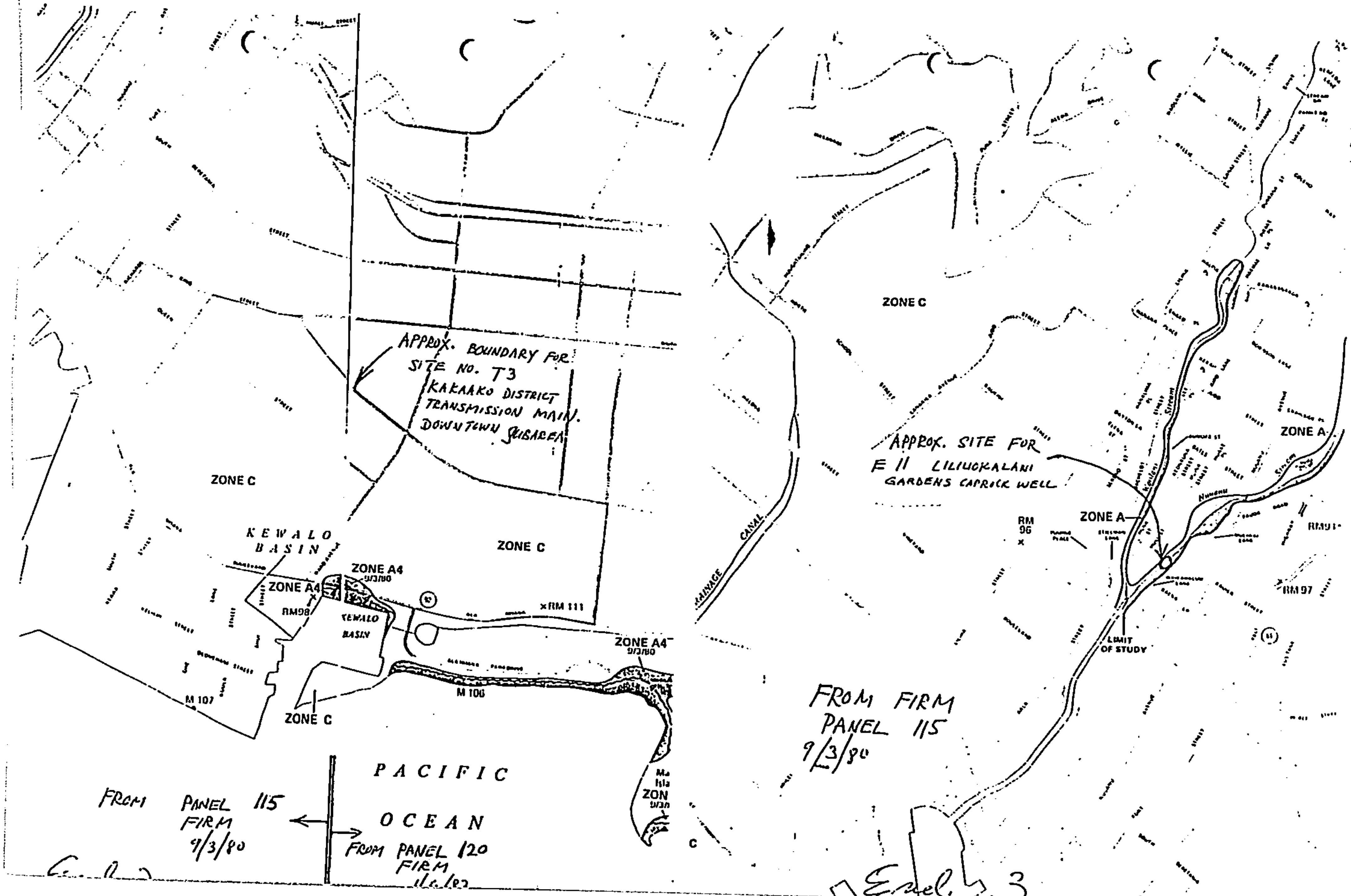
Kisuk Cheung
Chief, Engineering Division

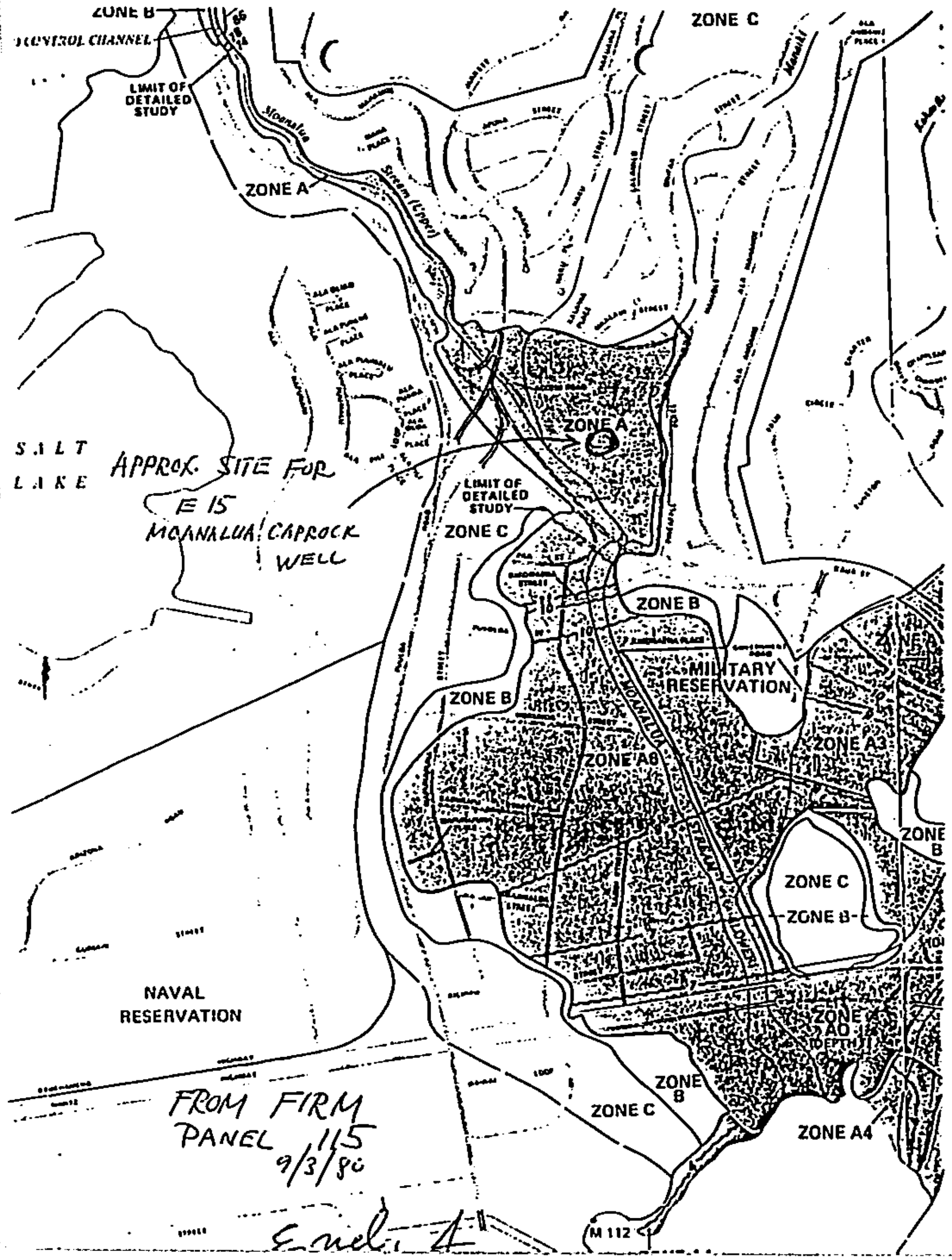
Enclosures

APR 9 4 22 PM '86



Encl. 1


APPROX. BOUNDARY FOR SITE NO. T3 KAKAAKO DISTRICT TRANSMISSION MAIN. DOWNTOWN SUBAREA
ZONE C
KEWALO BASIN
ZONE A4
9/3/80
ZONE A4
RM98
KEWALO BASIN
ZONE C
xRM 111
ZONE A4
9/3/80
M 107
M 100
ZONE C
PACIFIC
OCEAN
FROM PANEL 115 FIRM 9/3/80
FROM PANEL 120 FIRM
ZONE C
APPROX. SITE FOR E 11 LILIUOKALANI GARDENS CAPROCK WELL
ZONE A
RM 96 x
ZONE A
RM91
RM97
LIMIT OF STUDY
CANAL
FROM FIRM PANEL 115 9/3/80
Encl. 3



EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.
*	The numerals indicate the magnitude of difference between the 100-year and 10-year flood elevations. For numerals between 1-20, the difference is one half of the value; for values greater than 20, the difference is 10 less than the numerals shown. This information is used in establishing insurance rates.
—12—	100-year tsunami or riverine elevation line, with elevation in feet above mean sea level.
——	Zone boundary line

Encl. 5

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

April 17, 1986

RECEIVED
APR 21 1986
WILSON OKAMOTO & ASSOCIATES

Mr. Kisuk Cheung
Department of the Army
Chief, Engineering Division
U.S. Army Engineer District,
Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Subject: Your Letter of April 4, 1986 on the Draft EIS for Department of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu

Thank you for commenting on the Draft EIS for our proposed water system projects.

We will submit applications for permits for all projects requiring the Department of Army's approval.

We will incorporate in our report the flood zone designations for Manoa Well III and the Kakaako Transmission Main and for the alternative sites at Liliuokalani Garden Caprock Well and Moanalua Caprock Well.

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

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96850

April 15, 1986

Mr. Lawrence Whang
Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843

Subject: Draft Environmental Impact Statement for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii

Dear Mr. Whang:

The subject Draft EIS has been reviewed by personnel of the U.S. Geological Survey, Water Resources Division. We have no comments to make regarding the Draft EIS except for minor errors in gaging station identifications. They follow:

Page	Paragraph	Line	Comments
IV-24	1	4	Change Kalihi Stream Station 2239 to read 2293.
do.	do.	5	Add stations 2280, 2282 to Moanalua Stream.
do.	4	1	Change word "complied" to read "compiled".
B-7	1	4	Add prefix *** to station 162286000, Moanalua Stream at Tripler Hospital.

We appreciate the opportunity to review the subject Draft EIS.

Sincerely,

Charles J. Huxel, Jr.
Acting District Chief

cc: Mr. Michael Munekiyo

Apr 21 1 21 PM '86

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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RECEIVED
APR 30 1986
WILSON OKAMOTO & ASSOCIATES

April 25, 1986

Mr. Charles J. Huxel, Jr.
Acting District Chief
Water Resources Division
Geological Survey
U. S. Department of the Interior
P. O. Box 50166
Honolulu, Hawaii 96850

Dear Mr. Huxel:

Subject: Your Letter of April 15, 1986 on the Draft EIS for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu

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

The corrections on gaging station identifications will be made in the revised environmental document.

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 and Associates

RECEIVED
BD OF WATER SUPPLY
APR 18 11 57 AM '86

GEORGE R. ARIYOSHI
GOVERNOR

860985
MGR copy 4-18
DEP
P/E

HIDEO MURAKAMI
COMPTROLLER

MIKE N. TOKUNAGA
DEPUTY COMPTROLLER

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

LETTER NO. (P)1392.6

APR 17 1986

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
Honolulu, Hawaii

Dear Mr. Hayashida:

Subject: Draft Regional EIS for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii

The following are our comments regarding the subject document:

1. p. VIII-16. Site No. E6 - Kaahumanu Caprock Well. The Department of Education has indicated that they object to placing a well on the Kaahumanu Elementary School grounds, because the school is already about 2 acres below the minimum site size for an elementary school. We would like to recommend that the well be sited under the H-1 viaduct, at Sheridan Park or at Cartwright Field.

2. p. VIII-20. Capitol District Caprock Well. We are against placing a well on the Capitol grounds. It would detract from the appearance of the Capitol and would not be in keeping with the functions and uses associated with the Hawaii Capitol Historic District.

   We recommend that the area behind the Kinau Hale or the Liliuokalani Building be considered for the well site.

3. p. VIII-24. Site No. E13 - Kalakaua School Caprock Well. The DOE has indicated that a well located within the abandoned portion of Alokele Street would be acceptable, but would not recommend locating a well on the school grounds.

4. University of Hawaii - Manoa Campus. Attached are comments from the UH Facilities Planning and Management Office regarding facilities affecting the University of Hawaii at Manoa.

Should there be any questions, please have your staff call Mr. Cedric Takamoto of the Planning Branch at 548-5460.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

CT:jk
Attachment

UNIVERSITY OF HAWAII

Facilities Planning & Management Office
April 11, 1986

Mr. Teuane Tominaga
State Public Works Engineer
State of Hawaii - D.A.G.S.
State Office Building
Honolulu, Hawaii 96813

ATTENTION: Cedric Takamoto

Dear Mr. Tominaga:

SUBJECT: Draft Environmental Impact Statement for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii

We have reviewed the Draft EIS for the subject project and offer the following comments:

1) The University of Hawaii is directly affected by the following projects:

(a) Site No. 12 - Manoa Well I.
(b) Site No. 31 - Waahila "180" Reservoir and Transmission Line.
(c) Site No. 52 - Waahila "405" Reservoir and Transmission Main.

2) Site No. 12. Other than for exploration, the City BWS has not approached the University on the use of University lands for this purpose.

Sites S1 and S2. The University and the BWS are presently negotiating a land exchange for these sites.

3) Noise from construction activities and from operational equipment may be problems to the University. The former can be minimized by controls such as working hours, placement of equipment, etc.; the latter can be minimized by the proper selection of equipment and carefully designed housing.

4) Traffic hazards would not be materially increased during the construction of Site No. 12; it could be a serious problem during the construction of Sites S1 and S2 due to the narrow and winding University driveway that has to be utilized for access to the site. There may be young children playing in the area during the day.

5) The visual impact of the pump station in the quarry as well as the reservoirs on Waahila Ridge cannot be minimized. While landscaping will help, special attention must be given to location, elevation and color of the facilities to help minimize the visual impact.

6) The University may not accept the loss or degredation of the existing pond in the quarry. The pond has become a "place" on the campus where people meet to fish, to picnic, or to simply relax. Its loss now will substantially impact the campus environs.

We suggest that continuous dialogue be maintained by the BWS with the University to alleviate some of the potential problems.

Thank you for the opportunity to comment on the Draft EIS. We are returning herewith your copy of the subject document.

Sincerely,

Walter K. Muraoka
Campus Planner

WKM:pmh
Attachment
cc: Ed Yuen/T. Sahara

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

April 30, 1986

RECEIVED
MAY 02 1986
WILSON OKAMOTO & ASSOCIATES

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

Dear Mr. Tominaga:

Subject: Your Letter of April 17, 1986 on the Draft Environmental Impact Statement (EIS) for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu

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

We offer the following in response to your comments:

1. Your recommended sites for the potential caprock wells (Sites E6, E9, and E13) are acceptable to us.

2. Proposed projects within the boundaries of the University of Hawaii at Manoa campus are only conceptual at this time except for the Manoa Well I site. Supplementary statements will be prepared as required by Chapter 343 and will discuss impacts relating to noise, traffic and aesthetics.

3. All projects affecting the University of Hawaii-Manoa campus will be coordinated with them including mitigative measures to preserve the quarry pond.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates
University of Hawaii (Walter Muraoka)

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

LESLIE S. MATSUBARA
DIRECTOR OF HEALTH

In reply, please refer to:
EPHSO

April 1, 1986

APR 4 3 40 PM '86

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 S. King St., Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Draft Environmental Impact Statement for the Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii

Thank you for the opportunity to review and comment on the subject draft EIS. Section 11-20-29 of Chapter 20, Title 11, Administrative Rules, requires that all new sources of potable water serving public water systems be approved by the Director of Health prior to their use to serve potable water. Such approval is based primarily upon the satisfactory submission of an engineering report which adequately addresses all concerns as set down in Section 11-20-29. The engineering report must be prepared by a registered professional engineer and bear his or her seal upon submittal.

The Department of Health's Drinking Water Program would also appreciate updated strip charts and well location diagrams on all new sources and storage facilities.

Sincerely yours,

Jimmy
JAMES K. IKEDA
Deputy Director for
Environmental Health

cc: Mr. Lawrence Whang ✓
Mr. Michael Munekiyo

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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RECEIVED
APR 16 1986
WILSON OKAMOTO & ASSOCIATES

April 14, 1986

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

Dear Mr. Ikeda:

Subject: Your Letter of April 1, 1986 on the Draft EIS for the Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu

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

We will prepare and submit engineering reports in compliance with Section 11-20-29 of Chapter 20, Title II, Administrative Rules for all new drinking water sources.

Copies of our updated strip maps and well location diagrams for all new sources and storage facilities will be sent to your Drinking Water Section when they become available.

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

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

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

APR 16 1986

APR 21 1 21 PM '86

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 So. King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Thank you for the opportunity to review the draft environmental impact statement (EIS) for improvements to the Honolulu water system. We have a few comments to offer.

Conservation District

Some of the 26 improvements are on Conservation lands and will require a Conservation District use permit before the projects are started.

Historic Sites

We find that the majority of the proposed project sites are situated in highly urbanized environments and the probability of uncovering significant cultural remains is small (1986:IV-30). We further note that, as individual projects are undertaken, supplemental environmental impact statements may be required, and these statements will address the archaeological characteristics for the specific project site.

If any previously unidentified sites or remains (such as artifacts, shell, bone, or charcoal deposits, human burials, rock or coral alignments, pavings, or walls) are encountered, the Board of Water Supply should stop work and contact our Historic Sites Office at 548-7460 immediately. Work in the immediate area should be stopped until the office is able to assess the impact and make further recommendations for mitigative activity, if warranted.

Supplemental Information

The draft EIS indicates that the proposed well developments may affect stream flows. It is noted that the effects to stream flows cannot be estimated until pumping tests are conducted. The Board of Water Supply proposes to monitor all exploratory and production wells, and take mitigating actions, including reducing or terminating pumping, should the stream environment be adversely affected by a reduction in flow.

We would like the opportunity to offer further comment on the supplemental EIS's and construction details on specific improvements as they become available.

Water Resources

The draft adequately discloses potential impact to groundwater resources, springs, and streamflow.

We note that the region covered by the EIS conforms to the State's Honolulu Ground Water Control Area. Water development within this area is regulated under Chapter 177, Hawaii Revised Statutes, and Title 13, Chapter 166, Administrative Rules. Permits are required from this department for use of ground water within the control area. The EIS describes each project within the region and clearly indicates permit requirements.

The document notes that streamflow may be impacted by well development. We concur with the Board of Water Supply's proposal to monitor streamflow near wells and reduce or terminate well pumping to mitigate any impact that becomes evident.

We also note statements made on page VIII-4 & 5 regarding the alternative of desalting sea or brackish water for use as potable water. It should be noted that the State of Hawaii is planning a demonstration desalting plant on Oahu to determine if desalting brackish water is a viable alternative to meet Hawaii's future water needs.

Sincerely,

SUSUMU ONO
Chairperson
and
State Historic Preservation Officer

xc: Board of Water Supply
Wilson Okamoto & Assoc., Inc.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

April 25, 1986

RECEIVED
APR 29 1986
WILSON OKAMOTO & ASSOCIATES

Mr. Susumu Ono, Chairperson
Board of Land and
Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

Subject: Your Letter of April 16, 1986 on the Draft EIS for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu

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

We offer the following response to your comments:

1. A Conservation District Use Permit Application will be submitted for your approval before any work is done in conservation-zoned lands.

2. Should any unidentified archaeological sites or remains be encountered, all work will be stopped until your office is able to assess the impact and recommend mitigative activity.

3. Streamflow monitoring activities will be coordinated with your department and the U.S. Geological Survey.

4. Well Drilling Permits and Water Use Permits will be obtained from your department in conformance with Chapter 177, HRS, and Title 13, Chapter 166, Administrative Rules.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

5. We will note in the revised document that your department is planning a demonstration desalting plant on Oahu to determine if desalting brackish water is a viable alternative.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental
Quality Control
Wilson Okamoto and Associates

GEORGE R. ARIYOSHI
GOVERNOR

Wilson Okamoto & Assoc. – for your information and files.

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

WAYNE J. YAMASAKI
DIRECTOR

DEPUTY DIRECTORS
JONATHAN K. SHIMADA, PhD
WALTER T.M. HO
CHERYL D. SOON
ADAM D. VINCENT

IN REPLY REFER TO
STP 8.1266

April 2, 1986

RECEIVED
WILSON OKAMOTO & ASSOCIATES

Ms. Letitia Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

EIS - Development of Wells, Reservoirs, Transmission Lines, and Appurtenances
Honolulu, Hawaii

We have the following comments on the subject proposal.

Page VII-57, Item d. If Ala Moana Boulevard is affected, then preliminary and final construction plans must be submitted to the State Highways Division for review and approval.

Page VII-65, Item b. Kalihi Street does not intersect with Vineyard Boulevard.

Page VII-67, Item d. Preliminary and final construction plans for work within the State highway right-of-way must be submitted to the State Highways Division for review and approval.

We appreciate this opportunity to provide comments.

Very truly yours,

Wayne J. Yamasaki
Director of Transportation

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

April 15, 1986

RECEIVED
APR 16 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 April 2, 1986 on the Draft EIS for the Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu

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

We offer the following response to your comments:

1. We will submit for your review and approval all preliminary and final construction plans affecting Ala Moana Boulevard and any other work proposed in State highway right-of-ways.

2. We will revise Item b, page VII-65, to indicate that Liliha Street intersects Vineyard Boulevard and not Kalihi Street.

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

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: OEQC
Wilson Okamoto and Associates

GEORGE R. ARIYOSHI
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 South King Street, Room 115
HONOLULU, HAWAII 96813

LETITIA N. UYEHARA
DIRECTOR

TELEPHONE NO.
548-6915

April 17, 1986

APR 22 8 41 AM '86

Mr. Lawrence Whang
Board of Water Supply
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Whang:

Subject: Development of Wells, Reservoirs, Transmission Lines and Appurtenances Draft EIS

We have reviewed the environmental impact statement for this project and offer the following comments:

1. Several of the wells mentioned in the EIS have undergone exploratory drilling and testing while the effects of these wells on nearby streams have not been discussed. Stream fauna require certain stream flow rates in order to live. Well production should not reduce flow rates below these levels.

2. A large number of well developments have been discussed in the EIS. We wish to confirm that supplemental statements will be prepared prior to these wells going into production.

3. When selecting sites for reservoir tanks in conservation lands, consideration should be given to the amount of grading for tanks and access roads. Whenever possible, the site which requires the least amount of disturbance to conservation land should be selected.

Thank you for providing us the opportunity to review this EIS.

Sincerely,

Letitia N. Uyehara

Letitia N. Uyehara
Director

cc: Wilson Okamoto and Associates

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

RECEIVED
MAY 29 1986
WILSON OKAMOTO & ASSOCIATES

May 23, 1986

Ms. Letitia N. Uyehara
Director
Office of Environmental
Quality Control
State of Hawaii
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Your Letter of April 17, 1986 on the Draft Environmental Impact Statement (EIS) for Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu

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

We offer the following information in response to your comments:

1. Both the Board of Water Supply (BWS) and the State Department of Land and Natural Resources (DLNR) have already drilled exploratory wells for some of the sources mentioned in the document. Streamflow monitoring data for wells drilled and tested by the BWS will be appended to the Revised EIS.

   Should streamflows of a nearby stream be affected by a particular well, the BWS is committed to maintain minimum streamflows that are established by DLNR.

2. Environmental assessments will be prepared for projects mentioned in the environmental document that are undertaken by the Board. Also, supplemental EIS's will be prepared as required for development projects in accordance with Chapter 343, HRS.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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Ms. Letitia N. Uyehara
Page 2

May 23, 1986

3. Consideration in minimizing environmental impacts will continue to be given for projects within conservation zoned lands.

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 and Associates

P- 256/86

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

May 14, 1986
(RE:0433)

MAY 19 8 25 AM '86

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Re: Draft Environmental Impact Statement (DEIS)
Development of Wells, Reservoirs
Transmission Lines and Appurtenances
Honolulu, Hawaii.

The DEIS examines the environmental consequences of the development of various proposed Board of Water Supply (BWS) projects located in the Honolulu District of Oahu. Our review was prepared with the assistance of Paul Ekern, Agronomy and Soils; Matthew Spriggs, Anthropology; Frank Peterson, Geology and Geophysics; and Doak Cox, Geophysicist; and Martha Diaz, Environmental Center.

II Introduction

The decision to use the regional approach in the environmental assessment of groundwater development is certainly commendable and should avoid considerable duplication of effort. However, as recognized on p. II-3 supplemental EIS's may be required for individual developments. The final EIS should specify those developments for which the need for an EIS can now be determined, and should indicate that the rest of the developments will be subject to environmental assessment and subject to EIS preparation in the case of those for which negative declarations are found to be inappropriate, when plans for them have been detailed.

The types of proposed BWS water developments are highly site specific, consequently, non-site specific impact studies can only address the most generalized effects of a project. The particular concerns directly tied to the specific development sites that will ultimately be selected include: potential damage to archaeological sites; erosion or land slip and related drainage issues; agricultural issues related to impacts to farmers whose water supply may be affected by the developments; and seismic hazard design criteria for the reservoirs. Each of these issues will need to be addressed in a site specific document prior to construction.

III The Proposed Project

From the general discussion of source development (pIII-5 to 8) it appears that both well development and spring development is proposed and that most of the wells will tap the basal (bedrock) aquifer but that some may tap caprock aquifers. Because the potential impacts of the developments depend to a very large extent on the nature of the resources tapped, it would be helpful to provide a table identifying the source and nature of development proposed at each site (developments of dike springs, perched-water springs, basal aquifer springs; or well development of basal, dike, perched or caprock aquifers); or at least to make the identifications clear in the "project profiles" whose format is provided on p. VII-2.

IV Regional Environment

Archaeological/Historic Sites: No discussion is provided to evaluate significant archaeological and cultural resources in the project area. The need for this discussion was cited by the State Historic Preservation Officer, Susumo Ono, at the preparation stage. The subsequent response to his letter stated that "An assessment of the impact on archaeological resources will cover other surveys already done or reasons why surveys were not done, as well as the potential impact on subsurface deposits".(Letter to Ono, Jan. 11, 1985). The DEIS however, does not address any of these issues. Instead, it states (p. VII-6) that "Due to the conceptual nature of the projects at this time, archaeological surveys of each site were not conducted."

In reviewing the document it seems apparent that at least the general area of most of the projects have been determined and that at the minimum a walk-through survey could identify areas where archaeological remains would be least likely to be present.

Even exploratory well drilling can have serious impacts to historic sites. The destruction of archaeological remains at the Hakaha Wells project is a key example of what can occur when inadequate surveys are made prior to construction projects. The Kakaako Development Main and presumably other such projects, will certainly adversely affect subsurface archaeological remains.

Surely one of the key factors in deciding the specific project location would be the presence or absence of archaeological resources. It thus seems completely inappropriate that no archaeological survey of the project sites has been carried out prior to submission of this DEIS. The impacts of these developments on historic resources should be cited as a yet unresolved issue (Section XII) and should be addressed prior to construction.

9

V Relationship to Plans, Policies and Controls

The statement (p. V-2) that spring flow is being "wasted" is incorrect. Spring flows in fact provide the minimum stream flows required for in-stream uses, as is stated in sections VI-1 and VI-3.

An area of concern not mentioned in the DEIS is that of risk to the community with regard to reservoir construction. The need to upzone the seismic hazard zone on Oahu in terms of construction requirements has long been the topic of concern by local seismologists. In siting their structures, the BWS should examine closely the consequences of reservoir failure due to earthquakes and consider upgrading the construction requirements accordingly.

VII Water System Improvements and Related Impacts

In discussing the potential impacts of the development of Manoa Well II (p. VII-47) the possible reduction of flow in Waaloa and Manoa streams should be mentioned.

Site #13 Manoa Park Alluvial Well: We note in the section on potential impacts that if this particular well is developed, there will be a possible reduction in the flow of the Manoa Stream. Although the flow will be monitored to mitigate adverse impacts, it is not specified how, and to what extent, this will be accomplished.

Site #14 Waaloa Well: Waaloa stream is tributary of Manoa stream. It would appear that the use of the Waaloa well in conjunction with the development of the Manoa Park alluvial well would further reduce the flow of the Manoa Stream. This should be more fully addressed in the final EIS.

In the attached table an attempt has been made to classify the proposed water source developments, as suggested in the comment on Chapter III, purely on the basis of information in the DEIS without reference to other sources of information. In addition, the table notes proposed well developments for which exploratory wells have already been constructed and those for which negative declarations have been issued.

Furthermore, the table suggests appropriate further involvement with the EIS system in the case of each proposed development. Reasons for the suggestions are provided in the notes. PN (preparation notice) suggestions apply only to final developments, not to explorations.

IX Probable Adverse Impacts Which Cannot Be Avoided

The possible adverse impacts of the reduction in streamflow as a result of these groundwater development projects should be included in this section (p.IX-1).

We appreciate the opportunity to comment on this DEIS and look forward to your response.

Yours truly

Jacquelin N. Miller

Jacquelin N. Miller
Acting Associate Director

Attachments:
cc.: Patrick Takahashi
Lawrence Whang, BWS
Michael Munekiyo
Paul Ekern
Matthew Spriggs
Frank Peterson
Doak Cox
Martha Diaz

Subarea	Development	Source[a)]	Exploratory Well[b)]	EIS involvement[c)] Past	Suggested	Notes
B Waialae	1 Kuliouou well	B	X		A	1
	2 Kupaua well	B			A	1
	3 Pia well	B			A	1
	4 Wailupe well I	B	X		A	1
	5 Wailupe well II	B			A	1
	6 Kalani Iki well	B			A	1
	7 Kapakahi well	B			A	1
	8 Waialae Nui well	B	X		A	1
C Kaimuki	9 Waiomao well	B			A	1
	10 Palolo well II	D			PN	2
	11 Palolo well III	D			PN	3
	12 Manoa well I	B	X	ND	PN	4
D Downtown	13 Manoa well III	dike D			PN	5
	14 Waaloa well	dike D			PN	6
	15 Manoa well II	D?	X		PN	6
	16 Herring Springs	D?, P?			PN	2
	17 Kahuawai Springs				PN	2
	18 Nuuanu Aerator well	P			PN	2
	19 Kunawai Spring (or well)	D?, D?			PN	2
E Kalihi	20 Jonathan Spring well	B	X		A	7
	21 Kalihi wells II & III	D?, P?		ND	PN	6

General notes

a) Source: B = basal aquifer D = dike aquifer P = perched aquifer

b) Exploratory well: X = drilled and tested

c) EIS involvement: A = assessment, ND = negative declaration, PN = preparation notice

Detailed Notes:

1. Potential impacts noted are restricted to the short-term ones related to construction. Any water development will have a hydrologic impact. Possible interference with any existing wells and any identifyable basal springs should be noted in assessment. Determination on assessment may be ND or PN depending on impact potential.

2. Preparation Notice suggested because of the potential impacts on high-level springs and streams flows.

3. Preparation Notice suggested because of the potential interference with Palolo well II (and potential spring impact).

4. Preparation Notice suggested in spite of the previous issuance of a negative declaration because of the potential interference with the BWS Kaimuki wells.

5. Preparation Notice suggested because of the potential impacts noted and because, even if there were no impact on high-level springs, there would be an impact on the basal water resource.

6. Preparation Notice suggested because there must be long-term hydrologic interference in addition to the short-term impacts noted.

7. Reassessment suggested in spite of the negative declaration previously issued because of the potential impact on the spring and pond in the Park.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 6, 1986

RECEIVED
JUN 10 1986
WILSON OKAMOTO & ASSOCIATES

Ms. Jacquelin N. Miller
Acting Associate Director
Environmental Center
University of Hawaii at Manoa
2550 Campus Road, Crawford 317
Honolulu, Hawaii 96822

Dear Ms. Miller:

Subject: Your Letter of May 14, 1986 on the Draft Environmental Impact Statement (EIS) for the Development of Wells, Reservoirs, Transmission Mains and Appurtenances in Honolulu

Thank you for reviewing the environmental document for our proposed water system improvement projects. In response to your comments we offer the following which will be incorporated into the Final EIS (FEIS):

1. A table will be included in the FEIS indicating which projects may require supplemental EIS's.
2. When specific sites are selected for development, an environmental assessment will be prepared in accordance with Chapter 343, Hawaii Revised Statutes, and the Environmental Impact Statement Rules of the Department of Health.
3. A table identifying the source and nature of development will be included in the FEIS.
4. A brief discussion on archaeological and historical sites is provided in Section IV of the Draft EIS. As mentioned in the discussion, most of our proposed projects are tentatively sited within land areas that have already been altered or modified and the likelihood of encountering any archaeological or historical site would be remote. However, for the few

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

projects in undeveloped areas, an archaeologist will be hired at the time we decide to proceed with a particular project to survey the selected construction area for potential archaeological or historical resources.

The unknown impacts which the proposed projects may have on unrecorded or buried historical resources will be cited as an unresolved issue.

5. The BWS designs its structural facilities using seismic zone 3 criteria. This is done to assure that the water system will remain intact should a major earthquake occur within or near the islands.
6. When the Manoa Park Alluvial Well (Site #13) was test pumped, the U.S.G.S. gaging station near the well showed no effects to streamflow. To assure that an adequate flow is maintained in Manoa Stream, the BWS plans to monitor flows in Manoa Stream should the well be placed into service.
7. Waaloa Stream is an intermittent stream that flows only during periods of heavy rainfall. Waaloa Well (Site #14) would have no adverse impacts to flows in Manoa Stream. Also, the cumulative impact that Waaloa Well and Manoa Park Alluvial Well may have on Manoa Stream is not anticipated to be significant. However, streamflow will be monitored. If the monitoring shows streamflow in Manoa Stream is adversely affected, mitigative measures acceptable to both the Department of Land and Natural Resources and the Fish and Wildlife Service will be implemented.
8. The listing of the possible reduction of streamflow as a probable adverse impact which cannot be avoided will be added to the FEIS.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

Ms. Jacquelin N. Miller
Page 3

June 6, 1986

The regional EIS is basically an assessment of the Board's long range planning proposals. When the Board decides to proceed with any particular project, we will make a more detailed assessment and, if required, prepare a supplemental EIS for the 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: Office of Environmental Quality Control
Wilson Okamoto and Associates

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

FRANK F. FASI
MAYOR

DONALD A. CLEGG
CHIEF PLANNING OFFICER

GENE CONNELL
DEPUTY CHIEF PLANNING OFFICER

JB/DGP 3/86-7927

April 2, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
State of Hawaii
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Draft Environmental Impact Statement for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii

We have the following comments for your consideration.

1. Of the 26 water facility improvements being proposed for development within the five subareas of the Honolulu District, 5 presently do not conform to the Development Plan Public Facilities (DP/PF) Map for East Honolulu and 10 are inconsistent with the DP/PF Map for the Primary Urban Center. Amendments to the DP/PF therefore will be required. Those that are currently nonconforming are listed below:

<u>Waialae Subarea</u>
Kupana Well
Pia Well
Wailupe Well II (Note: This is presently being processed in the 85-86 Annual Review as 85/EH-1002.)
Kalani Iki Well
Kapakahi Well

<u>Kaimuki Subarea</u>
Waiomao Well
Palolo Well II
Palolo Well III

<u>Downtown Subarea</u>
Manoa Well III (Note: Presently being processed in the 85-86 Annual Review; assigned identification number 85/PUC-1009.)
Waaloa Well
Herring Springs
Nuuanu Aerator Well
Kunawai Springs Well or Diversion
Kakaako District Transmission Main

<u>Kalihi Subarea</u>
Kalihi Wells II & III

Although City funds allocated for planning and engineering may be expended for any of these nonconforming projects, monies for construction and/or land acquisition should not be released until these facilities are shown on the DP/PF.

For details on filing the amendment requests, please call Gary Okino of my staff at 527-6067.

2. Page III-12 of the dEIS which states:

"The BWS long-range plans include all <u>44 projects described within this document</u>" (emphasis ours)

appears to be inconsistent with the number (26) of projects being proposed within the five subareas of the Honolulu District.

If more than 26 projects are actually being proposed for development in the Honolulu District, these should be identified and mapped. This is essential if we are to clearly determine which of those projects are or not in conformity with the DP/PF Map.

On the other hand, if not more than 26 projects are being proposed for implementation, then page III-12 of the dEIS should be modified.

3. The Draft EIS lacks a comprehensive discussion on how each of the 26 water facility improvements being proposed will impact City streets and roadways.

The impact on existing city streets/roadways in heavily populated and urbanized areas such as Kakaako, (Kakaako District Transmission Main), Manoa (Manoa Well III), Lanakila (Kunawai Springs Well), and Salt Lake (Salt Lake Boulevard Transmission Main) are particularly critical.

The gravity of traffic congestion/disruptions and its effect on existing businesses and residences where an improvement is being implemented should be detailed.

4. No mention is made on pages IV-28 to IV-29 of the EIS to indicate how the Nuuanu Reservoir wetlands will be impacted by the development of the Nuuanu Aerator Well proposal. (See USGS quad map by the U.S. Fish & Wildlife Service.)

The section dealing with "Wetland Areas" should be expanded to discuss whether the Nuuanu Reservoir wetlands provide a valuable habitat for the region's wildlife and vegetation, control "flooding" that occurs occasionally in the area, and whether the wetlands are useful in the recharging of our underground supplies of water.

Under Section 404 of the Clean Water Act, the U.S. Corps of Engineers and the Environmental Protection Agency (EPA) share responsibility for protection of our wetlands. Thus, before an agency or contractor can fill a wetland, it must obtain a permit from the Corps. EPA, in turn, provides guidelines which are followed by the Corps.

5. Although it skirts the boundary of the Special Management Area (SMA) established under Ordinance No. 85-105, effective December 2, 1985, the proposed Kakaako District Transmission project does not appear to be affected by the requirements of the SMA.

For confirmation as to whether or not the proposal will be subject to the provisions of the SMA ordinance, it is suggested that the sponsor contact the City Department of Land Utilization.

Additionally, the proposed improvements may require approval from the Hawaii Community Development Authority which has authority for planning and implementing renewal projects in the Kakaako district.

6. The use of symbols or characters such as

OKF	KF
DS	MF
UR	MS

to describe the existing vegetation within each potential development site is confusing and ought to be avoided.

Because of the wide range of species covered under each plant classification (shown in Table 9), the use of these symbols seems inappropriate; unless, all of the species listed are actually in existence within the particular site.

The EIS should indicate only the plant life that presently exists in the project location site.

Such information would be helpful to many botanists and individuals who have particular interest and concern in preserving Hawaii's endangered and endemic plant species.

7. Construction cost figures for each of the water facility improvements being proposed, along with a construction timetable, should be provided in the EIS.

Will the Gramm-Rudman law, effective December 12, 1985, have any effect on any of the 26 water facility improvements being proposed? If no federal funds are expected, that should be stated in the EIS.

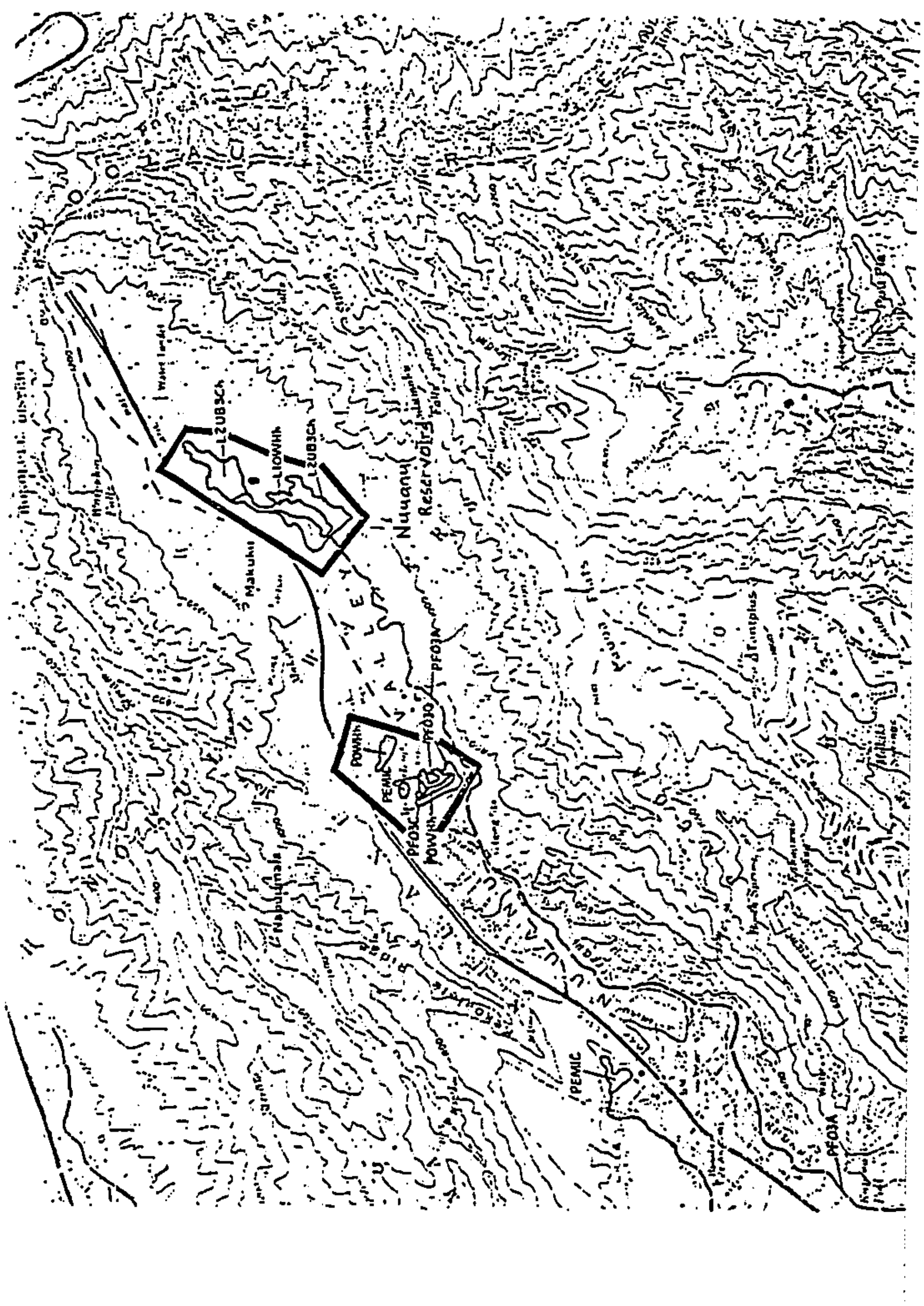
Sincerely,

Donald Clegg

DONALD A. CLEGG
Chief Planning Officer

cc: Board of Water Supply
(Larry Whang)
DLU (Robin Foster)

DOCUMENT CAPTURED AS RECEIVED



BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

RECEIVED
MAY 13 1986
WILSON OKAMOTO & ASSOCIATES

May 8, 1986

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 APRIL 2, 1986 ON THE DRAFT EIS FOR THE DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES AND APPURTENANCES AT HONOLULU

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

We have the following response to your comments:

1. We will be submitting requests to amend the Development Plan Public Facilities (DP/PF) Map for the current nonconforming projects when we are ready to proceed with them.

2. Page III-12 will be revised to indicate that we are proposing 26 projects and not 44 projects. The rest are alternative sources for which no determination have as yet been made on their development.

3. Additional environmental assessments will be prepared for each individual project to determine if a supplemental EIS will be needed. Impacts to traffic will be included in these assessments and/or supplemental EIS's.

4. We will include the Nuuanu Reservoir wetlands in our discussion on wetlands in Section IV. We will apply for a Section 404 permit with the Corps of Engineers for those projects which may have an impact on wetlands.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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YOUR LETTER OF APRIL 2, 1986
ON THE DRAFT EIS FOR THE
DEVELOPMENT OF WELLS, RESERVOIRS,
TRANSMISSION LINES AND
APPURTENANCES AT HONOLULU
PAGE 2

MAY 8, 1986

5. We will be coordinating our plans for the Kakaako Transmission Main with the Department of Land Utilization should the transmission main fall within the Special Management Area.

6. A general description of the vegetation found in the various locales is intended to give the reviewer a general picture of the types of plants that may be found at the various projects sites. Should any project affect endangered and endemic plant species, supplemental EIS's will be prepared to indicate the species affected and the mitigative measures that will be supplemented to minimize or prevent adverse impacts.

7. We are unable to provide cost estimates for each project nor a construction timetable, since many of the proposed projects are still in the conceptual stage. Construction cost estimates will be included in the assessment of any firm project and supplemental EIS's will be prepared as required.

If you have any questions, please contact Lawrence Whang at 527-6238.

Kazu Hayashida

KAZU HAYASHIDA

cc: Office of Environmental
Quality Control
Wilson Okamoto & Associates

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

JOHN P. WHALEN
DIRECTOR

(GU)
1542F

May 15, 1986

Ms. Letitia Uyehara
Office of Environmental Quality
Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Draft Environmental Impact Statement (EIS)
Development of Wells, Reservoirs, Transmission
Lines and Appurtenances at Honolulu, Hawaii

The Department of Land Utilization (DLU) has reviewed the subject document and has the following comments to offer:

1. Site No. T3, the Kakaako District Transmission Main, may involve the City and County's Special Management Area (SMA). The SMA in this particular area is makai from the centerline of Ala Moana Boulevard, and any development within it would require SMA approval. When the location of the main is established, it would be advisable for the Board of Water Supply to consult with DLU in order to determine whether any SMA approvals will be required.

2. Page IV-24, Streamflow - The Draft EIS states that the Board of Water Supply "would need to arrange for appropriate streamflow monitoring by the U.S.G.S. for development of proposed sources." The final EIS should contain assurances that arrangement for such monitoring have been made.

Thank you for the opportunity to comment.

Very truly yours,

for JOHN P. WHALEN
Director of Land Utilization

JPW:fm

cc: Board of Water Supply
Wilson Okamoto

ML
to

May 30, 1986

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

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

SUBJECT: YOUR LETTER DATED MAY 15, 1986 TO OFFICE OF ENVIRONMENTAL QUALITY CONTROL COMMENTING ON OUR DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES AND APPURTENANCES AT HONOLULU

We request clarification on the question of Special Management Area (SMA) approval for a transmission main installed within the Ala Moana Boulevard right-of-way.

Your comment No. 1 noted that the SMA in the Kakaako District is makai of the centerline of Ala Moana Boulevard, and any development within it would require SMA approval.

We understand, however, that HRS Chapter 205A-22, (3)(B)xiii exempts all ground utilities of any size with appurtenant above ground fixtures less than four feet in height installed within a utility corridor, such as Ala Moana Boulevard.

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

For KAZU HAYASHIDA

LHYW:ln
cc: K. Hayashida
L. Whang

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

TOM T. NEKOTA
DIRECTOR

April 3, 1986

APR 4 4 03 PM '86

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Draft Environmental Impact Statement for Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu

Parks which may be adversely affected by the proposed water system improvements include Kawao Park, Manoa Valley Field, Kunawai Springs, and Loi Kalo Botanic Garden. Please keep us informed as more detailed plans are prepared and the schedule for each proposed action is set.

Thank you for the opportunity to comment on the draft EIS

Sincerely,

Tom T. Nekota

TOM T. NEKOTA, Director

TTN:ei

cc: Mr. Lawrence Whang, Board of Water Supply
Mr. Michael Munekiyo, Wilson Okamoto & Assoc.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

April 15, 1986

TO: TOM T. NEKOTA, DIRECTOR
DEPARTMENT OF PARKS AND RECREATION

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

SUBJECT: YOUR LETTER OF APRIL 3, 1986 ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES AND APPURTENANCES IN HONOLULU

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

We will coordinate the projects involving the various City parks including any tentative construction schedule with your department.

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

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto & Associates

FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

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

FRANK F. FASI
MAYOR

FRANK K. KAHOOHANOHANO
FIRE CHIEF

LIONEL E. CAMARA
DEPUTY FIRE CHIEF

May 8, 1986

MAY 12 3 23 PM '86

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT
DEVELOPMENT OF WELLS, RESERVOIR,
TRANSMISSION LINES AND APPURTENANCES

We have reviewed the subject EIS and acknowledge your development of more productive wells, additional water storage facilities and related water improvement projects.

Our concern is to provide uninterrupted public fire protection to the Honolulu district during your improvement efforts. We would appreciate being informed when specific projects begin.

Should you have any questions, please contact Battalion Chief Kenneth Word at 943-3838.

Very truly yours,

Frank K. Kahoohanohano

FRANK K. KAHOOHANOHANO
Fire Chief

FKK:PJO:lm

cc: Mr. Lawrence Whang
Board of Water Supply

Mr. Michael Munekiyo
Wilson Okamoto & Associates, Inc.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

RECEIVED
MAY 21 ...
WILSON OKAMOTO & ...

May 16, 1986

TO: FRANK K. KAHOOHANOHANO, FIRE CHIEF
HONOLULU FIRE DEPARTMENT

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

SUBJECT: YOUR LETTER OF MAY 8, 1986 ON THE DRAFT EIS FOR THE DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES AND APPURTENANCES AT HONOLULU

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

We will inform you when we begin specific projects that may affect fire flows.

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

For KAZU HAYASHIDA

cc: Office of Environmental
Quality Control
Wilson Okamoto & Associates

KALIHI – PALAMA NEIGHBORHOOD BOARD NO. 15
c/o NEIGHBORHOOD COMMISSION OFFICE
CITY HALL, 4TH FLOOR
HONOLULU, HAWAII 96813-3014

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BD OF WATER SUPPLY
JUN 2 2 45 PM '86

864352
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MGR
DEP S3
P/E

May 30, 1986

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

Dear Mr. Hayashida,

SUBJECT: Comments on the Honolulu Regional Environmental Impact Statement

Having read the draft Environmental Impact Statement with special interest to Subarea 4, Kalihi, the Kalihi-Palama Neighborhood Board No. 15 finds no major objections to the proposed projects.

Of greatest impact to our district would be the construction at Site 20 - Jonathon Springs Well and road construction for Site No. T1 - Dillingham Boulevard Transmission Main.

The Board understands the need to accommodate our growing population and is in agreement with the proposed projects. The only stipulation the Board asks is that, prior to construction, there be coordination among other agencies also scheduling improvements for the Kalihi area. A prime example is the State Department of Transportation's plans to reconstruct and resurface Kalihi Street from Nimitz Highway to School Street and Likelike Highway from School Street to the vicinity of Burmeister Overpass and AT&T's plan to install cables.

With three different projects being proposed, our district can anticipate traffic and noise problems. Therefore, a joint effort should be conducted between these agencies to minimize possible traffic and environmental problems by coordinating construction dates, times and locations. By following a revised schedule, our roads will be excavated only once and not three times, and possibly decrease the workload for all.

We trust our comments will be taken into consideration. Thank you for the opportunity to voice our concerns.

Sincerely,

Christina B. Ariola-Heller

CHRISTINA B. ARIOLA-HELLER
Chair

cc: Senators Tony Chang,
Milton Holt, Duke Kawasaki
Representatives Michael Liu, Galen Onouye,
Dwight Yoshimura, Reynaldo Graulty, Romy Cachola
Councilmembers Donna Kim and Tony Narvaes

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

June 9, 1986

RECEIVED
JUN 13 1986
WILSON OKAMOTO & ASSOCIATES

Ms. Christina B. Ariola-Heller, Chair
Kalihi-Palama Neighborhood Board No. 15
c/o Neighborhood Commission Office
City Hall, 4th Floor
Honolulu, Hawaii 96813-3014

Dear Ms. Ariola-Heller:

Subject: Your Letter of May 30, 1986 on the Draft EIS for the Honolulu Regional Water System Improvements

Thank you for commenting on our environmental document.

We shall coordinate our plans with the other governmental agencies and utilities to minimize traffic and other related problems.

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

Very truly yours,

For KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

May 21, 1986

Mr. Henry Wood, Chair
Palolo Neighborhood Board No. 6
c/o 3260 Hoanoho Place
Honolulu, Hawaii 96816

Dear Mr. Wood:

Subject: Honolulu Regional Environmental Impact Statement
Public Informational Meeting

Thank you for attending our informational meeting and expressing your concerns regarding the impacts of developing the Waiomao, Palolo II, and Palolo III Wells upon water that is currently being used by farmers in upper Palolo Valley. In response to your comments at the meeting, we offer the following:

1. Development of either the Palolo Well II, Palolo Well III or the Waiomao Well is not anticipated to affect streamflows occurring at diversions utilized by farmers in upper Palolo Valley.

2. Pumping of basal sources such as at Palolo Well III is very unlikely to affect dike sources.

3. The Palolo Well II will develop a spring perched on Honolulu volcanics. Inasmuch as the spring water currently contributes to the flow of Pukele Stream, a decrease in flow downstream of the source will be experienced. However, this loss of flow is not anticipated to create significant adverse impacts since water below this point on Pukele Stream would ultimately be lost to ocean discharge.

4. Development of the Waiomao Well will not affect the existing swamp conditions at Kaau Crater.

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

COPY

May 21, 1986

In general, development of the three proposed sources in upper Palolo Valley should not jeopardize existing uses of water for mauka agricultural activities. However, we plan to install stream gages, if necessary, to monitor the flows and to ensure that existing flows are maintained.

If you have any questions regarding the technical aspects of the local hydro-geologic features and behavior, please contact Chester Lao at 527-5276.

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilson Okamoto & Associates, Inc.

PALOLO NEIGHBORHOOD BOARD NO. 6
3260 HOANOHO PLACE
HONOLULU, HAWAII 96816

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THE HONORABLE KAZU HAYASHIDA
MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96813

DEAR MR. HAYASHIDA:

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE DEVELOPMENT OF WELLS, RESERVOIRS, TRANSMISSION LINES, AND APPURTENANCES, AT HONOLULU, HAWAII.

I AM THE CHAIRMAN OF THE PALOLO NEIGHBORHOOD BOARD #6, BUT I AM SENDING THIS LETTER AS AN INDIVIDUAL, PENDING FORMAL ACTION BY THE BOARD AT IT'S REGULAR MAY MEETING ON 05/28/86. I ATTENDED BOTH OF THE INFORMATIONAL HEARINGS YOUR STAFF HELD ON THIS DOCUMENT, AS A BOARD REPRESENTATIVE.

THE COMMENTS IN THIS LETTER ARE LIMITED TO THE PROPOSED SITES NUMBERED 9, 10, AND 11, IN THE DRAFT EIS. ALL THREE OF THESE SITES ARE LOCATED IN PALOLO VALLEY.

I FEEL THAT BEFORE ANY OF THESE PROJECTS ARE PURSUED A SEPERATE EIS SHOULD BE PREPARED, ONE FOR EACH OF THE THREE PROPOSED PALOLO PROJECTS UNLESS ALL THREE ARE TO IMPLEMENTED AS A SINGLE DEVELOPMENT. THE DRAFT EIS IS MUCH TOO BROAD AND GENERAL AND THEREFORE IS SERIOUSLY LACKING IN THE SPECIFIC AND DETAILED INFORMATION ONE WOULD EXPECT TO FIND IN AN EIS.

LISTED BELOW ARE SOME OF THE QUESTIONS THAT WERE RAISED DURING MY DISCUSSIONS OF THE DRAFT EIS WITH PALOLO RESIDENTS AND FARMERS.

1. HOW MANY PARCELS IN PALOLO VALLEY, MAUKA OF KALUA STREET ARE "KULEANA LANDS" THAT HAVE VESTED WATER RIGHTS?

2. WHERE, EXACTLY, ARE THEY LOCATED?

3. HOW MUCH WATER IS EACH ENTITLED TO?

4. WILL ANY OF THE THREE PALOLO PROJECTS BE TAPPING DIKE WATER? IF SO, WHICH ONES AND TO WHAT EXTENT?

5. HOW WILL THE PROJECT AFFECT STREAM FLOW IN WAIOMAO STREAM?

6. HOW MUCH STREAM FLOW, DURING DRY-WEATHER, WILL BWS GUARANTEE IN WAIOMAO STREAM AND PUKELE STREAM?

7. WHAT IS THE CHEMICAL AND ACID CONTENT OF THE WATER TO BE DEVELOPED BY THE PROPOSED WAIOMAO WELL?

Simply thank him for the letter and indicate that ... will be considered ... a supplemental EIS ... of that time

8. WHAT TYPE OF FACILITY WOULD BE BUILT TO REMOVE THE TURBIDITY OF THE WAIOMAO WATER?

9. WHAT CRITERIA HAVE BEEN USED TO DETERMINE THE COST OF DEVELOPING THE WAIOMAO WATER AND CONVERTING IT TO POTABLE WATER?

10. HOW DOES THIS SOURCE RELATE TO THE AVERAGE COST-EFFECTIVENESS OF OTHER BWS SOURCES, INCLUDING AMORTIZATION OF CAPITAL COSTS, OPERATION AND MAINTENANCE COSTS?

11. WHAT IS THE CHEMICAL, ACID, AND COLOFORM CONTENT OF THE PALOLO WELL II SOURCE?

12. HOW MANY AGRICULTURAL CHEMICALS WILL BE TESTED FOR?

13. WILL DISCLOSURE BE MADE TO THE PALOLO BOARD IF ANY OF PERHAPS 100 DIFFERENT AGRICULTURAL CHEMICALS USED IN THE FARM AREA, OVER THE YEARS, ARE FOUND IN THIS WATER AT LEVELS ABOVE 1 PPB?

14. THE LA-I RD. FARM AREA IS A CESSPOOL AREA, HOW WILL THIS AFFECT THE PROPOSED PALOLO WELL II?

15. WHAT CRITERIA HAVE BEEN USED TO DETERMINE THE COST OF DEVELOPING THE PALOLO WELL II WATER AND CONVERTING IT TO POTABLE WATER?

16. HOW DOES THIS SOURCE RELATE TO THE AVERAGE COST-EFFECTIVENESS OF OTHER BWS SOURCES, INCLUDING AMORTIZATION OF CAPITAL COSTS, OPERATION AND MAINTENANCE COSTS?

17. WHY IS BWS CONSIDERING PALOLO WELL III (SITE 11)?

18. IF PALOLO WELL III WAS DEVELOPED WOULD BWS ENSURE PROPER MAINTENANCE OF KAWAO PARK?

19. PALOLO WELL III IS PROJECTED TO PRODUCE ONLY .2 MGD, AND WILL DECREASE YIELDS AT PALOLO WELL I. HOW DOES THIS SOURCE RELATE TO THE AVERAGE COST-EFFECTIVENESS OF OTHER BWS SOURCES, INCLUDING AMORTIZATION OF CAPITAL COSTS, OPERATION AND MAINTENANCE COSTS?

20. IN THE 1977 U. S. FISH AND WILDLIFE SERVICE'S STREAM CHANNEL MODIFICATION IN HAWAII STUDY FOUR CLASSIFICATIONS WERE USED. HOW HAVE PUKELE STREAM AND WAIOMAO STREAM BEEN CLASSIFIED?

21. IF THEY WERE NOT CLASSIFIED, HOW DOES BWS RATE THEM, AT THE PROPOSED DEVELOPMENT SITES, USING THE SAME CRITERIA?

22. OF THE FOUR TYPES OF WATER SOURCES AVAILABLE IN THE HONOLULU DISTRICT, WHAT TYPE OF SOURCE IS EACH OF THE PROPOSED PALOLO SITES?

23. WHAT IS THE EXACT HYDROLOGY OF THE THREE PROPOSED PALOLO SOURCES?

24. WHEN WERE THE HYDROLOGIC CHARACTERISTICS OF THE PROPOSED PALOLO SITES STUDIED?

25. WHO DID THE STUDIES?

26. WILL THE STUDIES BE RELEASED TO THE BOARD?

27. ARE THE STUDIES ACCURATE, GIVEN CURRENT CONDITIONS?

28. IF THE WAIGHAO AND PALOLO II SITES ARE TO BE DEVELOPED WILL NEW AND SCIENTIFIC HYDROLOGICAL STUDIES BE COMMISSIONED?

IF YOU HAVE ANY QUESTIONS, PLEASE FEEL FREE TO CALL ME AT 946-7922, DURING WORKING HOURS.

SINCERELY,

Henry W.W. Wood

HENRY W.W. WOOD

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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RECEIVED
MAY 23 1986
WILSON OKAMOTO & ASSOCIATES

May 20, 1986

Mr. Henry W. W. Wood, Chairman
Palolo Neighborhood Board No. 6
3260 Hoanoho Place
Honolulu, Hawaii 96816

Dear Mr. Wood:

Subject: Your Letter of May 8, 1986 on the Draft Environmental Impact Statement (EIS) for the Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu

Thank you for attending our public informational meetings and for commenting on the environmental document for our proposed water system improvement projects.

We concur that the information in the Draft EIS is broad and general and may not adequately assess the environmental consequences of a particular project. Should we decide to pursue any of the Palolo projects listed in the Draft EIS, a supplemental EIS will be considered in accordance with Chapter 343 and your questions will be answered at that time.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Wilson Okamoto and Associates

HAWAIIAN ELECTRIC COMPANY, INC. • PO BOX 2750 • HONOLULU, HI 96840-0001

ENV 2-1
NV/G

HEI

Brenner Munger, Ph.D., P.E.
Manager
Environmental Department
(808) 548 6880

April 8, 1986

RECEIVED
APR 14 1986
WILSON OKAMOTO & ASSOCIATES

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Environmental Impact Statement (EIS) for Development of Wells, Reservoirs, Transmission Lines and Appurtenances

We have reviewed the above EIS and note that the supplemental environmental impact statements (Section XII - Unresolved Issues) for each individual project should include the impact to HECO's existing facilities in the area and new facilities required to provide service to the projects. Enough detail should be provided so that conflicts with any proposed HECO facility can be determined.

Sincerely,

Brenner Munger

cc: Lawrence Whang, Board of Water Supply
Michael Munekiyo, Wilson Okamoto & Associates, Inc.

A Hawaiian Electric Industries Company

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

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April 16, 1986

RECEIVED
APR 21 1986
WILSON OKAMOTO & ASSOCIATES

Dr. Breuner Munger
Manager
Environmental Department
Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96840-001

Dear Dr. Munger:

Subject: Your Letter of April 8, 1986 on the Draft Environmental Impact Statement (EIS) for the Development of Wells, Reservoirs, Transmission Lines and Appurtenances in Honolulu

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

We will include in any required supplemental EIS's the impacts that our projects may have to HECO's existing facilities within the project areas and to new facilities required to provide electrical service to the projects. Adequate details will be provided for determining potential conflicts with proposed HECO facilities.

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 and Associates, Inc.

2484-02
April 9, 1986

PUBLIC INFORMATIONAL MEETING

SUBJECT: BWS Honolulu Regional EIS Public Presentation

PERSONS PRESENT: (See Attached Meeting Attendance Sheet)

INFORMATION ITEMS:

The public informational meeting was held at the Kalani High School Cafeteria and commenced at 7 PM.

The presentation by Mr. Whang and Mr. Munekiyo has been recorded.

The following are concerns expressed by the public:

- As there are no transmission mains proposed for East Oahu, can an assumption be made that the transmission mains in place are adequate to support development?
- Who determined the site location of the proposed facilities?
- What effect would Waiomao Well have on streamflow of Waiomao Stream?
- What would be the impact of Site Nos. 9, 10 and 11 (Waiomao, Palolo II and Palolo III) on the water that is currently being used by a farming community of Lai Road which is taking water directly from the stream?
    - Families have to move (upstream) every 3 to 4 years due to a lack of water. Therefore, if the BWS is developing about a million gallons of water a day, wouldn't this affect the community?
    - Also, a resident in the area is using water from a small well.
    - Is water leaking out of Kaau Crater?
    - Will development of wells affect the water level in Kaau Crater?
    - Will development of Palolo Well II adversely affect streamflow?
    - Will development of Palolo Well II affect upstream uses?
    - Any data on depth of Kaau Crater?

    - Does the existing tunnel take water from Kaau Crater? What is the length of the tunnel?
    - Will the new well affect the resident's existing well?
    - Will the new well affect the aquifer under the tunnel?
- Why are the magnitude of impacts to streamflow undetermined at this time?
- Will overdevelopment in Honolulu cause draft to exceed the sustainable yield?
- Is water being transported from the Pearl Harbor and Windward Districts?
- Will the ground water resources or water supplies for the Honolulu District be gone soon?
- Has the BWS researched saltwater use?
- Has Campbell Estate cancelled its proposed dual system for West Beach?
- Would the BWS use a dual system for Honolulu?

Nami Hamaguchi
Nami Hamaguchi, Planner

NH/ry

cc: Mr. Larry Whang

MEETING ATTENDANCE

PROJECT: BWS HONOLULU REGIONAL dEIS — PROJ. NO. 2461-02
MEETING: PUBLIC INFORMATIONAL — DATE: 4/9/86
LOCATION: KALANI HIGH SCHOOL CAFETERIA — TIME: 7PM

NO.	NAME (PLEASE PRINT)	ORGANIZATION	PHONE NO.
1	JOHN SAKAGUCHI	VTN PACIFIC	521-5651
2	Chester Lao	BWS	[illegible]
3	[illegible]	[illegible]	[illegible]
4	DEVIS SHIU	WILSON OKAMOTO & ASSOC	531-5261
5	Larry Whang	BWS	527-6138
6	[illegible]	Palolo NB #6	946 7922
7	Ted Strand	Palolo Ag District Assoc.	9487922
8	George Hui	BWS	527 5235
9	[illegible]	"	527 6134
10	Al Kirchner	NBH1 Hawaii Kai	395-6554
11	[illegible]	[illegible] Development Inc.	531-9955
12	R. Imose	Hawaii Housing Authority	848-3251
13	MIKE MUNEKIYO	WILSON OKAMOTO & ASSOC.	531-5261
14	NAMI HAMAGUCHI	WILSON OKAMOTO & ASSOC.	531-5261
15			
16			
17			
18			
19			
20			
21			

wilson okamoto & associates inc. honolulu hawaii

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

May 28, 1986

RECEIVED
WILSON OKAMOTO & ASSOCIATES

Ms. Nami Hamaguchi
Wilson Okamoto and Associates
P. O. Box 3530
Honolulu, Hawaii 96811

Dear Ms. Hamaguchi:

Subject: Your Letter of April 9, 1986 Requesting Information on Concerns Expressed at the Public Informational Meeting at Kalani High School

We offer the following response in answer to the questions listed in your letter.

1. "As there are no transmission mains proposed for East Oahu, can an assumption be made that the transmission mains in place are adequate to support development?"

   The transmission mains are adequate to support development. We have 24" and 12" mains in Kalanianaole Highway from Wailupe Booster to Hawaii Kai and a 30"/36" main transporting water from the Windward District to Hawaii Kai.

2. "Who determined the site location of the proposed facilities?"

   The well sites were determined by the Board of Water Supply (BWS).

3. "What effect would Waiomao Well have on streamflow of Waiomao Stream?"

   Waiomao Well may have an effect on the flow of Waiomao Stream. The extent of influence can only be determined by long term pumpage of the well.

4. "What would be the impact of Site Nos. 9, 10 and 11 (Waiomao, Palolo II, and Palolo III) on the water that is currently being used by a farming community of Lai Road which is taking water directly from the stream?"

The surface waters developed by the Lai Road farmers are perched on thick lava flows on the Pukele side of the valley and sustained on the Waiomao side by overflow from Kaau Crater. Our proposed wells will not affect the surface flows at the locations of the diversions by the farmers.

4a. "Families have to move (upstream) every three to four years due to a lack of water. Therefore, if the BWS is developing about a million gallons of water a day, wouldn't this affect the community?"

No. See discussion in preceding response.

4b. "Also, a resident in the area is using water from a small well."

The well pumps water perched on the Kaau volcanics and is too far upgradient to be affected by the Board's proposed wells.

4c. "Is water leaking out of Kaau Crater?"

The bottom of Kaau Crater is sealed by ponded lava, soil and organic deposits. Water leaves the crater by overflow eastward into Waiomao Stream.

4d. "Will development of wells affect the water level in Kaau Crater?"

No. See discussion in 4c.

4e. "Will development of Palolo Well II adversely affect streamflow?"

Palolo Well II is intended to develop the spring flow discharging seaward of the Palolo Avenue bridge. If the well is successful, the spring flow should stop and this would affect streamflow below the bridge.

4f. "Will development of Palolo Well II affect upstream uses?"

Palolo Well II will not affect upstream uses because of differences in elevation and the distance between the present uses and the proposed well.

4g. "Any data on depth of Kaau Crater?"

The visible depth of water in the crater is less than two feet based on an observation made about eight years ago.

4h. "Does the existing tunnel take water from Kaau Crater?"

The tunnel does not take water from the crater, but from water trapped behind dikes. Palolo Tunnel is 195 feet in length.

4i. "Will the new well affect the residents' existing well?"

The new wells will not affect the residents' well which is in Kaau lava.

4j. "Will the new well affect the aquifer under the tunnel?"

The aquifer under the tunnel will not be affected by the new well because of the distance, differences in elevation and hydrology.

5. "Why is the magnitude of impacts to streamflow undetermined at this time?"

Only by testing of the various wells can impacts to streamflow be determined with any reliability.

6. "Will overdevelopment in Honolulu cause draft to exceed the sustainable yield?"

No. Draft must remain within the sustainable limits set by the Board of Land and Natural Resources.

7. "Is water being transported from the Pearl Harbor and Windward Districts?"

Yes, water is imported to Honolulu from Pearl Harbor District and an insignificant amount from the Windward District.

8. "Will the ground water resources or water supplies for the Honolulu District be gone soon?"

No. Existing ground water resources will be available indefinitely as long as the ground water drafted is equivalent to the sustainable yield of the basin. Once we develop up to the sustainable limit of the ground water basins, alternative sources such as desalting brackish or sea water, may need to be considered for development to meet increasing water demands.

9. "Has the BWS researched saltwater use?"

The "Pearl Harbor Brackish Water Study" was completed in 1983 and identified sources of brackish water in the Ewa area that may be available for development using treatment methods such as reverse osmosis, ion exchange, etc.

We are currently working with the State Department of Land and Natural Resources and the University of Hawaii on a 1.0 mgd demonstration desalting plant in Ewa to gather data and operational experience.

10. "Has Campbell Estate cancelled its proposed dual system for West Beach?"

No. Campbell Estate is still pursing the dual water system concept. They have already drilled one brackish water well and are planning to drill a second one in the near future.

11. "Would the BWS use a dual system for Honolulu?"

We have plans to utilize dual systems on a very limited basis in Honolulu. We are considering the use of brackish or non-potable water, where available, for irrigation, parks, highways, and golf courses.

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

Very truly yours,

Kazu Hayashida

KAZU HAYASHIDA
Manager and Chief Engineer

PUBLIC INFORMATIONAL MEETING

SUBJECT: BWS Honolulu Regional EIS Public Presentation

PERSONS PRESENT: (See Attached Meeting Attendance Sheet)

INFORMATION ITEMS:

The public informational meeting was held at the Washington Intermediate School Cafeteria and commenced at 7 PM.

The presentation by Mr. Munekiyo was identical to that of the April 9, 1986 meeting held at Kalani High School.

The following are concerns expressed by the public:

- o Is there a time schedule for development of Site Nos. 13 to 19 in the Makiki area?
- o In what form were the agencies, organizations and individuals consulted?
  - Timeframe for distribution of document?
- o Are there any alternatives proposed besides water rationing and desalination (that will be placed in State Functional Plan) that would be implemented for a prolonged drought period?
  - Who has priority in this situation - agriculture or civilians?
- o Table 19 of the draft EIS lists non-potable sources. If these sources are not proposed to be developed, why are they identified?
- o Is the BWS' water system "interconnected" and what does "interconnected" mean?
- o The following concerns are related to the discussion of the Palolo Well which occurred at the previous public meeting:
  - Will development of basal water affect dike water resources?
  - What is the porosity of dikes in area?
  - Will wells tap basal resources at or around sea level?
  - Why would a well possibly affect streamflow?

  - There is a spring on the side of Kaau Crater near fissures.
  - Will development of Palolo Well II lower streamflow in Pukele Stream?
  - Why does the Palolo Well II situation differ from the situation at Waihee where the farmers lost water upstream after a well was drilled downstream?
  - Is the water to be developed for the Palolo Well II the same water that the residents are now tapping? Would development of a 5 mgd well affect upstream users?
- o Is there a limit on the expected yield of a source? Is this limit planned or a physical restriction?
  - For example, why is 1.0 mgd stated in the draft EIS when the yield is supposed to be 0.25 mgd?
  - Are yields estimated on the "high" side to avoid preparing a new EIS document?
- o Water Code - inventory factor.
- o When is development of Site Nos. S1 and S2 targeted?
  - Are storage tanks constructed above or below ground?
  - What is the anticipated storage capacity?
  - Is the flow from reservoirs gravity rather than pumped?
- o The left fork of Pukele Stream is perennial. WOA's figures should be corrected to reflect this.

Nami Hamaguchi
Nami Hamaguchi, Planner

NH/ry

cc: Mr. Larry Whang

Attachment

MEETING ATTENDANCE

PROJECT: BWS HONOLULU REGIONAL dEIS PROJ. NO. 2484-02
MEETING: PUBLIC INFORMATIONAL DATE: 4/14/86
LOCATION: WASHINGTON INTERMEDIATE CAFETERIA TIME: 7PM

NO.	NAME (PLEASE PRINT)	ORGANIZATION	PHONE NO.
1	FRED T. BEEMAN	SELF P.O. Box 3042 Honolulu 96802-3042	955-5257
2	[illegible]	75 [illegible] Honolulu HI [illegible]	[illegible]
3	[illegible]	BLUS	527-6138
4	RICHARD FUJII	"	521-6134
5	DONNA GOTH	BWS	538-3841
6	JOHN SAKAGUCHI	VTN PACIFIC	521-5651
7	CHESTER LAO	BWS	527-5276
8	HAROLD SAKAI	DLNR	548-7496
9	Henry Wood	N Board #6	948-7922
10	Mike Mitchener	Farmer	735-1600
11	Mel Murakami	City & County of Hon — Gen PL	527-6020
12	JAMES Y. OHTA, JR.	KALIHI UNION CHURCH	525-6212
13	Mike Okamoto	KCC (Kapiolani Community College)	735-2167
14	Kathleen Daschell	City Council - OCS	523-4851
15	[illegible]	Neighborhood Board #10	[illegible]
16	GEORGE HIU	BWS	
17	DENIS SHIU	WOA	
18	MICHAEL MUNEKIYO	WOA	
19	NAMI HAMAGUCHI	WOA	
20			
21			

wilson okamoto & associates, inc. — honolulu, hawaii

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

FRANK F. FASI, Mayor

ERNEST A. WATARI, Chairman
MILTON J. AGADER, Vice Chairman
DONNA B. GOTH
[illegible]
RUSSELL L. SMITH, JR.
WAYNE J. YAMASAKI

KAZU HAYASHIDA
Manager and Chief Engineer

June 5, 1986

Ms. Nami Hamaguchi
Wilson Okamoto and Associates
P. O. Box 3530
Honolulu, Hawaii 96811

Dear Ms. Hamaguchi:

Subject: Your Request of April 14, 1986 for Information on Concerns Raised at Informational Meeting Held at Washington Intermediate School Cafeteria

We offer the following in answer to your questions on the Honolulu Regional Environmental Impact Statement (EIS):

1. "Is there a time schedule for development of Site Nos. 13 to 19 in the Makiki area?"

   Currently, exploratory wells have already been drilled at Sites 13, 14 and 15. According to the Board of Water Supply (BWS) Proposed Six-Year Capital Improvements Program 1986 to 1992, the only projects in the Downtown subarea tentatively scheduled for construction are Site 12 (FY 1991), Site 17 (FY 1992), and Site 18 (FY 1987 for exploratory well).

2. "In what form were the agencies, organizations and individuals consulted? Timeframe for distribution of documents?"

   Consulted parties were contacted verbally or by being sent a copy of the EIS Preparation Notice.

   The documents were distributed as soon as they were available as in the case of the EIS Preparation Notice or after arrangements for a public informational meeting was finalized as in the case of the Draft EIS.

3. "Are there any alternatives proposed besides water rationing and desalination (that will be placed in State Functional Plan) that would be implemented for a prolonged drought period? Who has priority in this situation - agriculture or civilians?"

We are considering a conservation-oriented water pricing schedule as an alternative. Examples would be an increasing block rate or surcharges for usage above established levels.

Domestic use will have first priority in any emergency situation.

4. Table 19 of the Draft EIS lists non-potable sources. If these sources are not proposed to be developed, why are they identified?

The Board's first priority is the development of potable sources. However, as part of the Board's water conservation program, non-potable sources are planned to be developed for irrigation of parks, highways and buildings as the Board obtains commitments from public agencies and developers. Development of lower quality water for non-potable uses would conserve potable water for higher priority needs.

5. "Is the BWS' water system 'interconnected' and what does 'interconnected' mean?"

Presently, our Windward, Honolulu, and Pearl Harbor water systems are interconnected with each other. We are in the process of interconnecting our Honolulu/Pearl Harbor system with the Waipahu and Ewa/Waianae water systems. In the future, the Board may interconnect other independent water systems so that the Board will have an islandwide integrated system which can transport surplus water from one area to another.

The term interconnection means that the systems are connected by large transmission mains which permit the flow of water from one system to another.

6. "Will development of basal water affect dike water resources?"

No. Overflow from dike compartments or leakage through fissures in the dikes help contribute to the recharge of the basal aquifer. However, draft from the basal aquifer would not affect overflow or leakage through the dikes.

7. "What is the porosity of dikes in the area?"

The dikes are not porous. Porosity is essentially zero.

8. "Will wells tap basal resources at or around sea level?"

Yes. The wells will also tap basal water below sea level.

9. "Why would a well possibly affect streamflow?"

If a stream is fed by dike water, a well tapping the same dike water source would affect streamflow.

10. "There is a spring on the side of Kaau Crater near fissures."

There is an outlet waterfall on the Waiomao side of Kaau Crater.

11. "Will development of Palolo Well II lower streamflow in Pukele Stream?"

Development of Palolo Well II is not anticipated to affect Pukele Stream. As a precautionary measure, the streamflow will be monitored during the pumpage test of the well.

12. "Why does the Palolo Well II situation differ from the situation at Waihee where the farmers lost water upstream after a well was drilled downstream?"

Palolo Well II will probably encounter basal water which does not contribute to the streamflow, whereas, the Waihee Wells tapped water that contributed to streamflow.

13. "Is the water to be developed for the Palolo Well II the same water the residents are now tapping? Would development of a 5 MGD well affect upstream users?"

No to both questions. In addition to the reason given in Item 12, the Department of Land and Natural Resources (DLNR) will control pumpage since the proposed well is in the Honolulu Ground Water Control Area.

14. "Is there a limit on the expected yield of a source? Is this limit planned or a physical restriction?"

The expected yield of proposed wells is limited to the estimated sustainable yield or physical limitation of a particular ground water basin.

15. "For example, why is 1.0 mgd stated in the draft EIS when the yield is supposed to be 0.25 mgd?"

Yields for future wells mentioned in EIS's are "best" guesses. Only by actually drilling and pump testing the wells can the actual yields be determined.

16. "Are yields estimated on the "high" side to avoid preparing a new EIS document?"

Yields are estimated on both the high and low expectations. Should the yields be greater than that mentioned in the EIS, supplemental EIS's may be proposed if the project will have a significant impact to the environment.

17. "Water Code - inventory factor"

The latest proposed Water Code assigns responsibility to establish an inventory of all water sources to DLNR. A Water Code has not been adopted by the Legislature as yet. Responsibility for the inventory may change as other versions of the Code are proposed for adoption.

18. "When is development of Site Nos. S1 and S2 targeted?"

Site S1 is scheduled for construction in Fiscal Year 1989, and Site S2 is scheduled for construction in Fiscal Year 1990.

19. "Are storage tanks constructed above or below ground?"

Above ground.

20. "What are the anticipated storage capacity?"

Both reservoirs are proposed to have a capacity of 4 million gallons each.

21. "Is the flow from reservoirs gravity rather than pumped?"

The flow from our reservoirs are normally gravity flow except where we have a series of reservoirs serving a community on a heights, such as St. Louis Heights or Wilhelmina Rise. Each reservoir would then feed a booster pump which then lifts the water to an upper reservoir.

22. "The left fork of Pukele Stream is perennial. WOA's figures should be corrected to reflect this."

The U.S. Geological Survey stream gaging shows Pukele Stream is perennial.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

END

CERTIFICATION

I HEREBY CERTIFY THAT THE MICROPHOTOGRAPH APPEARING IN THIS REEL OF FILM ARE TRUE COPIES OF THE ORIGINAL DOCUMENTS.

2006
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Cathyrina Mizoshiro
SIGNATURE OF OPERATOR

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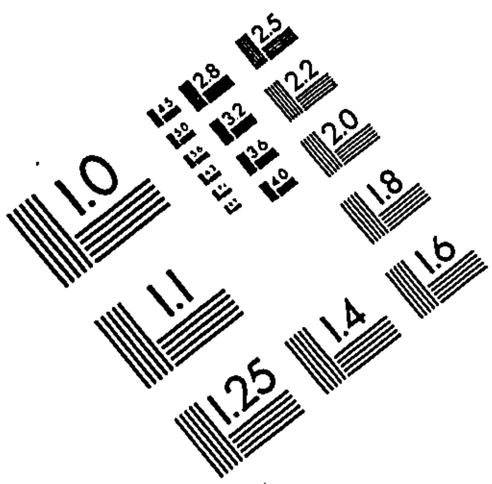

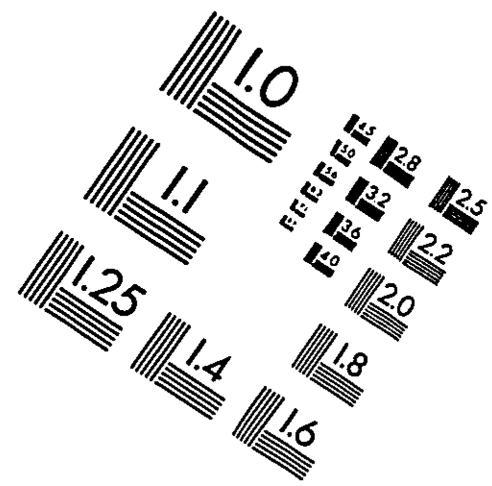

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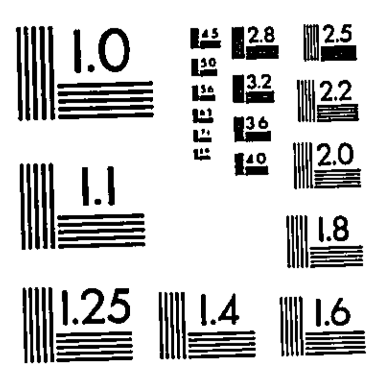

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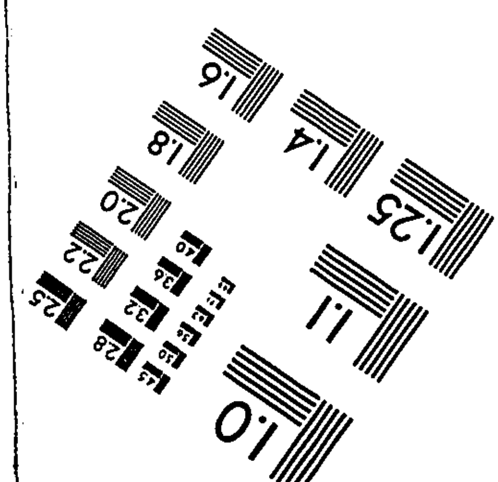

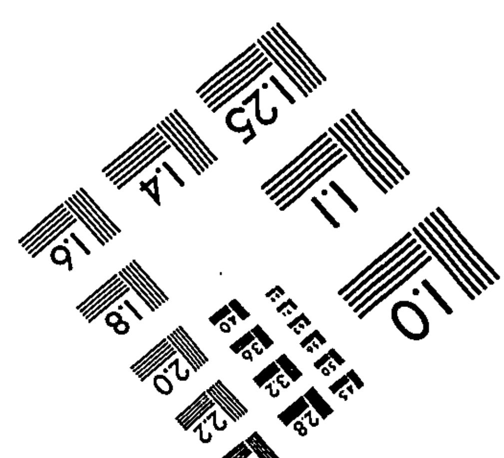

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